Resilient Mountain Solutions

Ten local solutions for global impact

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Disclaimer

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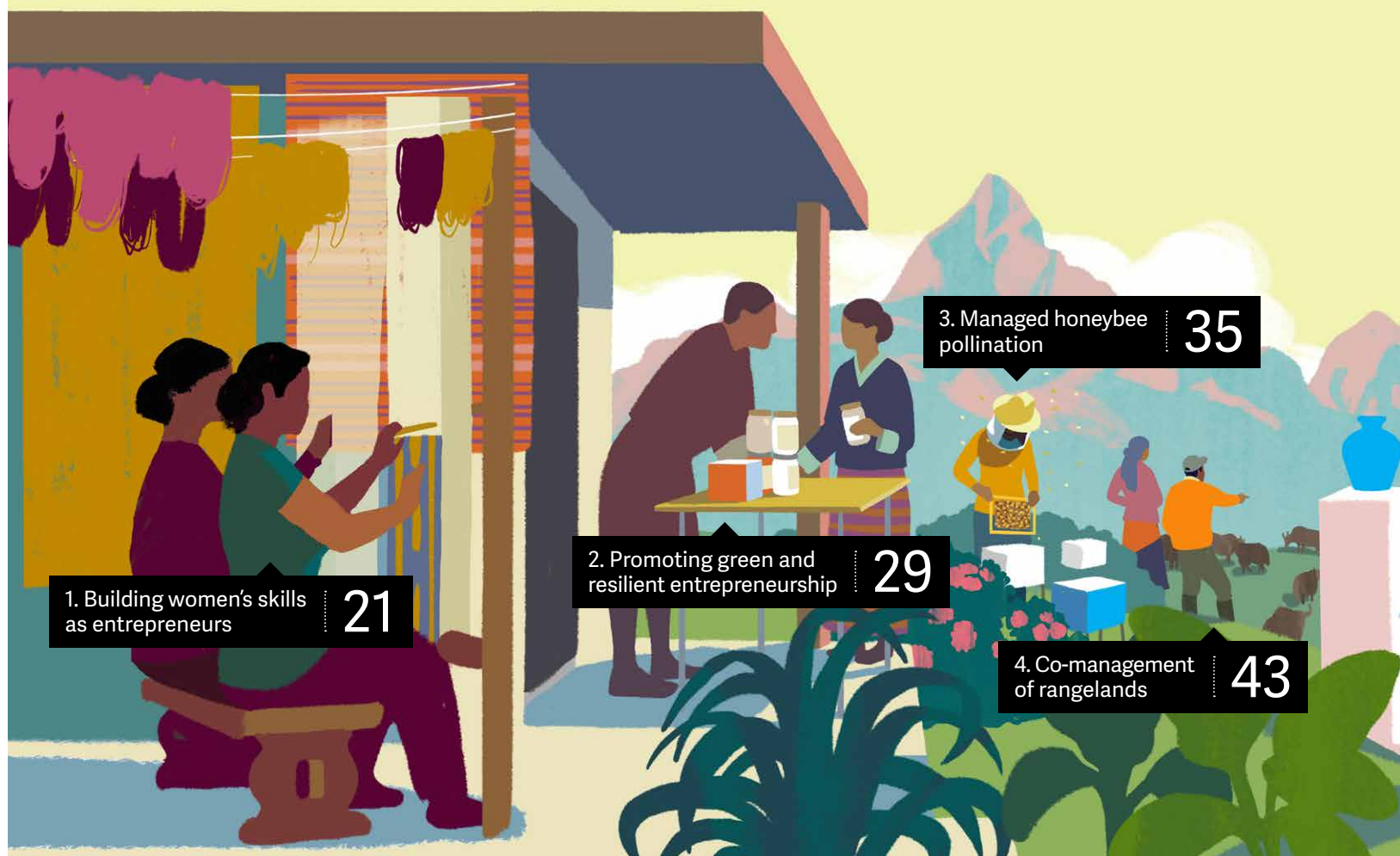**Copy editing**
Strategic Agenda

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Executive summary

In November 2022, on the eve of the 27th Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC COP27), The Economist reported that we will overshoot the target to limit global warming to 1.5°C degrees above pre-industrial levels no matter what. Even if measures were in place to reach this target, the Hindu Kush Himalayan (HKH) region would be locked into an increase of 1.8°C due to elevation-dependent warming, according to The Hindu Kush Himalaya Assessment published in 2019, edited by Wester et al.

The mountain peoples of the HKH are no strangers to increasing temperatures, weather extremes, natural hazards and the impacts these bring. At the same time, rural communities are faced with other shocks and trends, including economic hardship, rural–urban migration, political upheaval, demographic change and evolving social norms. While the region is locked into a certain degree of future warming, the risks and impacts largely depend on the ability of the countries and communities in the region to adapt and build resilience. Resilience is often defined as the ability to not only overcome stresses, shocks or setbacks, but also to transform to a better state. The good news is that significant opportunities exist for communities to meet the challenges – and to thrive – using existing solutions that are readily available. Opportunities to build resilience are the subject of this book.

The 10 solutions covered in this book have transformed the lives and increased the resilience of thousands of people across the HKH. Developed, tested and proven to be effective across several locations in the region, they have the potential to transform the lives of many more across the region and beyond. Chosen from many diverse solutions, the 10 that have made it into this book represent the diverse sectors, issues and approaches that reflect the variety of challenges across the HKH region.

These solutions are nature-based, meaning that rather than inflicting damage, they have a neutral or positive impact on nature in the long term. The solutions are simple, affordable and designed to mitigate the adverse impacts of climate change and to build the resilience of mountain peoples and ecosystems in the HKH. Women, youth and marginalized communities are at the centre of these solutions, because without empowering these groups, the goal of resilient mountain communities cannot be achieved.

Each section presenting a solution provides practical information, with an introduction to the solution, how it works on the ground and which technical tools and capacities are needed. Gender is a cross-cutting theme throughout the book and having women at the centre is fundamental for successful resilience building. Recognizing that investment and replication of solutions in new geographical areas (out-scaling) and their integration into policies (up-scaling) are crucial for the long-term and widespread impacts of the solutions. Finally, the book outlines further success factors crucial for scaling solutions and sustainable, long-term mountain resilience for the future.

The selected solutions featured in this book are:

Solution 1
Building women's skills as entrepreneurs
Supporting women in local enterprise to develop value chains can strengthen them socially and financially and reduce climate vulnerability.

Solution 2
Promoting green and resilient entrepreneurship
Green business can solve environmental problems, reduce poverty and contribute to economic growth in mountain communities.

Solution 3
Managed honeybee pollination
Managing honeybees can increase food production and biodiversity and provide income.

Solution 4
Co-management of rangelands
Co-management of rangelands supports pastoralists in restoring and sustainably using grazing areas.

Solution 5
Spring revival
Springshed management helps improve water security, biodiversity and climate resilience for communities facing water shortages.
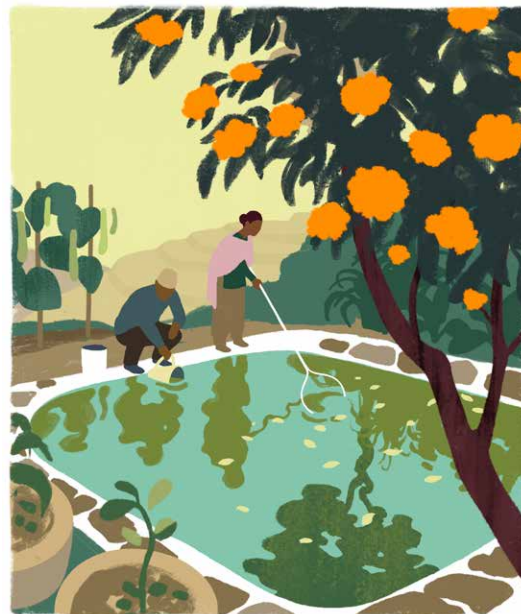
Solution 6
Storing water in low-cost ways
Simple, low-cost water retention methods can reduce water scarcity and make irrigation possible throughout the year.

Solution 7
Home garden and polyhouse
Simple, low-cost greenhouses and home gardens help combat food and nutrition insecurity in the mountains.

Solution 8
Energy-efficient technologies
Improved stoves for drying herbs and fruits can help reduce the use of fuelwood and protect people's health from hazardous smoke.

Solution 9
Digital services for disaster preparedness
Fire risk assessments and remote sensing data can use technology to reduce forest fire losses and help better prepare for and prevent forest fires.

Solution 10
Digital services for resilient agriculture
Digital services provide crop advice, weather forecasts, market prices and other information important to local farmer's livelihoods.

Chapter 1
Introduction
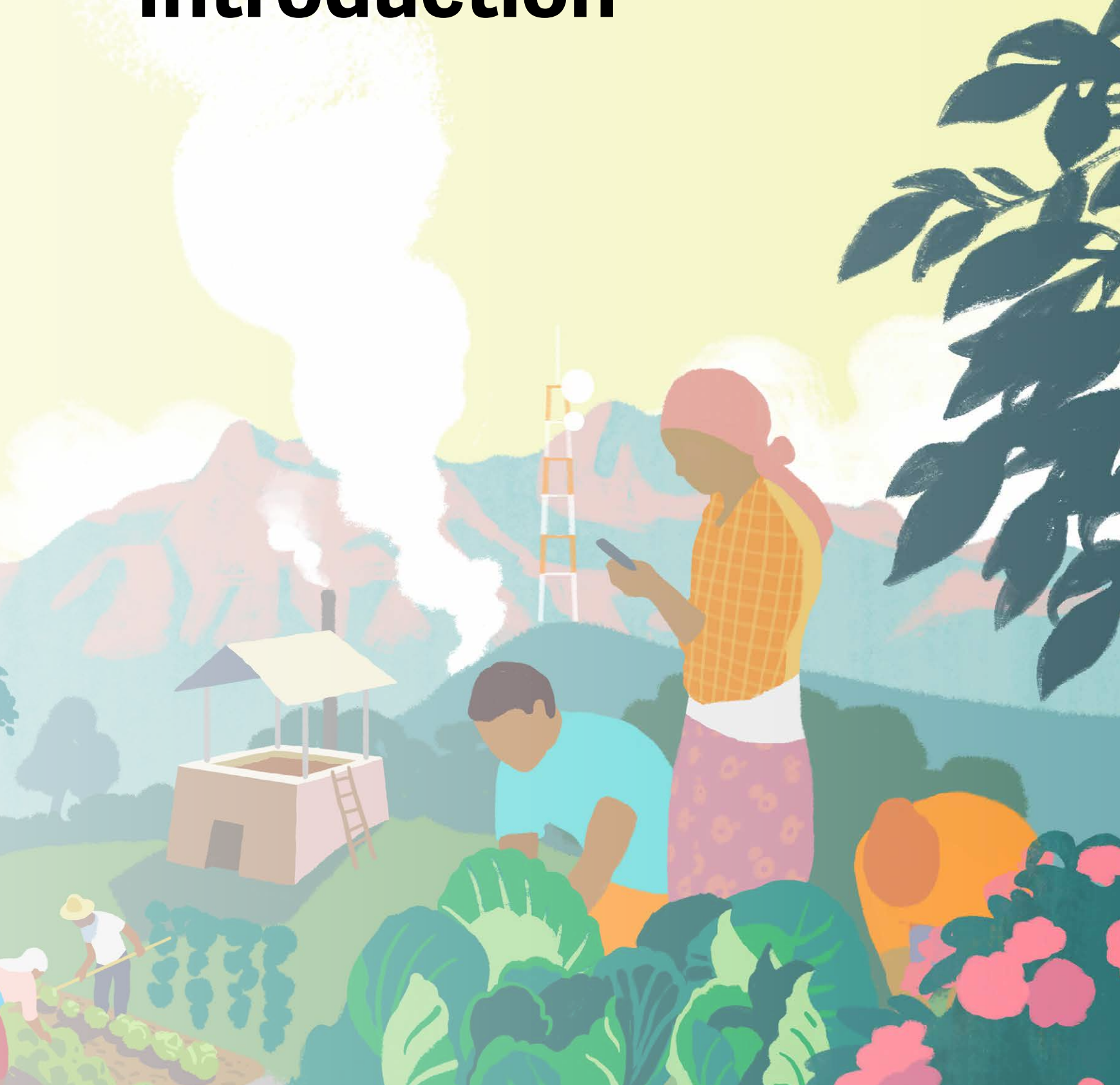
This book presents 10 efficient, cost-effective and custom-made solutions that have been tested in the Hindu Kush Himalayan (HKH) region and are suitable for up-scaling and out-scaling to other regions. Each solution can contribute to several of the United Nations Sustainable Development Goals (SDGs) and thus help ensure a better future for all. The 10 solutions showcased here are examples of a large number of diverse, nature-based solutions that provide long-term benefits to local communities, their environment and livelihoods by increasing their resilience to change.

Mountain resilience matters

Resilience is introduced by the Intergovernmental Panel on Climate Change (IPCC) as one of the climate action pathways to reduce the impacts of climate change on our societies.[1] According to the contribution of Working Group II to the Sixth Assessment Report of the IPCC, "climate resilient development is enabled when governments, civil society and the private sector make inclusive development choices that prioritize risk reduction, equity and justice".[2] Climate-resilient development is still underused, and the window of

Figure 1. The Sustainable Development Goals. The SDGs are a collection of 17 interlinked goals designed as a "blueprint to achieve a better and more sustainable future for all".[3] The SDGs were established in 2015 by the United Nations General Assembly and are intended to be achieved by 2030. They are included in a United Nations resolution colloquially known as the 2030 Agenda.

opportunity to meet the SDGs (see Figure 1) by 2030 is narrowing quickly. Decision-making processes for a more resilient society are now needed more than ever to mitigate the effects of climate change.

Opportunities for climate-resilient development are not equitably distributed around the globe. Climate impacts and risks exacerbate vulnerability and social and economic inequities, and consequently increase persistent and acute development challenges in the mountain regions, among other developing regions.[6] The world's mountain regions are home to up to 1.2 billion people – around 13 per cent of the global population.[7] They are also among the most vulnerable areas in the world to climate change, the consequences of which not only impact the mountain populations, but also the populations living in the lower lands.[8] Changes in climate and environment, as well as societal and economic shifts, are amplified due to the remoteness, harsh climatic conditions, altitudinal amplification of temperature rise and high poverty levels.[9] It is therefore important to focus on mountain communities to build resilience towards future environmental and social challenges.

Resilience in this book

In 2022, the IPCC[4] defined resilience as *"the capacity of social, economic and ecosystems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure as well as biodiversity in case of ecosystems while also maintaining the capacity for adaptation, learning and transformation. Resilience is a positive attribute when it maintains such a capacity for adaptation, learning, and/or transformation."*

In this book, in the context of the 10 solutions, resilience is defined as *"the ability of an individual, community, or a socioecological system to not only overcome a stress, shock or setback (recover or bounce back) but also to develop capabilities to move forward to a condition or a state that can help transcend to a better state."*[5]

Resilient mountain solutions in the Hindu Kush Himalaya

This book presents a variety of nature-based solutions that benefit local communities and their environment and livelihoods by increasing their resilience to change. Local actions, such as improving irrigation or

Nature-based solutions

Nature-based solutions are *"actions to protect, sustainably manage, and restore natural and modified ecosystems, that address societal challenges effectively and adaptively, simultaneously benefiting people and nature."*[10]

implementing resilient agricultural methods, improve food and nutrition security and increase crop yield. Creating local jobs protects and empowers communities. Socially inclusive solutions increase gender equality and youth engagement contributing to reducing poverty. Digital solutions often work across a larger geographic region, improving access to knowledge and helping reduce disaster risks, for example.

The solutions were developed and tested in the HKH region by the International Centre for Integrated Mountain Development (ICIMOD) and its partners, building on their long-term work in the region. The HKH region spans eight countries

Population in the Hindu-Kush Himalaya

AFGHANISTAN

Herat

Mazar-e Sharif

Kabul

PAKISTAN

Kandahar

Quetta

Peshawar

Islamabad

Gilgit

K2

Broad Peak

Gasherbrum II

Nanga Parbat

Gasherbrum I

*Takla
De*

Lahore

Sutlej

Indus

Dha

NEPAL

Pok

**T h a r
D e s e r t**

New Delhi

Jaipur

Lucknow

INDIA

Hyderabad

Karachi

Betwa

Son

Narmada

Tapi

Mahana

Raipur

Mumbai

Bhima

Godavari

Hyderabad

Population density
(persons per km²)

- >10000
- 1000 - 10000
- 500 - 1000
- 100 - 500
- 50 - 100
- 10-50

- • Cities
- ▫ Capital Cities
- Rivers
- △ Mountain Peaks above 8000m

Population in Hindu Kush
(Source: Hunzai et al., 2011)

AFGHANISTAN
PAKISTAN
INDIA
NEPAL
CHINA
BHUTAN
BANGLADESH
MYANMAR

100
50
10
1

(million people)
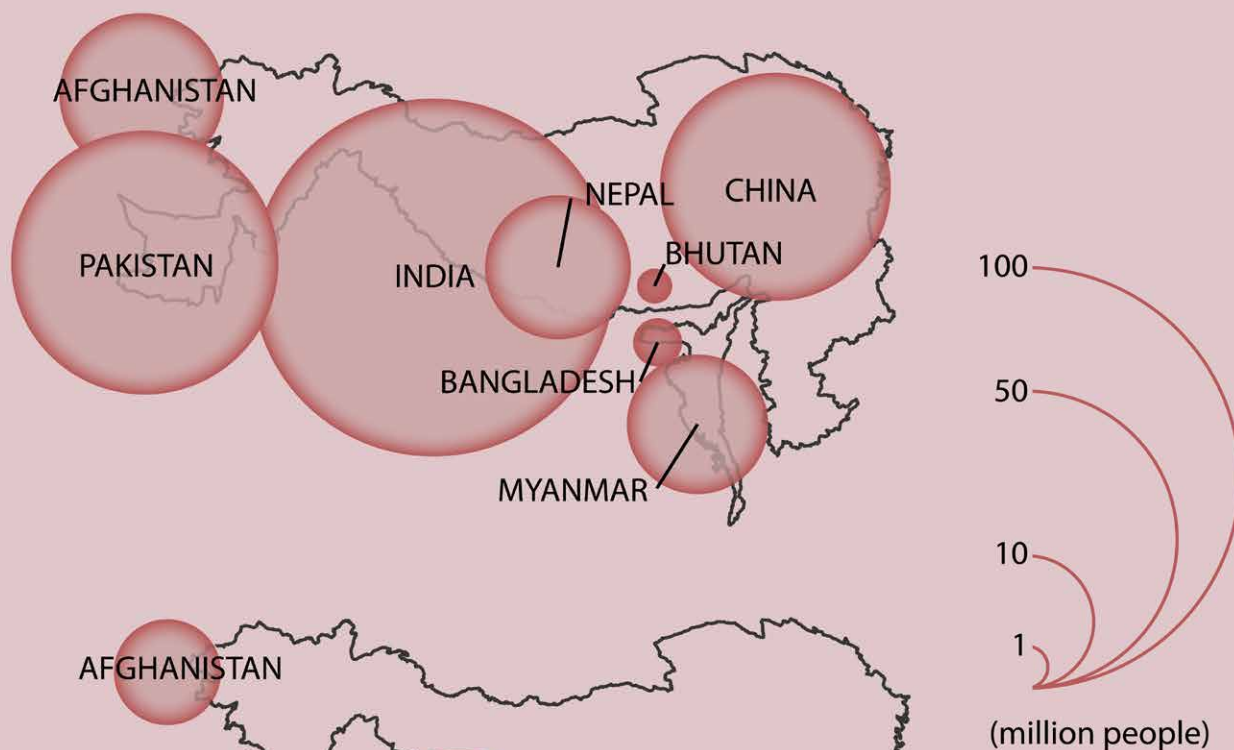
Population under poverty line in Hindu Kush
(Source: Hunzai et al., 2011)

AFGHANISTAN
PAKISTAN
INDIA
NEPAL
BHUTAN
BANGLADESH

Women, business and the law index
100 corresponds
to equal rights for women
as for men
at country level
(Source: World Bank 2022)

AFGHANISTAN
38

CHINA
76

NEPAL

PAKISTAN
55

INDIA
74

81

72

BHUTAN

BANGLADESH
49

59

MYANMAR

> 70

50-70

< 50
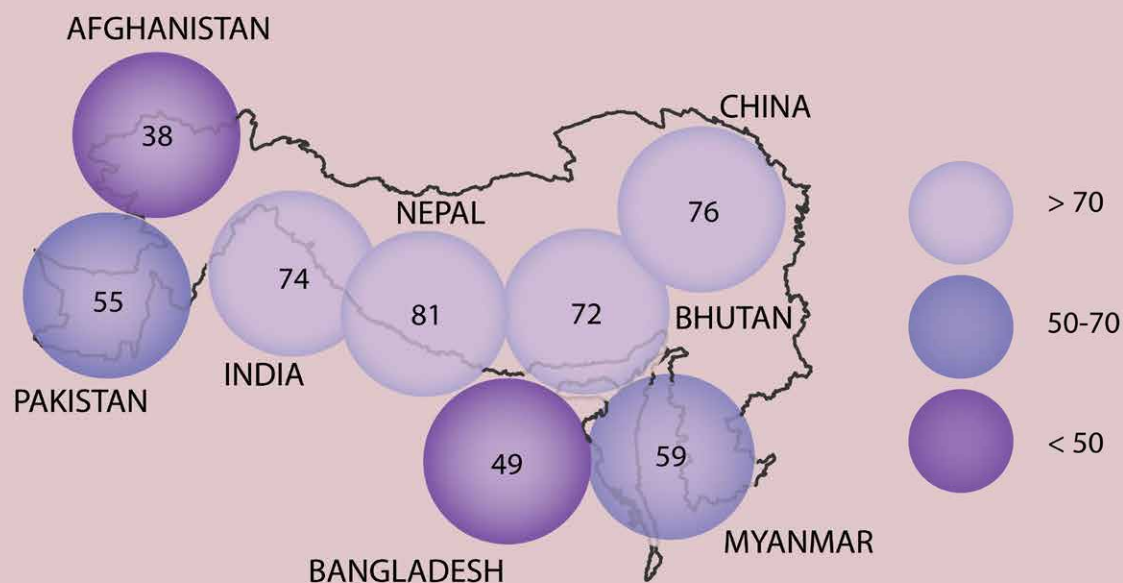
located in Asia: Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan. There are about 240 million people living in this region, mostly located in the mountain foothills of the region's border (see Figure 2).[11] Large cities within this region have high population density, above 10,000 people per km², such as Kathmandu in Nepal. In this area (China and Myanmar have no available data), 31 to 46 per cent of the population (about 49 million people) live below the poverty line.[12] Despite women having prominent role in local economy and natural resource management, they often lack access to businesses and are dependent on the men for income to the household. The Women, Business and the Law index[13] shows that most countries in the HKH still have work to do to achieve gender equality (see Figure 2).

