G20 SOUTH AFRICA 2025

# DISASTER RISK REDUCTION WORKING GROUP

Solidarity
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# A COMPENDIUM OF CASE STUDIES ON DISASTER RESILIENT HOUSING AND FACILITIES



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SOUTH AFRICA 2025

CDRI
Coalition for Disaster Resilient Infrastructure

# A Compendium of Case Studies on Disaster Resilient Housing and Facilities

Solidarity | Equality | Sustainability

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Tel: +91-11-4044-5999,
e-mail: publications@cdri.world

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# Table of Contents



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The cases presented in this compendium demonstrate ongoing and proactive efforts to accelerate actions to implement the Sendai Framework for Disaster Risk Reduction (SFDRR). These case studies highlight the significance of prioritizing disaster resilience of housing and facilities to reduce disaster-related losses and vulnerability.

For CDRI, this document emerges as a collaborative tool to advocate for and drive a fundamental transformation in the global discourse on disaster resilient infrastructure. With the support of its 60 Coalition Members – of which 14 are also G20 members.

In line with the shared mandate of G20 and CDRI, we hope that the good practices in this compendium will be especially useful for infrastructure stakeholders within the Least Developed Countries (LDCs), Landlocked Developing Countries (LLDCs) and Small Island Developing States (SIDS).

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### CDRI Team

Aishwarya Narendr, Specialist – Research

Susan Thomas, Senior Specialist – Media

Rana Divyank Chaudhary, Senior Specialist - Learning Initiatives & Publications

Payal Bhatnagar, Senior Specialist – Communications

Abhijit Datey, Lead Specialist – Research

Ranjini Mukherjee, Director – Research, Knowledge Management & Capacity Development

Ramraj Narasimhan, Senior Director – Programme Management & Technical Support

### Technical Consultant

Prabir Kumar Das

### Copyeditor

Chandrahas Choudhury

### Graphics Consultant

An Eye On

# Acronyms

| | |
|---|---|
| A*STAR | Agency for Science, Technology and Research (Singapore) |
| AAL | average annual loss |
| ADB | Asian Development Bank |
| ANS | Awas Nirman Sathi (Nepal) |
| ANSA | Afghanistan National Standards Authority |
| ASHA | Accredited Social Health Activist |
| BDA | Building Damage Assessment |
| BFIs | banks and other financial institutions |
| BNPB | National Disaster Management Authority (Indonesia) |
| BPPI | Badan Pelestarian Pusaka Indonesia (Indonesia) |
| BRL | Brazilian real |
| BRR | Badan Rehabilitasi dan Rekonstruksi (Indonesia) |
| BSPS | Bantuan Stimulan Perumahan Swadaya (Indonesia) |
| CBO | community-based organization |
| CBRI | Central Building Research Institute (India) |
| CCRS | Centre for Climate Research Singapore |
| CEDAP | Centre for Eco-centric Development and People's Action (India) |
| CR | Containment Reinforcement |
| CRBCPI | Climate Resilient Buildings and Core Public Infrastructure |
| CREAD | Climate Resilience Execution Agency for Dominica |
| CSEBs | Compressed Stabilized Earth Blocks |
| CSO | civil society organization |
| CSS | Comprehensive School Safety |
| CVP | Caja de la Vivienda Popular (Colombia) |
| DDA | Detailed Damage Assessment |
| DRI | disaster resilient infrastructure |
| DRR | disaster risk reduction |
| DMA | Disaster Management Authority |
| DRM | disaster risk management |
| ENS | Eco-Niwas Samhita (India) |
| EPC | Energy Performance Certificate |
| ES-NFI | Emergency Shelter and Non-Food Items |
| ESS | environmental and social standards |

| | |
|---|---|
| FAO | Food and Agriculture Organization |
| FCDO | Foreign, Commonwealth & Development Office |
| FCRIP | Flood and Coastal Resilience Innovation Programme (UK) |
| G20 DRRWG | G20 Disaster Risk Reduction Working Group |
| GBP | British pound |
| GBV | gender-based violence |
| GEWE | gender equality and women's empowerment |
| GFDRR | Global Facility for Disaster Reduction and Recovery |
| GHTC | Global Housing Technology Challenge |
| GIS | Geographic Information System |
| GMALI | Grant Management and Local Infrastructure (Nepal) |
| GRIHA | Green Rating for Integrated Habitat Assessment |
| GoI | Government of India |
| GoN | Government of Nepal |
| GRM | grievance redressal mechanism |
| GSDMA | Gujarat State Disaster Management Authority |
| IDB | Inter-American Development Bank |
| HAP | Heat Action Plan |
| HBDA | Housing and Building Damage Assessment |
| HDB | Housing & Development Board (Singapore) |
| HDI | Human Development Index |
| HMO | Houses in Multiple Occupation |
| IDR | Indonesian rupiah |
| IEC | Information, Education and Communication |
| IEM | Integrated Environmental Modeller |
| IGAHP | Indonesia Green Affordable Housing Program |
| ILO | International Labour Organization |
| INGO | international non-governmental organization |
| INR | Indian rupee |
| IOM | International Organization for Migration |
| IPCs | Interim Payment Certificates |
| JICA | Japan International Cooperation Agency |
| JPY | Japanese yen |
| LLDCs | landlocked developing countries |
| LMICS | low- and middle-income countries |

| | |
|---|---|
| LSL | Lesotho loti |
| MCMV | Minha Casa, Minha Vida (Brazil) |
| MDF | multi-donor funds |
| MDTF | multi-donor trust fund |
| MFI | microfinance institution |
| MoRD | Ministry of Rural Development |
| Mpa | megapascal |
| MRF | Mozambique Recovery Facility |
| MTC | Mobile Technology Clinic |
| NCA | Norwegian Church Aid |
| NCCBM | National Council for Cement and Building Materials (India) |
| NCEMA | National Emergency Crisis and Disasters Management Authority (UAE) |
| NDMA | National Disaster Management Authority (India) |
| NEMA | National Emergency Management Agency |
| NFM | Natural Flood Management |
| NGO | non-governmental organization |
| NRA | National Reconstruction Authority (Nepal) |
| OCHA | United Nations Office for the Coordination of Humanitarian Affairs |
| ODF | open defecation free |
| OD | owner-driven |
| ODHR | owner-driven housing reconstruction |
| O&M | Operations and Maintenance |
| PALPOC | Post-Cyclone Housing Reconstruction Strategy (Mozambique) |
| PFR | Property Flood Resilience |
| PMAY-G | Pradhan Mantri Awas Yojana–Gramin (India) |
| PPE | Personal Protective Equipment |
| PSEA | Protection from sexual exploitation and abuse |
| PUPR | Ministry of Public Works and Housing (Indonesia) |
| PWD | persons with disabilities |
| RCC | reinforced cement concrete |
| RDI | Resilience Development Initiative |
| RISHA | Rumah Instan Sederhana Sehat (Indonesia) |
| RPA | Responsible Partner Agreement |
| RPL | Recognition of Prior Learning |
| SCA | Swedish Committee for Afghanistan |

| | |
|---|---|
| SDGs | Sustainable Development Goals |
| SDSC | Systems Development Service Centre (Nepal) |
| SECC | Socio Economic and Caste Census |
| SEEDS | Sustainable Environment and Ecological Development Society (India) |
| SHCG | Safer Housing Construction Guidelines |
| SHGs | self-help groups |
| SIDS | Small Island Developing States |
| SINI | National Integrated Information System, Dominican Republic |
| SLTT | State, Local, Tribal, and Territorial |
| SMEs | Small and medium enterprises |
| SSICDC | Shree Swarna Integrated Community Development Centre (Nepal) |
| STFA | Special Trust Fund for Afghanistan |
| SuDS | Sustainable Drainage Systems |
| TAC | Technical Assistance Centre |
| UHI | Urban Heat Island |
| UK | United Kingdom |
| ULB | urban local body |
| UNDP | United Nations Development Programme |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| UNFPA | United Nations Population Fund |
| UNHCR | United Nations High Commissioner for Refugees |
| UNICEF | United Nations Children's Fund |
| UNOPS | United Nations Office for Project Services |
| USD | US dollar |
| VIP | ventilated improved pit |
| WASH | water, sanitation and hygiene |
| WB | World Bank |
| WFP | World Food Programme |
| WHD | Warm Home Discount Scheme (UK) |
| WHHs | women-headed households |
| WHP | Warm Homes Plan (UK) |
| WHO | World Health Organization |
| WMF | World Monuments Fund |
| ZIRP | Zimbabwe Idai Recovery Project |

# Introduction

## Disaster Resilient Infrastructure: A Global Urgency

In a world experiencing rapid climate change and escalating hazard risks, infrastructure systems face a range of direct and indirect impacts. This makes achieving infrastructure resilience an urgent global priority. Critical infrastructure sectors such as power, transport and telecom are an intrinsic part of a nation's economy and infrastructure resilience is inherently linked to the broader discussion on disaster risk reduction and climate resilience. It is, therefore, important that country governments take steps to protect existing and planned infrastructure assets and services from losses due to climate-induced disasters.

Coalition for Disaster Resilient Infrastructure (CDRI) estimates that under the present climate, the total global Average Annual Loss (AAL) that includes buildings and critical infrastructure sectors such as roads and railways, ports and airports, water and wastewater, telecom and power, amounts to up to USD732 billion. Out of the total global AAL, buildings used for residential, commercial, education and health purposes account for USD431 billion, underscoring the urgency of investing in infrastructure resilience to prevent further loss of assets, enhance service reliability, accelerate economic growth[1] geographies[2].

Low- and middle-income countries (LMICs) face a disproportionate burden of disaster-related infrastructure loss and damage. For instance, the relative risk in low-income countries across social infrastructure sectors such as education and health, at 0.41 percent, is over three times greater compared to high-income countries where it is 0.13 and 0.14 percent, respectively. While the infrastructure assets in these countries are sparsely distributed, they have a high exposure and vulnerability to hazard risks. This is largely due to inadequate governance and limited technical and financial capacity, which hinders their ability to attract the [3]investments needed for disaster resilient infrastructure and adaptation finance.[4] This is compounded by the fact that the AAL from climate-related hazards (70 percent) is considerably higher than that from geological hazards (30 percent). As a result, infrastructure systems that are already vulnerable and are not designed to cope with future climate uncertainties and may result in severe damage from both geological and climate-related hazards.

As much as 22 percent of total estimated global adaptation cost (USD81.6 billion) is dedicated to ensuring disaster resilience within the buildings sector, which includes residential buildings, offices, hospitals and schools.[5]

## Need for Disaster Resilient Housing and Facilities

Priority 3 of the G20 Disaster Risk Reduction Working Group (G20 DRRWG) Issue Note emphasizes the need for disaster resilient and accessible infrastructure that can withstand multiple hazards such as flooding, cyclones and the growing risks associated with extreme heat. The risk to buildings, and specifically housing and social infrastructure, due to climate and geo-hazards has been estimated to be up to USD431 billion[6] This underscores the importance of making all types of buildings, especially housing and social infrastructure such as schools and hospitals, disaster resilient. Such housing and facilities must not only ensure structural safety

[2] CDRI. (2023). Global Infrastructure Resilience: Capturing the Resilience Dividend - A Biennial Report from the Coalition for Disaster Resilient Infrastructure, New Delhi.

[3] https://openknowledge.worldbank.org/server/api/core/bitstreams/2d517bb2-50f9-577e-b31a-7d3f6a083163/content

[4] CDRI. (2023). Global Infrastructure Resilience: Capturing the Resilience Dividend - A Biennial Report from the Coalition for Disaster Resilient Infrastructure, New Delhi.

[5] UNOPS. (2021). Infrastructure for climate action. https://content.unops.org/publications/Infrastructure-for-climate-action_EN.pdf

[6] CDRI (2023). Global Infrastructure Resilience: Capturing the Resilience Dividend - A Biennial Report from the Coalition for Disaster Resilient Infrastructure, New Delhi.

but also maintain an acceptable level of operation/ functionality post-disaster.

As of 2018, over 1 billion people were living in slums or informal settlements globally, with 80 percent concentrated in Eastern and Southeastern Asia (370 million), sub-Saharan Africa (238 million) and Central and Southern Asia (227 million). Many such informal settlements are situated on lands already vulnerable to hazards such as flooding, and their deficient structural quality increases their vulnerability towards earthquakes as well. Any housing intervention towards building resilience must prioritize such settlements.

Resilience within the buildings sector can be achieved by integrating resilient approaches within different stages of the project lifecycle. For example:

- The planning stage can include climate design principles, and strict compliance with disaster resilient codes and standards to withstand multiple hazards along with sharing of knowledge and best practices.
- The development and delivery stage could emphasize holistic development for resilience by prioritizing integration of natural infrastructure, nature-based solutions, and by mainstreaming gender, disability, and inclusion into resilience.
- The management stage, through long-term resilience plans and governance, could carry out regular risk assessments of the built environment, making provisions for repair and retrofit to prevent disruption due to frequent and intense climate-induced disasters.

These efforts are crucial for averting damage, ensuring continued performance and fulfilling the Sustainable Development Goals (SDGs), thereby enabling LMICs and developing countries to realize the incremental benefits of development.

## About the Compendium

The Coalition for Disaster Resilient Infrastructure (CDRI), at the request of the DRR Working Group under the South Africa G20 Presidency, has developed this Compendium of Case Studies on Disaster Resilient Housing and Facilities to offer practical examples and learnings to policymakers, community leaders, architects, engineers, planners, investors and other stakeholders for taking actionable steps towards sustainable and resilient housing and settlements. These case studies provide valuable insights into the varied range of solutions that are available to enhance resilience of housing and other facilities. The wealth of knowledge created by this compendium will be useful for all.

The Compendium of Case Studies on Disaster Resilient Housing and Facilities will help advance the discourse under Priority 3 of the G20 DRR Working Group and contribute towards achieving Target D of the Sendai Framework for Disaster Risk Reduction, which aims to substantially reduce disaster damage to critical infrastructure and disruption of basic services by 2030.

The compendium comprises the following key components:

1) 26 case studies from 18 countries incorporating disaster resilient and universal design principles.
2) Key takeaways to inform global disaster resilient housing and facility practices.
3) A list of relevant publications and knowledge products.

It includes examples of large-scale national to local interventions spanning themes like policy and governance, design, technology and innovative financing mechanisms. The primary users of this compendium are envisioned to be policymakers, representatives from housing ministries, non-governmental organizations (NGOs) and community leaders.

The concept of 'resilient housing and facilities' revolves around 'housing and facilities planned, designed, built and maintained to withstand hazards and recover quickly from disasters with least cost, climate change impacts, or other disruptions'. The compendium unfolds this concept by explaining resilient interventions at different scales, from macro- (habitat/ neighbourhood) to the micro- (household and

other social amenities) level applications. This includes outlining the potential for integrating resilience across infrastructure lifecycles by detailing the programme implementation process and highlighting implementation challenges. The cases presented have been synthesized to clearly articulate their impact and learning in reducing vulnerability among population groups and services.

The case studies in this compendium were solicited from various G20 Member Countries, invited countries, invited organizations, as well as CDRI's partner and member organizations.

Compiling relevant use cases on disaster resilient infrastructure (DRI) is an ongoing initiative of CDRI, and this compendium is produced as a part of this effort. The contents and views expressed in the various case studies reflect the opinions of the contributing agencies and are not necessarily the official views of CDRI or the G20 DRR Working Group, South Africa Presidency.

Looking at the wide array of interventions, all the case studies in the compendium have been tagged with keywords that demonstrate their inherent characteristics. The tags are as follows:

### 1 Housing

Interventions with the target of embedding resilience in new and existing housing assets.

### 2 Facility

Interventions with the target of embedding resilience in new and existing facilities such as primary schools, primary healthcare centres and other community facilities.

### 3 Post-disaster

All interventions undertaken to make housing or facilities resilient to future disaster risks post major disasters.

### 4 Public housing programme

Large scale public housing programmes which are funded and managed directly by the government or through support from development institutions.

### 5 Owner-driven

Housing interventions undertaken by owners themselves.

### 6 Enabling initiatives

All policy and financial initiatives that encourage resilience of housing and facilities.

### 7 Retrofitting

All initiatives that cover alteration and amendments to existing housing and facility structures for embedding resilience. Such interventions are typically based on universally accepted resilient housing design principles, guidelines or disaster resilient codes and standards.

### 8 Vernacular approaches

Traditional construction practices that have withstood the impact of disasters over long periods.

## Resilience Interventions: Compendium at a Glance

Based on the diverse case studies received, the compendium has become a rich document that covers a wide array of examples showcasing how resilience has been embedded in large-scale public housing programmes, as well as in owner-driven housing interventions, for both new construction and the retrofitting of existing homes. Some of the main themes and emphases that emerge from these case studies are:

- **A focus on 'people, families and their vulnerabilities' while designing any large-scale public housing program has showcased better outcomes for residents** by addressing their sociocultural and economic needs and vulnerabilities, while also guaranteeing the long-term safety and operability of buildings against disaster risks.
- **The application of innovative, climate-adaptive designs and technologies for recovery and retrofitting in post-disaster scenarios** includes simple and prefabricated housing designs, hollow concrete blocks and measures like the installation of rainwater harvesting systems, that are affordable and reliable construction materials and technologies which require minimal technical knowledge, making them particularly beneficial for marginalized and disasters-prone communities.
- **Introducing resilience measures during the design of new housing as well as through retrofitting of existing ones help strengthen resilience over a long period. This also includes** integration and compliance with resilient building codes. The featured cases also highlight the importance of adapting, developing and strengthening relevant policies and frameworks to support and learn from these initiatives.
- **Centre-staging the beneficiaries in owner-driven housing construction allows for a cohesive development** of communities, reduced building costs, gender inclusivity, skill development among local workers, and broader acceptance of the new housing, which collectively ensures a quicker recovery.
- **Structural strengthening of critical facilities such as schools, primary healthcare centres and community shelters, and the development of essential facilities** like toilets, borewells, community markets and urban infrastructure systems (such as transport networks, feeder roads and schools) help ensure long-term community resilience. The featured cases of large-scale public housing programmes highlight the importance of connecting and enhancing housing projects to community infrastructure.
- **Significance of bridging traditional/vernacular knowledge with modern modifications** for new construction and retrofitting ensures that these time-tested and environment-friendly techniques can be trusted, scaled and adapted for disaster and climate resilience. This leads to cost-effective, large-scale housing developments that promote capacity building, inclusion and reduced vulnerability.
- **Application of financial and policy-based enablers** have enabled structural upgrades of existing and informal housing based on disaster resilient guidelines and frameworks and have facilitated access to legal, social, regulatory and technical assistance necessary for building design, construction, repair and retrofits. Non-structural interventions include development and delivery of DRR training programmes, the use of modern technology for damage assessment, capacity-building initiatives, and other policy-influencing activities such as large-scale housing surveys and modelling support implementation of various disaster resilient and affordable housing programmes, repair and retrofitting initiatives.

CDRI believes that this compendium will be an opportunity to strengthen the agenda of the G20 DRR Working Group, which is to consolidate and disseminate knowledge to empower developing countries including LDCs, LLDCs and SIDS to plan and invest in DRI as a cornerstone of a sustainable future. The compendium will prove useful to a variety of stakeholders and will inform disaster resilient housing and facilities practices globally.


United Kingdom
(p. 45, 137)
The Bahamas
(p. 145)
Dominican Republic
(p. 96)
Cuba
(p. 70)
Dominica
(p. 157)
Colombia
(p. 52, 178)
Brazil
(p. 89, 124)


United Arab Emirates (UAE)
(p. 83)
Afghanistan
(p. 24)
Japan
(p. 103)
Nepal
(p. 114)
India
(p. 38, 58, 162, 182)
Singapore
(p. 66)
Indonesia
(p. 17, 151, 167)
Malawi
(p. 106)
Zimbabwe
(p. 74)
Mozambique
(p. 130)
Lesotho
(p. 110)

# List of Case Studies

| No. | Country | Title | Page | Housing | Facilities | Post-Disaster | Public Housing | Owner Driven | Enablers | Retrofits | Vernacular |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Indonesia | Resilient Rebuilding with RISHA | 17 | ● | ● | ● | ● | | ● | | ● |
| 2 | Afghanistan | Owner-driven Earthquake Resilient Housing in Afghanistan: Preserving Cultural Heritage | 24 | ● | | ● | ● | ● | | ● | ● |
| 3 | India | Pradhan Mantri Awas Yojana – Gramin (PMAY-G), India | 38 | ● | | | ● | ● | ● | | |
| 4 | United Kingdom | Building Housing Resilience in the UK – Warm Homes Plan and Warm Home Discount Scheme | 45 | ● | | | | | ● | | |
| 5 | Colombia | Influencing Colombia's Housing Policies to Advance Resilience at Scale | 52 | ● | | | ● | ● | ● | ● | |
| 6 | India | Post-Earthquake (2001) Resilient Housing Recovery in Gujarat, India | 58 | ● | | ● | ● | ● | | | |
| 7 | Singapore | Integrated Environmental Modeller (IEM) for Public Housing Developments | 66 | ● | ● | | ● | | ● | | |
| 8 | Cuba | Supporting Post-Disaster Housing Recovery in Cuba through Local Production of Construction Materials | 70 | ● | ● | ● | | | ● | | |
| 9 | Zimbabwe | Zimbabwe Idai Recovery Project (ZIRP): Rehabilitation of Community Infrastructure – Education and Health Facilities | 74 | | ● | ● | | | | | |
| 10 | United Arab Emirates | Traditional Barjeel (Wind Tower) as a Passive Cooling Solution for Extreme Heat Resilience | 83 | ● | ● | | | | ● | | ● |
| 11 | Brazil | Integrated Urbanization of the Morro da Cruz Rock Massif in Florianópolis | 89 | ● | ● | | | | | | |
| 12 | Dominican Republic | Recovery and Resilience after Hurricane Fiona in the Dominican Republic | 96 | ● | | ● | ● | | ● | | |
| 13 | Japan | Policy on the Seismic Retrofitting of Housing and Other Buildings | 103 | ● | | ● | | | ● | ● | |
| 14 | Malawi | Japan–Malawi–UNDP Partnership for Inclusive Disaster Recovery | 106 | ● | ● | ● | ● | ● | ● | | ● |

| No. | Country | Title | Page | Housing | Facilities | Post-Disaster | Public Housing | Owner Driven | Enablers | Retrofits | Vernacular |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | Lesotho | Building Back Better: Housing Reconstruction Strategy for Vulnerable Households, Lesotho | 110 | ● | | ● | | | | | |
| 16 | Nepal | Owner-Driven Housing Recovery: Post-Earthquake Intervention in Nepal | 114 | ● | | ● | ● | ● | | | ● |
| 17 | Brazil | Policy Framework for Post-Disaster Housing Recovery – The Experience of Rio Grande do Sul in 2024 | 124 | ● | | ● | ● | | ● | | |
| 18 | Mozambique | Mozambique Recovery Facility: Enhancing Disaster Resilience in Housing and Community Infrastructure Post-Cyclone Idai | 130 | ● | | ● | ● | ● | | ● | ● |
| 19 | United Kingdom | Roch Valley Neighbourhood Flood and Climate Resilience Programme (Resilient Roch) | 137 | ● | | | | | ● | | |
| 20 | The Bahamas | Multi-Purpose Hurricane Resilient Shelter for Community in Abaco | 145 | | ● | ● | | | ● | | |
| 21 | Indonesia | Scaling Disaster and Climate Resilient Housing in Indonesia | 151 | ● | ● | ● | | | ● | | |
| 22 | Dominica | Housing Resilience in Dominica | 157 | ● | ● | ● | | | ● | | |
| 23 | India | Community-Driven Reconstruction of Flood and Earthquake Resilient Schools in Pulwama, Jammu & Kashmir, India | 162 | | ● | ● | | ● | | | |
| 24 | Indonesia | Omo Hada of Nias Island: Traditional Solutions for Seismic-Resilient and Climate-Adaptive Housing | 167 | ● | | ● | | ● | | | ● |
| 25 | Colombia | Response to Hurricane Iota: Community-Based Reconstruction Using Modern Technologies for Damage Assessment and Establishing Material Banks | 178 | ● | | ● | | ● | ● | | |
| 26 | India | Advisory Issued by NDMA on Heatwave Protection and Mitigation in Housing and Human Settlements | 182 | ● | | | | | ● | | |

# Case Studies

# 1. Resilient Rebuilding with RISHA

Country:

Indonesia

Submitted by:

National Disaster Management Authority (BNPB), Government of Indonesia

- Housing
- Facilities
- Post-Disaster
- Public Housing
- Enablers
- Vernacular


## Abstract

*The Ministry of Public Works, Indonesia, developed a prefabricated system called Rumah Instan Sederhana Sehat (RISHA) in 2004 to provide a quick and simple prefabricated home design for low-income and earthquake disaster-affected communities. RISHA's objective was to deliver fast, relatively affordable and resilient houses using prefabricated panels and mechanical connectors that require labour, simple tools and local materials to both produce and install. Units were assembled in under a day. The initiative provides a strong example of locally driven innovation in disaster recovery and sustainable development. RISHA targets economically disadvantaged and low- to moderate-income groups, particularly in post-disaster settings and areas facing persistent housing shortages.*

*RISHA's deployment has significantly reduced vulnerabilities among at-risk populations by replacing unsafe housing with seismic-resistant and health-compliant dwellings. RISHA also helped to narrow the housing backlog and restored dignity to low-income households by providing safe homes aligned with national standards.*


## Introduction to the Initiative

In Indonesia's housing sector, the Ministry of Public Works developed the Rumah Instan Sederhana Sehat (RISHA), launched on 20 December 2004, to provide an innovative technology for a quick and simple prefabricated home design with a knock-down system for low-income and earthquake disaster-affected communities. Implemented by the Ministry in collaboration with other stakeholders such as the National Disaster Management Authority (BNPB), regional governments, and private construction partners, RISHA aims to deliver fast, relatively affordable and

resilient houses using prefabricated panels and mechanical connectors that require skilled and semi-skilled labours, simple tools, and local materials to both produce and install.

RISHA has enabled the rapid deployment of durable housing, with units assembled in under a day and engineered to withstand high seismic activity. Its wide application – from post-disaster response in Lombok to permanent public infrastructure –demonstrates its effectiveness as a scalable, cost-efficient solution for resilient housing, making it a strong example of locally driven innovation in disaster recovery and sustainable development.

## Process and Impact of the Initiative

In Indonesia, the RISHA initiative targets economically disadvantaged and low- to moderate-income groups, particularly in post-disaster settings and areas facing persistent housing shortages. Developed by Indonesia's Ministry of Public Works and Housing (PUPR) in 2004, RISHA addresses the urgent need for relatively affordable, resilient homes that comply with national quality standards (SNI) and withstand natural hazards like earthquakes, floods and storms. The background for this initiative is rooted in seismic vulnerability (e.g., Indonesia's location on the Pacific Ring of Fire), chronic housing deficits (a backlog of around 12.75 million units in 2020), and limited purchasing power among lower-income households which, it is estimated, make up 70 percent of the Indonesian population.

Following the 2018 Lombok earthquake, RISHA was rapidly deployed for replacement and reconstruction of damaged homes. The PUPR's Research and Development Agency led this effort, partnering with state-owned enterprises (BUMN) such as WIKA Beton, Nindya Karya, and their concrete subsidiaries (subsidiary companies that specialize in concrete manufacturing) to produce and deliver prefab panels via mobile plants in Lombok.

Under government supervision, engineers in collaboration with local communities successfully constructed hundreds of basic housing units, each completed in as little as nine hours. Additionally, one-storey structures such as community halls and traditional houses (*balai dusun*) were developed, which demonstrated structural integrity by remaining intact during subsequent aftershocks.

Community participation (gotong royong), guided by engineers from PUPR and RE-KOMPAK (Community-driven Housing and Settlement Recovery Program) facilitators, ensured local buy-in and technical compliance.

Following the 2018 Palu earthquake and liquefaction, disaster-affected households and local communities benefitted from RISHA technology through the rapid construction of resilient housing and the provision of skills training for local workers.

Although less extensively documented in media sources, the PUPR's national record indicates that over 1,600 units of RISHA homes were built in liquefaction-affected zones. This implementation was carried out in stages every year. For example, by 2021, there were 230 units in Duyu, West Palu, Palu City, and 400 units in Pombewe, Sigi Biromaru, Sigi Regency in Central Sulawesi. In 2022, there were 712 units distributed in seven regions in Central Sulawesi. During this implementation, some materials (such as mechanical connectors) were delivered from other regions and the state-owned enterprises

(BUMN) collaborated with other applicators to produce and install these panels at site.

In the 2021 Mount Semeru's eruption disaster, this technology had been implemented to provide relocation houses for the affected people. The PUPR had built 1,951 units and collaborated with two state-owned enterprises (BUMN). During its implementation, 890 units were supplied from other regions (such as Bandung, Makassar and others). These enterprises had cooperated with many applicators to produce and also install the remaining units (approximately 1,061 units) on site. In recognition of the speed of construction, this project received an award from Indonesian World Records Museum (MURI).

For the 2022 Cianjur earthquake, PUPR once again selected RISHA to reconstruct durable post-quake housing in West Java. Prefabricated concrete panel homes were assembled quickly to provide permanent houses and school buildings for affected people. In terms of better and safer principles, PUPR had built 200 coupled/paired house units in Sirnagalih in 2023, 151 coupling house units in Murnisari by 2023, and some school buildings with the latest version of the RISHA technology distributed in Cianjur Regency. Similarly, BNPB also had a programme to build the permanent houses replacing buildings belonging to the heavy damaged category. These houses were constructed independently by house-owners and the location remained the same.

**Image 1:** The RISHA-type permanent housing built in Duyu, Palu, Central Sulawesi, during the construction process

*Source: Ministry of Public Works, Indonesia*

In 2023, PUPR conducted the permanent housing development with this technology in East Nusa Tenggara. The number of these houses was 2,100 units and construction was targeted to finish in the following year. In order to fulfil the required number of panels, the production activities were carried out by some applicators in some non-permanent workshops near the projects. Some state-owned enterprises were supplied from these workshops to construct and finish the required number of panels.

Core implementation features include:

- **Modular, knock-down design:** prefabricated panels assembled with bolts, requiring minimal labour and no site casting.
- **Seismic resilience:** engineered to withstand earthquakes up to seismic zone 6 (Indonesia's highest), using reinforced concrete and minimal wood.
- **Rapid assembly:** RISHA homes can be assembled in under a day by as few as three workers, accelerating post-disaster recovery.
- **Scalability and adaptability:** used for housing, schools, clinics, and community centres; delivery was scaled to include thousands of units through collaboration with state-owned enterprises (BUMN) like WIKA Beton and Nindya Karya.

RISHA's deployment has significantly reduced vulnerabilities among at-risk populations by replacing unsafe housing with seismic-resistant and health-compliant dwellings. It has emphasized equitable access by targeting those most affected by disasters and housing deficits. The locally integrated approach – with government, state-owned enterprises (BUMN), engineers and communities – strengthened capacity and reduced inequalities. Furthermore, prefab manufacturing reduced waste, cut costs around IDR23–25 million (USD1,500 to USD1,600) per unit during Lombok deployment, and offered flexible layouts to meet diverse needs. RISHA also helped narrow the housing backlog and restored dignity to low-income households by providing safe homes aligned with national standards.

## Lessons Learned

### Implementation Challenges and Mitigation Strategies

RISHA's rollout in Indonesia encountered several practical hurdles. One major challenge was mobilizing materials and panels, especially in remote or disaster-impacted areas, which slowed down delivery and assembly timelines. To address this, the Ministry of Public Works and Housing (PUPR) established mobile prefabrication units near affected zones such as Lombok and Cianjur, reducing transportation delays and ensuring a steady supply of components.

Another challenge was the high turnover of applicator workers and limited skilled labour. Training courses and licensing programmes were organized by PUPR's Directorate of Housing and Settlement Engineering to certify applicators. However, the growing demand in post-disaster reconstruction often surpassed the training pipeline capacity. Where possible, experienced applicators from previous deployments (e.g., Lombok) were redeployed to new sites (such as Palu and Cianjur), enhancing workforce continuity and quality.

Further, inconsistent panel moulds and mismatches between design and field conditions emerged as high-risk factors. Standardized moulds and stricter quality control protocols were introduced alongside updated guidelines from PUPR, which defined panel dimensions and

**Image 2:** Houses built with RISHA in Lende area (Palu City, Central Sulawesi Province) after the 2018 tsunami

*Source: Ministry of Public Works, Indonesia*

connections – though full adoption is ongoing.

Escalating raw material costs (e.g., rebar) and user demands that exceeded RISHA's modular capabilities, created moderate risks. To address this, digital guidelines now help communities align their needs, including multi-storey designs or special floor layouts, with the system's limitations, and additional budget allowances are provided to account for inflation.

Public perception of 'temporary shelters' and limited understanding of resilient housing was a challenge. Low public awareness and stigma around 'disaster housing' solutions occasionally hindered uptake among non-disaster households. Engagement efforts, via local government outreach and integrating RISHA into broader public housing campaigns, helped reposition it as a desirable, resilient housing brand – not just emergency shelters.

## Co-Benefits

RISHA delivered multiple co-benefits. First, the rapid, predictable construction using factory-made panels slashed construction times by about 30 percent and cut costs by roughly 8 percent compared to conventional methods in Indonesia – both crucial in post-disaster recovery contexts. These efficiencies benefited not only low-income or disaster-affected households, but also government agencies aiming to meet reconstruction timelines. Second, the system promotes local economic activity, as mobilization of mobile plants created temporary jobs and involved regional applicators – enhancing capacity in rural and peri-urban areas. Third, seismic resilience and standardized quality meant reduced future risk for communities

vulnerable to earthquakes – thus lowering long-term maintenance and disaster-relief costs. Fourth, environmental benefits were notable: lightweight panels (<50 kg each) reduced the need for heavy machinery, minimized on-site waste, and used fewer timber resources, supporting eco-friendly construction. Additionally, because RISHA can be used beyond housing – such as for clinics, schools and mosques – it contributed to resilient community infrastructure, fostering broader social welfare post-disaster.

### Scalability

RISHA has demonstrated strong scaling potential. By 2021, there were reportedly hundreds of thousands of units built across more than 60 regions, including non-disaster programmes like transmigration and public housing. However, scaling requires tackling systemic challenges:

- To scale RISHA effectively, Indonesia needs more certified builders and a permanent prefab production network. This ensures RISHA can be deployed quickly, safely and consistently, rather than only when special plants are set up after each disaster.
- Standardizing interoperable moulds and connection systems, ensuring design flexibility for a range of uses.
- Maintaining cost-efficiency at scale, even amidst rising material prices.
- Increasing public awareness; so RISHA gains traction for voluntary housing projects – not just as emergency aid. Initiatives by universities (e.g., UI's GRAHA) and practitioners exploring hybrid modular systems indicate continuing innovation for broader adoption.

**Image 3:** Specifically designed RISHA housing complex in Lende area (Palu City, Central Sulawesi Province)

## Way Forward

To realize RISHA's full potential, Indonesia may institutionalize its prefabrication system by establishing regional manufacturing hubs and bolstering the number of licensed applicators through sustained government and vocational training programmes. Standardized component moulds, interoperable connection systems and quality assurance guidelines should be developed and enforced to ensure design flexibility and structural reliability. Integrating RISHA into urban planning and public housing schemes – beyond emergency responses – will enhance both adoption and brand perception, while aligning with sustainability targets. Lastly, nurturing partnerships with academia, private developers and communities can spur innovation, hybrid applications and community ownership. These steps will support RISHA's scaling as a resilient, cost-effective housing solution capable of reinforcing Indonesia's overall disaster resilience and equitable development.

## Additional Information

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# 2. Owner-driven Earthquake Resilient Housing in Afghanistan: Preserving Cultural Heritage

Country:

Afghanistan

Submitted by:

United Nations Development Programme (UNDP)

- Housing
- Post-Disaster
- Public Housing
- Owner Driven
- Retrofits
- Vernacular


## Abstract

*This case study provides examples of community-led resilient housing recovery projects in Afghanistan that empowered the local communities by incorporating hazard-resistant features into familiar vernacular design, thereby bridging tradition and safety.*

*The extreme vulnerability of Afghanistan's housing stock was exposed after the June 2022 earthquake in Paktika and Khost provinces and the Herat earthquakes in October 2023. Since 2022, UNDP, with support from various partners, has provided technical and financial assistance for resilient housing recovery in Afghanistan. The case study shows how use of local materials and traditional techniques combined with appropriate seismic safety features made the houses more adaptable to local climate conditions, leading to natural energy efficiency and to resilience to natural hazards. It also demonstrates that not all damaged homes require full reconstruction. Retrofitting of partially damaged vernacular houses proved to be more cost-effective, time-efficient and culturally sensitive, while also reinforcing community trust in their traditional building knowledge.*


## Introduction to the Initiative

Following the 2022 and 2023 earthquakes in Afghanistan, UNDP supported community-led housing recovery in the Southeast region and Herat province through an owner-driven, vernacular approach. The focus was on empowering local communities by incorporating hazard-resistant features into familiar vernacular building, bridging tradition and safety. Starting with 156 homes in Paktika and Khost provinces (Southeast region) in 2022 – now fully occupied – the initiative expanded after the devastating 2023 Herat quakes (Western region), which led to the collapse of 13,000 houses and the fresh requirement for repair, retrofit, and rehabilitation of 37,000 homes.

**Image 1:** Transitional shelter constructed in December 2023 in Chahak village, Herat province. These shelters stand safe despite several aftershocks.

Soon after the Herat earthquake, 169 temporary shelters in Chahak village, Injil district were rebuilt through the same modality and in 2024, 235 permanent shelters were constructed in the same village. Additionally, through the Special Trust Fund for Afghanistan, 400 households in Kushk Robat Sangi district, Herat province, were rebuilt/retrofitted using local materials and seismic-resistant techniques. Merging cultural preservation with modern engineering, the model enhances resilience, empowers communities through training, and strengthens local capacity. Its adaptability and cost-effectiveness offer a replicable solution for disaster recovery in fragile, infrastructure-limited settings.

Finally, use of local materials and traditional techniques combined with appropriate anti-seismic features made the houses more adaptable to local climate conditions, leading to natural energy efficiency, while ensuring their resilience to natural hazards.

## Impact of the Initiative

The Herat Earthquake Response was enabled through three project/funding streams:

**November 2023 to January 2024:** Following the earthquakes in Herat province in October 2023, UNDP stepped in to provide housing support in Chahak village in Injil district, which had been completely destroyed by the earthquakes. The village was identified in coordination with the Emergency Shelter and Non-Food Items (ES-NFI) Cluster, a coordination mechanism within the humanitarian system focused on providing shelter and essential non-food items to people affected by crises. From November 2023 to early January 2024, UNDP supported the construction of 235 temporary shelters in Chahak village through an owner-driven construction approach

using a cash-for-shelter modality. This emergency intervention aimed to protect vulnerable families from harsh weather conditions during the cold season.

**May 2024 to April 2025:** Following the first phase, UNDP continued its support to the Chahak community by facilitating the construction of 169 permanent shelters using the same owner-driven construction approach. The initiative directly benefited 169 households in Chahak village, and indirectly supported approximately 1,183 household members.

**2024-2025:** Through resources from the Special Trust Fund for Afghanistan (STFA) for the Post-Earthquake Recovery and Resilience Building joint initiative in Herat, UNDP provided technical and financial assistance to 400 vulnerable households in Kushk Robat Sangi district, Herat province, to rebuild or retrofit their houses.

## Process of the Initiative

**Housing Group:** The initiative primarily targeted economically disadvantaged and vulnerable households, including women-headed households and families severely affected by the 2022 and 2023 earthquakes. These groups faced immense losses and often had limited resources to recover. The reconstruction and retrofitting support aimed to restore their dignity, improve safety, and reduce future risks.

**Need for the Initiative:** Afghanistan is one of the most disaster-prone countries in the world, due to its location at the convergence of several tectonic plates and its mountainous geography. Earthquakes, floods, landslides and harsh winters regularly cause widespread damage to lives, property and infrastructure. The June 2022 earthquake in Paktika and Khost provinces caused over 1,000 deaths and widespread

**Image 2:** Interior view of transitional shelters

destruction in the southeast Paktika and Khost regions, while the Herat earthquakes in October 2023 caused over 1,500 deaths and injured over 2,600 people. More than 13,000 houses collapsed completely, and approximately 37,000 required repair, retrofitting, and rehabilitation.

These disasters underscored the extreme vulnerability of Afghanistan's housing stock. Climate change is further compounding these risks by increasing the frequency and intensity of weather-related hazards. Consequently, there was an urgent need for a comprehensive recovery approach – one that would not only restore safe shelter but also strengthen long-term resilience.

Afghanistan's architectural heritage is deeply rooted in vernacular traditions. Afghan families have developed housing designs that take into account the local climate and optimize the use of essential resources like water for sustainability and comfort using local materials.

Consequently, in the wake of the 2022 earthquake in southeastern Afghanistan, a critical question emerged: How can reconstruction efforts preserve and leverage Afghanistan's traditional knowledge while ensuring modern standards of safety and resilience? In this context, UNDP identified a unique opportunity to support communities through an approach that integrates cultural preservation with modern technologies. The aim was to promote safe, sustainable and resilient reconstruction that honours local identity while addressing urgent shelter needs.

### Implementation

- The 2022 Southeast Housing Recovery initiative in Paktika and Khost was led by UNDP in collaboration with CARE International in Khost

**Image 3:** Another type of transitional shelter in Chahak village

**Image 4:** Structure of transitional shelters, Chahak village, Herat

province and ActionAid and the Swedish Committee for Afghanistan (SCA) in Paktika province, operated under the Responsible Partner Agreement (RPA) implementation modality, and UNICEF through a training and cash-for-shelter modality.

- In Herat province, the construction of 235 temporary shelters in Chahak village from November 2023 to January 2024 was implemented by UNDP through NCA (Norwegian Church Aid) though a cash-for-shelter modality. The subsequent construction of 169 shelters from May 2024 to April 2025 was also implemented through NCA.
- The 2024-2025 initiative focused on 400 households in Kushk Robat Sangi district, Herat province, is funded through the Special Trust Fund for Afghanistan, led by UNDP in partnership with CARE International. This is part of the Post-Earthquake Recovery and Resilience Building joint initiative in Herat province, involving other UN Agencies (UNHCR, IOM, UN-Habitat, ILO, UNFPA, UNOPS) and local community-based structures. Coordination among these actors has been facilitated by UNDP as the convening agency of this joint initiative.

All initiatives were underpinned by a strong community mobilization process in partnership with community-based governance structures. Additionally, in Kushk Robat Sangi district (STFA-funded initiative), nine Community-Based Shelter Committees and DRM Committees (including subcommittees for women) were established across the targeted villages to ensure inclusive participation, transparency, and monitoring. These committees played an essential role in overseeing beneficiary selection, resolving disputes, mobilizing contributions and supporting vulnerable households during reconstruction. The STFA initiative used a cash-

**Image 5:** Transitional and permanent shelters constructed in Chahak village

for-shelter modality, delivering funds in tranches tied to construction milestones:

- USD3,064 for new constructions (5 tranches)
- USD1,000 for retrofitting (3 tranches)

Continuous on-site coaching and supervision ensured that construction quality remained high. Demonstration shelters, such as the one built in Muhajir Abad village, served as live classrooms to train and guide local masons and household representatives. These sessions reinforced technical learning and helped ensure that new knowledge was applied in every phase of the shelter construction. Each household contributed their labour and, in many cases, locally sourced materials such as sand, stones or timber. The activation of the community members' agency in the shelter construction process, often combined with the involvement of skilled masons and neighbours, not only reduced construction costs but also increased ownership and pride in the outcomes.

UNDP implemented a context-sensitive, owner-driven housing recovery programme rooted in the use and enhancement of vernacular architecture techniques adapted for seismic resilience. All initiatives involved both retrofitting and new construction and were carried out through a combination of community engagement, capacity building, demonstration and technical oversight.

### Integration of Vernacular Architecture and Seismic Safety

The programme drew on Afghanistan's traditional building practices – such as domical vault roofs made from pakhsa (cob) and khasht-e-ham (adobe), and rubble stone masonry walls – while addressing their seismic vulnerabilities. In the Herat context, where domed roofs are a cultural hallmark, the retrofitting of partially damaged homes focused on enhancing structural integrity without compromising local identity. Retrofitting measures included:

- Horizontal wire mesh bands to tie wall systems together
- Structural anchoring of the domical vaults using GI wires through drilled joints

- Rebuilding and replastering with stabilized materials (e.g., gypsum-clay mortar)
- Repair of cracks with gypsum slurry
- Adding extra support at the corner of the openings

This process was staged and demonstrated in real households to facilitate replication.

In Kushk Robat Sangi district, for new construction, Compressed Stabilized Earth Blocks (CSEBs) were introduced as a safer, locally producible alternative to traditional adobe, leveraging local skills while improving seismic resistance. Gabion bands, stonemasonry foundations, and ductile design principles were incorporated to enhance structural safety under seismic loads.

By June 2025, through the STFA, a total of 224 shelters were newly constructed for families in Kushk Robat Sangi district whose homes were completely destroyed by the earthquake, while 176 partially damaged shelters were retrofitted or repaired. Among these, 83 shelters belonged to women-headed households (37 new constructions and 46 retrofits), ensuring the inclusion of some of the most vulnerable members of the communities.

