Mountain Resilience:

Torrent Catchment Restoration in the Pamir Mountains of Afghanistan

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EXECUTIVE SUMMARY

Panj River forms the border between Afghanistan and Tajikistan for over 1,000 kilometres

Afghanistan is a country of dramatic landscapes, but life can be harsh for communities living in its remote mountain regions. Floods, landslides, avalanches, and droughts frequently devastate farmlands, destroy homes, harm livestock, and cause loss of life. These risks are exacerbated by decades of political instability and armed conflict that have weakened Afghanistan's national institutions, damaged infrastructure, encouraged unsustainable agricultural practices, and fuelled conflict and competition over scarce natural resources. With dwindling natural assets, infrastructure, and services available, these mountain communities bear a heavy burden when hazards strike.

Considering the challenges facing Afghanistan's rural mountain communities, the United Nations Environment Programme (UNEP) and the Aga Khan Foundation (AKF) have partnered with the Government of Afghanistan and local communities to pilot ecosystem-based approaches to reduce the vulnerability and increase the resilience of mountain societies to natural hazards. The overall objective of this project is to create a replicable demonstration model for community-based ecosystem restoration of relatively small mountain torrent catchments and to improve livelihoods through rebuilding natural capital and optimizing ecosystem services to minimize the impacts of natural hazards.

Based on a structured selection process, the Deh-shahr catchment of around 60 km^2 and a population of approximately 3,000 people in the northeast province of Badakhshan was chosen as the project site. Located in the Pamir mountains, the watershed is typical of the many mountain torrents in this rugged region whose most prominent geomorphic feature is a large alluvial fan that empties into the Panj River (upper Amu Darya) straddling the border between Afghanistan and Tajikistan. Its terminal debris cone consists mainly of large rocks and boulders that regularly overspill during floods and deposits its heavy material load over prime agricultural land where the local community lives, farms, and raises livestock. Thus, not only is the local community at risk when a hazard strikes, but longer-term impacts on farmer livelihoods, food security, and public health are equally substantial.

As a first step, a series of consultations and workshops were organized with the local community in Deh-shahr to assess priorities and foster environmental stewardship. As a result, a Community-based Natural Resource Management (CBNRM) Committee was established by the local community, together with the Ministry of Agriculture, Irrigation and Livestock (MAIL), to safeguard their natural resources, mitigate natural hazards, provide local employment opportunities, and formalize participation in decision-making.

Next, the local community built a Participatory Three-dimensional Model to identify hazard hotspots and select appropriate interventions. A major advantage of this relief model is that it visualizes the landscape as defined by the community and allows for greater public participation regardless of education level, literacy, or role in the community. Through this process, the people of Deh-shahr selected a set of interventions to address the urgent risks of drought, landslide, and flood; support farmer livelihoods; improve food and energy security; and provide income-generating opportunities for locals.

Individually, each intervention improves farmer livelihoods and reduces the risks from natural hazards. When linked across the upper, middle, and lower catchments, however, these actions build off each other to create a healthier ecosystem capable of buffering many shocks in different ways. Moreover, with fewer shocks from natural hazards, the overall ecosystem of Deh-shahr catchment is becoming increasingly resilient and provides new opportunities for improving rural livelihoods, food security, and income generation.

Beginning from the upper catchment, rangeland restoration has shown that native plant species can reclaim their territory with time and conservation, thereby improving slope stability, reducing soil erosion, and providing fodder for livestock. At this high elevation, small actions can have big impacts downstream. Rangeland restoration is the first step in preventing landslides and floods from reaching the community below and improving the quality of riverine farmland by preventing the pummelling of houses, crops and land with boulders and rocks.

Similarly, a lack of water and irrigation in the middle catchment meant that the local community could not rehabilitate and make the most of this land. Left untended, these denuded slopes exacerbated natural hazards downstream. By improving water access in this area, primarily through the rehabilitation and extension of the Oshtuk mountain irrigation channel, the Deh-shahr community can now grow native fruit and forest trees on slopes. It is also enabling establishment of woodlots for more sustainable harvesting of fuel and timber. In addition, the construction of terraces, contour bunds, and gully plugs in the area further supports ecosystem restoration by reducing soil erosion and increasing the land's ability to absorb surface water. This should allow the Deh-shahr community to plant fruit and other trees over an additional area of around 100 hectares, which would represent around 60 per cent of the land currently under cultivation in the catchment. Working in concert, these interventions reduce the risk of hazards downstream and afford the Deh-shahr community greater access to fresh, nutritious foods and opportunities to earn additional income through the sale of fruit and nuts in local markets.

In the lower catchment, where the Deh-shahr torrent empties into the Panj River, the primary intervention was the construction of a one-kilometre-long flood protection dyke to channel water flow through the alluvial fan. This helps control floodwaters and the debris it carries from ruining areas where the community lives, works, and farms. As a result, with a reduced risk of floods, the local community has been able to reclaim fertile farmlands and plant trees along the riparian zone to buffer debris flows, provide fuel and timber, create a community recreational site, and stabilize the area in and around the alluvial fan. In addition, 125 solar water heaters were installed in vulnerable households to provide hot water for bathing, washing, and cleaning. Thereby, reducing reliance on fuelwood harvested from forests and rangelands and freeing up villager's time and labour which can be used for other income-generating activities.

Through these activities, the project achieved significant improvements in mitigating hazards, and reducing exposure and vulnerabilities to natural hazards for the people of Deh-shahr. Local villagers are eager to maintain, expand, and replicate these interventions now that they can see the multiple benefits of ecosystem-restoration activities first-hand in their community, especially in terms of improved agriculture productivity, income generation, food security and nutrition, and infrastructure protection in the village. This project demonstrates that through a combination of policy engagement, community-based planning, and targeted physical interventions, it is possible to achieve meaningful ecosystem restoration and improve rural livelihoods by rebuilding natural capital and optimizing ecosystem services to minimize the risks of natural hazards. Furthermore, it is especially promising that communities from neighbouring areas are taking note of this torrent management experience and showing growing interest in pursuing similar integrated catchment restoration approaches to help sustainably address their own livelihood challenges.

A detailed description and analysis of the project's, approaches, interventions and achievements are captured in the following sections of this report:

Section 1: Introduction
A brief overview of the physical and human geography of the Deh-shahr catchment and the mountain ecosystem restoration project.

Section 2: Natural Hazards and Rural Livelihoods in Mountain Areas
A description of the natural hazards occurring in Deh-shahr, their impacts on the local community as well as coping mechanisms, and the importance of linking upper, middle and lower catchments holistically.

Section 3: Project Interventions and Activities
A detailed description of each intervention undertaken as part of this project, including strengthening community organizational and technical capacities, and physical rehabilitation works from the upper to the lower catchment.

Section 4: Ecosystem Management Results and Impacts
Analysis of the impacts of project interventions on reducing adverse impacts of natural hazards and improving community livelihoods, at both individual and holistic levels.

Section 5: Lessons Learned and Next Steps
Identification of unexpected opportunities and challenges, recommendations for improvement, and plans for sustaining results.

Dominated by very steep slopes, arable land is a scarce asset in Deh-shahr catchment

BOX 1: PROJECT INTERVENTION HIGHLIGHTS

Upper Catchment (2,700 - 4,700 m.a.s.l.)

- Rangeland biomass monitoring sites were established on one hectare of land to demonstrate the regeneration potential of native plant species.
- A 150-hectare livestock exclusion zone was designated by the local community to support rangeland rehabilitation and combat soil erosion and landslides.

Middle Catchment (2,200 – 2,700 m.a.s.l.)

- 740 soil and stone bunds, 58 conservation ditches, and 440 terraces were constructed on slopes to slow water runoff, improve groundwater recharge, and prevent soil erosion. Additionally, some 7700 tree saplings were planted on the terraces, where their roots assist with soil stabilization and fruits afford new sources of food and income for local farmers.
- 120 gully plugs were constructed on mountain flanks to prevent the rapid and damaging flow of runoff, boulders, and rocks downstream towards the community.
- 41 ha of woodlots were established to reduce pressure on wild forests that are unsustainably harvested for fuel and building materials.
- 46 ha of rain-fed land reforested with indigenous walnut, almond, and apricot saplings that will help stabilize slopes and reduce the risk of floods and landslides while also providing valuable nutrition to improve the food security of local communities.
- 3.5 kilometres of the Oshtuk irrigation canal was rehabilitated to provide water to up to 100 hectares of sloped land planted with orchard trees to stabilize soil, provide additional income to local villagers, and diversify their livelihoods and food sources. If fully developed, this would represent a 60 per cent increase in the cultivated area in the catchment.

Lower Catchment (2,000 – 2,200 m.a.s.l.)

- Construction of one kilometer long flood protection dyke to channel water flow through the Deh-shahr alluvial fan to control floodwaters and the debris it carries from damaging areas where the community lives, works, and farms.
- Reforestation of around 5 hectares in the alluvial fan to buffer debris flow, floods and create a recreational riparian zone.
- 125 solar water heaters were installed in vulnerable households for providing hot water for bathing, washing, and cleaning, reducing reliance on fuelwood harvested from forests and rangelands.

1

INTRODUCTION

1.1. BACKGROUND AND CONTEXT

Afghanistan is a land-locked and mountainous country in Central Asia with an abundance of biodiversity and dramatic landscapes, ranging from the hot deserts of the south to the snow-capped peaks of the Hindu Kush. Over four decades of armed conflict and political instability in the country, however, have resulted in widespread deforestation, weakened institutions, damaged infrastructure, displaced populations, food insecurity, unsustainable agricultural practices, conflicts over natural resources, as well as a short-term approach to the use of natural resources.

For rural communities living in Afghanistan's mountainous areas, the challenges are even more profound owing to the region's steep terrain, complex geology, and highly variable precipitation patterns that increase vulnerability to floods, landslides, and droughts.[1] Repeatedly, these hazards cause significant loss of life and destruction of property, impacting rural farmer households' livelihoods, safety, and prosperity. These impacts are further compounded by the harmful effects of climate change on seasonal temperature and precipitation patterns, which further push farming communities to misuse natural resources and adopt negative coping mechanisms for subsistence.

In response to the urgent needs of Afghanistan's rural mountainous communities, the United Nations Environment Programme (UNEP) and the Aga Khan Foundation (AKF) have partnered with the Government of Afghanistan and local communities to apply ecosystem-based approaches to increase the resilience and reduce the vulnerability of mountain societies and their environment. In this undertaking, priority is given to ecosystem management activities that restore mountain habitats, reduce the risk of disasters, and sustain people's agricultural livelihoods.

A pilot demonstration of community-managed ecosystem restoration was conducted in a small torrent catchment, a typical landform across the Pamir Mountains. Many of the local communities congregate in torrential catchments, cultivating flood prone valleys and building on alluvial fans. The rugged and rocky Deh-shahr torrent basin in Shughnan district of Badakhshan province was selected as the project site. Deh-shahr is dominated by a large alluvial fan and debris cone that empties into the mainstem of the Upper Panj River (Amu Darya basin). It provides an ideal physical setting for demonstrating the interlinkages between ecosystem services and natural resource management as they occur in the upper, middle, and lower catchment areas.

Political map of Afghanistan showing the project location in Shughnan District of Badakhshan Province

1. ICIMOD (n.d.). *Adaptation and Resilience Building*, available at: https://www.icimod.org/regional-programme/adaptation-resilience-building

Most importantly, deforestation and rangeland degradation in Deh-shahr's upper catchment impede the land's ability to absorb water and maintain stability, leading to severe landslides and floods downstream in the lower catchment where communities live, shelter livestock, and keep farmland. Consequently, this project aims to showcase the effectiveness and applicability of ecosystem-based torrent management in the specific context and needs of Afghanistan's mountainous farming communities through community-based planning, preparation, and action.