The HKH region is on the front line of current environmental and socioeconomic changes and challenges. Common issues throughout the HKH include environmental degradation, poor natural resource management, food insecurity, vulnerability to extreme weather events, poverty, lack of social inclusion (especially for women and marginalized groups) and loss of traditional knowledge.[14]

The 10 solutions presented in Chapter 2 all contribute to building the climate resilience of mountain communities in the HKH by strengthening these communities both socially and economically, preserving their resources and preparing them to face the future. The solutions equip mountain communities with simple and affordable technologies and knowledge to build long-term resilience against current and future environmental and societal challenges. The solutions consider three dimensions of resilience: (1) climate resilience, (2) socioeconomic resilience, and (3) future resilience, and their specific impact areas (Figure 3). For each solution in Chapter 2, the most relevant impact areas are highlighted. This also indicates that, most often, combining several solutions has the greatest potential to achieve results at the community level.

To build a truly resilient mountain community, all members must be involved to reduce gaps between population groups. Being part of a marginalized group often leads to having limited involvement in the communities' management roles. Chapter 3 explains how women, youth and other marginalized people are put at the centre of the solutions. It is possible to improve the resilience of a community with a relatively small financial investment, but to achieve the SDGs in the coming years, the solutions need to be up-scaled and out-scaled, as discussed in Chapter 4. While the solutions focus on the HKH region, they can be applied to other mountain regions that face similar challenges by contextualizing the solutions according to the local needs and conditions. Scaling of the solutions is crucial to developing widespread resilience. Securing financial support from governing bodies is required for sustainable, long-term mountain resilience for the future.

← **Figure 2.** Demographic map of the Hindu Kush Himalayan region.

Dimensions of resilience and the Resilient Mountain Solutions (RMS) wheel in this book

The RMS wheel or framework is used to indicate areas in which the solutions are expected to have the most impact. It also highlights the multiple effects of each solution across and throughout the three dimensions of resilience:[15]

1) Climate resilience focuses on simple and efficient solutions aimed at improving practices around:
1. Renewable energy to move away from traditional fuels that have a negative impact on the environment.
2. Natural resource management, such as improving soil conditions and water availability and quality.
3. Agriculture, for example diversifying crops and adapting environmentally friendly technology and farming practices to changing climate and environmental conditions.

2) Socioeconomic resilience focuses on building resilient communities by:
1. Encouraging and supporting local economic and capacity-building initiatives through infrastructure development.
2. Promoting social inclusion, equality and access to resources throughout all levels of society, with a particular focus on marginalized groups and women.
3. Strengthening the capacity of local institutions to manage adaptation to socioeconomic and climate-related risks and vulnerabilities.

3) Future resilience focuses on the resources and networks needed for communities to dynamically adapt to unexpected changes, including:
1. Technologies, tools and knowledge to mitigate and recover from disasters.
2. Access to information such as weather forecasting, market information, crop advisory and peer-to-peer communication.
3. Financial mechanisms that mitigate vulnerabilities to economic risks.
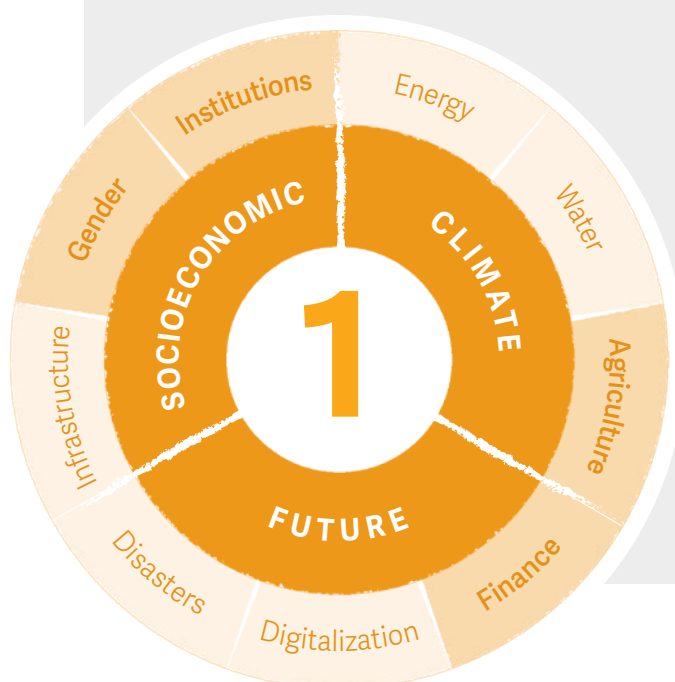
Figure 3. Resilient mountain solutions wheel.[16] The three dimensions of resilience are indicated in the inner circle, each consisting of three impact areas indicated in the outer circle. The relevance of the impact area is indicated with colour coding so that the areas that are most relevant are the darkest. In this example, Solution 1 is relevant for all dimensions of resilience, especially for building resilience in the financial, farming, gender and institutions sectors.

Chapter 2
Solutions

Solution #1

Building women's skills as entrepreneurs

Women-centric value chain programmes can lead to improved and inclusive livelihoods, empowerment and resilience. Value chains can help increase the prosperity of small enterprises so that they can deliver the most value, thereby providing multiple benefits for small communities.

Introduction

In many parts of the Hindu Kush Himalayan (HKH) region, women still face limited access to activities, processes and opportunities to develop a product and take it to market. Despite the good intentions of many development projects to target or include women, women and marginalized members of the community (due to aspects such as caste, class and ethnicity) are often overlooked.[1] Being overlooked, combined with how women negotiate their role both in the house and in the community, has led to multiple forms of oppression and exclusion for many women throughout the HKH region.[2]

Many women face social and cultural exclusion from the public sphere, resulting in a structural lack of access to financial mechanisms, committees and markets.[3] An increase in the number of men leaving rural communities (outmigration) often makes matters worse.[4] Typically, men move to urban areas or go abroad to seek employment. This places extra financial burden on the women left behind in rural communities because it takes time for the men to find work and send remittances back to the family.[5]

Globally, women are disproportionately poor,[6] despite their share of the workload often being greater. In Nepal, women (along with child labour) account for two thirds of the workload, but this has largely gone unacknowledged.[7] By recognizing and incorporating women's labour and roles into value chain projects, women can benefit from increased structural accessibility to the market and therefore enhance their economic sustainability.[8]

> " *I started small with one handloom, but today I have my own allo cloth weaving factory. I get orders from various cities in Nepal and even from India. The community centre is a place where we women come together and share our skills and help each other out. Women come here after finishing their morning household chores. Alone, we can't do much. Joining this group has provided many benefits. The project has actually opened our eyes and shown us what can be done utilizing the locally available allo plant. Improved design and weaving fine yarn can earn us more money for working the same amount of time. The skills I have gained have boosted my confidence and courage. I want to expand my business by adding more power looms and machines and making more beautiful products in the future.*

– Bagmati Dhami, allo fabric weaver from Khar Village Development Committee, Ward no. 2, Chaurigau, Nepal.

Photo by SABAH Nepal

The solution

The global value chain concept can be applied to many economic activities. It involves different actors playing different roles within the trading economy.[9]

Developing women-centric value chain programmes can lead to improved livelihoods, the empowerment of women within local communities and resilience to absorb, adopt and transform climatic and non-climatic shocks. Additionally, integrating women into all parts of the value chain (input, supply, production, marketing and disposal) allows for better access to the market and increased decision-making power.

Value chain creation requires a market study and evaluation of the implications for all members of the value chain. A five-step protocol has been developed to guide this process and support the implementation of this solution. The concept has been tested in rural mountain areas throughout the HKH region, including in Nepal and India.[10] Value chain workshops and programmes directed fully

> Value chain, as defined in this book describes:
> *The full range of activities needed to bring a product or service through the different phases of production and delivery to the consumer, and to final disposal after use.*
>
> *In the Hindu Kush Himalaya, value chains are influenced by the mountain-specific context, and products are mostly sold in their unprocessed form. Mountain value chains often miss out on the comparative advantages of being organic and natural, as economic gain takes place far away downstream, where value is added by processing, labelling, branding and retailing. Local value addition is rare, and mountain value chain stakeholders receive a meagre share of the value of the final product or service.*

FIVE STEPS FOR SUCCESS

1 Conduct a market study to discover women's skills and which available resources could best be adapted to demand and production needs.

2 Organize workshops to involve women, build awareness of benefits and engage potential entrepreneurs.

3 Educate producers to assess sustainable resource use and ensure business growth.

4 Create a community hub to share tools, knowledge and networks across different groups.

5 Build the business by registering the enterprise and developing collective marketing, products and branding.

Figure 4. Five-step protocol for rural entrepreneurship development for women.
Source: Modified from ICIMOD, 2018. Developing Rural Enterprise in Kailash Sacred Landscape – Nepal: Steps and Processes.

(or even partially) at women have led to an increase in women's participation in economic activities.[11] The concept is presented in Figure 4.

Allo (Himalayan nettle), tulsi and basil value chain development projects in place throughout the HKH region have already shown promising results. The projects focus on three broad areas – building resilient production systems, diversifying income options and encouraging supportive government policies (including sustainable provision of finance and other business services).

Developing new products from raw material adds value to the production chain. Above: Making allo wool from allo. Below: Knitting allo wool to produce shaws.

Photo by Kalash Shakya

Women entrepreneurs at a community centre in Godhani, Darchula.

The community enterprise Bhumiraj Allo Processing and Collection Centre was established in Godhani in Naugad Rural Municipality (Naugad Gaunpalika), Darchula District, in the far west region of Nepal. It is a preliminary site for the Kailash Sacred Landscape Conservation and Development Initiative and its members are predominantly women. The women participated in various trade fairs in major cities in Nepal and India to get a better understanding of market dynamics and market interactions. They received value addition training in making thread, bags, shawls and materials for clothing out of allo, and were also trained in stitching and knitting so that they could develop high-quality handicrafts, which were later branded and sold under the Kailash – Truly Sacred brand in SABAH Nepal outlets in Kathmandu. The initiative has brought a noticeable improvement to livelihood options, especially for women and marginalized groups in this remote mountainous region. Women were also encouraged to diversify their products, including beans, ghee and other high-value niche products under the same brand name to create

Figure 5. Map showing locations where women entrepreneurs were supported.

additional income and increase resilience by avoiding economic dependence on a single value chain.

Projects in other regions also provide training for women and encourage their inclusion in new value chain development, capacity-building and enterprise initiatives.

Challenges and risks

Building women's skills as entrepreneurs through value chain projects can be challenging, and certain considerations must be made to ensure that women are not overlooked. Projects might face local pushback from the community as they oppose local gender norms or other social norms. Possible internal differences among women must also be recognized, along with other forms of discrimination within cooperatives based on ethnicity, class, etc. Implementing value chain projects requires awareness and sensitivity to local norms, cultural practices and potential differences within a gender. At the household level, disturbance of traditional roles may lead to overburdening for women, while men in a supporting role may contribute to reducing this burden and further benefit their livelihoods.

Guma Devi Tamang making thread out of allo wool in Darchula District, Nepal.

Photo by Navaraj Pradhan/ICIMOD

Recommendations and scaling opportunities

Rural value chain development projects with women as the central focus must recognize the different needs and vulnerabilities of women; for example, the gendered difference to climate change vulnerability and the societal exclusions they often face.[12] However, it is also important that women are treated as agents of change rather than victims. Public funding schemes should reflect this through links with women's cooperatives and provision of realistic help for women's needs to mitigate their vulnerabilities.

For successful implementation, it is important to establish a specific development plan that includes the different levels of value chain development. If not, potential entrepreneurs will not be able to achieve what they set out to do. To address the lack of acknowledgement of women's contribution to value chains, value chain development that focuses on recognizing and building women's skills as

entrepreneurs should be out-scaled to encompass other villages and regions. Strengthening women's presence in value chains requires a lot of time and effort, and future programmes should incorporate more long-term approaches to further increase resilience.

The value chain development solution could also become more successful by increasing the focus on women's contribution to the economy at higher bureaucratic levels (up-scaling). The solution would have a greater impact when implemented through all levels of the government.[13] In the HKH region, as well as globally, value chain development can work with many different nature-based and agricultural products, as long as there is space in the value chain to develop it. Specifically, helping women build entrepreneurial skills not only increases the resilience of livelihoods and incomes and promotes gender equity, but it also goes a long way to combating poverty.

Summary

1. Women in the HKH region have limited social, political and economic influence.

2. There is great potential for women to increase their involvement in every aspect of value chain development.

3. Including social business organizations, such as SABAH Nepal, informs women home-based workers of ways to improve the livelihood of their household.

4. Creating a community centre for women allows them to join forces, ensures quality and provides a place where they can find support.

5. Value chains must be developed with respect for the sustainable use of natural resources and the local economic and cultural context.

6. Creating communities for women entrepreneurs to join efforts improves support and helps them gain negotiating power towards market actors.

7. Empowering women increases the resilience of livelihoods, acknowledges women's economic contribution and strengthens their direct access to markets or other economic institutions.
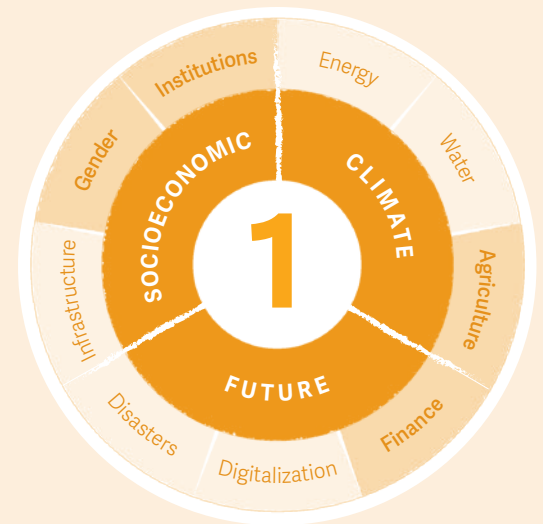
Solution #2

Promoting green and resilient entrepreneurship

Lack of employment opportunities in the mountain regions is causing poverty, especially in rural areas. Creating opportunities for developing green entrepreneurship can contribute to economic growth and improved livelihoods without degrading the environment.

Introduction

Fostering entrepreneurship in the mountain areas can be challenging. Many communities in the Hindu Kush Himalayan (HKH) region face problems, such as people moving away, poor infrastructure, lack of skills or education and limited access to markets.[1] Other challenges for entrepreneurs in mountain regions include lack of resources and limited access to, or unavailability of, technology and other services.

One way forward is to promote "green" and resilient entrepreneurship for mountain regions. In this case, we define green entrepreneurship as "the use of both commercial and ecological logics to address environmental degradation through the creation of financially profitable organizations, products, services, and markets".[2] In this context, "resilience" asks that the entrepreneurial activities contribute to a socioecological system that can withstand dramatic changes, are able to adapt to change and can potentially improve the current condition.

> **"** *I bake cookies with dru-na-gu, which is a traditional Bhutanese mix of nine cereals that are gluten free. I joined the start-up centre a little more than two years ago, without any real entrepreneur experience outside my village. Now, I have developed a multi-year business plan, adapted to the market in the city, staying authentic but also unique and useful for society. My business has grown well, I have hired four employees full-time. In five years' time, I want to transfer my business to my home village and put what I have learned to use for my people by creating a group of corporations, giving advice to fellow entrepreneurs and focusing on green sustainable products.*
>
> – Chimi Dema, green entrepreneur at the start-up centre in Thimphu, Bhutan

Photo by Chimi Rinzin/ICIMOD

The solution

Training and education in green entrepreneurship by dedicated start-up centres help build entrepreneurial capacity and diversify income sources. As such, they can provide income and subsequent improvements in people's livelihoods and socioeconomic resilience. This solution imparts new knowledge and know-how to mountain communities. It supplements traditional and local knowledge and could support the commercialization of local practices to increase their profitability and resilience. More specifically, the solution encourages young entrepreneurs – tomorrow's leaders of the sustainable economy – through an environmentally friendly idea, based on the principles of local, sustainable products and waste and packaging reduction, while still creating strong business potentials.

There are many green entrepreneurship initiatives throughout the HKH region, including one initiative in Thimphu, Bhutan.

Bhutan's Department of Cottage and Small Industries runs a start-up centre where entrepreneurs can get help with their business ideas, from idea development to taking them to market, and where they can receive mentoring, education, help with network building and exposure.[3] Business ideas have included handmade gift items, food products made from local produce, biodegradable packaging such as reusable fabric bags, biodegradable and reusable sanitary products; and the centre boasts a digital fabrication lab with 3D printers. The solution prioritizes women due to their historic and institutional exclusion from the business sector in the HKH region. It also empowers them by building their capacity to run their own business ventures and by altering traditional gender roles.

Tshering Yangzom founded Umami Condiments. Here, at the start-up centre in Thimphu, Bhutan

SIX STEPS
FOR SUCCESS

1. Flagship programme at the national level, promoting green and "Made local" products.

2. Call for young entrepreneurs to join the incubation programme.

3. Selection of green start-ups.

4. Training for young entrepreneurs on all aspects of developing their business.

5. Young entrepreneurs learn about market requirements by interacting with clients and promoting their products.

6. Two years on, entrepreneurs are ready to further develop their green business, with support from a network of start-up and mentors.

Figure 6. Six steps for green and resilient entrepreneurship development.

Photo by Chimi Rinzin/ICIMOD

Challenges and risks

A vital challenge of green entrepreneurship is that successful business and consequent expansion could possibly lead to environmental degradation and a rise in CO_2 emissions, meaning that the so called sustainable businesses are not always so sustainable after all. However, there is currently not enough evidence to support such a generalization.[4] With greater structural changes and institutional support, long-term environmental sustainability through business may be possible.[5]

Encouraging woman to take part in green entrepreneurship initiatives might challenge traditional gender roles and women's position in society. Resolving this requires cultural awareness and sensitivity towards local practices and norms. Another challenge is that of economic shock and making sure that green start-ups are sufficiently resilient to withstand such an event.

Photo by ICIMOD/Chimi Rinzin

Dechen fashion designer founder of Dchen atelier.

Recommendations and scaling opportunities

Green and resilient entrepreneurship is not confined to a specific local context, location or scale and can easily be out-scaled. The solution is already supported by the Bhutanese Government, and with the success of the Thimphu Centre, it will be promoted regionally, with two other centres planned in Bhutan. Replication is possible around the world and a similar entrepreneurship ecosystem is under development by the Government of Nepal. A strong institutional environment is necessary for entrepreneurship to become a vehicle for economic growth in developing countries.[6]

Summary

1. Entrepreneurship can increase socioeconomic resilience by diversifying income sources and educating professionals to better manage their businesses.