### Demonstration and Technical Prototyping

To showcase safe building practices and promote uptake, UNDP facilitated the construction and retrofitting of prototype shelters featuring earthquake-resilient techniques: two demo construction shelters in Chahak, now used by UNICEF as child-friendly spaces, and one demo retrofitted shelter in Kushk Robat Sangi district. This served as a visual and technical reference for communities and implementing partners. The prototype included:

- Stone masonry foundations to distribute seismic loads evenly

**Image 6:** Durable shelters constructed in Chahak village, using CSEBs and incorporating seismic features

- Horizontal wire mesh bands and vertical wire reinforcements
- Ductile design for energy dissipation during earthquakes
- Buttresses to reinforce the walls

### Capacity Building and Community Training

All reconstruction included tailored training sessions to ensure community-led reconstruction or retrofitting. In Herat, under the STFA Project, UNDP delivered a comprehensive training package. Some of its features were:

- 60 masons trained in practical retrofitting (roof anchoring, plinth reinforcement, crack repair)
- 30 engineers (including 7 female engineers) trained in technical assessments, earthquake-resistant design, and quality control
- 220 community members, including 130 women, trained in DRM and basic safe construction techniques
- 400 household representatives, including 83 women from female-headed households, received on-site coaching during construction

Trainings were delivered through a combination of weekly sessions, online courses, and practical demonstrations between November 2024 and June 2025. Female participation was actively encouraged, contributing to gender equality and local technical empowerment.

In Chahak village, training on disaster risk management, earthquake-resilient construction and maintenance of the new shelters was delivered to 235 households, including women.

### Owner-Driven Construction and Retrofitting with Technical Guidance

The project followed an owner-driven model, where households received conditional cash assistance and technical support to rebuild using their own labour and locally sourced materials (sand, timber, stones). This approach:

- Reduced construction costs
- Preserved community agency
- Promoted pride and ownership
- Ensured long-term maintenance and sustainability

Throughout, technical staff from UNDP and partners (NCA, CARE) provided continuous on-site supervision and coaching to ensure compliance with resilient construction standards. Retrofitting further addressed vulnerability by ensuring that all roof elements remain interconnected to retain their shape and structural integrity and connecting the roof securely to the walls so that all elements behave as a system under seismic forces.

### Policy and Standards Alignment

The Afghanistan Structural Code (ASC 2012), which is performance-based and developed by the Afghanistan National Standards Authority (ANSA), does not include codes for vernacular houses, but provides guidance on conventional structural materials and design. This project complemented policy efforts by producing 'Guidelines for Resilient House Construction, Repairs and Retrofitting in Afghanistan' (to be published), translating standards into community-friendly, demonstrable practices grounded in vernacular knowledge. The guidelines draw upon relevant Indian standards. They are not intended to completely prevent damage or collapse but aim to minimize risk to human life by improving the structural performance of houses during natural hazards. They also represent an incremental approach to safety, serving as a first step in building community capacity for safer housing. The technical guidelines are prescriptive so as to simplify their adoption and use by practicing engineers, masons and houseowners.

**Image 7:** Interior view of durable shelters made with wooden joists and planks

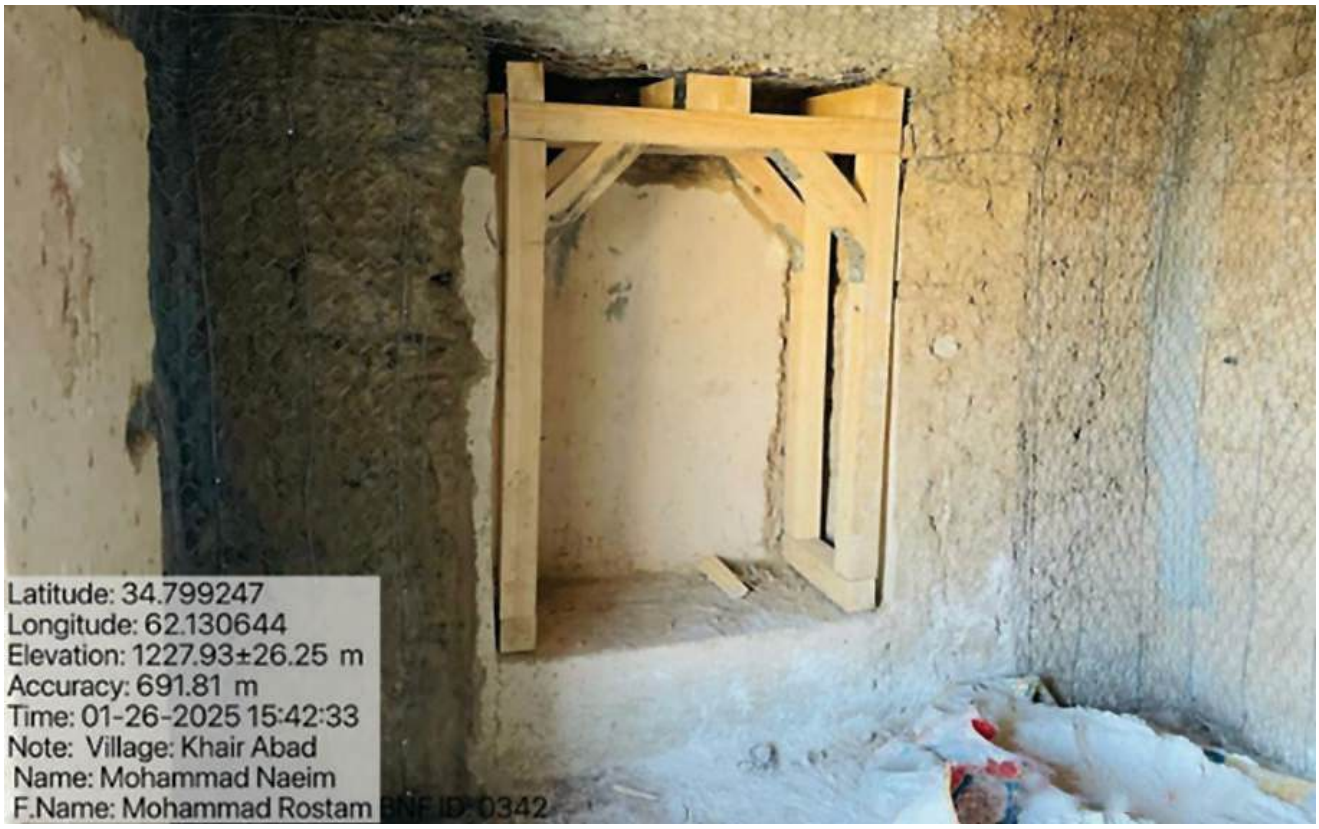


**Image 8:** A part of retrofitted shelter using wooden support in shelves and galvanized wires and meshes for wall reinforcement

**Contribution towards reducing vulnerabilities of at-risk populations and reducing inequalities**

The initiatives adopted an owner-driven, community-led recovery model that placed affected populations – especially women-headed households (WHHs) – at the centre. This approach enabled context-sensitive, hazard-resilient shelter reconstruction while strengthening local capacities, creating livelihood opportunities, and promoting inclusive governance.

In the STFA-funded project, gender equality and women's empowerment (GEWE) were mainstreamed throughout implementation. A total of 137 women, including 83 WHH representatives, were trained in disaster risk management (DRM), earthquake-resilient construction techniques, and the use of improved materials like CSEBs. WHHs were prioritized for shelter support, technical coaching, and leadership roles within recovery committees.

Recovery efforts were guided by consultations with 90 women to ensure shelter designs met safety, privacy and accessibility needs. Awareness sessions reached 133 women and 3 adolescent girls on women's rights, protection from sexual exploitation and abuse (PSEA), and access to complaint mechanisms such as the tollfree hotline called AWAAZ 410, thus fostering agency and protection.

Community governance structures institutionalized inclusion and accountability:

- 9 DRM Committees and 9 Shelter Committees were established, each with female members.
- 9 Women's DRM Subcommittees and 9 Women's Voice Groups ensured active participation of women in planning and oversight.

Trainings were held in culturally appropriate settings, enabling meaningful female engagement.

In the project in Chahak, 70 women were trained on anti-seismic features and maintenance of shelters, in addition to disaster risk management. A multi-channel grievance redress mechanism (GRM) was active in all supported villages, resolving 95 percent of submitted cases.

Shelters were constructed with anti-seismic features (lateral wall bands, seismic belts, roof anchoring), significantly reducing risk of collapse and homelessness. At the same time, technical skills gained by local masons – including women – supported future income generation.

By promoting participation, equity and capacity development, the initiative reduced both exposure to hazard risks and underlying social inequalities. It also enhanced long-term resilience and self-reliance, particularly for marginalized groups such as WHHs who were at risk of homelessness following the impacts.

## Lessons Learned

Various operational, technical and contextual challenges were encountered, requiring adaptive strategies and innovations:

Technical Challenges in Vernacular Construction

Earthen construction, while affordable and culturally appropriate, is particularly vulnerable to seismic shocks. This posed a design and implementation challenge in ensuring structural safety without compromising traditional building methods. The lack of national building codes addressing earthen architecture necessitated reliance on adapted international standards, such as Indian Standards IS 13827 and IS 13828 for earthen and low-strength masonry structures.

Application of Compressed Stabilized Earth

Blocks (CSEBs) as a more resilient alternative to traditional adobe faced challenges such as poor soil quality in some areas, slow production rates, lack of skilled artisans, and unavailability of certified labs for quality assurance. The project's technical guidance emphasized soil composition (optimal 60–70 percent sand, 5–15 percent clay) and highlighted risks from saline soil and water (over 1200 ppm TDS), yet consistent adherence to these standards proved difficult due to variability in field conditions and limited testing facilities.

Mitigation strategies involved:

- Field-based soil testing and training to guide appropriate soil selection.
- Staggered production of CSEBs, arranged in tagged batches and tested after curing.
- On-site technical coaching to ensure adherence to seismic-resistant construction techniques, including wall bands, roof anchoring, and corner strengthening.

### Structural Retrofitting as a Cost-Effective Alternative

A key lesson was recognizing that not all damaged homes require full reconstruction. Retrofitting of partially damaged vernacular houses proved to be more cost-effective, time-efficient, and culturally sensitive, while also reinforcing community trust in their traditional building knowledge. By developing and promoting locally adapted retrofitting techniques, the initiative strengthened the long-term viability of vernacular housing and reduced environmental and material costs.

### Implementation Constraints in Post-Disaster Settings

Reconstruction efforts triggered a sudden spike in demand for materials and labour, leading to:

- Delays due to unavailability of materials in local markets.

**Image 9:** Production of compressed stabilized mud blocks through manual machines within the community by the owners of shelters

**Image 10:** 868660 CSEB produced through hydraulic machines in Chahak village

- Seasonal constraints during the spring agricultural period, reducing labour availability.
- Inflation of material costs and logistical challenges in transporting reinforcement materials to remote areas.

These challenges were addressed through:

- Pre-identification and bulk procurement of materials with support from village-level Procurement Committees.
- Sensitization campaigns encouraging timely construction despite agricultural duties.
- Volunteer labour arrangements for vulnerable households (especially women- and elderly-headed).

### Absence of National Building Codes and Technical Knowledge Gaps

Afghanistan's regulatory environment lacks building codes tailored to local construction practices. This gap necessitated the use of hybrid approaches combining prescriptive guidelines with performance-based assessments. A field visit component was added to the training of the 30 engineers mentioned above, allowing them to observe hazard-resistant techniques in situ – highlighting the importance of contextualized learning.

### Low Literacy and Training Adaptations

Low literacy among community members, especially women, required adaptation of training materials. Technical sessions were simplified, translated into local languages, and delivered through visual aids and hands-on demonstrations. Women-only training sessions with female facilitators, organized through coordination with local elders, were key to securing community acceptance and increasing participation.

Best practices included:

- Culturally sensitive training design to ensure women's access and inclusion.

- Participatory approaches using visual and demonstrative learning for low-literacy groups.
- Community-based DRM structures to institutionalize disaster preparedness at the local level.

### Inclusivity and Community Empowerment

The creation of DRM Committees, Women's Voice Groups, and Community-Based Shelter Committees promoted inclusive governance and reinforced transparency and accountability. Women-headed households were prioritized for shelter support and received tailored assistance in procurement and construction oversight. These structures enhanced local ownership and trust while institutionalizing women's engagement in disaster risk reduction and recovery planning.

### Quality Assurance and Monitoring

The owner-driven model required a robust accountability framework to ensure quality and safety. A multi-channel Grievance Redress Mechanism (GRM) was deployed, complemented by regular technical coaching and milestone-linked cash disbursements. This ensured timely problem-solving and built confidence among beneficiaries.

### Co-Benefits of the Project

The initiative generated multiple co-benefits beyond shelter provision, contributing to both individual empowerment and broader community resilience. Trained local masons have begun applying disaster resilient construction techniques in neighbouring areas, generating new livelihood opportunities and replicating good practices.

Returnees – including some of the 2.4 million Afghans deported from neighbouring countries since late 2023 – also accessed employment through reconstruction activities, easing their reintegration. The initiative helped approximately 2,800–3,000 people regain safe, weather-resistant, and dignified housing. Some women-headed households avoided homelessness, while communities reported reduced anxiety and improved well-being. By integrating resilience with vernacular design, the project preserved cultural heritage and strengthened local knowledge systems – empowering households to rebuild confidently and in line with their sociocultural identity.

Additionally, coordinated recovery efforts improved access to water, energy, sanitation, and livelihoods, laying the groundwork for a holistic, multi-sectoral recovery and disaster risk reduction framework.

### Scalability of the Process

The initiative has already demonstrated strong potential for scalability, as evidenced by its successful expansion from the southeastern provinces of Afghanistan – following the 2022 Khost and Paktika earthquakes – to Herat province in response to the 2023 seismic events. The continuity of approach, adapted to evolving contextual and technical lessons, underscores the model's viability for replication across other earthquake-prone regions in the country.

Key enablers for scalability include the development of context-specific technical guidance and training materials. Building on the learnings from the southeast intervention, UNDP has supported the production of updated Technical Guidelines for Resilient House Construction, Repairs, and Retrofitting in Afghanistan – titled 'Taking Vernacular Forward' – which are ready for publication. These

comprehensive guidelines provide design and construction specifications for hazard-resistant vernacular housing using locally available materials and technologies. They expand the previous guidance developed post-2022 earthquake to now include construction with Compressed Stabilized Earth Blocks (CSEBs), burnt bricks, domical vaults made of khasht-e-kham (adobe), and jack arch roofs, alongside traditional pakhsa and stone masonry. The guidelines are supplemented by visual educational materials and training toolkits designed for masons, homeowners and community members, with a focus on practical demonstrations and low-literacy accessibility.

The model's owner-driven, community-centred methodology further supports scalability by leveraging existing local construction knowledge and social capital, while incrementally enhancing technical capacity. This approach not only reduces costs compared to contractor-led models but also strengthens long-term resilience through skills transfer and local employment generation.

## Way Forward

The initiatives are now almost completed, yet there is a need to promote safe construction widely across Afghanistan, as an earthquake risk prevention measure. The training materials and guidelines are to be published and shared with a growing number of stakeholders.

This includes the updated Technical Guidelines for Resilient House Construction, Repairs, and Retrofitting in Afghanistan, titled 'Taking Vernacular Forward', and the 2023 'Post-Earthquake Transitional Shelter Guidelines for Herat, Afghanistan 2023 November'.

## Additional Information

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# 3. Pradhan Mantri Awas Yojana – Gramin (PMAY-G),[7] India

Country:

India

Submitted by:

National Disaster Management Authority

- Housing
- Public Housing
- Owner Driven
- Enablers


## Abstract

*The Pradhan Mantri Awas Yojana, Grameen (PMAY-G) is an owner-driven government aided housing programme in rural India, for the people below poverty line and women-headed households who live in temporary structures. One of the primary objectives of the housing programme was to build high quality resilient houses across the country based on local materials and technologies that were labour-intensive, cost-effective and, environment-friendly. The owner-driven approach encouraged people to invest their own savings, reduced cost of construction by 10–30 percent, improved quality of construction and reduced future maintenance costs. Considerable reduction of $CO_2$ emissions (15-40 percent) was possible as compared to brick- and RCC-based construction.*

*Under the programme a very transparent system for management of data and information was instituted. All the data related to the beneficiaries, monitoring, and quality control of construction, financial disbursement were managed by the 'Awaas' app (a mobile application-based technology). All beneficiary-related data were uploaded by the village level government officials to the Awas App. The programme also led to the development of an institutional system for training and certification of masons, carpenters, electricians and plumbers.*

*Through this housing programme, Government of India (GoI) facilitated construction of 29.5 million houses for families who lived in substandard buildings. It covered approximately 130 million people in the rural areas of India and provided them with high-quality houses.*


## Introduction to the Initiative

The Ministry of Rural Development (MoRD), GoI, is responsible for accelerating socioeconomic development of rural areas. It focuses on poverty reduction, resilient housing and infrastructure and

[7] Prime Minister's Housing Programme - Rural

empowering communities through various schemes and Programmes. In 2016, MoRD launched the Pradhan Mantri Awas Yojana, Grameen (PMAY-G), an owner-driven, government-aided housing programme in rural India, for people below the poverty line and women-headed households who lived in temporary structures (e.g., with mud walls).

The allocated budget for the programme was USD51.11 billion (29.5 million houses x INR125,000 per house) (USD1 = INR72.15, 2019). PMAY-G aimed to achieve the goal of 'Housing for All' in rural areas by addressing the housing deficit and ensuring that all families without housing and those living in dilapidated homes or kutcha (mud) structures have access to pucca (permanent) resilient houses with toilet and drinking water. The programme was implemented during the period 2017–2022. Considering the success of PMAY-G, the GoI has approved a proposal to continue PMAY-G during FY 2024-25 to FY [8]an additional 20 million rural houses with an outlay of INR3.06 lakh crore (USD36.72 billion, June 2025).

PMAY-G was implemented by the various state governments of India and the funding was shared between the central government (60 percent) and state governments (40 percent). It was an owner-driven process, and the housing assistance was credited directly to the beneficiaries' bank accounts. The beneficiaries themselves procured materials and constructed their houses with the help of trained and certified masons and engineers.

## Process of the Initiative

**Main stakeholders:** The main stakeholders of the programme were the beneficiaries, local engineers, Block Development Officers, junior engineers, village heads, masons and local banks. The local building materials market played an important role since the beneficiaries often procured materials on credit when the tranches did not reach them on time.

**Need Assessment Survey:** The Socio Economic and Caste Census (SECC) of 2011 was conducted using a door-to-door enumeration exercise across rural and urban India. It was the first paperless census in India, utilizing handheld electronic devices. The survey gathered information on the socioeconomic status of households, to identify those eligible for various government welfare programmes. Based on the SECC data, a list of households without housing or those living in substandard houses in rural areas were identified and a list prepared. The list of the identified households was sent to the village level committees for verification and validation. The validated list of beneficiaries was approved by the respective government. The concerned households were then informed and an orientation workshop was conducted to make them aware of the process of house building and how to manage the construction work.

**Housing Delivery Method:** PMAY-G was set up as an owner-driven housing programme where the government assistance money was credited to the beneficiaries' bank accounts. The beneficiaries were themselves responsible to build their houses. They procured the materials, took part in construction and paid the constructions workers/ masons. Each beneficiary received approximately USD1,875 for building a housing unit of minimum 25 square metres of covered area. The designs were prepared with provision for incremental expansion by the beneficiaries over time. Typically, a housing unit constructed under the programme consisted of a room and a veranda, which helped the beneficiaries carry out any kind of home-based enterprise.

[8] https://rural.gov.in/en/press-release/expansion-pradhan-mantri-awas-yojana- gramin

**Water and Sanitation:** PMAY-G had a convergence with Swachh Bharat Mission-Grameen[9] (SBM-G), initiated in 2014 with the goal of making India Open Defecation Free (ODF). This massive project successfully mobilized nationwide participation, marking it as the largest behavioural change movement globally. By 2019, the mission celebrated the construction of over 100 million individual household toilets, declaring a large number of villages ODF, aligning with SDG Target 6.2 to achieve access to adequate and equitable sanitation and hygiene for all by 2030. Each household without a toilet received INR12,000 (USD166) for the construction of a permanent toilet. The PMAY-G beneficiaries having a substandard toilet or no toilet received the SBM money for building a permanent toilet.

In 2019, out of about 193.2 million households in rural India, only 17 percent had a tap water connection. To eradicate this problem, GoI launched a programme called the Jal Jeevan Mission in 2019 with an aim to ensure tap water supply to every rural home by 2024, with an outlay of INR3.60 lakh crore (USD50 billion) in five years. This has reduced the hardship of many women, as they no longer have to fetch water from a distance. PMAY-G beneficiaries had access to this mission.

**Financial Arrangement:** The government also facilitated an optional loan of up to INR70,000 (USD970) that a beneficiary could avail through banks or other financial institutions for the construction of their houses in addition to the assistance received from the government.

**Capacity Building:** To provide technical support to the beneficiaries, masons, carpenters and plumbers were trained and certified by the Construction Skill Development Council of India.[10] A cadre of certified training providers and

[9] https://swachhbharatmission.ddws.gov.in/.
[10] https://www.csdcindia.org/.

**Image 1:** A demo building at the construction stage

assessors were created under the programme. The certified training providers conducted two types of training programmes: a) a 45-day hands-on training for beginners to make them rural masons and, b) a two-week training for existing working masons under Recognition of Prior Learning (RPL). The assessors were certified individuals who were empowered to conduct tests of the trained masons and recommend certification for those who passed the exam. About 300,000 rural masons across India were trained[11] and certified in disaster resilient construction.

## Framework for Implementation

To support the implementation of PMAY-G; the MoRD developed a framework for implementation[12] which provided all necessary details related to the programme, such as a) all those who are eligible; b) financial aid and release of tranches; c) process of implementation including minimum standards, designs, etc.; d) encouraging the use of green designs and technologies. The framework was used for orienting the beneficiaries selected under PMAY-G.

**Planning, Design and Technology:** Prior to PMAY-G, houses in the rural areas used to be built with costly, energy- and emission-intensive materials such as brick, cement, steel, etc. MoRD encouraged the use of local building materials, e.g., cement stabilized mud block, treated bamboo, stabilized rammed earth, etc. To promote such technologies and designs, MoRD, with support from UNDP-India, appointed eight reputed architects and NGOs who reached the people's doorsteps in 18 states of India, carried out resource mapping and prepared designs through a participatory process. Based on the local climate, geology, natural hazards and social patterns, this exercise divided 18 states into 64

[11] https://www.pib.gov.in/PressReleasePage.aspx?PRID=2074713.
[12] https://pmayg.nic.in/netiayHome/Uploaded/Guidelines-English_Book_Final.pdf.

**Image 2:** Fully constructed house

**Image 3:** Beneficiary involvement in the construction process of multi-hazard resilient house in Tripura

housing zones with options for 40 local material-based technologies and 130 architectural designs. Since most of the technologies were based on local materials and derived from traditional architecture, they needed structural validation.

The Central Building Research Institute (CBRI), of India, was appointed to examine the designs and the technologies and make them safe against multi-hazards. Following validation by CBRI, MoRD and UNDP-India prepared a compendium (PAHAL[13]) which provided a menu of options for 140 designs and 40 construction technologies and shared the document with 18 states for dissemination. This was a significant milestone in the journey of the housing programme, as it provided specific guidance to the various state governments on the construction technologies, locally available materials, prevailing rural construction skill sets and disaster resilient measures to be incorporated in the houses. Efforts were also made to ensure that the beneficiaries were able to use these housing designs and construction technologies right away at the village level with materials sourced locally.

## Lessons Learned

High cost of construction, people's acceptance of local materials-based construction technologies and availability of skilled masons and carpenters were the three most important challenges faced by PMAY-G. Making the programme owner-driven reduced the challenges considerably. All PMAY-G designs were context-specific and developed by the beneficiaries through a participatory process. The use of local materials, trained construction workers and beneficiary-managed construction reduced the cost to a great extent. However, the cost of construction

[13] https://pmayg.nic.in/netiayHome/Document/Pahal.pdf.

and adoption of local materials in design remained the two major challenges. The use of treated bamboo and stabilized mud block in states like Assam and Tripura reduced the cost of construction, while also reducing the emission of CO2 and depletion of natural resources, e.g., regenerating bamboo takes about three years, stabilized mud block reduces CO2 emission compared to that of burnt bricks. In addition, treated bamboo and cement-lime stabilized mud block production have created livelihood opportunities for the local entrepreneurs and women's self-help groups (SHGs).

The focus of the resource-mapping exercise was to ensure that the houses were risk-informed and resilient. The designs validated by CBRI were adopted in many states, making PMAY-G houses risk-informed and hazard-safe. The trained and certified 300,000 masons and carpenters across the PMAY-G states reduced costs and improved quality of construction. The certification of the masons/carpenters has inculcated a sense of pride in them, while also increasing their employment opportunities. They are the future assets of rural India, which is a sustainable way of slowly making the rural landscape resilient. The established institutional system for training and certification of the construction workers is a significant contribution to resilient housing and facilities. Now the rural labourers have an opportunity to get trained and certified leading to enhanced earnings and a good social status. 'Awaas Plus' software developed under the programme has established a transparent system ensuring that no one is left out from PMAY-G.

PMAY-G buildings have a high potential for influencing rural housing in general. The scheme has generated examples of cost-effective, green and resilient housing at the village level, which is working as a positive catalyst for disseminating this trend of housing into the lower-income group and middle-income group households. This marks a shift from the housing for below-poverty-line households to rural housing in general.

## Way Forward

Prior to PMAY-G, all government-aided housing projects were top down. Each state used to send one or two standard designs to the beneficiaries, which were prepared at the state capital level by the architects/engineers. Such designs never satisfied the aspirations of the people. The designs were costly since they were RCC- and brick-based. PMAY-G has set a new trend of climate and disaster resilient housing in India. It has been participatory, owner-driven, affordable, based on local materials and traditional architecture, environment-friendly and above all, climate and disaster resilient. Encouraged by the success of PMAY-G, the GoI has extended the programme up to 2028-29. Under the extended programme, 20 million HHs living in substandard housing will be given financial assistance to construct affordable, climate and disaster resilient permanent homes.

## Key Findings:

- Participatory designs prepared by the beneficiaries fulfilled people's aspirations.
- Use of local materials, engaging trained construction workers and beneficiary-managed construction reduced building cost and enhanced quality.
- Large scale acceptance of local materials in construction remains a challenge, as brick and RCC are still popular.
- The use of treated bamboo and compressed

cement-lime stabilized mud blocks in construction has reduced costs and CO2 emissions and created livelihood opportunities for the local entrepreneurs and women's SHGs.

- Technologies validated by the national institute paved the way for their inclusion in the National Building Code.
- The training and certification of 300,000 masons and carpenters across the PMAY-G states has inculcated a sense of pride in them and increased their employment opportunities.
- The established institutional system for training and certification of the construction workers is a significant contribution to resilient housing and facilities in India.
- 'AwaasPlus' software developed under PMAY-G has established a transparent system ensuring that no one is left out from the housing programme. It is accessible online.

## Key Takeaways

- Owner-driven construction with the assistance money being credited directly to the bank account of the beneficiaries is a highly replicable model. The owner-driven approach is transparent, democratic and ensures that no one is left behind.
- Women-led housing programme has shown faster implementation and timely completion.
- Traditional architecture is climate and disaster resilient. It is based on local materials and culture. Lessons could be drawn from traditional architecture and adapted in housing based on building codes.
- Participatory design makes housing affordable, local culture-sensitive and fulfils people's aspirations.
- Awaas software for planning, monitoring and control is replicable.

## Additional Information

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# 4. Building Housing Resilience in the UK – Warm Homes Plan and Warm Home Discount Scheme

Country:

United Kingdom

Submitted by:

Foreign, Commonwealth & Development Office (FCDO), Government of United Kingdom

- Housing
- Enablers


## Abstract

*The United Kingdom due to its temperate climate, rapid urban development and the growing threat of climate change-induced extreme events is facing escalating challenges. The interlinked nature of these issues impact household well-being, economic stability and social equity, and necessitates comprehensive and integrated policy responses.*

*Warm Homes Plan is group of overarching strategies and initiatives by the UK government aimed at improving the energy efficiency of homes, reducing household heating costs and transitioning towards cleaner, low-carbon heating systems. The Warm Home Discount Scheme (WHD), operational since 2011, is a key policy designed to tackle fuel poverty and provide financial support to low-income households in UK to support them with their energy bills. WHD is a non-structural intervention aimed at tackling fuel poverty, improving thermal comfort and home habitability.*

*WHD scheme has laid a strong foundation for energy resilience among vulnerable households.*


## Introduction to the Initiative

The United Kingdom due to its temperate climate, rapid urban development and the growing threat of climate change-induced extreme events, is facing escalating challenges. The interlinked nature of these issues impact household well-being, economic stability and social equity, and necessitates comprehensive and integrated policy responses.

Housing, as the fundamental unit of human settlement, stands at the nexus of these challenges. Resilient development in the housing sector, therefore, becomes extremely vital for safeguarding communities, ensuring economic stability, and fostering equitable, resilient and sustainable development. This

good practice delves into two distinct initiatives in the UK that address housing resilience as part of the Warm Homes Plan (WHP) and Warm Home Discount Scheme (WHD).

The Warm Homes Plan (WHP) is a group of overarching strategies and initiatives by the UK government aimed at improving the energy efficiency of homes, reducing household heating costs, and transitioning towards cleaner, low-carbon heating systems. The budget for WHP is GBP13.2 billion (USD18 billion) including an initial GBP3.4 billion (USD4.6 billion) over the next three years.

The various initiatives under WHP are as follows:

- **Boiler Upgrade Scheme:** Offers upfront grants up to GBP7,500 to support the installation of air source heat pumps, ground source heat pumps and biomass boilers.
- **Warm Homes: Social Housing Fund Wave 3:** Allocates GBP1.2 billion, to be delivered from 2025 until 2028 by eligible social housing landlords, to improve housing standards.
- **Warm Homes: Local Grant:** Launched in 2025, provides a GBP500 million fund for energy upgrades of low-income homeowners and private tenants in England. It targets properties with lower Energy Performance Certificate (EPC) ratings (D-G)[14] and supports both energy efficiency improvements and cleaner heating solutions.

The Warm Home Discount (WHD) Scheme provides a discount (currently GBP150) on energy bills for eligible low-income and vulnerable households during winter and is funded through a levy on domestic energy bills. The scheme has been operational since 2011. The primary function of WHD is a non-structural intervention aimed at tackling fuel poverty, improving thermal comfort and home habitability. The scheme is currently funded through a levy on domestic energy bills. Since the scheme began in 2011, over GBP4 billion (over USD5 billion) in support has been provided to households. Subject to legislation, the expanded scheme has an expected spend of around GBP1 billion (around USD1.3 billion) in 2025/26.

## Impact of the Initiative

### The Warm Home Discount Scheme: A non-structural policy approach to energy resilience for households

The Warm Home Discount Scheme (WHD) is a key policy designed to tackle fuel poverty and provide financial support to low-income and vulnerable households in Great Britain to support them with their energy bills. Administered by energy suppliers in Great Britain, the scheme offers a GBP150 discount on energy bills for low-income households during the winter months. While this not a structural intervention towards housing resilience in the traditional sense of an asset upgrade, it enables households to heat homes without causing an impact on their financial stability, which in turn enhances housing resilience. Since its inception the scheme has provided support with energy costs for up to 3 million low-income households annually, proving highly effective. The Warm Home Discount scheme supported over 3 million households over winter 2024/25, with rebates funded through a levy on all domestic gas and electricity customers.

Since the scheme began in 2011, over GBP4 billion in support has been provided to low-income households. The government continues to deliver

[14] An Energy Performance Certificate rates a building's energy efficiency on a scale of A to G, with A being the most efficient and G the least.

this support, with plans to help around 6 million low-income households over winter 2025/26.

The primary objectives of the WHD are:

- To ease the financial burden of energy bills on low-income individuals and families.
- To help the lowest-income households struggling to afford adequate heating for their homes, thereby preventing health issues associated with cold indoor environments.
- To indirectly encourage households to heat their homes to a comfortable and healthy temperature, preventing damp and mould issues that can arise from underheating.

The WHD operates through two main groups:

**Core Group 1:** This group includes pensioners receiving the Guarantee Credit element of Pension Credit. These individuals typically receive the discount automatically, usually directly applied to their electricity bill.

**Core Group 2/Broader Group:** This group, which has seen several evolutions in its criteria, generally includes low-income households receiving certain means-tested benefits (e.g., pension credit, housing benefit, income-related employment and support allowance, income-based jobseeker's allowance, income support, universal credit). Eligibility within this group has historically involved the property meeting a 'high-cost-to-heat' criterion. This criterion is (subject to legislation) being removed for winter 2025/26, thereby expanding the scheme to include more low-income households on means-tested benefits. A data matching exercise identifies eligible energy billpayers and energy suppliers provide the discount to their eligible customers.

Participating energy suppliers are also expected to meet a separate spending obligation through Industry Initiatives including debt assistance, energy efficiency measures, benefit checks and energy advice. The scheme is funded by a levy on all domestic electricity customers, which highlights a shared societal responsibility for addressing fuel poverty.

While WHD is not a scheme targeting structural upgrades, it contributes to housing resilience through various non-structural interventions:

**Financial Resilience:** By reducing energy bills, the WHD frees up household income that can be allocated to other essential needs, including minor home maintenance, repairs, or saving for unforeseen emergencies. This strengthens the financial buffer against shocks.

**Health and Well-being:** Cold homes are detrimental to health, exacerbating respiratory conditions, cardiovascular diseases, and mental health issues. By enabling warmer homes, WHD improves occupant health, reducing pressure on healthcare services and contributing to the social resilience of communities. Healthy occupants are better equipped to cope with and recover from other stressors, including natural hazards.

**Reduced Risk of Deterioration:** Consistent heating helps to prevent issues like dampness, condensation, and mould growth, which can lead to structural deterioration over time. While the WHD does not directly insulate homes, it empowers residents to utilize existing heating systems more effectively, thus indirectly slowing down the degradation of the building fabric caused by cold and damp.

**Behavioural and Informational support:** WHD is often linked with energy advice services through the Industry Initiatives, which educate households on efficient energy use. This knowledge empowers residents to adopt sustainable practices, reducing energy waste and improving long-term resilience.

## Process of the Initiative

The Warm Home Discount scheme operates through a collaborative framework involving key stakeholders such as the Department for Energy Security and Net Zero (DESNZ), energy suppliers, the Department for Work and Pensions (DWP), the UK energy regulator Ofgem, and various charities. The scheme is delivered through a coordinated effort led by the DESNZ, in partnership with energy suppliers, DWP, and Ofgem, with strategic oversight provided by the WHD Delivery Board which oversees policy coordination, implementation and stakeholder engagement. Financially, the scheme is funded via a levy on domestic energy bills.

Capacity and awareness are supported in several ways. First, through a dedicated helpline that helps manage citizen queries and resolve issues efficiently. Second, recent reforms have introduced automatic targeting using government benefit data, reducing reliance on manual applications and improving reach among vulnerable groups. Awareness is further driven by seasonal campaigns and strategic outreach, including communication strategies that use press notices, social media posts and Q&A materials to engage households. Implementation follows a structured framework of monitoring and evaluation, while secure API integrations with DWP systems ensure precise eligibility targeting, General Data Protection Regulation (GDPR) compliance, and robust IT security.

## Lessons Learned

The Warm Home Discount (WHD) scheme in the UK, designed to help low-income and vulnerable households with their energy bills, has faced several implementation challenges over the years. These challenges often relate to eligibility, targeting, awareness and the broader context of energy affordability. Several challenges were encountered, and multiple lessons were learned.

### Key Area 1: Targeting and Eligibility

Initially, suppliers had discretion over who qualified for the scheme, leading to inconsistencies and a lack of awareness. There were also concerns that the scheme was not reaching all those most in need, particularly working-age families. The 'high-cost-to-heat' criteria, based on property characteristics rather than actual energy usage or home efficiency, sometimes excluded vulnerable households in smaller or newer homes.

### Mitigation

**Shift to Automatic Targeting:** Recent reforms (especially from 2022-23 onwards in England and Wales) have moved towards a more automated system, using data matching with government benefits (like Pension Credit Guarantee Credit and other means-tested benefits) to identify eligible households. This aims to reduce the need for applications and improve reach.

**Removal of 'High-Cost-to-Heat' Threshold:** For winter 2025/26, this threshold has been removed in England and Wales, expanding eligibility to all energy billpayers on relevant means-tested benefits. This is expected to significantly increase the number of households receiving the rebate by 2.7 million to around 6 million and improve targeting of fuel-poor households.

**Specific Provisions:** Low-income pensioners are automatically identified and receive rebates without needing to apply, while working-age households on means-tested benefits previously underrepresented due to manual processes or limited awareness now benefit from improved targeting. Park home residents and other niche

groups also receive support through tailored provisions. Automatic targeting is scalable across regions and adaptable to additional criteria, and the removal of the 'high-cost-to-heat' threshold broadens eligibility without requiring complex property-level assessments. These changes reduce administrative burdens and enable more households to access support. Tailored processes promote inclusivity, ensuring that vulnerable groups are not left behind.

### Key Area 2: Awareness and Accessibility

Many eligible households, especially in the 'Broader Group', were unaware of the scheme or found the application process confusing. This led to low take-up rates among some vulnerable demographics.

### Mitigation

**Increased Automatic Payments:** The move to automatic identification for core groups means many households now receive the discount without needing to apply, significantly improving accessibility.

**Communication Campaigns:** Efforts are made through official channels (e.g., GOV.UK, energy suppliers) to inform eligible households about the scheme, including sending letters to those automatically identified.

**Helplines:** Dedicated helplines are available for inquiries and to assist those who believe they are eligible but haven't received the discount. Non-digital users benefit from direct communication (e.g., letters) and helpline support. Helplines are also scalable, with digital support tools and increased capacity during peak periods ensuring timely assistance. Helplines play a vital role in improving user experience and resolving issues that might otherwise prevent access to the rebate. Vulnerable groups including elderly individuals, people with disabilities and those with limited digital access or literacy now benefit from simplified access to the Warm Home Discount. Broader Group households, which were previously underrepresented due to low awareness or complex application processes also benefit. This progress is supported by scalable infrastructure, including centralized messaging through GOV.UK, energy suppliers and automated letters, which can be easily expanded to reach wider or more targeted audiences.

### Key Area 3: Funding and Cost to Other Consumers

The Warm Home Discount is funded through a levy on all energy bills, meaning non-recipients effectively subsidize the scheme. As the scheme expands, this cost on average bills can increase, leading to concerns about overall affordability for all consumers.

### Mitigation

**Consultation and Review:** The government regularly reviews the scheme and consults on proposed changes, considering the impact on average bills.

**Seeking Other Savings:** There is a focus on identifying other potential savings within the energy bill (e.g., through Ofgem's review of operational costs or better control of consumer debt) that could offset the increased cost of an expanded WHD.

**Industry Initiatives:** A portion of the scheme's funding goes towards 'Industry Initiatives' run by energy suppliers, which can include debt support and energy efficiency advice, aiming for broader benefits beyond direct rebates.

Millions of low-income and vulnerable households receive direct support through the Warm Home Discount scheme. Non-recipients benefit

indirectly from efforts to control overall scheme costs, while energy suppliers gain flexibility through Industry Initiatives that allow them to tailor support and manage their obligations more effectively.

Consultation and Review processes are readily scalable, fitting naturally within ongoing policy cycles and regulatory oversight. Similarly, seeking other savings can be expanded through national-level mechanisms such as Ofgem's operational cost assessments[15] and broader debt management strategies. These approaches not only support scalability but also deliver a range of co-benefits. Vulnerable households, energy suppliers and the wider consumer base all stand to gain through improved energy efficiency and debt support delivered via Industry Initiatives, enhanced transparency and accountability fostered by regular consultations, and greater affordability for all consumers as operational savings help offset the overall cost of the scheme.

### Key Area 4: Inability to Keep Pace with Rising Energy Costs

The fixed amount of the discount (GBP150) has not always kept pace with significant increases in energy prices, especially during recent energy crises. This meant the rebate provided a diminishing proportion of a household's total energy bill, making it less effective in tackling fuel poverty.

### Mitigation

**Ongoing Review and Adjustment:** The government continues to review the scheme's effectiveness considering current energy prices and fuel poverty levels.

**Proposals for Expansion/Reform:** Consultations, like the one for 2025/26, aim to expand the reach to more households, which, while not directly increasing the per-household rebate, aims to support a larger number of those who need it most.

Low-income and fuel-poor households, particularly those whose energy costs have risen sharply in recent years, have been key beneficiaries of the Warm Home Discount scheme. As the scheme expands, it continues to bring newly eligible households into its scope, offering support to those struggling with affordability. In addition to direct beneficiaries, policy and delivery bodies gain clearer insights into the scheme's effectiveness and areas for reform, enabling more responsive and targeted interventions.

The ongoing review and adjustment of the scheme are easily scalable through existing government and Ofgem mechanisms. This scalability ensures that vulnerable households, policymakers and energy suppliers benefit from improved policy targeting, greater equity in energy support and enhanced public trust in the delivery of public services.

## Way Forward

As the UK continues to tackle fuel poverty, the Warm Home Discount (WHD) scheme remains a vital policy, delivering meaningful impact. To maximize its impact and ensure long-term sustainability, the scheme is undergoing continuous review and forward-looking improvements are actively being implemented.

First, the removal of the 'high-cost-to-heat' criteria for Scheme Year 2025/26 is a significant shift towards inclusivity, bringing around 2.7 million additional households into the scheme, significantly expanding its reach. To ensure this

[15] Energy price cap operating cost and debt allowances decision: overview.

broader eligibility translates into effective delivery, continued refinement of data-matching processes will be essential, both to maintain accuracy and efficiency.

Second, the WHD's integration with Industry Initiatives such as energy advice, benefit entitlement checks, and energy efficiency measures has proven both scalable and impactful. These non-financial interventions not only complement the rebate but also build long-term resilience by empowering households to manage energy use more effectively.

Third, while automatic payments have improved uptake, targeted outreach remains critical, particularly for digitally excluded communities. Strengthened partnerships with charities and community organizations also continue to play a vital role in ensuring that no eligible household is left behind and that trust in the scheme remains high.

Finally, the WHD is funded through a levy on domestic energy bills, a model that is regularly reviewed to ensure fairness and affordability. Transparent consultations and robust impact assessments will remain central to maintaining public support and ensuring effective delivery.

In sum, the WHD scheme has laid a strong foundation for energy resilience among vulnerable households. With thoughtful reforms, it can continue to play a central role in the UK's just transition to an inclusive energy future.

## Additional Information

### Webpage

https://www.gov.uk/the-warm-home-discount-scheme

# 5. Influencing Colombia's Housing Policies to Advance Resilience at Scale

Country:

Colombia

Submitted by:
Build Change

- Housing
- Public Housing
- Owner Driven
- Enablers
- Retrofits


## Abstract

*More than 28 million Colombians live in informal housing that is structurally inadequate and vulnerable to even moderate earthquakes. Since 2012, the Colombian government has initiated a programme to promote disaster resilient housing at scale. This included integrating an incremental approach to retrofitting to increase climate and disaster resilience, and structural assessment and improvement of existing housing. Coupled with the advocacy efforts to remove many of the financial and legal barriers by reforming subsidy policies, home improvement has a wider reach.*

*The use of digital technology has enhanced the quality, speed and efficiency of processes across all stages of the National Home Improvement Program's construction value chain. This played an integral role in the program's success, enabling the Ministry of Housing to achieve rollout at a speed and scale that would have been impossible otherwise.*

*The National code AIS 410, providing a legal pathway for retrofitting informal housing, was formally adopted as a national official document in 2023 by the Ministry of Housing. Resilient housing is now regarded as an integral part of Colombia's social development agenda.*


## Introduction to the Initiative

Over 77 percent of Colombia's population lives in cities – many in informal, earthquake-vulnerable housing. While housing subsidies have historically focused on rural areas and new builds, the need to upgrade existing informal homes in urban Colombia is urgent. Since 2012, the Government of Colombia, with the help of Build Change, has initiated a programme to promote disaster resilient housing at scale. This work helped unlock a USD136 million World Bank investment and led to the adoption of AIS 410-23, Colombia's first seismic guidelines for informal housing upgrades. With

successive administrations prioritizing this agenda, resilient housing is now central to Colombia's strategy for reducing risk and advancing social development.

## Impact of the Initiative

Estimates suggest that more than 28 million Colombians live in informal housing that is structurally inadequate and vulnerable to even moderate earthquakes. The government of Colombia, together with with Build Change, has been working to place the urgent need to upgrade substandard housing firmly on the public agenda and to create the necessary policy, economic and technical conditions to support the government to achieve this at scale by strengthening existing housing to be disaster resilient. The Ministry of Housing and the cities of Bogotá, Medellín, Cali and Bucaramanga have demonstrated the clear opportunity to save lives and reduce economic losses, and succeeded in driving national investment in resilient housing. With two different presidential administrations prioritizing resilient housing in their policy agendas, it is clear that resilient housing is now regarded as an integral part of Colombia's social development agenda.

