



# How can innovative solutions help close the adaptation gap in mountain regions?

11th December 2024 – International Mountain Day

Rosie Witton, Kate Williamson, Alex Mackey, and Johanna Zwahlen



# Agenda:

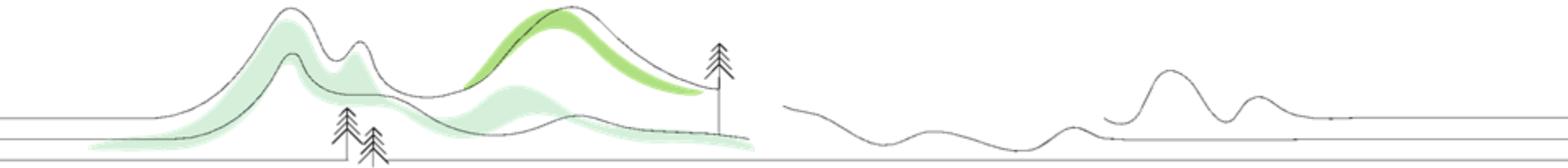
Welcome

What is innovation?

Speed talks & Q&A

- Managing forests for climate resilience in Nepal - **Dr Upama Ashish Koju**
- Analysis of the Machangara river sub-basin as an adaptive management strategy - **Verónica Quitigüña**
- Rehabilitating irrigation systems in Gajimarda, Azerbaijan – **Fuad Bagirov**

Closing and AOB

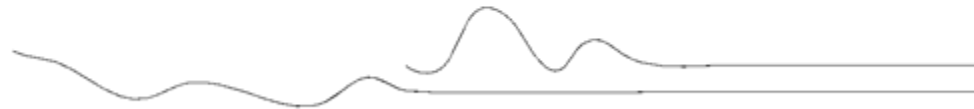
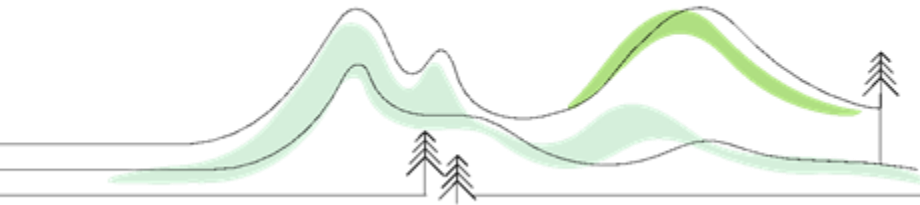


# What is innovation?

How do we define or interpret innovation?

Are there different types of innovation?

Do we need innovation in adaptation solutions?



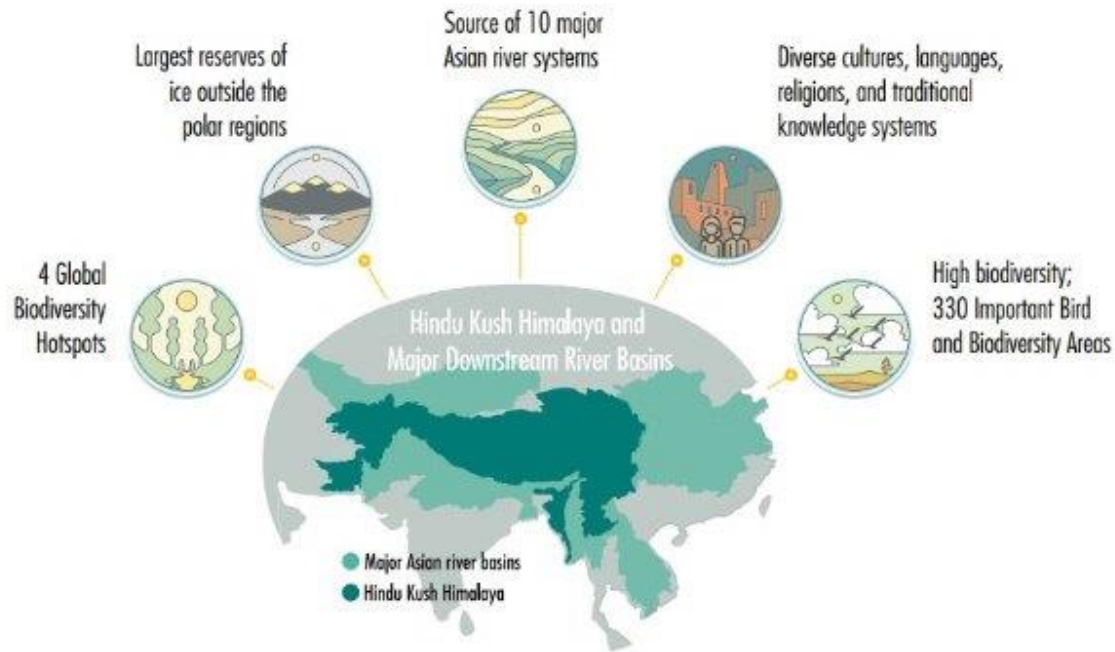
The logo for ICIMOD, consisting of the letters 'I', 'C', 'I', 'M', 'O', 'D' in a white, sans-serif font. A small, white, wavy line is positioned below the 'I' and 'M'.