The Hindu Kush mountain range, which runs through the north-eastern and central regions of Afghanistan, experiences the greatest snow fall

1.2. LEVERAGING PARTNERS AND STAKEHOLDERS

To address the challenges facing Afghanistan's mountainous communities, UNEP launched an Ecosystem-based Disaster Risk Reduction (Eco-DRR) initiative in 2012 in collaboration with government institutions, academia, civil society, non-government organizations (NGOs), and community-based groups. With generous support from the European Commission, the initial four-year pilot initiative applied community-based Eco-DRR measures in the Koh-e Baba Mountains of Bamyan province. The aim was to harvest lessons learned to upscale Eco-DRR across larger landscapes in the country, provide high-level national policy guidance, and support institutional coordination on disaster planning and prevention.

The abovementioned Eco-DRR initiative demonstrated the benefits of ecosystem-based approaches in reducing vulnerability to natural hazards in Afghanistan and mainstreaming climate change impacts into disaster planning at local, regional, and national levels. A key message from this experience is that rather than addressing individual hazards as isolated events, the Eco-DRR approach emphasizes the holistic interactions between land, air, water, flora, and fauna at the landscape level that bridges environmental issues and interventions across upper-, middle-, and lower-catchment areas.

Avalanche prevention structures

In recent years, UNEP has also helped leverage strategic partnerships with organizations such as the Aga Khan Development Network (AKDN), the International Centre for Integrated Mountain Development (ICIMOD), the University of Central Asia, and the Afghanistan Resilience Consortium (ARC) to upscale implementation of Eco-DRR interventions across larger geographic areas of the country. Specifically, UNEP has assisted partners in developing and delivering training materials, community-planning processes, guidelines and handbooks for intervention implementation, and climate change projections for temperature and precipitation.

By providing this support, many groups in Afghanistan now recognize the importance of landscape-level planning to improve the management of natural resources, support livelihoods and reduce disaster risk. For example, the ARC formally adopted a watershed-level planning approach that links communities and resources between upper and lower catchments and mainstreamed community-based planning into their intervention methodology across the country.[2]

The intergovernmental institution, ICIMOD, has also integrated a community-based Eco-DRR approach in their planning for environmental resilience to hazards and climate change across the whole of the Hindu Kush-Himalayas, ranging from Afghanistan to Myanmar. Similarly, Concern Worldwide is replicating the Eco-DRR approach in their watershed management interventions across the northeast of the country, demonstrating the value of presenting pilot demonstrations for upscaling elsewhere.

1.3. OVERVIEW OF THE DEH-SHAHR DEMONSTRATION PROJECT

Building upon the pioneering Eco-DRR initiative in Afghanistan in 2012, UNEP and the Aga Khan Foundation (AKF) undertook a mountain ecosystem restoration project in 2019 integrating Eco-DRR principles in Deh-shahr catchment of Badakhshan province, with the generous financial support of the European Commission. The overall objective of this new initiative is to create a replicable demonstration model for community-based management and restoration of relatively small mountain torrent catchments and to improve livelihoods through rebuilding natural capital and optimizing ecosystem services to minimize the impacts of climate change and natural hazards.

2. See the ARC's Community-based Disaster Preparedness (CBDP) plan and Hazard and Climate Vulnerability and Capacity Assessment (HCVCA) toolkit for example. Available at: https://www.unep.org/resources/mjmwt-aladwat/community-based-disaster-preparedness-toolkit

BOX 2: DEH-SHAHR KEY PROJECT INTERVENTIONS

#1 Strengthen community-based action planning to enhance traditional natural resource management and restoration at catchment/landscape level

#2 Rehabilitate degraded land and reduce disaster risk

#3 Increase access to renewable energies to reduce pressures on the local environment

#4 Improve rural livelihoods and food security

The Deh-shahr catchment is located in Shughnan district of Badakhshan province and was selected as the project implementation site based on defined assessment criteria. Initially, a macro-level assessment informed by Eco-DRR opportunity mapping was conducted to identify the region's priority areas for restoration activities. Through this process, a total of five preliminary catchment sites were identified and then screened against the following criteria:

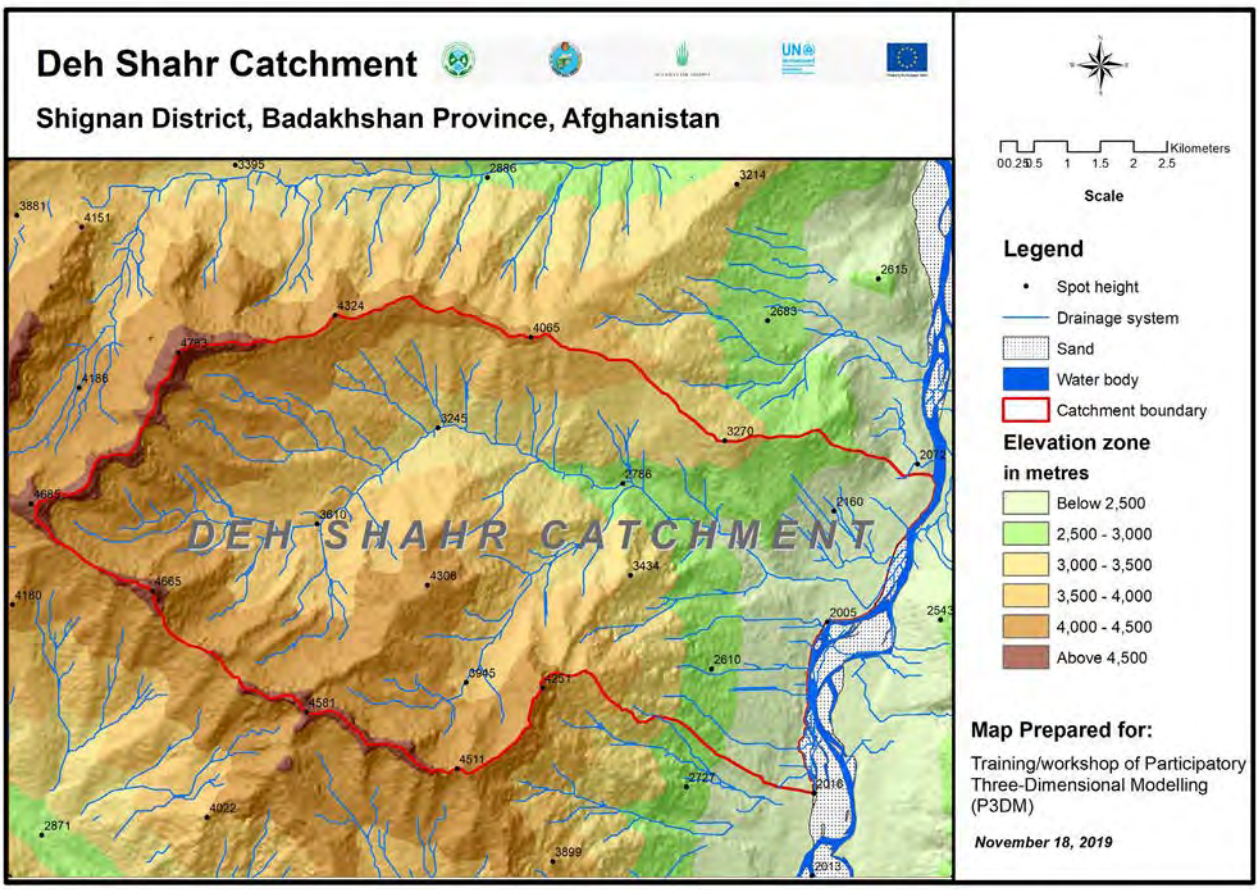
a. compact size (less than 75 km^2);
b. clearly defined environmental and disaster risks;
c. strong community interest and organizational capacity; and
d. secure and easy access to demonstration sites to facilitate replication and upscaling.

View of the Deh Shahr catchment from Tajikistan

1.4. LINKING LOCAL ACTIONS WITH NATIONAL, PROVINCIAL, AND DISTRICT LEVEL PLANNING

In Afghanistan, Community Development Councils (CDCs) are the lowest level of governance and are an ideal structure through which local actions can be linked with planning at the district, province, and national levels. The wider community regularly elects CDC members to represent their collective needs and priorities, especially regarding community development, infrastructure, allocation of natural resources, and conflict resolution.

In Deh-shahr, the local community has further embedded local-level environmental planning into its CDC by establishing a Community-based Natural Resource Management Committee (CBNRM Committee) to formalize the short-, medium- and long-term oversight of natural resources. More specifically, this CBNRM Committee is a formal structure that is overseen by the local representatives of the Ministry of Agriculture, Irrigation, and Livestock (MAIL) that aims to: prevent water and soil degradation; mitigate natural hazards; conserve forests and rangelands; provide employment opportunities for local workers; and formalize participation in decision-making on environmental and social issues.



Physical Map of Deh-shahr Catchment

While restoration interventions under this project are limited to the Deh-shahr catchment area, the lessons learned and best practices from these pilot demonstrations feed into regional planning, upscaling, replication, and national-level policies. Afghanistan's draft National Environment Policy now includes Eco-DRR as a key priority area. Also, Afghanistan has further developed and revised its national DRR strategy giving more significant consideration for Eco-DRR approaches and sustainable natural resource management. In addition, there is great potential for cross-border upscaling of activities with Tajikistan in order to support further landscape-level results. Finally, this experience contributes to Afghanistan's knowledge base on operationalizing ecosystem-based approaches to reducing disaster risk and improving human livelihoods in an integrated manner.

2

NATURAL HAZARDS AND RURAL LIVELIHOODS IN MOUNTAIN AREAS

2.1. BACKGROUND AND CONTEXT

Badakhshan is home to more than 982,000 people spread across a rugged and mountainous landscape that borders Tajikistan to the north, Pakistan and Kashmir to the southeast, and China in the east. Due to the steep and rocky terrain, only 3-4 per cent of the land in Badakhshan can be cultivated mainly along the narrow valley floors and alluvial fans. In the higher valley floors of the Panj watershed the available arable land is even less. Only one crop per year is normally possible due to long, harsh winters and short growing season. Subsistence livestock raising is practiced where pastures are favourable.

Shughnan district is highly prone to rockfall, avalanches, and floods

The Deh-shahr catchment is in Shughnan district of Badakhshan, nestled in the rugged Pamir mountains on the border with Tajikistan. Shughnan is home to approximately 27,750 people spread across 3,528 km^2 of rough mountainous terrain. Like most rural Badakhshan, Shughnan is also remote and isolated due to limited transport infrastructure, insecurity, and harsh weather in the long winter season. In such a challenging environment, community-based approaches such as self-help and participatory preparedness strategies are essential tools to reducing vulnerabilities and exposure to natural hazards and improving the overall management of scarce resources.

For the mountainous communities in Badakhshan, sound environmental management plays an essential and cost-effective role in securing livelihoods and reducing many of the risks posed by natural hazards. Essentially, healthy ecosystems serve as natural barriers that protect vulnerable communities and foster local biodiversity and ecological productivity. This is especially true for remote communities such as those living in the Deh-shahr torrent catchment that frequently endure droughts, floods, landslides, avalanches, and extreme temperatures but are often inaccessible to emergency or rescue workers when disasters strike. Thus, in the Deh-shahr watershed, the priority for this project has been to reduce the risk and exposure to natural hazards and improve the resilience of rural livelihoods through an ecosystem-based adaptation approach that combines nature-based solutions with conventional infrastructure interventions.

Rock fall is one of the major hazards in mountainous terrains

2.2. DEH-SHAHR CATCHMENT: NATURAL HAZARD OVERVIEW

2.2.1. DEH-SHAHR ALLUVIAL FAN AND DEBRIS CONE

In Afghanistan, winter snow and ice make up the largest proportion of renewable water annually, but these annual precipitation patterns are changing due to climate change. As temperatures increase and precipitation levels fluctuate, Afghanistan is already caught between two contrary threats: water shortages, often causing severe drought, and water excess, causing frequent destructive floods.