2. Entrepreneurship and enterprise development can lead to economic improvements and subsequent improvements in livelihoods, but true resilience is not guaranteed.

3. Engaging local community members in entrepreneurship in and for the community increases the chance of success.

4. Green and resilient entrepreneurship is particularly suited to fragile and vulnerable environments, such as the HKH region.

5. Start-up enterprises are often more up to date and open to change or adaption when it comes to technological solutions.

6. Supporting young entrepreneurs benefits the local economy, supports government objectives and prepares a future generation of entrepreneurs in the country.

7. By prioritizing women, gender barriers within business can be broken down, leading to economic and cultural empowerment for women.

Solution #3

Managed honeybee pollination

Managing pollination is one of the biggest challenges in ensuring sustainable food production for future generations. A worldwide decline in pollinators is disproportionately affecting indigenous communities and local subsistence farmers.[1] Introducing managed honeybee pollination can mitigate some of the negative consequences associated with this decline.

Introduction

Bees contribute to an extensive list of sustainable development initiatives, including biofuel production, income diversification, inspiring innovation in industry and infrastructure, and providing support to many ecosystem services.[2] There are about 20,000 species of bees in the world, including honeybees, bumblebees, carpenter bees, leafcutter bees and mason bees. Among these, it is honeybees that provide honey, beeswax, other hive products and pollination services.

Pollination – the transfer of pollen between flowering plants for fertilization and seed creation – is an essential process, and most food crops and flowering plants depend on pollination services.[3] Honeybees are among the most efficient pollinators, as they only visit certain crops to collect pollen to sustain their population. Managed honeybee pollination is needed in particular areas where the wild honeybee population is in decline through indiscriminate pesticide use or habitat loss, or there are too few other natural pollinators.

Photo by Sajjad Hussain/The Aga Khan Rural Support Programme

" *I have been a farmer for 25 years, and for the last 22 years I have had beehives in my orchards. Honey is considered healthy and a cure for different diseases, so the demand is high in our region. It is a good complementary income for me, and there are positive effects on my fruit trees. The quantity and quality of my fruits are better with beehives; I would like to have more in the future. With experience now, I know that there could be a tree disease, pest and insects or a natural disaster that impacts my production. With beehives, the harvest is more constant and keeps the average higher.*

– Abid Ali, farmer from Booni Gol Lotdur village in the region of Chitral, northern Pakistan

The solution

Managed honeybee pollination plays an important role in improving crop yield and quality, particularly in locations with an inadequate number of natural pollinators. This nature-based solution can be adapted to different local circumstances and across different altitudes, ecosystems and environments.

When applying managed honeybee pollination services, the choice of honeybee species must be considered. The choice of species – Asian bee *(Apis cerana)* or European bee *(Apis mellifera)* – depends on the need, the availability of the bee species and the climatic conditions. In mountain plain areas, farmers may opt for *Apis mellifera*, while in higher altitude areas, and particularly for crops that bloom during early spring, *Apis cerana* would perform better.

The number of honeybee colonies required for pollination varies depending on the crop. It also depends on the number of plants (density), how attractive the flowers are to the bees and the strength/population of the bee colony, among other factors.[4] As an example, 5–8 *Apis mellifera* hives or 10–12 *Apis cerana* hives per hectare are recommended for apple pollination when the plant has 5 per cent bloom.

Knowledge of how to correctly manage bee colonies is needed. There are different steps to follow for how the bees are introduced or moved, where to place the hives, packing and transportation, what kind of maintenance is required, and how to prevent pesticide poisoning or predators.

Managed honeybee pollination creates a win-win situation for both farmers or orchard owners and beekeepers. The latter may rent their bees for pollination services, whereas farmers and orchard owners benefit from improved crop yield and quality. Managed bees can also help revive the

FIVE STEPS
FOR SUCCESS

1 Identify locations where biodiversity and farmers would benefit from managed bee pollination.

2 Evaluate the size and number of hives needed, depending on local vegetation.

3 Provide training to the farmers, and especially women.

4 Monitor yields for best practice.

5 Livelihoods are improved by better harvests and additional income from honey.

Figure 7. Tips for successfully managing honeybees.

wild bee population if efforts are made to promote agroecological practices and integrated farming. However, to sustain natural insect pollinators, there is a need to opt for safe or biopesticides over harmful ones. To help revive natural pollinator populations, including wild honeybees, it is also important to protect their habitat, conserve biodiversity and allow natural flora that is a source of nectar and pollen for bees to regenerate.

Managing honeybee populations and honey harvesting have been part of the culture in the Hindu Kush Himalayan (HKH) region for generations. The act of beekeeping in the mountains of Nepal goes back to ancient times and is considered a part of Nepal's cultural heritage. Traditional and indigenous knowledge is important for the future of honeybee management and the conservation of wild honeybee

Asian honeybee collecting nectar from a daisy flower and helping pollination
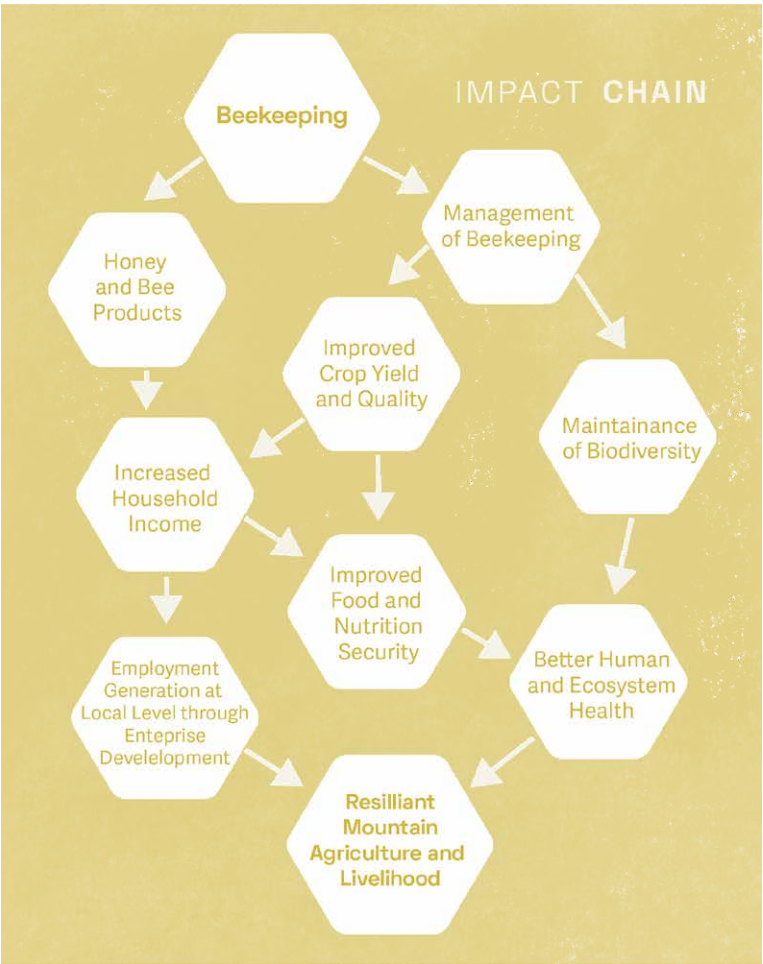
Figure 8. Impact chain showing benefits of beekeeping.

populations, which is at risk of declining in these rural mountain areas.[5] Honeybee management also introduces new equipment and techniques that are more suited to out-scaling and up-scaling.[6]

The management of honeybees has already been implemented in various parts of the HKH region (Bangladesh, Bhutan, Pakistan, India and Nepal) where there are crops that both support it and that need bee pollination to survive and thrive. Training in honeybee management was delivered and participants were able to learn from local and international experts.

The honeybee management solution provides employment opportunities in beekeeping, and a sustainable source of income for the beekeepers. It can, for example, help combat high rates of youth unemployment in rural areas.[7] In particular, the solution can benefit women in the community.[8] A number of bee-related projects have enabled women to take an active role in the value chain development of bee products, such as the production and marketing of honey, beeswax-based skincare creams, propolis, royal-jelly based products and pollen capsules. This can help combat the social exclusion that often acts as a barrier for women's roles in the

Photo by Surendra R. Joshi/ICIMOD

Local beekeepers with their bee hive in Godawari, Nepal.

Photo by Anna Sinisalo/GRID-Arendal

Woman beekeeper in Kavre, Nepal.
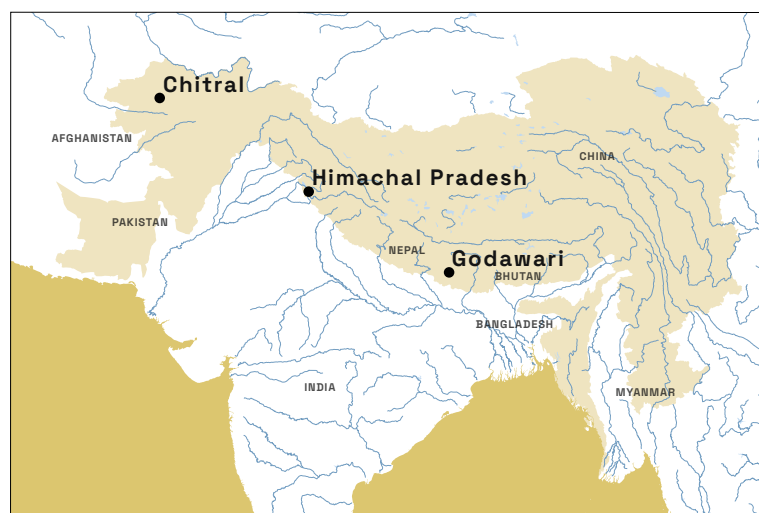
Figure 9. Map showing locations where managed bee pollination solution was tested.

value chain. Beekeeping, for pollination or honey production, is suitable in high altitude environments and is therefore a valid livelihood opportunity in mountainous areas such as the HKH region.

Challenges and risks

Lack of knowledge in rural mountain communities on the importance of existing natural pollinators, and lack of available information and equipment can pose challenges to successful implementation of the beekeeping solution. In addition, the solution requires adequate knowledge about local bee populations and species, since large-scale migratory beekeeping is controversial and can potentially harm local pollinator populations. For example, introducing the European honeybee species in new areas has reportedly displaced local pollinators.[9] Introducing new pollinators has also increased competition for resources with local pollinator populations in some cases.[10]

There is also the risk of disease transfer from managed bee colonies to wild bees.[11] Managed bees need careful attention and a specific focus on avoiding diseases and competition for forage to avoid negative effects on wild bee populations.

In areas where integrated crop-livestock farming is a common practice and biodiversity is rich, the pollination service is largely performed by wild bees and other natural pollinators. This means that non-managed bees are just as important for pollination activities.[12] Research is ongoing in order to fully understand the impact of managed bees on pollination and on the wild pollinator populations living in surrounding areas. Managed bee pollination is still often thought of as a short-term rather than a long-term solution.

Recommendations and scaling opportunities

Continuous monitoring of the impact of managed bees on pollination and on the wild pollinator populations is needed. A long-term solution must include changes in agricultural practices to support wild pollinator populations and ensure conservation of habitats to create a long-term win-win situation. The importance of all pollinators, and not only bees, for agriculture and food security in the short and long term needs to be identified and recognized at all levels.

If practised in an environmentally sustainable and locally appropriate manner, the honeybee management solution could be out-scaled to benefit more communities with support from organizations and government. Orchard owners' associations, research and extension agencies, development partners and universities can all demonstrate the benefits of pollination services and share their learning at various levels. However, policy reorientation, institutional strengthening and human resources development is needed to further advance pollination services that meet the needs of mountain communities and increase their resilience.[13]

Up-scaling could be achieved by incentivizing beekeepers to manage honeybees in movable hives that can be rented, transported and placed in the crop field. Up-scaling can be achieved through policy instruments and institutional mechanisms that facilitate the arrangement of pollination services (e.g. the State Department of Horticulture of Himachal Pradesh has a subsidy scheme for this).

Summary

1. An estimated three quarters of the world's crops and over 80 per cent of all flowering plants depend on animal pollinators, especially bees.

2. Pollination services are under threat due to a declining number and diversity of bees and other pollinators affected by the use of chemical pesticides, loss of habitat and other threats. This reduces agricultural productivity and disproportionately affects indigenous communities and local subsistence farmers.

3. Managed bee pollination has multiple benefits in the areas where natural pollinators have declined, which include:
    *   improved crop yields for farmers
    *   improved overall agrobiodiversity, including the replenishment of soils
    *   new economic opportunities by selling the byproducts (honey, beeswax and pollen) and by providing bee pollination services.

4. Related initiatives, such as preserving nature for bees, can be a positive contribution in the fight against climate change.

5. Introducing new or non-native bee populations can displace local pollinators, spread disease and produce honey of lower quality. However, with suitable equipment and training, knowledge and willingness, these challenges can be overcome.

6. The solution can benefit many more communities through correct environmental practice and institutional support.
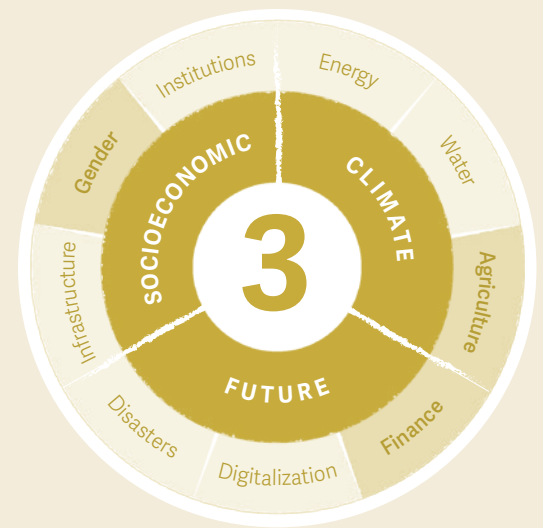
Solution #4

Co-management of rangelands

Rangeland herders and pastoralists are often marginalized and excluded from development and policymaking processes. This threatens traditional livelihoods as well as the ecology of the rangelands that support them. Co-management of rangelands can help overcome challenges and improve mountain community's resilience.

Introduction

Rangelands are important as a habitat for wildlife, biodiversity and for the livelihoods of mountain communities.[1] They also provide many other ecosystem services, such as carbon capture and regulation of water resources. Although land use has changed over time, rangelands still cover nearly 60 per cent of the Hindu Kush Himalayan (HKH) region.[2] Rangelands offer ecosystem resources to around 240 million people in the mountains and to another 1.9 billion people downstream.[3] They are important for many unique mountain cultures that hold traditional and indigenous knowledge, and around 25 to 30 million pastoralists depend on rangelands for their livelihoods.[4]

There are multiple pressures on rangelands affecting pastoralists and their livelihoods. Climate change has altered the length of grazing periods, allowing herders to occupy pastures for longer periods. At the same time, rangelands and communities have become more exposed to climate extremes and natural hazards such as droughts, floods, permafrost melting and landslides. Changing temperatures and precipitation patterns can also favour invasive plant species that take over and negatively impact the mountain ecosystems.[5]

Economic activities that often do not take into consideration local populations, such as mining or large scale tourism, add further pressures to rangelands. At the local level, competition for rangeland resources such as fuelwood or fodder for grazing can lead to land degradation directly affecting pastoralists. Furthermore, fragmentation of rangelands is occurring because national boundaries and fences are limiting herding practices, mobility pathways and endangered species migration.[6] In some cases, even national conservation plans have failed to preserve herding practices by evicting pastoralists from their traditional livelihoods.[7]

Communities living in rangelands are generally dependent on livestock rearing. The livestock policies are prepared and enforced by multiple ministries that have different jurisdiction concerning rangelands. With different ministries and other local-level governing actors enforcing their rules and regulations, some of which conflict with each other, rangeland communities must not only adapt to changing climatic conditions, but also challenging regulations.[8]

A flock of Sheep grazing in Ghalegaun, Nepal.

Photo by Jitendra Raj Bajracharya/ICIMOD

The solution

The solution aims to empower pastoralists in co-management practices and to build capacity in areas such as rotational grazing management, pasture management and rangeland re-vegetation. The main goal is to make the rangeland ecosystems sustainable and reduce conflicts despite the multiple pressures. Environmental assessment carried out by experts as an initial step provides information about the status of the rangeland and sets common ground for local communities and institutions to build necessary partnerships for better rangeland management.[9] Subsequently, pastoralists should be included in decisions being taken by local, regional and national authorities that concern rangelands. The rangeland co-management solution can reduce harmful practices by introducing consented regulation, such as banning burning to clear areas or defining boundaries for seasonal pastures. The solution requires regular evaluation and revision of plans to be able to adapt solutions to current and future issues.

Co-management of rangelands should include a sustainable sharing of resources among wildlife, vegetation and human activities at the local, regional and transnational levels. This approach is consistent with the landscape approach adopted by the United Nations Convention on Biological Diversity, which suggests better inclusion of the different parties.[11] The benefits of these types of co management include reliable winter hay production, combating desertification, improved human wildlife co-existence through habitat connectivity, and regeneration of pasturelands via fencing.

Targeted training of different actors is part of the solution. In Pakistan, for example, specific training sessions on rangeland management and use of digital tools such as the Rangelands Decision Support System application, have been organized for young Pakistani women. The online application helps support decisions on how to best manage

FIVE STEPS
FOR SUCCESS

1 — Identify areas with declining productivity, user conflicts or degraded land.

2 — Provide common ground for discussion for each party to develop a long-term partnership.

3 — Agree on co-management plans for the future.

4 — Hold periodic meetings to identify issues and monitor the situation.

5 — Revise the plans on a regular basis.

Figure 10. Tips for successfully co-manage rangelands[10]

rangelands by displaying maps with information on bioclimate, biomass, phenology and grazing patterns for each season.

In the HKH region, different animals are used in livestock farming, including goats, sheep, cows, buffalos, dromedary and yaks. Yaks are traditional animals for rangeland herding and are one of the most common forms of livestock. They can easily adapt to the high altitude and cold climate of the mountain environment. Mountain populations use yak products on a daily basis, including meat, milk, wool, hide and even dung as fuel for heating and cooking. Yak herders, however, face increasing challenges due to changing environmental conditions and the shift in the economy towards urbanized areas. This can lead to the migration of younger generations, degradation and overgrazing of the most suitable and highly productive rangelands,

> *We were one of the stakeholders in the regional rangelands programme coordinated by ICIMOD and implemented through the respective government extension systems. The co-management approach has helped us in bringing multiple stakeholders onto the same platform for collective planning, decision-making and sustainably managing rangelands for livelihood benefits. For instance, we were exposed to the idea of managing the grazing resources based on carrying capacity. We understood the need to reduce the numbers of unproductive yaks to minimize grazing pressure. However, we required support for breed improvement schemes. This was facilitated by the government livestock department providing quality breeding bulls as they were also on-board in our consultation and planning process. Further, we had another issue with the Department of Forest as we use large quantities of fuelwood for periodic maintenance of our temporary shelters and for heating purposes. It has been our tradition for many years as we do not have any alternative source of energy. However, this issue was also minimized as the government stakeholders introduced fuel efficient cook stoves and milk processing machines, that required less heating. This has helped reduce large-scale use of fuelwood and therefore contributes to forest conservation and biodiversity. Additionally, these collective efforts have motivated all 40 yak herders in the community to establish a formal yak herders network. Our network is already collaborating with the private sector to add value and market yak products as niche mountain products.*

– Mr. Janga Bahadur Gurung, Vice-Chair, Pancthar, Ilam, Taplejung Yak Network, Eastern Nepal.

Photo by Jitendra Raj Bajracharya/ICIMOD

Yak is one of the iconic livestock in the HKH, people depend on them for meat, milk, wool, hide or even fuel.

decreasing livestock health and causing human-wildlife conflicts. However, with improved living conditions, rural outmigration effects may be limited.

Improving resource management will make it easier to face the challenges related to a changing economy and warming climate.

Challenges and risks

The vast area covered by rangeland in the HKH region is shared between eight countries with a diverse spectrum of cultures, practices and ecosystems, ranging from subtropical savannas to alpine meadows in the highest mountains.[12] Pastoralism has existed for centuries and has contributed to the richness of cultural diversity in the rangelands. Current borders do not fully take into account the vegetative cover, and traditional pastoralism practices such as transhumance and interbreeding are put at risk through border fencing

and political decisions. Moreover, these lands are often located in the immediate vicinity of the cryosphere, which is undergoing rapid changes – increasing the hazard risks of permafrost collapsing and inducing landslides and structural damages in these environments.[13]

Changes do not happen overnight in rangelands. At higher elevations, any ecological changes involving restoration require a longer period of time to occur, leading to a challenge in proving that this

solution is viable. Poor rangeland management in the HKH region has led 15–37 per cent of flora or fauna species to the threat of extinction, with shrubs and bushes encroaching on the grasslands. There is also an interconnected conflict between the preservation of the ecosystem through protected areas and the preservation of herders' livelihoods.[14] Nevertheless, sustainable long-term management of the rangelands (that is not reliant on quick results) is necessary for both the ecosystem as a whole and the livelihoods of the men and women who depend on ecosystem services.

