

Resilient Mountain Village: A Pilot Demonstration Project on Earthquake Reconstruction and Rehabilitation in Dhungentar, Nuwakot

Project Report

November 2018

FOR MOUNTAINS AND PEOPLE



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Contents

Executive Summary	iv
1. Introduction	1
1.1 Introduction to Dhungentar	1
1.2 Resilient Mountain Village Concept	3
2. Disaster-Resilient Infrastructure	5
2.1 Pre- and Post-Earthquake Infrastructure Status	5
2.2 Reconstruction Support Modality and Technologies	6
2.3 Road, Trail, and Bridge Construction	8
3. Community Mobilization and Capacity Development	11
3.1 Community Familiarization	11
3.2 Local Community Organizations	12
3.3 Community Spaces	14
4. Livelihoods and Enterprise Development	17
4.1 Local Block Production	17
4.2 Livelihood Training Programmes	19
4.3 Agriculture Model: An Integrated Farming System for Diversified Income	22
4.4 Workstation Improvement	24
5. Access to Services and Environment Improvement	26
5.1 Water and Health	26
5.2 Technology	27
5.3 Environment	28
5.4 Model House: Promoting Environment-friendly & Self-sustaining Households	29
6. Lessons Learned	31
7. References	34
8. Project Partners	35

Executive Summary

In the aftermath of the catastrophic 2015 earthquake in Nepal, ICIMOD – as an intergovernmental organization committed to knowledge generation and development in the Hindu Kush Himalaya –focused on initiating reconstruction efforts, promoting long-term recovery, and building resilience among mountain communities.

Accordingly, in partnership with the National Reconstruction Authority (NRA) and with support from the International Development Research Centre (IDRC), ICIMOD implemented a pilot demonstration project from April 2016 to September 2018 – ‘Resilient Mountain Village: A Pilot Demonstration Project on Earthquake Reconstruction and Rehabilitation in Dhungentar, Nuwakot’. This report presents the wide range of reconstruction and development activities undertaken in Dhungentar by ICIMOD.

The report begins with an introduction to Dhungentar’s socioeconomic landscape and post-disaster status. The vulnerabilities and challenges faced by the community are pointed out, and the project’s approach and aims are also discussed (p. 1). Project activities were shaped by the concept of resilient mountain villages, which involves an integrated approach to sustainable development. This project focused on building structures – both physical and social – that would support the community during shocks. Further, Dhungentar’s socioeconomic condition was uplifted in collaboration with local institutions, government agencies, private-sector partners, and, most importantly, the community itself. Local engagement and resilience building therefore underpinned all project activities.

With all houses except one classified as fully damaged in the aftermath of the earthquake, the pressing need for disaster-resilient infrastructure in Dhungentar was apparent. Secure infrastructure is particularly important in Dhungentar given the settlement’s socioeconomic fragility, which makes it difficult to recover from shocks. Accordingly, this pilot demonstration project focused on building disaster-resilient houses and toilets, along with improving road connectivity within and to the settlement to stimulate development and ensure future resilience against disasters (p. 5).

The engagement of community members is integral to the development of any community. This project sought to mobilize locals in the reconstruction and rehabilitation process using a participatory approach, encouraging community ownership to ensure lasting development (p. 11). Different local community organizations were formed to entrust greater decision-making responsibility to the community. Similarly, community congregation areas were improved and constructed to create better spaces for discussion, learning, and growth.

Marginalized and Dalit communities constitute an overwhelming majority of the Dhungentar settlement, and their economic insecurity is highlighted by dependence on subsistence agriculture and traditional, low-earning occupations. The income-earning population is largely composed of men, and a sizeable segment of the community has migrated abroad for employment. Accordingly, this project focused its rehabilitation activities on improving livelihoods and laying the foundation for the establishment of local enterprises capable of uplifting the entire settlement (p. 17). Particular emphasis was placed on organising training programmes on income-generating skills, mobilising the untapped women workforce, and building sustainable local enterprises that offer employment.

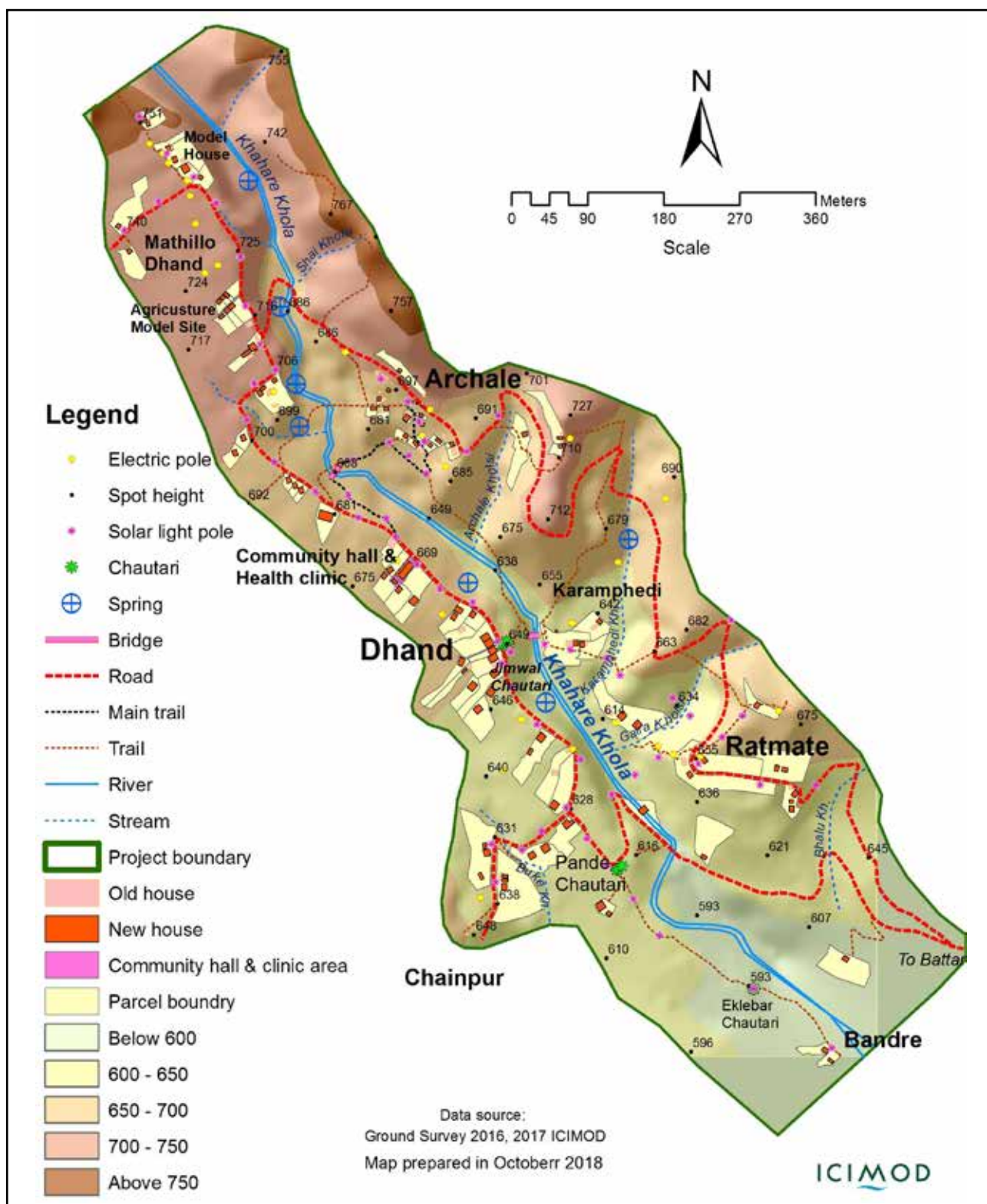
Access to services such as irrigation and health are essential for post-disaster recovery and long-term development. Further, the introduction of information technology for practical uses can catalyse growth, whereas the application of environment-friendly systems promotes continued self-sustenance. Therefore, access to fundamental services was improved and, in some cases, created (p. 26).

This project aimed to serve as a showcase for sustainable reconstruction and rehabilitation in a post-disaster situation, with a potential for up-scaling and wider knowledge dissemination. Sharing successful interventions and difficulties commonly faced in implementing wide-ranging post-disaster development activities were crucial objectives of this pilot demonstration project. This report therefore includes experiences and learnings from the project, which could offer valuable insight into the distinctive challenges in building resilient mountain villages (p. 31).

1. Introduction

1.1 Introduction to Dhungentar

Dhungentar settlement is located in Bidur Municipality, western Nuwakot – around 50 km northwest of Kathmandu. The settlement covers 96 households spread across five village clusters: Ratamate, Karamfedi, Archale, Dhand, and Mathillo Dhand. The 2015 earthquake fortunately did not claim lives in the settlement, but considerable damage was inflicted upon its infrastructure and, consequently, people's livelihoods.



Following a 2016 social survey by ICIMOD, the need for disaster-resilient infrastructure in Dhungentar was apparent, with houses, schools, roads, and workplaces affected. Before the earthquake, only two houses were constructed with permanent, durable materials. In the aftermath, all houses in the settlement (except one) were classified as fully damaged. Archale was also recognized as a landslide-prone area, prompting numerous households to relocate. Further, road connectivity within Dhungentar and to the closest town (Battar) – which was already quite poor and inadequate – was affected by the earthquake. The difficulty locals faced in initiating reconstruction work and resuming their daily lives evidenced the need for better infrastructure to support community activities and ensure access to basic services.