In the Deh-shahr catchment, the most prominent geomorphic feature is a large alluvial fan that empties directly into the mainstem of the Panj River. A terminal debris cone – created by the main torrent channel comprising mainly large rocks and boulders – regularly overspills and deposits its materials over prime agricultural land where the local community lives, farms, and raises livestock.

Deh-shahr alluvial fan with old flood protection dyke

As a result, this debris encroaches on prized fertile land rendering it effectively sterile for agriculture. This alluvial fan is also the most prone to significant disaster risk for the local community, given its high exposure to flash floods and landslides. As water collects in the upper catchment during spring and autumn, it is routed through a series of tributary gullies until it joins a single intermittent but fast-flowing torrent in the middle catchment. These conditions trigger flooding events that threaten the community in the lower catchment and tumbling rocks and boulders that threaten people and damage infrastructure and property.

2.2.2. DROUGHT

Afghanistan is one of the most drought-sensitive countries globally and has endured drought for much of the last decade. In 2021, Afghanistan faced its worst drought in 30 years, impacting 25 of the country's 34 provinces, including Badakhshan which is one of the hardest hit. Fifty-five percent of Afghanistan's population (23 million people) are facing acute food shortages, which has contributed to displacing over 700,000 people this year. For mountain communities in Afghanistan, the challenges of drought are further compounded by the impacts of climate change at higher elevations, resulting in greater fluctuation of seasonal temperatures and precipitation patterns, including increased incidence of extreme events.

In the Deh-shahr catchment, drought conditions contribute to land degradation by desiccating forests, rangelands, and farmlands. Dry and barren lands in the upper and middle catchments are often stripped by heavy rains and snowmelt, compounding the risk of landslide and rockfalls in the lower catchment as slopes become saturated and unstable without trees or plants to anchor the soil. Moreover, without suitable vegetation cover, denuded lands cannot support animal husbandry, which has severe socio-economic impacts on the local community.

2.2.3. FLOOD

Afghanistan is highly vulnerable to floods, with the rate of flood deaths per capita among the highest in the world. In 2009, floods in the mountainous northeast of Afghanistan, including Badakhshan, killed nearly 1,200 people, affected almost 29,000 households, and caused the loss of more than 35,000 heads of livestock. And, as climate change accelerates winter snow and ice melt rates, seasonal floods are becoming increasingly severe and frequent, posing ever greater threats to life, livestock, and property.

Prime agricultural land in the alluvial fan was regularly washed away by floods or rendered sterile by debris flows

The Deh-shahr catchment suffers from both flash floods and seasonal floods, which differ in the speed and quantity of water flow. In both cases, owing to the steep slopes of the high mountain upper catchment, rain and snowmelt are channelled into an intermittent torrent that flows unobstructed straight downstream to the local community in the lower catchment. Hence, there is no middle transport reach to buffer the floods. In addition to inundations from excessive amounts of water, floods in Deh-shahr bring the added risk of tumbling rocks and boulders that threaten to damage the built-up sides of the torrent, as well as a newly constructed bridge, farmland, and other property. The power of this debris flow is evidenced by the formation of a substantial debris cone where the torrent reaches the Panj River, which degrades the quality of riverine farmlands. Thereby directly impacting the livelihoods, food security, and health of the local population.

2.2.4. LANDSLIDE

Afghanistan is a geologically active country with frequent earthquakes where the Eurasian and Indian tectonic plates meet. In mountainous areas, like the Deh-shahr catchment, rain, and snowmelt across denuded lands in the upper and middle catchment cause large amounts of soil erosion and increased risk of landslides from loosely joined waterlogged soils in the lower catchment. For example, in 2014, following a week of heavy rains, two large landslides in Badakhshan destroyed over 300 houses, affecting more than 14,000 people and claiming the lives of up to 2,700 villagers in Argo district. Deforestation, soil erosion, and land degradation are partially to blame but can be addressed via Eco-DRR approaches that focus on stabilizing soil on slopes, such as planting trees, contour bunds, terracing, rangeland protection, and other land conservation measures.

2.3. EARLY WARNING AND DISASTER MITIGATION PLANNING

In 2020, UNEP conducted an assessment on the current state of Early Warning Systems (EWS) in Afghanistan. This included organization of a training workshop in Shughnan district to gather information on current EWS setups and familiarize the community members from different villages with the community-based early warning systems and their role in reducing disasters risks. A case study on Shughnan's community-based early warning system is available online. Based on the findings, a community-based early warning system was established by the Aga Khan Agency for Habitat (AKAH) in 2017 which covers 56 out of 59 villages in Shughnan District. Relying on historical data and other assessments and surveys, AKAH has conducted risk mapping of the villages in Shughnan district. As a result Village Disaster Management Plans were developed for each village by national and international experts and the community members.

Community members participating in a training workshop on early warning system

To provide a better coverage of the district, AKAH selected two locations in Arakht and Werezn villages for the establishment of Weather Monitoring Posts (WMP) to collect data on a number of hydrometeorological parameters in the area. The collected data is compared with other international sources by national and international experts at AKAH's headquarters in Kabul and based on that, warnings are issued to the concerned areas for potential hazards as risks emerge. The warning message is communicated to the heads of communities and the established teams via mobile phone primarily, or back up means of communication such as Radio, Thuraya, Codan, VCN, etc. For improving and coordinating disaster response purposes, AKAH has also established different emergency teams in villages, such as the Community Emergency Response Team (CERT), Avalanche Preparedness Team (AVPT), and the School Emergency Response Team.

2.4. ECOSYSTEM-BASED ADAPTATION FOR DISASTER RISK REDUCTION

2.4.1. LINKING UPPER, MIDDLE AND LOWER CATCHMENTS

Eco-DRR can be defined as "the sustainable management, conservation, and restoration of ecosystems to reduce disaster risk, to achieve sustainable and resilient development."[3] One of the greatest strengths of the Eco-DRR approach is that it frames the three tenets of disaster risk – hazard, exposure, and vulnerability – within the overall landscape of the ecosystem rather than as disparate or isolated events. Thus, reducing any one of these three elements will contribute overall towards the reduction of disaster risk. For example, when looking at an area like the Deh-shahr catchment, hazards may manifest differently in the upper, middle, and lower catchments. Still, the key to reducing disaster risk for the whole area lies in recognizing the connections between the various components of the ecosystem.

Specifically, the Deh-shahr catchment experiences considerable erosion due to heavy rainfall, snowmelt, and landslides that originate in the upper and middle catchment but have the most significant impact in the lower catchment where they damage homes, farmland, property, and livestock. Given the immense power of landslides, rockfalls, and avalanches, stopping one might seem a herculean task. Targeted interventions, however, in the upper and middle catchments – such as terracing steep land, installing gully plugs, planting trees to stabilize slopes, and rehabilitating rangelands – can significantly reduce the risk of the hazard occurring or at least help reduce its severity downstream.

A small and well-defined catchment, Deh-shahr provides a good model for replicating community-based ecosystem restoration including Eco-DRR measures

3. Estrella and Saalismaa, 30 :2013.

2.4.2. COMMUNITY-BASED ENVIRONMENTAL STEWARDSHIP

Nature-based interventions have another advantage in that they are technically simple and can be built and maintained by local communities with limited use of specialized tools, expensive materials, or construction equipment. This community-based approach further incentivizes beneficiaries to become environmental stewards and invest in the upkeep and maintenance of Eco-DRR and restoration interventions, which, in turn, helps ensure the continued resilience of the community to natural hazards and their detrimental effects.

Community members guided by a mirab or water master divert a mountain stream into an irrigation canal

2.5. LOCAL LIVELIHOODS AND HAZARD RESILIENCE

Approximately 80 per cent of Afghanistan's population depends on agriculture for subsistence, most of whom are in rural areas with limited access to services or infrastructure. These farming communities are often the most vulnerable to natural hazards and climate change that impact the resources they depend upon, such as clean water, farmland, forests, and rangelands. When access to these natural resources is disrupted, people's livelihoods, safety, and food security are put in peril.

Conversely, healthy ecosystems and well-managed natural resources can protect against natural hazards and help safeguard rural livelihoods, especially in sensitive high-altitude mountain areas. For example, intact forests and well-managed rangelands can buffer roads and infrastructure from erosion, floods, and landslides by improving soil stability and groundwater recharge.[4] In short, healthy and resilient ecosystems foster healthy and resilient livelihoods and vice versa.

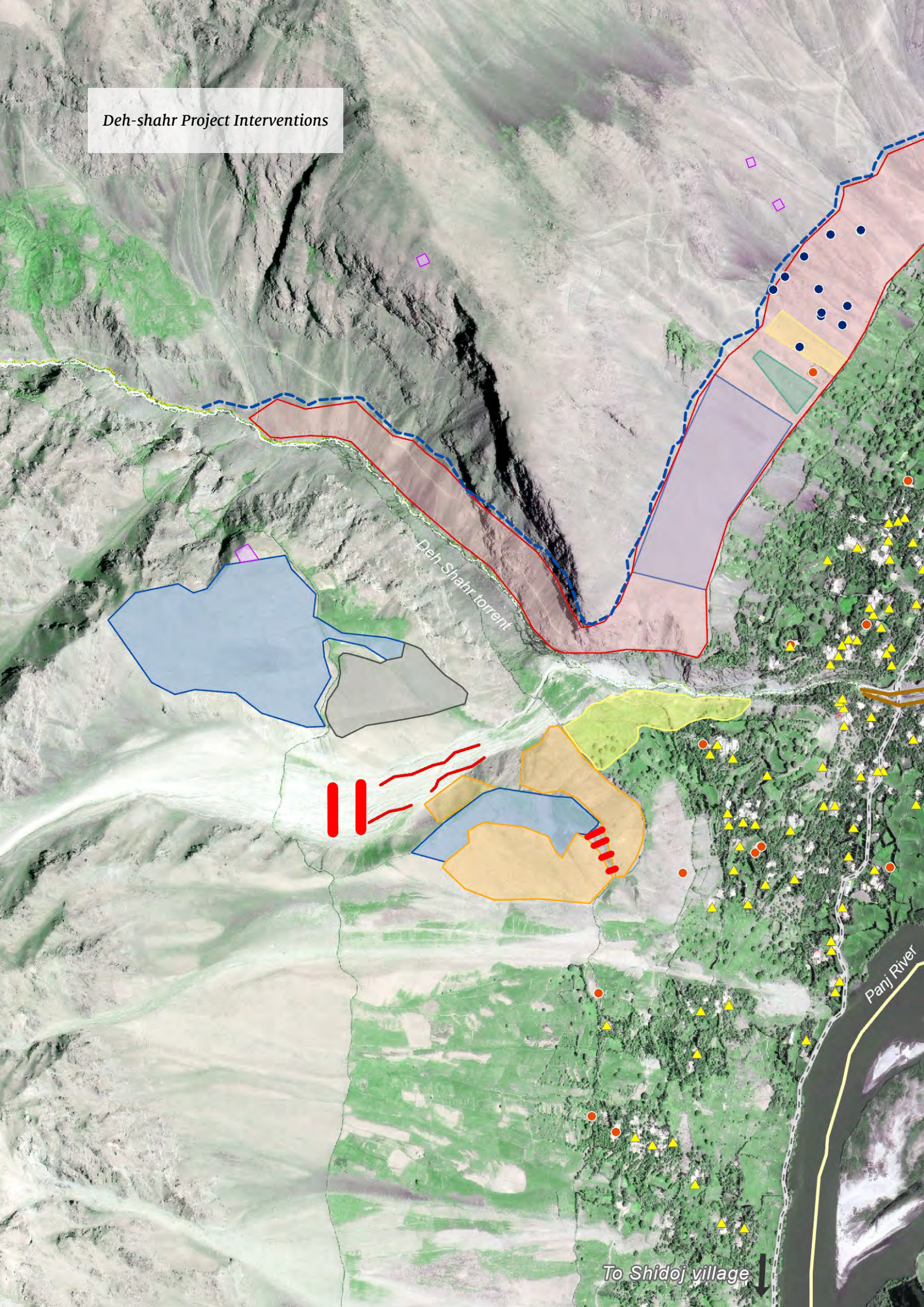
4. IUCN, available at: https://www.iucn.org/resources/issues-briefs/ecosystem-based-adaptation