**Engaging cities to drive impact at scale:** City-level engagements in Colombia have played a critical role in creating proofs of concept to drive impact at scale, serving as demonstrations of what could be achieved by adopting similar policies and programmes at the national level. In Bogota, technical expertise has been provided to the city-level social housing agency, Caja de la Vivienda Popular (CVP), to support cost-effective retrofitting of existing informal housing under Plan Terrazas, with the aim of improving and expanding 1,250 houses. By using habitability improvements as an incentive, homeowners undertake structural upgrades, leading to increased safety and resilience. The implementation was supported by simplifying the permitting procedures, advocating for subsidy increases and reforms, and providing technical assistance, technology and training to government officials. Plan Terrazas and other city-level proofs of concept have helped unlock government funding for structural improvement that lay dormant until now.

In Bucaramanga, 12 homes were strengthened as proof-of-concept and supported partners on another 560 homes. In Cali, the people were provided legal, technical and social guidelines for implementing 'Curaduria Publica', a public permits office that provides free technical assistance for informal house-owners to assess and plan home retrofits. BCtap,[16] an end-to-end technical assistance platform powered by Build Change that pairs technology with subject matter expertise to take resilient housing programmes to scale, was adopted in the Colombian urban housing context and the government leaders were advised on implementation of the newly signed AIS 410-23.

**Improving Regulations and Unlocking Bottlenecks:** One of the keys to success in Colombia has been simplifying homeowner qualification processes, design, and construction permit regulations for the implementation of resilient housing. The objective has been to reduce bottlenecks and eradicate unnecessary barriers for the most vulnerable to improve their homes. These obstacles can discourage common-sense structural retrofits, deter people from taking action, and prevent potentially impactful resilient

[16] More information about the BCtap is available here: bctap.buildchange.org.

housing policies and programmes from being fully operationalized.

One example of major regulatory reform resulting from the advocacy work is the Curaduría Cero (Zero Curatorship) initiative. Under Curaduría Cero, the assessment, design, and permissions processes of informal housing have been reclaimed from private agencies and placed back into the hands of local government. This ensures that permits for existing informal housing in cities are provided free of charge to those who are the most vulnerable.

Some of the most significant policy change works in Colombia were initiated in 2015, when it was realized that, while building codes existed for new, disaster resilient construction, there were no code-compliant guidelines for structural improvements to existing informal housing. To address this, the first code-compliant evaluation and design method for retrofitting existing masonry housing up to three stories was developed in Colombia. This was further developed into a Retrofit Manual for the National Vocational Training Service (Servicio Nacional de Apredizaje, or SENA). The manual was approved by the Colombian Construction Code Commission. The builder-training curriculum was expanded to include retrofitting of existing housing.

This led to the drafting of engineering policy AIS 410, providing a legal pathway for retrofitting informal housing. After years of advocacy, AIS 410 was formally adopted as a national official document in 2023 by the Ministry of Housing. These are the first national standards relating to upgrading informal housing for resilience, incorporating existing home retrofit manuals into the construction code of Colombia. This major milestone on the journey to upgrade and formalize informally built housing is an example for other countries. It demonstrates the potential impact of innovative bottom-up practice coupled with top-down policy advocacy.

### Expanding Colombia's National Home Improvement Program

The initiative successfully advocated to expand the reach of Colombia's National Home Improvement Programme (called 'Cambia Mi Casa' under the current administration) from only habitability upgrading to include home strengthening measures. This included integrating an incremental approach to retrofitting to increase climate and disaster resilience, evolving the programme into a groundbreaking initiative that includes structural assessment and improvement of existing housing.

These changes were supported by cost benefit studies, which demonstrated the huge cost saving of retrofitting as compared to new construction. In Bogotá, structural upgrades of one-story homes were completed with an average materials and labour cost of USD4,533 – approximately 32 percent of the cost of building a new house of the same size, and 40 percent of what it costs to build a new social housing unit in Colombia. Coupled with the advocacy efforts to remove many of the financial and legal barriers by reforming subsidy policies, home improvement has a wider reach.

To support the expansion of the Program, digital technology has been leveraged to enhance the quality, speed and efficiency of processes across all stages of the National Home Improvement Program's construction value chain. This played an integral role in the program's success, enabling the Ministry of Housing to achieve rollout at a speed and scale that would have been impossible otherwise.

In response to this, in May 2021 the World Bank announced USD136.7 million of financing to improve housing and the vulnerable neighbourhoods in urban and rural Colombia. This demonstrated that it is possible for civil society and governments to work together to develop and initiate successful resilient housing programmes, and that these programmes have the potential to leverage significant development finance to achieve the scale.

There is continuous technical support to implement and scale the National Home Improvement Program to reach its goal of improving the quality and disaster resilience of 400,000 home improvements by 2026. Support is also being provided to the community-based organizations to provide technical assistance as direct implementers of the program. In 2023, Cambia Mi Casa doubled the amount of subsidy available for home improvement and additional sources of financing, including compensated interest rate loans. These have been created for community organizations participating as implementers of the home improvement program.

## Process of the Initiative

**Main stakeholders:** The key stakeholders of the initiative have been Build Change, the Ministry of Housing, Caja de la Vivienda Popular (CVP) in Bogota, the city governments in Bucaramanga and Cali, the Colombian Construction Code Commission, and the World Bank.

**Context:** From a seismic point of view, Colombia is in a highly active seismic zone, where the Nazca, Caribbean and South American plates converge.

**Image 1:** Plan Terrazas team in the field, Bogota, Colombia

A majority of the population in Colombia (83 percent) lives in intermediate to high seismic hazard zones. It is important to mention that a significant part of the building stock of Columbia was constructed before the nation's first seismic design code (1984) was in place. There has been good progress regarding seismic safety, since the seismic risk scenarios are available for the major cities of the country. However, there is still a need to undertake such studies in other regions.

**Design and Technology:** The programme utilized technological tools like Fulcrum and magicplan to record the assessment on-field. Regulations such as AIS 410-23 for retrofits and technical assistance platforms such as BCtap also informed the design.

## Lessons Learned

**Continue to build on the AIS 410-23 approach:** AIS 410-23 has presented a significant opportunity to implement retrofitting on a national scale, thereby amplifying the impact of risk mitigation efforts. Currently, though, its application has certain limitations, e.g., constraints on the number of storeys (maximum of 3) and restrictions on cantilevers, etc. However, with further research and investigation, there is potential to expand the applicability criteria and incorporate additional innovative retrofitting solutions. This could lead to a more comprehensive and effective approach to improving the resilience of structures beyond the current limitations.

**Use a holistic approach:** Through a holistic approach that seeks to transform housing systems, retrofitting of housing can improve people's quality of life and health, create jobs, reduce inequality and stop unsafe construction practices permanently. Therefore, when crafting home improvement programmes, it is imperative to factor in investments across these different categories. In terms of disaster risk mitigation policies, it is advisable to formulate comprehensive strategies that encompass progressive options for risk management at various levels. This approach is vital for garnering greater community acceptance and active participation in these initiatives.

**Act with urgency to address a growing problem:** Improving vulnerable housing is an effective way to safely add more homes and increase density at a lower cost. Nevertheless, the Plan Terrazas programme in Bogotá highlighted a key challenge: densely urbanized areas already have a scarcity of single-story constructions that could be relatively easily incorporated into such programmes. The rapid urbanization witnessed in Colombian cities has intensified the demand for immediate solutions, underscoring the need for timely responses.

**Leverage advantages of homeowner-driven programme implementation:** While home improvement costs are generally lower than new construction, there remains a pressing need to address and further reduce these expenses to enable greater scalability. Adopting a homeowner-driven model where funds are directly assigned and managed by homeowners themselves can further reduce time and costs related to construction and improve homeowner engagement in the process. Simultaneously, exploring mixed financial solutions that involve a combination of public and private investments can substantially bolster the availability of funds and significantly enhance the feasibility and implementation potential of these programmes.

**Leverage technology for quality, scale and transparency:** Advancements in digital technology should persist, accompanied by comprehensive training and support for stakeholders at various levels. This guarantees that technology solutions are widely accessible to the people, which makes the system efficient and is integrated into workflows to improve the cost-effectiveness of home strengthening efforts while streamlining implementation and monitoring of projects on a large scale.

## Additional Information

### Video Link

Build Change. (2023). Build Change Advances Landmark Seismic Resilience Guideline. YouTube. https://www.youtube.com/watch?v=4lLYtZYStsM

### Website

https://buildchange.org/location/colombia

# 6. Post-Earthquake (2001) Resilient Housing Recovery in Gujarat, India

Country:

India

Submitted by:

National Disaster Management Authority, Government of India

- Housing
- Post-Disaster
- Public Housing
- Owner Driven


## Abstract

*On 26 January 2001, an earthquake of magnitude 7.7 on the Richter scale struck the Kutch district of Gujarat, India. Post-earthquake, the Government of Gujarat undertook a monumental task, implementing a massive owner-driven housing reconstruction programme that resulted in the construction of more than 200,000 resilient houses. The case study demonstrates how robust institutional mechanisms, policy instruments, community participation and skill development resulted in the successful implementation of this large-scale disaster resilient housing programme within three years.*

*The case study offers rich insights into the implementation framework of the owner-driven housing reconstruction programme; the planning, design and technological innovations that were introduced, and most importantly, the pivotal role of local communities in rebuilding their houses. Their active participation and contribution were instrumental in the success of the programme.*


## Introduction to the Initiative

On 26 January 2001, an earthquake of magnitude 7.7 on the Richter scale struck the Kutch district of Gujarat, India. It caused massive destruction in 21 of Gujarat's 25 districts. About 28 million people in 7,000 villages were affected. The number of collapsed and damaged dwellings were 215,255 units and 928,369 units respectively. The losses due to damage and destruction of houses including the value of household goods were estimated to be USD1.1 billion.[17] Rural water supply asset loss was USD50 million and the restoration cost was USD96 million.

In response, the Government of Gujarat implemented a large-scale housing reconstruction programme which involved a wide range of partners, including communities, government agencies, NGOs, private sector organizations and international aid agencies.

[17] 1 USD = 47 INR, 2001

Key partners included the Gujarat State Disaster Management Authority (GSDMA), the World Bank, the Asian Development Bank, the United Nations Development Programme (UNDP), and numerous NGOs like CARE India and SEEDS India.

Within a period of three years, more than 200,000 houses were reconstructed through an owner-driven housing reconstruction (ODHR) approach and supplemented by the efforts of NGOs. The repair of 925,344 houses was also completed in a short time.

Professional agencies were engaged for the purpose of preparing development plans and town-planning schemes. GSDMA, with a small band of dedicated functionaries, undertook innovative measures and a range of activities which supplemented the reconstruction process, such as information dissemination on building codes and insurance, capacity building, policy and legal frameworks, and community awareness. The state created a pool of skilled human resources on seismic-safe construction and set up a competent institutional system to face future hazards. Public awareness on safe construction created a demand for resilient housing in the state.

## Process of the Initiative

**Main Stakeholders:** The earthquake-affected people were at the heart of the housing reconstruction programme. The Government of Gujarat constituted the Gujarat State Disaster Management Authority (GSDMA) to execute and coordinate the complex task of reconstruction and rehabilitation. The GSDMA was registered as a society under the Societies Registration Act. The other partners were the World Bank (WB), the Asian Development Bank (ADB), United Nations Development Programme (UNDP), private sector organizations, charitable organizations and numerous NGOs.

**Need Assessment Survey:** Under the lead of the Government of Gujarat and the Government of India (GoI), a comprehensive assessment of damages and needs was conducted by a Joint Assessment Team from the World Bank and the ADB. For the damage assessment, 2,051 teams comprising 2,932 technical staff, 1,794 revenue officers and 2,798 others were constituted. All of them were properly briefed and oriented for the complex task. It was also necessary to have uniformity in approach and methodology when such a large number of teams undertook in different areas. Detailed formats were prepared for the purpose of damage assessment. Guidelines were issued for detailed documentation. Based on assessment, the teams classified affected houses into five categories, from G-1 to G-5.[18]

**Housing Delivery Method:** Owner-driven reconstruction of housing was the most important feature of the programme, with an emphasis on multi-hazard resistant construction and capacity building of communities. People reconstructed their houses themselves, with the assistance and facilitation of the government. In addition, NGOs undertook construction of some houses under the public-private partnership programme. The owner-driven reconstruction approach established that housing recovery in a post-disaster situation could be fast, cost-effective and compatible with the pattern of living of the affected people.

**Water and Sanitation:** Immediate measures were taken after the earthquake to supply water through tankers and the repair of pipelines. Rural water supply involved restoration and strengthening of water supply systems relating

[18] https://bmtpc.org/DataFiles/CMS/file/Earthquake_Hazard_Guidelines_2010.pdf

**Image 1:** Participatory earthquake-resilient design development
*Source: SEEDS, India*

to 40 towns and 1,762 villages. The recovery included reconstruction/retrofitting of 250 tube wells, 2,789 km of water pipelines and 630 civil structures.

**Financial Arrangement:** Financial assistance of USD851 per unit was given to the owners of completely destroyed huts. Financial assistance for completely destroyed houses was up to USD1064 for built-up areas up to 25 square metres, up to USD1490 for built-up area up to 35 square metres, and up to USD1915 for built-up area up to 45 square metres.

For partially damaged houses, the assistance packages were USD64 for houses having cracks of at least ½ inch width, USD149 for houses with damage up to 10 percent, USD319 for houses with damage up to 25 percent, and USD638 for houses with damage up to 50 percent.[19]

For completely damaged houses, assistance was disbursed in three installments: 40 per cent at the preparatory level, 40 per cent when the construction reached the lintel level and the remaining 20 per cent after completion of construction.

The Government of Gujarat decided that all the reconstructed houses would be insured. The insurance covered 14 types of risks including fire, earthquakes, explosions, cyclones and floods. Insurance companies were selected and different districts, or parts of districts, were allocated to them. The premium rate was fixed by the Tariff Advisory Committee. The premium was USD7.43 for an insured sum of USD2129. The premium amount was deducted when the third instalment was paid to the beneficiary.

**Capacity Building:** Because of the widespread damage and destruction, there was huge demand for masons from neighbouring regions and states. Yet most of them were not familiar with hazard-resistant construction and retrofitting. It was not feasible for masons to undergo training for a long period. Hence, a one-week training programme was designed and training-provider agencies were appointed to implement the training. About 20,000 masons were trained by the Directorate of Employment and Training, and another 700 by the National Council for Cement and Building Materials (NCCBM). About 500 masons were trained by an NGO as a part of community-based disaster preparedness. Masons were also trained by other NGOs and District Rural Development Agencies. Overall, more than 29,000 masons were trained, and they were also given a kit worth USD26 which was used for construction work.

**Framework for Implementation:** The enforcement of seismic codes, particularly in the areas located in seismic zone IV and V, was important. A Task Force was set up for this purpose. It comprised national-level experts, representatives of NGOs and some senior officers of the state government. About 1,900 engineers were recruited to supervise the housing reconstruction work and to provide technical guidance to the people. The instalments for housing reconstruction were transferred to the beneficiary's bank account.

## Planning, Design, Technologies

**Relocation:** The Gujarat government decided that villages with more than 70 per cent of buildings damaged should be relocated with the consent of the villagers. For this purpose, approval of the Gram Sabha or the Village Council was mandatory. Most of the people preferred in-situ reconstruction. Only 5,720 HHs (2.7 percent)

[19] 50 percent damage category meant that the cost of damage was 50 percent of the current replacement cost, and similarly for the other damage categories.

**Image 2:** Brick masonry building with reinforced cement concrete seismic bands
*Source: SEEDS, India*

were fully relocated; 10,640 HHs (5 percent) were partially relocated in the sense that they were reconstructed houses within the same revenue village. The remaining 92.3 percent of the houses were reconstructed in-situ.

**Design:** Under the ODHR, the owners reconstructed their houses themselves. There was no rigid or uniform design for the houses. Owners themselves could choose a design meeting multi-hazard resistance standards, based on their needs and preferences.

**Technologies:** Several guidelines were developed related to various aspects of repair and reconstruction of houses. The guidelines took account of local resources and local technologies. Some innovative construction technologies were adopted.

**Gender Empowerment:** A government resolution was issued making it mandatory to register the houses in the joint names of husband and wife, thus ensuring the partnership and rights of women in the reconstruction process.

**Housing Insurance:** The Government of Gujarat decided that all the reconstructed houses would be insured. The premium rate was fixed by the Tariff Advisory Committee. It was mandatory to insure all reconstructed houses for 10 years. The premiums for insurance were deducted from the housing assistance. To spread awareness regarding housing insurance, a number of steps were taken such as discussion at Gram Sabha meetings, distribution of pamphlets among the public, posters displayed at government offices and public places, etc.

**Communication:** Over one billion pamphlets on earthquake-resistant design for repair and reconstruction were distributed. The following guidelines were prepared by the GSDMA to promote disaster-resistant construction practices:

- Guidelines for cyclone-resistant construction of buildings in Gujarat
- Guidelines for construction of compressed stabilized earthen wall buildings
- Guidelines for repair, restoration and retrofitting of masonry buildings in the Kutch earthquake-affected areas of Gujarat
- Guidelines for reconstruction and new construction in the Kutch earthquake-affected areas of Gujarat
- Guidelines for control on quality of construction in earthquake-affected areas of Gujarat

**Technical Audit:** Independent technical audit and quality control of the houses through a process of third-party audit was undertaken to ensure that they conformed to hazard-resistant standards. The process was handled by three agencies, namely the National Council for Cement and Building Materials (NCCBM), the Central Building Research Institute (CBRI), and the Indian Institute of Technology, Powai, which developed a quality control manual for quality checks on the buildings reconstructed. They also developed a training programme for engineers. The NCCBM, a GoI agency, was assigned the work of third-party quality audit.

**Grievance Redressal Mechanism:** A grievance redressal mechanism was also set up to help address the issues and challenges faced by the affected communities.

## Lessons Learned

**Post-Disaster Housing Damage Assessment was a complex task:** The damage assessment in rural areas and small towns was a challenging task because more than a million families were involved. In many cases, people had more than one house and some houses had tenants. An important issue which emerged during the

**Image 3:** Earthquake- and high wind-resilient building
*Source: Hunnarshala Foundation*

process of reconstruction was the problems of tenants. The programme focused on houseowners. With the collapse of houses, tenants were automatically displaced. In many cases, after reconstruction, owners refused to rent out the premises to tenants. In some cases, arrangements were made to allot land to tenants on payment of development charges. Engineers and builders today are aware of multi-hazard resistance construction practices. Municipal byelaws have been modified. There has been some improvement in the construction practices. However, total enforcement will take some time.

**The housing reconstruction programme led to significant skill development of engineers and masons:** For the purpose of technical supervision and technical guidance on owner-driven reconstruction, approximately 1,900 engineers were recruited on a temporary basis and stationed at villages. Measures for capacity building and dissemination of information were undertaken to enable the villagers to lead the repair and reconstruction of their houses following multi hazard resistant construction technologies.

**Increased community awareness:** The awareness of local people about multi-hazard resistant buildings has improved considerably. Under the leadership of the GSDMA, risk mitigation action has been a continuous process ever since the 2001 earthquake.

**Role of NGOs:** The housing reconstruction programme laid out a clear path on engagement of NGOs. The NGOs and other agencies adopted 285 villages in five districts for construction of houses. In most cases the NGO/agency and the Government of Gujarat shared the expenditure on a 50:50 basis. Under this programme, 42,528 houses were constructed (about 20 percent). All these initiatives have combined into a system that has created an enabling environment in Gujarat for scaling up disaster resilient housing.

## Way Forward

The owner-driven reconstruction approach to housing recovery and reconstruction at a large scale was unprecedented. The earthquake-affected people themselves led the construction of their own houses. The mandatory registration of a reconstructed house with husband and wife as joint owners helped in gender empowerment. The creation of materials banks created at the local level to provide building construction material at reasonable rates helped to check inflation. NGOs were associated with the reconstruction process right from the beginning. In order to facilitate public-private partnerships, a framework was conceptualized and a formal procedure was prescribed at a very early stage of the reconstruction. Overall, the Gujarat earthquake recovery efforts have been widely acclaimed by international experts and multilateral agencies. The Gujarat State Disaster Management Authority (GSDMA) received a Certificate of Merit at the 2003 UN Sasakawa Award for Disaster Risk Reduction.

## Key Findings

- Damage assessment was a challenging task due to the scale and geographical spread of the assessment exercise.
- The focus was on houseowners with insufficient attention towards tenants, who were a numerically significant constituency among the population affected by the earthquake.
- An increased awareness about earthquake-resistant construction was observed. However, it would take a long time for building codes to be fully enforced.

- Municipal byelaws were modified; however, an effective system is not yet in place.
- Skill level and awareness of the people regarding disaster-resistant buildings increased significantly and the post-earthquake housing recovery had a strong influence on society.
- The system developed created an enabling environment for upscaling disaster resilient housing.

## Key Takeaways:

- Owner-driven reconstruction of houses was an appropriate effort on a large scale. It allowed the houseowners to lead the process with other stakeholders as facilitators and created awareness about the significance of earthquake-resistant construction practices among communities. This model can be replicated in similar situations.
- The swift and large-scale mobilization of human and material resources after the disaster, with the help of multiple stakeholders, makes the effort a worthy case study for other post-disaster housing reconstruction programmes.
- The framework developed at a very early stage of the recovery and reconstruction to facilitate public-private partnership helped in optimization of resources of all stakeholders, which can be replicated.

## Additional Information

### Readings

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# 7. Integrated Environmental Modeller (IEM) for Public Housing Developments

Country:

Singapore

Submitted by:

Civil Defence Force and
Housing Development Board,
Government of Singapore

- Housing
- Facilities
- Public Housing
- Enablers


## Abstract

*According to the Centre for Climate Research Singapore (CCRS), the country's maximum daily temperature could reach 35 to 37 degrees Celsius by the year 2100, if carbon emissions continue to rise at the current rate. This is compounded by the Urban Heat Island (UHI) effect. The Housing & Development Board (HDB) of Singapore provides affordable and quality homes for over 80 percent of its population. In 2018, HDB developed an Integrated Environmental Modeller (IEM) which enables planners, architects and engineers to simulate the interaction of environmental factors and their combined effects on an urban setting. This enabled them to enhance thermal comfort for the users of the community spaces. The initiative's impact extends across the socioeconomic spectrum, ensuring equitable access to environmentally optimized living spaces.*

*The two-year pilot, launched in 2021, showed that the cool coatings can reduce ambient temperatures by up to 2°C and reduce electricity consumption.*


## Introduction to the Initiative

The Centre for Climate Research Singapore (CCRS) has projected that Singapore's maximum daily temperature could reach 35 to 37 degrees Celsius by the year 2100, if carbon emissions continue to rise at the current rate. This is compounded by the Urban Heat Island (UHI) effect, a phenomenon where urban areas, which are more built-up and densely populated, are warmer than rural areas.

The Housing & Development Board (HDB) is Singapore's public housing authority and provides affordable and quality homes for over 80 percent of the resident population in Singapore. As the master planner and developer of HDB towns, HDB has actively integrated climate-sensitive design in Singapore's public housing projects to adapt to the tropical climatic conditions. In 2018, HDB partnered with the Agency for Science, Technology and Research

(A*STAR) to jointly develop the Integrated Environmental Modeller (IEM).

The IEM is an advanced modelling tool which uses high-resolution 3D city models that enable planners, architects and engineers to simulate the interaction of environmental factors such as solar irradiance, wind flow, air temperature and noise levels, as well as their combined effects on an urban setting. With IEM, planners can simulate how the placement and configuration of HDB blocks affect wind flow, and where amenities, such as playgrounds and childcare centres, should be located so they are comfortable for their users. Similarly, the tool helps to identify potential hotspots and implement mitigation measures, such as placing greenery or applying cool materials, to reduce the build-up of heat even before construction starts.

The total budget for the IEM was USD4 million.

## Process and Impact of the Initiative

The IEM initiative benefits all residents living in Singapore's public housing (including both middle-income and economically disadvantaged groups). With approximately 80 percent of Singapore's resident population living in public housing, of which 90 percent own their homes, the initiative's impact extends across the socioeconomic spectrum, ensuring equitable access to environmentally optimized living spaces.

Singapore's tropical climate presents challenges that necessitated this initiative:

- Year-round high temperatures and humidity create urban heat island effects
- Dense urban development intensifies environmental challenges
- Climate change impacts require proactive mitigation measures

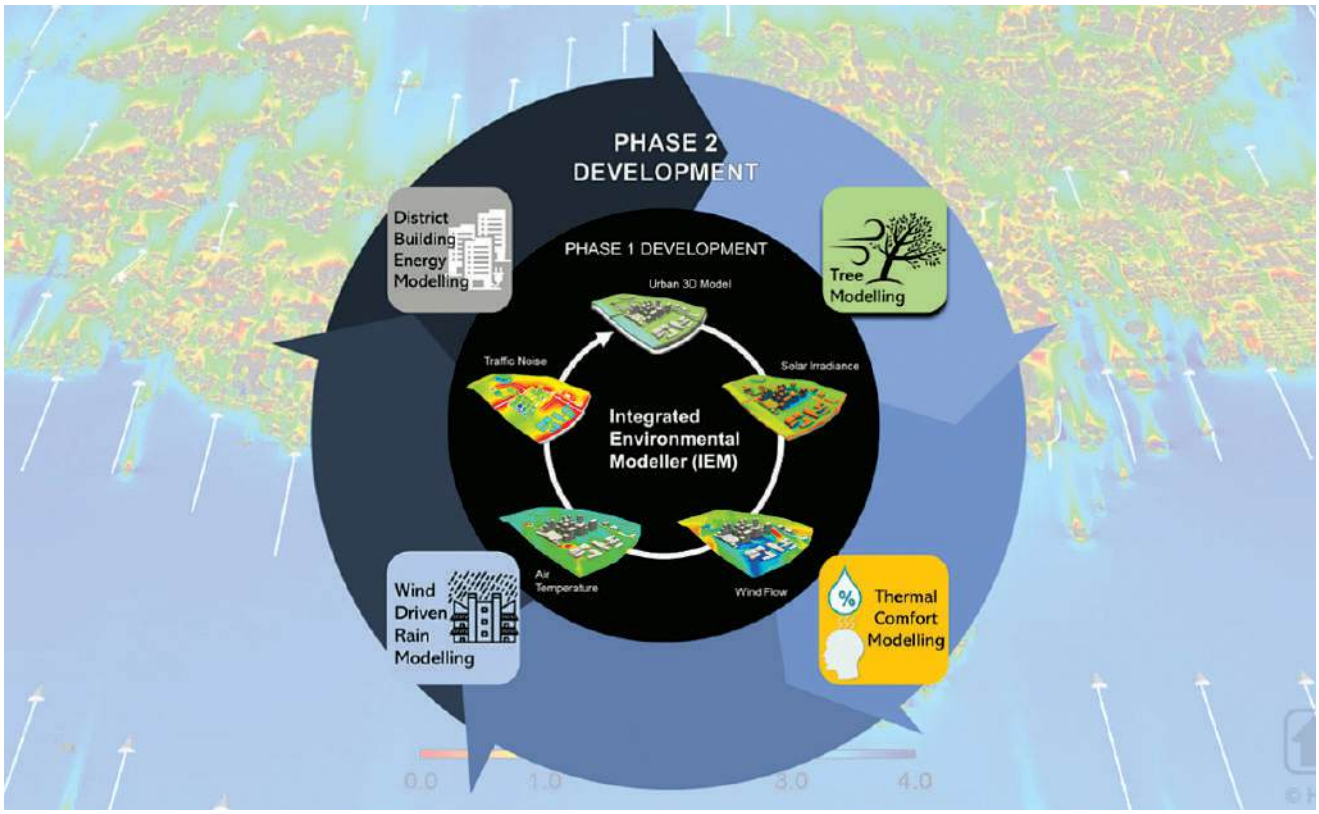


**Image 1:** Phases of Integrated Environmental Modeller (IEM)

- Growing need for data-driven approaches to create more comfortable living environments
- Increasing importance of energy efficiency and sustainability in public housing

The initiative represents a collaborative effort between two key government agencies:

**Housing & Development Board (HDB):** Provides expertise in public housing development and implementation

**Agency for Science, Technology and Research (A*STAR):** Contributes technological capabilities and research expertise

These organizations jointly developed and implemented the IEM as an advanced urban planning tool, first testing it in the town of Punggol before expanding to other developments. Punggol has been selected by HDB to be developed into its first eco-town in Singapore. As an eco-town, Punggol offers an ideal testing ground for implementing innovative sustainable housing solutions. Its waterfront location and undeveloped land provide opportunities to incorporate comprehensive environmental planning from the ground up. The estate serves as a model for future developments, alongside other significant projects such as Tengah, HDB's first smart and sustainable town, and the Bayshore estate.

The implementation encompassed several key components:

- Simulation of the interaction of environmental factors such as solar irradiance, wind flow, air temperature, and noise levels, as well as their combined effects on an urban setting
- Strategic placement of buildings and amenities based on environmental data
- Implementation of heat mitigation measures through optimal positioning of greenery and community facilities
- Application in new public housing developments such as the Northshore district in Punggol Eco town as well as several other key developments in Tengah and the Bayshore estate.

The initiative contributes to social equity and inclusivity:

- Ensures access to well-designed community spaces and amenities
- Improved environmental design that improves well-being for all HDB residents regardless of demographic characteristics (age, ethnicity, etc)
- Reduces energy costs through better natural ventilation and cooling, benefiting lower-income households
- Minimizes the formation of urban heat islands in residential areas
- Enhances overall liveability and comfort in public housing regardless of location or price point

Through these comprehensive measures, the IEM initiative demonstrates Singapore's commitment to creating inclusive, sustainable, and comfortable living environments for all residents while addressing environmental challenges.

## Lessons Learned

IEM started on-prem, which limited accessibility and scalability. This was addressed by deploying cloud-based IEM for greater accessibility. The entire network of government agencies was benefitted by this approach. The potential adoption by private developers or design consultants is scalable.

## Way Forward

### Research and Innovation

HDB will continue its partnership with A*STAR

and other research institutions to explore new technologies and methodologies for environmental sustainability. This includes studying emerging materials, innovative cooling systems and advanced environmental monitoring techniques.

In 2021, HDB launched a pilot project to apply cool coatings — a type of specialized paint containing additives that reflect the sun's heat, reducing surface heat absorption and emission — to approximately 130 HDB blocks in Tampines. Findings from the two-year pilot showed that the cool coatings can reduce ambient temperatures by up to 2°C. Besides enjoying a cooler environment, residents living in blocks painted with cool coatings also experienced a reduction in electricity consumption, as less energy from air conditioning systems is needed to cool their flats. Following the successful pilot, HDB will work closely with the Town Councils to extend the cool coatings initiative to all existing HDB estates by 2030.

## Additional Information

### Video Link

Singapore Housing & Development Board. (2022) Smart Planning tool – Integrated Environmental Modeller. YouTube. https://www.youtube.com/watch?v=K9jFS6SU6cY

Bloomberg News. (2024). Does The Perfect City Exist? https://www.bloomberg.com/news/videos/2024-11-14/does-the-perfect-city-exist-video

### Webpage

https://www.a-star.edu.sg/ihpc/ihpc-tech-hub/features/uss/integrated-environmental-modeller-(iem)

# 8. Supporting Post-Disaster Housing Recovery in Cuba through Local Production of Construction Materials

Country:

Cuba

Submitted by:

United Nations Development Programme (UNDP)

- Housing
- Facilities
- Post-Disaster
- Enablers


## Abstract

*Housing is among the most affected sectors due to disasters. The recovery and reconstruction of homes and essential infrastructure require large quantities of construction materials, which are often not readily available. This can significantly delay recovery efforts, leaving affected families in vulnerable and precarious housing conditions for years. To respond to such situations, the Micro/Small Industry Program was launched in 2008 by the National Group for the Local Production of Construction Materials. Cuba became a key partner, developing a robust methodology that has been successfully replicated across the country following the impacts of Hurricanes Sandy (2012), Matthew (2016), Irma (2017), and Ian (2022). This initiative promotes business development and generates employment and income opportunities, while promoting a speedy recovery through housing rehabilitation and reconstruction. The micro/small industry programme developed in Cuba presents a proven and effective model for post-disaster resilient housing recovery.*


## Introduction to the Initiative

The micro/small industry programme initiative responds to the need for a large volume of construction materials during the post-disaster recovery process. Micro and small enterprises help meet this high demand. By supporting local industries, this initiative promotes business development and generates employment and income opportunities, while promoting a speedy recovery through housing rehabilitation and reconstruction.

The initiative has benefitted 17,000 households with the necessary construction materials (cement blocks and bricks, roof tiles and slabs), through capacity building for 60 micro and small industries with equipment, training, and technical assistance in business management.

**Image 1:** Material Production Facilities

## Process and Impact of the Initiative

The housing sector is among the most affected by disasters, which often damage or destroy the most vital asset for urban and rural populations in developing countries. The recovery and reconstruction of homes and essential infrastructure such as schools and health centres require large quantities of construction materials. However, these materials are often not readily available, their production takes time, and some must be imported. These constraints can significantly delay recovery efforts.

The Micro/Small Industry Program was launched in Cuba in 2008 by the National Group for the Local Production of Construction Materials. UNDP Cuba became a key partner, developing a robust methodology that has been successfully replicated across the country following the impacts of Hurricanes Sandy (2012), Matthew (2016), Irma (2017) and Ian (2022).

In the aftermath of these hurricanes, the housing sector was the hardest hit, with 262,703 dwellings affected in Santiago de Cuba, 42,338 in Guantánamo, and 145,974 in the central provinces. There was an urgent need for low-cost, high-quality materials to meet the demands of local governments and low-income families.

The initiative focuses on the most vulnerable population and highly exposed and affected municipalities. From the provinces covered by the intervention, Guantánamo Province continues to have a Human Development Index (HDI) below the national average. It currently has the highest unemployment rate in the country (4.5 percent), the lowest average monthly salary, and the largest negative internal migration balance. This situation particularly affects young people, who benefit most from the revitalization of small local industries producing construction materials.

### Key Elements of the Program's Success:

- **Needs Assessment:** Identification of specific needs by municipality, selection of micro/small industries to be created or

strengthened, appropriate technology choices, and identification of required financial and material investments.

- **Investment Planning:** Tailored to local contexts, emphasizing traditional construction systems (e.g., vaulted roofs[20]) and renewable energy.
- **Technical Assistance:** On-site support and quality assurance to ensure performance and sustainability.
- **Technological Sustainability and Maintenance:** Equipment usage and maintenance plans, local management of spare parts and repair shop support.
- **Strategic Alliances:** Collaboration with government authorities, the private sector and local producers.
- **Efficient Procurement and Logistics:** To support the strengthening of small industries.
- **Knowledge Exchange and Training:** Capacity building for local stakeholders – workers, technicians and managers of small-scale industries. Local government company administrators who coordinate the small-scale industries. In the case of vaulted ceilings and other construction techniques: masons, construction technicians, and designers. In general: government decision-makers.

### Key Achievements

- Production capacity to meet high post-disaster demand for construction materials.
- Job creation, with an average of 5 to 10 jobs per business.
- Approximately 50 percent lower production costs and consumer prices, due to the use of local resources and reduced fuel consumption.
- Integration of the private sector through the creation of local construction material companies.
- Established national capacity for technical support, including the National Building and Construction Materials Program (PLMC), universities and provincial governments.
- A pool of trained technical experts ready for deployment when needed.

This initiative is implemented by UNDP in partnership with the Government of Cuba, with funding from the Russian Federation, Swiss Development Agency, European Union, the Government of Romania, and UNDP itself.

## Lessons Learned

### Challenges and Mitigation Strategies

- The work took place in an environment of economic restrictions, where access to industrial resources such as cement and steel was limited and there was a deficit of energy resources due to a lack of generating capacity and fuel. To mitigate this challenge, the use of local natural resources and raw materials, as well as local labour, was promoted.
- Governance sustainability. To achieve this end, the Economic and Social Strategy was launched to boost the economy, which highlights the construction sector as a priority, as well as its impact on job creation and meeting social needs such as housing and basic services.
- Lack of financial resources to replicate the experience in other municipalities. To mitigate this, the Municipal Development Strategies have been aligned with provincial government policies, including specific lines of action for

[20] https://www.undp.org/es/cuba/noticias/construir-desde-la-tierra-formacion-en-tecnicas-constructivas-resilientes-con-materiales-locales-en-pinar-del-rio

housing and habitat improvements.

- Shortage of raw materials. To address this challenge, debris management (urban mining) has been improved, that includes the analysis of raw material, selection, transportation and processing.

### Potential for scaling up

The micro/small industry programme developed by UNDP in Cuba presents a proven and effective model that can be used in post-disaster situations to create or revitalize the production of construction materials at the local level in affected areas, providing a rapid solution to meet the demand for housing reconstruction while also seizing the economic opportunity.

## Additional Information

### Website

UNDP. (2022). Producción Local de Materiales de la Construcción, para una mayor resiliencia de las comunidades.
https://www.undp.org/es/cuba/publicaciones/produccion-local-de-materiales-de-la-construccion-para-una-mayor-resiliencia-de-las-comunidades

# 9. Zimbabwe Idai Recovery Project (ZIRP): Rehabilitation of Community Infrastructure – Education and Health Facilities

Country:

Zimbabwe

Submitted by:

United Nations Office
for Project Services (UNOPS)

- Facilities
- Post-Disaster


## Abstract

*This case study showcases the efforts made under the Zimbabwe Idai Recovery Project (ZIRP) to build the resilience of community infrastructure. Tropical cyclone Idai struck eastern Zimbabwe on 15 March 2019, unleashing heavy rains and powerful winds that triggered extensive flooding. The catastrophe led to a significant loss of life and extensive damage to infrastructure, property, crops and livestock, leaving 270,000 individuals in urgent need of humanitarian aid. The Zimbabwe Idai Recovery Project applied a clustered spatial planning approach for building back the community infrastructure, thus ensuring that services were clustered within accessible distances to foster a multiplier effect on community resilience.*


## Introduction to the Initiative

Tropical cyclone Idai struck eastern Zimbabwe on 15 March 2019, unleashing heavy rains and strong winds that caused widespread flooding. The disaster resulted in significant loss of life and extensive damage to infrastructure, property, crops and livestock, leaving 270,000 people in urgent need of humanitarian aid. The Zimbabwe Idai Recovery Project (ZIRP), implemented in the wake of Cyclone Idai's devastation in 2019, stands as a transformative community infrastructure initiative aimed at fostering resilience, restoring livelihoods, and rebuilding critical services in Zimbabwe's nine districts severely affected by the cyclone, with a target population of 270,000.

The Zimbabwe Idai Recovery Project (ZIRP) Community Infrastructure focused its efforts on two districts severely affected by the cyclone, aiming to reach approximately 45,000 households initially identified as being in need. ZIRP, a multi-sectoral emergency response and recovery initiative with a budget of USD72 million, was funded by the World Bank, managed by the United Nations Office for Project Services (UNOPS), and executed by eight UN agencies (WFP, FAO, WHO, UNFPA, UNICEF, UNOPS,

**Image 1:** Hode Primary School Ablution Facility

IOM and UNESCO). UNOPS was appointed the project manager, responsible for disbursing funds for a multi-agency effort structured into three components, and also responsible for the infrastructure delivery component.

## Impact of the Initiative

ZIRP's community infrastructure initiative has had a far-reaching impact. By restoring critical services and connecting them through road infrastructure, the project addressed immediate needs and laid the groundwork for long-term resilient development. This initiative demonstrated how strategic, inclusive and coordinated infrastructure investments can catalyze recovery, promote dignity, and uplift vulnerable populations during crises. The project significantly contributed to several Sustainable Development Goals (SDGs) such as:

**Goal 4 (Quality Education):** Benefited learners through rehabilitated schools and educational supplies.

**Goal 5 (Gender Equality):** Engaged women as community workers and supported women vendors through the construction of a safe agro-market.

**Goal 6 (Clean Water and Sanitation):** Restored water and sanitation services to households.

**Goal 9 (Industry, Innovation, and Infrastructure):** Rehabilitated crucial community infrastructure, including roads, health facilities, schools, water points, irrigation schemes, and an agro-market.

The project activities aligned with national development strategies, emphasizing community ownership by building local capacity and providing operation and maintenance manuals for rehabilitated infrastructure. These initiatives ultimately provided vital access to basic social services and markets, fostering overall development and resilience within communities.

## Process of the Initiative

**Main stakeholders:** For the community infrastructure, i.e., the Education and Health Facilities, the key stakeholders were the cyclone and flood-affected local communities in Chimanimani and Chipinge districts. The other stakeholders were the World Bank (financed) and the eight UN Agencies (WFP, FAO, WHO, UNFPA, UNICEF, UNOPS, IOM and UNESCO). UNOPS was the project manager.

**Scope of the Intervention:** Led by UNOPS and funded by the WB, the community infrastructure component of the ZIRP exemplifies a holistic, multi-sectoral approach to disaster recovery, focusing on the rehabilitation and construction of interconnected social infrastructure such as schools and health centres, supported with irrigation schemes and roads.

Alongside education, ZIRP prioritized access to quality healthcare by constructing and refurbishing health centres – notably, Mutsvangwa Maternity Facility, St. Peters Isolation Centre (a response to the COVID-19 pandemic) and Old Mutare Mission Hospital Laboratory. These facilities were rebuilt focusing on climate resilience, accessibility, and the integration of health and safety measures in line with the World Bank Environmental and Social Standards. Building health facilities near schools and population centres strengthened the health-education link, which is essential for sustainable human capital development.

**Community-Driven Approach:** A community committee was established at each implementation site in collaboration with local leadership committees to support the maintenance and operation of facilities. Local contractors and workers were also involved to promote skills transfer and economic empowerment. The project also focused on gender inclusion, ensuring that women were part of infrastructure planning and decision-making processes. Communities supported construction activities from the project's inception, including site clearance, through to the commissioning of the buildings. The communities were also engaged in the upkeep and maintenance of assets post-construction.

**Water and Sanitation:** Schools were equipped with durable structures, sanitation facilities, and water distribution systems, ensuring that learners could continue their education in a safe and healthy environment. Beyond education, these facilities promoted social cohesion, child protection, and continuity of psychosocial support, particularly important in cyclone-affected areas. Under the project, 3,803 households received access to potable water.

**Financial:** Formal agreements were established with local contractors, with payments distributed in stages, based on targets achieved, through Interim Payment Certificates (IPCs). Contractors issued monthly wages to labourers based on timesheets. Moreover, grievance redressal mechanisms were implemented at project sites to improve transparency and accountability. Communities were encouraged to voice their concerns, including those related to contractors. When issues arose in disbursing payments to local workers or community members, UNOPS worked with third-party payment systems to ensure recipients received their dues.

**Capacity Building:** During the implementation and construction phases, the UNOPS team facilitated capacity-building activities for local workers and contractors, focusing on new construction techniques. This involved training on installing 345mm thick walls for improved insulation and thermal comfort, along with a double truss timber roof system supported by V-shaped timber posts. Additionally, contractors received training in health, safety, and social and environmental practices.

## Planning, Design, Technology and Environment

**Planning:** At the heart of ZIRP's infrastructure intervention was the construction and rehabilitation of networked schools – learning environments designed not only to provide access to education but to serve as resilience hubs during and after emergencies. The integration of these infrastructure components – schools, health centres, water supply systems, and roads – was deliberately designed to create a cluster of networked and non-networked infrastructure (health centres, primary schools, secondary schools, and community feeder roads) that amplified socioeconomic benefits. Rather than building standalone facilities, ZIRP applied a clustered spatial planning approach, thus ensuring that services were clustered within accessible distances to foster a multiplier effect on community resilience. For instance, a rehabilitated school (non-networked

**Image 2:** Mutsvangwa Rural Health Centre


**Image 3:** St Peter's Mission Hospital Isolation Centre

infrastructure) served not only as a learning facility but also as a temporary shelter during disasters, while an adjacent clinic offered ongoing health education and emergency care. Additionally, the rehabilitation of roads connecting these facilities enhanced accessibility to services for the community.

The road infrastructure component was equally critical. Many communities in the targeted districts had become inaccessible due to washed-away roads and collapsed river crossings, isolating them from markets, schools and health services. ZIRP invested in the rehabilitation of community feeder roads and crossings, which not only restored connectivity but also created local employment through labour-intensive methods. These roadworks significantly reduced travel times, improved access to health and education services, and boosted local economies by reconnecting farmers to markets. The improved road network was pivotal in enabling the transport of construction materials and medical supplies to remote areas.

**Design:** For the design of schools and health facilities, UNOPS collaborated with regional private sector entities, including architects and structural engineers, to ensure that the buildings were based on local and indigenous knowledge and expertise in climate resilience. A consultative design process was adopted, incorporating feedback from stakeholders such as teachers, students and parents.

**Technology:** To safeguard long-term functionality, risk mitigation measures such as retaining walls, stormwater drainage systems, and resilient roofing designs were incorporated. Climate data from Tropical Cyclone Idai: analysis of the wind, rainfall and storm surge impact, a report prepared by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), was used during the loading analysis for the structures, with increased ground acceleration also taken into account. Site planning emphasised water management, seismic resistance and ecosystem-based risk mitigation. As part of the landscape design strategy, an ecosystem-based risk mitigation approach was adopted, which included water recharge and erosion control measures that contributed to drought mitigation and flood risk reduction. For the structures, foundations, and wall designs, focus was kept on stability, durability and reduced embodied carbon. Design and technological measures adopted included robust structural systems, such as reinforced concrete, stone, and 345mm thick brick masonry, as well as double-truss timber roof framing to withstand seismic and wind forces. Additionally, strong connections and corrosion-resistant fasteners enhanced overall structural integrity, strengthening the buildings against environmental and climatic challenges.