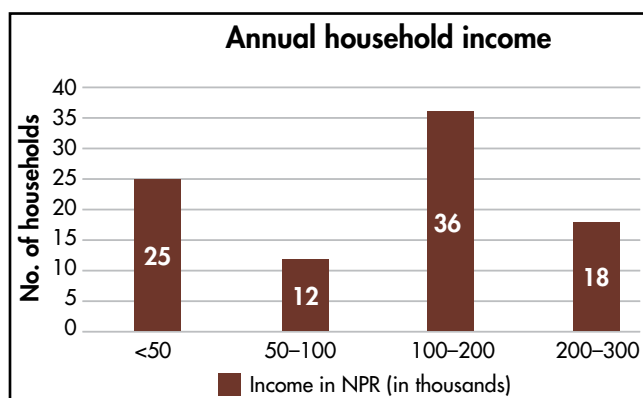
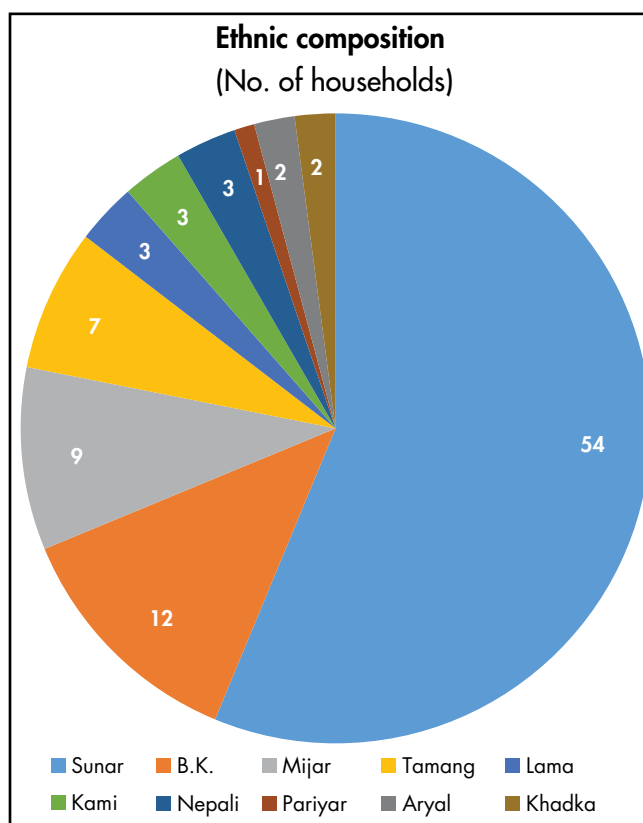
To compound problems, the community was socioeconomically vulnerable and lacked proper support systems and social security nets to rebound from the shock. All but four households in Dhungentar are from marginalized or Dalit ethnicities, and locals are primarily dependent on subsistence agriculture and traditional, low-income occupations. The average annual household income in Dhungentar is NPR 127,703, whereas the national average annual household expenditure in rural areas is NPR 248,893 (Central Bureau of Statistics, 2015–16). Natural disasters affect victims indiscriminately, but an individual's ability to recover is strongly shaped by systems of social and economic stratification. Low-caste, low-income groups are more likely to remain in makeshift shelters and face more difficulty in reconstruction (Asia Foundation, 2017). Despite the caste system being outlawed in Nepal, people from so-called lower castes still face discrimination in access to public goods, including in the distribution of relief materials (Dalit Civil Society Massive Earthquake Victim Support and Coordination Committee, 2015).

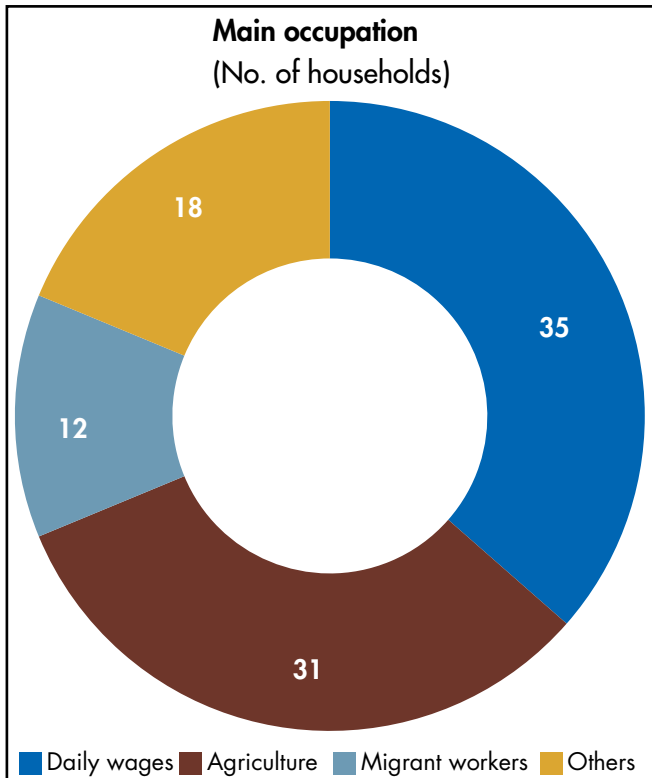
Out of 96 households in Dhungentar, 11 did not own land and were living as tenants. Many plots of land are owned by villagers from so-called upper castes living outside the settlement, and Dhungentar locals lease these plots for agriculture. The exclusion from access to and ownership of productive assets, such as land, compounds poverty.

With a dearth of employment opportunities and entrepreneurial possibilities given Dhungentar's inadequate infrastructure and poor market linkage, the out-migration rate among local men is high.

The majority of men who do work within Dhungentar are involved in traditional skill-based occupations (masonry, blacksmithing, tailoring, carpentry, etc.) or casual off-farm labour, which has led to the feminization of agriculture.

In Dhungentar's context, this feminization does not necessarily denote empowerment; it is generally accompanied by exclusion of women from skill-based professions and land ownership. Only around 38% of women over 16 years of age are involved in income generation, and only around 20% of houses are owned by women. Even among the women house owners, almost 58% are widowed or separated, indicating ownership due to forced circumstances rather than empowerment. Social restrictions and limited access to productive resources mean that such involvement of women in agriculture is restricted to subsistence. Consequently, although climatic conditions in Dhungentar are





conducive to agriculture, the crops cultivated in the village lack variety and market penetration is limited.

The community clearly required support in terms of infrastructure, modernization of traditional occupations and practices, development of economic activities and entrepreneurial possibilities, and improved access to services within the settlement. There was also a need for empowering women and increasing social cohesion and participation to create a united village. Therefore, the project devised a novel concept to comprehensively address these areas of concern.

1.2 Resilient Mountain Village Concept

The pilot demonstration project sought to create a resilient mountain village for its development activities in Dhungentar. This concept involves an integrated approach to sustainable development, encompassing economic, social, and environmental dimensions to ensure resilience and adaptation.

For Dhungentar, this resilience-building process

was formulated in a post-disaster reconstruction and rehabilitation context. The community's needs, strengths, and aspirations were taken into consideration when framing the project's approach. Emphasis was placed on mobilising the community and encouraging ownership of the project activities, and indigenous knowledge and practices were harmonized with innovative modern practices to ensure gradual adaptation and sustained development.

The project focused on helping Dhungentar locals rebuild, recover, and rebound in a manner that insulates them from future shocks. With socioeconomically marginalized communities comprising the majority of the



Santosh Raj Pathak

project beneficiaries, the aim was to support a particularly vulnerable village through a difficult transition period and to ensure that the village builds on its strengths and grasps opportunities. The project intended to address infrastructural frailties, reduce socioeconomic vulnerabilities, and elevate the living standards of Dhungentar locals in the long term, thereby building a resilient mountain village that is smart and adaptable to change.

A multipronged approach was necessary to address different facets of Dhungentar life. Reconstruction of houses required immediate attention, and community infrastructure also needed considerable development. The community was encouraged to participate in these reconstruction activities to allow integration into the project's vision and voice their opinions on planning and prioritization. Different programmes were organized specifically to encourage such participation.

Accordingly, in coordination with its local implementation partner Sahayata Samajik Sanstha, the project divided its development activities into four core areas, or building blocks: disaster-resilient infrastructure, community mobilization and capacity development, livelihoods and enterprise development, and access to services and environment improvement. These core building blocks address Dhungentar's vulnerabilities and involve activities that comprehensively strengthen the community and serve as a model for reconstruction and rehabilitation in a post-disaster situation.