Rangeland management is largely dictated by the pastoral landscape, climate, season, topography and sociocultural factors.[15] It is therefore contextual to specific rangelands where local knowledge and wisdom is beneficial for management. Given the multiple functions of rangeland ecosystems and the various users involved, the co-management approach ensures collaboration among stakeholders for the sustainable use of rangelands. There are also social challenges to consider in future rangeland management and in ensuring the sustainable livelihoods of pastoralists and herders. Issues such as conflict resolution, equal inclusion of all pastoralists and equal power in decision-making and benefit distribution all need to be solved in the participatory committees. Discrimination against women in pastoralism remains an issue. In the division of labour, men are usually in charge of herding. Women, however, often have a better comprehension of the traditional ways to preserve the ecosystems and can be instrumental in selecting good pastures if they are equally included in the decision-making process.[16]

Recommendations and scaling opportunities

Efforts towards knowledge advocacy by bringing policymakers and governments together have begun to strengthen the support towards pastoralists in the eight HKH countries of Afghanistan, Bangladesh, Bhutan, China, India, Nepal, Myanmar and Pakistan. Including women is also important for improving rangeland management.[17] In Nepal, Bhutan and China, women are active in pasture management committees at the village level. In Upper Mustang, Nepal, women's knowledge is particularly recognized, and women's representation is enough to fill the quota. However, despite some improvements, there is still progress to be made in terms of women's access to leadership, empowerment and roles in decision-making.[18]

Up-scaling of this solution is necessary due to the transboundary nature of many rangelands. National and international cooperation to develop co-management policies that are suitable for all is a challenge, but is recommended for creating sustainable use of rangelands that support local livelihoods and economies. Forums at the national and regional levels are an important tool to promote transboundary cooperation in the management of the rangelands. The co-management system has been out-scaled in the Tibetan plateau, for example, after it was successfully implemented in Hongyuan County where herders, researchers and policymakers came together on an equal-footing to discuss pastoral development issues.[19]

Summary

1. Pastoralism is a traditional practice for livestock management, and co-management aims to enable the use of local knowledge in decision-making.

2. Building the resilience of rangelands is necessary, and is possible through improved co management that will increase benefits to the pastoralist communities and support ecosystem services.

3. The co-management approach must focus on women's empowerment, not only to participate in the decision-making processes but also to ensure that their rights are realized and secured.

4. Sustainable and inclusive land management can restore degraded areas, help resolve conflicts, protect biodiversity and provide grazing land for all.

5. Better co-management of rangeland allows pastoralists to maintain their livelihood despite the increasing climate vulnerability of ecosystems.

6. The solution institutionalizes knowledge in the communities, enabling adaptation of the pastoralism practices in the long term despite ecosystem changes due to climate events.
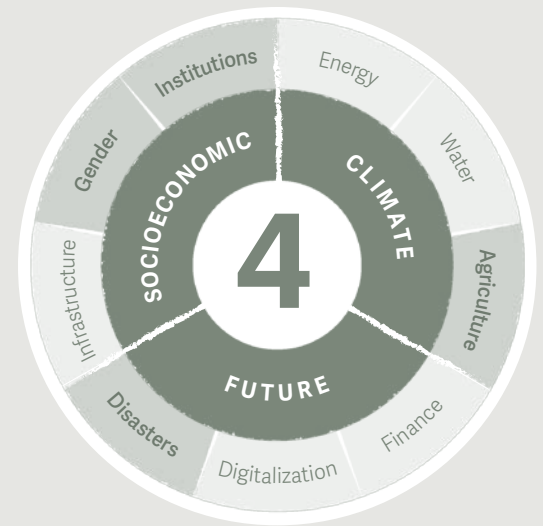
Solution #5

Spring revival

Spring revival is a nature-based solution to improve water security and build climate resilience in the mountains. Many towns and villages in the Hindu Kush Himalayan (HKH) region are facing increasing levels of water insecurity and an estimated 30–50 per cent of springs have dried up or reduced discharge over the last three to four decades, which poses a threat to local communities.

Introduction

Springs are an essential source of water for mountain communities, supplying over 90 per cent of the water for domestic uses in the mid-hills of the HKH.[1] They also provide water for agriculture and cultural or religious activities, as well as helping sustain river baseflow and biodiversity in the region. Underground aquifers supply the array of springs that emerge in the hills, and the groundwater systems are usually recharged by snow and rainfall.

Climate change has led to more intense weather events. Rainfall patterns have shifted, with more intense rainfall during monsoon season and more frequent and longer droughts.[2] Despite some regions receiving significant amounts of precipitation (rain or snow) the springs appear to be drying up, causing water shortages that poses a threat to the communities that rely on them.[3] Land-use, socioeconomic and demographic changes also lead to higher demand for spring water, especially in the more densely populated areas around the mid-hills of the HKH. Women are often the most affected by the water shortages, as they now have to travel further to collect water.

One nature-based solution to water shortages is spring revival in coordination with improvements in water and landscape management.

> " *I take the discharge measurement twice a month in the Patal ko dhara spring. The discharge of the spring was quite low earlier, but after constructing trenches above the spring and conserving the spring source, the spring discharge has increased. It used to take one minute to fill a one litre bottle but after the recharge measures were implemented it takes 15 to 18 seconds to fill a one litre bottle. This means that now it takes much less time to fetch water and we can spend more time on other things*
>
> – Rashmi Dhakal, Community Resource Person in Kuikelthumka, Nepal

Photo by Oda Mulelid/GRID-Arendal

The solution

The spring revival solution is designed to significantly increase and improve water supply and water quality over several years. This solution entails a combination of hydrogeological, social and governance aspects.

The initial phase is to map springs in the area that is suffering from the drying of existing water sources. To be able to assess the current situation, and later on the effectiveness of the revival, it is important to start monitoring the water discharge from the spring, as well as precipitation, before any further steps are taken.

A key component of spring revival is understanding social conditions and structures; this will help guarantee success and ensure that it will provide equal access to water. Training in restoring and maintaining the spring can be organized by the community members. Forming a springshed management committee consisting of trained community members will often ensure the sustainability of the solution. Equal representation across genders and vulnerable groups within the community in the training and the springshed management committee is required to increase equal access to water.

Parallel to the training and committee formation, an understanding of the groundwater system and the water infiltration that recharges the spring is needed. This requires inputs from professionals, such as hydrogeologists, who can help determine the key locations to carry out the work. Providing simple hydrology training for local community members also builds capacity and strengthens their resilience.

Following spring revival through structural, vegetative and management measures, discharge, rainfall and water needs must be continuously monitored to measure the success of the revival and to assess whether more springs need to be revived in the area to ensure water accessibility to all.

SIX STEPS FOR SUCCESS

1. Comprehensive mapping of springs and springsheds.
2. Setting-up of a data monitoring system.
3. Understanding social and governance aspects.
4. Identification of recharge areas.
5. Implementation of recharge measures and management protocols.
6. Measuring the impact of spring revival.

Figure 11. Tips for successfully revive springs.[4]
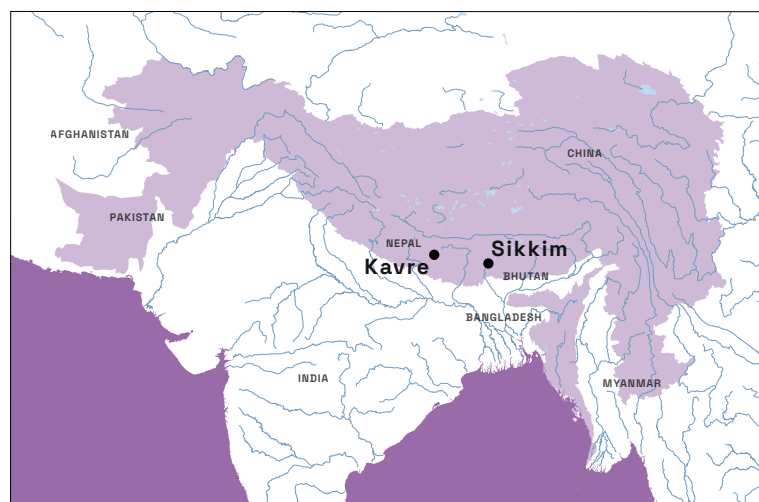
Figure 12. Map showing locations where springs were revived

There are good examples of spring revival in the HKH. In Sikkim, India, more than 50 springs and five lakes have been revived. Because of this, the farmers in the area have better access to water and can grow a larger variety of fruits and vegetables, which improves both their income and food security. The results in Sikkim show that increased water for better irrigation encouraged farmers to cultivate new crops, such as beans, cabbage, radish, cauliflower and chilli, along with rice paddies and tomatoes. Crop yield has increased by 15 per cent and cultivation of irrigated crops by 25 per cent.5 Farmers have also cultivated perennial fruits, such as guava, banana, orange and litchi, following the success of the initiative. This resulted in greater understanding of groundwater infiltration and the relationship between ponds upstream and springs below, both for researchers and for the local community. Similar positive results have been seen in pilots in Nepal and Bhutan.
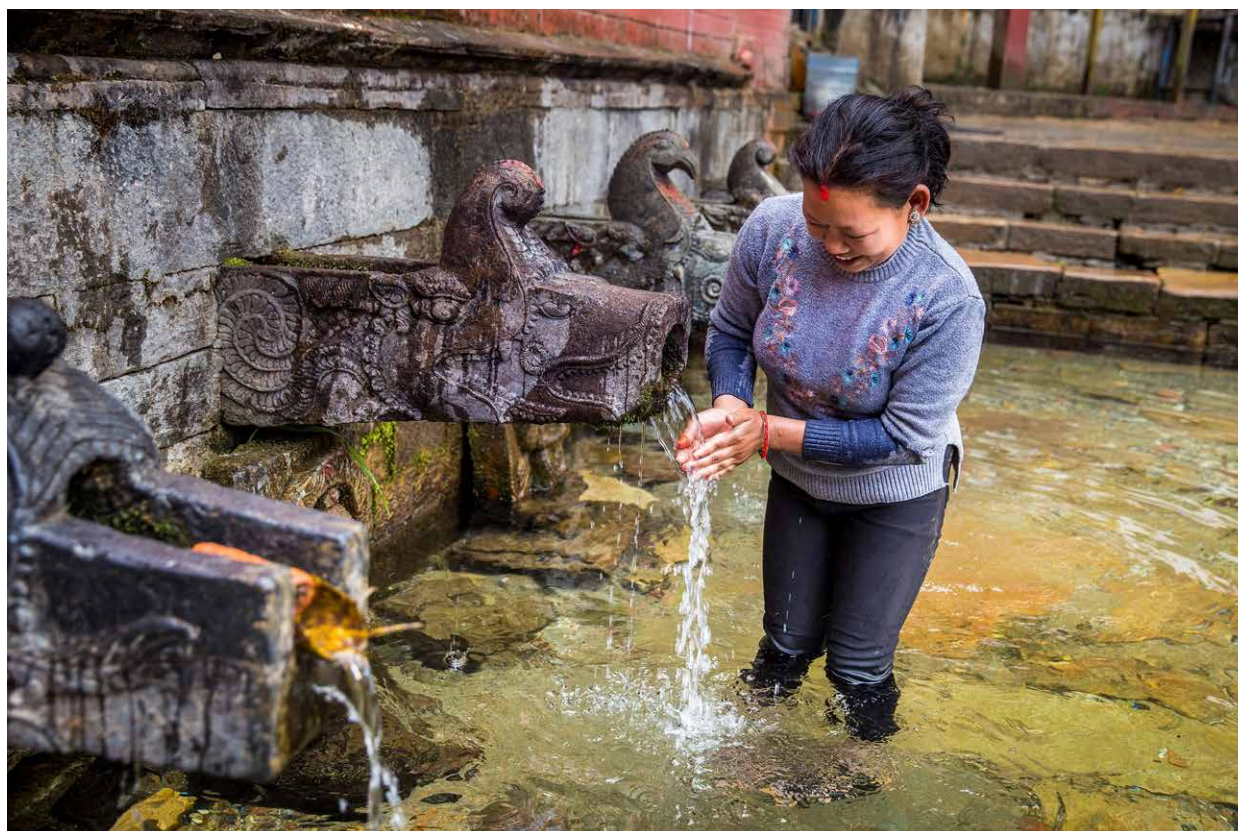
Photo by Jitendra Raj Bajracharya/ICIMOD

Traditional stone drinking fountain (Dhara) in Godawari, Nepal

Challenges and risks

There is an increased awareness of spring flow depletion, deteriorating water quality and spring conservation measures at the local level. However, technical capacity and knowledge is often lacking, particularly for defining the extent of the recharge area. Such work is currently carried out by hydrogeologists and experts from outside the region. Therefore, addressing issues with the spring revival solution requires effort and coordination from policymakers, specialized hydrological organizations and local authorities.

Development activities, such as building roads and other infrastructure, can affect the groundwater supply of nearby springs. Therefore, it is crucial to include water security aspects in the planning from the outset. Other major concerns are forest degradation and other land-use changes, as well as excessive groundwater mining.

Anthropogenic factors, such as the increased use of agrochemicals and waste disposal, can lead to contamination of spring water. This results in adverse impacts on both human and environmental health and requires increased investments for water treatment. Sound, local-level water management is also crucial to avoid discrepancies, inequalities and other social issues, such as upstream/downstream conflicts.

Spring revival projects can suffer without adequate and long-term institutional support from local and national governments to cover a wide geographical area and large financial needs.

Recommendations and scaling opportunities

From the start, the support of local government is essential to the success of the spring revival solution. Financing is crucial and should be included in annual budgets. Local spring management systems should be based on good governance principles. One way is to empower spring water user groups to manage their springs and recharge areas. Spring revival management activities usually require collaboration among multiple stakeholders, including upstream and downstream communities, residents of more than one watershed, and authorities of different administrative units. Scaling spring revival solutions upward and outwards in the mid-altitude mountains will benefit the rivers and communities downstream and help prevent future drought. Some incentive-based mechanisms might be needed between spring users and recharge area users to avoid conflict and ensure mutual benefits.

Women and marginalized members of the community should be included in the water user and management groups. Usually, women are in charge of the household water supply, so a decrease in spring water levels directly affects them as they may need to travel further to fetch water. Because women are the ones who fetch the water from springs, they have extensive knowledge of the springs and of water demand. Women should be included in all steps of the spring revival protocol, starting with the comprehensive mapping of springs.

The springshed revival solution has already been out-scaled to new locations in Bhutan, India and Nepal following the six-step protocol. Spring revival, using local and hydrogeological knowledge, was also included as a major intervention under the Royal Government of Bhutan's 12th Five Year Plan (2018–2023) for the renewable natural resources sector. The results indicate that the solution could succeed throughout the HKH region.

Summary

1. Spring water levels are decreasing throughout the HKH region due to both climate change and anthropogenic factors.

2. Springs are essential, for both household water and agriculture, and their depletion places a heavier burden on community members, especially women who mostly fetch the water.

3. The solution follows a six-step protocol to combine new knowledge with a hydrogeological focus on the spring recharge area with pre-existing infrastructure, within considerate traditional practices of local water management, for example, traditional ponds, soil and water conservation.

4. Local participation and control, particularly among women and marginalized groups, is important at all stages of the spring revival and management process to avoid exacerbating inequalities and to empower communities.

5. Future activities should be carried out in close cooperation with other institutions involved in similar work, such as local government and local non-governmental organizations.
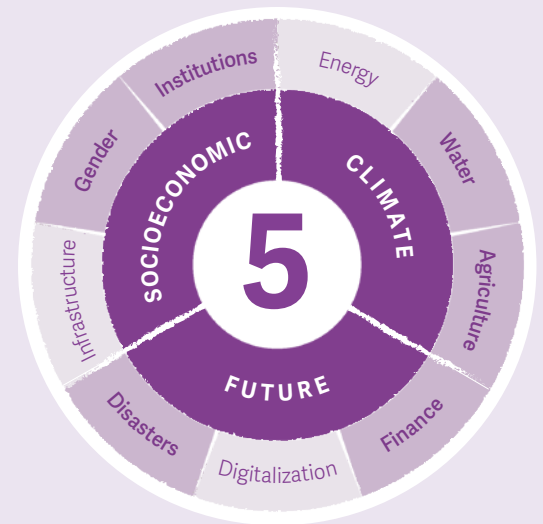
Solution #6

Storing water in low-cost ways

Simple, low-cost water retention methods can prevent water shortages and make irrigation possible throughout the year. Water shortages are one of the challenges faced by farming communities in the Hindu Kush Himalayan (HKH) region. Climate change causes more intensive rainfalls and droughts, creating challenges for local farmers. Water can be retained locally and used in a smarter way by establishing low-cost ponds and environmentally friendly irrigation and farming techniques with multiple benefits. These benefits include improved access to water, increased yields, reduced time for water collection and better climate resilience.

Introduction

Climate change is exacerbating the variability of rainfall in the HKH region, which faces long periods of drought and water scarcity for seven to eight months of the year; around 80 per cent of annual precipitation occurs during the four to five monsoon months.[1] However, water is needed year-round for drinking, household consumption and irrigation in farming. During the monsoon months, water is abundant, but this is not the case all year round. Infrastructure to store water in times of abundance is important to ensure continuous access to irrigation throughout the year.

Additionally, it is expected that the intensity of rainfall will increase, causing more severe floods and other natural disasters. Higher-intensity rainfall during the monsoon season combined with the mountain run-off makes it difficult to store water. However, low-cost water storage methods make it possible to harvest and use the available water throughout the year.

Traditional water harvesting techniques have played a vital role in supporting the rural population in water-scarce areas.[2] However, traditional knowledge has sometimes been lost and the requirement for low initial investments has created a need to promote low-cost water retention methods in the mountain regions. Most of the traditional techniques involve structures designed to collect rainwater or water from the streams but also more advanced structures for groundwater harvesting.[3]

Low-cost water retention methods focus on storing water or increasing water retention in soils to strengthen resilience to drought and to distribute the available water equally within the community. Simple low-cost ponds combined with environmentally friendly irrigation and farming practices are the most suitable ways to save and store water in rural mountain communities.

> **"** *We have been using a soil cement tank for our house for five months. We saw it first in the village, it was installed not far from here. We were sceptical because of the use of local soil in the sand cement mix. It is solid, much more durable than the plastic liner for ponds we used before. We essentially use the water for vegetables and, combined with organic fertilizers, we have good production. Some years we had to go to the market to buy vegetables, but not anymore. We save money this way and I hope to expand our activity to a commercial business in the near future.*

– Sabitri Kuikel, from Namobuddha Municipality, in Kavre, Nepal

Photo by Jitendra Raj Bajracharya/ICIMOD

The solution

This solution covers specific water retention methods, such as water storage ponds for streams, rainwater and wastewater. It also includes ways to use water for crops through mulching and drip irrigation, which are appropriate for saving water. It is particularly relevant for mountain villages due to the precipitation conditions and risk of drought in some mountain regions, which are exacerbated by climate change. Due to their low implementation costs and potential benefits, these methods are also widely promoted to help develop small-scale farming in economically marginal areas.

Traditional large-scale centralized water storage involves large dams and reservoirs. However, the solution here focuses on decentralized, very small and local-scale reservoirs that directly benefit the communities who build them. Small local ponds are also made for collecting wastewater run-off from household chores, which could be used for irrigating a home garden or kitchen garden. The techniques chosen depend on the amount and timing of rain, and the soil type, geology and topography of the area.[4]

In areas with clay soil, earthen ponds can be made by digging a hole of considerable size in the ground to retain wastewater. However, when the soil is porous, pond lining is required to stop seepage. Plastic lining can be used for smaller ponds built by farmers in Nepal (2 m x 1.5 m x 75 cm depth, with a storage capacity of 2,000 litres). Larger community-managed plastic ponds (5.5 m x 7.5 m x 1 m depth, with a storage capacity of 40,000 litres) can be constructed to collect wastewater from drinking water taps and small streams. For larger ponds, the lining can be made of soil cement.[5]

Mulching is a simple, cheap method in which a protective layer of organic mulch (straw, bark chips, grasses) or inorganic mulch (plastic, stone/brick

FIVE STEPS FOR SUCCESS

1. Identify localities experiencing or expected to experience water related shortages.

2. Introduce farmers and households to the concept, benefits, construction materials and maintenance techniques.

3. Select households with an interest in having low-cost water retention for their crops.

4. Set up drip irrigation methods to optimize water usage.

5. Develop community resilience towards dry spells.

Figure 13. Tips for storing water in low-cost ways.

chips) is spread over the surface of the soil. Mulching improves the soil's water capacity, total porosity and moisture retention, as well as reducing erosion.[6] Mulching increases agricultural resilience by both limiting the impacts of dry weather and protecting the soil during heavy rainfall.