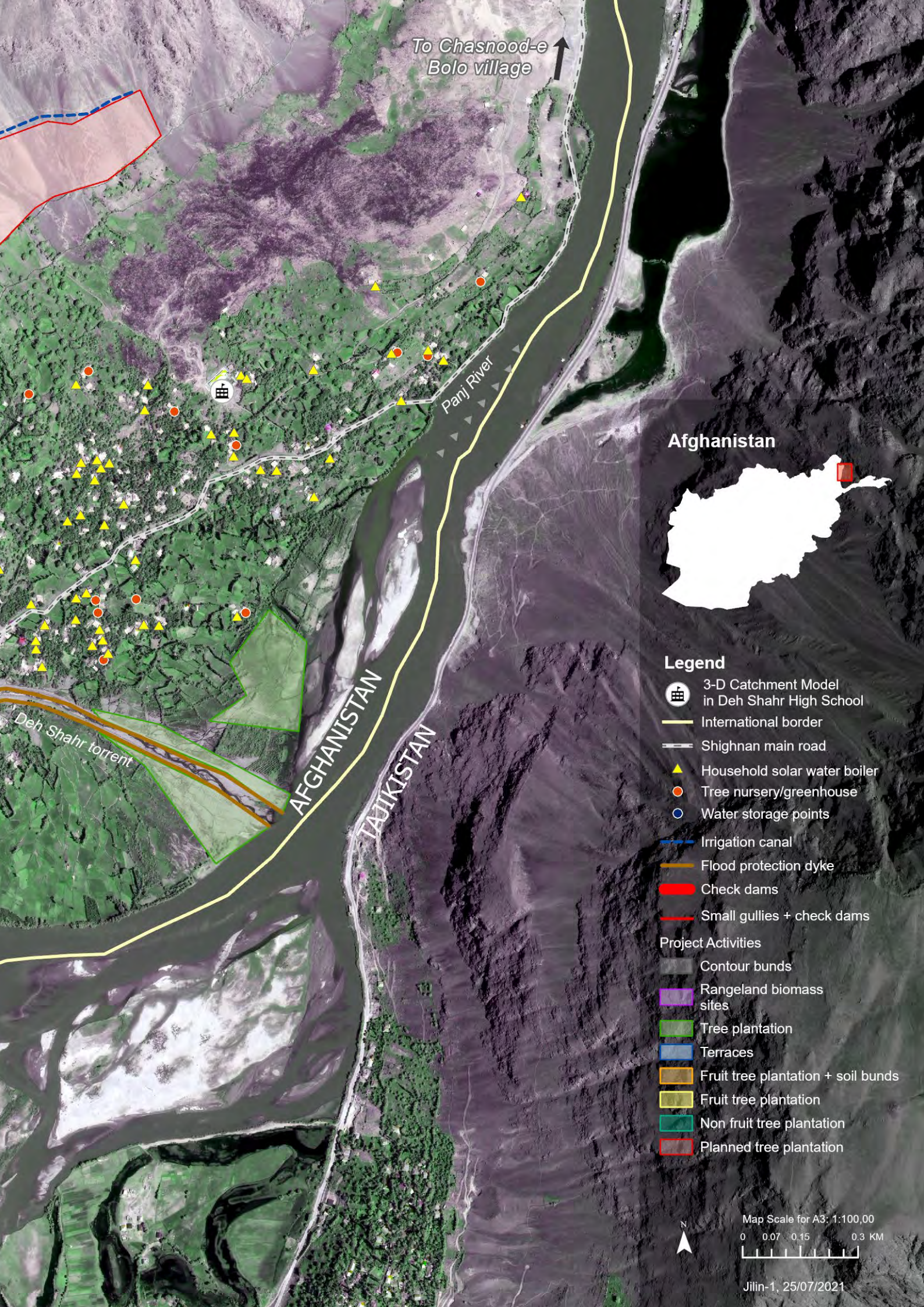
Recognizing the intrinsic relationship between people and the ecosystems they inhabit, a central aspect of all Eco-DRR interventions is livelihoods improvement through better access to resources, improved food security, and new employment and income-generating opportunities. In the Deh-shahr catchment, the project team and local community have made concerted efforts to ensure that all Eco-DRR interventions provide substantive benefits and improve livelihoods.

Terracing on slopes, for example, has the benefit of stabilizing land, countering erosion, and reducing the risk of flood and landslide. At the same time, they also expand the available farmland available to the community and provide new opportunities for cultivating fruit trees, generating income, and improving food security. Similarly, controlling the flow of the large torrent as it enters the lower catchment prevents flooding and protects vital farmland that is in short supply, and helps improve the reliability of crop harvests.

The multi-purpose benefits of Eco-DRR interventions are also particularly appealing for local community members and help foster local environmental stewardship by demonstrating the advantages and gains from adopting ecosystem-based restoration approaches.

Terraces were constructed to stabilize slopes and limit soil erosion


Deh-shahr Project Interventions
Deh-Shahr torrent
Panj River
To Shidoj village


To Chasnood-e Bolo village
Panj River
AFGHANISTAN
TAJIKISTAN
Deh Shahr torrent
Afghanistan
Legend
3-D Catchment Model in Deh Shahr High School
International border
Shighnan main road
Household solar water boiler
Tree nursery/greenhouse
Water storage points
Irrigation canal
Flood protection dyke
Check dams
Small gullies + check dams
Project Activities
Contour bunds
Rangeland biomass sites
Tree plantation
Terraces
Fruit tree plantation + soil bunds
Fruit tree plantation
Non fruit tree plantation
Planned tree plantation
N
Map Scale for A3: 1:100,00
0 0.07 0.15 0.3 KM
Jilin-1, 25/07/2021

3

PROJECT INTERVENTIONS AND ACTIVITIES

3.1. OVERVIEW

Deh-shahr is a small mountain torrent catchment characteristic of the Pamir mountains of Afghanistan and neighbouring Tajikistan. It covers around 60 square kilometres and is surrounded by high summits, with the peak elevation reaching 4,783 meters above sea level (m.a.s.l.). The catchment's defining geomorphological process is a large alluvial fan covering an area of some 1.5 km^2 that flows directly into the mainstem of the Panj River. The apex of the depositional alluvial fan is around 2,000 m.a.s.l., giving an overall height difference in the catchment of about 2,780 meters. The population of 2,890 inhabitants is mainly dependent on farming and livestock husbandry for their livelihoods. At the same time, there is a growing dependency on the service sector due to the limited arable land availability. An estimated 161 hectares or 2.7 per cent of the Deh-shahr catchment area is cultivated, of which 114 hectares is rainfed and 47 hectares is irrigated. The local community's main environmental challenges include overgrazing and deforestation of the upper catchment and mountain slopes with all the attendant impacts on food security and nutrition, water availability, and increased disaster risks.

The natural hazards prevalent in the Deh-shahr torrent catchment – namely flood, drought, and landslide – are complex in their origins and impacts. There is no silver bullet that can eliminate the risk of a disaster. Instead, an integrated approach is needed that combines the strengths of local knowledge with environmental assessment, community mobilization, and targeted physical interventions.

By fostering environmental stewardship and planning among local communities, the natural resource base can recover and be utilized in more conscientious ways that benefit locals the most. Meanwhile, the physical interventions specifically address the risks of flood, drought, and landslide by improving slope stability, reducing soil erosion, reforestation, and using low-water irrigation practices for saplings. Thus, the holistic combination of soft community governance and hard physical interventions helps ensure the sustainability of the project activity in the Deh-shahr catchment and their continued use, uptake, and replication by local communities.

Check-dams, soil bunds and tree plantations help stabilize slopes

3.2. COMMUNITY ORGANIZATION AND PLANNING

3.2.1. COMMUNITY MOBILIZATION AND STEWARDSHIP

People's participation and local ownership are the cornerstones of community-based natural resource management. Therefore, the involvement of local community members in the planning, decision-making, implementation, and maintenance of all project activities has been a critical element throughout the implementation of the Deh-shahr catchment project. Through a concerted mobilization effort, the local community was effectively engaged to take on greater responsibility and become environmental stewards for the benefit of all residents.

Community members drawing a village hazard map

Over the last two years, the people of Deh-shahr have been engaged in an iterative planning process to identify the area's primary hazards and possible solutions. This has emerged as a grassroots process from the Deh-shahr community, which is a major achievement for mobilizing locals and instilling a sense of environmental stewardship over the management of natural resources. To support the community in formulating and prioritizing their needs, the project organized a series of practical workshops to increase knowledge, technical skills, and strengthen coordination:

1. Community sensitization and mobilization on ecosystem restoration and protection
2. Participatory Rural Appraisal (PRA) to identify priorities and challenges for the preparation of Community-based Natural Resource Management (CBNRM) plans
3. Conducting village resource mapping
4. Development of community-based natural resource management planning.[5]

Through these consultations and field visits, local community members were able to better understand the ecosystem-based adaptation approach, identify vulnerable sites for hazards (flood, avalanche, soil erosion, etc.), and articulate a shared vision and specific objectives for improved natural resource management in their community.[6]

5. AKF semi-annual report Jul-Dec 2019, p. 5.
6. AKF QPR Jul-Sep 2019, p. 3.

Consultations with communities to define project interventions

3.2.2. FARMER FIELD SCHOOLS

Building off the workshops mentioned above, the project team and local community members established Farmer Field Schools (FFSs) to impart new land, water, and forest management skills. One specific focus area of these long-term field schools is drought-resistant fodder crops.

These FFSs sessions are held throughout the growing season, during which local farmers can compare production technologies for various fodder crops (alfalfa, Altriplex, prangos (aghond), etc.). In total, nearly 200 kgs of fodder seeds were planted over three hectares of private rain-fed land in the Deh-shahr catchment. In doing so, local farmers learned new techniques for fodder crop cultivation on rain-fed lands, rather than on irrigated land as in the traditional practice, while simultaneously reducing land degradation and erosion, as well as water consumption.

A Farmer Field School session for women in Deh-shahr village

3.2.3. COMMUNITY-BASED NATURAL RESOURCE MANAGEMENT COMMITTEE

Deh-shahr's community has further integrated environmental planning into local administration by establishing a Community-based Natural Resource Management Committee (CBNRM Committee) under its CDC. This establishes a structure for formalizing the short-, medium- and long-term oversight of natural resources throughout their catchment. This CBNRM Committee is composed of 11 executive members (9 men, 2 women), who are residents of Deh-shahr. They are tasked with developing village-level hazard and environmental management plans, which includes identifying hazard sites, and confirming selection of Eco-DRR interventions to address them.[7] The CBNRM Committee is a formal association that is overseen by the local representatives of the Ministry of Agriculture, Irrigation and Livestock (MAIL) that seeks to: prevent water and soil degradation; mitigate natural hazards; conserve forests and rangelands; provide employment opportunities for local workers and formalize participation in decision-making on environmental and social issues.