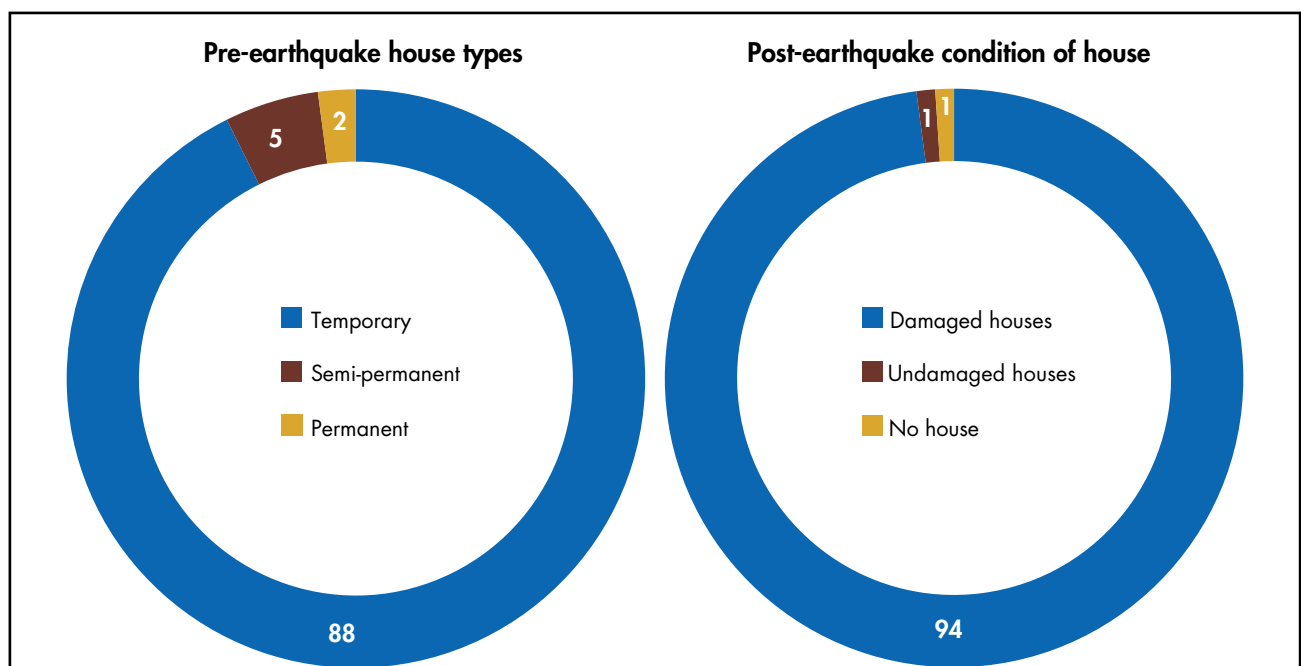
Kundan Shrestha

2. Disaster-Resilient Infrastructure

The need for disaster-resilient infrastructure in Dhungentar was apparent following the earthquake. Secure infrastructures are particularly important in Dhungentar given the settlement's socioeconomic fragility. Accordingly, this pilot demonstration project focused on building disaster-resilient houses and toilets, along with improving road connectivity within and to the settlement to stimulate development and ensure future resilience against shocks.

2.1 Pre- and Post-Earthquake Infrastructure Status

Before the earthquake, only two of the 96 houses in Dhungentar were constructed with permanent materials. The rest were built with traditional non-durable construction materials and mud as a binding material. The absence of bands in the sill, lintel, and gable and the lack of proper bonding in the load-bearing wall lent poor structural integrity to the houses. Consequently, all houses except one were fully damaged by the earthquake.



2.2 Reconstruction Support Modality and Technologies

ICIMOD's pilot demonstration project in Dhungentar promoted the adoption of interlocking compressed stabilized soil blocks (CSSBs) for the construction of disaster-resilient houses and toilets in Dhungentar. Interlocking CSSBs are composed of a mixture of soil and sand compressed using a manual or motorized press machine and further stabilized with cement. This technology was approved by the National Reconstruction Authority (NRA), Government of Nepal (GoN), in March 2017 (Ministry of Urban Development, Government of Nepal 2017).

The need for reconstruction aid in Dhungentar is highlighted by the fact that the highest annual income is NPR 300,000/household. Accordingly, the support modality involved assistance to beneficiaries through the following:

- Construction labour and materials equivalent to NPR 200,000 to houses using CSSB and RCC technologies, in addition to the NPR 300,000 grant distributed by the GoN in three tranches
- For each household adopting the CSSB technology: distribution of 2,200 locally produced CSSBs and support in construction labour and materials equivalent to NPR 35,000 (excluding CSSBs) for toilet construction

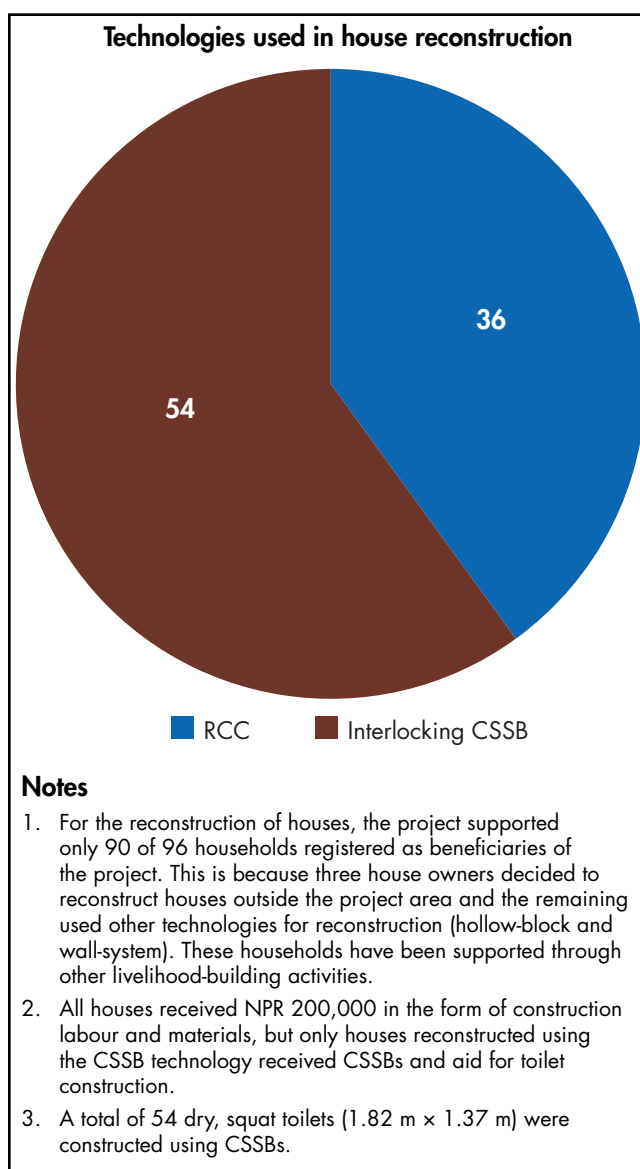
However, this technology was not imposed upon the beneficiaries. While aid was provided for 54 houses using the CSSB technology, 36 houses used the reinforced cement concrete (RCC) technology, which is more prevalent throughout Nepal. Beneficiaries eschewing the CSSB technology were not entitled to CSSBs or aid for toilet construction. A separate agreement was arranged with such beneficiaries for the disbursement of support from the project.

Due to exceptional circumstances, three households were given dispensation and were fully funded by the project. Ram Bahadur Sunar in Mathillo Dhand (given his wife's mental health disability), Nani Maya Sunar in Archale (given her status as a cancer patient), and Til Kumari Sunar (on account of her being a widow living alone) were given this special consideration.

2.2.1 Adoption of Interlocking CSSB Technology

The interlocking CSSB technology was developed by Habitech Center – a research and development centre at AIT Solutions, Asian Institute of Technology, Thailand – and has been applied to post-disaster reconstruction in countries across the world, such as Thailand, Myanmar, and Pakistan. This technology ensures earthquake resilience through the use of horizontal and vertical reinforcement (rebar, cement, horizontal bands) in strategic points, creating an interlocked structure.

Given the Dhungentar community's vulnerability to disasters and low economic status, interlocking CSSBs are particularly suited for reconstruction in the settlement. These blocks are cost-effective as they utilize locally available soil. Further, CSSBs do not require highly skilled labour for production or construction. This capacity for local production generates employment opportunities and opens the possibility of establishing a local enterprise.





Compared with RCC, interlocking CSSBs present some advantages that are particularly suited to Dhungentar's needs and capacity.

2.2.2 Interlocking CSSBs vs. RCC Technology

Cost-effective

The interlocking nature of CSSBs allows for dry stacked, mortar-less construction, which reduces the need for skilled labour and shortens construction time. These reductions lower the cost of labour by as much as 80% (Anand and



Ramamurthy 2005). This technology also allows for the use of local soil in production and can be produced and constructed by unskilled labourers after simple training, thereby reducing costs and generating local employment. Given the low economic status of the Dhungentar community, a low-cost housing solution is imperative.

Greater stability

Walls constructed with interlocking CSSBs adjust progressively without damage or cracking during earthquakes as they are not bonded with cement. With traditional mortar, the bricks come under strong tension during tremors and eventually crack (Pillai 2001).

Energy-efficient

Compressed earth blocks require anywhere from 1/5 to 1/15 of the energy for production when compared to fired bricks and concrete masonry units, which means considerably lower CO₂ emission (Maini 2010). Moreover, damaged blocks have been used for the construction of the 367-m Dhand–Archale trail.

Cultural preservation

Without compromising on disaster resilience, CSSB houses reflect the vernacular architecture of traditional Dhungentar houses, thereby helping preserve the community's identity.