**Socioenvironmental:** The World Bank Environmental and Social Standards, for example, ESS1: Assessment and Management of Environmental and Social Risks and Impacts, and ESS5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement, were strictly adhered to throughout project execution, with regular monitoring, training and grievance redress mechanisms made available for all workers and stakeholders. To strengthen environmental and social safeguards during project implementation, a comprehensive set of resources was developed and effectively implemented. These include the Asbestos Management Plan, Natural Materials Procurement Guidelines (for river and pit sand, and gravel extraction), Infection Control and Waste Management Plan, Land Acquisition

**Image 4:** Double truss timber roof system with V-shaped timber post supports

Documentation, Grievance Redress Logs, and GBV and PSEA referral systems. These measures ensured a robust framework for addressing environmental and social concerns, ensuring compliance and mitigating potential risks at every stage of the project.

## Lessons Learned

### Hybrid delivery model for sustainable impact

One of the challenges faced was balancing the speed of implementation with sustainability and inclusion. This was addressed by using both local labour-intensive and contractor-led infrastructure works. This approach not only sped up infrastructure construction but also promoted long-term project sustainability by enhancing community technical capacity to maintain and manage the infrastructure, thereby extending its lifespan.

The adopted framework is replicable because its mix of labour-intensive and contractor-led infrastructure can serve as a model for other projects. Additionally, focusing on community technical capacity development helps facilitate the transfer of knowledge and skills to new regions.

The project's co-benefits included empowering local communities, creating additional employment opportunities, fostering skill development, and encouraging ownership of infrastructure. For the government and donors, it represented a sustainable and affordable approach to infrastructure development that reduced reliance on external contractors and enhanced community resilience. Additionally, it offered local businesses and contractors opportunities to participate in the labour-intensive aspects of the projects.

### Fostering effective inter-agency collaboration

The primary challenge involved risks of duplication, inefficiencies, and coordination gaps. To address these issues, strong partnerships among UN agencies enabled cost-effective and efficient project implementation, serving as a valuable model for collaboration and coordination in future UN projects.

This effective inter-agency collaboration could be replicated in other regions and projects. A framework was developed to establish coordination mechanisms and joint planning processes that other UN agencies and partners could adopt. This experience could be recognized as a good practice in effective collaboration models to guide future partnerships.

Co-benefits showcase a successful partnership between the UN family and the beneficiary communities. This collaboration resulted in efficient resource utilization, reduced duplication of efforts, and enhanced intervention impact through synergistic strategies, ultimately contributing to comprehensive development outcomes. It enhanced coordination of aid and development activities within the government, aligned efforts with national priorities, and strengthened partnerships. Increased accountability and clear evidence of funds' impact boosted donor confidence.

### Networked infrastructure for enhanced impact

Cyclone Idai severely disrupted infrastructure services, washing away roads and damaging health and education facilities. This resulted in communities experiencing fragmented service delivery. However, these challenges were overcome by adopting a clustered network

approach to reconstruction and development, as successfully demonstrated in Chiimba village under ZIRP.

The approach involved developing a central infrastructure that served surrounding communities, starting with central non-networked infrastructure hubs (primary schools, secondary schools, health centres) and gradually expanding the network (roads) to reach more beneficiaries.

The co-benefit of the project was an improved standard of living for the local communities; e.g., improved access to essential services (education, healthcare and markets), enhanced economic opportunities, increased social cohesion, and reduced travel times. Enhanced access to schools and health facilities potentially led to improved educational outcomes and public health.

## Way Forward

### Institutionalization of Integrated Infrastructure Planning

The success of ZIRP's networked approach – linking schools, health centres, and road infrastructure – could be adopted as a national planning model for post-disaster recovery and rural development. The Government of Zimbabwe, in collaboration with partners, could mainstream this approach into district development plans and the broader National Development Strategy (NDS1), ensuring cross-sectoral coordination in future infrastructure investments.

### Strengthening Operations and Maintenance (O&M) Systems

To maintain infrastructure quality and functionality, it is essential to strengthen O&M frameworks at the community, district and national levels. This includes formalizing community-based maintenance committees, allocating recurring budgets for public infrastructure upkeep, and integrating O&M protocols into local authority procedures.

### Building Local Capacity for Climate-Resilient Construction

ZIRP's capacity-building initiatives and the use of labour-based construction methods and local contractors have developed assets and skills in the affected districts. Going forward, the government and development partners could invest in formal certification, enterprise support, and ongoing training for these local actors, ensuring a prepared workforce for future infrastructure projects and promoting local economic empowerment.

### Enhancing Infrastructure Monitoring and Data Systems

Digital tools and GIS mapping used during ZIRP implementation provided valuable real-time oversight. A national platform for infrastructure monitoring could be developed, leveraging these tools for planning, maintenance tracking, disaster preparedness and accountability. Integration with national statistics systems would also enable better decision-making and transparency.

### Leveraging ZIRP Lessons for Future Recovery Programming

ZIRP has demonstrated the value of coordinated, multi-sectoral recovery. Future interventions – especially in disaster-prone regions – could draw on ZIRP's technical models, community engagement practices and safeguard frameworks. This includes embedding disaster risk reduction (DRR) measures in infrastructure design and promoting local participation and inclusive development, particularly for women,

youth and persons with disabilities.

### Mobilizing Resources for Expansion and Continuity

To scale and replicate the ZIRP approach, resource mobilization is essential. The government, with support from the World Bank and other development partners, could establish a financing framework that sustains infrastructure investments in underserved communities. Blended finance models, public-private partnerships, and climate finance instruments are potential options that could be considered.

### Institutional Memory and Knowledge Transfer

Documenting ZIRP's processes, tools and community innovations is vital for institutional learning. A national knowledge-sharing platform or collection of best practices has been curated and shared with the Department of Civil Protection and could be distributed among government agencies, universities, local authorities and NGOs involved in development and recovery.

In conclusion, the ZIRP community infrastructure initiative, which aimed to rebuild educational and health facilities in Zimbabwe following Cyclone Idai, demonstrated the significant impact of resilient infrastructure projects centred around people. The success was driven by coordination among UNOPS (as project manager), the World Bank (funder), eight UN agencies, the Government of Zimbabwe, and local communities, facilitating efficient resource use. Transparency and accountability were ensured by setting up grievance mechanisms to ensure fair pay for local workers; and local participation through community committees supporting construction, maintenance and operations, as well as involving local contractors and labourers for skills transfer and economic growth, with women actively participating in planning and decision-making.

## Additional Information

### Video Link

Zimbabwe Idai Recovery Project. (2020). From emergency to intermediate recovery after Cyclone Idai. YouTube. https://www.youtube.com/watch?v=WayKrnDLCvs

### Webpage

https://zirp-zimbabwe.org/community-and-risk-infrastructure/

### Readings

UNOPS. Supporting Post-Disaster Recovery in Zimbabwe. https://www.unops.org/news-and-stories/stories/supporting-post-disaster-recovery-in-zimbabwe

# 10. Traditional *Barjeel* (Wind Tower) as a Passive Cooling Solution for Extreme Heat Resilience

Country:

United Arab Emirates (UAE)

Submitted by:

National Emergency Crisis and Disasters Management Authority (NCEMA), Government of UAE

- Housing
- Facilities
- Enablers
- Vernacular


## Abstract

*The traditional Barjeel (wind tower) houses of the United Arab Emirates are designed to naturally cool indoor spaces in the extreme heat of the Arabian Gulf region. In traditional settings, this could lower indoor temperatures by 5°–10°C. The Barjeel functions as a passive ventilation system, capturing and directing wind into living spaces while expelling hot air, ensuring thermal comfort without mechanical systems. The Barjeel is constructed from locally available coral stone, traditional gypsum plaster, palm fronds and mangrove wood, making it both cost-effective and well-adapted to the socioeconomic and environmental context.*

*The Barjeel model has high replication potential in arid and semi-arid regions. Its flexible design allows for integration into both new constructions and retrofitting of existing structures. By combining traditional wisdom with modern engineering, the Barjeel can evolve into a globally relevant model for climate-adaptive, disaster resilient housing. For broader impact, the lessons from the Barjeel could be reflected in building codes, national housing policies and disaster resilience guidelines.*


## Introduction to the Initiative

This case study presents the traditional Barjeel (wind tower) houses of the United Arab Emirates, a centuries-old architectural innovation designed to naturally cool indoor spaces in the extreme heat of the Arabian Gulf region. The Barjeel functions as a passive ventilation system, capturing and directing wind into living spaces while expelling hot air, ensuring thermal comfort without mechanical systems. Today, these indigenous design principles are being studied and adapted for modern sustainable buildings, offering low-energy and climate-resilient solutions. The practice illustrates how cultural heritage can guide contemporary resilience strategies, especially for communities vulnerable to extreme heat risks.

## Process and Impact of the Initiative

The United Arab Emirates (UAE) experiences some of the most extreme heat conditions in the world, with summer temperatures regularly exceeding 45°C and humidity levels reaching 90 percent in coastal areas. Historically, long before the advent of mechanical air conditioning, communities in the UAE developed and benefited from innovative architectural strategies to adapt to these harsh environmental conditions.

One of the most notable of these is the Barjeel, or wind tower – an indigenous architectural feature that functions as a passive cooling and ventilation system. Passive cooling refers to methods of cooling a building without mechanical devices, instead relying on natural processes such as wind movement and temperature differentials to expel warm air and draw in cooler breezes.

Historical records and archaeological findings suggest that wind-catching structures were present in settlements along the Arabian Gulf coast and inland oases for hundreds of years, serving as a practical means of cooling homes and public buildings. In the United Arab Emirates, their use became prominent in the late 19th and early 20th centuries. Over time, the Barjeel became an iconic element of Gulf heritage architecture, blending functionality with cultural identity.

The Barjeel is a vertical tower structure rising above the roofline of a building, with open vents on all four sides to capture prevailing winds from multiple directions. These openings funnel wind downwards into interior spaces, creating airflow that displaces warm air, which naturally rises and exits through upper vents or opposite openings (see image 1). This process not only reduces indoor temperature but also improves ventilation, lowers humidity and maintains a healthier indoor environment by preventing air stagnation. In traditional settings, this could lower indoor temperatures by 5°–10°C.

Constructed from locally available materials such as coral stone, traditional gypsum plaster, palm fronds and mangrove wood, the Barjeel was both cost-effective and well-adapted to the socioeconomic and environmental context of the

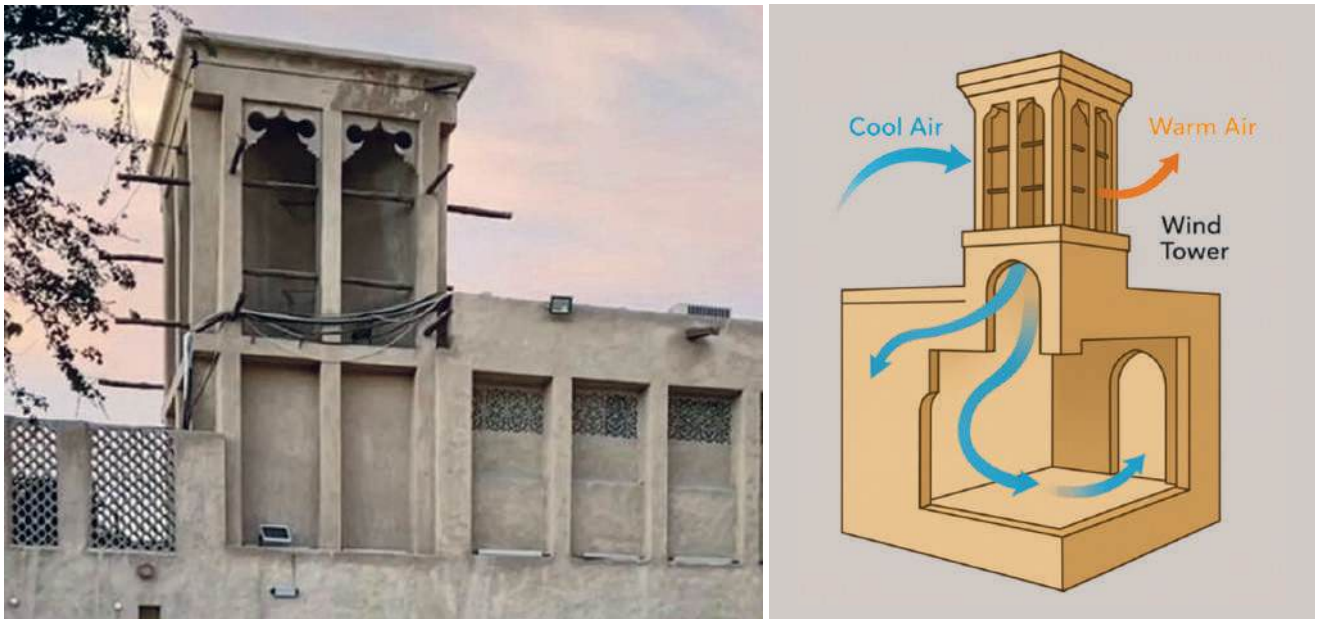


**Image 1:** Barjeel (Wind Tower) and its cooling mechanism

time. These materials provided natural insulation and durability, enabling the towers to endure extreme summer heat for decades.

From a disaster resilience perspective, extreme heat is a persistent and escalating hazard, posing significant risks to human health, energy systems and urban liveability. In line with the guiding principles of resilient housing, resilience encompasses both structural measures – physical design, material selection and construction methods – and non-structural measures, such as functional features that sustain safety, comfort and service continuity.

The Barjeel exemplifies both. Structurally, it is designed to withstand harsh climates without reliance on electricity; functionally, it ensures continued ventilation and cooling even during power outages or energy supply disruptions. This makes it particularly relevant in disaster risk reduction frameworks, as it offers passive, self-sustaining thermal comfort during heatwaves or post-disaster recovery periods.

Historically, Barjeel structures served both residential and public facilities, ensuring habitable indoor conditions during extreme heat events and infrastructure failures. Their scalability – from single-family homes to community buildings – aligns with the Compendium's emphasis on adaptable, community-driven resilience solutions.

Today, heritage districts such as Al Fahidi in Dubai preserve functioning Barjeel structures – around 50 per 0.25 km² – which provide valuable insights into traditional design, craftsmanship and climate-adaptive engineering. These houses were repurposed into shops reflecting their early adaptive reuse, and expanded to serve cultural, educational and tourism functions, hosting museums, art galleries and heritage centres. Architectural research, heritage records and field studies continue to document these systems, creating a knowledge base for modern applications.

In contemporary design, the principles of the Barjeel are being reimagined to enhance sustainability. A notable example is the 45-metre wind tower in Masdar City, which channels breeze into a central courtyard, cooling open spaces without mechanical systems. The tower

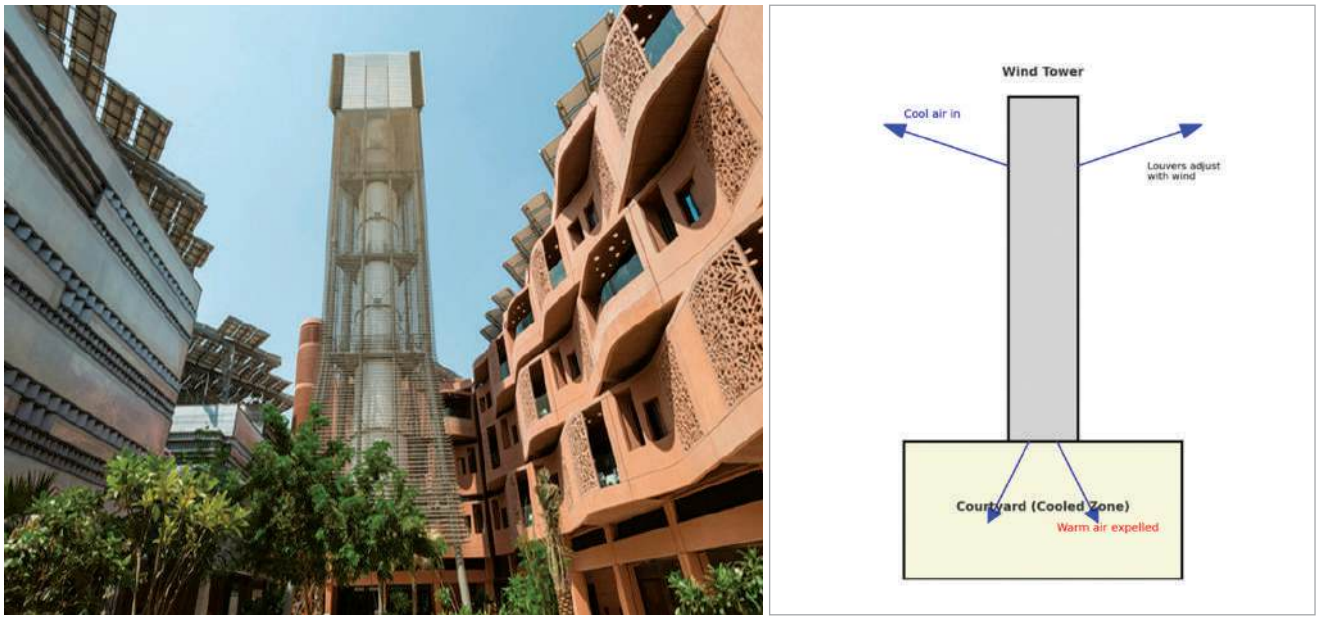


**Image 2:** Barjeel at Masdar City and its cooling mechanism

integrates modern technology, including sensors that adjust its louvers based on wind direction, ensuring effective cooling. It is a landmark public infrastructure within Masdar City, designed to provide thermal comfort in pedestrian areas. Its purpose is to reduce reliance on air-conditioning by creating naturally cooled gathering spaces for residents, visitors and community events.

It operates on the same traditional principle of wind catchers – drawing cooler air from above while expelling warmer air – yet updated with automated systems that regulate airflow. The cooled air is then directed into the central courtyards, creating a noticeably milder microclimate for occupants without relying on electrical air conditioning.

This makes the tower more than an architectural showcase; it functions as part of the climatic infrastructure of the urban community. Although not a housing complex itself, its concept has direct applicability to disaster resilient housing and facilities. By adapting the Barjeel principle, similar systems can be integrated into public facilities such as courtyards, schools, healthcare centres and community hubs, where they contribute to enhancing climate resilience, particularly during extreme heat events, and ensuring service continuity in conditions of power outages or cooling system failures.

This adaptation demonstrates that heritage-inspired designs can be seamlessly integrated into urban landscapes while meeting performance, resilience and sustainability standards. These contemporary and heritage applications highlight the broader benefits of Barjeel-inspired systems, which address vulnerabilities on multiple fronts:

- **Economic:** Reduces the reliance on mechanical cooling, thereby reducing electricity bills for low-income households and easing pressure on the power grid.
- **Environmental:** Lowers greenhouse gas emissions by reducing energy consumption.
- **Health:** Mitigates heat-related illnesses by maintaining safer indoor temperatures.
- **Cultural:** Preserves and revitalizes traditional knowledge, fostering intergenerational connections and community ownership.

Barjeel-based solutions support global and national resilience frameworks. They contribute to:

- SDG 11 (Sustainable Cities and Communities) by promoting climate-adaptive housing.
- SDG 13 (Climate Action) by reducing emissions and enhancing heat resilience.
- SDG 7 (Affordable and Clean Energy) by improving energy efficiency.

They also advance the Sendai Framework for Disaster Risk Reduction by:

- Addressing underlying risk factors linked to extreme heat.
- Strengthening the resilience of critical housing infrastructure.
- Integrating traditional knowledge into modern disaster risk reduction strategies.

Furthermore, the G20 Disaster Risk Reduction Working Group's emphasis on scalable, inclusive and sustainable practices is reflected in the Barjeel's adaptability, low-cost operation, and cultural grounding. By bridging heritage wisdom with modern engineering, it offers a roadmap for sustainable, disaster resilient urban design in the UAE and similar high-heat environments worldwide.

## Lessons Learned

The documentation and analysis of the Barjeel offer valuable insights into how traditional passive cooling can be systematically integrated

into modern disaster resilient housing strategies. Its ability to maintain habitable indoor conditions during extreme heat events without reliance on mechanical cooling systems directly aligns with the Compendium's emphasis on both structural and non-structural measures for resilience.

Field studies and performance modelling confirm that traditional wind towers can reduce indoor air temperatures by approximately 5°–12°C compared to outdoor conditions, depending on variables such as ambient wind speed, tower geometry, humidity levels and integration with other technologies. This evidence validates the Barjeel as a proven method for mitigating extreme heat risks, particularly during power outages, infrastructure failures or situations where air conditioning is inaccessible.

While the Barjeel offers clear benefits in enhancing thermal comfort and disaster resilience, its implementation in modern contexts presents several challenges. Adapting the traditional tower design to dense urban environments can be complex, as variations in building height, surrounding structures, and wind patterns may limit its performance. This can be mitigated through the use of advanced design tools such as Computational Fluid Dynamics (CFD) simulations, which help optimize tower geometry and placement for maximum airflow efficiency. Its benefits are maximized in environments without high-rise buildings that obstruct wind flow, allowing unobstructed air currents to enhance the tower's passive cooling performance.

In climatic conditions where hot, still days occur, the Barjeel's passive cooling effect may be reduced. This limitation can be addressed by integrating low-energy support systems, such as solar-powered fans, to maintain airflow without undermining its low-energy character. Additionally, public perception remains a barrier, as some view the Barjeel as an outdated architectural element. Awareness campaigns and demonstration projects can shift this perception by showcasing modern applications that combine cultural heritage with contemporary resilience needs.

In addition to the above lessons and technical considerations, Barjeel-inspired systems generate a range of added benefits that extend beyond thermal comfort, reinforcing their role in holistic resilience strategies. These benefits include:

- **Energy Efficiency:** Reduces peak electricity demand and lowers greenhouse gas emissions.
- **Economic Savings:** Lowers household energy bills, benefiting low-income residents.
- **Cultural Preservation:** Maintains a living connection to UAE heritage, reinforcing a sense of identity.
- **Health Benefits:** Reduces heat-related illnesses and improves indoor air quality by promoting constant airflow.

Through addressing the above challenges with practical solutions, the Barjeel could be successfully integrated into modern disaster resilient housing strategies, scaling its benefits from individual buildings to community-level resilience. This demonstrates that low-tech solutions can complement high-tech systems. Modern disaster risk reduction strategies often focus on advanced technologies, yet the Barjeel illustrates that low-tech, passive design features can be equally critical, especially in resource-constrained or post-disaster environments.

The Barjeel model has high replication potential in other arid and semi-arid regions experiencing

extreme heat. Its flexible design allows for integration into both new constructions and retrofitting of existing structures. Moreover, locally sourced materials and community-based construction not only reduce costs but also can create green jobs and stimulate local economies, making it an attractive and sustainable solution for diverse contexts.

For the Barjeel to transition from a heritage feature to a mainstream disaster resilience measure, possible actions may include:

- **Standardization:** Develop technical guidelines for modern Barjeel construction, ensuring safety, durability and performance.
- **Pilot Programmes:** Implement demonstration projects in vulnerable communities to showcase practical benefits.
- **Capacity Building:** Train architects, engineers and builders in integrating wind towers into modern designs.
- **Policy Integration:** Advocate for inclusion in national disaster resilience frameworks, urban planning regulations and green building certification systems.

### Integration with Policy and Standards

For broader impact, the lessons from the Barjeel could be reflected in building codes, national housing policies and disaster resilience guidelines, ensuring that passive cooling is recognized as an essential design consideration in hot-climate contexts. These lessons demonstrate that by combining traditional architectural intelligence with modern engineering, the Barjeel can evolve into a globally relevant model for climate-adaptive, disaster resilient housing.

## Additional Information

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# 11. Integrated Urbanization of the Morro da Cruz Rock Massif in Florianópolis

Country:

Brazil

Submitted by:

Ministry of Cities,
Government of Brazil

- Housing
- Facilities


## Abstract

*The integrated urbanization of the Morro da Cruz Rock Massif initiative aimed to improve living conditions in 16 communities that were home to 5,677 families, of which 438 lived in risk-prone areas. The intervention improved the quality of life of families, living in precarious settlements and landslide-risk areas. The urban infrastructure developed as a part of this programme was built resilient considering landslides and floods to protect at-risk communities.*

*Two types of housing were implemented: modular houses and concrete block houses. Larger families were provided with modular blocks, each with adaptations to meet their specific needs, while smaller families were provided with modular houses. The initiative included construction of a water supply network, a sewage collection network, earthmoving, paving, a rainwater drainage network, an electricity supply network, installation of public lighting poles, retaining walls, soil stabilization and environmental recovery works. The project also includes land regularization actions, which are currently under way, with the aim of guaranteeing possession of properties to 5,290 families.*

*The partnership between residents and the government brought benefits to everyone.*


## Introduction to the Initiative

The integrated urbanization of the Morro da Cruz Rock Massif was carried out through a contract signed between the Ministry of Cities and the Municipal Government of Florianópolis in the state of Santa Catarina, with the transfer of resources from the General Budget of the Union (OGU) and the contribution of resources by the municipal government as a counterpart. The intervention improved the quality of life of families in situations of social vulnerability, living in precarious settlements and landslide-risk areas, through integrated actions that covered socioeconomic issues, housing, environmental issues, land and urban infrastructure, access to public services and equipment, with

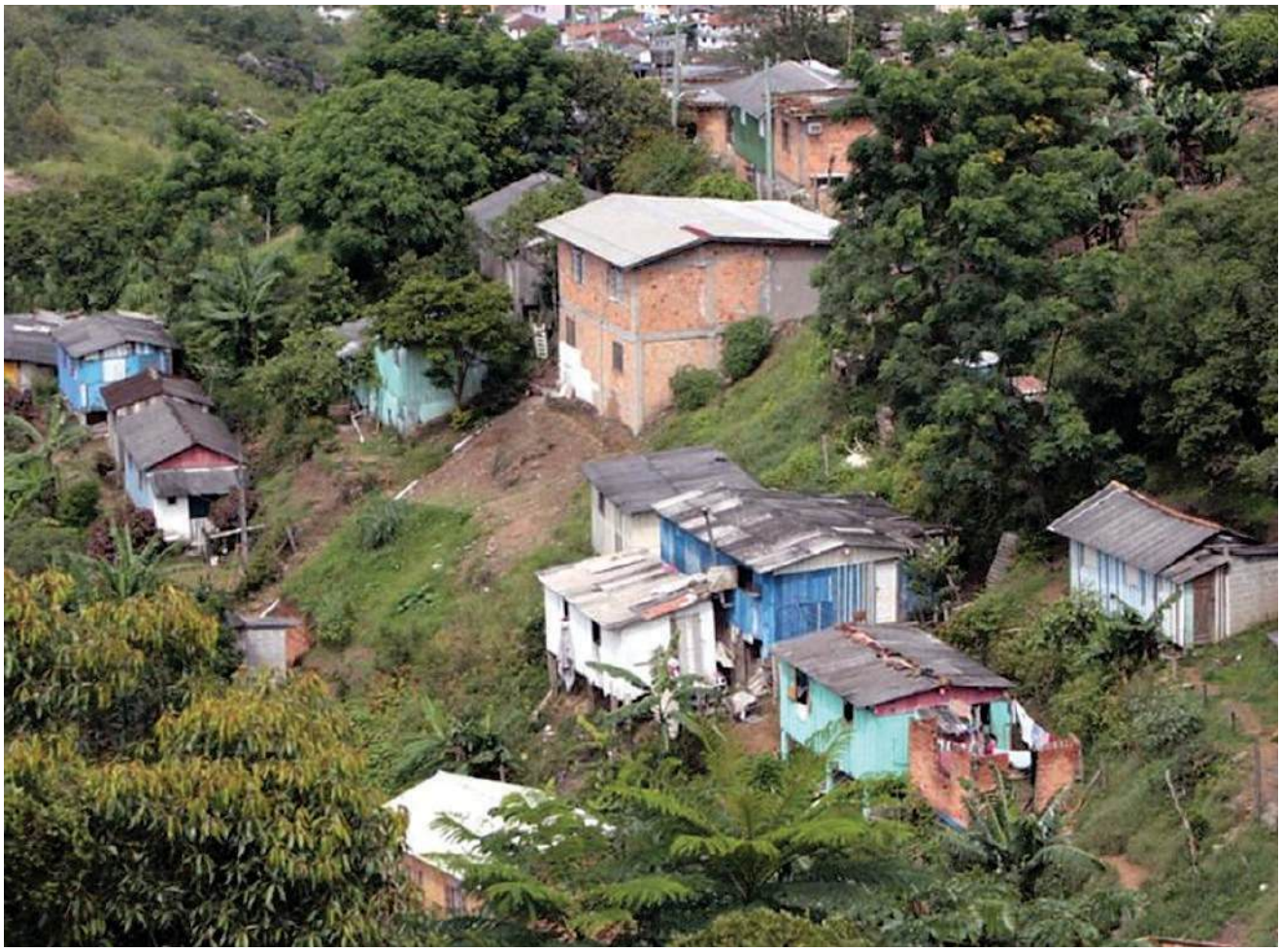

**Image 1:** Caiera community

incorporation of disaster risk reduction measures. The urban infrastructure developed as a part of this programme was built to be resilient to landslides and floods to protect at-risk communities.

## Process and Impact of the Initiative

The initiative was part of the Informal Settlements Urbanization–Growth Acceleration Program (PAC-UAP) implemented by the Ministry of Cities, which aims to support the government in raising the quality-of-life standards of families in situations of social vulnerability living in informal settlements, through the provision of urban infrastructure, improvement of housing conditions, risk reduction, provision of equipment and land regularization actions. The intervention aimed to improve living conditions in 16 communities that were home to 5,677 families, of which 438 lived in risk-prone areas.

In this context, the Municipal Government of Florianópolis registered the intervention proposal in the Federal selection process of the Slum Upgrading Program, and it was selected in 2007. The total investment was USD13,068,343, of which USD8,639,897 came from the General Budget of the Union from the federal government and USD4,428,446 from the municipal government. To execute the works, the municipal government held bidding processes to hire specialized companies to implement the infrastructure and carry out the technical social work.

The projects included infrastructure works to provide access to basic sanitation, electricity, and public lighting services, as well as to improve accessibility conditions. Considering the existence of residences in areas susceptible to risks, on the hillside, the objective was to reduce the risk of landslides and flooding, allowing the consolidation of most families in the intervention area itself. 45 plumbing and sanitation facilities were built, which not only improved the quality of life but also the hygiene and health conditions of the beneficiary families.

Although, the intervention consolidated families and maintained existing social capital, there were


**Image 2:** Urban resilient and inclusive infrastructure in different communities at risk in Morro da Cruz Rock Massif, Florianópolis

cases where resettling families was the only solution. A total of 91 housing units were built in the intervention areas to accommodate the resettlement cases. The main reasons for relocation were the technical and financial unfeasibility of overcoming the families' risk conditions, or the scope of the engineering works, such as opening roads to improve community accessibility. The locations for the implementation of the housing were defined based on a risk study, land availability and proximity to the housing targeted for removal.

Two types of housing were implemented: modular houses and concrete block houses. The definition of families eligible for each type took into account family composition. Larger families were provided with modular blocks, each with adaptations to meet their specific needs, while smaller families were provided with modular houses.

Thus, for smaller family compositions, single-storey modular houses were built with two bedrooms, bathrooms, living room and kitchen, distributed over 39 square metres. This type underwent adaptations depending on the terrain, such as elevated foundations and slope containment construction, to ensure adequate health and accessibility conditions. It should be noted that the intervention area has steep slopes and inclines, which require site-specific adaptation works to enable the construction of houses and unconventional forms of construction, such as modular walls, to speed up the process and avoid logistical problems.

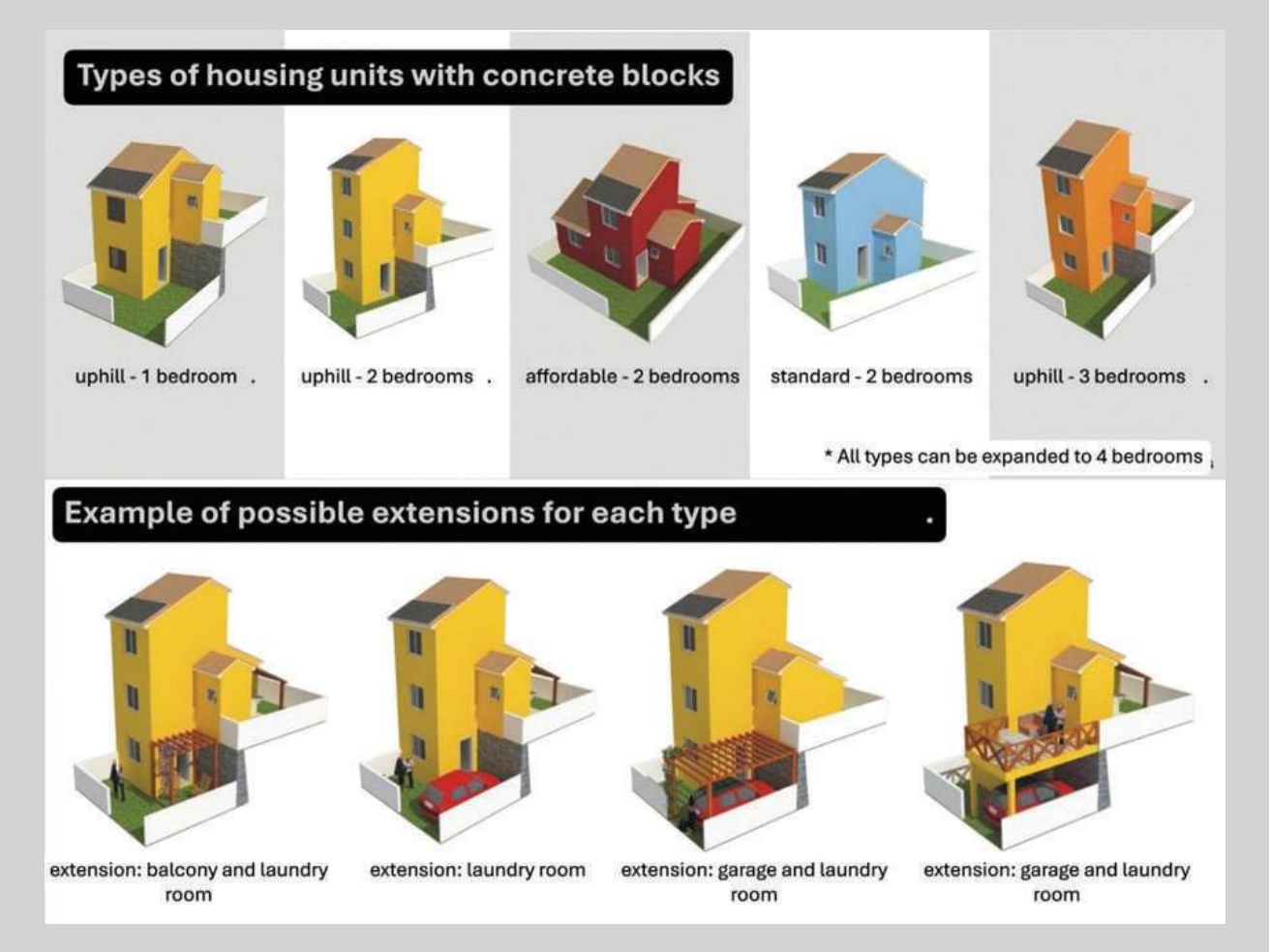


**Image 3:** Concrete block housing units, adapted to the site and with the possibility of expansion

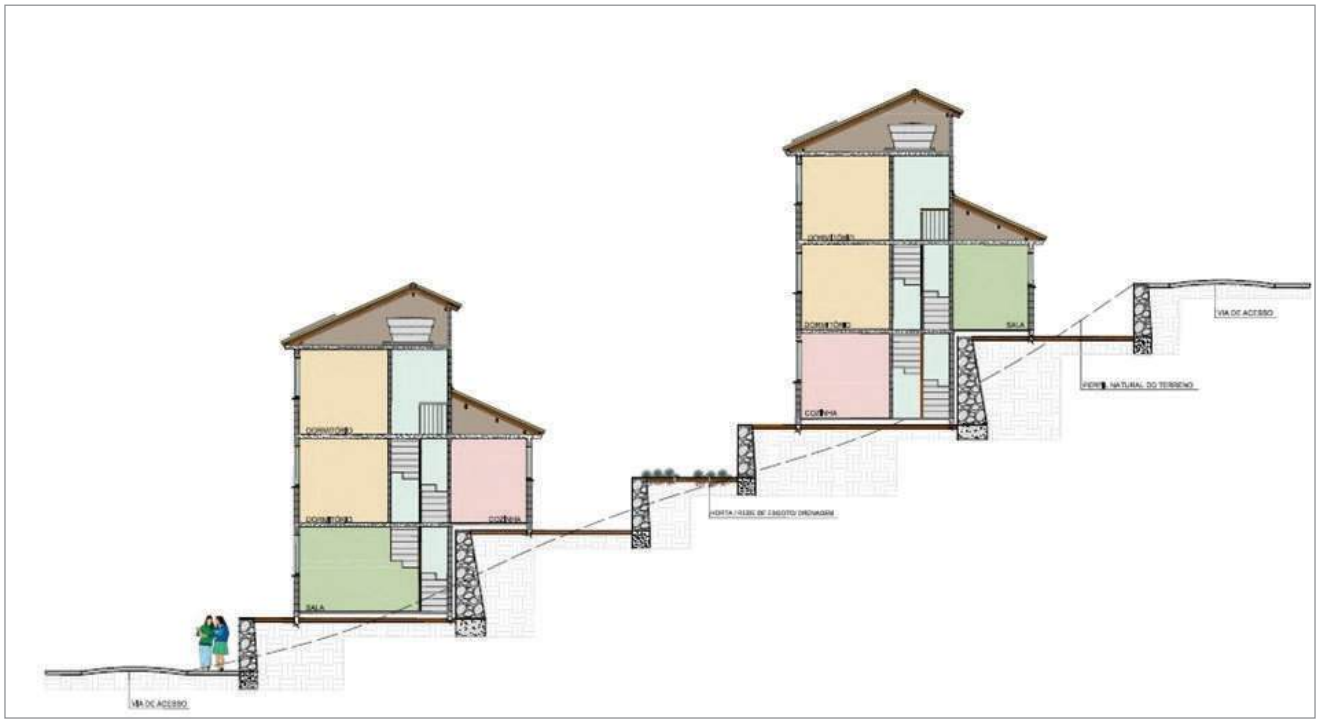

**Image 4:** Concrete block housing units, section

On steeply sloping land with high housing demand, two- or three-storey houses were built using concrete block construction technology. The size of the houses varies according to family demand – for example, one-bedroom houses (40.4 m²), two-bedroom houses (55.05 m²), or two-bedroom houses, one of which is accessible (51.09 m²) – as well as adaptations according to local conditions, such as those built on sloping, steep or flat terrain. This type of housing allows for expansion to up to four bedrooms, adapting to the growing demand of families.

The works included construction of a water supply network, a sewage collection network, earthmoving, paving, a rainwater drainage network, an electricity supply network, installation of public lighting poles, retaining walls and soil stabilization, and environmental recovery works. A warehouse was also built in the Caiera community to sort and select solid waste with the aim of generating income for the local population. In terms of the environment, a park headquarters was built with the aim of promoting the preservation of local flora and fauna and providing sports and leisure amenities for residents.

The project also includes land regularization actions, which are currently under way, with the aim of guaranteeing possession of properties to 5,290 families. This land was originally characterized as public land and has been occupied over time. The project also included carrying out mobilization and guidance actions for the beneficiary families and monitoring throughout the implementation of the project, as well as conducting a post-intervention evaluation.

## Lessons Learned

The two major challenges in implementation were of logistics involved in construction and negotiations for public improvements. Transporting materials in hard-to-reach locations in a rugged region with narrow alleys, and the use of machinery and equipment was impossible in many places. As the area was illegally occupied, implementing public improvements required

negotiation with each resident, since construction interfered with their space. This challenge was mitigated by a city-hall implemented management committee with the residents as participants. This gave them an opportunity to express their views and voices.

It should be noted that, in addition to the construction of housing, this intervention included the comprehensive urbanization of the territory, with slope containment, road opening and paving, drainage works, and basic sanitation. To this end, monthly meetings were held with residents and local leaders from each community so that the intervention would be appropriate for the residents themselves. The benefits of this partnership were felt in the execution of the works, in the improvement of the socioenvironmental quality of the area, as well as in the integration of the population with public agencies and public service companies to help meet needs that were previously ignored.

These initiatives can be scaled up to other communities, given that partnerships between residents and the government bring benefits to everyone. However, the success of the partnership depends on social work and a clear understanding of the role of every individual in solving their personal and collective problems.


**Image 5:** Modular housing units adapted to the site

**Image 6:** Concrete block housing units

# 12. Recovery and Resilience after Hurricane Fiona in the Dominican Republic

Country:

Dominican Republic

Submitted by:

United Nations Development Programme (UNDP)

- Housing
- Post-Disaster
- Public Housing
- Enablers


## Abstract

*Hurricane Fiona (2022) struck the low-income coastal districts of Dominican Republic, where 60 percent of homes were wooden with zinc roof. In response, the Ministry of Housing and Buildings launched a resilient recovery programme in Sabana de la Mar urban area focusing on economically disadvantaged households, women-headed families, the elderly and persons with disabilities. The post-disaster needs assessment deployed drones and geospatial technologies during the Housing and Building Damage Assessment (HBDA), which mapped 2,589 roof-damaged homes. The findings shaped an integrated plan with three pillars: restoring livelihoods, rehabilitating climate-resilient housing, and strengthening local risk management and territorial governance.*

*Limited skill in resilient construction was overcome by establishing community brigades and training master builders, who collectively repaired or rebuilt homes – skills they now carry forward for future resilience efforts.*

*A community-scale renewable-energy initiative guaranteed decentralized power, which not only protected homes from hurricanes but also ensured that lighting, communications and livelihoods remain operational during and after the disaster.*


## Introduction to the Initiative

After Hurricane Fiona struck the Dominican Republic in September 2022, UNDP and the Ministry of Housing and Buildings launched a resilient-recovery programme in Sabana de la Mar urban area. A low-lying coastal municipality in Hato Mayor Province, on the western shore of Samaná Bay in the north-east region of the Dominican Republic, Sabana de la Mar is highly exposed to hurricane storm surges and recurrent flooding.

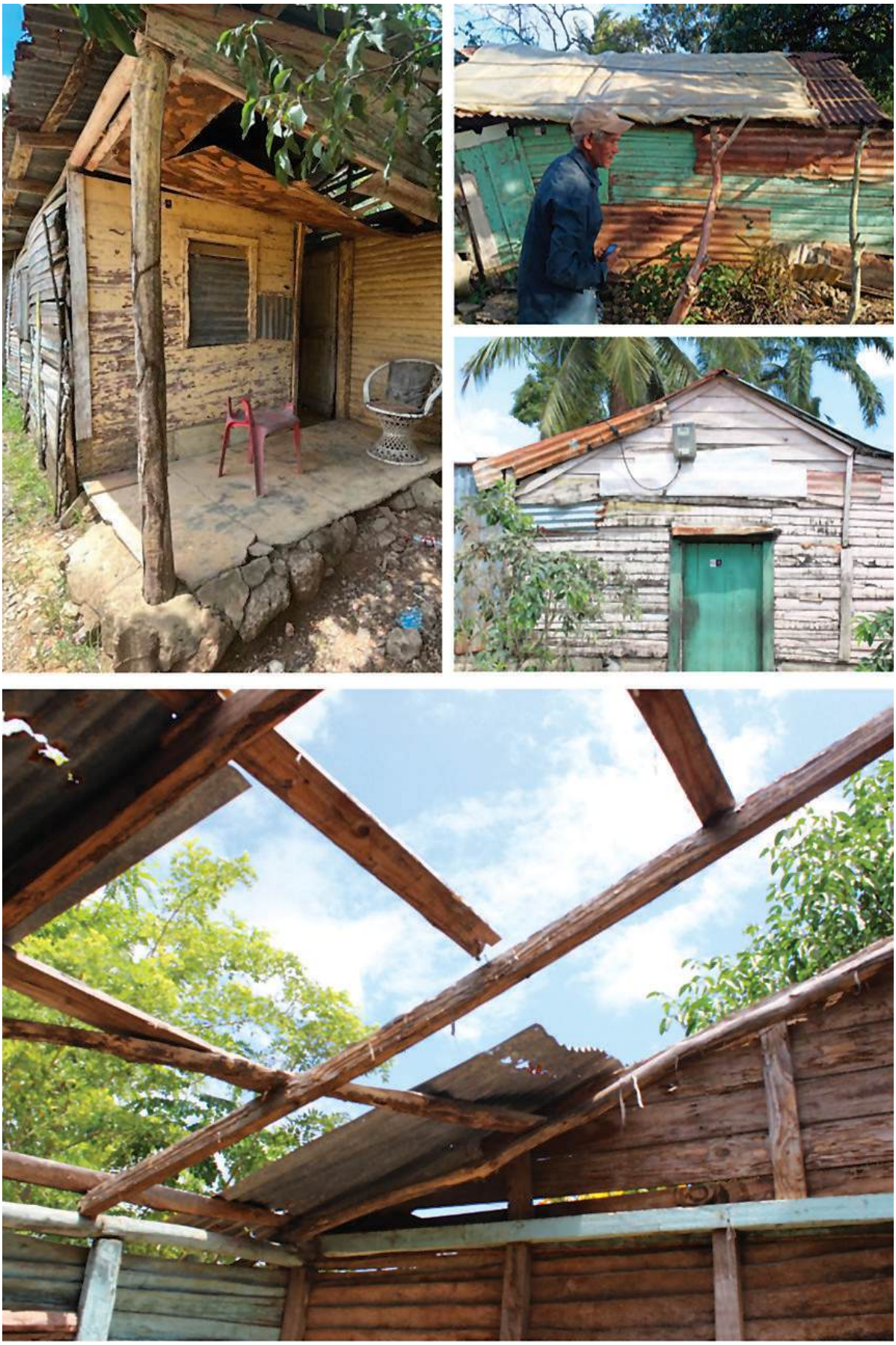

**Image 1:** Post-disaster damage to a house in Sabana de la Mar

The hurricane damaged 8,708 houses (2,638 of them destroyed) and disrupted electricity, water supply, and schooling in eight provinces. In response, national authorities requested UNDP's support to produce reliable, gender-disaggregated damage data and to pilot resilient reconstruction models aimed at reducing future storm-related losses. Using the Housing and Building Damage Assessment (HBDA) in census mode, 2,589 roof-damaged homes were mapped. The findings shaped an integrated plan with three pillars: restoring livelihoods, rehabilitating climate-resilient housing, and strengthening local risk management and territorial governance. The project delivered safer houses, income opportunities and technical training to the most vulnerable households, while reactivating and updating the Municipal Committee for Prevention, Mitigation and Response. Its territorial, participatory, multisectoral model is ready for replication in other hydrometeorological hotspots.