Meeting of the community-based natural resource management committee

3.2.4. COMMUNITY-BASED PARTICIPATORY THREE-DIMENSIONAL MODELLING

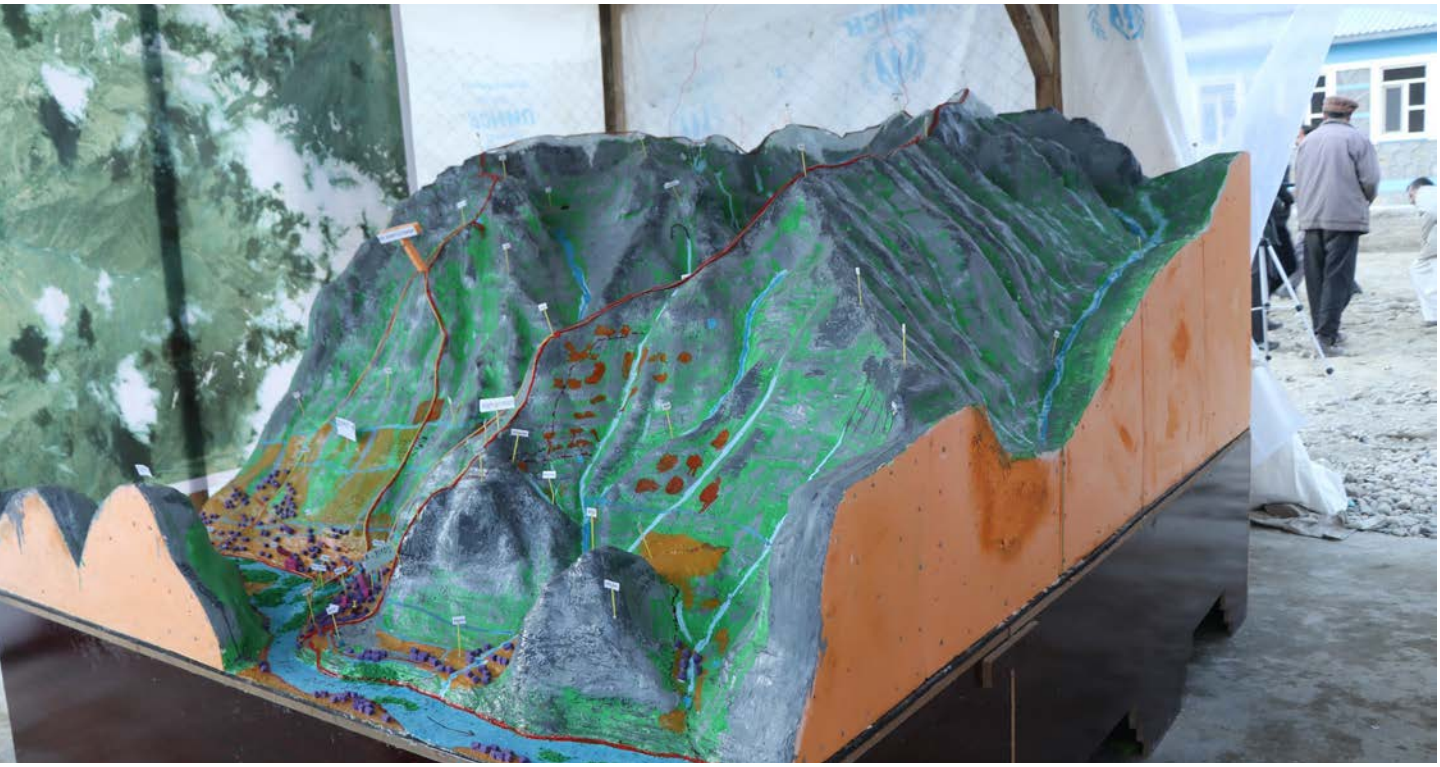
Community mapping plays an important role in understanding key environmental threats and identifying appropriate ecosystem management solutions. To guide the implementation of Eco-DRR interventions, a Participatory Three-dimensional Model (P3DM) of the Deh-shahr catchment was developed by the CBNRM Committee together with local government officials and international experts. The process was fully participatory and required multiple planning and preparation steps to ensure that the full breadth of local knowledge about natural hazards and resources was captured in a scaled (1:5,000) and geospatially referenced model.

7. AKF QPR Jul-Sep 2019, p. 7.

Participants preparing a three-dimensional model of Dehshahr catchment

First, a series of introductory sensitization sessions were organized to raise awareness about the key hazards in the area and share knowledge about the interconnectedness of hazards and natural resource management across the upper, middle, and lower catchment areas of the Deh-shahr alluvial fan.

Next, the participants sketched out the major environmental features and areas of risk and vulnerability to natural hazards in their community, as well as opportunities to improve agricultural development and natural resources management. They then developed a unified legend for identifying its key land cover and land use elements.



The completed Participatory 3D Model

Subsequently, this preliminary map was converted into a three-dimensional topographical representation of the Deh-shahr catchment manufactured by local community members. Thus, the final model not only serves as a valuable spatial planning and land use management tool but has also created an open social space for discussions related to disaster prevention and natural resource management.

Another advantage of the stand-alone relief model is that it is a visual representation of the landscape as defined by the community. Unlike a narrative report or technical text, it allows for greater public participation regardless of education level, literacy, or role in the community.

View of Deh-Shahr cactchment taken from Tajikistan by the Austrian explorer Martin Mergli in 2009.

3.3. PHYSICAL REHABILITATION WORKS

Through the abovementioned workshops, farmer field schools, and participatory modelling processes, the local community in Deh-shahr was able to collectively identify hazard hot spots and design key interventions to address these risks and improve the management of their natural resources. As a result, the Deh-shahr community identified three priority areas for practical action:

1. Reducing reliance on fuelwood by increasing access to appropriate renewable energy technologies.
2. Supporting community livelihoods and reducing disaster risks through reforestation, rehabilitation of degraded land and construction of diversionary mountain irrigation canal; and
3. Flood control measures including flood dyke construction and reforestation of alluvial fan.[8]

3.3.1. UPPER CATCHMENT (2,700 – 4,700 M)

Overgrazing of upper catchment rangelands is a key driver of ecosystem degradation

Rangeland Biomass Monitoring Plots

More than half of Afghanistan's total land area is covered by rangelands, which support extensive animal husbandry through sedentary seasonal transhumance and migratory systems that account for over 50 per cent of Afghanistan's total agricultural GDP.[9] In addition to providing fodder for sheep and goats, rangelands also provide communities with vital food, fuel, building materials, medicinal plants, and habitat for wildlife. Collectively, these resources account for a critical part of the natural capital and ecosystem services that Afghanistan's rural farming communities depend upon. Nevertheless, overgrazing of pastures has resulted in land degradation, increased desertification, conversion to rain-fed wheat cultivation, and overall decreased productivity.[10]

8. Report of Participatory Three-Dimensional Modelling (P3DM) of Deh-Shahr Catchment, p. 1.
9. Climate Change and Governance, p 31.
10. Highland Rangelands of Afghanistan: Significance, Management Issues, and Strategies, p. 15. Available at: https://lib.icimod.org/record/28842/files/2.HAR.pdf?type=primary

Community members constructing a rangeland biomass monitoring plot

In the Deh-shahr catchment, rangeland degradation is a critical underlying driver of soil erosion, landslides, rockfalls and flooding caused by the loss of vegetation on denuded land in the upper catchment.[11] To raise awareness about this issue and rehabilitate damaged rangelands, the project team worked with local livestock farmers to establish one hectare of fenced rangeland biomass monitoring plots to prevent animals from grazing on local plant species, surrounded by 150 hectares of exclusion zone. Over time, the fenced and exclusion zones allowed the local community to observe the regrowth of native plant species in real time. Moreover, the rangeland plots provided the local community with physical evidence on the massive impact of uncontrolled grazing and the need to adopt less intensive pasturing systems, such as rotational grazing that allow plants and soil adequate time to recover.

A fenced rangeland monitoring exclusion zone

11. Mountain Partners, p. 26.

3.3.2. MIDDLE CATCHMENT (2,200 – 2,700 M)

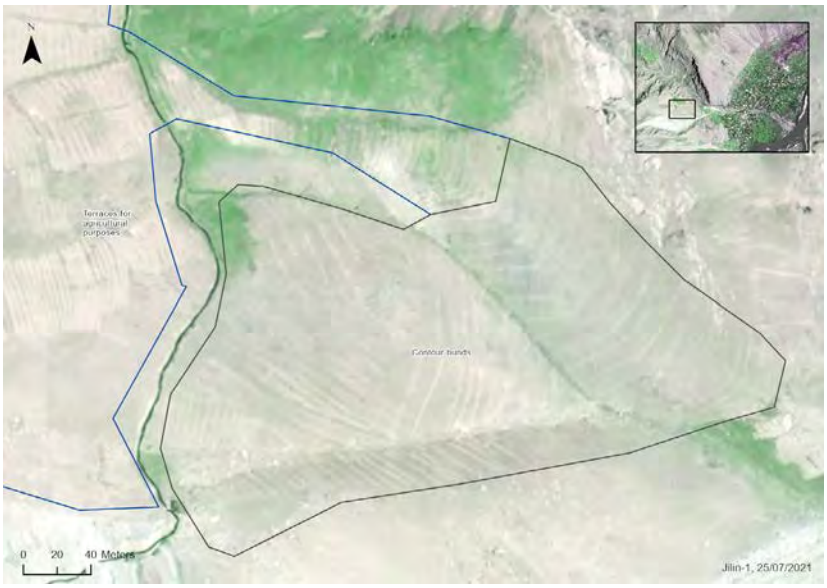
Land Rehabilitation

a) Contour Bunding

Contour bunding involves the placement of lines of stones along the natural rises of a landscape, such as along a slope to help reduce soil erosion and retain rainfall and snowmelt before it becomes runoff. Contour bunds are a relatively simple, low-tech, and inexpensive method to reduce land degradation, which local communities can easily maintain throughout the year.

Contour bunds help stabilize steep slopes

In the Deh-shahr project area, three types of contour bunds, including 180 stone bunds, 560 soil bunds, and 58 conservation ditches, were built on 27 hectares of land, helping to reduce the amount of soil erosion from the middle catchment and improve the soil penetration of rain, snow, and ice to recharge groundwater aquifers. In addition, local villagers planted wild almond, apricot, and alfalfa around these contour bunds. These saplings are thriving even without irrigation due to the natural water retaining properties of the bunds themselves, which underscores the overall sustainability of these nature-based interventions.



The map highlights the conservation ditches built in Deh-shahr sloping lands

Conservation ditches conserve water and prevent run-off on slopes

b) Land Terracing

Similar to contour bunds, land terracing aims to reduce soil erosion and improve groundwater storage and recharge by intercepting runoff. However, terraces are larger structures and involve the construction of small terrace walls (not more than one meter high) and filled in with soil which provides further possibilities for productive crops, forestry, and fruit trees.

Community members constructing terraces

In the Deh-shahr project 440 terraces have been constructed on over 41 hectares of slopping lands. These terraces and slopes have been planted with 7,700 fruit and forest trees, in two campaigns in 2020 and 2021, and fodder intercrops for livestock, which further contributes to the local community's livelihoods, nutrition, and food security.

Terraces stabilize slopes and enable sustainable farming livelihoods

c) Gully Plugs

Gully erosion can be very rapid, damaging, and difficult to control as large rocks and boulders flow from the upper to lower catchment areas. Control measures to prevent this destructive erosion, and its associated landslides and avalanches, start at the top of the gully where they are plugged with gabions, check dams or rock structures to slow the downstream flow of water and materials.

Construction of gully plugs or check-dams in the upper catchment area

In the Deh-shahr project area, 120 gully plugs with a volume of 3325 m^3 were constructed by local community members on mountain flanks to protect approximately 16 hectares of downstream land from dangerous boulders, landslides, floods, and avalanches. Each gully plug measures 1.5 meters high and 10 meters wide.

Gully-plugs reduce the risk of flash floods and avalanches

Reforestation

a) Fuel and Timber Woodlots

Afghanistan's forests and wooded areas are important sources of food, fuel, construction materials and timber for local communities. Unfortunately, following decades of war and environmental mismanagement, these forests have fallen victim to the tragedy of the commons and only around two per cent of Afghanistan's land cover remains forested.[12] Without woodlots or affordable alternatives for fuel, communities harvest slow-growing native shrubs on rangelands.[13] In addition, overgrazing and over-extraction of fuelwood have resulted in widespread land degradation and the removal of vegetation, which would otherwise mitigate flooding by capturing surface runoff during heavy rains and rapid snowmelts, as well as landslides when soils become waterlogged.