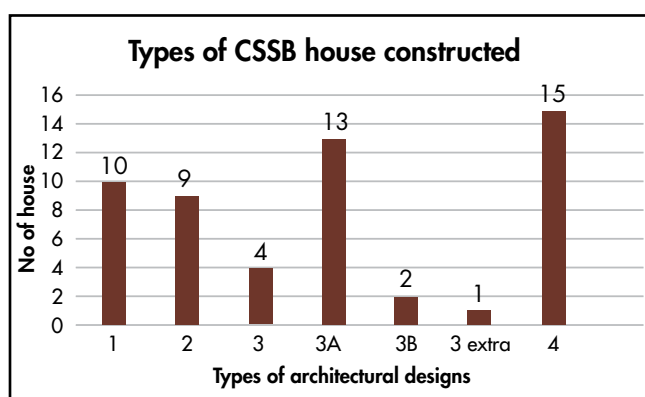
2.2.3 Persistence of RCC Technology in Dhungentar

Despite the apparent advantages of interlocking CSSBs over RCC, only around 59% of the reconstructed houses in Dhungentar adopted the former. Thirty-four households persisted with the latter for the reconstruction of their houses, even forgoing the CSSBs distributed for house and toilet construction. In consideration of the needs and aspirations of beneficiaries, houses constructed with the RCC technology were also supported by the project in the form of construction materials and labour equivalent to NPR 200,000.

The prevalence of the RCC technology in Nepal and the perception of safety associated with it were major factors for the construction of RCC houses. Despite creating awareness on the benefits of the CSSB technology, there was also a degree of distrust in the adoption of a new technology. In addition, beneficiaries with greater spending capacity preferred more freedom in determining the size and design of their house.

According to household size, land availability, and investment capacity, beneficiaries opting for CSSB houses could select their preferred house design from seven architectural drawings: Type 1 (217 Sq. ft.), Type 2 (279 sq. ft.), Type 3, 3A, 3B (409.78 sq. ft.), 3 extra (494 sq. ft.) and Type 4 (284 sq. ft.).

Since these fixed designs are single-storey houses with two to four rooms, beneficiaries also preferred RCC because it allowed for the possibility of future house expansion.



2.3 Road, Trail, and Bridge Construction

The pilot demonstration project identified the improvement of road connectivity within and to the Dhungentar settlement as an important step towards building a resilient village. Proper road networks will also support the project's livelihood-building programmes through better market linkage and access to urban services in Battar Town and Kathmandu.

Dhungentar is composed of five cluster villages: Ratamate, Karamfedi, Archale, Dhand, and Mathillo Dhand. Ratamate, Karamfedi, and Archale are located on steep hillsides, whereas Dhand and Mathillo Dhand are situated on the same gradual hillside.

2.3.1 Archale–Karamfedi Access Road

The main road from Battar leads to Dhand and Mathillo Dhand. A branch of the same road reached only up to Ratamate before the earthquake, leaving Archale and a part of Karamfedi inaccessible by vehicle. This presented considerable difficulty in the transportation of construction materials for this project.

Bidur Municipality initiated the construction of a 1,537-metre access road from Ratamate through Karamfedi to Archale. To accelerate reconstruction efforts and improve intra-connectivity, the project contributed NPR 500,000 towards this construction. This access road was completed in late October 2017, after which construction activities in the inaccessible project sites were considerably expedited.



2.3.2 Dhand–Archale Trail Road and Bridge

Dhand and Archale, situated on hillsides separated by the Khahare Khola (non-perennial stream), were connected by a narrow dirt trail road before the earthquake. Without a proper bridge to cross the stream, the trail became slippery and hazardous during monsoon.



Accordingly, the project constructed a wider, 367-metre-long trail road from Dhand to Archale. This trail was paved with CSSBs that were damaged during production. A bridge (span 6.5 metres and width 1.65 metres) was then constructed over the Khahare Khola to connect the trail road.

2.3.3 Dhand–Karamfedi Trail Road

Dhand and Karamfedi (situated on the same hillside as Archale) were also connected by a narrow dirt trail road before the earthquake. Since the narrow bridge on this trail remained functional even after the earthquake, only the 115-metre trail was improved.

The construction of these trail roads and the bridge significantly eased the difficulty in transporting construction materials to Archale and Karamfedi and improved the road connectivity within Dhungentar.



3. Community Mobilization and Capacity Development

The engagement of community members is integral to the development of any community. This project sought to mobilize locals in the reconstruction and rehabilitation process, encouraging community ownership for lasting development. This mobilization began before the beginning of the project with a familiarization programme for project beneficiaries and continued with other participatory approaches and sessions. Different community groups were formed to entrust greater decision-making responsibility to the community. Similarly, community congregation areas were improved and constructed to create better spaces for discussion, learning, and growth.

3.1 Community Familiarization

3.1.1 Familiarity Programme for Dhungentar Villagers

In November 2016, ICIMOD organized a two-day familiarity programme for Dhungentar villagers at Godavari Knowledge Park and Habitech Building Technology at Sankhu. Altogether nine villagers (four men and five women) participated in the programme. The main objectives of the program were as follows:



- Observe, understand, and learn about different livelihood, water management, and farming activities at Godavari Knowledge Park;
- Observe the demonstration of the production of interlocking compressed stabilized soil blocks (CSSB) and understand its importance in building earthquake-resilient shelters; and
- Interact with community-led reconstruction groups of Sankhu.

The familiarity programme allowed the participants to understand the reconstruction and development concept proposed for the Dhungentar settlement and identify the activities suitable for their area and way of life. More importantly, the programme served as an effective platform to initiate preliminary discussion and helped introduce the concept of resilient mountain villages to representatives of Dhungentar.

3.1.2 Participatory 3-D Modelling (P3DM)

Participatory 3-D modelling (P3DM) is an interactive mapping method used to obtain an overview of the geographical dimension of any mountain landscape (Joshi et al. 2016). P3DM integrates local spatial knowledge with data to produce scaled, geo-referenced relief models. Pushpins, yarns, and paint are used to depict land use and cover and other details on the model.



To promote active community participation in project activities, a participatory 3-D model was built in the project office in Dhungentar in June 2016 with technical guidance from ICIMOD's geospatial team and the active engagement of 11 local participants. This activity was particularly suited for Dhungentar as it allowed villagers to participate in the entire process of 3D model building before much of the project activities were launched, initiating community engagement in the new project.

Training sessions were conducted on map reading, P3DM's objectives and past success stories, and the model-building process. Participants were divided into groups for specific tasks in the modelling process.

P3DM helps locals acquire a broader perspective regarding their area's geography and thus enables them to better communicate their needs and manage their resources. The model can be used to assess the implementation of development activities and serves as an interactive medium for community participation, spatial learning, discussion, information exchange, and decision making.

3.2 Local Community Organizations

Local community organizations play a vital role in building a community's capacity to address prevalent issues, withstand external shocks, and develop into a self-sustaining settlement. Such organizations allow community needs and interests to be protected and addressed by local representatives, who can democratically identify solutions. Accordingly, the pilot demonstration project strived to establish such organizations as part of its community-focused activities.

3.2.1 Mothers' Group of Dhungentar

In Dhungentar, women's participation in income generation is very poor; only around 38% of women over 16 years of age earn an income. Similarly, their disadvantaged status is highlighted by the fact that only 19 of 96 houses in Dhungentar are owned by women.

With a sizeable number of men working away from Dhungentar, the vacuum in community leadership needs to be filled by women. Apart from imparting income-generating skills to women to promote financial autonomy, this project focused on empowering women to collectively address social issues, create local social safety nets, and actively lead the community. Consequently, the Mothers' Group of Dhungentar (Dhungentar Aamasamuha) was formed, following a one-day orientation programme on its necessity.



The group convenes monthly to discuss the community's pressing issues and ways to address them. The group has mobilized for different community betterment activities, such as clean-up campaigns. Members have also assisted in construction activities, such as the construction of the Dhand–Ratamate trail road, setting of the damp proof course (DPC) of the multipurpose community centre, and repair works on the Dhand–Archale bridge when heavy rain scoured its foundation.

As a community safety net, the Mothers' Group of Dhungentar has opened a community savings fund, with small monetary contributions collected from community members each month. This fund will be used for the group's activities and will serve as a line of credit at a low interest rate to those in need.

3.2.2 Social Mobilizers

Four young women were identified from different village clusters in Dhungentar for assisting in the implementation of various project activities. These social mobilizers were engaged in basic door-to-door data collection, information dissemination, procurement, and community mobilization. As beneficiaries of the project, they offered valuable insight into the problems, needs, and workings of the community and acted as an important link between the project and the people.

The goal of recruiting these social mobilizers was to engage youths in the reconstruction and development of their own community and help them become catalysts of change. Working as social mobilizers provided them with experience and skills for their future growth. The social mobilizers also attended the skill training programmes organized in the settlement, and one of them has become a vendor for e-Sewa, a Nepalese e-commerce company.



3.2.3 Dhungentar Reconstruction and Development Community

The Dhungentar Reconstruction and Development Community was formed to ensure that the project's reconstruction and development activities are uniformly spread throughout the settlement. This local community organization was formally registered at the municipal office to ensure its legitimacy and commitment to Dhungentar's progress.

This 11-member community allows locals to actively shape in Dhungentar's reconstruction and assume ownership in development activities. The 6503 sq. ft. land for the multipurpose community centre in Dhand was purchased by the project in the name of the Dhungentar Reconstruction and Development Community. The future functioning and maintenance of the community centre will be overseen by this community.

3.3 Community Spaces

Community spaces offer physical platforms for the development of social bonds and networks, strengthening a community's resilience and capacity. Such spaces improve individual wellbeing and stimulate community participation and civic engagement. With increased community interaction and civic engagement, the community-building process becomes more democratic and the benefits are universal.

3.3.1 Multipurpose Community Centre

A multipurpose community centre was constructed in Dhand to create a venue that facilitates community mobilization and capacity building. Designed by Skybridge Limited and further improved by Sarosh Pradhan & Associates, the 1,810 sq. ft. centre will accommodate group activities such as meetings of the local community organizations, workshops, and trainings and provide community services such as health camps and child care. It will also serve as an information technology centre, with locals receiving access to the four Dell computers contributed World Distributors Nepal. With separate toilets for males and females, the centre can also be used as an emergency operation centre.