## Process and Impact of the Initiative

In 2022, a joint team from the Ministry of Housing and Buildings ('Ministerio de la Vivienda y Edificaciones'), the National Office for Seismic Evaluation and Building Vulnerability ('Oficina Nacional de Evaluación Sísmica y Vulnerabilidad de Infraestructuras y Edificacione'), and UNDP, deployed the Housing and Building Damage Assessment (HBDA) in the Sabana de la Mar area. Under the assessment, 2589 homes were surveyed and the results were uploaded into the National Integrated Information System ('Sistema Integrado Nacional de Información', SINI). This information guided recovery actions: like roof repairs, reconstruction, and targeted socioeconomic assistance. On the governance side, UNDP supported the drafting of a Municipal Emergency Plan, a new SDG-aligned Development Plan, training of local response committees and equipping the Civil Defence unit.

With the help of the NGO Habitat for Humanity, 22 houses in Sabana de la Mar were upgraded or rebuilt; 18 of these were households headed by women. Community masons and carpenters formed three technical brigades. The En Marcha (In Motion) business-recovery scheme coached almost 60 micro-enterprises (64 percent women-led) to restore income streams. The Ministry of Housing and Buildings supplied in-kind materials; Habitat for Humanity contributed USD35,000; and the World Food Programme (WFP) channelled emergency cash for 200 undocumented women-headed households.

A gender-and-inclusion filter ensured that resources reached the most vulnerable. Of 22 houses repaired, 18 belonged to women-headed households, and the HBDA captured pregnancy, disability and age markers to refine prioritization. Municipal capacities were strengthened through development of local plans, allocation of budgets and constitution of local committees to mainstream climate risk sensitive development. Business mentors and revolving credit facilities accelerated the revival of retail and service activities.

UNDP-Dominican Republic collaborated with UNDP Colombia to strengthen national capacities in post-disaster needs assessment, leveraging Colombia's experience in deploying drones and geospatial technologies during the Housing and Building Damage Assessment (HBDA).

Additionally, a joint mission (2022) was conducted in Sabana de la Mar, combining door-to-door HBDA data collection with a four-day drone mapping operation supported by the UNDP's Accelerator Lab. High-resolution orthophotos of the entire urban area and a rural sector were generated and integrated into the municipal GIS. This integration refined damage scoring and enabled precise targeting of recovery interventions, including roof repairs, full rebuilds, and socioeconomic assistance.

**Image 2:** Examples of post-disaster retrofits

Beyond immediate recovery, this collaboration is laying the foundation for sustainable capacity development. By transferring technical expertise in drone operations and GIS-based analysis, it empowers local and national institutions in the Dominican Republic to adopt innovative, data-driven approaches for future disaster response. This initiative serves also as a powerful example of how South-South cooperation can accelerate resilience-building and strengthen regional solidarity in the face of climate-related challenges.

In addition to the physical damage, the hurricane severely impacted livelihoods –particularly those of subsistence, micro and small enterprises that depend directly on tourism. As a result, their income-generation models were significantly weakened. Hence, parallel to the physical recovery efforts, the initiative also focused on restoring livelihoods and promoting economic resilience. The economic resilience phase aimed to support the financial recovery of the affected individuals by strengthening their livelihoods through UNDP's regional 'In Motion' programme. This initiative benefited 54 micro and small enterprises – most of them women-led – by enhancing their business capabilities and competitiveness. Support included group training, confidential one-on-one coaching, digital strategy development, and business renewal with non-reimbursable seed capital. As a result, significant improvements were achieved in sales and profitability.

Families now live in houses engineered to withstand Category-3 hurricanes, reducing their risk of future displacement. Meanwhile, targeted support helped women entrepreneurs reopen sooner and regain their markets, narrowing the gender income gap. At the governance level, the municipality moved from ad-hoc relief to a structured risk-management system, cutting decision-making times during crises. Finally, both the HBDA methodology and the cyclone-resilient housing manual have become standard tools for the Ministry of Housing) and SIUBEN (the Dominican Republic's national registry for identifying and classifying individuals and households for social protection programmes) and benefit calculations, laying the groundwork for nationwide replication.

## Lessons Learned

The following lessons were learned during the project implementation:

- Concentrated geographic focus on only one municipality accelerates visible impact and stakeholder buy-in.
- Integrating housing, livelihoods and governance yields co-benefits greater than siloed interventions.
- Digital tools like HBDA enhance transparency and attract co-funding by providing evidence in days, not weeks.
- Gender-responsive targeting increases social acceptance; community members become advocates for resilient practices.
- Early partnerships with specialized NGOs (such as Habitat) leverage complementary expertise and funding.

### The Challenges and Mitigation Actions

On the level of constructing resilient housing the challenges were:

- upfront costs of resilient design features
- limited access to funding
- lack of awareness about resilient building techniques
- lack of skilled construction workers and engineers

- inadequate skill of retrofitting
- lack of access to good options of resilient housing

The overall project faced three key challenges. First, fragmented damage records were addressed by deploying the HBDA digital survey alongside drone imagery, resulting in a unified dataset covering 2,589 households. This data has been integrated into the National Integrated Information System (SINI) and visualized through real-time dashboards for the Emergency Operations Centre. Second, limited local expertise in resilient construction was overcome by establishing community brigades and training 15 master builders, who collectively repaired or rebuilt 22 homes – skills they now carry forward for future resilience efforts. Third, to counter the frequent exclusion of women from reconstruction decisions, the project prioritized women-headed households and ensured that 64 percent of In Motion participants were women – directly benefiting 18 households and 38 businesses, in alignment with newly adopted municipal guidelines.

## Co-Benefits of the Project

Among the co-benefits are: re-roofing and structural upgrades now follow a guide developed by the NGO Habitat for Humanity, the Ministry of Housing and UNDP that anchors zinc sheets and walls to withstand Category-3 winds, reducing the likelihood of repeated storm damage and debris generation in future events. Additionally, the En Marcha scheme, supporting SMEs, strengthened almost 60 micro and small businesses, 64 percent of them led by women. Local carpenters and masons formed community brigades for the housing repairs, circulating project funds inside Sabana de la Mar and creating paid work opportunities, generating an economic restoration.

Another co-benefit was enhancing social and gender equity. Out of 22 homes already rehabilitated, 18 belong to women-headed households, reflecting a gender-responsive beneficiary selection that also prioritized families with pregnant women, persons with disabilities and the elderly.

The drone imagery improved data quality and cut verification time from weeks to days, giving decision-makers an immediate, georeferenced picture of damage and destruction. The mission also transferred knowhow between UNDP offices, training four Dominican technicians in flight planning and photogrammetry, and generating orthophotos that the municipality can reuse for zoning and environmental monitoring.

Finally, the Household & Building Damage Assessment (HBDA) tool was transferred to the Ministry of Housing and integrated into the National Emergency Information System (SINI), enabling faster, evidence-based targeting of aid after disasters. The municipality now has updated emergency, contingency and development plans aligned with the Sustainable Development Goals (SDGs).

## Upscaling Potential of the Initiative

The Ministry of Housing has requested the replication of this approach in two additional municipal districts within the province of Higüey. This includes strengthening MSMEs in the construction sector to enhance their capacity to respond swiftly during emergencies by supplying housing materials to the most affected areas. Additionally, the initiative aims to quantify homes built with vulnerable materials and in poor condition, allowing for early reconstruction efforts ahead of the hurricane season. The replication of this experience was formalized

through the signing of a renewed project agreement with the Ministry of Housing, accompanied by an increased budget allocation to support implementation. The municipal risk-planning approach is aligned with the national disaster risk reduction (DRR) policy, paving the way for scaling through the National Emergency Commission.

Beyond the housing-and-livelihoods package, the programme is fully integrated with UNDP's community-scale renewable-energy initiative PER Renovables (Poseidón Energía Renovable S.A.), which is a Dominican Republic-based company focused on electricity generation from renewable sources and guarantees decentralized power before, during and after disasters. PER Renovables already operates 13 run-of-river micro-hydro plants with a combined capacity of 352 kW, supplying electricity to 1,348 rural homes, clinics and schools across four provinces. Because both initiatives are managed by community cooperatives under municipal oversight, the energy component meshes naturally with the housing-recovery workflow. PER Renovables also uses the same blended-finance model – EU grants, national funds and in-kind labour – that financed the post-Fiona housing repairs. Therefore, funding channels and cost-sharing arrangements are familiar to government partners.

Coupling resilient housing with decentralized renewable energy not only protects homes from Category-3 hurricanes but also improves the odds that lighting, communications and livelihoods remain operational, offering municipalities a practical, scalable blueprint for climate-resilient recovery.

## Additional Information

### Video Links

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# 13. Policy on the Seismic Retrofitting of Housing and Other Buildings

Country:

Japan

Submitted by:
Cabinet Office,
Government of Japan

- Housing
- Post-Disaster
- Enablers
- Retrofits

## Abstract

*The Japanese government has established a subsidy programme for seismic assessments of houses and for retrofitting homes that do not meet current seismic standards. This system is designed so that anyone who owns an eligible home –regardless of their income level or social status – can apply for assistance. In 2024, approximately 133,000 detached houses and about 180,000 apartment units have undergone seismic retrofitting using the national subsidy program.*

*The seismic resistance rate of homes in Japan has increased from 75 percent in 2003 to 90 percent in 2023.*

## Introduction to the Initiative

In Japan, the Great Hanshin-Awaji Earthquake of 1995 resulted in over 6,000 deaths, many of which were caused by the collapse of buildings. A significant number of the collapsed buildings had been constructed under the old seismic standards. In response to this, the Japanese government enacted the Act on Promotion of Seismic Retrofitting of Buildings to promote seismic assessments and retrofitting of buildings built under the old standards, and has taken various measures to encourage such retrofitting.

Additionally, Japan has established subsidy programmes administered by the national and local governments, allowing owners of eligible buildings to carry out seismic assessments and retrofitting at a reduced personal cost through the use of these subsidies.

These programmes are designed to be accessible regardless of the income level or social status of the building owners, as long as the buildings are at risk of collapse. As a result, they contribute significantly to reducing human and economic damage from earthquakes and play a key role in building a more resilient society.

## Process and Impact of the Initiative

In Japan, the structural requirements for buildings were originally stipulated by the Building Standards Act enacted in 1950, which required verification that buildings would suffer little to no damage in the event of a moderate earthquake occurring roughly once every few decades. However, in 1981, the standards were revised, and the current requirement is to verify that buildings will not collapse or suffer structural failure during a major earthquake that may occur once every several hundred years.

During the Great Hanshin-Awaji Earthquake in 1995, over 6,000 people lost their lives, with a large proportion of fatalities caused by building collapses and fires. Notably, many of the collapsed buildings had been constructed before the 1981 revision of the building standards. In response, the government recognized the need to improve the earthquake resistance of buildings constructed prior to 1981 and enacted the Act on Promotion of Seismic Retrofitting of Buildings in 1995, implementing various measures to promote seismic retrofitting.

The Japanese government has established a subsidy programme for seismic assessments of houses and for retrofitting homes that do not meet current seismic standards. The subsidy rate and upper limit to support retrofitting vary depending on the type of housing. This support is provided primarily in the form of national government assistance to local governments. For private buildings, the national government bears a portion of the cost when local governments provide subsidies to building owners. For example, in the case of detached houses, a combined subsidy of up to JPY1.15 million (USD7,779 at 2025 rates) is available from both the national and local governments.

However, since criteria for subsidy eligibility may differ by municipality, homeowners who wish to receive subsidies for seismic assessments or retrofitting need to consult with their local government. Some local governments have created user-friendly systems by, for example, publishing lists of certified architectural firms that provide seismic diagnosis and retrofitting services. The national government has also developed a searchable database that allows the public to check what types of support programmes are available in each municipality.

This system is designed so that anyone who owns an eligible home can apply for assistance, regardless of their income level or social status. By lowering financial and informational barriers, the system plays a critical role in reducing fatalities and economic losses caused by earthquakes.

As of fiscal year 2024, approximately 133,000 detached houses and about 180,000 apartment units have undergone seismic retrofitting using the national subsidy program.

In addition to this, tax incentives and loan programmes are also being used to further promote the seismic strengthening of housing. As a result, the seismic resistance rate of homes in Japan has increased from 75 percent in 2003 to 90 percent in 2023.

## Lessons Learned

Currently, approximately 80 percent of houses with insufficient seismic resistance are detached houses, and municipalities with higher aging populations tend to have lower seismic retrofit

rates. Therefore, promoting seismic retrofitting of detached houses, particularly those inhabited by households made up of elderly people, remains a key challenge.

Seismic strengthening of buildings, including residential structures, not only helps prevent direct damage caused by collapse but also contributes to maintaining critical disaster prevention functions – such as disaster response bases, emergency transportation routes and evacuation paths – in the event of a disaster. Accordingly, the Act on Promotion of Seismic Retrofitting of Buildings and related subsidy programmes not only enhance the safety of buildings but also play a significant role in building a more resilient and disaster-prepared society.

# 14. Japan–Malawi–UNDP Partnership for Inclusive Disaster Recovery

Country:

Malawi

Submitted by:

United Nations Development Programme (UNDP)

- Housing
- Facilities
- Post-Disaster
- Public Housing
- Owner Driven
- Enablers
- Vernacular


## Abstract

*Cyclone Idai in 2019 affected nearly 1 million people in Malawi, displacing thousands and destroying many homes. The affected populations, mostly economically disadvantaged, were living in temporary shelters and were exposed to high risks. The initiative constructed 200 disaster resilient houses, trained 900 local artisans (including women) and supported market rehabilitation, water access, and artisan training. It significantly reduced the vulnerability of flood-affected households, promoted sustainable reconstruction practices and empowered communities through legal and technical support, making it a replicable model for durable recovery.*

*The project adopted an owner-driven and community-led reconstruction approach, based on the principle of 'architecture by the people', where community members played an active role in selecting, adapting and constructing homes. Local builders and artisans were trained to reproduce resilient housing designs, making the construction process both scalable and community-owned. This approach ensured that the housing solutions were tailored to local needs and strengthened community capacity in the long term.*

*The initiative facilitated legal empowerment through the issuance of land lease certificates and training on will and inheritance planning, especially for women.*


## Introduction to the Initiative

The Japan–Malawi–UNDP Partnership for Inclusive Disaster Recovery was launched to support post-Cyclone Idai recovery in Zomba and Phalombe districts in Malawi. Implemented by UNDP with funding from the Government of Japan and Habitat for Humanity Malawi as a technical partner, the initiative focused on climate-resilient housing and community infrastructure.

The initiative constructed 200 disaster-resilient houses and supported market rehabilitation, water access and artisan training.

It significantly reduced the vulnerability of flood-affected households, promoted sustainable reconstruction practices and empowered communities through legal and technical support, making it a replicable model for durable recovery.

## Process and Impact of the Initiative

In 2019, Cyclone Idai affected nearly one million people in Malawi. It caused massive destruction in southern Malawi, especially in Zomba and Phalombe districts, displacing thousands and destroying homes. The affected populations, mostly economically disadvantaged, were living in temporary shelters and exposed to high risks.

The Japan–Malawi–UNDP partnership was developed as a post-disaster recovery initiative to support the construction of durable, climate-resilient houses and infrastructure using the 'Build Back Better' principle. Implemented by UNDP and Habitat for Humanity Malawi, in coordination with the Department of Disaster Management Affairs (DoDMA), the project aimed to promote human security through safe, dignified and resilient infrastructure. It also strengthened community resilience and stakeholder capacity by promoting safer construction practices.

Key results included:

- Construction of 200 disaster-resilient houses and ventilated improved pit (VIP) latrines for displaced families.
- Training of 900 local artisans in Safer Housing Construction Guidelines (SHCG) and resilient building techniques.

**Image 1:** A newly constructed house and a toilet

- Installation of four boreholes and rehabilitation of two irrigation schemes, enhancing water access.
- Rehabilitation of two community markets with sanitary facilities to restore economic activity.
- Legal empowerment through the issuance of land lease certificates and training on will and inheritance planning, especially for women.

This approach addressed both immediate recovery and long-term resilience by integrating physical reconstruction with livelihood support and legal protection. It provided shelter, improved sanitation and water services, supported small-scale traders, and ensured communities were better prepared for future shocks.

The project placed strong emphasis on women-led housing initiatives by promoting the participation of female artisans in climate-resilient construction. Women were not only beneficiaries, but also active contributors involved in on-site construction activities. This approach enhanced gender empowerment through both skill-building and income generation, helping to create more inclusive and resilient communities.

The project adopted an owner-driven and community-led reconstruction approach, empowering households to take part in designing and building their homes. Community members contributed labour, supervision and local knowledge during the reconstruction process. This participatory model ensured a greater sense of ownership, cultural appropriateness and long-term sustainability of the houses constructed.

Traditional building techniques in Malawi often involve the use of mud, thatch and reeds, which were recognized in the report as vulnerable to climate hazards such as floods and cyclones. In response, the project used cement bricks/blocks.

This blend of local wisdom and modern engineering ensured that the new housing retained cultural relevance while being structurally safer.

The initiative also highlighted the idea of 'architecture by the people', where community members played an active role in selecting, adapting and constructing homes. Local builders and artisans were trained to reproduce resilient housing designs, making the construction process both scalable and community-owned. This approach ensured the housing solutions were tailored to local needs and strengthened community capacity in the long term.

## Lessons Learned

### Challenges and Mitigation Strategies:

- Limited availability of skilled artisans was addressed by training 900 local workers, building long-term capacity in safer construction.
- Cultural design preferences influenced acceptance, hence beneficiary engagement in design processes improved satisfaction and ownership.
- Land tenure insecurity was mitigated through legal training and distribution of land lease certificates, especially empowering female-headed households.
- Resilient design features are expensive for the most vulnerable households; however, use of locally available resources and government support is crucial.
- Access to water and sanitation was a challenge due to water scarcity and poor hygiene. Boreholes and VIP latrines were installed. This improved WASH and health outcomes.
- The damaged markets disrupted livelihoods. Economic recovery was orchestrated by rehabilitating two markets that benefitted 340 small-scale traders.

### Co-Benefits and Scalability:

- Artisan training created new employment and income streams.
- The project supported the revitalization of local economies through market rehabilitation.
- Women gained greater control over land and inheritance rights, promoting gender equity.
- The use of locally available materials and community labour made the model cost-effective and replicable.

The holistic approach, which combined shelter, infrastructure, capacity-building and legal support, is well-suited to be scaled nationally and regionally.

## Way Forward

UNDP and partners plan to integrate this approach into future disaster recovery frameworks and housing policies. The housing models were adopted by the Ministry of Lands and Housing and made available to local authorities to be accessed by communities.

The model is being considered for replication in other disaster-prone districts in Malawi and could inform regional approaches to resilient recovery.

Future initiatives will strengthen monitoring systems, mainstream gender equality and explore climate financing for resilient infrastructure.

## Additional Information

### Readings

Japan-Malawi-UNDP Partnership for Inclusive Disaster Recovery, United Nations Development Programme.
https://www.undp.org/africa/publications/japan-malawi-undp-partnership-inclusive-disaster-recovery

# 15. Building Back Better: Housing Reconstruction Strategy for Vulnerable Households, Lesotho

Country:

Lesotho

Submitted by:

Disaster Management Authority, Government of Lesotho

- Housing
- Post-Disaster


## Abstract

*This case study represents how the Disaster Management Authority (DMA), the department of Building Design Services (BDS) under the Ministry of Public Works and Transport, and the Lesotho Defence Force (LDF) have been building houses for vulnerable households affected by hazards such as strong winds/windstorms, hailstorms and heavy rains. This is an ongoing housing programme, and every year, depending upon the need, houses are being constructed through various mechanisms, including engaging contractors. The DMA ensures that homes are built resiliently. The case study provides the implementation framework for the housing programme, the details of the various technologies used for creating the houses and the policy and financial challenges faced by the DMA in implementation.*


## Introduction to the Initiative

Climate change is intensifying and increasing the recurrence of hazards like droughts, heavy rains, hailstorms and windstorms. In 2009 and 2013/2014, Lesotho was affected by windstorms, which destroyed 150 houses. Since 2009 onwards, the government of Lesotho, through the Disaster Management Authority (DMA), has been building houses for vulnerable households affected by hazards such as windstorms, hailstorms and heavy rains. Eligible people were provided with two-roomed houses with the assistance of the department of Building Design Services (BDS) under the Ministry of Public Works and Transport and the Lesotho Defence Force (LDF). Due to limited government funding, the DMA prioritized destitute households while undertaking house reconstruction.

## Impact of the Initiative

The DMA ensures that houses are built in line with Build Back Better (BBB) principles and that their durability is not compromised, so that they remain resilient in the event of similar

hazards in the future. The houses built in line with BBB principles were resilient as well as comfortable against harsh climatic conditions.

## Process of the Initiative

**Main Stakeholders:** The main stakeholders were the vulnerable households, the DMA, the BDS and the LDF.

**Scope of Work:** In 2009 about 60 houses were reconstructed. In 2023/2024 about 288 houses were destroyed by windstorms countrywide, and the DMA managed to reconstruct 122 houses of the most vulnerable households. For the year 2025/26, the organization has planned to reconstruct 100 houses and has set aside an amount of LSL21,000,000 (approximately USD1,235,294). Since Basotho, the primary ethnic group inhabiting Lesotho (comprising 99 percent of the population), own land, the government is not obliged to purchase or secure land for affected households, except in exceptional cases. In 2023 many of the vulnerable houses were reconstructed by Lesotho Defence Force, and the DMA bought building materials. In FY2024, the DMA engaged contractors to help with house reconstruction, and monitoring of the construction and issuance of certificates of completion is still done by BDS.

**Housing Delivery System:** The DMA works with the department of Building Design Services (BDS) under the Ministry of Public Works and Transport, and independent construction companies. By the terms of the agreement, the DMA buys the building materials, and the construction company is paid for the labour. The department of Building Design Services makes the plans for two-roomed houses to be delivered to recipients, and monitors the construction work. When the construction company completes a house, BDS issues a certificate of completion.

**Financial support:** For the construction of the houses, USD12,353 was allocated per house.

**Design:** BDS prepared the design, which envisages two-room units of about 30 square metres of covered area with two doors and four windows. Each element incorporated in this two-roomed house is selected for functionality, durability and resilience to local environmental conditions. From reinforcement choices to roofing style and water management systems,

**Image 1:** Old and new house in concrete blocks

**Image 2:** New house built with concrete blocks

the design supports a strong, safe and sustainable structure built to last.

**Technology:** The depth of the foundation was 1 metre, and the base slab of 28 MPa concrete was 250mm thick. This was adopted to meet the minimum structural engineering standards for small- to medium-sized residential buildings. Mesh wire was used in concrete floors. A polyethylene damp-proof membrane was laid under the concrete slab to prevent moisture from the soil rising into the house, reducing mould growth and dampness and creating a healthier indoor environment. The floor was finished with tiles.

Brick force wire mesh was laid every 3 block courses to control horizontal cracking due to shrinkage or thermal movement. To improve load-bearing capacity, wall ties were provided, particularly in high-stress areas like corners and window sills. Concrete lintels were installed above all window and door openings. Gable roofs were chosen over other types so as to let hail and snow slide off easily, preventing roof damage. Properly braced gable ends were used to withstand strong winds.

Fascia boards, gutters, and down pipes were installed along the roof edges to collect rainwater into storage tanks for household use. This was an important feature of the roof in a water-scarce area. A concrete apron around the perimeter of the building was laid with a slope to channel rainwater away from the foundation. This prevents erosion and water ponding, which

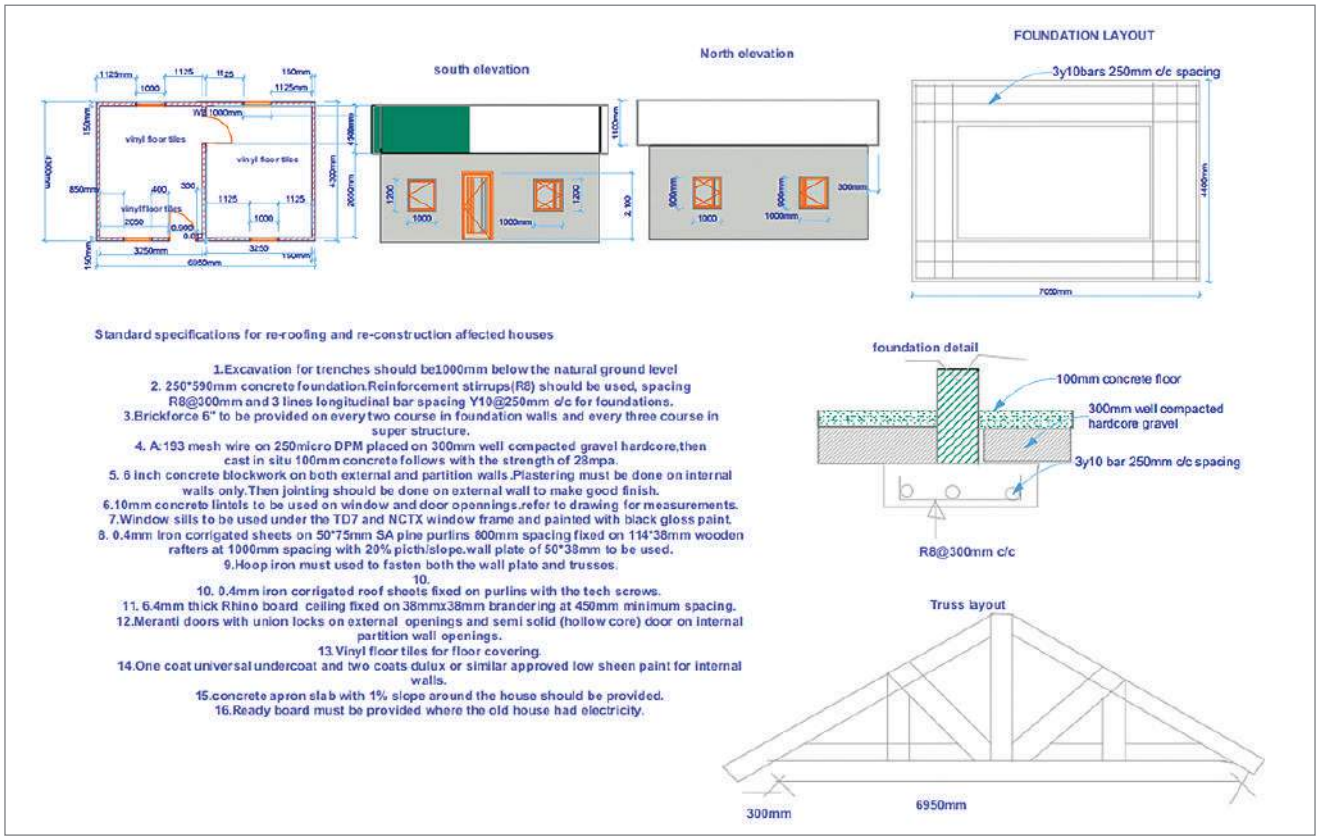


**Image 3:** Technical detail of the house designs

would otherwise weaken the structure. It also reduces weed growth and provides a clean perimeter for walking and maintenance.

## Lessons Learned

Funding: Limited funding was a challenge in the project, which led to limited coverage. The topography was also a major challenge. Regular monitoring to ensure adherence to standards was highly challenging and expensive. This challenge was overcome by the DMA by strengthening resource mobilization through collaboration and partnerships with the private sector and NGOs.

Policies: A major challenge was the lack of implementation and dissemination of related policies or frameworks (building codes). It is suggested that the Ministry of Local Government should ensure implementation and dissemination of relevant policies or frameworks. There is a need for law enforcement and compliance with the safety codes.

Knowledge and Culture: One of the challenges faced was to make the society risk-informed. The project handled this issue by awareness campaigns and education.

Topography: Accessibility to some areas was not easy. As a result, monitoring the quality of the house construction works was a challenge. There is a strong need for innovation in this area, such as the use of drones fitted with cameras.

## Additional Information

### Video Link

Disaster Management Authority, Lesotho. Building Back Better After Disaster. Facebook. https://m.facebook.com/story.php?story_fbid=pfbid02yZ9wfx1G6pFvdu6v5Rv7aytXew8kqKErsZzM3213qdELXZ6S2EzKHiN471XD542yl&id=100064702147413&sfnsn=wa&mibextid=RUbZ1f

# 16. Owner-Driven Housing Recovery: Post-Earthquake Intervention in Nepal

Country:

Nepal

Submitted by:

United Nations Development Programme (UNDP)

- Housing
- Post-Disaster
- Public Housing
- Owner Driven
- Vernacular

## Abstract

*In 2015, Nepal was struck by a massive earthquake of 7.8 magnitude with its epicentre in Gorkha district. Nearly 500,000 houses were destroyed, and more than 250,000 houses were partially damaged. Government of Nepal adopted owner-driven housing reconstruction (ODHR) approach for reconstruction and retrofitting of private houses destroyed or damaged by the earthquake. Socio-technical assistance was provided to the affected houseowners during the reconstruction process. A total of 26,912 resilient houses were built in the Gorkha district. A significant number of houses was constructed using local materials that created employment opportunities for local masons, and supported cost-effective and environment-friendly reconstruction. More than 6,800 masons were given hands-on training on reconstruction and retrofitting. The intervention benefitted approximately 124,000 million people.*

*The recovery aimed to reduce future vulnerabilities through improved and resilient shelter and infrastructure, enhanced knowledge about resilient reconstruction, retrofitting and socioeconomic empowerment of the community. Nepal's reconstruction approach is also acknowledged as being a successful model of inclusive recovery with a built-in mechanism to address the needs of most vulnerable people, in line with the principle of 'leave no one behind', a core principle of the SDGs.*

## Introduction to the Initiative

In 2015, Nepal was struck by a massive earthquake of 7.8 magnitude with its epicentre in Gorkha district, causing a large-scale destruction and damage to the buildings. Nearly 500,000 houses were destroyed and more than 250,000 houses were partially damaged.[21] Approximately 9,000 people lost their

[21]https://www.worldbank.org/content/dam/Worldbank/document/SAR/nepal/PDNA%20Volume%20A%20Final.pdf

lives and more than 22,000 people were injured. As a response to the disaster, the Government of Nepal initiated a housing recovery programme to bring normalcy to the lives of the affected people.

Nepal adopted the owner-driven housing reconstruction (ODHR) approach for reconstruction of private houses destroyed by the earthquake, under which socio-technical assistance was provided to the affected houseowners during the reconstruction process in partnership with various development partners. One of such programmes was the Nepal Housing Reconstruction Programme, financed by the Government of India (GoI), that supported rebuilding of 50,000 houses in two of the worst-affected districts, Gorkha and Nuwakot, through a grant of USD150 million to the Government of Nepal. The socio-technical assistance for the reconstruction programme in Gorkha was provided by the United Nations Development Programme (UNDP), with an additional grant of USD8.8 million from GoI, to support the reconstruction of 26,912 houses[22] as well as the repair/retrofit of 38 houses as technology demonstration. The outputs of the socio-technical assistance provided by UNDP were: 1) 26,912 resilient houses constructed; 2) 1,600 men and women trained as masons; 3) training manuals prepared for new, repaired and retrofitted houses, d) several master trainers and trained engineers, e) ODHR process documented and capacities enhanced for future reconstruction.

UNDP Nepal partnered with two district-based NGOs – Shree Swarna Integrated Community Development Centre (SSICDC) and Systems Development Service Centre (SDSC), Gorkha – to mobilize over 47 engineers, 18 social mobilizers and 86 master masons, under technical and handholding support of four collaborating institutions from India with experience in post-disaster housing reconstruction. In addition, UNDP partnered with the Microsoft Innovation Centre for real-time monitoring of reconstruction and management of reconstruction data of 26,912 houses.

## Impact of the Initiative

Under the programme, out of 26,912 resilient houses built across the earthquake-affected areas of Gorkha district, a significant number of houses were constructed using local materials and technologies that created employment opportunities for local masons, and supported cost-effective and environment-friendly reconstruction. Under the initiative, more than 6,800 masons were given hands-on training on reconstruction, including 500 on retrofitting. The use of local materials such as stone, mud and wood lowered the cost of construction and reduced considerable amount of $CO_2$ emission compared to brick and RCC[23] based construction. All the houses were made resilient to future disasters based on the principles of Build Back Better (BBB), which benefitted approximately 124,000 million people (26,912 buildings x 4.6 persons/household). The engagement of the beneficiaries under the owner-driven housing reconstruction approach and the provision of socio-technical facilitation support to the beneficiaries during reconstruction created a unique opportunity for them to think about long-term post disaster recovery beyond the engineering aspects of resilient housing only. A special feature of the programme was the focus on the vulnerable groups based on age, disability,

[22]Government of India partnered with UNDP to provide socio-technical facilitation to the affected house owners from 42 wards of 2 urban and 6 rural municipalities in Gorkha district, for housing reconstruction. The programme commenced from 8 March 2018. https://www.np.undp.org/content/nepal/en/home/projects/GHRP.html.

[23]https://neksap.org.np/uploaded/resources/Publications-and-Research/Reports/Annual%20Household%20Survey%202015_16_Major%20findings.pdf.

ethnicity and gender, and the development of a special package to support such groups to benefit from the reconstruction programme. Being cost-effective, built on local materials and resources, and locally owned, this model of housing reconstruction could be adapted in neighbouring countries and similar contexts with local adjustments.

## Process of the Initiative

**Main Stakeholders:** The main stakeholders of the housing recovery programme were Government of Nepal (GoN) including the local governments, development partners including other country governments, multilateral development banks and FIs, INGOS, the beneficiaries, NGOs, community groups, businesses and commercial entities. On behalf of the GoN, the National Reconstruction Authority (NRA), established in December 2015, led the entire earthquake recovery and reconstruction programme and provided strategic guidance on reconstruction priorities such as the need for repair and retrofitting of damaged houses.

**Detailed Damage Assessment:** A template was developed by the Government of Nepal to carry out Detailed Damage Assessment (DDA). The programme supported the collection of detail damage assessment data by deploying qualified assessors from selected municipalities of Gorkha district. The assessors were provided hands-on training on data collection techniques together with social mobilization and negotiation skills

**Box 1:**

**Orientation on Repair and Retrofitting of Damaged Buildings**


Orientation of the houseowners on Build Back Better (BBB) and buy-in by them are essential for improved building construction. The UNDP-facilitated programme on repair and retrofitting included the following during discussions with the houseowners:

- ➔ Damage categorization
- ➔ Repair and retrofitting process and its implementation
- ➔ Socioeconomic relevance of retrofitting of traditional buildings

The discussions were followed by a demonstration of retrofitting of damaged and non-compliant houses. The participants of the programme included AWS, engineers, sub-engineers, community facilitators, and team coordinators.

**Image 1:** Community Meetings

as well as an orientation on understanding the sensitivities of the vulnerable groups. In addition, a massive public outreach programme was launched to avoid confusion about data collection during the DDA process.

**Owner-Driven Housing Reconstruction Approach:** Under the ODHR approach, the reconstruction process proceeded with the beneficiaries placed at the centre of housing design and construction. Beneficiaries were allowed to make a choice about the typology of the house, use of local construction materials and resources, and to take key decisions related to construction management and finance. Previous experience of the ODHR approach was widely used in Nepal's reconstruction programme in collaboration with participating organizations. The GoI-funded housing reconstruction programme was managed by UNDP and UNOPS; the Government of Japan-funded reconstruction programme was managed by Japan International Cooperation Agency (JICA); the Multi-Donor Trust Fund (MDTF)-funded reconstruction programme was managed by the World Bank, etc. Under this approach socio-technical facilitation support was provided to the beneficiaries through deployment of trained social mobilizers, trained masons, carpenters, plumbers, electricians and local artisans. Additional financial support of USD500 was provided as a top-up grant to each vulnerable houseowner to complete the construction.

**Box 2:**

**Mobile Van Technology Clinic**

UNDP made extensive use of the Mobile Technology Clinic (MTC), an off-road vehicle with an Information, Education and Communication (IEC) system powered by solar power consisting of a TV, video camera, computer and audio system to disseminate information. These vehicles can also carry physical models on safe construction, posters, brochures and other IEC materials to conduct awareness campaigns at the community level.

**Image 2:** Communities participating in MTC campaigns
*Source: UNDP, Nepal*

**Water and Sanitation:** It was mandatory for the housing design under reconstruction to include the provision of structurally resilient toilets in each house, which was strictly followed up before releasing the final tranche of the reconstruction grant by the government. However, a new toilet was not necessary if the houseowner had a functional, undamaged toilet after the earthquake. While the grant to beneficiaries under the housing recovery programme was limited to support the construction of houses only, community infrastructure such as water supply was also built from the funding of development partners and the local governments.

**Funding:** As per the GoN's reconstruction policy, financial assistance of USD3000 was provided to each affected house owner to reconstruct a structurally safe house in compliance with seismic resilience standards. The grant of USD3000 was spread over three tranches linked to three distinct stages of reconstruction and was released upon verification of integration of earthquake safety features at each stage. An additional amount of USD500 was given as a top-up grant to vulnerable households. For those who did not have enough funds to complete the reconstruction, there was provision for a concessional loan facility up to USD3000 with a repayment term of five years at five percent interest rate under the Integrated Working Procedure for Subsidized Credit.

**Revolving Fund:** After the 2015 earthquake, in some areas, a revolving fund scheme was developed and implemented by the local

**Box 3:**

**Masons' Training**


UNDP delivered extensive training for masons to upskill them for earthquake resilient construction. Over 6,800 local masons were trained on resilient construction practices, including new technologies like retrofitting.

**Image 3:** Training of Masons
*Source: UNDP, Nepal*

governments to help the house-owners avail short-term, interest-free loans to ensure that reconstruction works were uninterrupted. This provision was helpful in maintaining continuity in the reconstruction activities considering potential delays in the timely release of the government grant. It supported vulnerable households through short-term loans of specific amounts, which was reimbursed by the house-owners as soon as the tranches were released to their bank accounts. This allowed the fund to be used by other needy houseowners. This concept, first introduced by UNDP, was rolled out in Gorkha and successfully practiced in some of other earthquake-affected areas in Nepal.

**Capacity Building:** UNDP and other partners leveraged work experience of at least a decade prior to the earthquake in developing the training curriculum, identifying materials for safe construction as well as training of engineers and masons. The Gorkha housing reconstruction programme significantly contributed to capacity building of the houseowners, the community, the local governments and others. A total of 6800 masons, carpenters, plumbers and electricians were trained to support resilient reconstruction and retrofitting works of the affected households through the GOI-funded and UNDP-managed Gorkha housing programme. UNDP provided a special information kit named 'Gyan Jhola' (Wisdom bag) to all field staff involved in housing reconstruction. The bag contained government guidelines and procedures, educational materials on the technical aspect of the housing reconstruction, and the contact details of local officials. It further enhanced socio-technical facilitation services for the houseowners. Reconstruction in Nepal also prominently involved women – as masons, engineers and social mobilizers – thus providing them a scope for employment, training and income generation.

## Design and Technology

**Design:** Housing designs were based on modern and traditional materials. The government authorities collaborated with partnering organizations and young professionals to develop design catalogues[24] that included building designs and technologies to facilitate housing reconstruction after the 2015 Nepal earthquake. The recovery strongly promoted traditional construction based on local culture, local architecture, local materials and labour. The programme encouraged the use of affordable, green designs and technologies, which were cost-effective, generating local income, and had low embodied energy and GHG emission intensity – and above all were thermally comfortable. The affected households were encouraged to choose a design from the catalogues which would suit them.

**Technologies (new buildings):** Reconstruction was based on technologies that enabled expedited construction of cost-effective, resilient buildings. While field-based study helped to identify the most appropriate technology for reconstruction based on the surrounding environment and available resources through community-level consultations, the decision was dependent on resources that the houseowners were able to mobilize beyond the housing grant, as the reconstruction was owner-driven.

**Repair and retrofitting:** Initially, the homeowners, builders, policymakers, engineers and architects were not familiar with the process and benefits of retrofitting. They lacked confidence in the overall safety of a retrofitted house. To make retrofitting acceptable to the people, Nepal adopted the following guidelines: a) minimal structural and architectural interventions; b) minimal cost of the intervention; c) minimum downtime, and d) a few tips provided for improving seismic safety of

[24]Design Catalogue for Reconstruction of Earthquake Resistant Houses Volume II, https://dudbc.gov.np/content/2426/2426-design-catalogue-for-reconstru/.

**Box 4:**

**Containment Reinforcement (CR) Technology**

CR technology was developed to reconstruct stonemasonry houses after the 2015 Nepal earthquake to maximize the use of local materials, reduce the construction cost, and simplify earthquake-resilient technology for masonry buildings. The design followed the prevailing architectural form of the earthquake-affected area to reflect the local culture. It utilized welded wire mesh and galvanized wires to reinforce walls and wires to tie building elements to improve the 'box effect'. The technology was easy to understand and implement, sensitive to quality control, and errors were easy to fix. Shock table texts were conducted to verify compliance of the technology with the Nepal Building Code. They showed satisfactory results.

*Source: UNDP, Nepal*

buildings by simple retrofitting measures. Retrofitting was suggested for buildings based on modern as well as traditional technologies, but financial support from the government was limited to USD38 housing units were selected for retrofitting. These units served as sites for hands-on-training of masons on retrofitting techniques, which were fully retrofitted during the training, serving as demonstration sites for others. [25]Most of the damaged masonry buildings that were repaired and retrofitted adopted splint and bandage construction and containment wires as the technique was structurally sound, economical and retained the traditional character of buildings.

Socio-technical facilitation support was provided to the affected people by a group of personnel trained in technical and social skills related to housing reconstruction. The main purpose of the support was to ensure that resilient housing features were introduced in reconstruction and retrofitting in a cost-effective manner. The main features of the support were: a) providing access to the information on different kinds of financial and technical assistance available for reconstruction, repair and retrofitting and making people aware of their entitlements, rights and responsibilities; b) bridging the knowledge gap between the disaster-affected people, authorities, banks and other financial institutions (BFIs) about housing reconstruction and the compliance procedures; c) supporting house-owners in housing reconstruction; and d) supporting house-owners in meeting the compliance requirements; and e) addressing their grievances.

Despite having appropriate criteria for the identification of vulnerable households after the 2015 earthquake, the disparities in terms of coverage and inclusion posed significant implementation challenges. The inclusion of local governments, community members, and community-based organizations (CBOs) in the process helped to identify vulnerable households. UNDP had helped over 2,500 vulnerable households through social mobilization and appropriate building technology to ensure that they were not left behind.

## Lessons Learned

The implementation of the reconstruction and

[25]https://www.scribd.com/document/594830238/Ready-to-Use-Manuals-for-Repair-and-Retroftting-of-Masonry-Structures.

retrofitting programme using the ODHR approach threw up several challenges. The main challenges encountered were: a) beneficiaries considered the approach as an additional burden as it required their close engagement; b) beneficiaries had very little knowledge about technical requirements and the process of safe reconstruction/retrofitting and, c) vulnerable families were unable to participate in the reconstruction activities due to complicated compliance requirements to receive the housing grants. Several lessons were learned while resolving these issues.

Working closely with the affected houseowners, together with a package of financial solution and socio-technical support provided at the doorstep at each stage of reconstruction, resolved many of the problems. The provision of a special financial instrument as a top-up grant beyond the socio-technical support and the mechanism of the revolving fund addressed the concerns of vulnerable houseowners and mitigated the financing gap. Despite the socio-technical support provided to the individual homeowner identified as the beneficiary, the approach invited community ownership and shared

**Box 5:**

**Support to Vulnerable Households**

Vulnerable households generally require extra support to overcome hurdles such as administrative procedures to reconstruct their houses. Community consultation and door-to-door visits by the field team led to the identification of Bishnumaya Sarki in Padelithok, Gorkha Municipality Ward 5. She had been living in a temporary shelter after her house collapsed during the 2015 Gorkha earthquake, being unable to rebuild her house due to her financial situation and her social background. Bishnumaya, a 57-year-old woman living alone, survived on handouts from passers-by near the Gorkha Palace area, a site popular with visitors.