Drip irrigation is another cost-effective irrigation technology that is suitable for small-scale farming in mountain regions such as the HKH. With drip irrigation, water is led from a tank or water pond through a pipe system to the home garden or field, where it drips slowly onto the soil through emitters or drippers, which are located close to the plants. Drip irrigation improves soil moisture conditions by delivering water directly to the roots of plants.[7] The method is widely used in sub-Saharan Africa.[8]
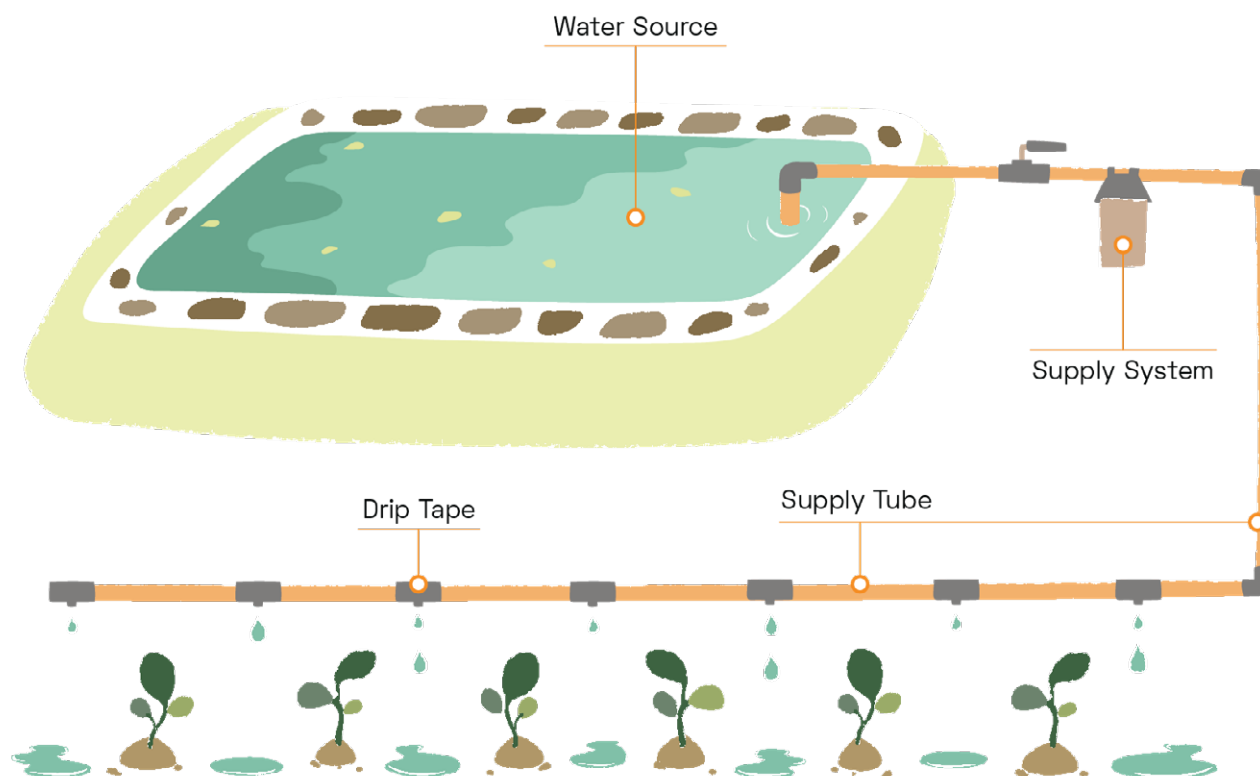
Farmers in Kavre, Nepal, have started using soil cement tanks to store water, which they use to irrigate their lands through drip and microsprinkler irrigation. They have also observed improvements to the soil quality since soil moisture is retained even during dry periods.

Water storage pond made of soil cement in Kavre to store rainwater for the dry season.

Figure 14. Illustration of a drip irrigation system lead from a water storage pond

In Nepal, the impact of drip irrigation on grass fodder indicated better use of the available land, fertilizer and water.[9] Drip irrigation has also reduced labour for women, who fetch water in the mountain communities.[10] Water retention methods can reduce the time women spend fetching water, in some cases reducing it from more than an hour to 15–30 minutes.[11] The outmigration of men in many rural areas has also led to women taking a more active role in water retention management.[12]

When implementing this solution at the community level, active participation of local users at all stages is vital to the success of local water governance and management, irrespective of the type of management community (private or government). Local users should be at the centre of all activities. The most important point is whether local user participation is ensured, meaning they

Figure 15. Map of locations where the storing water in low-cost ways solution has been successfully tested.

can make and enforce their own rules, monitor and take action against violators, and above all manage resources, primarily labour.[13]

Challenges and risks

Implementing low-cost water retention methods presents some challenges. For example, drip irrigation is difficult to implement on steep hillsides, where it requires extra modifications to function. Minor concerns have been raised about how water storage ponds could reduce the infiltration of rainfall and possibly deteriorate existing underground reserves and watersheds; however, these are of less significance due to the small size of the storage ponds in this specific water retention solution. Socially, although women have often gained an increasing role in resource management due to men moving away from rural areas, they still have fewer water rights, and access to these water storage systems is often limited by gender.[14]

It is also essential to consider how the water retention systems affect the populations both downstream and upstream. In Andhra Pradesh, for example, it was found that upstream water storage systems could significantly alter the water availability downstream. If water storage systems upstream negatively impact populations downstream, or vice versa, a compensation scheme should be put in place to reward those who make an extra effort to preserve resources.[15]

Recommendations and scaling opportunities

Storing water in low-cost ways requires capacity-building to create community-based management of common ponds, involving the users in the creation and implementation of management rules and giving them the tools required to resolve conflicts based on water access.[16] It is recommended that capacity is built within upstream and downstream communities, and cooperative management by these communities and authorities is encouraged.

There are also recommendations for implementing drip irrigation in agricultural development projects,[17] including:
• redesigning drip systems to help prevent common problems
• investing in education for adopters that focuses on maintenance and repairs
• encouraging the adoption of complementary technologies to support the functioning of drip systems.

These cost-effective water retention solutions are suitable for up-scaling and could help increase regional food security and resilience to drought. Wastewater collection allows any excess water to be used in irrigation. The technology is particularly suited to small-scale farming. After piloting the method in Nepal, the government has promoted the building of water storage ponds in 14 other districts. India announced its "Neeranchal" programme in 2015 to support watershed development, and since 2003, the Afghan Government has helped fund community-based water storage facilities.[18] While in Myanmar, the villages neighbouring the pilot sites have expressed their wish to adopt this technology.[19] ICIMOD has organized exchange visits and workshops to share the lessons learned from the pilot sites and encourage local governments and line departments to promote water storage ponds.

Summary

1. The HKH region faces water management problems due to extreme weather events, drought and monsoons.

2. Water storage ponds are a traditional practice to harvest rainwater and to collect water from small streams and store it near households, but may have been lost over time in some areas.

3. The low-cost water retention methods are very much aligned to local knowledge and do not require much change to some existing practices.

4. The solution requires very little investment, and most farmers will be able to afford it.

5. The solution promotes an "environmentally friendly local governance framework".

6. Storing water for irrigation using low-cost methods can provide socioeconomic opportunities, increasing yields that can either be sources of subsistence or cash crops.

8. The solution enhances water management and efficient use of water, which is essential to ensure both food security and economic sustainability.

8. With climate change expected to increase extreme weather events such as drought and heavy rainfall, low-cost water retention methods are essential to ensure water during the dry months.
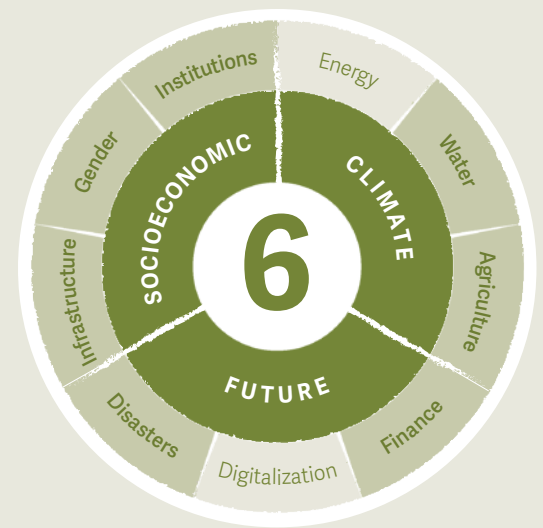
Solution #7

Home garden and polyhouse

Home gardens and polyhouse vegetables help combat food and nutrition insecurity in the mountains. In the Hindu Kush Himalayan (HKH) region, the local environment is not favourable for year-round agricultural production. Many households in villages also suffer from low socioeconomic status.[1] This often results in poor nutrition and diet among mountain community households.

Introduction

Home gardening is a common practice that is found all over the world, in rural and urban areas alike. Growing crops in home gardens can supply a household with vegetables during the year as a secure food source. However, in mountain regions such as the HKH, the growing season is much shorter than in more temperate regions, which means that vegetables cannot always successfully mature.

Polyhouses can be a relatively low-cost solution to the unfavourable climatic conditions and short growing seasons that mountain communities face. Home gardening can be adapted to local circumstances, including in the mountain regions of the HKH, and be a part of a wider gender-responsive approach to increase household resilience to changes caused by climate change (see Chapter 3).

The home garden polyhouse solution can improve nutrition and food security for rural communities in developing countries[2] by significantly increasing crop productivity compared to open fields.[3] Polyhouses allow for off-season vegetable production and enable a wider range of produce to be grown and sold for cash at local markets, including fruits, medicinal plants and ornamental plants. Households also share the vegetables with their neighbours. This provides additional household income and helps foster community bonds.

Home garden on the foothills in the Kavre district, Nepal.

Photo by Jitendra Raj Bajracharya/ICIMOD

The solution

Home gardening often relies on constructing a polyhouse, a simple but effective greenhouse-like structure in which to grow vegetables. A polyhouse works using the same principle as a greenhouse: plastic sheets over a bamboo or metal structure trap heat within the walls by letting in light. Polyhouse benefits include lengthening the growing season and protecting crops against insects such as mites and white flies.[4] Additionally, the plastic sheets are easy to transport to remote locations. The plastic used for polyhouses is durable, lasting around five years, and when it wears out or becomes damaged, it is usually reused as a surface for drying herbs and leaves in the sunshine. It is a preferred solution in remote areas and mountains for small-scale farmers who cannot afford high-tech greenhouses.

In the north-eastern Himalayan region of India, home gardens are very popular with the local communities, particularly shifting cultivators. Here, home gardens have not only helped ensure the availability of seasonal food, but also household dietary diversity. According to women household members, home gardens have helped reduce their drudgery and improved the health of household members.[5] In the HKH region, three villages in Myanmar – Thu Kha Loi Di, Tant San and Lwe Moon – have successfully integrated polyhouses into their home gardens, with improved water-collection and irrigation methods for a longer growing season.[6]

A home garden solution requires inputs such as water and fertilizer. A range of water-collection methods are suitable for home gardens (see Solution 6). Rain harvesting is common in home gardening and is a widespread tool that can help villages in water-scarce areas increase their water supply and improve water quality. Community-based rainwater harvesting solutions are viable and sustainable solutions in addition to polyhouses and home gardens. Those solutions can be implemented successfully in various parts of Asia and Africa.[7]

FIVE STEPS FOR SUCCESS

1. Develop capacity to build polyhouses and grow different/new crops adapted to better nutrition.

2. Provide support for polyhouse construction and rainwater harvesting and run training sessions on the use of natural fertilizers.

3. Plant crops earlier in the season and harvest for longer periods.

4. Improve household nutrition and food security.

5. Families dry or preserve surplus and even sell it at the market to make money.

Figure 16. Tips for successful home-gardening.

Fertilizer is another essential component of home gardening. Jholmal, for example, is an organic fertilizer and pesticide that is made from fermented cow dung, buffalo urine and various composted vegetables.[8] It has been used by farmers in India and Nepal for centuries, and is suitable for home gardens in the HKH region.[9] Jholmal can be used to improve mountain soils that are infertile due to topsoil run-off of and arid conditions.[10]

Using locally produced fertilizer, such as jholmal, would help communities and farmers to be self sufficient, instead of relying on imported chemical inputs, market mechanisms and their fluctuating prices, or state subsidies to buy them. Additionally, it is often the role of women to manage manure, so using local fertilizer could empower women

Photo by Kinley Wangchuk

Ms. Kiba Lham growing mustard greens (Brassica juncea) to be eaten by local families in a polyhouse in Haa, Bhutan. The polyhouse allows the growing season to be extended; the seeds were sown in October in the previous year, which is very early at this location.

" *At first it was difficult to grow crops in the polyhouse because we didn't know how to do it. Three years later, we have the experience and training, and we grow chillies, tomatoes and cabbage, among others. Sometimes, we grow plants from seed in the polyhouse, then plant them in the soil during the summer season, which helps protect the young plants from insects and bad weather. Another positive thing is that we don't depend on produce from neighbouring countries as much as before, especially for organic products.*

– Sonam Zam, farmer from Haa village, Bhutan

Photo by Kinley Wangchuk

Polyhouse made of wood structure and plastic coating, in Haa village, Bhutan.

in the community as they become the knowledge holders on how to best use the organic fertilizer. Using good fertilizer in polyhouses leads to low evapotranspiration rates, which in turn decreases irrigation needs, thereby reducing the burden of irrigation for women in the farming communities.

Challenges and risks

Home gardens can be considered green and sustainable, depending on the inputs and resources used. One main challenge is to avoid using fossil-fuel-driven irrigation mechanisms such as diesel-driven irrigation pumps. A shift from commonly used conventional fertilizers and pesticides can also be challenging to facilitate, especially if there is a lack of knowledge about how to manufacture organic alternatives such as jholmal.

Land ownership and access, the local environment, and convenience are common obstacles to home gardens for people living in rural villages. Those from the poorer segments of society, who do not have the same financial resources to buy seeds or access to suitable land, are unable to cultivate home gardens as easily as the more resource-rich community members.

Home gardens are inherently a small-scale solution. Governments, non-governmental organizations and others with significant local knowledge could promote this solution, but it might not be feasible everywhere, and it often has less impact on the lives of those in the poorest segments of society, who lack access to some of the necessary resources.

Water availability, especially during the drier seasons, is the biggest concern for home gardeners in the mountain villages of the HKH. However, this can be contextually addressed, as it has been in the villages of Thu Kha Loi Di, Tant San and Lwe Moon in Myanmar, for example.[11] Rooftop rainwater harvesting has proved to be a sustainable source of water in other areas, such as Haryana, India, where the state water supply is insufficient; and it may prove useful in other regions that face water shortages.[12] A rainwater harvesting system also requires regular repairs and maintenance – there is little existing knowledge about this in local communities; therefore, there is a need for both capacity development and provision of the necessary materials.

The polyhouse should be designed so that local materials, such as bamboo wood, can be used. However, the cost of other materials, such as plastic coating, nails, ropes, seeds and fertilizers, often require incentives and these materials have to be bought and transported from elsewhere. After the polyhouse is built, no major maintenance costs are expected.[13]

Recommendations and scaling opportunities

It is recommended that polyhouses and home garden initiatives plan for and include water storage or irrigation systems that make water available off season. Community-based rainwater harvesting can be combined with home gardens in water-scarce areas. Local knowledge on soil, water availability and crops is also essential. To ensure the sustainability of rainwater harvesting, activities require local engagement and a user committee, a sustainable source of funding for community projects, a clear plan for the operation and maintenance of the system, and regular capacity-building activities.[14]

The home garden initiative can be promoted as a sustainable and resilient solution. The materials used for the polyhouses can even be reused and recycled.

For example, the plastic can used for four to five years, and then used as a carpet to dry crops or thresh grains, for an additional five years.

The home garden initiative is suitable for out-scaling. Farmer-to-farmer diffusion (where farmers are trained alongside testing new technologies, then return to their own farms and share knowledge with neighbours and communities) can help identify crops that can be grown in polyhouses. The solution is often promoted as part of a package of farming solutions; for example, a home garden with drip irrigation or mulching to ensure optimal production and harvests. This can be useful in other regions that face similar challenges to mountain communities.

Summary

1. Mountain communities struggle to provide nutritious food year-round due to environmental conditions that are often exacerbated by climate change.

2. Home gardening can be part of a wider approach to increase household resilience to changes caused by climate change.

3. Home gardens in polyhouses provide nutritious crops that might otherwise be unattainable and can be a source of income if the products are sold. Diversification in diet and income increases socioeconomic resilience.

4. The solution needs a specific type of plastic material and knowledge/skill for construction, but once it has been introduced to farmers it seems adaptable to the available materials.

5. Home gardening minimizes production loss from climate extremes and creates microclimatic conditions to enhance crop production.

6. The solution is efficient on a small scale, where it is an ideal solution to enable vegetable production in winter to improve food security, but it still requires some financial investments and access to resources.
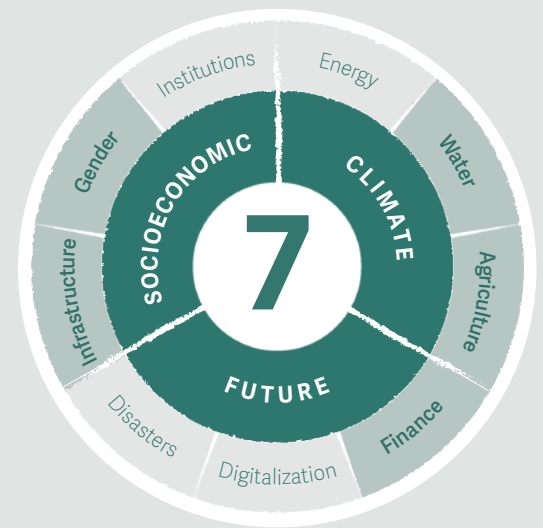
Solution #8

Energy-efficient technologies

Improved stoves for drying herbs and fruits can help save fuelwood and protect people's health from hazardous smoke. Producing goods in a value chain normally requires some form of energy. For example, mountain-based products such as cardamom require drying, but traditional drying methods benefit neither the environment, the product nor the people involved.

Introduction

Overexploitation of natural resources in the Hindu Kush Himalayan (HKH) region is a major issue and includes the destruction of forest and shrubland for fuelwood. Fuelwood – wood that is grown for burning in commercial activities – is an important energy source in the rural HKH,[1] the overextraction of which contributes to forest degradation in the area.[2] Overextraction is often due to the large amounts of fuelwood needed to produce mountain-based products such as cardamom, of which Nepal is the largest producer in the world, followed by India.[3]

Relatively simple energy-efficient solutions can offer multiple benefits to the value chain development of mountain-based products, such as bamboo, yak milk and cardamom. Improved drying systems that are more energy-efficient can help mitigate environmental degradation while simultaneously improving the finished product.[4] They also have a positive impact on the health of community members exposed to smoke from the fuelwood used in traditional drying systems.

The cardamom is harvested and dried in November. Around 80 per cent of the fresh weight is removed in the drying process. As there are few sunshine hours in that season, the drying process is reliant on drying ovens, locally called bhatti, powered by fuelwood fires. The traditional processing method for drying cardamon takes around 24 hours and is 15 per cent efficient at most, with large quantities of wood being

Cardamom plants from North Sikkim, India.

Photo by Jitendra Raj Bajracharya/ICIMOD

Photo by Surendra R. Joshi/ICIMOD

Traditional bhatti in Sikkim, India with smoke passing through the cardamom as it dries over a period of 24 hours.

Photo by Jitendra Raj Bajracharya/ICIMOD

Large cardamom (Amomum subulatum) is a high-value cash crop and a major source of cash income for farmers in the eastern Himalayan region.

wasted.[5] Fires lit under the bhatti are constantly kept fuelled so that heat and smoke flow up through the cardamon pods as they are dried. The pods are raked frequently to ensure uniform drying. When all the pods are dry, they are rubbed against a rough surface to remove the "tail", after which they are ready for market. This process leaves the pods a dark brown colour, with a smoky flavour. The smoke produced by bhatti drying ovens causes health problems for the farmers who must rake the pods during the drying period.[6] The resulting form of cardamon is mainly sent to markets in Bangladesh and Pakistan.