The 6,503 sq. ft. land for the centre was purchased by the project in the name of the Dhungentar Reconstruction and Development Community to ensure the community maintains ownership of the structure and determines future functions.



3.3.2 Chautari and Solar Street Lamps

A chautari in rural Nepal is a platform around a centrally located tree in the community that is commonly used as a resting space or assembly point for announcements, events, or community meetings. Chautari offer space for community engagement and are an important part of information flow in the community. Accordingly, a chautari in Dhungentar was improved to enable community bonding and beautify an important community landmark.



To further improve community spaces, AEPC supported the instalment of 75 solar street lamps across the settlement. These solar lamps operate on two 1200-W solar panels.



4. Livelihoods and Enterprise Development

Marginalized/Dalit communities constitute the majority of Dhungentar's residents, and their economic insecurity is highlighted by dependence on subsistence agriculture and traditional, low-earning occupations. Given Dhungentar's socioeconomic vulnerabilities, this pilot demonstration project focused its rehabilitation activities on improving livelihoods and laying the foundation for the establishment of local enterprises capable of uplifting the entire settlement. Particular emphasis was placed on organising training programmes on income-generating skills, mobilising the untapped women workforce, and building sustainable local enterprises that offer employment.

4.1 Local Block Production

Given the need for cost-effective, disaster-resilient construction materials and the lack of skilled manpower in Dhungentar, the establishment of a local production site for interlocking compressed stabilized soil blocks (CSSBs) was highly suitable.

Two machines were procured from Innovative Design Concern (INDECO) and four from Habitech Center, Asian Institute of Technology, Thailand – developers of this interlocking technology – and a local production site was set up. A five-day training programme (followed by an 11-day supervision phase) was organized for 22 local participants (3 male, 19 female) from all cluster villages of Dhungentar. This launched the reconstruction activities in the settlement and initiated local participation in the project's development activities.

The participants were instructed on production procedures and trained regarding machine operation and maintenance. By the end of this training programme, this trained local workforce produced 4,695 CSSBs for local construction and continued production for five months. They were also involved in the construction of two full-scale model houses in Dhungentar.



CSSB PRODUCTION ENTERPRISE

Earthquake Reconstruction and Rehabilitation Project, Dhungentar, Nuwakot

ICMCO's pilot demonstration project mobilised Dhungentar's natural and human resources to make disaster-resistant interlocking compressed stabilised soil blocks (CSSBs). Learn about the simple production process and how a production enterprise could be established in Dhungentar.

1 TESTING

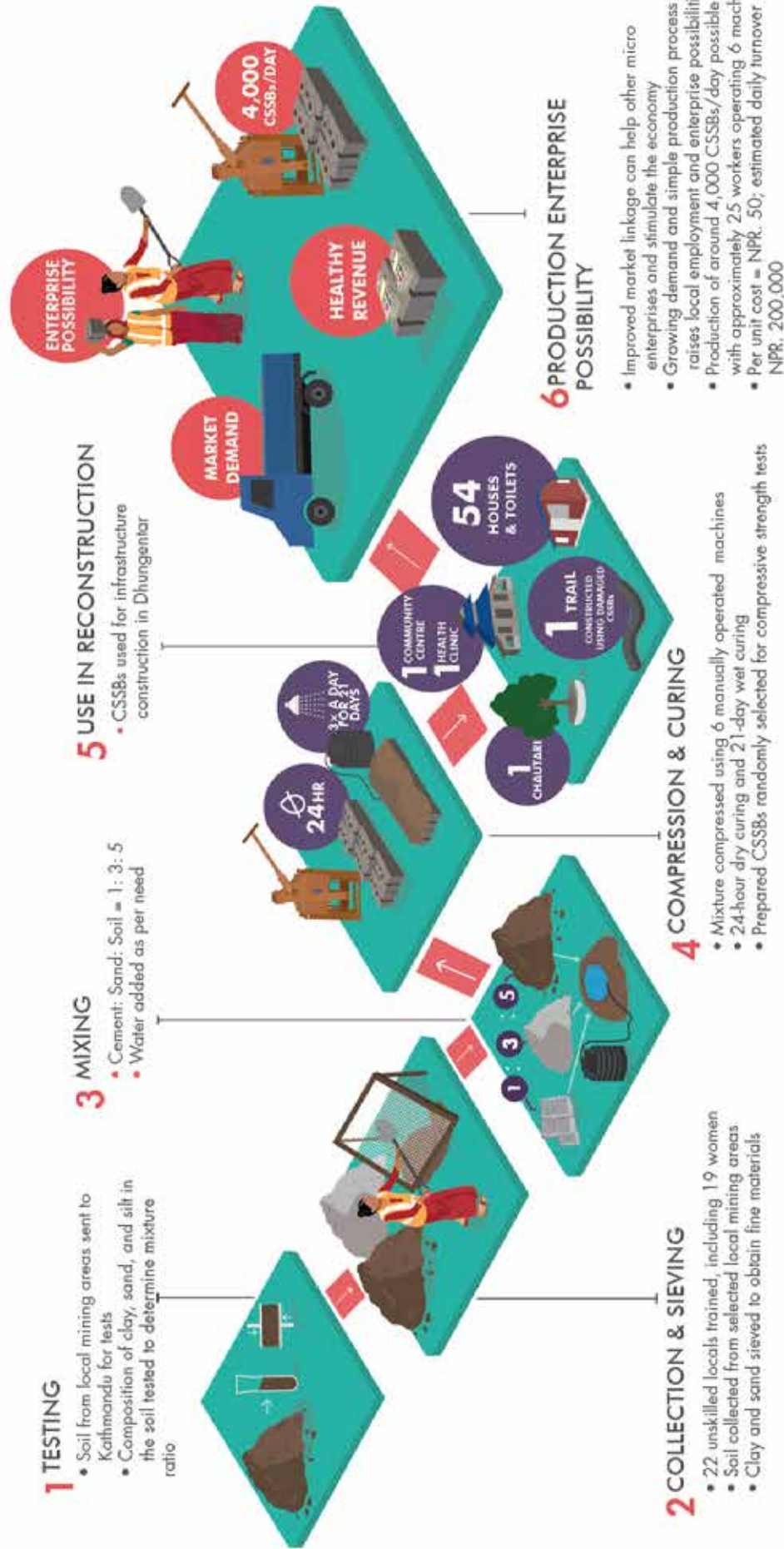
- Soil from local mining areas sent to Kathmandu for tests
- Composition of clay, sand, and silt in the soil tested to determine mixture ratio

3 MIXING

- Cement: Sand: Soil = 1: 3: 5
- Water added as per need

5 USE IN RECONSTRUCTION

- CSSBs used for infrastructure construction in Dhungentar



However, these trainees were unable to continue this production for a sustained period because of social restraints and the short-term nature of the work. Masons from other districts then took over production and construction activities. The project plans to create a local cooperative and hand over ownership of this block production site. The enterprise will be supported initially to establish market linkages, and this cooperative can then organize production and offer stable employment opportunities to locals.

By training and mobilising locals in the production and construction processes, this project not only reduced costs for households but also presented the community with an enterprise that can generate employment opportunities.

4.2 Livelihood Training Programmes

A one-day needs assessment was conducted with the participation of 48 locals in September 2017 to identify and understand the types of training required by the community. Accordingly, training courses were designed with consideration of the community's capabilities (skill and investment capacity), available resources, and local niche and were attended mostly by women of the Dhungentar community. Women's participation was a significant step towards empowerment, as women lag behind in economic participation and financial independence, with only around 38% of women over 16 years of age earning an income and only around 20% of houses owned by women.

The training programmes were intended to disseminate knowledge on various relevant matters and develop practical skills for starting small home-based businesses, with the possibility of building local microenterprises. The series of training programmes was supported with a two-day introductory session on enterprise development in March 2018.

4.2.1 Kitchen Gardening

Kitchen gardens are an important and cost-effective source of food for family consumption that can allow subsistence farming to be expanded to commercial agriculture, thereby providing food security and improving livelihoods. Kitchen gardens can empower communities to manage on-farm agricultural biodiversity while promoting dietary diversity for healthier families and ecosystems (Gautam et al. 2006).



Around 32% of households in Dhungentar are engaged in subsistence agriculture for their livelihood, and around 47% of households either own no land or possess landholdings less than 1 ropani (5,476 sq. ft.) in area. Consequently, imparting knowledge on the benefits of optimum utilization of available spaces for kitchen gardening was deemed important.

Two training sessions were conducted in February 2018 on effective kitchen gardening skills that can improve livelihoods. The training was attended by 20 project beneficiaries and involved information dissemination regarding the following: multi-crop farming, crop diseases, seed selection, cultivation methods, water scheduling, nursery establishment, and market values of produce.

4.2.2 Liquid and Laundry Soap-Making

During the needs assessment, Dhungentar locals had identified laundry soap-making as their primary interest. Accordingly, a one-day training on liquid soap-making and a two-day training on laundry soap-making were conducted for 23 project beneficiaries in February 2018. The training consisted of sessions on raw material ingredients, mixing procedure, associated costs, and quality control.