After a couple of visits, and by engaging ward members in assuring Bishnumaya of their support to initiate her house reconstruction, the project team facilitated reconstruction of her house with two rooms. The project team also contributed their labour support in excavation and other masonry works until plinth level, and continued providing all required assistance and guidance including administrative, technical, and social support. It continued its coordination with the ward office for local guardianship and as a morale-booster to Bishnumaya. The house was completed in three months and Bishnumaya was relieved to move into her new home.

**Image 4:** Ward Chair attending Bishnumaya Sarki's housewarming event
*Source: UNDP, Nepal*

accountability, which was important for the success of the programme.

The other challenge was inaccessibility due to a lack of motorable roads to the affected areas, which resulted in a higher transportation cost of construction materials such as sand, cement and steel, which required transporting from outside. However, the ODHR approach aimed to make use of local construction materials to the extent possible to reduce the cost of construction, which was supported by government policy. Typologies of buildings permitted under the reconstruction programme were not only those using modern technology like reinforced cement concrete (RCC), but also those using traditional technology such as stonemasonry. The latter was included in the design catalogue approved by the government after extensive structural calculations. Nepal's building codes further supports using local

**Box 7:**

**Man Kumari Gurung's Journey to a Newly Constructed House with Support of the Awas Nirman Saathi**

Man Kumari Gurung, an inhabitant of Gorkha Municipality 5, Rohatepani, has two children and is the head of her family as her husband is working abroad. She had been staying in a temporary shelter made of CGI sheets for the past three years until she met Gobinda Shrestha, Awas Nirman Sathi (ANS) of the Nepal Housing Reconstruction Project, Gorkha. Awas Nirman Saathi are the trained masons with good social skills who were deployed by the project to provide door-to-door support. Man Kumari Gurung did not know about her inclusion in the government's beneficiary list and unaware of the procedure to sign the participation agreement to access the government's reconstruction support. When informed by the Awas Nirman Saathi that she was enlisted, she was overwhelmed and relieved.

Within a few days, she was assisted by the ANS, who linked her with the ward office to start off the agreement process. After completing the required procedures in a week, she was registered and was provided with the participation agreement as a beneficiary to start the house reconstruction. Since the land where her house was damaged was inadequate, she decided to relocate herself to Barpak where she had some ancestral land. After receiving the first tranche, she instantly commenced reconstruction in dry-stone masonry by hiring local trained masons and under continuous guidance from the project team.

As her house reconstruction progressed, she continued receiving tranches till it was finally completed in September 2018. She has also received the final tranche and the overall process took 77 days. Man Kumari shared her satisfaction with the team and said, “It's like a dream to me that I am now back in a house of my own. It is like a miracle, how the ANS approached me and guided me through the process to be able to construct my house.”

**Image 5:** Man Kumari Gurung holding her participation agreement book that ensures reconstruction support
*Source: UNDP, Nepal*

construction materials in building construction. Therefore, under the ODHR approach, there was an emphasis on extensive use of local construction materials, which were easy to transport to the site at low cost.

The extensive learning gained from the ODHR approach builds a strong foundation for a system of affordable housing reconstruction managed by the community, which can be replicated in other areas to respond to future post-disaster housing recovery needs. Capacities built at the local level to prepare a network of trained human resources, the process of documentation about community empowerment and partnership, the provision of instruments used to address the issues of vulnerable houseowners and avoid the financing gap during reconstruction, and the flexibility to innovate building designs and construction technologies are important elements of a sustainable reconstruction system. It is essential to reinforce the collective experience and professional and personal networks built up by the beneficiaries from this initiative, which constitutes a repository of knowledge and memory that is available in the future. This will also motivate them to sustain their interest in disaster risk reduction and management.

As a positive economic impact, the investment for post-earthquake recovery made in Gorkha district encompassing 124,000 million people (26,912 x 4.6 persons/household) contributed to raising their standard of living from the pre-disaster level and ensured safety against future hazards.

An important learning from the reconstruction programme in Gorkha was that under the ODHR approach, people generally adopted RCC and brick-masonry building construction, replacing the traditional architecture. This largely changed the housing landscape of the place without preserving the traditional aesthetic character. This is a common phenomenon in Nepal's urban and semi-urban regions where new houses are built. Therefore, there is a need of appropriate policy guidance for new house construction encouraging the use of traditional architecture.

## Way Forward

Nepal viewed the post-earthquake recovery effort as an opportunity for promoting a sustainable and resilient community beyond the structural safety of houses. It aimed to reduce future vulnerabilities through improved and resilient shelter and infrastructure, enhanced knowledge about resilient reconstruction, retrofitting and recovery, and socio-economic empowerment of the community. Simultaneously, it built connections to long-term community development goals such as improved livelihoods and enhanced quality of life and socioeconomic well-being rather than merely rebuilding a resilient house. Nepal's reconstruction approach is also acknowledged as being a successful model of inclusive recovery with a built-in mechanism to address the needs of most vulnerable people, in line with the principle of 'leave no one behind', a core principle of the Sustainable Development Goals (SDGs).

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# 17. Policy Framework for Post-Disaster Housing Recovery – The Experience of Rio Grande do Sul in 2024

Country:

Brazil

Submitted by:

National Secretariat for Civil Protection and Defense, Ministry of Integration and Regional Development, Brazil

- Housing
- Post-Disaster
- Public Housing
- Enablers

## Abstract

*The Ministry of Integration and Regional Development of the Government of Brazil launched a rapid humanitarian programme called 'Reconstruction Aid' after the devastating floods of May 2024 in the state of Rio Grande do Sul in southern Brazil. The state experienced extreme rainfall of more than 400mm in 72 hours due to which more than 15000 homes were destroyed. The programme is implemented through initiatives in digital governance and social protection and direct cash transfers to affected families. The initiative supported resilient owner-driven reconstruction through specially established engineering guidelines, reducing the number of homes in risk-prone areas through relocation and construction of other community infrastructure resilient to disaster risks. Through consolidating public policies that combine social protection and resilient urban planning, Brazil is advancing towards building a post-disaster housing approach that protects lives and reduces inequalities.*

## Introduction to the Initiative

In May 2024, the state of Rio Grande do Sul, in southern Brazil, experienced extreme and prolonged rainfall, with some areas recording more than 400 mm in just 72 hours. This led to historic river floods and inundations, affecting the homes of around 430,000 families and destroying more than 15,000 houses.

In response to the floods and the major impact on housing and public infrastructure, the Ministry of Integration and Regional Development (MIDR), in coordination with other actors at the Federal, state, and municipal levels, adopted a set of emergency measures. Among them, the government launched the rapid humanitarian programme 'Reconstruction Aid', aimed at providing immediate financial assistance to affected families. The programme strengthened public trust and institutional coordination, serving as an example of how social protection and digital governance can work together to improve disaster

**Image 1:** Flood impact captured in Rio Grande do Sul, Brazil

management outcomes. Its focus was on restoring minimum living conditions through a direct cash transfer of BRL5,100 per affected family as emergency support.

Regarding resilient infrastructure, the Government of Brazil emphasizes the mandatory application of Brazilian Technical Standards (ABNT/NBR) in permanent housing programmes, as a central guideline of its housing policy. These standards set requirements, performance criteria and minimum parameters for design, execution, materials and building systems. They are mandatory references for both public and private construction works, aimed at ensuring structural safety, durability and building quality.

Finally, the post-disaster housing policy adopts a phased approach, incorporating proper land-use planning and the construction of resilient housing, with the purpose of reducing risks, minimizing damages and losses, and strengthening community resilience.

## Process and Impact of the Initiative

The following actions are under way to operationalize the policy framework:

**Construction techniques for resilience:** In Brazil, self-construction is a common practice, especially in peripheral areas, often resulting in fragile houses built without technical criteria and highly vulnerable to adverse events, even of lower magnitude. Compliance with technical standards aims to reverse this situation by ensuring minimum safety, durability and performance standards in new constructions. By establishing engineering design guidelines, the policy promotes disaster risk reduction, strengthens community resilience, and transforms housing into a vector of safety, dignity and sustainable development.

**Relocation of existing housing:** In addition to rebuilding houses that were definitively destroyed or severely damaged in new safe areas, the policy also promotes the relocation of houses adjacent to disaster-affected areas, thereby reducing the number of homes in risk-prone zones.

**Vacated areas:** In areas where homes have been relocated, guidelines establish the development of low-cost public infrastructure and environmental systems, such as community facilities and linear parks, to prevent these areas from being reoccupied.

**Resilient public infrastructure:** Beyond housing, the policy also addresses the reconstruction of destroyed public infrastructure in a resilient manner, incorporating the principles of Build Back Better (BBB) and considering the impacts of climate change. For bridges, for instance, studies conducted by the Hydraulic Research Institute of the Federal University of Rio Grande do Sul recommend that reconstruction projects include hydraulic design calculations based on updated hydrological patterns. These analyses consider extreme events in recent time series and project future increases in water flow linked to climate change. This preventive approach ensures that such structures withstand future extreme events, avoiding critical disruptions to mobility and logistics while reducing recurring reconstruction costs and population impacts.

**New approaches to post-disaster housing demand:** The Federal Government, through the National Secretariat for Housing in partnership


**Image 2:** Minha Casa, Minha Vida housing programme site, Government of Brazil

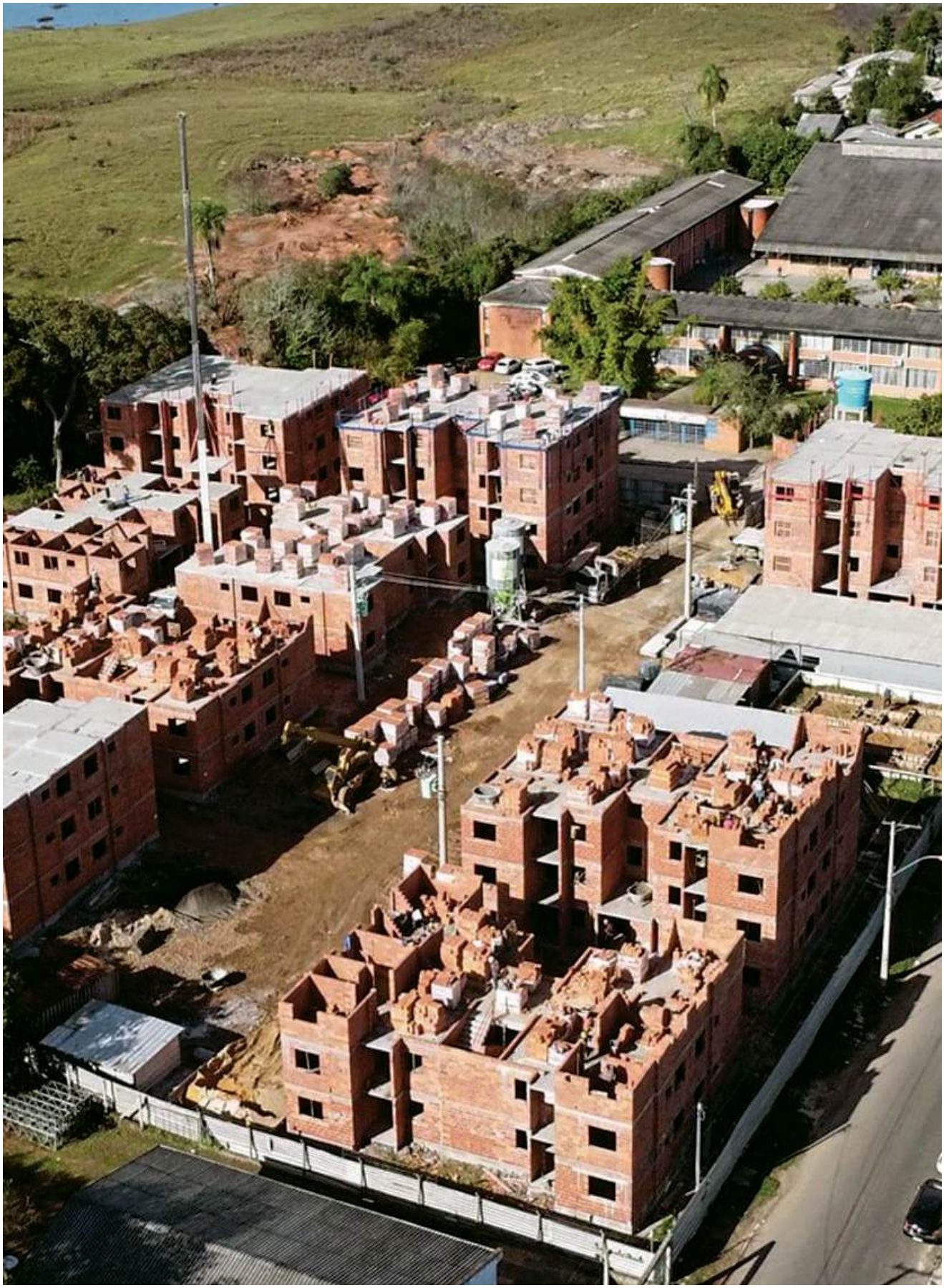

**Image 3:** Minha Casa, Minha Vida housing programme site, Government of Brazil

with the National Secretariat for Civil Protection and Defense, has introduced new housing supply strategies to address the demand created by destroyed homes in Rio Grande do Sul. Previously, the supply of housing units destroyed or permanently interdicted due to disasters was typically carried out through direct transfers of funds to municipalities. While consolidated, this model often faced challenges such as limited local technical capacity to develop projects and complete necessary procedures, or a lack of suitable land in safe areas. As a result, new programmes were made available to facilitate housing access, including the direct acquisition of new or used properties available on the market. Diversifying housing supply models has contributed to faster responses to affected families, thereby reducing the duration of their exposure to temporary shelters.

## Way Forward

The Ministry of Integration and Regional Development (MIDR) is committed to consolidating and expanding the Post-Disaster Housing Recovery Strategy as a structural public policy, aligned with broader initiatives on climate adaptation, social inclusion and territorial resilience. This approach is fully in line with Brazil's commitments under the Sendai Framework for Disaster Risk Reduction, the Paris Agreement on Climate Change, and the principles established by the G20 Disaster Risk Reduction Working Group (DRRWG).

The policy can serve as a climate-adaptive social protection reference, especially in the Global South, where challenges of vulnerability, urban informality and extreme climate events are intensifying.

The main strategic priorities going forward include:

- **Development of innovative and sustainable housing solutions:** A pilot project is under way to produce prefabricated houses for post-disaster contexts, suitable for both temporary and permanent use. These units are built with sustainable materials adapted to local climate conditions and comply with Brazilian Technical Standards (ABNT/NBR).
- **Integration of resilience into the 'Minha Casa, Minha Vida' (MCMV) program:** The post-disaster housing recovery policy has been incorporated into MCMV guidelines, prioritizing families at risk, displaced by disasters, or in social vulnerability. Special attention is given to households headed by women, the elderly, persons with disabilities, and low-income populations. The new housing units are planned in safe areas with adequate infrastructure, in full compliance with ABNT standards.
- **Strengthening scalable financial and digital mechanisms:** The Reconstruction Aid programme demonstrated the critical role of rapid emergency cash transfers in restoring minimum living conditions. The MIDR will continue investing in interoperable digital solutions to improve efficiency, shorten waiting times for affected families and reduce prolonged reliance on temporary shelters. These mechanisms will be further refined and integrated into social protection and risk management platforms.
- **Resilient territorial and land-use planning:** The policy remains committed to relocating families to safe areas, coupled with strategies for sustainable land use, environmental recovery and the development of public facilities. Vacated areas are converted into collective-use spaces, such as linear parks, reducing reoccupation risks and generating socio-environmental benefits.

As extreme climate events intensify, it becomes urgent to consolidate public policies that combine quality reconstruction, social protection and resilient urban planning. Brazil is thus advancing in building a post-disaster housing policy that protects lives, reduces inequalities and anticipates the challenges of the climate crisis, leaving no one behind.

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# 18. Mozambique Recovery Facility: Enhancing Disaster Resilience in Housing and Community Infrastructure Post-Cyclone Idai

Country:

Mozambique

Submitted by:

United Nations Development Programme (UNDP)

- Housing
- Post-Disaster
- Public Housing
- Owner Driven
- Retrofits
- Vernacular

## Abstract

*The Mozambique Recovery Facility (MRF) covered economically disadvantaged populations severely affected by Cyclone Idai in 2019. MRF was an owner-driven housing construction initiative focusing on reconstruction and retrofitting of houses with resilient design and techniques. MRF facilitated skill development of the communities and youth through training and employment. The initiative included retrofitting of existing damaged homes, constructed new disaster-resilient houses using climate-adapted designs and materials, and promoted inclusive approaches involving women and vulnerable groups.*

*Under MRF, 1,113 resilient houses were constructed based on local materials to withstand repeated cyclones. The youth and women were trained to produce construction materials such as blocks. The intervention promoted labor-intensive, cost-effective and environmentally friendly technologies. The initiative reduced the vulnerability of many households to recent flooding and cyclones, strengthened local capacity in resilient housing construction, and contributed to social and economic resilience in the affected communities.*

## Introduction to the Initiative

The Mozambique Recovery Facility (MRF) works collaboratively with a wide network of partners to carry out its recovery and reconstruction initiatives. These partners include the Government of Mozambique, especially through local government structures and the Reconstruction Cabinet (Gabinete de Reconstrução Pós-Ciclones, GREPOC), which leads coordination and ensures quality assurance alongside United Nations agencies such as WFP, ILO, and UN Women, who help integrate gender inclusion and complementary roles in programming. MRF also partners with 23 NGOs, civil society organizations (CSOs) and community-based organizations (CBOs) to implement housing self-construction, support livelihoods and foster community engagement. Academic

institutions contribute through technical supervision and project support from professors and interns. The private sector – including commercial associations, construction companies, and trader groups – plays a role in training, capacity building, material provision and civil works implementation. Additionally, local communities and associations, such as farmers' groups and small enterprises, are actively involved in supplying locally sourced construction materials, supporting livelihood interventions and organizing savings groups.

This multi-stakeholder partnership ensures an integrated approach combining governmental leadership, UN expertise, civil society mobilization and community ownership for sustainable recovery, and aims to enhance disaster resilience of the cyclone-affected communities through livelihood, housing and community infrastructure, targeting the most vulnerable disaster-affected communities.

The owner-driven housing construction initiative focuses on reconstruction and retrofitting of houses with resilient design and techniques while facilitating the skills development of the communities and youth through skill trainings and employment. This programme has improved community resilience and reduced vulnerability, showcasing scalable approaches in post-disaster recovery and resilient infrastructure development in flood and cyclone prone regions.

## Process and Impact of the Initiative

**Target Group:** The housing intervention covered economically disadvantaged populations in Mozambique, especially those severely affected by Cyclone Idai in 2019.

**Background:** Mozambique has endured a series

**Image 1:** Training of artisans on resilient rehabilitation, Manga neighbourhood

**Image 2:** House built in the Mandruzi neighbourhood after Cyclone Idai, that withstood subsequent cyclones

of interconnected crises, starting with the devastating Cyclones Idai and Kenneth in 2019, which underscored the vulnerability of housing and infrastructure to extreme weather. These events were compounded by Cyclone Freddy in 2023, the global COVID-19 pandemic, and persistent violent conflict in the Cabo Delgado province. Collectively, these challenges have impacted more than 1.8 million people and displaced over 1 million due to ongoing insecurity. In response, the United Nations Development Programme (UNDP), in partnership with the Government of Mozambique, established the Mozambique Recovery Facility (MRF), a multi-donor initiative focused on 19 districts across Sofala, Zambezia and Cabo Delgado. This programme emphasizes the urgent need for resilient reconstruction to mitigate future disaster risks.

**Implementation:** UNDP Mozambique coordinated with government agencies, local communities and international partners to implement resilient housing reconstruction. This involved community consultations, capacity building for engineers and local builders in resilient techniques, and distribution of construction materials adhering to updated resilient building codes. The local community played a central role in leading the housing initiative from planning to completion through active involvement in beneficiary selection and construction activities. The selection process was conducted using a grassroots '10-house leadership' system, where groups of 10 houses recommended the most vulnerable and affected families based on clear criteria. This approach helped prevent local power struggles and fostered community ownership. Beneficiaries

**Image 3:** Women beneficiaries involved in producing construction blocks after receiving technical training

also contributed unskilled labour to the civil works, promoting shared responsibility and active participation. Social mobilization efforts raised awareness, motivated participation, and ensured transparency throughout the project. Collaboration with community-based organizations (CBOs) and NGOs further supported social mobilization, project management and coordination with local leaders.

In addition to community engagement, the initiative involved local leadership and government structures to provide legitimacy and support coordination. For example, the self-organized '10 houses' groups were regrouped into 40 houses. The group leads form a committee to coordinate with the local government leadership. This ensured a bilateral strong bond between community, local authorities and project executives. The project interventions were guided by the community at the '10 houses' level and coordinated upwards to the local authorities. In addition to the self-construction of houses, this organizational structure also coordinated and monitored the capacity-building efforts and trained local artisans and youth engineers in resilient construction techniques, ensuring quality standards and enhancing local skills. The allocation of land use rights (Direito de Uso e Aproveitamento da Terra, DUAT) to beneficiary families in resettlement areas empowered them with legal land ownership, reinforcing long-term tenure security and community commitment to the housing.

A total of 1,113 resilient houses were constructed in line with the Post-Cyclone Housing Reconstruction Strategy's (PALPOC) recommendations, effectively withstanding repeated cyclones without sustaining minor

damage. These houses utilized local materials, with youth and women trained to produce construction materials such as hollow concrete blocks, promoting labour-intensive, cost-effective and environmentally friendly technologies. The resilient construction fully mainstreamed the Build Back Better (BBB) principles, incorporating rainwater harvesting systems and sanitation units (latrines). Alongside plot demarcation on land provided by the government, the project supported beneficiaries, mostly women, in obtaining land ownership documents, a process typically lengthy and costly in Mozambique. This comprehensive, community-centred approach ensured strong ownership, minimized conflicts and promoted sustainable and resilient reconstruction.

The initiative also included retrofitting existing damaged homes, constructing new disaster-resilient houses using climate-adapted designs and materials, developing technical guidelines and promoting inclusive approaches involving women and vulnerable groups.

**Impact:** The initiative reduced the vulnerability of thousands of households to recent flooding and cyclones, strengthened local capacity in resilient housing construction and contributed to social and economic resilience in affected communities. The UNDP's successful model approach of housing reconstruction was adopted by the government (GREPOC) and other development institutions (the World Bank) active in the reconstruction of houses.

## Lessons Learned

**Challenges Faced in Housing Reconstruction:** MRF encountered several structural and operational challenges in its mission to rebuild resilient housing and community infrastructure following Cyclones Idai and Kenneth. One major obstacle was the absence of comprehensive government policies and technical guidelines for resilient housing, which created uncertainty and inconsistency in reconstruction efforts. Additionally, there was an initial shortage of skilled labour, particularly artisans and engineers trained in climate-resilient construction techniques. Community engagement posed its own difficulties, as local power dynamics and trust deficits hindered inclusive participation. On the logistical front, limited availability of construction materials, compounded by recurring natural disasters, disrupted supply chains and delayed progress.

**Mitigation Strategies Implemented:** To overcome these challenges, MRF adopted a multi-pronged strategy. A key milestone was the development of resilient house construction guidelines (PALPOC), which provided standardized technical specifications for resilient housing reconstruction. This was complemented by demonstration projects showcasing retrofitting techniques and training modules tailored for local conditions. The programme also launched capacity-building initiatives targeting local craftsmen, engineers and vocational trainees, often in collaboration with institutions like vocational training institute (Instituto de Formacao Profissional, IFPELAC) and universities.

To ensure effective implementation, MRF developed operational guidelines that clarified roles and responsibilities among stakeholders. Civil society organizations (CSOs) and community-based organizations (CBOs) were actively engaged in community mobilization, while adaptive engagement strategies helped navigate local sensitivities. Funding was bolstered through multi-donor partnerships, and local sourcing of materials was prioritized to reduce costs and improve sustainability.

**Co-Benefits Achieved:** The recovery efforts yielded a range of social and economic co-benefits. Notably, 60 percent of housing

**Image 4:** A group of houses built for families displaced by Cyclone Idai in the Mutua neighbourhood[26]

beneficiaries were women-headed households, reflecting a strong gender-inclusive approach. Women were also empowered to take on construction roles, breaking traditional barriers and enhancing their economic agency. Training programmes not only supported housing reconstruction but also generated livelihoods, improving community resilience and self-reliance. The use of locally sourced materials and community-led construction enhanced technical capacity and awareness of disaster risk reduction (DRR). These efforts significantly boosted employability, especially among women, who emerged as skilled labourers in the reconstruction sector.

**Scalability of the MRF Approach:** The integrated approach developed under MRF is highly scalable. Its success in Mozambique demonstrates potential for replication in other cyclone- and flood-prone regions, both within the country and across neighbouring nations. The institutionalization of resilient building codes,

[26]This neighbourhood initially sheltered more than 600 families who lived in tents and buildings made of wood and plastered with adobe (clay). In addition to the construction of resilient houses, they benefited from a market, livelihood facilities, a community centre, and a school, also built from scratch.

combined with standardized training modules, provides a robust framework for expansion. By embedding resilience into policy and practice, the MRF model offers a blueprint for sustainable and inclusive recovery in disaster-affected contexts.

## Way Forward

**Scaling and Replication of Recovery Initiatives:** The reconstruction of resilient homes across Mozambique offers valuable lessons for scaling up successful practices. By documenting community-led solutions and best practices from the Mozambique Recovery Facility, policymakers can support replication in other provinces through knowledge exchanges and technical cooperation. Multi-donor partnerships are also vital for expanding access to funding, enabling reconstruction programmes to reach broader populations while maintaining high standards of safety and resilience.

**Strengthening Policy Integration of Resilient Housing Standards:** To ensure that rebuilt homes can withstand future hazards, resilience must be embedded within national housing policies and construction guidelines. The adoption of Build Back Better (BBB) principles should inform updated building codes and urban planning regulations. Technical standards should be clearly communicated and enforced, while communities must be encouraged to lead the design of housing that reflects their local preferences and environmental conditions. This policy integration is key to institutionalizing resilient reconstruction practices across the country.

**Enhancing Disaster Risk Financing:** Strengthening financial support mechanisms is essential for advancing resilient housing reconstruction. This includes expanding access to disaster recovery funding and insurance for affected households, particularly those rebuilding homes.

**Expanding Community-Led Resilient Housing Initiatives:** Local communities must be at the heart of housing reconstruction efforts. Empowering community-based organizations (CBOs) to lead housing projects enhances accountability and ensures that homes are designed and built to meet actual needs. Providing technical assistance and financing to community initiatives promotes the construction of climate-adaptive, durable housing. Gender-responsive programming is particularly important, allowing women to play active roles in shaping housing design, implementation and governance, thereby contributing to more equitable and inclusive recovery outcomes.

## Additional Information

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# 19. Roch Valley Neighbourhood Flood and Climate Resilience Programme (Resilient Roch)

Country:

United Kingdom

Submitted by:

Foreign, Commonwealth & Development Office (FCDO), Government of United Kingdom

- Housing
- Enablers


## Abstract

*The Roch Valley Neighbourhood Flood and Climate Resilience Programme is an initiative in an economically and socially disadvantaged area in northwestern England, with a history of significant flooding, increasingly intensified by climate change. The project integrates housing, flood risk management and community engagement to improve climate resilience in disadvantaged areas. It aims to address both the physical and social dimensions of risk through holistic, community-focused interventions. The interventions are designed to mitigate immediate risks as well as to deliver long-term benefits for residents' well-being, financial security and environmental sustainability. The project has aligned various funding streams and housing renewal objectives to maximize improvements in the housing stock.*

*Aspects of the project established a valuable evidence base to inform future interventions and policy development. The project has demonstrated that government integration could make interventions feasible and cost-effective and there are opportunities for both local government and the insurance industry to work collaboratively on flood risk issues in vulnerable communities.*


## Introduction to the Initiative

The Resilient Roch project in northwestern England is delivered by Rochdale Borough Council in partnership with the National Flood Forum and Environment Agency under the Flood and Coastal Resilience Innovation Programme. The project integrates housing, flood risk management, and community engagement to improve climate resilience in disadvantaged areas.

By piloting a coordinated approach to housing surveys, flood risk planning, and neighbourhood resilience, the initiative has improved efficiency, supported sustainable housing upgrades, and strengthened community preparedness. This is a good practice in cross-sector collaboration, innovative governance, and

risk-informed investment, offering lessons for flood-prone, deprived communities globally. By examining these diverse initiatives, this good practice aims to highlight the complexities, successes and ongoing challenges in making the housing sector resilient in the UK. The projected budget is USD8.67 million.

## Impact of the Initiative

The Roch Valley Neighbourhood Flood and Climate Resilience Programme – Resilient Roch – is a targeted investment initiative situated in an economically and socially disadvantaged area in northwestern England. This area has a longstanding history of significant flooding, a challenge increasingly intensified by climate change and rising surface water run-off due to urbanization. While traditional flood defences remain essential, bringing significant mitigation benefits, the level of protection they provide is limited, leaving many communities exposed to residual flood risks.

Exacerbating these challenges, some of Rochdale's housing stock includes a substantial number of Victorian and Edwardian terraced properties, many of which are in poor condition. These homes often suffer from low energy efficiency and are particularly vulnerable to flooding, compounding the risks faced by residents.

Recognising the complex and interconnected nature of vulnerability – particularly in areas where flood risk intersects with other forms of deprivation such as fuel poverty and substandard

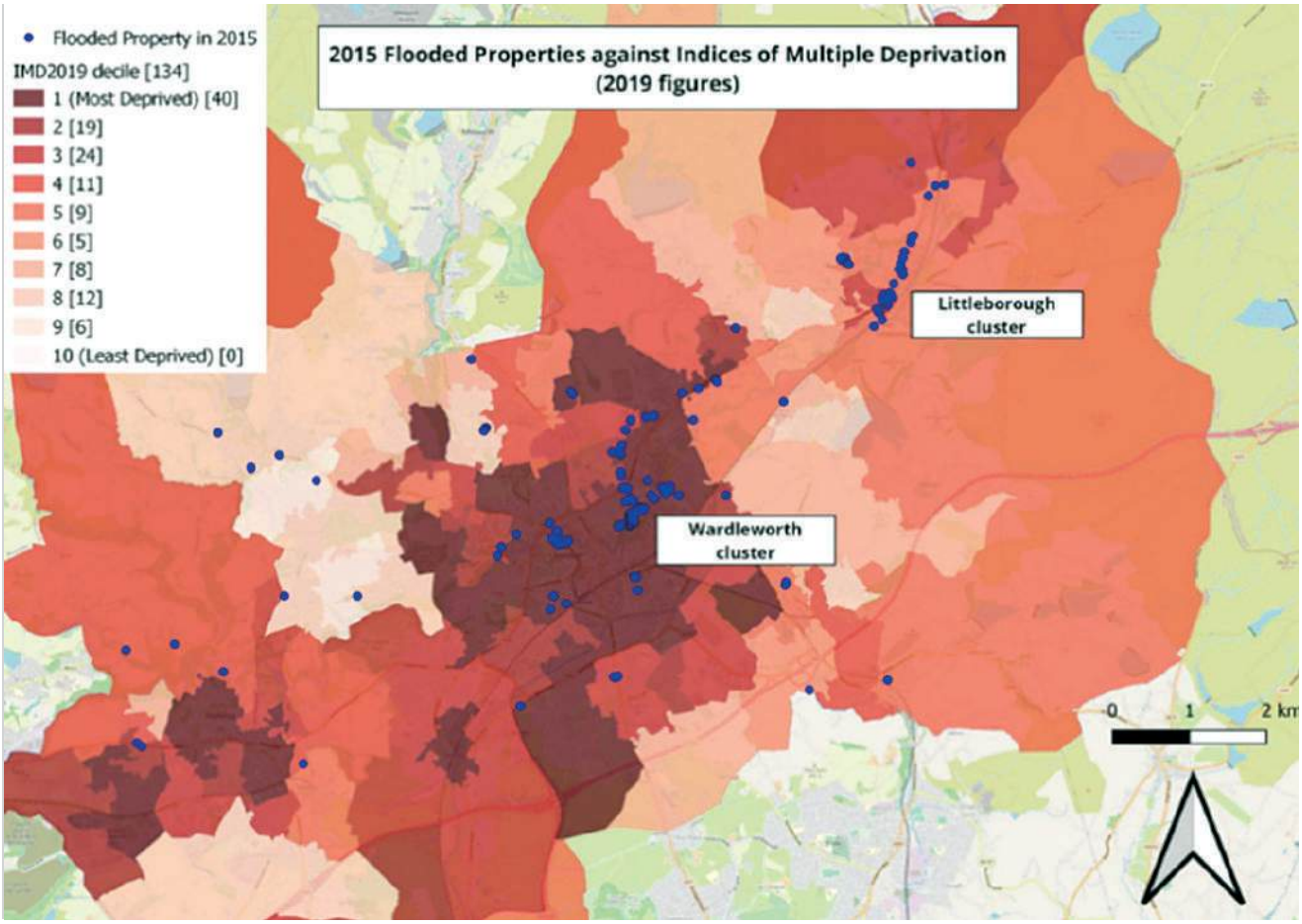


**Image 1:** Flooded properties against indices of multiple deprivation (2019 figures)
*Source: Rochdale Borough Council*

housing – the programme was conceived as a pioneering, integrated approach to resilience. It aims to address both the physical and social dimensions of risk through holistic, community-focused interventions.

The inspiration behind Resilient Roch stemmed from the recognition that these interconnected issues could not be addressed in isolation. By combining property flood resilience measures with energy efficiency upgrades, the programme aims to create sustainable, future-ready homes that are better equipped to withstand the impacts of climate change. Interventions are designed not only to mitigate immediate risks but also to deliver long-term benefits for residents' well-being, financial security and environmental sustainability.

As part of the UK Government's Flood and Coastal Resilience Innovation Programme (FCRIP), Resilient Roch serves as a testbed for innovative, cross-sectoral approaches to flood risk management. It advances whole-of-society and whole-of-property resilience by embedding strategies across housing, environment and community engagement teams within Rochdale Borough Council, and through partnerships with organizations such as the Environment Agency and the National Flood Forum.

The Project has three core objectives:

**Integrated, holistic and embedded strategies for local flood resilience**

Advancing place-based resilience through coordinated, system-wide approaches, tailored to local contexts and embedded within communities.

**Residual risk frameworks for adaptive climate measures**

Developing a framework to assess and manage residual risks, enabling adaptation strategies that take account of local circumstances and evolve over time.

**Testing innovative property flood resilience and climate adaptation interventions**

Piloting innovative policy and practice approaches for property-level flood resilience and climate adaptation, leveraging tools such as housing strategies and identifying a role for the local housing authority in delivering enhanced climate resilience through standards and regeneration.

## Key features of the Resilient Roch Project

**Residual Risk Frameworks:** Developing adaptive frameworks to assess and manage residual flood risks, tailored to local contexts and capable of evolving over time.

**Holistic Resilience Improvements:** Enhancing both flood and climate resilience at the property level, for instance by integrating property resilience with energy efficiency interventions.

**Enhanced Surface Water Management:** Implementing Natural Flood Management (NFM) and Sustainable Drainage Systems (SuDS) to reduce surface water run-off.

**Financial Resilience:** Supporting households and businesses in developing stronger financial resilience to flood-related impacts, for example through providing engagement workshops and training on property insurance with insurers, insurance brokers and community advisors, e.g., Housing and Citizens Advice services.

**Community Participation and Empowerment:** Building trust and capacity through resident engagement, enabling communities to understand, own and respond to flood risk.

**Integrated Governance and Implementation:** Coordinating across council departments and external partners to deliver system-wide, embedded resilience strategies.

**Policy Innovation:** Piloting new approaches to property-level adaptation, including the use of housing strategies and the role of local

**Image 2:** A joined-up approach to property assessment facilitates the opportunity for specifying more flood resilient, warmer homes measures such as cavity wall insulation

*Source: Rochdale Borough Council*

authorities in delivering climate resilience through standards and regeneration.

Resilient Roch exemplifies a multi-modal, embedded approach to resilience – one that is not only technically robust but also socially inclusive and locally grounded. It offers a replicable model for advancing place-based resilience in other vulnerable communities across the UK.

## Process of the Initiative

The Resilient Roch project exemplifies an integrated housing delivery process that aligns climate resilience with housing renewal through coordinated, cross-sectoral interventions. By combining assessments of flood resilience, energy efficiency, and building (structural) condition, the project streamlined interventions and maximized the impact of public sector funding, including support from the Flood and Coastal Resilience Innovation Programme.

A robust implementation framework was established through cross-sector collaboration between Rochdale Borough Council, JBA Consulting and community partners, enabling efficient scheduling, data sharing and resident engagement. Within the Council, there is a unique collaboration between the Lead Local Flood Authority and Housing Authority roles due to the shared recognition of the importance of property condition and good management for effective flood and climate resilience.

Capacity and awareness were built through trusted local networks, clear branding, and tailored communication strategies, helping to overcome barriers such as language, cultural sensitivities and tenant reluctance. Technological innovation was embedded through the use of combined survey tools and the integration of sustainable drainage systems (SuDS) and property flood resilience (PFR) measures,

including flood doors, sump pumps and cavity drainage systems.

The integrated, cross-sectoral approach allowed other flood resilience and climate change dimensions to be incorporated, particularly discussions and surveys on financial resilience and insurance when the project was engaging with householders. The project not only improved housing conditions and reduced flood vulnerability but also laid the groundwork for future policy innovation by demonstrating the value of whole-of-property and whole-of-society approaches to climate adaptation.

## Lessons Learned

The Resilient Roch project has aligned various funding streams and housing renewal objectives to maximize improvements in the housing stock. By addressing underlying issues that heighten residents' vulnerability to flooding and fuel poverty, the project tackles key challenges faced by people in deprived areas. A prime example of this was the discharge of multiple property surveys simultaneously. The project encountered several challenges, from which multiple lessons can be drawn.

### Key Area 1: Operational and Logistical Challenges

The delivery of integrated housing and resilience interventions presented several logistical and communication challenges. For instance,


**Image 3:** Property benefiting from a 'stable' style flood resilient door to create an escape route to evacuate the property without compromising its flood resilience

*Source: Rochdale Borough Council*

coordinating multiple assessments on building condition, flood risk, and energy efficiency – particularly when combining different types of inspections – proved complex, occasionally leading to inefficiencies and confusion among residents. While splitting assessments helped reduce strain on residents, it increased administrative overheads. Clear branding and council-led coordination were essential in maintaining clarity and trust throughout the process.

Among some of the benefits were: reduced strain for residents, more efficient surveys, more appropriate interventions due to an integrated approach e.g., cavity wall insulation appropriate for flood risk situations. The combined approach offers the opportunity of addressing multiple issues in one go, rather than in several projects. The project is scalable to any situation where building condition, flood risk and energy efficiency issues combine. It is an integrated, coordinated approach that allows the use of combined funding streams.

### Key Area 2: Resident Engagement and Trust

Engaging residents effectively required careful navigation of trust and privacy concerns. Some tenants were hesitant to report poor housing conditions due to fears of eviction or limited alternative housing options. The presence of council officers on-site helped build rapport and enabled safe, non-threatening reporting mechanisms. However, the perceived intrusiveness of home visits – especially those involving multiple personnel or internal photography – deterred some residents. Surveyors had to balance their duty of care with sensitivity to these concerns.

The early intervention mitigates greater public sector involvement across multiple sectors e.g., health, housing, flooding, trading standards. The approach is scalable where local government flooding and housing teams are well integrated or coordinated. Significant housing issues were identified, and support was provided to rectify them, wherever possible.

### Key Area 3: Access and Equity Considerations

Accessing privately rented and Houses in Multiple Occupation (HMO) properties was often hindered by absentee or uncooperative landlords, complicating efforts to assess and improve conditions. Language and cultural barriers, particularly in areas of cultural and ethnic diversity, further slowed communication and required tailored engagement strategies. Trusted local groups played a pivotal role in overcoming these barriers and encouraging participation. The trusted relationships were developed through working with an honest broker (National Flood Forum) in these communities continuously since 2013.

More residents were able to benefit from the project than with traditional publicity-driven approaches. The honest broker approach is scalable, particularly where there is continuity of engagement. The approach resulted in additional benefits with other elements of the project, such as promoting and improving access to residential property insurance (an important aspect of financial resilience).

### Key Area 4: Broader Impacts and Opportunities

The project uncovered numerous hidden housing vulnerabilities, including serious safety issues such as structural defects and a carbon monoxide leak. These findings prompted immediate interventions by the council to ensure tenant safety. On-the-ground engagement also enabled effective signposting to other services,


**Image 3:** Property benefiting from a 'stable' style flood resilient door to create an escape route to evacuate the property without compromising its flood resilience

*Source: Rochdale Borough Council*

such as mobility grants and emergency home repairs. The approach is scalable where there is good communication and coordination between departments and sectors. The positive outcomes were safer houses in better condition, residents living under less strain, and homes that are more energy-efficient, flood-resilient and of better build quality.

### Key Area 5: Policy Issues

The initiative highlighted the limitations of current funding models, which often restrict the integration of flood resilience, energy efficiency and housing improvements. A more flexible, whole-of-property funding approach could enhance future delivery.

The challenges around the difficulties of using multiple funding streams have been captured. A cross-government departmental approach will be needed to enable better compatibility of funding streams. The local government will benefit from funding streams that are easier to integrate across sectors. The residents will benefit from projects that treat properties more holistically. The approach is scalable where national policy provides the opportunity.

### Future Innovation

Aspects of the project established a valuable evidence base to inform future interventions and policy development. Site visits and follow-up meetings were adapted to gather nuanced insights into household insurance uptake and financial resilience and could contribute to more socially equitable climate resilience strategies.

## Way Forward

Whilst the project has demonstrated the benefits of taking an integrated, cross sectoral approach to complex flood risk issues in vulnerable communities, there are further opportunities to develop community resilience.

The project has highlighted areas where government integration could make

interventions more feasible and cost-effective. A particular example is the coordination of the funding criteria for funding streams across different government departments – flooding, housing and energy. Anything to do with the impact of flooding on people does involve housing policy and there are opportunities to improve resilience, such as by clarifying the roles and responsibilities of landlords, letting and managing agents, especially when flooding occurs. These policy and legislative opportunities need to be investigated further.

Property Flood Resilience (PFR) is a relatively new set of tools with huge potential. The benefits are not the same as traditional civil engineering solutions, which are well understood. In vulnerable communities there are questions about how long-term maintenance will be achieved, especially in low-income households and in properties where there is a high turnover of residents. In these situations, the assumptions about the lifetime of each of the measures may need further consideration, which in turn may have implications for benefit-cost calculations.

The project has shown that there are opportunities for both local government and the insurance industry to work collaboratively on flood risk issues in vulnerable communities. Further collaboration would deliver mutual benefits in several areas, such as social housing, small businesses, sharing of information and data to improve outcomes and investment opportunities. Further work is also needed to improve accessibility where it is needed, to improve affordability for those on low incomes, and in targeting the most appropriate policies to people in different circumstances. Dissemination of some of the interventions developed could be useful in other vulnerable communities, such as by rolling out some of the training workshops to organizations working in vulnerable communities across the country.

The Resilient Roch approach to delivering better outcomes could be used anywhere. Disseminating the characteristics of the work done is an important aspect of the way forward.

## Additional Information

### Readings

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Local Government Association UK. Resilient Roch: Coordinating property-level surveys for integrated climate resilience. https://www.local.gov.uk/case-studies/resilient-roch-coordinating-property-level-surveys-integrated-climate-resilience

# 20. Multi-Purpose Hurricane Resilient Shelter for Community in Abaco

Country:

The Bahamas

Submitted by:

United Nations Development Programme (UNDP)

- Facilities
- Post-Disaster
- Enablers

## Abstract

*When Hurricane Dorian (2019) struck The Bahamas, more than 75 percent of homes were damaged or destroyed and at least 70,000 people became homeless. One of the responses was the construction of a Multi-Purpose Community Shelter in Abaco. The initiative primarily serves the economically disadvantaged communities in Central Abaco. Many of them were living in informal housing, which were erased, exposing entrenched vulnerabilities and highlighting the absence of formal hurricane shelters in the Abacos. The Government of The Bahamas identified a pressing need for a dedicated hurricane shelter in Central Abaco to serve both crisis response and community development functions.*

*A High-Standard Hurricane Shelter and Community Centre (10,000 square feet area) was constructed in Central Pines Subdivision, designed as the first dedicated hurricane shelter in The Bahamas capable of withstanding Category 3–5 storms. During non-hurricane periods, the Centre functions as a multi-use community hub.*

## Introduction to the Initiative

Following the catastrophic impact of Hurricane Dorian in 2019, which severely affected Abaco and Grand Bahama, the United Nations Development Programme (UNDP) Multi-Country Office in Jamaica, with financial support from the Government of India, assisted the Government of The Bahamas in enhancing climate resilience. The initiative entailed the construction of a Multi-Purpose Community Shelter in Abaco, implemented by the Disaster Risk Management Authority (DRM Authority) in coordination with the Office of the Prime Minister and the Ministry of Public Works. This intervention exemplifies best practices in climate adaptation and disaster risk reduction, and the protection of vulnerable communities in hazard-prone areas while addressing the growing frequency and intensity of hydrometeorological hazards in the Caribbean.