The cardamom drying process puts pressure on the available local fuelwood sources.[7] The pressure impacts local households who need fuelwood and miss out, and degrades the forest itself as trees are removed for fuelwood. This forest degradation has a negative effect on biodiversity, energy security, water retention capacity and carbon sequestration.[8] It also increases the risk of landslides in the area.

Additionally, women often play a lead role in the growing and harvesting processes of large cardamom and are often tasked with collecting fuelwood, which takes a long time and is very hard, physical work. A more energy-efficient drying system could therefore benefit local farmers as well as those who are part of the value chain, requiring less time and energy to power.

FOUR **STEPS**
FOR SUCCESS

1 Hold a workshop with farmers who are using low-efficiency systems or methods such as *bhattis*.

2 Support farmers interested in this solution in finding funding mechanisms to support the transition.

3 Undertake structural improvement of the low-efficiency technologies such as *bhattis* before the next harvest and provide support if needed.

4 Support new funding schemes to create incentives for farmers to transition to any more energy-efficient or renewable energy solutions.

Figure 17. Tips for successfully setting up energy efficient technologies.

The solution

The solution is to improve the structure of the existing mud and metal ovens used for drying so that smoke is channelled out to the side, rather than rising up through the drying cardamon pods. The structural improvements also mean that heat circulates more efficiently inside the oven, and less fuelwood is needed to dry the cardamon. B etter heat control also reduces the time needed for drying the large cardamon from 24 hours to about 10–12 hours, and reduces the amount of fuelwood needed for the process.[9]

Although the most environmentally friendly long-term solution would be a solar dryer,[10] this solution is relatively simple and low-cost to implement, and will reduce the amount of fuelwood needed[11] and decrease exposure to smoke inhalation. Solar dryers still need to be adapted to cope with large amounts of produce in a short period of time, such as the cardamom harvest, but are suitable for other products.
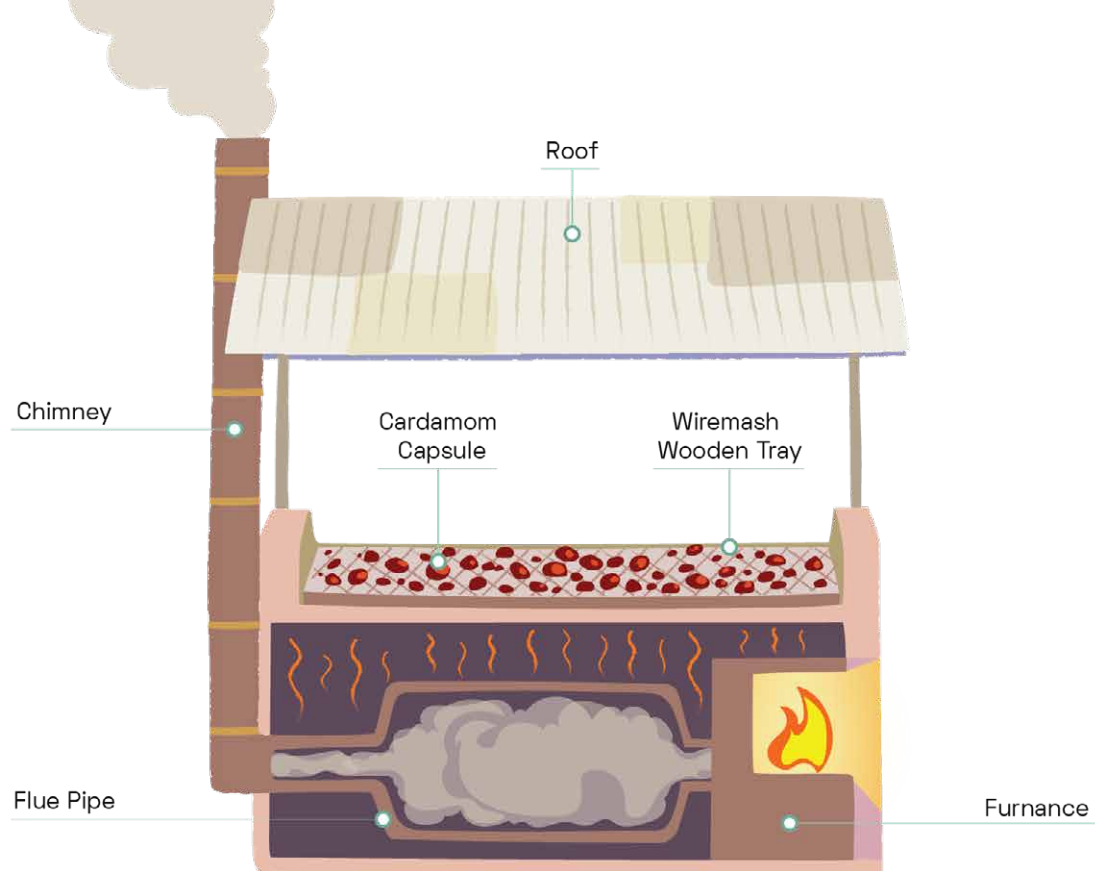
Figure 18. Illustration of an improved bhatti with smoke channelled above the roof.

Improved bhatti channelling smoke into a chimney, with better fuelwood efficiency and a drying time of about 10–12 hours in Sikkim, India.

Challenges and risks

The improved drying oven, which is more energy efficient, is only a relevant solution for cardamom production at this stage. This is a challenge because there are other products that need drying, but require other types of ovens.

Farmers only have a few incentives to improve energy efficiency and convert to other renewable sources. The Alternative Energy Promotion Centre in Nepal offers financial support and capacity development to encourage conversion to wind, hydro, solar and biofuel energies. Local governments can also provide some funding for such initiatives. Although renewable energy use is increasing throughout the HKH region, further action is needed to deploy renewable energy sources to specific products and value chains. As with most new technologies, there can be social reluctance to moving away from traditional methods. Barriers, such as expensive initial investment for cardamom solar dryers, prevent some farmers from adopting the

technology. Although other farmers can afford it, the economic disparity between farmers who can and farmers who cannot increases. Solar dryers require maintenance, and while they are a worthwhile initial investment, after time they may require repair and replacement, leading to further costs.[12]

A further challenge is the increased value of cardamom produced in the more efficient ovens. Non smoky cardamom is more valuable in the European market, which can lead to an increase in the market value and increased revenue for the farmers of Nepal.[13] However, in order to sell such cardamom in the European market, new business connections would likely need to be established. While the smoky flavour is preferred in Pakistan and Bhutan, which make up the historical market, farmers need to be supported in the shift of value chain. This is especially true for Nepal, which is the biggest producer of large cardamom in the world, with a 68 per cent share of the global market.

Recommendations and scaling opportunities

Out-scaling of drying solutions, such as the improved bhatti, is beneficial for areas where traditional bhattis are already in use and overextraction of wood for fuel is an issue. This solution is especially relevant for those regions where the harvesting season is not feasible for solar dryers. The improved bhatti is safer to use and can have a positive impact on farmer health. While the specific solution of the improved dryer is connected to cardamom production, it could also benefit other value chain products that require a similar process. For example, fruits and vegetables are usually produced in surplus in the summer harvest season, resulting in lower selling prices. Drying the

surplus extends the life of the produce by up to one year, making it possible to sell those products when the demand and market price are higher. The feasibility of a solar dryer should always be assessed for drying purposes, as it uses renewable energy from the sun to efficiently and hygienically dry food at temperatures below 70 degrees Celsius with little capital investment. Also, while the initiative is primarily aimed at local value chain production, up-scaling could be beneficial for increasing subsidies and other policies and financial mechanisms that support renewable energy systems, such as the Alternative Energy Promotion Centre in Nepal.

Summary

1. Overextraction of firewood is degrading the environment in the mountain regions.

2. Energy-efficient technologies, such as improved drying ovens (bhattis) or solar dryers can help develop value chain products and reduce negative impacts on the environment and farmer health.

3. Women benefit from diversifying energy sources and more energy-efficient technologies through reduced smoke exposure and less burden to collect fuelwood.
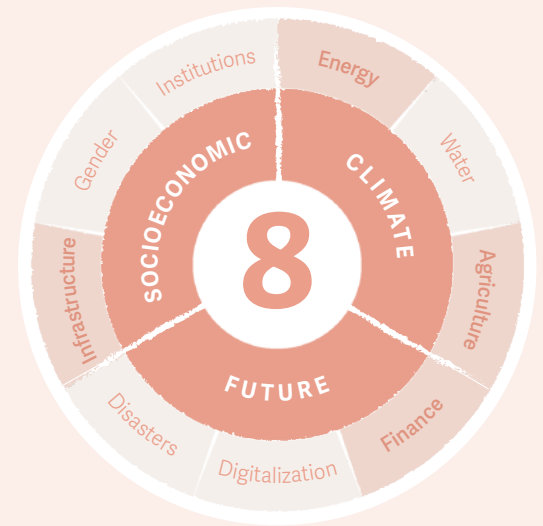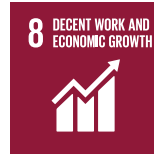
Solution #9

Digital services for disaster preparedness

In the Hindu Kush Himalayan (HKH) region, the warmer temperatures and precipitation irregularities associated with climate change have increased the risk of forest fires – a trend that is predicted to worsen.[1] Remote sensing technology can help identify the fires and provide a tool for better preparedness and the planning of prevention measures.[2]

Introduction

While forest fires are a natural part of many ecosystems and play an important role in forest regeneration, they can also pose a severe threat to human life, flora and fauna, and cause damage to infrastructure. Warmer temperatures are increasing the risk of forest fires, but natural causes cannot account for all. Humans also start forest fires involuntarily, in the case of cigarette butts thrown by the roadside or during agricultural practices to clear new areas for cultivation.[3]

In mountainous areas such as in Nepal, the topography and infrastructure make it difficult to access and suppress forest fires that spread quickly due to the sloping terrain. This is true for other countries in the HKH region and for many mountainous regions around the world. However, satellite data provide a powerful tool to monitor fires and assess landscapes to improve preparedness. This type of data can also be used in warning systems to alert citizens at an early stage of a fire, which can reduce the risk to human lives.

Recently, disaster preparedness applications that use remote sensing technology to obtain valuable and practical information for planning have been developed for various disaster risks, one of which is a forest fire detection and monitoring system set up in Nepal.[4]

Land preparation for shifting cultivation in Mizoram, India.
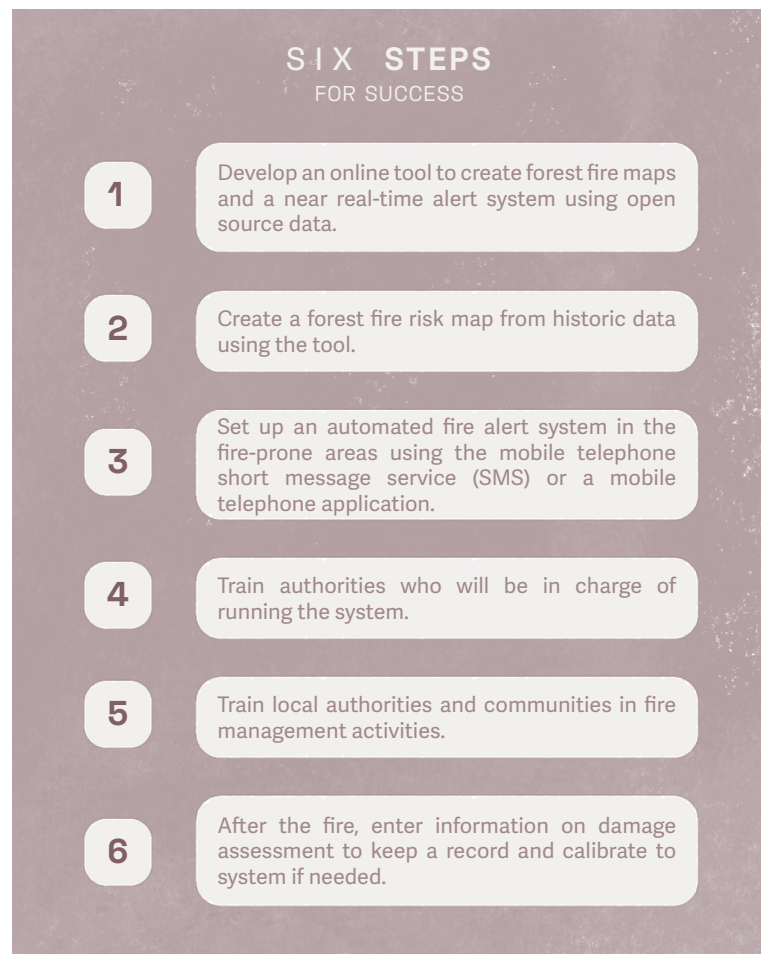
Photo by Bhaskar Singh Karky/ICIMOD

The solution

The solution is an online application using remote sensing data in combination with training and awareness-raising, which can be modified for different locations at a relatively low cost and requires very little maintenance once set up. The focus of this application is on increasing community preparedness for forest fire risks by providing forest fire maps created from satellite images to plan fire prevention and management at the local level. To achieve this, the national and Local level decision makers should be involved from the very beginning to engage ground forces. Collaboration commitment from authorities at different levels is required for success. Training the end users to use the online application is a crucial part of the solution.

At first, the system user, for example a geographic information system (GIS) expert, will create a forest fire risk map using various free online data sets, including MODIS satellite data, looking at temperature anomalies and visible smoke. This can be done through free GIS applications using already existing open-source codes developed for Nepal but applicable to other locations.[5] The risk map is essential for fire management and can be used as a tool by the authorities to engage communities and reduce the risk of major fire outbreaks and their consequences through preparation and planning.

For example, in Nepal, where many forests are managed by communities, the Federation of Community Forest Users is a part of the forest fire detection and monitoring system and works closely with village authorities to strengthen capacity and advise when defining fire-prone areas. These areas are defined by looking at different variables, such as topography and the amount of available dry biomass.

An online, interactive version of the forest fire risk map shows the current ongoing fires in the country. This interactive map is linked to remote sensing technology, which provides data from satellites three times every 24 hours. Surface temperature anomalies are registered and

SIX STEPS
FOR SUCCESS

1 Develop an online tool to create forest fire maps and a near real-time alert system using open source data.

2 Create a forest fire risk map from historic data using the tool.

3 Set up an automated fire alert system in the fire-prone areas using the mobile telephone short message service (SMS) or a mobile telephone application.

4 Train authorities who will be in charge of running the system.

5 Train local authorities and communities in fire management activities.

6 After the fire, enter information on damage assessment to keep a record and calibrate to system if needed.

Figure 19. Tips for successfully setting up a forest fire detection and monitoring system.

where such anomalies occur, the system looks for smoke in the same area. These two variables are then used to give an estimate of the likelihood, and a confidence level, of a fire at a given location. An alert (SMS and email) containing the longitude, latitude, time of fire occurrence and confidence level is sent to relevant forest officers and village administrators in the area where the fire is occurring. Generally, alerts with more than 75 per cent confidence level are considered to be accurate and are acted upon. The authorities report whether there is a fire or not at the location, then act according to the appropriate protocol. Users can also manually register fires in the system if the satellites have not done so.

"*The tool helps us determine, to some extent, forest fire burned area and frequencies of forest fire incidences. It is difficult to assess the conditioned changes in short time periods (since 2020). Over the last couple of years, we have had forest fires in high mountain areas of the province during spring season due to prolonged dry periods. Besides that, in southern plain areas, forest fire surface increased twofold. If a dry period is prolonged, then more forest fires occur. Nowadays, forest fire frequency is increasing due to longer drought.*

– Rabindra Maharjan, Acting Sunsuari Province Forest Director

After a fire, a damage assessment form is completed. The form records the human, natural and infrastructural damage caused by the fire. The fire prediction model is also evaluated annually, and the fire risk is recalculated every year based on the actual forest fire occurrence data. Data from the previous year is manually entered into the system so that the computer's algorithm can create a better prediction model. This can, for example, analyse the accumulation of dry biomass. This creates a new risk map which is distributed to the relevant authorities in preparation for the coming fire season.

Forest fire risk assessment training held in Kathmandu, Nepal, with future end users from the Department of Forestry of the Government of Nepal.

Prevention actions

There are many preventive actions to mitigate forest fire risks and increase preparedness in high-risk areas. For example, constructing and maintaining permanent firebreaks, which are paths in the vegetation cleaned of burnable material (such as dry wood and leaves) that can help slow down or stop the fire from spreading. Clearing leaf litter and vegetation along the roads can reduce the likelihood of ignition from the roadside and further spreading of fire. Since many of the fires are exacerbated by agricultural practices, raising awareness in the local community about fire-safe agricultural practices, as well as about improved and controlled agricultural fire management (such as proper clearing of undergrowth that can rapidly spread fire) can be a powerful mitigation tool in preventing anthropogenic forest fire.[6] If a forest fire occurs, the use of firefighting equipment and maintenance of firebreaks should be used to limit the damaged area.

Community meetings to inform about safe agricultural practices and how to reduce the risk of fires.
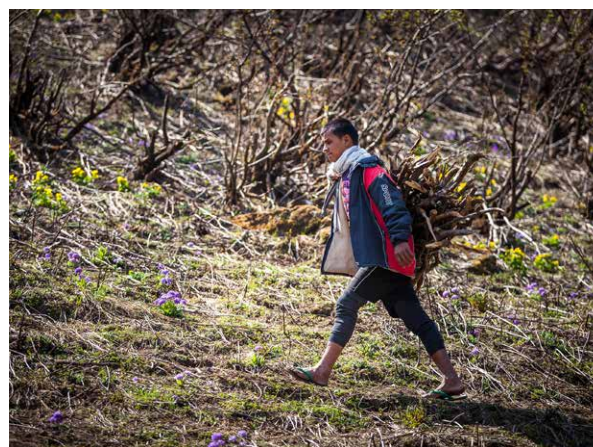
Photo by Surendra Raj Joshi/ICIMOD

Collecting firewood in Nepal helps by clearing the ground of burnable material.
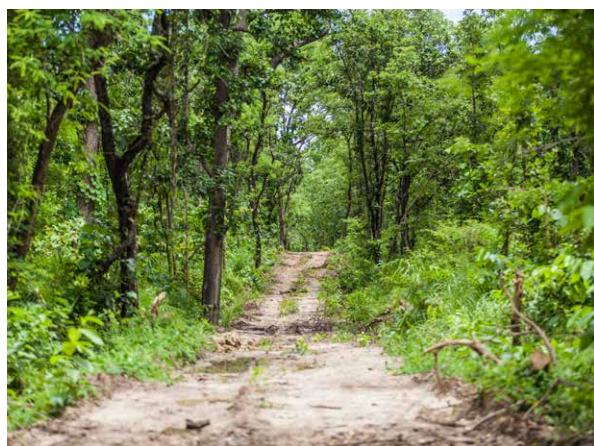
Photo by Jitendra Raj Bajracharya/ICIMOD

Firebreaks in the forest of Chitwan, Nepal.

Photo by Jitendra Raj Bajracharya/ICIMOD

Firewood vendor at Lahan, Saptari Nepal.

Photo by Jitendra Raj Bajracharya/ICIMOD

Challenges and risks

The forest fire detection and monitoring system, which is based on satellite images, can be affected by cloud cover masking the heat signal from fires. Cloud cover leads to temperature anomalies being missed, and smoke is not visible so there is little data to feed into the application and the resulting maps lack useful information.

The system uses free, open access satellite images. However, new system users require significant training before being able to report to the platform, which requires time. On the other hand, this helps build IT capacity among the users.

Another concern is that not everyone will be able to receive information from the warning system because the technology is subject to reliable power supply, mobile network coverage and good interpretation by users. However, SMS and text messaging has proven to have a large outreach in other warning systems, such as flood warnings in West Africa, as well as social messaging groups (e.g. WhatsApp). In addition, hard copies of the fire risk maps should be shared with communities without access to those technologies.

Recommendations and scaling opportunities

Up-scaling the solution to a new area requires technical skills and some start-up investment to cover the initial cost of computers, setting up an SMS system and training the people involved. However, the costs of maintaining and using the application are relatively low. One can use a simple laptop to prepare the fire risk maps with a GIS application.

Similar remote sensing technology that uses satellite imagery has been used to model and analyse forest fire risk in Iran,[7] Spain[8] and Brazil,[9] among other places. This type of system that uses satellite imagery can be used anywhere, as long as there is available funding. The initial investment is required to develop the system for a new location. Up-scaling might even produce better solutions with increased data provided by local authorities.

In Nepal, there has been a steady transition towards the government taking more responsibility for the system, with support from the ICIMOD. The aim is to implement the system in neighbouring regions and countries throughout the HKH. The updated Forest Fire Alert System is already being out scaled to Bhutan and Myanmar, where the ICIMOD has begun training relevant stakeholders on how to use GIS tools for forest fire management. The process, however, will take several years before it is fully operational and handed over to the national authorities.