Given the readily available ingredients, simple production procedure, and market demand of soaps, the liquid soap-making training was particularly well received and highly suitable for community skill building and livelihood improvement. The easy production and reasonable returns on investment have encouraged some community members to continue small-scale production of these products. They periodically make and sell liquid and laundry soaps to the service and auto industries in Battar Town, Nuwakot.

4.2.3 Incense Stick-Making

A two-day training session on incense stick-making was conducted in February 2018 for 16 project beneficiaries. The training provided skills on required ingredients, raw material mixing, fragrance appliance methods, drying procedure, and packaging method.

A primary ingredient used in incense stick-making is the resin-based binder obtained from the bark of Kaulo tree (*Machilus odoratissima*), which is abundantly available in Nepal's Mahabharat range (UNDP Nepal n.d.).

Other raw materials required for incense production are available locally or in nearby Battar Town: bamboo sticks, charcoal dust, diethyl phthalate, white oil, and fragrance.



4.2.4 Poultry farming & animal husbandry

Poultry farming and animal husbandry are extensively practiced in Dhungentar; however, the widespread use of traditional practices has limited the possible economic and environmental benefits. To help locals move beyond the present subsistence farming system and acquire surplus agricultural produce to generate income and secure livelihoods, the project organized separate three-day training programmes on both poultry farming and animal husbandry in March 2018, with 20 and 19 participants attending, respectively.

The training programmes involved instructions on a wide range of tested methods, low-cost technologies, and best practices, with the aim of developing integrated mountain farming systems. Topics such as shed improvement, brooding requirements, rearing methods, feed composition, and disease prevention were covered.

Many trainees have started increasing the scale of their poultry farming by prohibiting the use of eggs for meals, focusing instead on allowing chicks to grow and breed. Shed improvement activities have been undertaken by a few households as well. With beneficiaries contributing wood and tin, the project has been constructing two-tiered poultry sheds on a needs basis. A few cattle and goat sheds are also being improved and expanded, with a urine collection system installed in these sheds to allow local production of bio-pesticide.

4.2.5 Crystal-making

A crystal-making training programme was conducted in April 2018 to teach 12 participants how to make crystal jewellery. With materials readily available in the market, participants learned how to use crystals to make simple bangles, traditional necklaces, earrings, and rings. Participants procured required materials from Battar Town and have formed small, informal groups for the production of crystal jewellery.



4.3 Agriculture Model: An Integrated Farming System for Diversified Income

The project's overarching goal of promoting sustainable development in Dhungentar involved engaging the locals as stakeholders in their own livelihood betterment. Hence, helping a local build an agriculture model with an integrated farming system capable of generating income was deemed to be a suitable stimulant for community action and replication. Hira Lal Sunar, a project beneficiary residing in Mathillo Dhand, was identified as a champion who would be committed (financially and physically) to this venture.

The principal aim of building this model was to help others in the community realize the benefits of implementing innovative and tested methods of agricultural production, thereby encouraging them to adopt the same technologies. The 20-ana (6,845 sq. ft.) model farm used an integrated approach to livelihood improvement through increased and diversified farm yield and effective resource management.



This approach involves using the by-products of daily household or farming activities as inputs for other farming activities. For instance, harvested rain water and household waste water collected in a plastic pond can be used for drip-feed irrigation. Hira Lal Sunar's agriculture model exhibits different methods for the optimal use of water (plastic pond, drip-feed irrigation) and recycling of farm waste for agricultural production. The model offers diversified sources of income, ranging from organic farming in a multi-crop system and floriculture to systematic fishery and beekeeping, allow for economic security and further growth.

Sunar's agriculture model will hopefully act as a springboard for community-wide implementation of innovative, modern agricultural technologies that can improve livelihoods and help build a resilient mountain village.

HIRA LAL SUNAR'S AGRICULTURE MODEL

Reconstruction and Rehabilitation Project, Dhungentar, Nuwakot

ICIMOD's pilot demonstration project in Dhungentar supported Hira Lal Sunar, a beneficiary of its earthquake reconstruction and rehabilitation programmes, in transforming his 6,845 sq. ft. land into an agriculture model. By shifting traditional, subsistence agriculture to a modern, integrated farming system for agribusiness, this sustainable model offers diversified income sources and can be replicated throughout the community.

COMPOST PIT

- Domestic waste products and cattle manure decompose here, creating compost
- Final, a homemade bio-fertiliser and bio-pesticide, can be prepared

PLASTIC-JINED POND

- Stores household waste water
- Useful for irrigation during dry season



Common carp

- Tolerates low oxygen levels, pollutants, turbidity and stagnant waters¹
- Grows to 2.5-3.5 kg in 10-14 months²

PLASTIC TUNNEL

- Stabilises temperature
- Lowers usage of pesticides and increases yield
- Allows off-season cultivation



Hira Lal Sunar used to work in construction but returned to Dhungentar permanently after the 2015 earthquake struck and his daughter was diagnosed with a heart condition. He views his modernised farm to be a viable income source to support his wife and two children, who also assist him in certain agricultural activities.

HARVESTED RAINWATER

- Rainwater is diverted to the fish pond as this allows water circulation, which benefits the fish

FISH POND

- Fish polyculture increases production per unit area and offers higher economic benefits³
- Fish excretion provides nutrients to plants



Grass carp

- Grows to 0.5-1.5 kg in 8-10 months⁴



Silver carp

- Grows to 5 kg in 3-4 years⁵

BEEKEEPING

- Apis cerana does not require artificial comb foundations, sugar feeding, or antibiotics⁶
- Honey can be extracted for six months in a year



Estimated honey production

- 6.8 kg/month from each of 5 bee hives

NPR: 700-800/kg

HORTICULTURE

- Over 24 varieties of fruits and vegetables using multiple cropping



Capsicum

- NPR: 100-200/kg



Round chili

- NPR: 200-300/kg



Lime

- NPR: 200-300/kg



Macadamia nut

- NPR: 1,000-1,500/kg

- Over 7 species of flowers



Marigold

- NPR: 50-200/garland

MUSHROOM FARMING

- The mushroom tunnel's roof is covered with straw and watered to control temperature



Oyster mushroom

- Germinalises in 2 weeks in plastic bags stuffed with straw
- Each bag yields up to 3 kg in 2 months

NPR: 200-300/kg

DRIP-FEED IRRIGATION

- 50 litre tank stores water from plastic-lined pond
- Allows precise delivery to plant roots
- Minimises irrigation costs through efficient water usage
- Curbs weed growth⁷



Manual irrigation



Water for cooling roof



Pollination



Water circulation



Bio-pesticide

¹ General information about Carp. Retrieved from <https://www.fao.org/fishing/aquaculture/species/carp/general-information>

² FAO Species Profile. Retrieved from <http://www.fao.org/fishery/aquaculture/species/en/>

³ National Aquaculture Survey Overview. Nepal. Retrieved from <http://www.fao.org/fishery/aquaculture/nepal/>

⁴ Sultanaurayana, K., Nelayan, P., Salwan, M., Bari, S. U., Nadeem, R. P., & Gupta Lakshmin, N. (2011). Low Cost Drip — Cost Effective and Precision Irrigation

Tool in B. Cotton. Central Institute for Cotton Research, Technical Bulletin No. 1/2011.

⁵ Porey, A. Source of Nutrition, Medicine and Cash Income for Himalayan Farmers. Retrieved from <http://www.icimod.org/Pgs/1519>

All prices are approximations of the market value in Bote, Nuwakot, and have been provided by the project's livelihoods officer.

4.4 Workstation Improvement

4.4.1 Blacksmith Work-Shed Improvement

The historical caste-based system of work distribution still dictates the professions of a sizeable segment of the Dhungentar community. Although the system is now outlawed, its lingering repressive effects are apparent, with a considerable number of locals engaged in traditional, low-income occupations. While the project's other livelihood-building activities offer new opportunities for income generation and economic stability, existing practices and structures also require reforms to improve livelihoods.



There were two makeshift blacksmith work sheds in Mathillo Dhand and Archale that function as workstations for numerous blacksmiths in the settlement. Since these sheds were damaged during the earthquake, this project made improvements to their structure and equipment.

4.4.2 Water Mill Improvement



Rural communities in Nepal still operate traditional water mills for basic mechanical work. Three traditional water mills were operated by their owners in Mathillo Dhand, Karamfedi, and Ratamate. Operating on the kinetic energy of rivulets, these water mills are used by the owners for processing grains. Villagers also offer remuneration or a portion of the ground grains for use of the water mill. However, these mills and their water canals were damaged beyond use during the earthquake.

To ensure that access to this service is resumed, the project assisted in the improvement of these water mills. The working space was improved in all water mills by laying a cement foundation. In Ratamate, the canal leading to the water mill was improved. In Mathillo Dhand, the supply and flow of water was improved using penstock pipes, and electric operation of the mill was also enabled.

4.4.2 Carpenter Shed Construction

A new shed was constructed in Archale for carpentry works. New equipment and tools were provided for the carpenters' group, who produced house frameworks and furniture for the community. The group also built two- or three-tiered chicken coops commissioned by locals. These coops, unlike traditional coops, have more space and allow locals involved in poultry farming to expand their stock.

5. Access to Services and Environment Improvement

Strong structures are necessary for any community's security against future shocks. Access to services such as drinking water, irrigation, and health are essential for post-disaster recovery and long-term development. Further, the introduction of information technology for practical uses can catalyse growth, whereas the application of environment-friendly home systems and practices allow for continued self-sustenance. Therefore, to make Dhungentar a resilient mountain village, this pilot demonstration project emphasized on improving access to fundamental services and creating a green, self-reliant village.