## Impact and Process of the Initiative

### Target Housing Group

The initiative primarily serves economically disadvantaged and low-income communities in Central Abaco – many previously living in informal, hurricane-vulnerable housing. These populations suffered the most severe losses during Hurricane Dorian and lacked access to safe, resilient infrastructure.

### Background and Need for the Initiative

On 1 September 2019, Hurricane Dorian made landfall in The Bahamas as a Category 5 storm, bringing winds of up to 185 mph (298 kmph) and storm surges up to 20 feet. It stalled Abaco for over 36–48 hours, resulting in catastrophic destruction of USD3.4 billion, more than 75 percent of homes damaged or destroyed, at least 70,000 people homeless, and widespread loss of infrastructure and utilities.

Informal settlements – especially those housing Haitian migrants – were erased, exposing entrenched vulnerabilities and highlighting the absence of formal hurricane shelters in the Abacos. The Government of The Bahamas identified a pressing need for a dedicated hurricane shelter in Central Abaco to serve both crisis response and community development functions.

### Implementation Structure and Collaborating Organizations

This initiative was financed by the Government of India, channelled via UNDP's Multi-Country Office in Jamaica, and executed locally by the Disaster Risk Management Authority (DRM Authority) in coordination with the Office of the Prime Minister, the Ministry of Public Works (MOPW), the Disaster Preparedness Unit, and the National Emergency Management Agency (NEMA).

UNDP provided project coordination, technical guidance, and oversight, while local engineering firms (Chris Symonette & Associates) and contractors (Wilkem Solutions) managed site execution. A UNDP-assigned engineer conducted regular monitoring and quality assurance, including random site visits and formal inspections at key construction milestones.

UNDP's involvement post-Dorian led to Household & Building Damage Assessment (HBDA) across Abaco and Grand Bahama (assessing over 5,000 structures) and supported the development of the National Disaster Resiliency Strategy and Resilient Recovery Policy & Guidelines approved by the Cabinet in October 2020.

### Project Activities and Technical Strategy

#### Leveraging HBDA Findings and the Build Back Better (BBB) Approach

The project was built directly on UNDP's HBDA findings and the nation's BBB policy framework. This ensured that interventions aligned with vulnerabilities identified by data and the national strategy and were informed by technical learning gained during post-Dorian recovery efforts.

#### Construction of a High-Standard Hurricane Shelter and Community Centre

A 10,000 square feet facility in Central Pines Subdivision, designed as the first dedicated hurricane shelter in The Bahamas capable of withstanding Category 3–5 storms (winds up to 180+ mph). The shelter featured impact-resistant windows/doors, reinforced concrete structure, solar and backup power, water-storage, LED lighting, emergency supply storage, sanitation, laundry and food preparation areas, and recreational/community-use spaces.

#### Multi-Use Community Amenities

During non-hurricane periods, the Centre functions as a multi-use community hub addressing broad community development

**Image 1:** Shelter construction

needs, providing space for educational, craft, recreational, youth and public activities, and administrative support.

**Technical Assistance, Supervision, and Procurement Quality**

- Engineering and architectural oversight ensured compliance with the Bahamas Building Code and BBB resilience standards.
- UNDP webinars for training, model home construction exercises, and a mobile Technical Assistance Centre (TAC) – deployed in a retrofitted vehicle – provided homeowner-level training on safe reconstruction and build back better techniques.
- All procurement of reconstruction materials and Personal Protective Equipment (PPE) followed Best Value, Fairness, and Competition standards to ensure durable, cost-effective, and socially responsible sourcing.

**Quality Assurance Mechanisms**

UNDP maintained strong oversight through:

- Formal inspections at foundation placement, rebar, and near substantial completion
- Engineer-led milestone visits around foundation and pre-completion stages
- Quarterly reports
- Monthly technical meetings during project implementation
- Technical Working Group oversight which involves all key stakeholders

This structured monitoring ensured that the shelter adhered to design, safety and resilience benchmarks.

**Site Selection Criteria**

Location was chosen via a weighted preference analysis, considering:

- Central proximity to population centres and transport nodes;
- Access to utilities, medical and emergency services;
- Stable limestone-based geology at sufficient elevation;
- Accessibility for persons with disabilities; youth and recreational amenities; disaster-ready infrastructure such as independent power, potable water, mass feeding, medical conversion readiness and command centre functions.

## Impact: Addressing Vulnerabilities and Promoting Equity

**Strengthening Physical Safety and Resilience**

The Abaco Centre provided a purpose-built shelter that significantly reduced physical risk for vulnerable, low-income communities, offering reliable hurricane protection and addressing disaster-service gaps in the Abacos.

**Enhancing Community Development and Social Inclusion**

As a multi-functional facility, the Centre reduced social isolation and inequality by enabling educational, vocational and recreational activities for groups often excluded from formal infrastructure.

**Capacity Building and Local Empowerment**

The use of BDA technology, TAC outreach, homeowner training, and BBB policy guidance strengthened local technical capacity – for government staff, contractors and communities – to build safer, more resilient housing post-crisis.

**Policy Integration and Institutionalization**

By embedding project-driven outputs into national strategies – such as the Resilient Recovery Policy and the National Disaster Resiliency Strategy – resilience has become part of The Bahamas' institutional architecture, promoting equitable infrastructure development across regions.

### Equity through Replicability

The design and successful delivery of the Abaco Centre set a model for future replication across other at-risk, under-resourced communities in The Bahamas, ensuring resilience is not limited to urban centres or wealthier districts.

This initiative stood as a comprehensive, resilience-oriented response, targeting the most vulnerable populations affected by Hurricane Dorian, addressing critical shelter needs through climate-smart engineering, empowering communities with technical knowledge and access to safe facilities, and reinforcing national disaster preparedness systems. It exemplified how evidence-based design, inclusive planning and quality governance combine to reduce vulnerability and advance equitable, long-term resilience.

## Lessons Learned

### Implementation Challenges and Mitigation Strategies

**High upfront costs of resilient design:** Designing the shelter to withstand Category 3–5 winds and including solar energy, impact-resistant glazing, water storage, and off-grid utilities necessitated a higher initial investment. By leveraging the Government of India co-finance and UNDP technical support, efforts were made to optimize procurement via Best Value for Money, ensuring cost-effectiveness without compromising resilience.

**Limited local skilled labour and engineering capacity:** Early post-Dorian efforts revealed local construction teams lacked experience with high-wind structural standards. Mitigation: UNDP's mobile Technical Assistance Centre (TAC), webinars on resilient building, model-home framing exercises, and site-level supervision by engineers and architects ensured capacity building and code compliance.

**Procurement integrity and material quality:** The risk of substandard, non-durable materials could have undermined BBB goals. Mitigation: transparent procurement using clear criteria (quality, life-cycle cost, vendor reputation) and competitive, fair sourcing in line with UNDP standards.

**Site-specific geological and logistical issues:** Sinkholes or unstable limestone formations discovered during excavation required remediation. Mitigation: remedial foundation stabilization, use of geotechnical assessments in siting, adherence to site-selection criteria and close supervision of structural works.

**Weak shelter governance and preparedness systems:** Pre-Dorian emergency shelters lacked trained management and robust procedures. Mitigation: establishing the Abaco Centre as a purpose-built facility with dedicated operations planning, and embedding training and governance elements into institutional frameworks (DRM Authority).

### Co-Benefits and Inclusive Impacts

Capacity-building and technical knowledge transfer: Engineers, public officials, contractors and homeowners benefited from South-South exchange workshops in resilient design and construction techniques, enabling safer reconstruction across the island.

Community and social development benefits: The facility doubled as a community centre offering public gatherings, educational, craft and recreational activities, food and sanitation facilities, laundry, administrative space and youth engagement. This supported social cohesion, youth empowerment, and gender-balanced community activity.

**Policy strengthening and institutional resilience:** The project catalysed Cabinet approval of the

National Disaster Resiliency Strategy, Resilient Recovery Policy, and institutional assessment tools, embedding resilience across governance and planning mechanisms.

**Environmental and economic co-benefits:** Use of solar power and efficient utilities reduced energy costs, while procurement and construction created local temporary employment and supported local firms.

### Scalability and Replication Potential

The initiative is scalable: documented technical designs, procurement protocols, capacity-building modules, site-selection methodology and quality-assurance protocols provide a replicable template.

The approach demonstrates spin-off benefits: training materials and policies can be adapted nationally for future hurricane-resistant infrastructure in other Family Islands.

By building government institutional capacity and resilient infrastructure, the model supports expansion into sectors such as resilient schools, community clinics or MSME hubs.

## Way Forward

Building on the lessons learned, future stages of the initiative should focus on institutionalizing resilience across The Bahamas. This includes formalizing training modules and operational protocols developed through the Abaco project into the national curriculum for building-code compliance and emergency shelter management. Integration of the Abaco model in disaster preparedness policy enables replication, extending to other Family Islands via a network of resilient multi-purpose centres.

The project should also support community engagement, encouraging local governments and civil society in capacity-building and maintenance of shelter infrastructure. Sustainable financing models, such as revolving funds or public–private partnerships, can mitigate high upfront costs. Finally, ongoing monitoring and evaluation, including post-use drills, shelter maintenance reviews and community feedback loops will ensure long-term functionality, continuous improvement, and equitable access to safe infrastructure in hurricane-prone regions.

## Additional Information

### Video Link

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### Readings

UNDP. (2022). Abaco Hurricane Shelter to be completed under India-UNDP project. https://www.undp.org/jamaica/press-releases/abaco-hurricane-shelter-be-completed-under-india-undp-project

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# 21. Scaling Disaster and Climate Resilient Housing in Indonesia

Country:

Indonesia

Submitted by:
Build Change

- Housing
- Facilities
- Post-Disaster
- Enablers


## Abstract

*This case study demonstrates how the Government of Indonesia has reduced the vulnerabilities of its housing stock over time through the implementation of two key public housing schemes: BSPS (Home Improvement Subsidy Program) and the IGAHP (Indonesia Green Affordable Housing Program). BSPS demonstrates that by providing subsidies to low-income homeowners for implementing structural and non-structural improvements, and through various other quality control mechanisms, governments can improve the resilience of the existing housing stocks at the country level. The case study also provides details of the IGAHP, which is a similar home improvement subsidy scheme but with an added focus on climate resilience and environmental sustainability. Unlike BSPS, IGAHP involves the banking sector, with subsidies disbursed through banks as part of the home loan application process.*


## Introduction to the Initiative

Indonesia faces high disaster risk, with over 300 disasters from 1990–2021 and over 21,500 earthquakes in the past decade. Poor construction quality makes homes especially vulnerable. Since 2005, there have been efforts across Indonesia to strengthen housing and improve construction standards, benefiting over 450,000 people. The Government of Indonesia with Build Change and institutions like the World Bank influences national subsidy programmes, improved housing quality, expanded access to affordable financing for home retrofits, and supported green-climate-resilient housing initiatives. These efforts proved that resilient housing for low-income communities is possible at scale in Indonesia.

**Image 1:** Field visit with UNOCHA representative

## Impact of the Initiative

The Government of Indonesia with support from Build Change leverages financial incentives, efficient technology, housing policies and programmes, and homeowners' demand to strengthen existing vulnerable homes and ensure the safe construction of new houses. The post-2004 earthquake and tsunami interventions have implemented homeowner-driven housing reconstruction and retrofit programmes, DRR training programmes, brickmaker[27] capacity building programmes, policy influencing activities, and technical assistance Programmes in Aceh, West Sumatra, Bengkulu, Central and West Java, Lombok and Central Sulawesi. To date, this work has resulted in 453,726 people living in 90,013 safe buildings. This proof of concept has resulted in a significant reduction in the loss of lives and livelihoods. For example, when two powerful earthquakes hit West Sumatra in 2009, none of the buildings that received technical inputs from the post-2007 earthquake initiatives and met the minimum standards for seismic safety were damaged.

**Supporting Government Policies to Improve Structural Resilience:** The Indonesian government has implemented the Bantuan Stimulan Perumahan Swadaya (BSPS) subsidy programme as part of the government's commitment to improve the quality of 1 million homes annually,

[27] A capacity building program to develop 1) brickmakers' technical capacity to improve the quality of production to meet national requirements; 2) brickmaking SME owners' financial capacity, in which the majority are also brickmakers and women, to improve financial literacy for operational tracking, 3) marketing the good quality bricks, by supporting the establishment of quality brickmakers' network with the buyers, and 4) more environment-friendly brick production, where different ways to burn the clay brick were tested that produce lower emissions.

increasing this to 3 million homes per year in more recent years. While BSPS provides a strong framework with many of the key components necessary to become an even more successful scaled housing subsidy program, there are a number of areas in need of improvement, particularly regarding construction quality. The construction quality of housing is an issue in Indonesia. In 2017, Statistics Indonesia revealed that almost 80 percent of residential houses in the country are constructed by homeowners without the involvement of engineers and government, resulting in a high number of substandard houses. These houses have been severely damaged during the earthquakes of recent years.

In 2019, the Government of Indonesia, together with Build Change, formed an advisory group on retrofitting options and conducted an evaluation of Indonesia's national housing subsidy program in partnership with the Ministry of Public Works and Public Housing. This work included stakeholders' interviews and surveys of over 500 houses in three separate regions of Indonesia, including homes that had received subsidies for housing improvement under the World Bank-funded government program.

This work identified serious compliance issues with regard to structural requirements. Only 11 percent of the inspected houses fully complied with the minimum earthquake-resistant building standards, demonstrating that the subsidy provided was insufficient to meet minimum safety standards. To overcome this problem, the government, with support from Build Change, undertook actions for improving low-income housing construction and the development of a work plan in collaboration with the Ministry of Public Works and Public Housing, the World Bank, and numerous stakeholders to promote and enforce higher quality control standards for housing construction subsidized by the BSPS program.

The need to increase the subsidy provided to homeowners to comply with minimum safety standards was accepted[28] by Indonesia's national government, which increased the subsidy and improved quality monitoring procedures. This resulted in an increase of participating homeowners meeting structural compliance requirements from , according to the Ministry of Public Works. 75[29]

**Evolving from disaster response to prevention:** To prevent loss of homes, lives, and livelihoods due to disasters, Indonesia has taken several steps. Starting with the Better Building Materials program, and school retrofit programmes to ensure that the schools are structurally resilient, this has expanded to providing access to financing for home strengthening and climate adaptation upgrades, including the launch of a new programme in 2024 focused on extreme heat. Support from the Global Innovation Fund has enabled Build Change Indonesia and KOMIDA, a women-centred local microfinance institution (MFI), to jointly develop and roll out incremental climate adaptation loans that enable women living on less than USD5 per day to make affordable investments that improve the climate resilience of their homes.

The Indonesia Green Affordable Housing Program (IGAHP) was initiated in 2024 to encourage affordability in green housing for low-

[28] In 2018, the subsidy was up to 15 million Rupiah (USD925) for home improvement and 30 million Rupiah (USD1,850) for new construction. It was then increased by 17 percent in 2020, to 17.5 million Rupiah for home improvement and 35 million Rupiah for new construction. Now it has increased by 33 percent, or 20 million Rupiah for home improvement.

[29] Following the 11% assessment report in 2019, the government made necessary changes (with WB advocacy & funding) and in 2020, the number increased to 29%, and further to 75% in 2022.

income communities at scale. IGAHP encourages the use of environment-friendly building materials, energy-efficient design, climate change and disaster resistance, and access to financing to make climate-resilient and green housing affordable to Indonesia's low-income communities. The steady increase in the government's capacity to deliver resilient housing coupled with World Bank investment has accelerated the progress significantly.

## Process of the Initiative

**Main Stakeholders:** The main stakeholders were local low-income communities, who were supported by the Government of Indonesia, Build Change, and institutions like the World Bank, Ministry of Public Works and Housing, and the local microfinance institution KOMIDA.

**The Context:** Between 1990 and 2021, Indonesia faced over 300 disasters (about 70 percent climate-related) impacting the lives of 11 million people. Approximately 110 million people (40 percent of the population) across roughly 60 cities are exposed to disasters in Indonesia. Over the past four years, the large majority of disaster events recorded were hydrometeorological hazards intensified by climate change.

Additionally, Indonesia is surrounded by many active faults and is the most seismically active country in the world. In the last 10 years, over 21,500 earthquakes of magnitude 4 and higher have occurred in Indonesia. This risk is compounded by Indonesia's high population density, with an estimated 22 million people living in areas with a high risk of earthquakes.

### Housing Delivery Method

#### Public Housing Programmes

The government implements various housing incentive schemes to help close the gap in access to adequate and resilient housing. The government has played a role in influencing the development of two key large-scale programmes: BSPS and IGAHP. BSPS (Home Improvement Subsidy Program)

The BSPS programme provides subsidies to low-income homeowners to support structural and non-structural improvements to their existing homes. In 2018, the subsidy was up to IDR15 million (USD925) for home improvement and IDR30 million (USD1,850) for new construction. In 2019, the government conducted an evaluation the program's effectiveness. Based on the findings, it then increased in the subsidy amount

**Image 2:** Before and after photos of a retrofitted home

and implemented improvements in quality control mechanisms. The subsidy was increased by 17 percent in 2020, to IDR17.5 million for home improvement and IDR35 million for new construction. Now it has been increased further to 33 percent. Each beneficiary can receive up to IDR20 million, with 17.5 million allocated for building materials and 2.5 million (12.5 percent) for labour costs.

**IGAHP (Indonesia Green Affordable Housing Program)**

IGAHP is a similar home improvement subsidy scheme but with an added focus on climate resilience and environmental sustainability. Set to officially launch in early 2026, it is currently being supported by the government in its pilot phase by the provision of technical assistance and grants to participating homeowners. The government grant is being used to incentivize structural strengthening and the integration of green building components when homeowners apply for housing loans. Unlike BSPS, IGAHP involves the banking sector, with subsidies disbursed through banks as part of the home loan application process.

**Private Sector/MFI-led Initiative**

Through a partnership with KOMIDA, a women-focused microfinance institution (MFI), the government is supporting the integration of climate adaptation and disaster resilience into existing home renovation loan products. The initiative began with technical assessments and cost analyses of heat-stress adaptation interventions, conducted with a small group of KOMIDA members. Based on these findings and affordability assessments, the government supported the development and finalization of a new loan product. KOMIDA began rolling out the product in May 2025, and nearly 50 members have already taken up loans for heat-stress adaptation upgrades.

**Financial Arrangement:** Under IGAHP, homeowners who apply for home financing through participating banks and agree to incorporate key building standards and green building recommendations are eligible to receive a cash incentive of up to IDR 5.8 million (approximately USD350). For the MFI program, to encourage adoption of the new resilient home loan product focused on heat-stress adaptation and seismic strengthening, KOMIDA offers cash incentives (amount to be determined) to members who choose to take up the loan. For example, for a beneficiary named Marnah – who is a member of KOMIDA and also a recipient – the total cost of improvement for the house (36 square metres) is approximately USD2,200, of which USD1,350 (61 percent) is for strengthening works and USD850 (39 percent) is for other non-structural works, such as painting and adding a roof terrace and light gable wall. The financing mechanism comes from the combination of loan and subsidy. Marnah's loan capacity can only cover about 75 percent of the costs, while Build Change provides subsidy for the remaining 25 percent.

**Framework for Implementation:** The plan adopts a homeowner-driven approach that spans from the design phase through to project completion. Homeowners' design preferences serve as the foundation for developing tailored recommendations to improve resilience. These recommendations are then refined using the government's technical resources – such as guidelines and the BCtap platform – which help programme administrators or MFI officers work with homeowners to determine feasible improvements based on available financing and repayment capacity.

Homeowners are also responsible for selecting their own builders. To support quality implementation, the government provides

training and outreach to homeowners, equipping them with the knowledge to ensure key principles are followed – either by overseeing the work themselves or by directing their builders to adhere to established standards.

**Design and Technology:** Basic designs are provided by homeowners, or developed based on homeowner's preferences, after which Build Change provides a review.

## Lessons Learned

In Indonesia's housing sector, there is a high degree of inconsistency between building codes, regulations, and their enforcement – particularly for single-story homes. For example, a design for subsidized housing submitted by a developer received building approval despite not meeting government building codes. This kind of regulatory ambiguity, including uncertainty about which standards apply, significantly increases the risk of non-compliance from the design to construction stage.

Government housing programmes like BSPS have strong potential, but require improved quality control, increased subsidies, and better enforcement to meet safety standards. In Indonesia, the construction quality is often poorly controlled. It has been observed that implementing quality control mechanisms can be challenging, particularly when they are not institutionalized or integrated into programme policy. For example, in one of the housing finance programmes, there were initially no quality requirements tied to subsidy disbursement. This has changed; quality compliance is now a condition in the financing agreements between banks and homeowners, allowing subsidies to be released only when construction meets the required standards. The government is exploring additional incentives, such as reduced interest rates or free green building certification, to further encourage compliance.

Local capacity building and partnerships drive sustainability – from training MFI staff to influencing national housing policy. A key challenge is the limited resources allocated for enforcement, including a lack of field facilitators and insufficient tools to support effective quality control in implementation. The use of digital technology, such as BCtap, will be a valuable opportunity to bridge the gap between quality supervision requirements and available resources.

Awareness and demand for climate resilient and disaster resilient housing remain low, despite Indonesia's frequent exposure to extreme weather events and earthquakes. The government could leverage the launch of IGAHP in 2026 as a strategic opportunity to promote greater awareness of climate risks and safe construction practices among homeowners, developers and local authorities.

## Way Forward

- Expand successful retrofit and safe construction models by including technical support and quality standards in government housing programmes from the start – through rules, loan terms, and how projects are carried out.
- Leverage the upcoming launch of the IGAHP to mainstream resilient, green, and affordable housing and expand climate adaptation financing mechanisms, especially for vulnerable, low-income households.

## Additional Information

### Website

https://buildchange.org/location/indonesia

bctap.buildchange.org

# 22. Housing Resilience in Dominica

Country:

Dominica

Submitted by:

United Nations Development Programme (UNDP)

- Housing
- Facilities
- Post-Disaster
- Enablers


## Abstract

*Hurricane Maria (2017) caused catastrophic damage to Dominica's housing sector, destroying or severely impairing over 90 percent of the island's homes. The government's interventions included rebuilding homes and critical infrastructure to withstand Category 5 hurricanes and enhancement of long-term resilience capacities against future climate shocks.*

*Over 400 contractors and construction workers were trained in resilient construction methods, generating local employment and building long-term capacity. National building standards have been revised. The intervention integrated gender-sensitive and community-based approaches to ensure inclusive recovery.*

*The initiative focused on the most vulnerable households, especially those who lost homes in Hurricane Maria. The affected households received technical support for resilient housing repairs and roofing kits. Low-income families and women-headed households (with elderly and persons with disabilities) were prioritized. This intervention has benefitted more than 8,000 persons.*

*The initiative was oriented to build the capacities for a resilient recovery, through strengthened institutional framework, improved housing standards and trained local labour. The intervention enhanced information management capacities, e.g., a mobile application for damage assessment of the affected buildings.*


## Introduction to the Initiative

After Hurricane Maria struck Dominica in 2017, the United Nations Development Programme (UNDP) swiftly established a project office to support the government in managing the immediate response, recovery and long-term resilience building. UNDP's recovery efforts evolved into a comprehensive portfolio of

initiatives, implemented in partnership with the Climate Resilience Execution Agency for Dominica (CREAD), and with the support of Engineers Without Borders and the governments of Japan, China and the UK.

Hurricane Maria caused catastrophic damage to Dominica's housing sector, destroying or severely impairing over 90 percent of the island's homes. This initiative included rebuilding homes and critical infrastructure to withstand Category 5 hurricanes, as well the enhancement of long-term resilience capacities against future climate shocks.

The collaboration aimed to strengthen local capacity by training over 400 contractors and engineers in resilient construction techniques and updating national housing guidelines. UNDP also supported the government in conducting damage assessments and coordinating reconstruction efforts, while integrating gender-sensitive and community-based approaches to ensure inclusive recovery.

## Process and Impact of the Initiative

The initiative addressed the widespread destruction of housing and infrastructure caused by Hurricane Maria in 2017, which devastated over 90 percent of the island's buildings. Thousands of homes were either destroyed or severely damaged; thus, there was an urgent need to rebuild safer, more resilient homes. However, the internal capacities were limited, with outdated construction standards, shortage of skilled labour, and weak institutional capacities to coordinate and implement a large-scale recovery process.

Given this context, the reconstruction initiative was oriented towards building the capacity for a resilient recovery through a strengthened institutional framework, improved housing standards, construction of safer public buildings and trained local labour.

The initiative partnered with government agencies, such as the Office of Disaster Management and the Climate Resilience Execution Agency for Dominica (CREAD), to develop and implement the Building Damage Assessment (BDA) system and to produce the Guide to Dominica's Housing Standards. UNDP also worked closely with national ministries, especially the Ministry of Housing, Lands and Water Resource Management and the Ministry of Planning and Economic Development

The initiative focused on the most vulnerable households, especially those who had lost homes in Hurricane Maria. These households received resilient housing repairs, roofing kits and technical support. Low-income families and women-headed households (with elderly and persons with disabilities) were prioritized. On an average, this intervention has benefitted more than 8,000 persons.

Some key outputs included:

- A comprehensive building damage assessment of 29,431 structures, of which 25,477 were classified as residential.
- In nine months, by the end of July 2018, 500 houses, four hospital buildings, five medical clinics, three schools and six buildings in Dominica State College were restored.
- Over 400 contractors and construction workers were trained in resilient construction methods, generating local employment and building long-term capacity.
- Over 2,000 persons were engaged in the dialogue around resilient, compliant building standards through public sessions in communities.


**Image 1:** Before and after roofing retrofits

- National building standards have been revised.

Through this initiative, Dominica aimed to become the world's first climate-resilient nation. This required integrating disaster risk reduction and climate adaptation into all reconstruction efforts.

## Lessons Learned

Some challenges faced during the implementation were as follows:

**Limited Local Capacity:** Many local builders lacked training in resilient construction techniques, and there was a shortage of certified engineers and inspectors to enforce standards.

**Coordination Gaps:** Multiple actors (government, NGOs, donors) led to overlapping efforts and inconsistent application of standards, and delays in approvals and distribution of material.

**Affordability and Accessibility:** Resilient materials and designs were often more expensive, and vulnerable households struggled to meet co-financing requirements.

**Community Awareness:** Some homeowners were unaware of the new standards or sceptical of their benefits, showing a resistance to change from traditional building practices.

**Regulatory and Institutional Weaknesses:** Outdated or unenforced building codes, and limited integration of housing standards into national legislation and planning frameworks.

To mitigate these challenges, the following measures were undertaken:

### Capacity Building

- UNDP trained over 400 local builders and assessors in resilient construction
- Developed and distributed the Guide to Dominica's Housing Standards
- Technical assistance and oversight
- Provided on-site technical support and inspections during reconstruction
- Established a Roofing Technical Assistance Plan to ensure compliance

### Financial and Material Support

- Bundled technical assistance with material kits for vulnerable households
- Partnered with donors (e.g., UK Foreign, Commonwealth & Development Office) to subsidize resilient reconstruction
- Community engagement
- Conducted public awareness campaigns and workshops
- Built model homes to demonstrate resilient techniques

### Policy Integration

- Supported the government to align housing standards with the Climate Resilience and Recovery Plan (CRRP)
- Worked with CREAD to institutionalize resilience in national planning

### Co-Benefits:

Some co-benefits from this intervention are related to information management capacities. With support from the Microsoft foundation, a mobile application for the damage assessment was created, and equipment was donated to automatically process data, including the status of the re-roofing, GPS coordinates and pictures of affected buildings. These capacities remained in the government counterparts for disaster risk and recovery needs assessments and monitoring.

### Potential for Scaling Up:

The initiative has a great potential to scale-up considering the following elements:

**Proven Model:** The initiative has demonstrated success in building climate-resilient homes, training local labour, and integrating housing standards into national recovery plans.

**Replicable Tools and Frameworks:** The Guide to Dominica's Housing Standards and the Roofing Technical Assistance Plan can be adapted to other contexts. Moreover, the Building Damage Assessment (BDA) system is scalable and digitized.

**Regional Demand:** Many Caribbean nations face similar vulnerabilities to hurricanes and climate change. Countries like Saint Lucia, Grenada and Antigua could benefit from similar interventions.

## Additional Information

### Video Links

UNDP. (2018). Hurricane Recovery in the Caribbean – 1 Year Later. YouTube. https://www.youtube.com/watch?v=VPaNr2w3Icg

UNDP. (2018). Recovery in the Caribbean. ouTube. https://www.youtube.com/watch?v=VzsOsCbUFSU

### Readings

Guide to Dominica's Housing Standards https://www.undp.org/sites/g/files/zskgke326/files/migration/bb/undp-bb-Guide-to-Dominicas-housing-standards-UNDP.pdf

# 23. Community-Driven Reconstruction of Flood and Earthquake Resilient Schools in Pulwama, Jammu & Kashmir, India

Country:

India

Submitted by:
SEEDS India

- Facilities
- Post-Disaster
- Owner Driven


## Abstract

*This case study describes the reconstruction of resilient schools after the 2014 floods in Jammu & Kashmir, India by the NGO SEEDS India. The 2014 floods devastated education infrastructure across J&K, including over 1,000 schools. Many children in Pulwama continued learning in unsafe, temporary spaces, reinforcing trauma. Recognizing this, SEEDS partnered with United Way India to reconstruct schools in three villages – Chatlam Lalpora, Drangbal, and Bajibagh. The project has not only ensured safe, resilient learning spaces but also positioned schools as community resilience hubs. This case illustrates the power of bottom-up resilience-building grounded in solidarity, inclusivity and sustainability – aligned with the Ubuntu spirit of South Africa's G20 vision.*


## Introduction to the Initiative

Following the 2014 floods in Jammu & Kashmir (J&K), the NGO Sustainable Environment and Ecological Development Society India (SEEDS) in partnership with United Way India led the reconstruction of three flood-damaged government schools in Pulwama. This initiative restored 24 classrooms in three schools (eight each) with earthquake- and flood-resistant features (raised plinth for floods, continuous lintel beams and reinforcement on gable ends for earthquakes) using locally available materials and participatory design. This directly benefited over 500 students and built community resilience through school safety programmes. The project exemplifies owner/community-driven reconstruction embedded with structural resilience, green building elements and inclusive design principles.

The 2014 floods devastated education infrastructure across J&K, including over 1,000 schools. Many children in Pulwama continued learning in unsafe, temporary spaces, reinforcing trauma. The need was to restore infrastructure while embedding resilience against future disasters; provide safe, inclusive learning environments; and

improve community preparedness. Recognizing this, SEEDS partnered with United Way India to reconstruct schools in three villages – Chatlam Lalpora, Drangbal and Bajibagh.

## Impact of the Initiative

Over 500 students now study in safe, resilient, inclusive environments. School safety awareness improved among children, parents and teachers. Community involvement promoted ownership and sustainability of efforts.

## Process of the Initiative

**Main stakeholders:** The target group was economically disadvantaged schoolchildren (KG–Class VIII). The key stakeholders were 500+ students and school communities, teachers, parents, students and the entire village community.

**School Management Committee (SMC):** The SMC provided feedback on shelter design based on local needs and monitored construction progress on-site, helping resolve local issues and ensuring community oversight.

**Role of SEEDS:** SEEDS led construction and implementation, including procurement, contractor hiring, quality control and community awareness sessions. It also trained community members, especially women, to participate in the building process.

**Role of the Government:** Facilitated permissions, supported beneficiary identification, and ensured the project aligned with local recovery and development expectations.

**Water and Sanitation:** Each school included a water station with dripless taps to minimize water wastage, and toilets connected to septic tanks to ensure safe, on-site sanitation. These elements were designed to meet hygiene needs while being water-efficient and easy to maintain.

**Financial Arrangement:** United Way India.

**Image 1:** Resilient two-block school campus at Govt. Boys Upper Primary School, Chatlam, featuring elevated design and inclusive sanitation units

**Image 2:** Flood- and earthquake-resilient school building at Govt. Girls Middle School, Drangbal, showcasing community-led reconstruction and GRIHA-compliant design, seismic gap, load bearing structure, gable ends reinforced

**Capacity Building:** Disaster preparedness training, search and rescue, first aid taskforces on lifesaving skills, awareness training.

**Framework for Implementation:** SEEDS undertook Total Station Surveys and Soil Tests, developed designs through participatory workshops and awareness training on disaster resilient structures, coordinated with government departments for approvals, used local materials and employed local labour. Green features and child-friendly learning aids were integrated into 26 reconstructed classrooms. Disaster preparedness training and School Disaster Management Plans were also implemented.

**Planning, Design and Technology:** The school designs were prepared though a participatory process and the construction technologies were based on locally available materials. The built-up areas of the schools were 265.22 square metres in Chatlam, 323.12 square metres in Bajibagh, and 322.24 square metres in Drangbal. The construction costs of the schools were USD66,931 in Chatlam, USD66,419 in Bajibagh, and USD75,520 in Drangbal. The construction technologies adopted were load-bearing stepped foundations, brick and wood walls and galvalume sheet roofs. Good quality bricks were available locally and the construction workers had excellent skills in brick and wood-based construction works.

## Lessons Learned

**Key Area 1: Construction in Remote Zones**

Among some of the challenges were weather, security issues, highway closures, etc. These were mitigated by hiring local labour, decentralized

**Image 3:** Newly reconstructed flood-resilient school building in Bajibagh, Pulwama, designed with local materials and earthquake-resistant features

**Image 4:** First-floor corridor of Bajibagh School, featuring locally crafted wooden joinery, sloped metal roofing, and child-friendly design elements for safety and climate adaptation

material storage and timeline adjustments. The scalability of the approach is high. The co-benefits included employment for locals, a model for development in fragile settings, and increased business for local material vendors.

**Key Area 2: Lack of Awareness of Disaster Resilience**

Limited safety literacy among stakeholders was a challenge, which was overcome by integrating the school safety education and School Disaster Management Planning. There is a potential for scaling up such efforts across the education sector.

**Key Area 3: Limited Access to Materials**

Mining restrictions and winter accessibility were the challenges that were mitigated by adopting locally available substitutes and a flexible procurement process. The gains derived from such an approach were the promotion of the circular economy and traditional skills.

**Key area 4: Inclusion of Green Elements**

Low awareness of GRIHA (Green Rating for Integrated Habitat Assessment)[30] and eco-friendly materials was attempted to be mitigated by using low-VOC paints, compost pits, dripless taps, and green nets during construction. No trees were cut or contours disturbed, and rainwater recharge was adopted. An improvement in air quality and environmental learning was observed.

## Way Forward

This intervention has proven that even in fragile, disaster-prone areas, school infrastructure can be both safe and participatory. Going forward, SEEDS envisions a phased scaling of this model across other hazard-prone geographies in India and globally, particularly in underserved or post-disaster zones. A key recommendation is to institutionalize child-friendly and disaster-resilient school standards in public construction norms. Inclusion of GRIHA-aligned green infrastructure elements demonstrated that environmental sustainability need not be sacrificed for resilience or affordability. The integration of the community in the design, supervision and use of school buildings also offers lessons for local governance models and sustainability.

[30]GRIHA is a green building rating that has been adopted by the Ministry of New and Renewable Energy. It attempts to minimize a building's resource consumption, waste generation, and overall ecological impact to within certain nationally acceptable benchmarks.

# 24. Omo Hada of Nias Island: Traditional Solutions for Seismic-Resilient and Climate-Adaptive Housing

Country:

Indonesia

Submitted by:

Resilience Development Initiative (RDI) and National Disaster Management Authority, Government of Indonesia

- Housing
- Post-Disaster
- Owner Driven
- Vernacular


## Abstract

*Omo Hada, the traditional architecture of Nias Island, built by the Ono Niha (Nias people), is seismic and climate-resistant and thermally comfortable. Construction of Omo Hada without nails, its wooden pillars and driwa bracing system enable it to withstand earthquakes and strong winds. The Omo Hada form links traditional wisdom, disaster resilience, and climate adaptation across centuries.*

*Omo Hada construction involves local communities and the traditional craftsmen who play a central role in maintaining seismic safety features and construction techniques that ensure earthquake resistance. These collaborative efforts ensure that the traditional technical wisdom of communities remains preserved as cultural heritage and practical solutions for disaster resilience. Omo Hada offers a proven blueprint for climate- and disaster-resilient living in vulnerable areas. Sustaining Omo Hada requires suitable policy, innovation and community action.*


## Introduction to the Initiative

The traditional *Omo Hada* house from Nias Island in Indonesia, built by Ono Niha (the indigenous Nias people) through customary rituals, exemplifies traditional architecture that is seismic- and climate-resilient. Constructed without nails, its wooden pillar structure and *driwa* bracing system are able to withstand earthquakes and strong winds, as seen in how Omo Hada survived catastrophic events (e.g., the M8.7 Nias-Simeulue earthquake of 2005). Omo Hada also remains a thermal comfort model in tropical climates, with its elevated design, strategic ventilation, and heat-resilient materials ensuring natural cooling. Preserved by the Nias Heritage Museum, Omo Hada links traditional wisdom, disaster resilience and climate adaptation across centuries.

## Impact of the Initiative

The authentic nature of the traditional architectural artifacts of Nias is significantly expressed through the layout of the settlement

**Image 1:** Impact of the 2005 Nias Earthquake on Omo Hada on Nias Island
*Source: Museum Pusaka Nias (2005); authors' documentation (2005)*

and the form of the houses or dwellings, which are known as Omo Hada traditional housing. Historically, Omo Hada was built for both commoners and elites, and, according to the Badan Pelestarian Pusaka Indonesia (BPPI) or Indonesian Heritage Trust, can be classified into: (1) *Omo Sebua* or *Omo Nifolasara* (the home of *Barö Si Ulu* – the king of a village, the largest in size and adorned with mythical dragon ornaments); (2) *Omo Niföbabatu* (home for *Si Ulu Sito'olo* – the second stratum after *Barö Si Ulu*); (3) *Omo Niföbabatu* (home for *Si Ulu* – not yet eligible to elevate their social status); and (4) *Omo Nitörö* (residence for ordinary people, *sato*).

At present, Omo Hada – particularly the Omo Nitörö type – is mainly inhabited by economically vulnerable communities on Nias Island, including subsistence farmers and fishermen who depend on traditional livelihoods. Conservation efforts focus on low-income households in remote villages, where modern construction is still unaffordable and culturally inappropriate. These communities face interrelated challenges, such as geographical isolation, high risk of disasters due to Nias' location along the Sunda megathrust fault line, and tectonic instability that triggers regular earthquakes. Additionally, the humid tropical climate (with average temperatures of 28–32°C and relative humidity of 85 percent), hilly terrain and limited infrastructure hinder economic mobility, forcing heavy reliance on agriculture and fishing. Nevertheless, deep-rooted local wisdom in housing and social organization maintains resilience, making Omo Hada both a cultural heritage and a practical solution for adapting to climate change and earthquakes.

The urgent need to preserve these traditional houses became undeniable after the devastating M8.7 earthquake that struck Nias in 2005. While modern concrete structures collapsed, villages such as Bawomataluo remained standing as living proof of the resilience of Omo Hada architecture. Having withstood three major earthquakes – in 1861, 2004, and 2005 – many of these 300-year-old structures remain intact, demonstrating unmatched seismic performance. Their survival through several generations of tectonic hazards provides undeniable evidence that traditional Omo Hada engineering solutions surpass conventional modern construction in this high-risk zone. Image 1 shows Omo Hada, which was affected by the 2005 earthquake, where the main structures, namely the ehomo (main columns), walls, and roof, appear to still be standing and intact. The damage appears to be minimal, with only slight tilting or shifting of position due to foundation movement. The addition of supports (bamboo), likely installed after the earthquake, ensures stability. Images 2 and 3 show the wooden frame structure and board walls. The building is tilted and almost completely collapsed (shifted from its foundation), possibly due to a shallow foundation that is not firmly embedded in the ground. Image 3 shows brick walls without adequate reinforced concrete frames. The main damage is in the form of wide cracks in the walls and partial collapse.

In addition to its crucial role in earthquake resilience, Omo Hada's passive cooling features – such as tall pillars and temperature-regulating materials – are becoming increasingly important as heat stress from climate change increases in

**Image 2:** Impact of the 2005 Nias Earthquake on Omo Hada modern housing on Nias Island
*Source: Museum Pusaka Nias (2005); authors' documentation (2005)*

**Image 3:** Impact of the 2005 Nias Earthquake on Omo Hada modern housing on Nias Island
*Source: Museum Pusaka Nias (2005); authors' documentation (2005)*

**Image 4:** Omo Hada, Nias
*Source: Museum Pusaka Nias*

Nias. However, rapid urbanization and generational shifts threaten this traditional knowledge, with fewer *Fanekhe Duha* (traditional house builders) still mastering the skills to construct Omo Hada. Post-earthquake policies prioritized concrete housing, excluding Omo Hada from building codes and reconstruction aid, despite its proven earthquake resistance. A study by Intan and Nasruddin (2018) highlights that without urgent preservation of the megalithic heritage and earthquake-resilient techniques of Omo Hada, these structures risk extinction. This urgency has spurred collaborative efforts to adapt and expand this time-tested design as a dual solution for disaster risk reduction and climate adaptation, ensuring its legacy for future generations.

The preservation of Omo Hada is a community-led effort, supported by various parties working to preserve ancestral knowledge from generation to generation. Local communities and traditional craftsmen play a central role in maintaining construction techniques, ensuring

**Image 5:** Omo Hada disaster-resilient components: (top) elevated design (reduces humidity and prevents flooding) and driwa (V-shaped supports installed diagonally between vertical posts under the house); (middle) stone pedestals (can shift with horizontal forces without breaking during earthquakes); (bottom) high roofs made of sago palm (reduce heat radiation)
*Source: Museum Pusaka Nias; arsitag.com; Redaksi PI*

the transmission of earthquake-resilient design expertise. Following the 2005 earthquake, the Indonesian Heritage Trust (BPPI) compiled a comprehensive book titled *Nias*, from Past to Future, documenting Nias' cultural heritage, including its historical settlement patterns and architectural heritage. In 2018, the Housing Research and Development Agency (Balai Litbang Perumahan) conducted structural and thermal performance tests on Omo Hada, scientifically validating its resilience. International recognition further strengthens conservation efforts. The World Monuments Fund (WMF) has designated Omo Hada villages such as Bawomataluo and Hilinawalo Mazingo as World Heritage Sites, raising global awareness and conservation initiatives. These collaborative efforts ensure that the traditional technical wisdom of communities remains preserved as cultural heritage and practical solutions for disaster resilience.

The structural integrity of Omo Hada, if preserved, can significantly minimize disaster risk while enhancing climate change adaptation. Its resilience has been proven during major earthquakes, such as in 2005, when these traditional houses only had minor damage despite the intense shaking, even as modern buildings collapsed. This strength lies in the key architectural features, particularly the *ehomo* (main columns) and *driwa* (diagonal braces) that reinforce stability, both of which rest on stone plinths, which can shift horizontally during an earthquake without breaking. Thermally, the design ensures indoor comfort (23.6°C on average) in the hot tropical region without energy-intensive cooling – a very important advantage for low-income households. In addition to structural benefits, reviving traditional Omo Hada techniques empowers marginalized communities to build safe and affordable housing using local materials and skills, thereby reducing reliance on expensive and imported modern methods. Furthermore,

recognition as a World Heritage Site enhances the identity of traditional communities and fosters economic opportunities through culturally sensitive tourism, thereby strengthening resilience and sustainability.

Omo Hada from Nias Island exemplifies how traditional knowledge creates housing that is inherently resilient. By combining the flexibility of wood, passive climate control, and strategic settlement planning, Omo Hada offers a proven blueprint for climate- and disaster-resilient living in vulnerable areas, showing that sustainability is firmly rooted in ancestral wisdom. As climate and seismic threats increase, this model underscores an important lesson that reducing vulnerability starts with listening to history.

## Process of the Initiative

**Main Stakeholders:** The stakeholders were: low-income communities and heritage conservation projects, young craftsmen and communities (self-construction), policy makers and residents and climate-vulnerable populations.

**Housing Delivery Method:** Traditional Omo Hada houses are primarily built through community efforts, involving local craftsmen and Ono Niha, who utilize local knowledge and traditional rituals. The construction process is collaborative, often using a system of gotong royong (mutual cooperation), in which community members work together under the guidance of master builders (*Fanekhe Duha*).

**Water and Sanitation:** Not applicable, no information provided. However, given its elevated design and tropical adaptation, it is likely that traditional practices for water collection and waste management were integrated into the layout of the settlement.

**Financial Arrangement:** Funding for the preservation and reconstruction of Omo Hada and infrastructure on Nias Island has historically depended on a combination of community contributions, state budgets and international grants. During the 2005–2008 rehabilitation and reconstruction period, the Nias Island Sub-District Development-Rehabilitation and Reconstruction Project (Proyek Pengembangan Kecamatan-Rehabilitasi dan Rekonstruksi Pulau Nias/PPK-R2PN) was funded by a combination of multi-donor funds (MDF) and the state budget. Housing reconstruction was carried out by the Nias Rehabilitation and Reconstruction Agency (Badan Rehabilitasi dan Rekonstruksi/BRR) in collaboration with NGOs, the Asian Development Bank (ADB) and the World Bank.