Summary

1. Climate change induced forest fire risks are increasing in the HKH.

2. Remote sensing data can help monitor the fires, identify risk zones and improve fire preparedness.

3. The forest fire detection and monitoring system uses satellite imagery to map forest fires and alert the relevant authorities in order to minimize loss and damage.

4. The forest fire detection and monitoring system solution can be implemented anywhere, but is particularly suited to mountain areas due to their topography and the difficulty of access.

5. The solution increases climate change adaptation and helps protect local biodiversity, human lives and food crops from the destruction of fires.

6. The solution helps build the capacity of public institutions to prevent and suppress fires.[10]

8 DECENT WORK AND ECONOMIC GROWTH

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
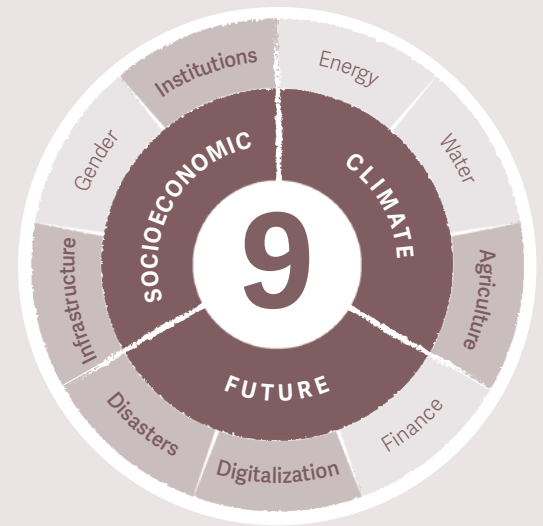
Solution #10

Digital services for resilient agriculture

Remote areas in the Hindu Kush Himalayan (HKH) region often lack access to markets and service providers, such as agriculture advisory services. These services can benefit farmers and farmer groups, keeping them up to date with important information, such as new technologies or market trends. This solution will make these services accessible through an online application (app), training provision and the development of facilities to support the community.

Introduction

Complex topography and lack of infrastructure can be limiting factors, hindering farming communities from accessing relevant and timely information, such as weather forecasts or information about seeds, pests, fertilizers and market prices. Therefore, digital services that use satellites and information communication technologies (ICT) offer novel opportunities to support farmers to increase food and nutrition security, as well as take advantage of economic opportunities.

Access to market information is vital to farmers so that they can correctly price their products and capitalize on market fluctuations. Having market information empowers farmers to negotiate a better price for their products from intermediaries in the agricultural supply chain. Agricultural producers in remote mountain regions are often unaware of market prices and rely on information from traders and agents to determine whether, when, where or for how much to sell their crops.[1] Delays in obtaining this data or misinterpretation of second-hand pricing information has serious consequences for agricultural producers, who may end up underselling the value of their products or delivering too little or too much product.[2]

There are various freely available data sources and mobile services that can, and already do, take advantage of the increasing number of mobile phones to spread relevant information. In Kavre district in Nepal, for example, the mobile telephone short message service (SMS) has been used since 2014 to send information on weather forecasts, market prices and other agricultural advice to 200 lead farmers. It was estimated that those lead

Photo by Jitendra Raj Bajracharya/ICIMOD

Farmers in in Kavre, Nepal, spread organic fertilizers in their field, based on the guidance from the digital app.

farmers later shared the information with around four to seven neighbouring farmers, ensuring a wider reach for the service.[3]

By exploiting the opportunities arising from increased smartphone ownership, even in rural areas, the SMS solution has undergone a dynamic evolution towards a system including increased agricultural services that support commercial and smallholder farmers at all stages of the crop value chain. Different apps or platforms should be connected and allow information-sharing from a specific individual or group of farmers to the community for optimum adaptation to the changing environmental conditions.

The solution

The solution is "one-stop-shop" apps for smartphone users based on free data about vital agricultural and market information. These apps will be developed and targeted at smallholder farmers in specific remote mountain areas.

The solution can provide farmers with information throughout all the agricultural stages. Depending on the location, farmers should be provided access to suggestions of the best-adapted crops to grow in their particular area. Information such as the water needs, the growing cycle and retail prices should be integrated into the app, which needs to have an offline mode that allows increased flexibility for farmers without a reliable Internet connection.

The following factors should be assessed to best implement this solution:
- the number of farmers in the community
- the availability of mobile network and Internet connectivity in the specific area
- the preparedness of the local administration and bureaucratic institutions for developing the technology and ensuring long-term support.

The use of this kind of app has enhanced farmers' decision-making capacity to plan harvesting and other farming activities; made it easier for farmers to receive the correct price for their produce by

FIVE STEPS FOR SUCCESS

1. Set up an institutional collaboration with existing farmers' groups to maintain social structure.

2. Harvest data on weather, crops statistics, crop calendars, market prices and farming practices.

3. Develop a digital platform where the data will be accessible online and offline.

4. Create community-based facilities serving as support and a sharing hub for farmers.

5. Keep the digital platform up to date and engage more farmers and local administrative actors.

Figure 20. Tips for successfully setting up a digital service for farmers.

providing market information; and has helped farmers adapt to climate change by providing relevant technical information that encourages more resilient practices.[4]

> " *I have been using this app for more than a year. In my community, not all of us have an Internet connection and so several women farmers come to me to ask about an issue they might have. If the information is not in the app, we can post a question and we get an answer back. One time, I was at Bhakunde market to sell my cauliflower. A trader offered me 20 Nepalese rupee per kg, but I showed him the app with the real market price, then I sold it for 50 Nepalese rupee per kg. I would encourage all other women farmers to use the app. It is useful and easy to use!*
>
> – Ashmita Adhikari, Namobuddha Municipality, Khawa in Kavre, Nepal

The digital services solution appears to have particular benefits for rural women, as they find it easier to work with a more neutral third party through the app. Men moving away from rural areas has resulted in increased responsibilities for women in the agricultural sector. The advisers for agriculture and market information are mostly men, whom women are reluctant to interact with due to traditional roles and societal norms.

When creating a digital platform, it is important to include various academic information and functional tools, which are very beneficial to users of the app. The development of apps needs an initial cost to cover expenses such as co-design, development, content curation, application hosting, expert consultation and other operation costs.

Photo by Jitendra Raj Bajracharya/ICIMOD

Ashmita showing her tomatoes growing in the garden, following the GeoKrishi Farm app on her mobile phone located in her pocket.

Case Study

In collaboration with GeoKrishi, Pathway Technologies and Services Pvt. Ltd., and in coordination with the implementing partner the Center for Environmental and Agricultural Policy Research, Extension and Development (CEAPRED), The International Centre for Integrated Mountain Development's Resilient Mountain Solutions initiative has developed four apps that provide location specific agriculture advice and other tailored information to end users in Nepal:

1. Geokrishi Farm
A mobile app to provide access to timely and context-specific advice for individual farmers.

2. Geokrishi Ext
An app and web system for extension service providers to streamline communication and knowledge exchange, track farmer progress and build loyalty.

3. Geokrishi Enterprise
A customizable web platform for operational and strategic decision-making, tracking and monitoring collective progress, assessing yield and risks, forecasting productions, optimizing aid disbursement, identifying potential markets, and activating collective buying and selling.

4. Samuhik Bazar
A business-to-business dynamic marketplace platform that promotes product collection and efficient supply chain operation.

These applications are interconnected to enable information-sharing between users. In addition, a dedicated call centre, incubation centres and other types of information hubs with trained staff have been established to support the end users. (Source and more information: http://geokrishi.farm/solution)

GeoKrishi Farm App interface in Nepali. Main menu featuring different crop selections, market value of those crops, weather forecast and interactive platform to share photos or comments.

GeoKrishi has been downloaded more than 5,000 times from the Google Play Store and has a current user rating of 4.6 out of 5. There are more than 8,000 registered users, around half of whom use the app regularly. A recent study shows that 79 per cent of all users are satisfied with the app, while a few feel that it is a little complicated for the user.

Challenges and risks

Since these digital solutions go beyond the purely technical development of the apps, strong local connections are important to ensure their sustainability. It is therefore important to work closely with local implementing partners to ensure that the information provided through the app is useful and relevant and that households can understand and act on the information they receive. This will require continuous monitoring and commitment from the partners.

Fundamental steps to ensure the longevity of this solution include establishing collaboration with local administrative actors and farmer groups, building capacity in key individuals and confirming continuous support to the end users of the digital services. The farmers need continuous support for decision-making, organized via call centres, incubation centres and community facility centres.

Such centres require Internet connectivity and trained individuals who can guide the local farmers and maintain effective communication between the service providers and farmers. It is important that the local authorities or knowledge centres are involved from the beginning and are committed to engage with the service in the long term. This often requires commitment at the governmental level.

Lack of Internet coverage is a particular bottleneck to the full use of the app in remote areas. While several of the app's functions should work in offline mode, the initial set-up and certain functions still require Internet access. Also, while smartphone ownership is increasing, the most disadvantaged may not have access to the app if they do not have a smartphone or Internet access. Coverage has to be assessed before developing this solution in a certain area.

Recommendations and scaling opportunities

For further out-scaling of the app, it is possible to adapt the language, agricultural information and system to another country or region as the platforms are highly dynamic and flexible. Similar solutions have been in use around the world for some time: in Uganda, digital services have helped farmers increase their production by 10 per cent, while in Niger they have increased farmers' profits by 29 per cent and reduced market price dispersion by 10 per cent.[5]

Summary

1. Remote communities in the HKH region lack access to vital market information and agricultural advisory services.

2. This digital solution uses satellite and ICT to overcome specific rural and mountain challenges.

3. The solution radically strengthens the capacity of farmers' advisory services when physical visits are difficult to manage – such as during the Covid-19 pandemic and particularly in rural locations – meaning that farmers still have access to information.

4. A digital transformation increases access to agricultural advisory services for rural women.

5. Digitalization enhances the link between remote farmers and the market.

6. Extreme weather conditions are expected with climate change, so SMS and farming apps can help farmers prepare against drought, wind and rainfall, and harvest their produce accordingly.

7. The connectivity of farmers is increasing; therefore, the user pool will grow, with even more information being shared.

8. The solution not only helps farmers share relevant information on prices but also helps them promote their products and find buyers.
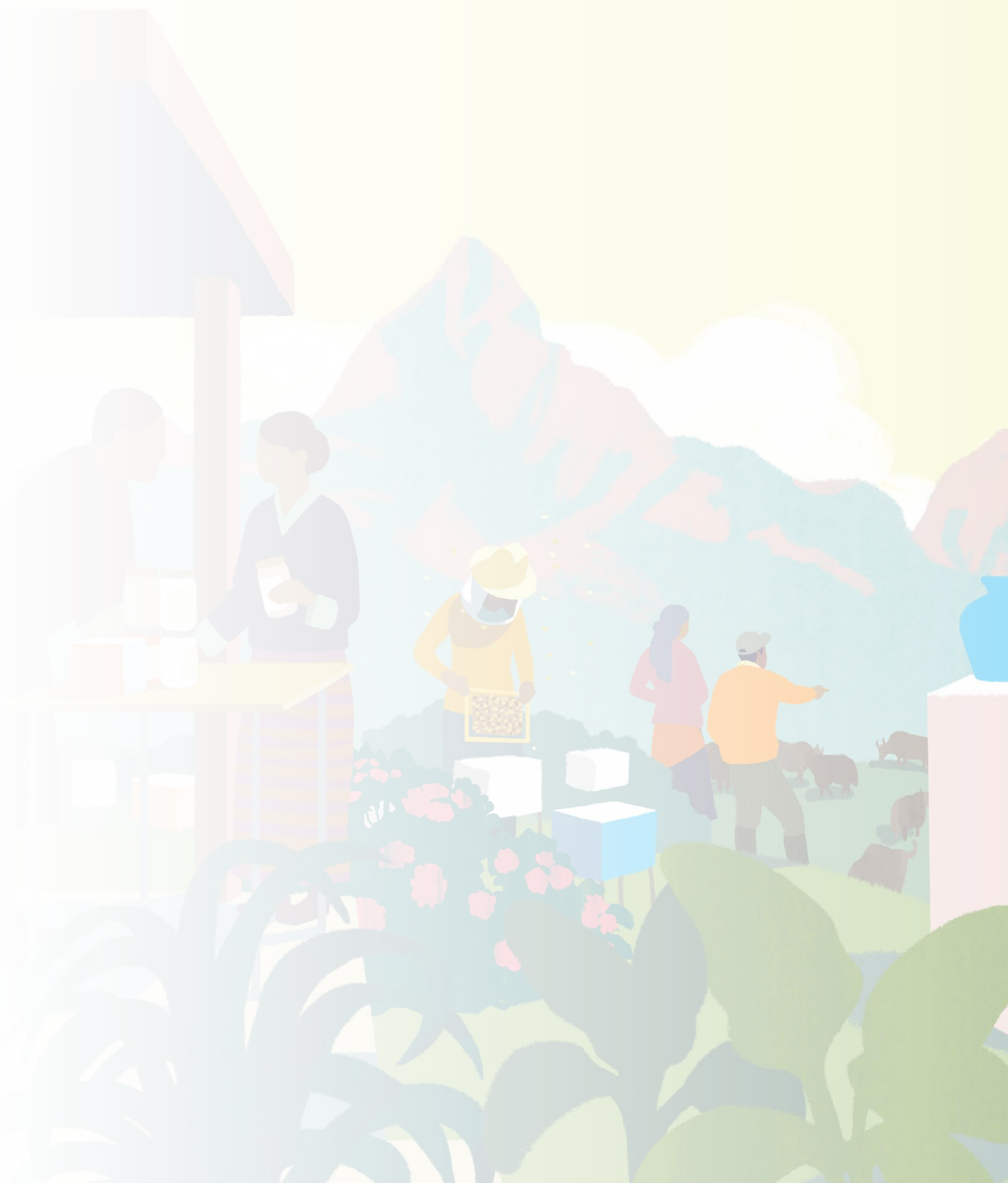
Chapter 3

Women at the centre

The solutions in this book acknowledge that empowering women and other marginalized groups is vital to achieving the goal of building resilient mountain communities in the face of climate change. Such empowerment needs long-term commitment to societal transformative change that addresses the drivers of marginalization. The solutions create meaningful impact when the root causes of marginalization are considered and when they are adopted by all parties at different levels, from the local population and stakeholders to regional and national decision-making bodies.

Women carrying allo in Kavre, Nepal.

Introduction

While nobody can escape the impacts of climate change, certain social groups experience greater loss of resources and greater impacts to their livelihoods and cultural identity than others.[1] Mountain women across different socioeconomic categories are disproportionately affected because of structural inequalities in the distribution of rights, assets, resources, and power such as access to education, information, technology, decision-making processes and property rights.[2]

Mountains and rural regions of the Hindu Kush Himalaya (HKH) face outmigration of the younger generations, who move to urban areas for new opportunities.[3] The changing climate is likely to exacerbate this trend. For example, in China, India, Nepal and Pakistan, it is more likely that at least one household member will migrate in search of work from places affected by slow or rapid onset water hazards.[4] Moreover, the gender balance in communities is not maintained, since it is mainly young, educated men who leave the household to find work.[5]

The feminization of agriculture due to outmigration does not necessarily lead to the empowerment of women, as they often remain politically marginalized at the local level.[6] Even if outmigration has the potential to bring new opportunities to mountain communities (through investments with the help of remittances in greenhouses, sprinklers and drip irrigation used to improve agricultural water management[7]), it also creates labour shortages and increases the already heavy agricultural workload of mountain women by pushing them to take on new responsibilities in addition to their traditional roles.[8] Gender-based cultural constraints often prevent women participating in decision-making and taking up roles in management committees, policy development and governance. To be able to assume these roles, women need opportunities and space to build their capacity, but also strong support from institutions and stakeholders across all sectors, including agriculture, business management, technology and innovation.[9] This is where the solutions play an important role.

The solutions work towards a gender-transformative approach,[10] which understands the differential needs of men and women and considers the drivers that lead to the marginalization of women. These drivers vary according to their race, ethnicity, caste and ability.[11] The gender-transformative approach works simultaneously at many levels, acknowledging that a change at the individual level is only sustainable with positive change at the household, community and national levels, including national policymaking.[12]

Assessing and addressing vulnerabilities

When introducing solutions to new areas, the work should always start by assessing multiple dimensions of vulnerabilities, including gender analysis, to understand the relationship between the genders, their access to resources, power distribution and other constraints they face relative to each other at the local level.[13] The reasons for vulnerability are often largely social and economic,[14] and are exacerbated by the different exposures to climate change. It is important to gain understanding of the social, economic and environmental processes and practices that contribute to uneven distribution of vulnerability at the location,[15] working closely with women and marginalized groups.

Members of the Common Facilitation Centre in Godhani, Darchula, interacting and making allo fiber.

Resilient Mountain Solutions

Gender across the 10 resilient mountain solutions

The 10 solutions presented in this publication have shown improvements in livelihoods, as well as empowerment and demarginalization of women. A combination of solutions can be used to increase gender equality, inclusivity and the resilience of mountain communities. Based on the experiences with the 10 solutions, figure 21 shows which gender approach is included in each solution.

a. Gender strategy and action plan

A gender strategy and action plan should be developed, based on the vulnerability assessment, to address inequalities. These plans should be developed together with the local women to respond to the areas of inequality identified, often related to access to resources, governance, cultural factors and the distribution of knowledge.[16] Through the gender strategy and action plan for Naugad municipality in Solution 1: Building women's skills as entrepreneurs, 75 women were selected among those with lowest household income and from marginalized communities. They benefited along different nodes of the value chain, from production to market development and they are now running a community business centre on their own.
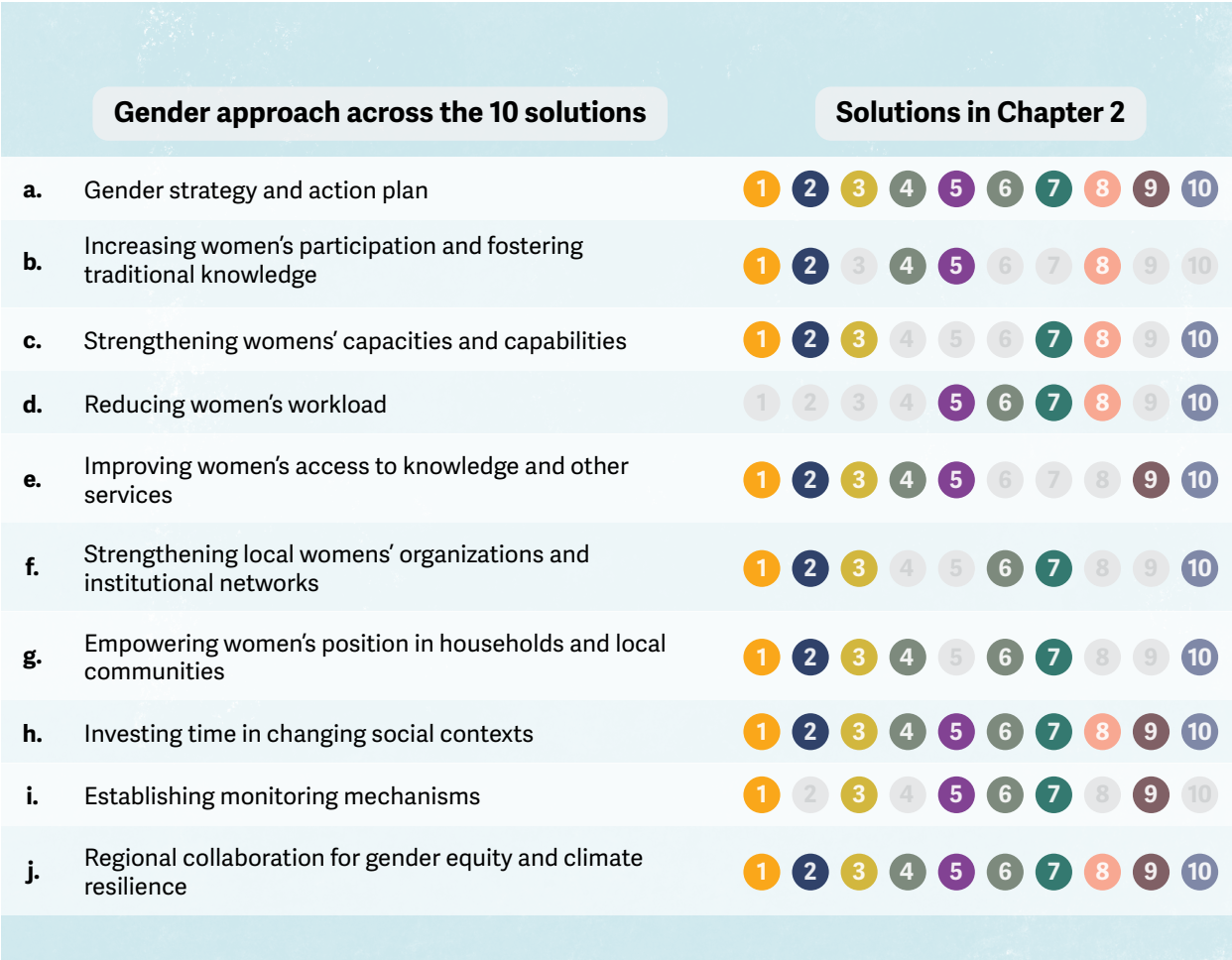
Gender approach across the 10 solutions	Solutions in Chapter 2 (1–10; ● = included)
a. Gender strategy and action plan	1 ● 2 ● 3 ● 4 ● 5 ● 6 ● 7 ● 8 ● 9 ● 10 ●
b. Increasing women's participation and fostering traditional knowledge	1 ● 2 ● 3 ○ 4 ● 5 ● 6 ○ 7 ○ 8 ● 9 ○ 10 ○
c. Strengthening womens' capacities and capabilities	1 ● 2 ● 3 ● 4 ○ 5 ○ 6 ○ 7 ● 8 ● 9 ○ 10 ●
d. Reducing women's workload	1 ○ 2 ○ 3 ○ 4 ○ 5 ● 6 ● 7 ● 8 ● 9 ○ 10 ●
e. Improving women's access to knowledge and other services	1 ● 2 ● 3 ● 4 ● 5 ● 6 ○ 7 ○ 8 ○ 9 ● 10 ●
f. Strengthening local womens' organizations and institutional networks	1 ● 2 ● 3 ● 4 ○ 5 ○ 6 ● 7 ● 8 ○ 9 ○ 10 ●
g. Empowering women's position in households and local communities	1 ● 2 ● 3 ● 4 ● 5 ○ 6 ● 7 ● 8 ○ 9 ○ 10 ●
h. Investing time in changing social contexts	1 ● 2 ● 3 ● 4 ● 5 ● 6 ● 7 ● 8 ● 9 ● 10 ●
i. Establishing monitoring mechanisms	1 ● 2 ○ 3 ● 4 ○ 5 ● 6 ● 7 ● 8 ○ 9 ● 10 ○
j. Regional collaboration for gender equity and climate resilience	1 ● 2 ● 3 ● 4 ● 5 ● 6 ● 7 ● 8 ● 9 ● 10 ●