5.1 Water and Health

Traditionally, farmers in Dhungentar depended heavily on rainwater for irrigation of their crops. With a proper irrigation system, agricultural yield and variety can be increased. During construction of the Dhand-Archale trail road, a traditional irrigation canal was obstructed. Hence, a new irrigation canal (length = 16 m; width = 0.58 m) was constructed along the trail to regulate irrigation of nearby lands. An HDP pipe (pressure = 2.5 kg/cm³; diameter = 6"; length = 5 m) was also installed for cross-drainage.



A one-day survey on community health and personal hygiene was conducted by students of Trishuli Medical College in February 2018 to identify areas of action. According to the 2016 social survey conducted by the project, rheumatoid arthritis, blood pressure, and asthma were found to be common health problems among Dhungentar locals. With the nearest hospital 7 km away in Battar and the nearest health post 2 km away in Khadka Bhanjyang, the availability of a health clinic within the settlement for basic health check-ups and first aid was imperative. Hence, a two-room, 294 sq. ft. health clinic was constructed next to the multipurpose community centre in Dhand. In coordination with local government bodies, a trained medical expert will be placed on duty at the health clinic.



5.2 Technology

In today's rapidly advancing technological landscape, access to and familiarization with modern technological capacities is essential. Understanding the needs of the Dhungentar community and gradually introducing appropriate technologies can not only make daily activities more convenient but also promote growth and learning among the younger generation.



Accordingly, to increase access to basic services, e-Sewa, a Nepalese e-commerce company, recruited Samikshya B.K. as a local vendor. B.K., who also works as a social mobilizer for the project, offers online payment services such as mobile phone recharge, TV subscription payment, utilities payments, and travel bookings. In this manner, access to various other services can also be offered in due course of time, allowing Dhungentar to transform into a smart village.

Moreover, four Dell computers donated by World Distribution Nepal were set up at the project field office in Dhungentar for the purpose of providing informal training to the social mobilizers. These computers will later be placed in the multipurpose community centre for use by locals. To facilitate learning and communication, Nepal Telecom has set up a Wi-Fi hotspot in the community centre. Expanding capabilities in this way can modernize the community and improve access to knowledge and services exponentially.

5.3 Environment

A wide variety of saplings were distributed throughout the settlement to improve the vegetation, mitigate landslides, and provide new sources of nutrition and income generation in the long run. Plants such as lychee, pineapple, pomegranate, macadamia nut, papaya, lime, globe amaranth, marigold, and chrysanthemum have been planted by landowners in available spaces. On World Environment Day 2018, an event was organized during which more than two hundred trees of various species provided by Dabur Nepal were planted at landslide-prone areas by Bidur Municipality local government leaders, NGO partners of the project, and community members.

Periodic clean-up campaigns are organized by the Aamasamuha, with community members volunteering for the activity. The Aamasamuha attempts to raise awareness on the importance of proper waste management and the adoption of environment-friendly practices. 20 communal dustbins were placed throughout the settlement for better waste disposal and a cleaner community. Each household in Dhungentar also received a smaller dustbin for domestic waste disposal.

To promote clean energy usage, the project has installed biogas plants in Dhungentar, with households receiving labour assistance and construction material equivalent to NPR 15,000 from the project, in addition to government subsidy. Households constructing toilets (using interlocking compressed stabilized soil blocks) along with biogas plants were given NPR 50,000 by the project. Further, the Clean Cooking Alliance conducted an open session on the environmental and health benefits of the community-wide use of clean fuel. Local community members were informed about the benefits of smoke-free kitchens and clean cookstoves and the applicability of the technology in rural settings. Three solar lamps (3 W each) were distributed by the project to each household in a bid to promote solar energy.



5.4 Model House: Promoting Environment-friendly & Self-sustaining Households

In an attempt to encourage households in Dhungentar to adopt environment-friendly practices in daily household management, this project partnered with Alternative Energy Promotion Centre to fully fund a model house that showcases an integrated system of water, energy, and farm management. The model house was constructed for Til Kumari Sunar, a widow living alone in Mathillo Dhand, to support a particularly vulnerable beneficiary and encourage her to champion modern, cost-effective practices for daily household tasks.



The three-room house has been constructed using interlocking compressed stabilized soil blocks (CSSBs), which were locally produced, utilize soil found in Dhungentar, and are eco-friendly since they are not fired during production. This technology is also disaster-resilient and cost-effective. The biogas plant installed in the model house reduces dependence on firewood and creates a clean cooking environment. This considerably lowers expenses on liquefied petroleum gas and is a sustainable, clean alternative because Til Kumari possesses cattle, which provide manure for biogas production. The biogas plant helps in waste management, and its by-product (slurry) can be used as an organic fertilizer.

Various solar-powered technologies are operated at the model house, providing clean alternatives and lowering costs. A parabolic solar cooker is used for basic cooking and boiling water, and a solar dryer is used to dry and preserve food items. Three solar lamps (3 W each) supplement lighting in the house and are particularly useful since power outages are common in Dhungentar.

Til Kumari has an organic farm where she uses plastic tunnels and drip-feed irrigation to maximize yields. Water for irrigation is stored in two ways: rain water is harvested and stored in a tank and domestic waste water is stored in a plastic pond. These storage methods are particularly important during the dry season. Using slurry from the biogas plant as an organic fertilizer, fruits and vegetables such as cucumber, tomato, bean, round chilli, lettuce, leaf mustard, lady's finger, and bitter and snake gourd are grown in the farm. Any surplus produce after domestic consumption is sold in Dhungentar or nearby settlements.

These self-sufficient and innovative technologies show the way forward for post-disaster recovery and resilience building. With Til Kumari Sunar demonstrating on a daily basis how clean technologies can be practically adopted and resources optimized for securing livelihoods, this house can serve as a replicable model of sustainable lifestyle for households in Dhungentar and other earthquake-affected regions in Nepal.

The Rotary Club (Durbar Marg) donated 100 units of essential toolkits to the Dhungentar community on the occasion of Dashain 2018 for their daily household management. These toolkits included water filters, mini water containers, saws, hammers, nails, screwdrivers, pliers, trowels, clotheslines, and tarpaulins.

6. Lessons Learned

Coordinate aid disbursement and partner with private sector organizations

ICIMOD's partnership with the NRA through a memorandum of understanding provided a legitimate basis for the project to operate and also opened up the possibility of scaling up the model to other parts of Nepal. However, coordination regarding aid disbursement presented some challenges. The NRA's earthquake relief grant to beneficiaries – given in three instalments after ascertaining that homes being reconstructed meet specified structural requirements – was not disbursed in tandem with the project's own aid disbursement, thereby delaying reconstruction activities. Moreover, the NRA's grant was transferred directly to the beneficiaries' bank account, so it was not possible to ensure that those funds were used in reconstruction. Therefore, in future collaborative reconstruction projects, a coordinated aid disbursement policy is necessary. Policy should be formulated in such a way that the NRA's disaster-relief funds are released to the organization tasked with reconstruction and rehabilitation of the earthquake-affected area, contingent on that particular organization's competency, performance, and transparency. Such a mechanism can ensure expeditious disbursement of grants, proper utilization of funds, and swift progress of project activities.

As the project was conceived as a pilot model village with replication potential in a post-disaster situation, it was also successful in mobilizing private sector co-financing and contributions, not only from a corporate social responsibility (CSR) angle but also from a business development standpoint. As part of their CSR initiatives, private sector companies made substantial contributions to different project components. Although many companies visited the project site and were interested in building business partnerships, the sample size of the village was too small for viable business solutions. However, in the context of the recent decentralization of Nepal's governance system, the project can serve as a development model for a municipality, which would be a suitable market size for private sector companies.

Clearly communicate project support to beneficiaries

Since the project mobilized various complementary resources to each beneficiary, including the NRA's disaster relief grant, it was critical to be clear about exact contributions and maintain parity. It is important to communicate to beneficiaries the project's aid delivery modalities and categorically inform them about components beyond the project's scope. This is necessary to pacify demands from surrounding villages that were affected by the earthquake but which fall outside the project area. Clear information dissemination regarding the project's focus area and intervention activities also helps ensure transparency and resist pressure from local political groups.

In Nepal's context, people's willingness to accept aid is greater than their willingness to contribute to collaborative programmes. In Dhungentar, the project implemented various programmes that required voluntary community participation or financial contributions from beneficiaries. However, participation in such programmes was visibly less than that in fully aided initiatives. Project effectiveness increases with local commitment and investment, and community ownership and participation dictates the sustainability of project actions. It is therefore necessary to provide clear information on the support and form of aid that will be provided by the project and the activities that should be performed by the beneficiaries. Proper intervention should be carried out to create awareness among beneficiaries regarding the need for balancing the willingness to accept and willingness to pay.

Build local implementation partner's capacity

The concept of resilient mountain villages incorporated not only post-earthquake reconstruction but also livelihood and community improvement activities to allow Dhungentar locals to live secure and sustainable lives. However, to execute this vision, the project needed to deal with complex social dynamics and unforeseen logistic challenges, which required extensive planning and pragmatic adaptation. Navigating through ground-level problems requires a dedicated project team working in close coordination with a competent local implementing partner. The institutional arrangement in Nuwakot proved very challenging because of inadequate local capacity and overlapping functions between ICIMOD's field team and the local partner.