Local communities rely on fuelwood to get through the harsh winters

12. Indexmundi, available at: https://www.indexmundi.com/facts/afghanistan/indicator/AG.LND.FRST.ZS
13. Mountain Partners, p 26

A woodlot from tree stem cuttings protects sloping lands

To reduce pressure on wild forests in the Deh-shahr catchment, woodlots were established on 41 hectares of rain-fed and irrigated lands to provide local communities with dedicated access to fuel and timber. In addition, some 3,000 apricot saplings, 700 walnut saplings, 2,200 almond saplings, 5,000 sea buckthorn saplings, 93,000 cuttings of poplar, 25,000 cuttings of willow and 15,000 cuttings of Russian olive were planted on public lands collectively shared by the local community members to encourage local stewardship and conservation of forest resources. To safeguard this investment, the communities selected two community members to oversee the planted saplings and ensure they are protected in the initial stages of their growth.

Water tanks were installed to ensure regular watering, which is critical for survival of tree cuttings

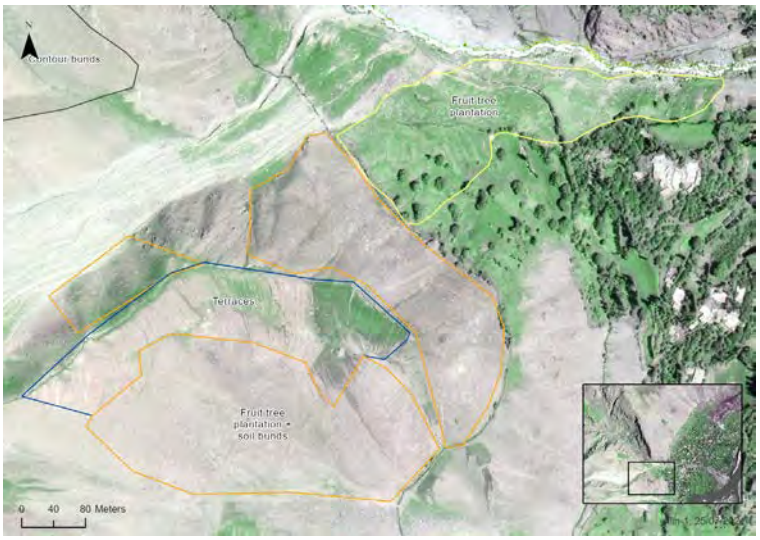
b) Reforesting Rain-fed Land

Overgrazing and deforestation in the dryland areas of the Deh-shahr catchment have denuded the landscape of much of the upper and middle catchment. Without locally adapted trees to stabilize slopes and absorb excess rain and snow melt, downstream communities face increased risk of landslide, flood, and soil erosion. To reduce this risk, the project team reforested 46 hectares of land with indigenous walnut, almond, and apricot saplings that will help stabilize slopes and reduce the risk of floods and landslides, while also providing valuable nutrition that can improve the food security of local communities.

Tree seedlings raised in polybags enjoyed a high survival rate, a technique that was hitherto little known

The reforestation of the Deh-shahr middle catchment was achieved through a community-based approach that fosters local ownership and improved forestry management methods at the local level. For example, local communities were introduced to a new method of raising and transplanting saplings in polybags, which performed well when planted on slopes. This contrasts with traditional nurseries where transplanting of bare root saplings does well in irrigated valley bottoms but experience low survival rates on slopes due to lack of water.

Similarly, the community members were introduced to new methods for water trapping, water conservation, and mulching to ensure survival of young saplings through the hot and dry summer. Three hectares of land were also cultivated with 200 kgs of wild alfalfa seeds as a rapid solution to improve vegetative land cover, reduce soil runoff, inhibit gully formation, and conserve soil moisture until the saplings mature.



Map showing the reforested areas in Deh-shahr catchment

Tree saplings are wrapped in thorn branches to guard against grazing animals

Notably, all saplings planted in the Deh-shahr catchment were raised by a group of 30 women who were supported by this project to establish greenhouse nurseries. Thus, while gender divisions may exist in the community – especially for women working outside their homes – the construction and use of greenhouses increases women's participation in environmental planning, implementation, and decision-making.

Most of the fruit tree nurseries are managed by women

c) Tree-planting Campaign

Building upon the successes of the woodlots and dryland reforestation in the Deh-shahr catchment area, community members worked with local government institutions to organize two tree-planting campaign in fall 2019 and spring 2020. As part of this campaign, a total 434 saplings of wild almond and apricots were planted in rain-fed areas, helping raise awareness of the value of trees and forests in a healthy and functional ecosystem. Moreover, this activity helped galvanize the community-led approach to natural resource management and the importance of close coordination between local authorities and their constituents on environmental matters.

Tree plantation campaigns

Tree plantation campaigns

Tree Type	Location	Surveyed Year	Average Height (cm)	Survival Rate (Average)	Technique used
Walnut	South of Torrent	2020	159	98%	Sapling
Almond	South of Torrent	2020	124	97%	Sapling
Apricot	South of Torrent	2020	124	100%	Sapling
Russian Olive	North of Torrent	2020	30	0%	Cutting Saplings
Mulberry	North of Torrent	2020	30	0%	Cutting Saplings
Poplar	North of Torrent	2020	30	0%	Cutting Saplings
Walnut	North of Torrent	2020	185	81%	Cutting Saplings
Almond	North of Torrent	2020	185	80%	Cutting Saplings
Apricot	North of Torrent	2020	185	68%	Cutting Saplings
Walnut	Upper Catchment	2020	50	75%	Seedlings from Polybags
Almond	Upper Catchment	2020	50	93%	Seedlings from Polybags
Apricot	Upper Catchment	2020	50	93%	Seedlings from Polybags

Rehabilitation of Oshtuk Mountain Irrigation Canal

The Oshtuk irrigation canal is an abandoned offtake channel from the Deh-shahr torrent located in the middle catchment area that was rehabilitated and modernized under the project. Taking advantage of slope gravity, the 3.5-kilometre canal diverts water flows across the mountain flank which should enable the irrigation of up to 100 hectares of sloped land. If fully developed, this would represent an approximately 60 per cent increase in the total area currently under cultivation in Deh-shahr catchment.

Community members working to connect the Oshtuk mountain irrigation canal after cutting through the rocks

The completed canal in a rocky outcrop segment

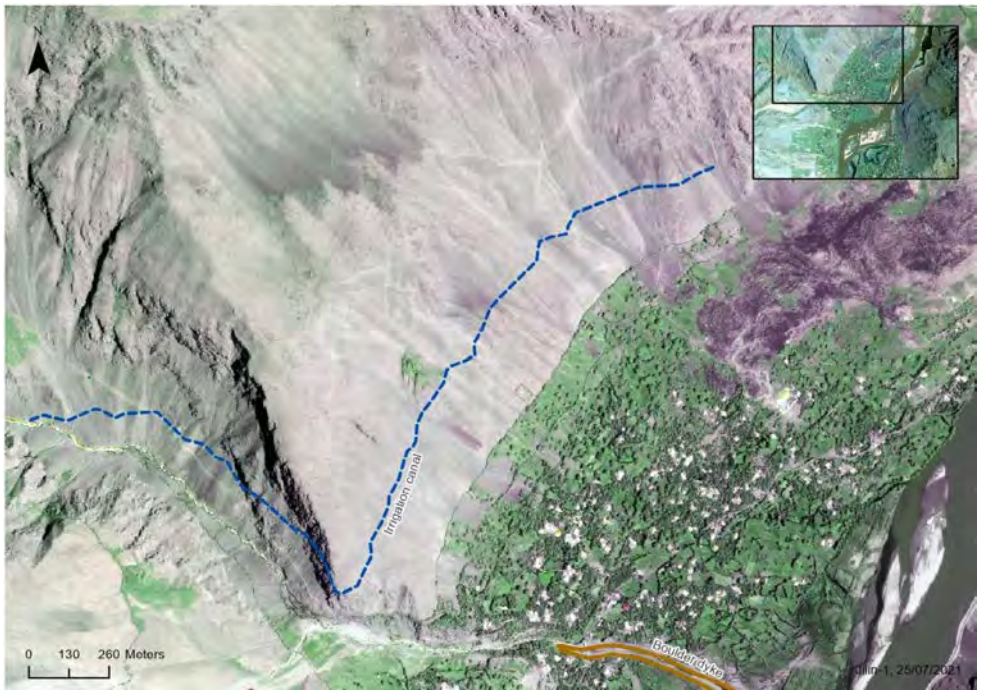
Capture of glacial melt waters to supply mountain irrigation canals

Rehabilitation of mountain irrigation canal using dry stone building technique

The slopes are to be planted with fruit trees including wild varieties as well as poplars and willows along the canal to stabilize soil, provide additional income to local villagers, as well as diversify their livelihoods and food sources. Farmers are also being encouraged to experiment with junipers and conifers especially in areas with shallow soils. The local community proposed this intervention to support tree saplings during the sensitive early years of growth when having a regular water supply is critical for their survival.

Cutting through hard rock during Oshtuk canal rehabilitation

In the past, the local community recognized this need but was unable to complete construction of the Oshtuk irrigation canal without additional guidance, support, and resources. With the completion of the irrigation canal, fruit saplings growing on mountain slopes will have a much better chance of survival and provide the local community downstream with the benefit of their ecosystem services. In addition, the rehabilitation of the Oshtuk irrigation canal created valuable income-generating opportunities for local community members, further incentivizing adoption of a community-based approach rather than hiring outside parties to undertake construction. At the same time, the project sensitized the community on the importance of carefully managing slope irrigation and phasing tree plantation over time to maximize natural regeneration; as improper irrigation can inadvertently exacerbate landslide, rockfall and gully erosion risks.



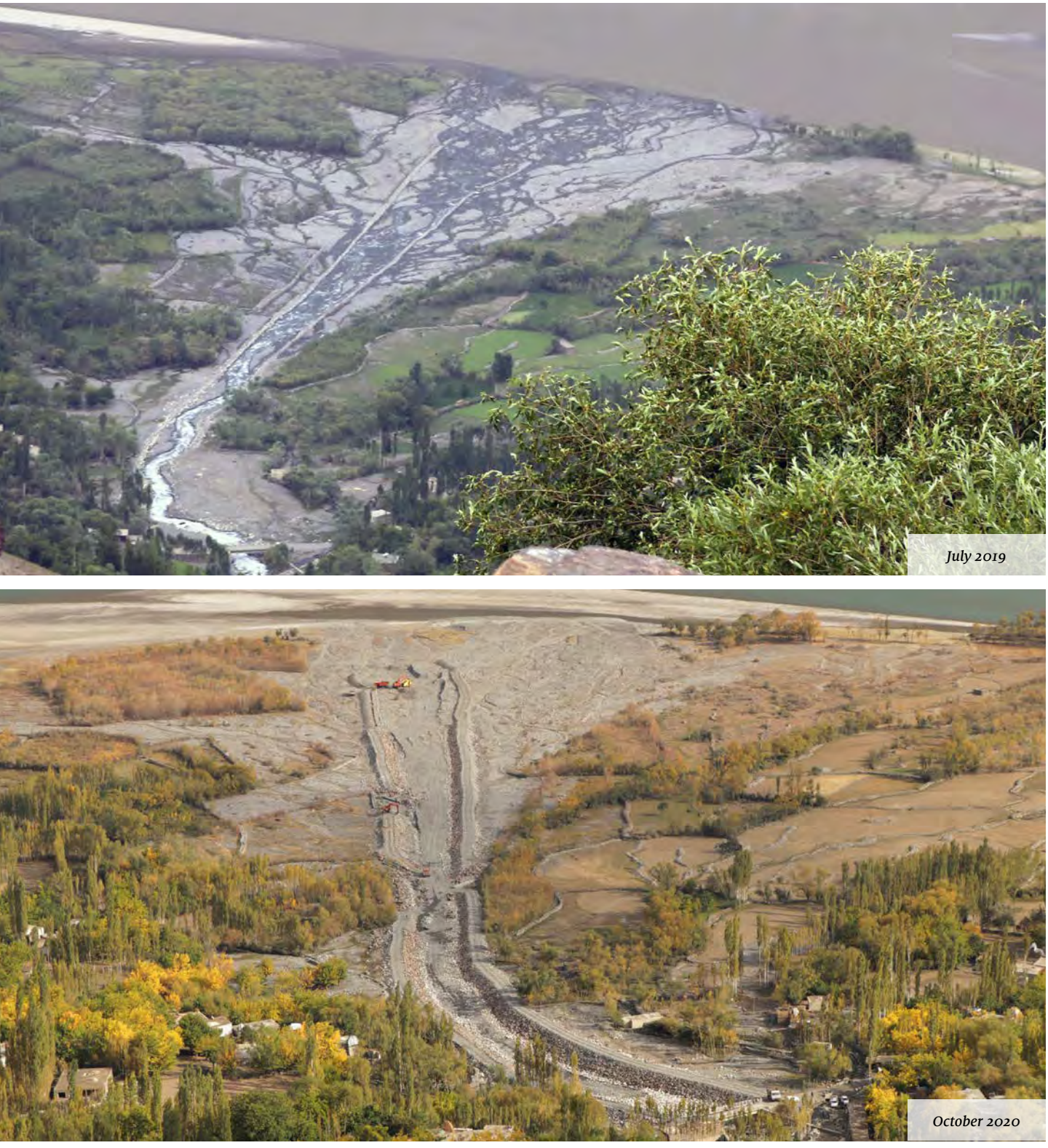
Oshtuk irrigation canal constructed under the project to support tree plantation on mountain slopes