Figure 21. Examples of how gender is considered in the solutions presented in this book.

b. Increasing women's participation and fostering traditional knowledge

Programmes, training and other activities should aim for an equal (or more) percentage of participants to be women. For example, the start-up centre introduced under Solution 2: Promoting green and resilient entrepreneurship, prioritizes young women entrepreneurs due to their historic and institutional exclusion from the business sector in the HKH region. Supporting women's traditional skills, such as weaving allo, is important. In Solution 1: Building women's skills as entrepreneurs, a focus was given to forming a women's group to build their capacity and to establish a community enterprise owned and run by women, and to redirect skills for new nature-based markets.

c. Strengthening women's capacities and capabilities

Building women's capacities and capabilities in financial literacy, using digital tools and technologies, and accessing new markets empowers them both economically and socially. This can be done through targeted training, exposure visits and cross-learnings. In Solution 3: Managed honeybee pollination, which traditionally involved few women, women's capacity was increased by proposing new opportunities to market value added bee products. Several women farmers were additionally awarded "best beekeeper" status for their beekeeping skills to inspire more women to come forward to expand their capabilities beyond their traditional mindsets.

d. Reducing women's workload

Several of the solutions aim at reducing women's workload by addressing labour-intensive tasks such as fetching water for the household. In Solution 5: Spring revival, the drudgery of fetching water has been reduced, with shorter travel distances allowing more time to be used for other

activities. More generally, it is essential to promote coordination and linkages between relevant institutions and sectoral agencies to develop, strengthen and distribute timesaving and women-friendly technologies for drinking water, irrigation, cooking and agroprocessing (processing of raw materials and intermediate products derived from the agricultural sector).

e. Improving women's access to knowledge and other services

Knowledge enhancement often requires an interactive process in which researchers, practitioners and local women jointly shape the availability, dissemination and use of knowledge, which increases the likelihood that the information will meaningfully contribute to adaptive responses to climate change.[17] For example, Solution 10: Digital services for resilient agriculture provides women with access to vital information about market prices, weather forecasts and an agro-advisory service, which increases their power to negotiate and make well-informed decisions.

f. Strengthening local women's organizations and institutional networks

Supporting and strengthening existing and new women's organizations and networks at the local level to ensure women's engagement enables them to influence climate change-related decisions and programmes to meet their needs and priorities. Community centres in Solution 1: Building women's skills as entrepreneurs, and start-up centres in Solution 2: Promoting green and resilient entrepreneurship, provide meeting spaces for networking, capacity-building, sharing skills and experiences, which builds a safety net. Institutional networks are also strengthened by establishing business linkages with other businesses, customers and government institutions. Creating a network of entrepreneurs makes each individual and the group more resilient to climate or market shocks.

g. Empowering women's position in households and local communities

Providing women with access to finances is an improvement that naturally strengthens their position and their decision-making power, both in the household and the local community. For example, in Solution 7: Home garden and polyhouse, women from marginalized groups attended training where they learned to increase income and productivity through managing home gardens.

h. Investing time in changing social contexts

Cultural barriers still exist for women in the mountains. For example, women may not be allowed to leave their homes to participate in training and programmes. When mountain women's mobility increases, cultural barriers start breaking down. The same happens when women's access to finance and decision-making increases. This is a transformative process that takes time and requires inclusion of the whole community. It is important to identify and support men who are gender champions and support women and women's leadership. Therefore, in order to change social contexts and mindsets, it is important to invest more time and resources in building prerequisites before interventions.

i. Establishing monitoring mechanisms

Establishing gender-sensitive and inclusive monitoring mechanisms helps adapt the solutions to local contexts to prevent further deepening of inequalities. This can be done by supporting the collection of disaggregated data and targeting women specifically. For example, in post-assessment for Solution 9: Digital services for disaster preparedness, it was found that women are more vulnerable to the impacts of forest fires, as they ensure the well-being of their family members along with themselves. This solution improves their capacity and decision-making to ensure they are better prepared for forest fires.

j. Regional collaboration for gender equity and climate resilience

Strengthening the capacity and networks of regional, national and local organizations helps improve the implementation and scaling of solutions through regional collaboration. In Solution 4: Co-management of rangelands, women's knowledge of rangeland management and their representation is recognized in Nepal; however, their access to leadership decision-making could draw inspiration from countries like China through regional collaboration. Each of the solutions presented in this book is a platform for regional collaboration and provides opportunities for out-scaling such solutions to multiple countries.

Chapter 4

The power of up-scaling and out-scaling
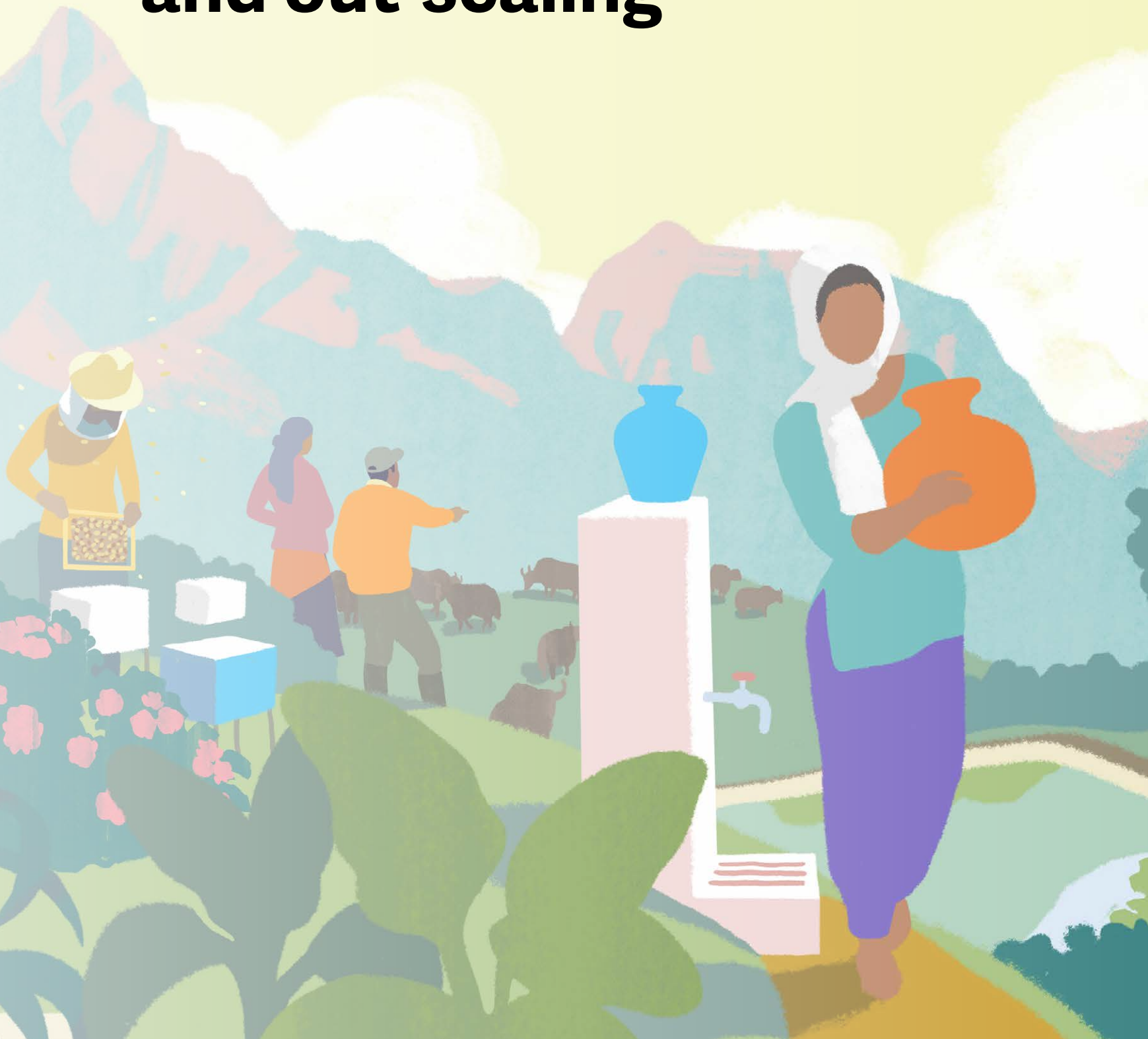
The solutions have been successfully developed in multiple sites in the Hindu Kush Himalayan (HKH) region. They are often simple, affordable and local which is likely why they have worked so well. While monitoring of the solutions is needed in these locations to troubleshoot any issues, evaluate their impact and ensure their sustainability, scaling the solutions upward (bureaucratically) and outwards (geographically) can create a greater culminative positive impact on communities and the environment and can reduce the impacts of climate change.

Before scaling, the vulnerabilities and economic viability of the solutions must be assessed to contextualise the solution for the specific location. Communities themselves must be fully included in the decision-making processes and social differentiation such as ethnicity, caste, class, gender and ableism, among others, need to be factored in to ensure that all voices count in the decision-making process.[1] To be scaled, the initial solution has to respond to the need of the community at the local level, and it should be focused and effective.

Combining several solutions usually makes the outcome more successful. For example, home gardening (Solution 5) increases water demand for crop irrigation and could be combined with simpler ways to store water (Solution 6) and/or managed bee pollination (Solution 3), to ensure that the home garden production is optimized. It is, however, important to consider the local context and challenges in order to better adapt the combination of solutions and achieve the best results.

Investment and replication of solutions in new geographical areas (out-scaling), and their integration into policies (up-scaling) are vital to support local livelihoods, prevent health issues, manage disaster risk and preserve valuable ecosystems and biodiversity and thus achieve long term and widespread resilience.[2]

Building blocks for scaling

Resources, partnerships, local context and knowledge management are the four main factors that influence the scaling process.[3] These factors should be considered for successful scaling and integration of the solutions into long-term adaptation plans to build the resilience of mountain communities, ecosystems and livelihoods. The four factors are often interlinked and influence one another. For example, a strong partnership with high-level authorities can improve the potential to secure funds and other resources for up-scaling. These factors can have both negative and positive impacts that should be taken into account when up-scaling and out-scaling mountain solutions.[4] However, they should not be seen as a prerequisite or reason to delay implementing urgent adaptation measures where necessary.

Resources
Having the correct financial, human and time resources available is crucial to scaling efforts.[5] Financing is one of the main resources – even the simpler solutions require financial investments, for example, for basic materials or training. Finance mechanisms need to be equitable, prioritizing the needs and livelihoods of the most vulnerable.[6] The national and state budgets are needed to make the solutions more sustainably embedded in national policies.

Strong institutional capacity and support from both governing bodies and other organizations is necessary for out-scaling efforts, so that other communities can benefit from the solutions. This is the case for solution 9: digital services for disaster preparedness, where the government and local authorities are taking responsibility for the system, with support from ICIMOD and working closely with the Federation of Community Forest Users.

Many solutions take years, even decades to reach their full scaling potential, so it is important that time is also considered as a resource when implementing solutions. Longer-term benefits may need a long-term approach to implement; for example, solution 5: spring revival can take years. Communities may also need financial support during any potential time lag for solutions to start delivering benefits.[7]

Partnerships

Successful scaling relies on strong partnerships.[8] This includes within and between public and private funding bodies and donors, civil society organizations such as local non-governmental organizations (NGOs), intermediate bodies such as advocacy or training organizations, and local communities.

Many of the solutions provide proven examples and new opportunities for partnerships and cooperation between various bodies that have offered potential for scaling throughout the HKH region. For example solution 2: Promoting green and resilient entrepreneurship, Bhutan's Department of Cottage and Small Industries runs a start-up centre for private sector with support from ICIMOD and other partner organizations.

The partner can become a champion – an individual or an entity without whose dedicated support, or perhaps advocacy, the solution would not succeed. But although each partner has something different to offer, working together is what makes the difference when successfully implementing and scaling a solution.

Local context

There is no one-size-fits-all approach and solutions can hit local barriers that are defined by specific local cultural contexts. What works in one area may not be replicable or provide equal benefits for all community members in another. However, to achieve equitable solutions, a thorough understanding and adaptation to the local context is imperative to scaling efforts. The local community is a key partner in driving the approach since nobody knows the local context better. Particular attention must be paid to equitable solutions and benefits when it comes to marginalized groups and women within the local community. Local social contexts differ, and needs-driven solutions should account for this and be context specific.

Solution 1: Building women's skills as entrepreneurs focuses on developing a value chain of traditional local nettle wool, which is a knowledge held by women in specific locations in Nepal. Some components of this solution have been tailored to the local context, adapted to the plants, skills and target market to sell the products. Combining the local context with any kind of solution takes a bit more effort but it is worth it in the long term.

Knowledge management

The solutions encompass a knowledge dimension for a variety of practices that are suitable for scaling, providing that the knowledge and lessons can be shared efficiently. Many local solutions institutionalize knowledge into the local communities, which can lead to successful, long-term adaptation to the challenges faced.[9] Adequate long-term monitoring of solutions identifies the gaps where appropriate adjustments can be made. Likewise, monitoring and evaluation of the pilots can inform best practices of how to adapt to future uncertainties when it comes to scaling the solutions. Monitoring from high-level authorities can aid the up-scaling efforts, while intermediate bodies and services are crucial in facilitating knowledge-sharing among stakeholders.

Information and communication technology (ICT) has a greater role to play than ever, making

knowledge accessible to even the remotest mountain communities, providing the resources for at least a basic communications network as well as giving access to market information. This also enables peer-to-peer knowledge-sharing between remote mountain communities. With suitable investment in communications infrastructure, coupled with ICT development, the scaling potential is limitless. This became very significant during the 2020/2021 COVID-19 pandemic. As travel restrictions and lockdowns came into force, remote villages became isolated, without the prospect of outside visits from service representatives such as agricultural extension services. With the ICT developed in Solution 10: Digital services for resilient agriculture, remote mountain communities could continue to receive the information they needed in an efficient manner, from market price information to weather forecasting and disaster warnings.

We need champions

The experience with the solutions has shown that successful scaling of solutions requires champions who are passionate about the cause to drive the process. Champions can be individuals or organizations working on the ground, or even policymakers or their advisers. Some of the champions who have been involved with the solutions in this book are discussed below.

Local organizations
NGOs, private sector and other types of local organizations, who know the local context, are involved in implementation. They identify the needs with the community, as well as the solutions to respond to these needs, and they play a significant role during the implementation phase of the solution.

In case of solution 1: building women's skills as entrepreneurs and solution 6: simpler ways to store water local private sector and NGO have acted as champions to implement and scale the solutions. Local organizations such as SABAH Nepal and CEPREAD have valuable experience and knowledge, which needs to be included at the early stages of up-scaling plans in order to contribute fully to the objective of increased climate resilience.

Kashi Maya Gurung, in the center of the photo, working for the Center for Environmental and Agricultural Policy Research, Extension and Development (CEPREAD) surrounded by women entrepreneurs in Nepal.

Photo by Nand Kishor Agrawal/ICIMOD

Governing bodies

Governing bodies, such as governmental departments, district line agencies or municipalities, can incorporate the solution into local, regional and national action plans with the support of individuals, ensuring it is aligned with the targets of the governmental development and adaptation policy framework.

Reviving springs and lakes in the Sikkim region in India (solution 5) was achieved over multiple years, during which the governing body the Rural Management and Development Department (RMDD), part of the Government of Sikkim, has played an essential role. In the early stages, the support of the RMDD was mostly financial, but after seeing the positive results, the Government of Sikkim decided to incorporate the solution directly into their workplan and fully support it, from finance to implementation on the ground. This was possible because the objectives of both the solution and the governing body had the same goal of restoring water security in the Sikkim region.

The start-up centre in solution 2 has been supported from the early stages by the Bhutan Department of Cottage and Small Industry, part of the Ministry of Economic Affairs. This interest from the national government builds strong foundations and emphasizes the importance of this solution for the government, enabling entrepreneurs to get help with their business ideas, from development to taking them to market, and to receive mentoring, education, network building and exposure.

A strong individual

Most often, strong individuals advance a cause by inspiring people they encounter among different stakeholders or governing bodies. Acting as champions, they ensure promotion of the solution for other locations and make sure that the solution will be adapted according to the local context. Strong individuals can be from any level: trainees, trainers, members of advocacy bodies or knowledge-sharing or governmental bodies. Relying on such individuals is not mandatory, but experience has shown that embracing and involving more people in advancing the cause increases the chances of success.

In the case of solution 5: spring revival Phool Maya Tamang, an elder from Kavre, Nepal area has advocated for the solutions to come to her own community initially not part of the plans. Her efforts has led to develop a model spring revival site near Kathmandu which is visited by many decision makers for learning and inspiration.

Conclusion

Building the resilience of mountain areas is possible and will not only benefit local communities and ecosystems, but also those located downstream. The solutions developed and implemented in the HKH have proven to be efficient. Up-scaling and out-scaling is the next step in terms of building resilience. Out-scaling solutions to a wider geographical area allows climate resilience to be increased, which in turn will contribute to mitigating the effects of climate change and their socioeconomic impact. This requires investments, time and effort. From the experience gathered over the years, some specific factors have been identified as essential to include from the very beginning to increase chances of success and achieve the long-term vision. To successfully up-scale and out-scale solutions at the national, regional and global levels, there are a number of best practices. These include; building on already existing partnerships and developing new ones with local communities and organizations, adapting to the local context including knowledge management, and managing resources better by including governing bodies. Lastly, but most importantly, identifying champions to foster momentum and positive change through engagement process initiated from the beginning of the implementation of the solution.

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Chapter 3

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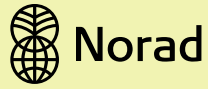9. Adapted from Gurung, D. D. and Bisht, S. "Women's empowerment at the frontline of adaptation: emerging issues, adaptive practices, and priorities in Nepal", ICIMOD Working Paper 2014/3 (Kathmandu, International Centre for Integrated Mountain Development, 2014).
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Chapter 4

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This book presents 10 efficient, cost-effective and custom-made solutions that have been tested in the Hindu Kush Himalayan (HKH) region and are suitable for up-scaling and out-scaling to other regions. Each solution can contribute to several of the United Nations Sustainable Development Goals (SDGs) and thus help ensure a better future for all. The 10 solutions showcased here are examples of a large number of diverse, nature-based solutions that provide long-term benefits to local communities, their environment and livelihoods by increasing their resilience to change.