**Capacity Building:** To preserve cultural heritage, including knowledge about building sturdy, earthquake-resilient Omo Hada traditional architecture, various capacity-building efforts have been undertaken. The Nias Heritage Museum has a cultural programme, one of which is training for carpenters. During the rehabilitation and reconstruction of traditional houses on Nias Island between 2005–2008, training was provided that involved young people as carpenter assistants.

**Framework for Implementation:** Omo Hada is not a specific housing programme. However, lessons can be learned from the 2005–2008 Nias housing reconstruction programme, which was implemented based on the principles of 'building back better' and community-based development. The Nias BRR formed Sector Working Groups and a Joint Secretariat with the local government to coordinate activities. A participatory approach was implemented through village meetings and the formation of community self-help groups. In addition, the BRR collaborated with traditional and religious institutions to ensure that the programme was in line with local needs.

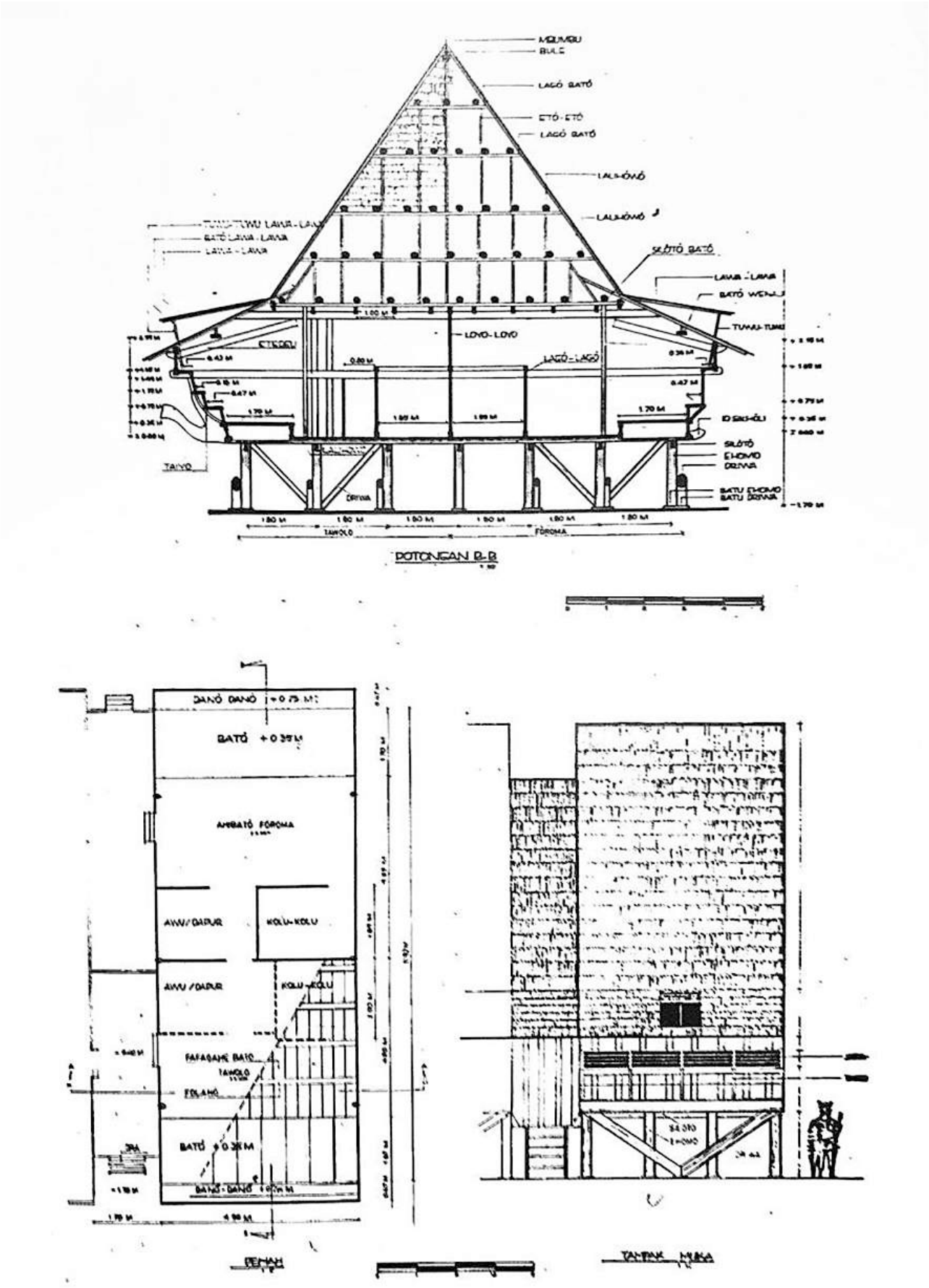


**Image 6:** Cross-sectional View of Omo Hada, Nias
*Source: BPPI (2008)*

**Planning, Designs, Technologies:** The Omo Hada design integrates seismic resilience through the use of flexible wooden frames, stone foundations (*umpak*), V-shaped bracing (*driwa*) on the ground floor pillars/columns of the stilt house, and climate adaptation components (elevation design, natural ventilation, thatched roof). Digital documentation of mortise-tenon joinery and material testing support preservation efforts. Structural and thermal performance studies by the Center for Housing and Settlement Research and Development under the Ministry of Public Works and Public Housing validate the reliability of this structural design.

## Lessons Learned

From the review of several books and literature (listed in the Readings section), the construction of Omo Hada serves as a good practice of traditional houses that are resilient to climate and disasters, as follows:

The construction uses a V-shaped cross bracing system (*driwa*) on the main pillars. This bracing absorbs horizontal earthquake forces, increases stiffness, and prevents collapse. Structural tests proved that this system increased the lateral load capacity up to 4 percent drift without failure.

The wooden poles are not planted directly on the ground, but rest on neatly arranged stone pedestals. During an earthquake, the poles can shift with the horizontal force without breaking. This technique is key to the earthquake resistance of the 300+ year old house in Bawomataluo.

The structure uses local hardwood (15 percent moisture content, according to SNI) with ductile properties (ductility ratio 2.5–3.5). The connection uses a wooden peg system without nails, allowing flexibility during earthquakes. The compressive/bending test showed that the strength of the material meets the ultimate load.

The structure is adaptive to tropical climates, where:

- Underneath the house (≈1.8 m high): reduces moisture, avoids flooding, and downdrafts.
- Sloping walls and adjustable louvers (*jerejak*): vertical openings optimize cross-ventilation and privacy.
- High roof (palm fiber/sago material): reduces heat radiation and facilitates upward flow of hot air.
- Thermal studies prove the effective temperature in Bawomataluo to be 'comfortably optimal' (22.8°–25.8°C).

Construction involves traditional rituals (*famaluwa*) and mutual cooperation. The choice of location on the hills (tsunami-safe), orientation of the house facing north, and abstinence from certain wood materials are based on local knowledge. The community is involved in preservation through research guidance.

### Implementation Challenges and Mitigation Strategies

The preservation of Omo Hada faces four main challenges, including material durability, threatened loss of craftsmanship skills, social preference for modern housing, and climate adaptation gaps. Material limitations arise from termites, tropical decay and scarce hardwoods for Omo Hada, which are mitigated by standardizing the moisture content of the wood (15 percent, as per SNI 7073:2013) and using stone step foundations to avoid contact with the ground.

The decline in the number of craftsmen and *Fanekhe Duha*, as well as youth disinterest in traditional techniques, can be addressed through artisan apprenticeships, other culture-related programmes by the Nias Heritage Museum, and digital documentation of mortise-tenon joinery.

People prefer 'modern' concrete houses since there is a misconception that Omo Hada is outdated. This was addressed by demonstrating the seismic resilience of Omo Hada, for example through lecture or seminar materials showcasing its resilience from the historical experience of the previous disaster (M8.7 earthquake in 2005) which caused only minor damage to the structure.

The zinc roof that replaced the palm fiber roof increased heat retention, as well as increased humidity. Climate risks, which were exacerbated by the zinc roof, were mitigated by reviving palm thatch and adjustable louvers (*jerejak*), which have been proven to maintain indoor temperatures. Beneficiaries include subsistence farmers and fishermen who get safe and cheap shelter, while tourism growth creates jobs.

### Scalability

Omo Hada's design is highly scalable in seismic and tropical regions. Its driwa and stilt foundation require only locally available materials (wood and stone), making it possible to replicate in similar hazard zones. In Indonesia, scalability is demonstrated through inclusion in the national disaster resilience guidelines (SNI 1726:2019 on standard earthquake resistance planning procedures for building structures). The communal *gotong royong* model reduces costs compared to contractor-led construction, enabling adoption in resource-constrained areas. Recommendations in the form of hybrid prototypes to cope with climate risks, such as combining timber frames with modern insulation, are also being widely tested and developed, showing potential for urban applications.

### Co-Benefits

This initiative resulted in multi-sectoral co-benefits, among others:

- **Cultural:** World Heritage status (e.g., Omo Hada in Bawomataluo) revitalizes traditional identity and attracts many tourists each year, as well as funding conservation.
- **Economic:** Heritage tourism creates livelihoods for many artisans as well as a sustainable source of timber supporting local forestry.
- **Environmental:** Natural ventilation and thatched roofs significantly reduce energy use and $CO_2$ emissions. Zero-carbon cooling reduces electricity dependency for low-income households.
- **Health:** Cooler indoor temperatures reduce the risk of heatstroke in a warming climate.
- **Gender Equity:** Weaving cooperatives led by women produce thatched roofs, increasing household income.

## Way Forward

Sustaining Omo Hada requires suitable policy, innovation and community action. First, integrate its seismic principles (flexible connections, diagonal bracing) into Indonesian building regulations (e.g., SNI 1726:2019) for mandatory use in high-risk zones. Second, establishing a 'Resilience Heritage Centre' could be a good recommendation to train builders in hybrid techniques (e.g., wood-concrete composites) and preserve that knowledge across generations, as well as digitize designs for modular replication. Third, allocate funds for conservation grants, prioritizing the repair of houses to make them resilient to climate change. Finally, forge partnerships between the government, private sector and research institutions. Universities can lead material research and development, while tourism developers can design low-impact heritage circuits. These steps will transform Omo Hada from a cultural artifact into a solution that can be applied in disaster-prone communities

around the world, proving that ancestral wisdom is essential in the climate crisis.

## Additional Information

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# 25. Response to Hurricane Iota: Community-Based Reconstruction Using Modern Technologies for Damage Assessment and Establishing Material Banks

Country:

Colombia

Submitted by:

United Nations Development Programme (UNDP)

- Housing
- Post-Disaster
- Owner Driven
- Enablers


## Abstract

*Following the devastation of Category 5 Hurricane Iota in November 2020, the United Nations Development Programme (UNDP) implemented a community-based reconstruction initiative in Colombia's San Andrés, Providencia and Santa Catalina archipelago.*

*The initiative utilized Housing and Building Damage Assessment (HBDA), deploying modern technologies such as drones and satellite imagery to rapidly georeference damage and prioritize support for the most vulnerable populations. A pilot housing repair project, centred on a materials bank, empowered local workers and families by providing them with construction materials, technical guidance and training. This approach accelerated recovery, strengthened local economies by using local supply chains, and fostered community ownership. The case study demonstrates a successful and scalable model for resilient and participatory recovery in disaster-prone regions.*


## Introduction to the Initiative

On 15 November 2020, the archipelago of San Andrés, Providencia and Santa Catalina, located in the Colombian Caribbean, was hit by Category 5 Hurricane Iota. The hurricane had a devastating impact on the islands, claiming the lives of at least two people and affecting 93.3 percent of buildings. UNDP implemented a Housing and Building Damage Assessment (HBDA) to guide reconstruction, using drones, satellite imagery and socioeconomic data to prioritize support for the most vulnerable. A pilot housing repair initiative empowered local workers and families to rebuild with technical guidance and materials, emphasizing climate-resilient construction and community ownership. These efforts reflect a shift toward more participatory, sustainable and culturally respectful recovery in Providencia.

The initiative was coordinated with the Disaster Risk Management

Unit, the provincial governments, the Colombian Society of Engineers, and the intervening communities, including the local workforce and native foremen.

## Process and Impact of the Initiative

The UNDP HBDA assessment complements the first assessment conducted by the government, which focused on humanitarian response, and incorporates a larger number of socioeconomic variables to analyse the impact of the hurricane. The HBDA's original methodology, which included 243 questions to assess structural damage to affected buildings, was supplemented with socioeconomic information from the surveyed households. This guided post-crisis stabilization and development decisions.

The process included:

- negotiation with counterparts
- adaptation of data collection tools and review of secondary sources of information, both pre-crisis and post-crisis, collected by other actors
- development of technological resources for the operation, such as satellite imagery, data visualization sites, etc. and hiring and training of HBDA staff
- conducting visual inspections and uploading inspection data

Data collection was supported by field technology resources, such as the use of drones and 360-degree cameras to capture aerial images. This allowed for a detailed review of the damage and its georeferencing, as well as the magnitude of the impact and, above all, access to areas with limited mobility.

The assessment analysed 1,241 infrastructure units: 1,142 in Providencia and 99 in Santa Catalina. The assessment provided general information on the level of damage to roofs and/or walls, determined whether buildings suffered apparent damage to their foundations or floors, and classified the infrastructure units according to the damage categories. The information gathered in this rapid characterization exercise allowed for the prioritization of deliveries from the Materials Bank to provide shelter to the population in the short term, as well as prioritizing the subsequent phase of repairs and reconstruction.

To accelerate the recovery process, and considering that families were already beginning self-construction, UNDP proposed a pilot intervention in which people with construction knowledge would have access to materials and support to independently repair projects with improved construction standards. Those without knowledge also received support with technical advice from the Colombian Society of Engineers, studies and designs, and native island foremen.

In this pilot project, priorities were established using the following criteria: adults over 60 years of age; people with physical and/or mental disabilities; people with chronic illnesses; separated or unaccompanied minors; pregnant women; families with 100 percent roof damage and 50 percent wall damage; homes up to 80 square metres.

Additionally, through the Materials Bank, support was provided to approximately 15 additional families who needed tiles, wood, cement or tools they had in stock, so they could manage their own repairs with the appropriate guidance of technicians from the Infrastructure for Development program. Some of the most significant results are:

- The empowerment and positioning of the local workforce
- The opportunity to provide a source of income through work

**Image 1:** Community-based reconstruction in Colombia

- Facilitating the process of acquiring and deploying materials on the island during the crisis
- Creating trusted networks with the community to attract human talent with experience in repair and reconstruction processes
- Purchasing materials for the repair process from local companies
- Training in administrative matters

## Lessons Learned

### Challenges and Mitigation Measures

**Access to the affected areas:** Technological support deployed on the ground, such as the use of satellite imagery, drone images, and 360-degree cameras, enabled access to locations with limited mobility due to the disaster for a more detailed review of the damage. This not only saved resources and effort but also provided

more accurate information on the extent of the damage and its georeferencing. Without these tools, many buildings would not have been easily identified by field teams.

**Challenges in institutional coordination:** Better coordination between cooperating agencies and response entities was required. In this regard, the Early Recovery Cluster has been working since mid-2021 on coordination, the exchange of experiences and knowledge, as well as the joint design and development of the National Strategy for Resilient Recovery.

There was also the challenge of implementing a logistics chain in a location lacking stable supply chains due to the devastation caused by the disaster. This has budgetary implications and leads to time delays, material losses, and, in many cases, political implications. Therefore, a national list of potential proponents was established to activate supply channels from the main production centres, either directly to the organization or to local businesses that can sustain the operation.

### Potential for Scaling Up

The potential to scale up the UNDP housing recovery initiative in Providencia is strong, especially given the success of the pilot and the lessons learned. Here are three key areas where scaling is feasible and impactful:

**Community-based reconstruction model:** The pilot demonstrated that empowering local workers and families with materials, training and technical support leads to faster, more resilient and culturally appropriate reconstruction. This model can be scaled across other hurricane-affected areas in Colombia or the Caribbean, especially where logistics are challenging and community trust is essential.

**Use of technology for damage assessment:** The HBDA's use of drones, 360-degree cameras and georeferenced data collection proved effective in rapidly assessing damage and prioritizing interventions. This tech-enabled approach can be replicated in other disaster-prone regions to improve response speed and accuracy, especially in remote or insular communities.

**Materials bank and local supply chains:** The Materials Bank concept – providing families with access to construction materials and tools – can be expanded to support broader self-recovery efforts. By sourcing materials locally and integrating technical guidance, this approach strengthens local economies while accelerating reconstruction.

## Additional Information

### Video Links

PNUD Colombia. (2021). Sobrevuelo 360 Isla de Providencia Desastre IOTA. https://youtu.be/5GSOe0_9tT8

Build Change. (2023). Build Change Advances Landmark Seismic Resilience Guideline. https://youtu.be/4lLYtZYStsM?si=MdijZaFvXsRlVIuS

### Readings

UNDP. (2021). Del desastre a la recuperación: así es la reconstrucción 360 del archipiélago de San Andrés, Providencia y Santa Catalina. https://www.undp.org/es/colombia/noticias/del-desastre-la-recuperacion-asi-es-la-reconstruccion-360-del-archipielago-de-san-andres-providencia-y-santa-catalina

UNDP. Uso de nuevas tecnologías de información para dar respuesta a catástrofes. https://www.undp.org/es/colombia/uso-de-nuevas-tecnologias-de-informacion-para-dar-respuesta-catastrofes

# 26. Advisory Issued by NDMA on Heatwave Protection and Mitigation in Housing and Human Settlements

Country:

India

Submitted by:

National Disaster Management Authority, India

- Housing
- Enablers


## Abstract

*India faces a growing threat from heatwaves, which disproportionately affect vulnerable, low-income settlements with thermally inadequate housing. In response, the National Disaster Management Authority (NDMA) issued a 2025 advisory to guide states and Union Territories (UTs) in implementing a tiered framework for heatwave protection. This initiative promotes a comprehensive approach, from immediate community-level interventions to long-term policy reforms for embedding resilience in housing and human settlements.*


## Introduction to the Initiative

In addition to the National Guidelines for preparation of action plan for the prevention and management of heatwaves, released in 2019, the National Disaster Management Authority (NDMA) has in 2025 issued a specific advisory on heatwave protection and mitigation in housing and human settlements. The advisory was circulated to all the state governments and UTs in India.

India has witnessed a sharp rise in the frequency, intensity and duration of heatwaves over the past decade, exacerbated by urban expansion, deforestation, climate change and socioeconomic vulnerabilities. Heatwaves are now classified as a major disaster risk under the Disaster Management Act, 2005. Housing remains a critical area of concern for heatwave protection, considering that India has a significant amount of informal housing stock and that several new housing programmes such as PMAY (U/G) (Pradhan Mantri Awas Yojana urban/rural) are currently under way.

The impacts of heat are most acutely felt in low-income and densely populated settlements – including informal settlements, slums, worker colonies and far-flung rural habitations that are underserved, where housing structures lack thermal comfort, and communities have limited access to cooling, water or early warning systems. The increasing occurrence of heatwaves, as also rapid urbanization and its resultant effects – such as urban heat islands,

limited green cover and non-reflective building materials – contribute to dangerously high indoor temperatures. This calls for attention not only to housing but also to human settlement planning.

As a result, many states and districts across India, in alignment with the 2019 National Guidelines have prepared their Heat Action Plans (HAPs) and have focussed on the vulnerability of slums and informal settlements against extreme heat.

This advisory further aims to guide all States/UTs to urgently implement and integrate heatwave protection strategies into housing, human settlements and planning practices – across both rural and urban contexts – to protect vulnerable populations and build long-term resilience to heatwaves in India.

## Process of the Initiative

### Framework for Action

States/UTs are advised to adopt a three-tiered framework: Immediate Relief, Medium-Term Actions, and Long-Term Actions, supported by cross-cutting governance, stakeholder engagement and financing mechanisms.

### Immediate Measures

**Map and prioritize vulnerable settlements:** Identify and map vulnerable urban and rural settlements using socioeconomic, disaster and climate vulnerability indicators – focusing on informal settlements, slums, rural hamlets and areas with high surface temperatures (urban heat islands). Different settlement typologies and their needs must be addressed specifically.

**Locate vulnerable population groups:** Prioritize interventions in areas inhabited by the elderly, children, persons with disabilities, outdoor workers and other marginalized communities.

**Community awareness and heat preparedness:** Disseminate heat safety 'Dos and Don'ts' through IEC campaigns, community radio stations, local volunteers and public health workers. Campaigns should be organized at the settlement level via residents' welfare associations, CBOs, Accredited Social Health Activist (ASHA) workers, SHGs, and local volunteers.

**Community water-shade points, emergency cooling and shelter provisions:** Set up cooling centres, water points, shaded areas, oral rehydration salt distribution and fans at the settlement level based on community vulnerabilities and needs.

**Heat-resilient low-cost modifications in existing homes:** Promote affordable cool roof techniques (e.g., white paint, solar reflective materials, insulating overlays) through urban local bodies, panchayats (village councils) and CSOs. Encourage the use of jute mats, ventilated shading, curtains and water sprinkling around homes. Promote rooftop water tanks with insulation. Local adaptation is essential.

### Medium-Term Measures

**Mainstream heat resilience in all housing schemes:** Integrate passive cooling design principles in PMAY (Urban and Gramin), rental housing and other affordable housing schemes. Promote materials with high thermal performance (e.g., fly ash bricks, CSEBs, lime plaster, bamboo composites). Settlement layouts must include adequate ventilation, green spaces and shaded common areas. Revise detailed project reports for PMAY and AMRUT (Atal Mission for Rejuvenation and Urban Transformation) schemes to mandate climate resilience indicators and heat adaptation standards.

**Upgrade human settlements with resilience measures:** Implement in-situ upgradation plans

that include heat-resilient roofs, improved ventilation and retrofitting of existing homes. At the settlement level, improve access to water, electricity, shading and greenery. Enable partnerships with CBOs, RWAs, CSOs and housing collectives to co-develop heat mitigation improvements. Promote tree planting and green layout planning.

**Adopt and enforce the Eco-Niwas Samhita (ENS):** States/UTs are advised to adopt ENS – the energy conservation building code for residential buildings – as notified by the Bureau of Energy Efficiency (BEE). ENS guides thermal comfort, energy efficiency, daylighting and ventilation, especially in hot and composite climates. Integrate ENS into PMAY and other schemes through building approvals, tender documents and layout designs.

Adopt additional climate-resilient standards: Adopt further standards/guidelines on thermally comfortable and climate-resilient housing and settlement planning as issued by the Ministry of Housing and Urban Affairs, BEE or other competent authorities.

### Policy-Level Measures

**Mainstream heat resilience in housing programmes and policies:** Incorporate passive design, thermal comfort standards and appropriate material use into building byelaws, master plans and housing scheme guidelines.

Adopt thermal comfort as a housing prerequisite: Recognize thermal comfort as a core component of safe and adequate housing and settlement planning. Ensure minimum housing standards for climate resilience in all new constructions, especially for low-income groups.

**Climate-informed urban and rural land use planning:** Promote zoning and planning practices that reduce heat exposure, including mixed-use layouts, shaded open spaces and low-rise developments with adequate ventilation.

Capacity building: Key initiatives focus on two main areas of capacity development:

- **Awareness and Education:** Targeted campaigns and the dissemination of multilingual toolkits and guides to educate households, workers and entire communities on heat risks and practical, heat-adaptive measures.
- **Skill Development:** Training of professionals and skilled labourers, including architects, engineers, masons and construction workers on heat-resilient housing design, the use of climate-appropriate materials and proper maintenance practices.

## Impact of the Initiative

Integrating Heat Action Plans in housing and built environment components would likely lead to several significant impacts:

**Enhanced Urban Governance and Planning:** Policy integrations would formalize heat resilience within city, district and state-level planning as a core governance function. Prioritizing vulnerable settlements and affordable housing ensures that planning efforts are equitable and target the most at-risk populations.

**Systemic Mainstreaming of Resilience:** Integrating passive cooling principles and thermal performance standards into housing schemes like PMAY would ensure that future housing stock is inherently heat-resilient. This moves the approach from a reactive, post-disaster response to a proactive, preventative strategy.

**Enhanced Housing Quality and Standards:** The adoption and enforcement of standards like the Eco-Niwas Samhita (ENS) would formalize

thermal comfort as a prerequisite for safe housing, raising the overall quality of new construction, particularly for low-income groups.

**Localized Adaptation:** The promotion of low-cost, heat-resilient modifications and the use of natural materials would enable households to take immediate action and would empower communities to improve the thermal comfort of their existing homes without requiring large-scale capital investments.

## Additional Information

### Readings

National Disaster Management Authority, India. (2019). Prevention and Management of Heat Wave. https://nidm.gov.in/PDF/pubs/NDMA/27.pdf

National Disaster Management Authority, India. (2025). Advisory on Heatwave Protection in Housing and Human Settlements. https://ndma.gov.in/sites/default/files/PDF/Reports/Advisory-Housing.pdf

# Advancing Disaster Resilient Housing and Facilities

# Advancing Disaster Resilient Housing and Facilities

The 26 case studies included in this Compendium provide a wide range of resilient interventions which could be adapted in different contexts with necessary modifications. This chapter summarizes the lessons learned and the key recommendations emerging out of these case studies which may support advancement of disaster resilient housing and facilities in different geographies and hazards and governance contexts.

## Lessons Learned

### Policy, Building Codes, Building Byelaws, and Regulations

- Resilient housing and facilities' development needs national policies providing comprehensive guidelines for ensuring consistency among building codes, regulations, and their enforcement.
- Having an institutional system for training, assessment, and certification of construction workers on resilient construction underpins successful efforts towards resilient housing and facilities.
- Retrofitting can be a significant opportunity on a national scale to reduce the vulnerability of the existing housing stock and amplify the impact of risk mitigation efforts. A technology-based data acquisition system for retrofitting need assessment of the existing housing stock is a cost-effective method for quick response.
- Adaptation of traditional architecture based on local materials and culture, and its further inclusion in the building codes and regulations needs technology-validation by appropriate institutes and authorities.
- Land tenure insecurity could be mitigated through legal training and distribution of land lease certificates, especially empowering female-headed households.

### Planning, Design and Implementation

- The Owner-Driven Housing Approach is democratic, transparent, reduces construction cost, induces ownership of the process, and strengthens long-term resilience. Women-led housing programmes are a proven system of resilient housing delivery.
- Post-disaster owner-driven housing recovery involves multiple actors and needs strong coordination to avoid overlapping/duplication of activities.
- Beneficiary selection process for any housing programme needs to be inclusive and gender-responsive. Very often, post-disaster housing recovery focuses on affected houseowners only. There is a need to include the affected tenants as well.
- Using modern technologies (satellite imagery, drone images, 360-degree cameras, etc.) enables fast and high-quality damage assessment data collection, especially in remote or insular communities, and reduces verification time.
- Retrofitting, wherever cost-effective, can be an alternative to new construction.
- Participatory designs prepared by the beneficiaries make housing affordable and local culture-sensitive and fulfils people's aspirations.
- Use of traditional techniques preserves the local-level aesthetic character and cultural identity of a place.

- Zero-carbon cooling, natural ventilation, and cool roofs significantly reduce energy use and $CO_2$ emission.

### Materials and Technologies

- Use of local green materials, engaging trained construction workers, and beneficiary-managed construction reduces building cost and enhances quality of construction.
- Procurement of substandard, non-durable materials in a post-disaster situation often undermines the Build Back Better objectives. In post-disaster situations, reconstruction efforts trigger a sudden spike in demand for materials and labour, leading to increase in cost and delays due to unavailability of materials. This can be addressed by using locally available construction materials and ensuring an efficient procurement system.
- Use of local materials helps strengthen local supply chains and create livelihood opportunities. The use of treated bamboo and compressed cement-lime stabilized mud blocks in construction have reduced costs and $CO_2$ emission and created livelihood opportunities for the local entrepreneurs and women's self-help groups.
- In a few post-disaster situations, setting up of material banks for providing access to construction materials and tools to the affected families worked well. Local micro and small enterprises producing construction materials to support post-disaster housing recovery is an effective model to meet the demand while also seizing the economic opportunity.

### Awareness and Capacity Building

- Limited risk and resilience literacy among stakeholders could be overcome by undertaking mass awareness programmes, community-based risk reduction planning, and school safety education. Culturally sensitive simplified trainings can be delivered for homeowners in local languages and through hands-on activities.
- Local builders, construction workers, engineers, and inspectors need training in resilient construction techniques to implement resilience standards in new house construction and retrofitting of existing houses.

### Financing

- Strengthening financial support mechanisms is essential for advancing resilient housing reconstruction. The upfront costs to implement resilient designs and technologies are often prohibitive, and vulnerable households often struggle to meet co-financing requirements. Use of locally available resources and availability of an alternative funding system supported by the government and other development partners may help to overcome the financial gaps.
- Enablers like energy discount schemes designed to help low-income and vulnerable households, subsidies for retrofitting, and extreme heat management guidelines for housing and settlements help generate concrete actions at the local level and contribute towards building resilience of the local communities.

## Recommendations

Resilient housing requires a comprehensive approach with active engagement of a wide range of stakeholders (governments, communities, and private actors) and concrete actions like awareness and advocacy, disaster and climate risk assessment, application of

technologies, mobilization of finances, governance, knowledge, and skill building. Based on the lessons which emerged from the various case studies, three key recommendations have been put forward for governments/people/NGOs and all other relevant stakeholders to promote and facilitate resilient housing and facilities in any hazard-prone context. Each key recommendation is then divided into further actions that will be needed to implement the recommendation.

These recommendations are structured to be the necessary steps for any government to create an enabling environment for enhancing demand and supply of disaster resilient housing and facilities.

### 1. Bring People Centre Stage

**Participatory planning and design:** People are the key stakeholders in the process of achieving resilient housing and facilities. The first step in encouraging them to demand disaster resilient housing is to make them risk-literate. Risk literacy may be improved by making them aware about the degree of risk of their current living place by using hazard and vulnerability maps, providing easy access to granular risk information, information about various resilient construction techniques of retrofitting, the upper limit of retrofitting costs compared to rebuilding, and cost-benefit analysis. Governments will need to adopt culturally suitable awareness campaigns and easy-to-understand communication practices to achieve it.

**Owner-driven approaches:** The second step will be to adopt owner-driven processes for building and rebuilding – especially in post-disaster contexts. Owner-driven (OD) approaches have been established as a successful and sustainable model to build housing as well as allied facility buildings. A participatory process that spans the entire project lifecycle fosters democratic decision-making and transparency, and ensures that no one is left behind. Housing designs that are prepared by the people are aligned to their needs and aspirations, and culturally sensitive. Such housing and facility design also needs to be gender-sensitive and to take into consideration the needs of persons with disabilities (PWDs).

### 2. Create an Ecosystem for Resilient Housing and Facilities

Governments at all levels will need to ensure that all households, especially those with low incomes, have access to land, materials, professional services, and finance to either access disaster resilient housing from markets or are able build their own. This will require four actions.

**Reforming policies, codes, standards, and regulations and their enforcement:** Governments will need to review existing policies for housing and facilities based on the impacts of past disasters. National codes will need to be updated from time to time in light of the latest knowledge. The municipal/urban local bodies' building byelaws and construction standards and guidelines will need to be reviewed and updated to comply with national building codes. Adequate number of building inspectors with knowledge of resilient construction will be needed to ensure that building construction works comply with building byelaws and regulations. All codes and standards will have to account for regional and local needs. Also necessary are technology-based standards and regulations which include building codes, zoning regulations, and other rules that regulate technological activities. Construction guidelines need to encourage utilization of local building materials, less energy-intensive construction techniques, and traditional construction systems

which have proven to be disaster resilient.

**Embrace traditional wisdom:** Traditional wisdom on thermal resilience and multi-hazard safety exists in all countries. These traditional practices need to be examined and upgraded to present safety standards and adapted in the construction of housing and facilities. Adaptation of traditional architecture will reinforce community trust in their traditional building knowledge and enrich the cultural landscape of a place. Such practices are generally cost-effective, environment-friendly, and represent regional identity. There is a strong need for the inclusion of such techniques in existing building codes.

**Enhance access to habitable land:** Human habitation requires a secure plot of land with access to basic services. Land in the urban areas is scarce and expensive. Even in rural areas, many households which are either marginalized or are living below the poverty line may not have access to land. This might push them to build houses on plots located in higher-risk areas prone to landslide, flooding, earthquakes, etc. Setting up a system that ensures equitable access to habitable land and the provision of security of tenure with legal protection against forced evictions, harassment, and other threats is most essential.

**Enhance access to construction subsidies, finance, and home insurance:** For new and resilient construction or for retrofitting an existing house with resilient features, a household may require access to affordable loans as household savings may not be sufficient. One of the crucial issues in housing finance for informal settlements is the collateral required by the banks / financial institutions for loans, which is often unavailable. Hence, enhancing access to housing finance is crucial.

Another prevalent gap especially in many low-income countries is adequate access to housing insurance. Premiums are high in high-risk locations, which are often unaffordable for low-income households and hence, there is a need for innovation in this regard. National governments could undertake innovative finance and insurance mechanisms that are able to cover all kinds of households to enhance resilience.

Subsidies may support enhancement of resilience against certain hazards. Such subsidies include those for undertaking seismic risk assessments and retrofitting of housing at a reduced personal cost to meet current seismic standards; home improvement subsidies that promote a variety of non-structural and structural improvements such as passive design, application of traditional knowledge, and natural cooling systems; and subsidies for reducing household heating and cooling costs to improve thermal comfort and support vulnerable households.

**Build capacities of construction stakeholders:** Post-disaster needs assessments conducted in many parts of the world have revealed that one of the major causes of building collapse / severe damage was non-compliance with existing building codes and safety standards. This could be attributed to inadequate knowledge of resilient construction among engineers and construction workers. Additionally, there is a shortage of professionally trained engineers and architects for retrofitting works. Governments need to devise a rapid and cost-effective building assessment method for large-scale retrofitting; conduct periodic training of construction workers, architects, and engineers to promote resilient construction for all new housing; and establish a system for certificate training programmes and courses.

**Promote knowledge exchange through international cooperation:** There is a need to promote collaborative research with the countries where resilient housing has successfully been implemented, especially retrofitting measures. Good examples of innovations in materials and technologies, effective financing systems, and resilience-inducing building codes and standards can all be widely disseminated. Countries and regions can cooperate to share resources, expertise, and good practices to build resilient and sustainable housing for all.

### 3. Set Up Systems for Resilient and Speedy Post-Disaster Housing Recovery

**Rapid damage and needs assessment:** Deploy modern technologies such as drones and satellite imagery for acquiring rapid damage assessment data in difficult terrain, especially after a disaster.

**Skill-building:** Conduct periodic training of construction workers and engineers on resilient retrofitting and new construction. Establish an institutional system for training and certification of masons on resilient reconstruction and retrofitting. Such skill-building activities also create livelihood opportunities for local communities. Encourage capacity-building of women construction workers.

**Material bank and micro and small enterprises:** To meet the high demand for materials in post-disaster housing and facilities recovery situations, establish a material bank or support micro and small enterprises to ensure timely delivery of high-quality construction. Provide socio-technical assistance to the affected houseowners during the reconstruction process.

**Systems for housing stock assessments and registers:** In many countries, data on the existing housing stock is often not updated and information on the age of the buildings, structural typologies, and engineered/non-engineered construction is not available. Governments should create systems to generate data on the existing housing stock. Countries should also develop tools for conducting housing stock risk assessment and post-disaster damage and need assessments.

# Important Reference Documents

# Important Reference Documents

## Model Guidelines

### Compendium of Indigenous Innovative Building Materials and Construction Technologies (2021)

Ministry of Housing and Urban Affairs, Government of India

The document is a compendium of 73 innovative construction technologies bucketed under four categories, namely (a) Building system products, (b) Products/technologies primarily from recycling of industrial/agricultural wastes, waste management systems, (c)Materials/components (doors, windows, construction chemicals, insulation, plumbing, plastering, machinery), and (d) Technology already shortlisted under Global Housing Technology Challenge (GHTC)-India

### Compendium of Prospective Emerging Technologies for Mass Housing (2017)

Ministry of Housing and Urban Affairs, Government of India

The compendium consists of 16 innovative construction systems for development of mass housing. They include (a) Formwork Systems, (b) Precast Sandwich Panel Systems, (c) Light Gauge Steel Structural Systems, and (d) Steel Structural Systems

### Compendium of Traditional Earthquake Resilient Construction (2023)

National Disaster Management Authority, India

The document aims to identify and understand traditional building construction practices of northern and northeastern states in India and their associated essential siting and architectural and structural features imparting earthquake resilience to them. The document also focuses on identifying traditional buildings and suggesting suitable safety measures for strengthening them using state-of-the-art measures available in literature.

## Resilient Housing Guidance for the Maldives (2024)

World Bank

This guidance document was developed following assessments of existing housing conditions and construction practices; interviews on selected islands; and a continuous, consultative process, supported by focus group discussions, stakeholder forums, and one-on-one meetings with island councils, local practitioners, and contractors and homeowners with regular inputs from the core team at the Ministry of Construction and Infrastructure. The recommendation in this Guidance is based on international best practices and engineering design calculations for the Maldivian context.

## Prakriti Hunar Lokvidya (PAHAL) (2016)

Ministry of Rural Development, Government of India

The document identifies the process of developing housing typologies for clearly identifiable housing zones in 10 states of India. Housing zones in each of the selected states were identified based on local materials and technologies, vulnerability to disasters/hazards, livelihood aspects linked to housing designs, and existing community skills. The effort has been to develop at least one representative housing design typology for a particular housing zone. The designs have been validated through state-level consultants with concerned stakeholders including government officials, engineers, local architects, masons, and especially, rural communities.

## The Build Change Guide to Resilient Housing (2021)

Build Change

The guide has been designed as an essential handbook for governments, practitioners, and funders of home improvement programmes to successfully execute a resilient housing programme or to enhance their existing one. It is both a summary of the Build Change philosophy and model, and a practical manual focused on the design of national strategies, and operational and investment plans. The guide includes detailed examples and case studies from housing programmes around the world, to demonstrate how the Build Change model is being applied across a wide range of contexts. The guide is intended for use in all places where there is a qualitative housing deficit, and in areas at risk from earthquakes and windstorms.

**The guidance relates to improving residential structures of three storeys or fewer.**

## Global Building Resilience Guidelines (2022)

International Code Council

Global Building Resilience Guidelines are intended to inform and encourage the development of building codes that incorporate future-focused climate resilience. The Guidelines are relevant for all building code and standards-writing bodies. The Guidelines are organized around principles that provide a basis for advancing building resilience through building codes. The Guidelines also consider the need for the upgrade of existing buildings, and maintenance and compliance processes for all buildings, even though these fall outside the typical scope of most code development bodies.

## Resilient Building Codes Toolkit (2022)

US Department of Housing and Urban Development

The intent of this guide is to bring transparency and clarity to building codes, especially with respect to resilience. The main objective of this work is to create a centralized repository and platform that allows the building community to navigate an otherwise challenging environment. Ultimately, the goal is to enhance resilience in the built environment, specifically with respect to housing and other critical building assets.

## Heatwave Action: House Owners' Guide to Alternate Roof Cooling Solutions (2021)

National Disaster Management Authority, India

The handbook guides homeowners in the Indian climatic context on affordable, easy-to-use roof cooling solutions for existing homes, tackling rising indoor temperatures and the urban heat island effect. It considers local typologies and climate zones, ensuring practical, effective choices.

## National Guidelines for Preparation of Action Plan – Prevention and Management of Heat Wave (2019)

National Disaster Management Authority, India

The guideline aims to provide a framework for developing heat action plans for implementation, inter-agency coordination, and impact evaluation of heatwave response activities in cities/towns. The guideline examines the underlying reasons for extreme temperatures, strategies for dissemination of information and early warnings, key steps involved in development of action plans, and the creation of a national-level disaster database to enable policy decisions.

## Building Regulation for Resilience (2015)

World Bank

This document analyses the regulatory capacity for disaster risk reduction, highlighting lessons, experiences and challenges in the building regulation process. It proposes an integrated, programmatic approach with seven major priorities and practical measures to close the implementation gap. The agenda suggests that international regulatory governance can be a powerful tool for proactively protecting populations, avoiding disasters, and promoting sustainable, resilient urban development, particularly in vulnerable low- and middle-income countries.

## A Global Assessment of Building Codes (2025)

World Bank
Global Facility for Disaster Reduction and Recovery (GFDRR)
Inter-American Development Bank (IDB)

Rapid global urbanization necessitates enhanced building codes to ensure the future built environment is safe and resilient. This report assesses building codes in three key areas – structural safety, green building, and accessibility – to support policymakers in creating sustainable and adaptable cities that can withstand climate impacts and rapid growth.

### Roadmap for Safer Schools (2017)

Global Facility for Disaster Reduction and Recovery (GFDRR)

This roadmap document outlines a strategic approach to enhancing the safety of school infrastructure. Grounded in Pillar 1 of the Comprehensive School Safety (CSS) Framework, it emphasizes that effective school safety requires a thorough understanding of the entire project lifecycle, from planning and design through to maintenance. The document advocates for a coordinated investment strategy that links improvements in school infrastructure with broader initiatives in school disaster management and risk reduction education, ensuring maximum impact at both community and national levels.

## Collections of Case Studies

### Compendium of best practices for housing in Africa (2021)

Habitat for Humanity

The document presents positive stories (19 best-practice cases from innovative experiences in 11 African countries) of change in the areas of adequate and affordable housing, including basic services, land tenure, and slum upgrading within Africa. These stories clarify the context, actors, steps taken, results, impact, and lessons learned. They illustrate innovations and cutting-edge practical applications while demonstrating effective practices that can be replicated and scaled.

### Compendium of Programs and Mechanisms for Funding Infrastructure Resilience (2025)

Cybersecurity and Infrastructure Security Agency, USA

This compendium catalogues federal, state, and non-governmental programmes and funding mechanisms with the potential to finance and support efforts to enhance infrastructure resilience and security. This list identifies potential funding and technical assistance programmes and sources that can help communities make infrastructure resilience and security a reality.

### A Compendium of Good Practices on Disaster Resilient Infrastructure (DRI) (2024)

Coalition for Disaster Resilient Infrastructure

The document provides insights into and practical examples of strategies for resilient infrastructure. It highlights the importance of context-specific solutions and demonstrates that infrastructure resilience requires strategies tailored to local conditions, risks, and capacities. The compendium also demonstrates that an understanding of social vulnerabilities and inclusivity has a critical role in achieving infrastructure resilience.

### Roof Over Our Heads (ROOH) – Volume II (2024)

Society for Promotion of Area Resource Centres (SPARC)

The book documents the challenges faced by informal communities in the face of climate change. This publication, which includes a 'crucible for change,' showcases the vulnerabilities of these communities and highlights their coping mechanisms.

## Policy Documents

### Pre-Disaster Housing Planning Guide (2024)

Federal Emergency Management Agency, USA

This document provides guidance for State, Local, Tribal, and Territorial (SLTT) governments on developing and implementing pre-disaster housing plans and strategies. It is organized according to three key topic areas (planning and preparedness; partner identification, organization, and coordination; and disaster housing transition strategy) for SLTT governments to consider when planning for, coordinating, and executing a post-disaster housing recovery strategy.

## Research Documents

### Resilient and Sustainable Housing Models against Climate Change: A Review (2023)

Ruíz, M. A., & Mack-Vergara, Y. L. (2023)

The study contextualizes the concepts of urban resilience and sustainability against climate change so that housing models that respond to these concepts could be identified. As a result of an extensive literature review, three resilient housing models and four sustainable housing models are presented and discussed with a focus on the main characteristics necessary for meeting urban resilience and sustainability against climate change.

### Estimating the benefits of Climate Resilient Buildings and Core Public Infrastructure (CRBCPI) (2020)

Institute for Catastrophic Loss Reduction

This project estimates the benefits of the Climate Resilient Buildings and Core Public Infrastructure (CRBCPI) programme using an economic analysis method called benefit transfer. It quantifies benefits in terms of the present value of avoided future economic and life-safety losses, both in dollar terms and in terms of lives saved and nonfatal injuries avoided. It also describes less tangible benefits in qualitative terms, such as by characterizing the initiative's contribution to Canadians' peace of mind and how the initiative will facilitate better informed, less expensive decision-making by smaller local governments.

### Housing Reconstruction in Post-Earthquake Gujarat (2006)

Overseas Development Institute

This paper aims to contribute to housing construction post-disaster through participatory strategies by way of an exploration of local perceptions of housing reconstruction in the aftermath of the earthquake that hit Gujarat in India on 26 January 2001. Through comparative analysis, it explores five different approaches: the owner-driven approach; the subsidiary housing approach; the participatory housing approach; the contractor-driven approach in situ; and the contractor-driven approach ex nihilo.

*This document is a launch edition*
*and may undergo minor changes in design.*

**Coalition for Disaster Resilient Infrastructure (CDRI)**

4th & 5th Floor, Bharatiya Kala Kendra, 1, Copernicus Marg, New Delhi - 110001, India
**Email:** info@cdri.world **Telephone:** +91 11 4044 5999 **Website:** www.cdri.world

@CDRI_world @coalition-for-disaster-resilient-infrastructure @coalitionfordri