3.3.3. LOWER CATCHMENT (2,000 – 2,200 M)

Deh-shahr Torrent Correction and Debris Cone

The Deh-shahr alluvial fan is the central geomorphic feature of the catchment. It extends from the narrow point where the torrent enters the floodplain creating a wide depositional triangle that reaches down to the banks of the Panj River. It is in this zone where much of the local community lives, works, and farms. While physical rehabilitation works in the upper and middle catchments focus on stabilizing slopes and preventing land degradation, the primary focus in the lower catchment is to manage the floodwaters carrying large boulders, rocks and debris from upstream and cause flooding, damage to infrastructure, and spoil farmlands along the riverbank. To address these challenges, the local community selected a hybrid solution which combines: i) the construction of a one-kilometre-long flood protection dyke to channel the flow and direction of floodwaters; and ii) reforestation of the alluvial fan to buffer debris flows and flood events and create a recreational riparian zone.

Map highlighting the reforested areas around the Deh-shahr torrent's flood protection dyke



Deh-Shahr alluvial fan before and during construction of the new flood protection dyke

In 2017, the local community constructed a small stone dyke to control descending floodwaters with support from international partners. Although an impressive structure was built with hand tools and manual labour, it was ultimately not effective in directing the flood waters. Lacking a foundational base, water soon started to seep and sometimes gushed through the dyke causing it to fall apart. Furthermore, the dyke only extended almost halfway through the alluvial fan and did not reach the mainstem of the Panj River. Hence the floodwaters continued to change course and threaten nearby lands.

An on-the-ground view of the old and new flood protection dyke of Deh-Shahr alluvial fan

View of Deh-shahr alluvial fan with the old and new flood protection dykes taken from Tajikistan

Community consultations on flood protection dyke and alluvial fan reforestation

Corrections to the torrent channel carried out through this project comprises a one-kilometre long embankment – 4 meters high and 9 meters wide – to evacuate the debris and flood waters to the mainstem of the Panj River. The embankment has a solid foundational base, and the channel is lined with large stone boulders. Thereby, ensuring rapid routing of torrent waters and preventing excessive overflow from damaging adjacent farmlands, infrastructure, and homes. The benefits of this intervention are clearly visible in satellite imagery taken in August 2021 that shows a distinct improvement in channelling torrent waters and protecting surrounding infrastructure and farmland.

As with the rehabilitation of the Oshtuk irrigation canal, the torrent correction generated valuable income-earning opportunities for the local community, further highlighting the socio-economic benefit of pursuing a community-based approach to reducing disaster risk.

Finally, around five hectares of the alluvial fan was afforested on both sides of the torrent to further reinforce the dyke. This included planting around 25,000 cuttings of willow, poplar, Russian olive, and sea buckthorn. Combining 'hard' engineering and 'soft' natural interventions to manage the Deh-shahr torrent exemplifies a hybrid approach to reducing flood risk in the vulnerable alluvial fan zone. Furthermore, the establishment of a riparian green zone and improved access to the river waterfront by way of the dyke road has created a site for relaxation and pleasure for the local community.

Extensive tree plantation was carried out by the communities in the alluvial fan

Solar Water Heaters

Access to clean and renewable fuels is of vital importance to the health and wellbeing of Deh-shahr's community members. It also has an important role in helping reduce pressure on forests and rangelands as sources of fuel for cooking and heating in winter. By one account, biomass resources contribute around 90% of total domestic fuel usage in rural areas of Afghanistan.[14]

People rely on wood and shrubs for daily fuel needs

Most of this fuelwood comes directly from local forests and rangelands, further exacerbating the environmental degradation of the area. Local community members estimate that on average nearly 70 to 100 kg of fuelwood is used for heating water per household on biweekly basis. Therefore, reducing this pressure on the local environment using new and innovating renewable energies can significantly impact the pace and extent of land degradation.

Solar water heaters were installed in 125 households

14. US National Renewable Energy Agency (2011) available at: https://www.nrel.gov/docs/fy11osti/49358.pdf

Map highlighting the Solar Water Heater's distribution in Deh-Shahr village

To reduce this stress on the ecosystem, disadvantaged local households welcomed the installation of 125 solar water heaters by the project enabling year-round bathing, washing, and cleaning. Across the board, beneficiaries are pleased with the provision of these new technologies that provide hot water and reduce domestic expenditure on energy. Furthermore, they have the added benefit of improving indoor air quality and reducing respiratory illnesses by replacing polluting indoor woodburning stoves that produce much smoke and soot.

A beneficiary equipped his bathroom with a shower system to capitalise on use of solar water heaters

4

ECOSYSTEM MANAGEMENT RESULTS AND IMPACTS IN THE DEH-SHAHR CATCHMENT

As discussed earlier, one of the greatest strengths of the ecosystem-based approach to mitigating disasters is that it frames the three tenets of disaster risk – hazard, exposure and vulnerability – within the overall landscape of the ecosystem rather than as disparate or isolated events. Furthermore, practical interventions are designed to provide multiple benefits with specific emphasis on improving livelihoods and food security. Through this holistic approach, ecosystem-based interventions implemented in the Deh-shahr catchment aim to influence all three components of the disaster risk equation to mitigate hazards, reduce exposure, and reduce vulnerabilities.

4.1. MITIGATING HAZARDS

This project promoted an interrelated set of ecosystem-based measures to mitigate the impacts of floods and droughts caused by decades of ecosystem degradation in the Deh-shahr catchment. Individually, each of these interventions has a targeted impact to mitigate the risk of specific hazards in the upper, middle and lower catchments. Collectively, however, the interventions build off each other to strengthen the overall ecosystem, integrate ecosystem services throughout the catchment areas, and increase the community's resilience to the hazards of flood, drought, and landslides.

Vegetation cover reduces the risk of soil erosion, flash floods and avalanches

Rangeland restoration aimed to reverse the denudation of lands in the upper catchment, provide fodder for livestock, and underscore the need to control and manage livestock herd size. Likewise, in the middle catchment area, contour bunds, gully plugs, and terraces aimed to reduce soil erosion and stabilize slopes, especially once planted with trees and fodder crops, which helps prevent landslides and floods by slowing the flow of water downstream. The provision of solar water heaters to vulnerable households also reduced the use of fuelwood and halted further degradation of rangelands and forests in the area. Meanwhile, rehabilitation of the Oshtuk canal helps divert water to provide vital irrigation to trees planted on slopes to reduce risk of floods and landslides downstream. Increasing the potential land available for orchard cultivation by up to 100 hectares or almost 60 per cent of the present land under cultivation should also help diversify livelihood resources for local villagers. Lastly, in the downstream area of the Deh-shahr catchment, high value farmland in the alluvial fan has been protected with a one-kilometre-long retaining embankment and trees planted on both its sides to reduce risk of flooding, destruction of property, and loss of agricultural land to erosion and debris flows from floods and landslides.

4.2. REDUCING EXPOSURE

Understanding where and when a hazard might strike is a key part of reducing exposure and ensuring that people and property are out of harm's way. Nobody wants to live in a flood zone, but often marginalized and poor community members do not have alternate options. Similarly, local knowledge of past hazards is essential to reducing exposure but as climate change progresses local communities are often left without the knowledge and resources to adequately adapt.

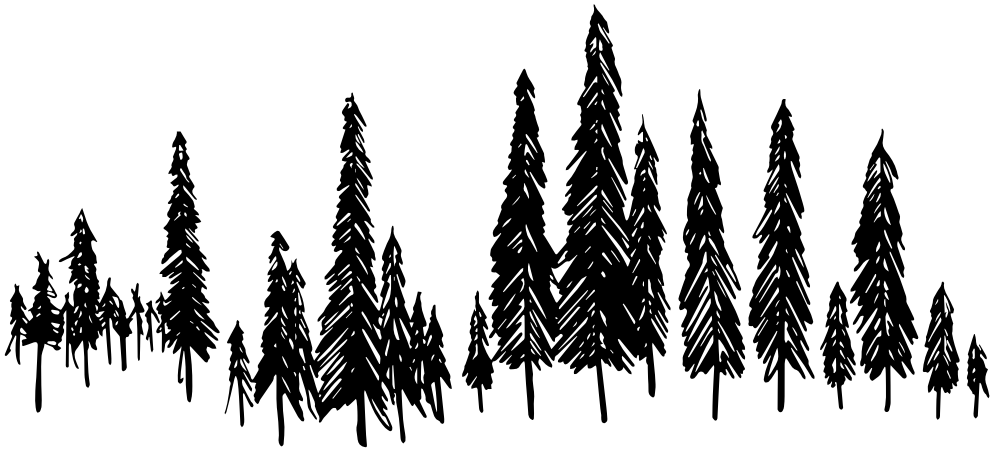
A series of terraces and stone bunds on the slopes of Deh-shahr catchment

Through extensive community consultations, the villagers in Deh-shahr have developed maps and plans that identify hazard hotspots, track ecosystem health, and monitor the use of natural resources. These planning exercises culminated in the construction of a three-dimensional topographical model (P3DM) of the Deh-shahr catchment as a valuable spatial planning tool that, unlike a narrative report or technical text, allows for greater public participation regardless of education level, literacy, or role in the community. Through this P3DM model, the Deh-shahr villagers can guide current and future development away from areas prone to flood, landslide, and drought, thereby better safeguarding their property, resources, and families' lives.

4.3. REDUCING VULNERABILITIES

This project has enabled the inhabitants of Deh-shahr catchment to better cope with and manage natural hazards by diversifying livelihood sources and increasing household income through establishing tree nurseries, expanding agricultural lands, rehabilitating rangelands, and reforesting slopes with high-value crops. For example, the construction of contour bunds and terraces on slopes allowed villagers to plant fruit trees without irrigation, which was not previously possible. Thereby supplementing the nutritional intake of families and the generation of additional income through the sale of high-value apricots, walnuts, and almonds. The establishment of nurseries and greenhouses also generates valuable income to women, especially as they often do not work outside the home. Similarly, the construction of the Oshtuk mountain irrigation canal and correction of the Deh-shahr torrent in the alluvial fan zone provides villagers with expanded agricultural lands. Furthermore, it protects farmland and infrastructure from floods, debris flows and landslides, which helps increase livelihood resilience by safeguarding each year's crops.