A local implementing partner is usually a small organization with expertise limited to local development needs and processes, so it may possess only rudimentary capacity to work in line with guidelines and directives of national and international institutions. Therefore, capacity building training in, for instance, finance and accounting or different forms of reporting, is necessary to enhance their capabilities. To overcome such deficiencies, the project team began carefully planning for contingencies and clearly communicating and delineating responsibilities with partners and beneficiaries. However, it was apparent that collaborating partners required capacity building during the initial phase to ensure smooth implementation of project activities.

Adopt a participatory approach to encourage community ownership

Community engagement is absolutely critical in the design and implementation of a project from the initial stage. This requires careful social engineering and continuous meaningful engagement. Initially, it was difficult to gain the community's trust and encourage participation in project activities. This was primarily because villagers were uncertain about the project's vision and offerings. Moreover, since the majority of the community belongs to marginalized ethnic groups, it was difficult to bring about a progressive mind-set and a collaborative environment. This was further aggravated by gender imbalance and discrimination: out-migration for employment and indulgence in vices (drinking and gambling) is predominant among local men and women usually do not have financial or decision-making autonomy. Therefore, empowering and mobilizing community members, particularly women, was central to the project's success.

In Dhungentar, a social survey and needs assessment was conducted to conceptualize the project design. Further, locals were engaged in the preparation of a participatory 3-D model of the project site. Using this model, community elders were consulted to learn about the history of different geological hazards and their indigenous disaster response and mitigation knowledge. Significantly, the Mothers' Group of Dhungentar (Dhungentar Aamasamuha) mobilised the womenfolk in various village improvement activities and strengthened the lines of communication between the project team and the community. Similarly, the Dhungentar Reconstruction and Development Community was formed to assist the project by facilitating effective communication with the community, liaising on project implementation, and navigating through entrenched village politics. Particular emphasis was placed on the improvement of the chautari and construction of the multipurpose community centre as they serve as important hubs for community information flow and democratic decision-making.

Address village-specific needs with local resources and proven technologies

Any project area's specific needs and strengths should be assessed during project planning to ensure the effectiveness of initiatives. Given the economically disadvantaged status of the Dhungentar community, reconstruction of houses needed to be cost-effective. Therefore, the CSSB technology – already proven as a cheap and disaster-resilient option in post-earthquake reconstruction around the world – was approved by the NRA and introduced in Dhungentar. Moreover, community members were trained in the production process, which utilized local natural resources. This self-sufficiency not only generated community ownership in the project but also offered local employment opportunities.

The project also learned that it was necessary to find champions of different innovative practices and technologies to achieve community-wide awareness and adoption. As soon as the project was able to deliver in tangible terms and demonstrate its contributions to not only rebuilding houses but also bouncing forward with livelihood enhancement opportunities, there was a noticeable improvement in the community's perception of the project and willingness to participate. Using this momentum, the project identified the following champions to increase community participation in vital areas with potential: Hira Lal Sunar for agribusiness growth, Til Kumari Sunar for environment-friendly and self-sufficient household management, CSSB production trainees for the establishment of an enterprise, and the project's social mobilisers for the use of technology for development. Demonstrating tangible benefits of newly introduced practices and technologies is an effective way of propagating them throughout the community. For example, Hira Lal's agriculture model used a plastic tunnel to introduce mushroom farming in Dhungentar's subtropical climate, which locals generally assumed would not be favourable for mushroom production. Local champions can therefore shift community perceptions by showing possibilities.

Facilitate market linkage for more opportunities

Proper market linkage can help promote entrepreneurial activities and agribusiness ventures, thereby allowing communities to become resilient and flourish. Dhungentar's infrastructure was improved to establish the foundation for self-sufficiency. After the reconstruction of private houses, roads and trails were constructed to ensure access and connectivity. Subsequently, traditional structures supporting livelihoods such as watermills and blacksmith sheds were improved to allow resumption and growth of income-generating activities following the earthquake. Skill-based training was then imparted to locals, mostly women, to encourage small-scale entrepreneurship. The agriculture model demonstrated the potential for agribusiness in the community.

In this manner, Dhungentar's capacity to fully utilize local resources and strengths was raised. With better road connectivity, transport of goods became easier. However, Dhungentar locals required networking and market knowledge to reach local businesses in Battar, and the locals' inexperience in this area meant they could not properly market their home-made or organic products. This was a major oversight in the project's planning for livelihood opportunities. Training programmes are needed to build people's business acumen, and establishing different cooperatives can help businesses sustain by providing access to credit. In the initial phases, commitment is needed from local businesses to maintain transactional relationships with such aspiring, inexperienced entrepreneurs.

7. References

- Anand, K.B. & Ramamurthy, K. (2005). Development and evaluation of hollow concrete interlocking block masonry system. *The Masonry Society Journal*, 23(1), 11-19.
- Asia Foundation (2017). *Independent impacts and recovery monitoring phase 4: April 2017*. Retrieved from <https://asiafoundation.org/wp-content/uploads/2017/10/Aid-and-Recovery-in-Post-Earthquake-Nepal-Synthesis-Report-Phase-4-1.pdf>
- Central Bureau of Statistics (2015-16). *Annual household survey 2015–16*. Retrieved from http://cbs.gov.np/image/data/2017/Annual%20Household%20Survey%202015_16_Major%20findings.pdf
- Dalit Civil Society Massive Earthquake Victim Support and Coordination Committee (2015). *Waiting for “justice in response”*. Retrieved from <https://reliefweb.int/sites/reliefweb.int/files/resources/REPORT-OF-IMMEDIATE-ASSESSMENT-Relief-for-Dalits-in-NEPAL-2015.pdf>
- Gautam, R. et al. (eds.) (2006). Home gardens in Nepal. Proceedings of the Workshop on Enhancing the Contribution of Home Garden to On-farm Management of Plant Genetic Resources and to Improve the Livelihoods of Nepalese farmers: Lessons Learned and Policy Implications, Pokhara, Nepal. 6–7 August 2004.
- Herskedal, N.A. et al. (2012). *Interlocking compressed earth block walls: Out-of-plane structural response*. 15th World Conference on Earthquake Engineering, Lisbon, Portugal. 2012.
- Joshi, G. et al. (2016). *A manual on participatory three-dimensional modelling (P3DM)*. Kathmandu: ICIMOD.
- Maini, S. (2010). *Earthen architecture in the world*. Auroville Earth Institute. Retrieved from http://www.ada.gov.sa/idc/groups/public/documents/AR_ADA_Researches/004568.pdf
- Ministry of Urban Development, Government of Nepal (March 2017). *Design catalogue for reconstruction of earthquake resistant houses (Vol. II)*. Retrieved from <https://www.buildupnepal.com/wp-content/uploads/2017/04/DESIGN-CATALOGUE-VOLUME-II-FINAL.pdf>
- Pillai, R.R. (2001). Building technology for quake-hit zones. *The Hindu*. Retrieved from <http://www.thehindu.com/2001/02/04/stories/0404211c.htm>
- UNDP Nepal (n.d.) *Incense making enterprise sees huge success*. Retrieved from <http://www.np.undp.org/content/nepal/en/home/ourwork/povertyreduction/successstories/incense-making-enterprise-sees-huge-success.html>

8. Project Partners

Core Partners

The National Reconstruction Authority (NRA) and the International Centre for Integrated Mountain Development (ICIMOD), with support from the International Development Research Centre (IDRC), implemented this pilot demonstration project on earthquake reconstruction and rehabilitation in Dhungentar, Nuwakot.

Collaborating Partners

The following organisations were involved in the implementation of the project's core activities at the local level:

- Sahayata Samajik Sanstha
- Innovative Design Concern (INDECO)
- Manushi

Government Partners

ICIMOD acknowledges the guidance and cooperation of the following government bodies during the implementation of the project:

- Bidur Municipality
- Department of Urban Development and Building Construction (DUDBC) District Administrative Office (DAO)
- District Agriculture Development Office (DADO)
- District Coordination Committee (DCC)
- District Disaster Risk-Reduction Committee (DDRC)
- District Emergency Operating Centre (DEOC)
- District Forest Office (DFO)
- District Horticulture Office
- District Soil Conservation Office (DSCO)
- Nepal Electricity Authority (NEA)

Co-financing Partners

ICIMOD expresses its appreciation of the following co-financing partners for their financial contribution towards different project activities:

- National Reconstruction Authority (NRA): Co-financed the reconstruction of houses
- Alternative Energy Promotion Centre (AEPIC): Co-financed the construction of biogas plants; contributed 96 sets of solar lamps for all households; two 1,200 W solar panels for community solar street lamps
- Nabil Foundation: Supported the construction of the multipurpose community centre
- Rotary Club – Durbar Marg: Donated 100 units of Aquabox - water filter to each household

Private Sector Partners

The involvement of the following private sector partners was integral to the project's livelihood improvement and capacity-building activities:

- Biogas Sector Partnership-Nepal (BSP-Nepal)
- Dabur Nepal
- e-Sewa
- Rakshya Kunja Supply Pvt. Ltd.
- Rapti Renewable Energy Pvt. Ltd.
- Sarosh Pradhan and Associates
- World Distribution Nepal

Knowledge Partners

The following organisations were instrumental in creating and disseminating knowledge related to reconstruction and rehabilitation in Dhungentar:

- Asian Institute of Technology (AIT)
- Asian Institute of Technology and Management (AITM)
- Center for Rural Technology Nepal (CRT/N)
- Clean Cooking Alliance
- Housing Recovery and Reconstruction Platform (HRRP)
- Nepal GIS Society
- Nepal Telecom
- Save the Children
- Trishuli Medical College



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