Nurseries contribute to reducing community vulnerability and provide a livelihood option



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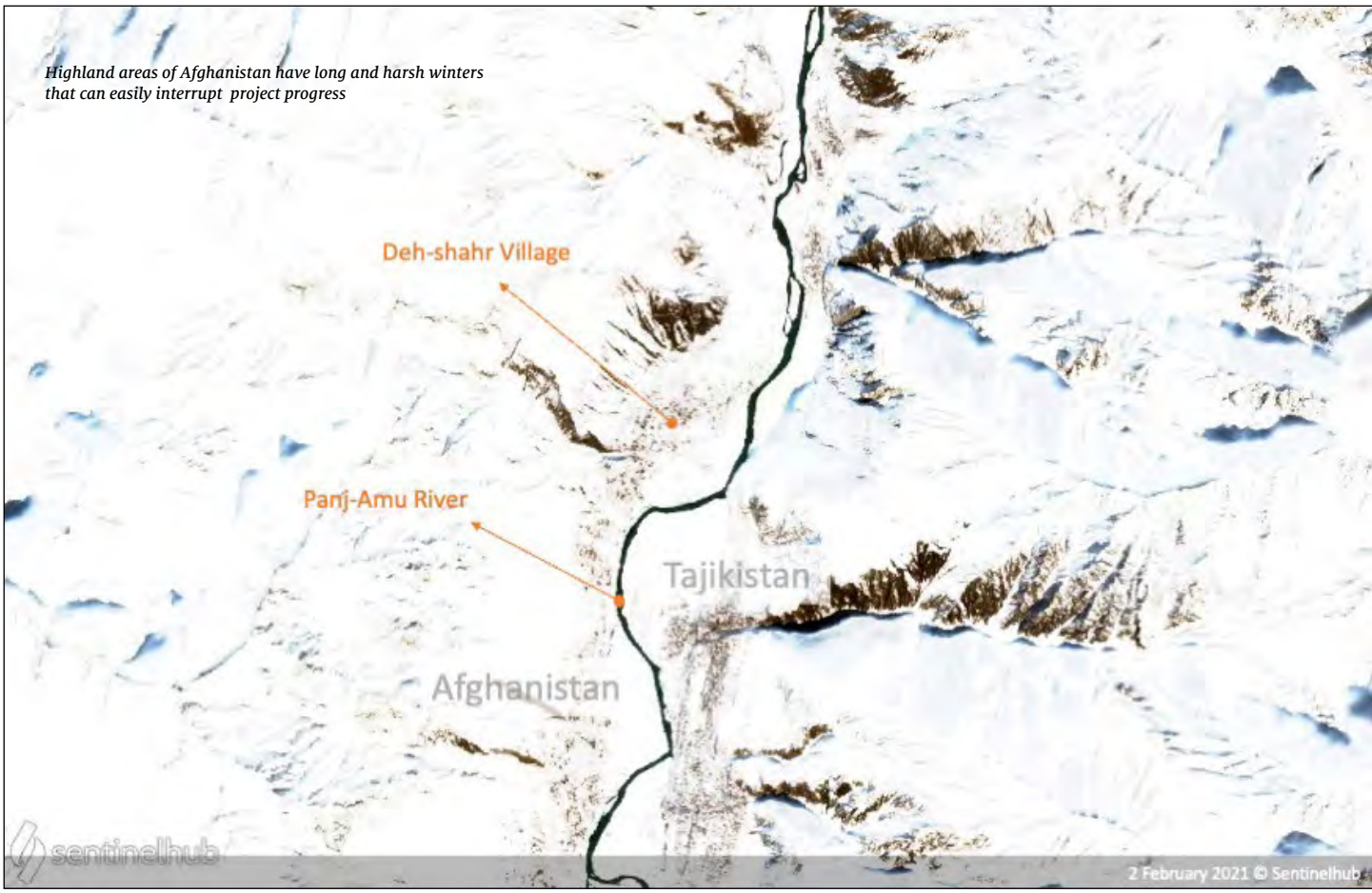
LESSONS LEARNED AND NEXT STEPS

This final section reflects on the main lessons learned from this project to inform design, implementation, replicability, and sustainability of similar ecosystem-based approaches and initiatives in Afghanistan and globally. The project has demonstrated that ecosystem management and restoration can be effectively integrated with conventional, engineering solutions through a community-based approach that holistically considers all aspects of the landscape to support more resilient development. Several factors, however, need to be considered to support project implementation, maximize results, and ensure sustainability and replication.

5.1. IMPLEMENTATION CHALLENGES

Given the remote location, limited resources, and weak infrastructure present in the Deh-shahr catchment, it is not surprising that there were unforeseen challenges during project implementation. Nevertheless, as each challenge presented itself, the project team worked with local villagers to find adequate solutions and continue advancing towards set objectives. Some of the biggest challenges faced include:

- Villagers were often reluctant to travel to the remote project sites in the upper catchment, such as the rangeland biomass monitoring and exclusion zones, due to the rough terrain and long trekking time that otherwise could be spent on income-earning wage labour in the community. However, this challenge was overcome by the project team accompanying villagers for implementation monitoring to provide motivation and build solidarity, though in the future this issue will need to be addressed for further upscaling and replication.
- In certain areas, cuttings planted on slopes lacked adequate and timely water supply and died in the dry summer heat. Subsequently, the project assessed its options and worked with villagers to first complete the construction of the Oshtuk irrigation channel before replanting the slopes with tree saplings or cuttings. Also, to increase the survival rates of willow, poplar and Russian olive cuttings, villagers agreed that it would be best to replant them along existing waterways where they can develop their root stock more vigorously.
- Engineering plans for the torrent correction had focused on securing the critical zone of where the torrent enters the alluvial fan. However, the last 600-meter segment before the torrent empties into the Panj River was left unchanneled. Engineering challenges were also experienced in cutting through hard rock when building the Oshtuk irrigation canal. These challenges were overcome by amending the technical design and securing additional funds to extend the dyke construction to the Panj River, and mobilizing the necessary equipment to complete the mountain irrigation canal. Furthermore, villagers volunteered their time and labour for the construction efforts, especially as they saw the need and value for improving water management throughout the catchment.
- Biodiversity targets were not sufficiently taken into consideration in the project design. Future replication initiatives should examine ways to integrate biodiversity conservation measures including alignment with the National Biodiversity Strategy and Action Plan (NBSAP) should be prioritised.
- The long and harsh winter season meant that most field interventions needed to be completed within a relatively short time window from March/April to October/November. Therefore, prior careful planning and scheduling of interventions was imperative to ensuring timely implementation of activities, which also necessitated good coordination with relevant stakeholders.



Highland areas of Afghanistan have long and harsh winters that can easily interrupt project progress

5.2. MAINSTREAMING ECOSYSTEM MANAGEMENT INTO NATIONAL POLICY AND PROGRAMS

Through this project, the restoration of the Deh-Shahr catchment demonstrates the benefits of ecosystem-based adaptation to improving livelihoods and reducing vulnerability to natural hazards in Afghanistan. In recent years, UNEP has also leveraged strategic partnerships with other national and international groups in Afghanistan to further promote ecosystem-based approaches in the country's wider development and humanitarian assistance programs.

In particular, UNEP has assisted partners in developing and delivering training materials, community-planning processes, guidelines and handbooks for intervention implementation, and climate change projections for temperature and precipitation, amongst others. By providing this support, many groups in Afghanistan now recognize the importance of integrating ecosystem-based adaptation approaches into conventional DRR and humanitarian programming to improve the management of natural resources and reduce disaster risk.

Regarding national-level policy, the Deh-shahr demonstration provides a tangible model and lessons learned that can inform the government's official DRR planning and strategies. For example, Afghanistan's draft National Environmental Policy now includes Eco-DRR as a key priority area. Likewise, Afghanistan has also further developed and revised its national DRR strategy to integrate Eco-DRR approaches and sustainable natural resource management. More specifically, the experience can also help catalyse replication of similar initiatives for the management and restoration of small torrent catchments in the Pamir Mountains and similar high mountain systems.

5.3. ENSURING PROJECT SUSTAINABILITY

A major concern of any project is the sustainability of its interventions and impacts beyond its limited lifespan. In this case, the Deh-shahr catchment project lasted around two and half years (32 months), which is a relatively short period for an ecosystem management project that typically needs seven to ten years to show substantial environmental changes. Nevertheless, it yielded several successful results for the local community and the rehabilitation of their ecosystem.

One way in which the project integrated the principle of sustainability from the beginning was the adoption of a community-based approach to ensure that locals themselves identify priority issues, participate in the design of interventions, and understand how they work, gain the skills for their implementation, and assume responsibility for maintenance of the actions carried out. Community contributions either in-kind or through partial investment was a prerequisite for many activities (e.g., reforestation, installation of solar water heaters). Furthermore, interventions prioritized use of local materials and techniques (e.g., dry stone construction) even where these had to be supplemented with modern design and technologies.

Nevertheless, given the complex circumstances in Afghanistan today, some challenges will likely constrain further uptake, replication and scaling-up of ecosystem-based approaches piloted in Deh-shahr catchment. These include, for instance, the unstable political and security situation in the country, as well as weak institutional capacity of national and local governments, poor and limited infrastructure, and community mobilization to understand the long-term benefits of implementing ecosystem restoration interventions in the short run. Difficulties in mobilizing international partners and financing for implementing ecosystem-based initiatives is also a major challenge under the current circumstances. Thus, it is not possible to guarantee that the project activities and results will be sustained, we can reflect on some factors that support long-term outcomes:

First, the high community ownership and uptake of field interventions at the local level indicates a clear interest in continuing and replicating the initiatives. For instance, local villagers are very pleased with contour bunds and terraces, and the gravity irrigation canal, especially as they allow for a substantial increase in the cultivation of fruit trees and fodder plants without energy requirements.

Second, by working with other partner organizations and groups in the region, the pilot demonstration in Deh-shahr provides hard evidence of how community and ecosystem-based planning can produce concrete results for reducing disaster risk. This has already been reflected in better integration in AKF's agricultural development programme, and ARC's approach to building resilience to hazards across northern Afghanistan and other organizations like Concern Worldwide and ICIMOD.

Third, the Deh-shahr CBNRM Committee has also committed to overseeing follow-up and maintenance of interventions, supported by local NGO partners as needed. This helps ensure that the infrastructure for environmental management established through this project remains active and participatory in the ongoing ecosystem rehabilitation works of the area.

Fourth, to improve and strengthen the existing Early Warning System established in 2017 by AKAH, the establishment of a low-cost and effective watershed-specific community-based EWS could be highly beneficial for people and ecosystems at risk in addressing their specific needs in real time.

Lastly, at the national level, the Eco-DRR approaches piloted in the Deh-shahr catchment have been integrated into the draft National Environment Policy as well as National DRR Strategy, which creates a clear framework for government, NGOs, CSOs, academia, and other groups to invest in ecosystem-based approaches and interventions in future DRR programming across the country.

6

ACRONYMS AND REFERENCES

ACRONYMS

AKDN	Aga Khan Development Network
AKF	Aga Khan Foundation
ARC	Afghanistan Resilience Consortium
CBNRM	Community-Based Natural Resource Management
CDC	Community Development Councils
DRR	Disaster Risk Reduction
EbA	Ecosystem-based Adaptation
Eco-DRR	Ecosystem-based Disaster Risk Reduction
EWS	Early Warning System
FFS	Farmer Field School
ICIMOD	International Centre for Integrated Mountain Development
NEPA	National Environmental Protection Agency
MAIL	Ministry of Agriculture, Irrigation and Livestock
NGO	Non-Governmental Organization
P3DM	Participatory Three-Dimensional Modelling
UNEP	United Nations Environment Programme

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