# Managing forests for climate resilience in Nepal

Upama Ashish Koju

Date: 11<sup>th</sup> December 2024

# Introduction



**240 million**

people depend directly on the HKH for their lives and livelihoods

**1.9 billion**

people depend on the HKH for water, food, and energy

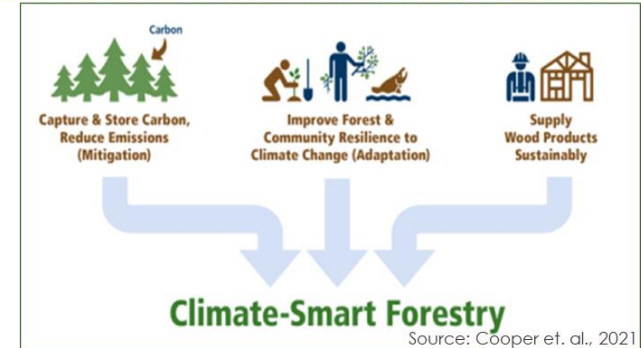
**> 35%**

of the world population benefits indirectly from HKH resources and ecosystem services

- An inter-governmental regional learning and knowledge centre mainly serving 8 HKH regional countries focusing mountain development, climate resilience and biodiversity conservation
- Mission: Foster partnership for scientific knowledge, regional cooperation and innovative solutions addressing critical environmental challenges impacting mountain ecosystem and livelihood
- Climate change growing concern due to its impact on biodiversity, livelihood and our earth system

## Background

- Rapid change and degradation: of HKH with rapid economic and social changes leading unplanned infrastructure development and forest degradation
- Climate change impact : exacerbating these issues, leading to increased vulnerability,
  - Nepal forest one of most vulnerable to climate change th 45% total area under forest
- Critical role of forest management: to mitigate climate change
- Data gap : no precise information on forest degradation, climate change impacts, hindering forest management and planning



# ICIMOD's work on Managing forest for climate resilience

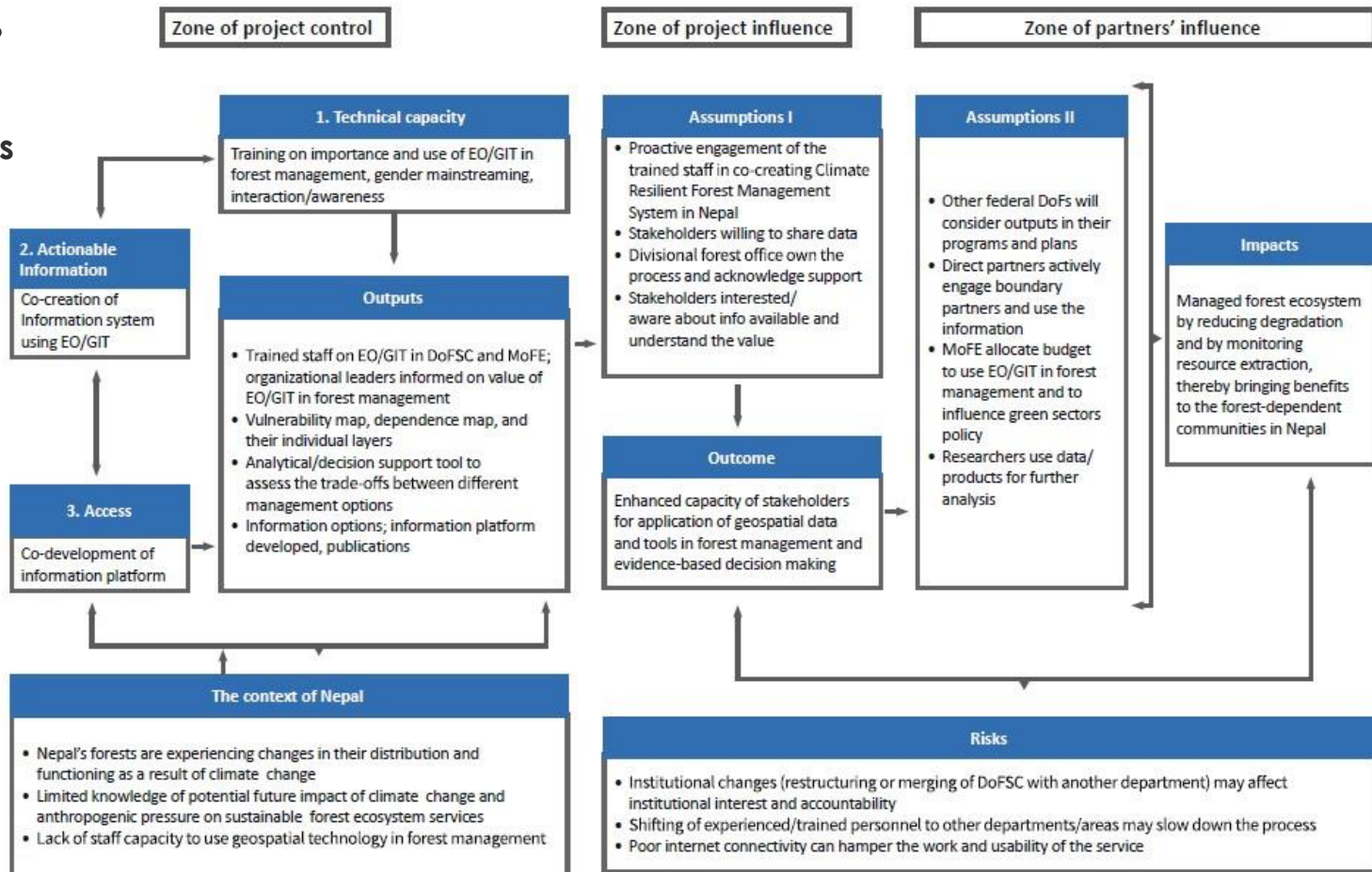
- CRFMS: The Climate resilient Forest Management System
- Developed under the SERVIR/HKH Initiative
- Link: <http://geoapps.icimod.org/CRFMS/> open access tool
- Provide user friendly access to all information of the i. Climate sensitivity, ii. Forest degradation and iii. Forest fire risk for all the 77 districts of Nepal



# CRFMS ...

## ➤ Scope and Services

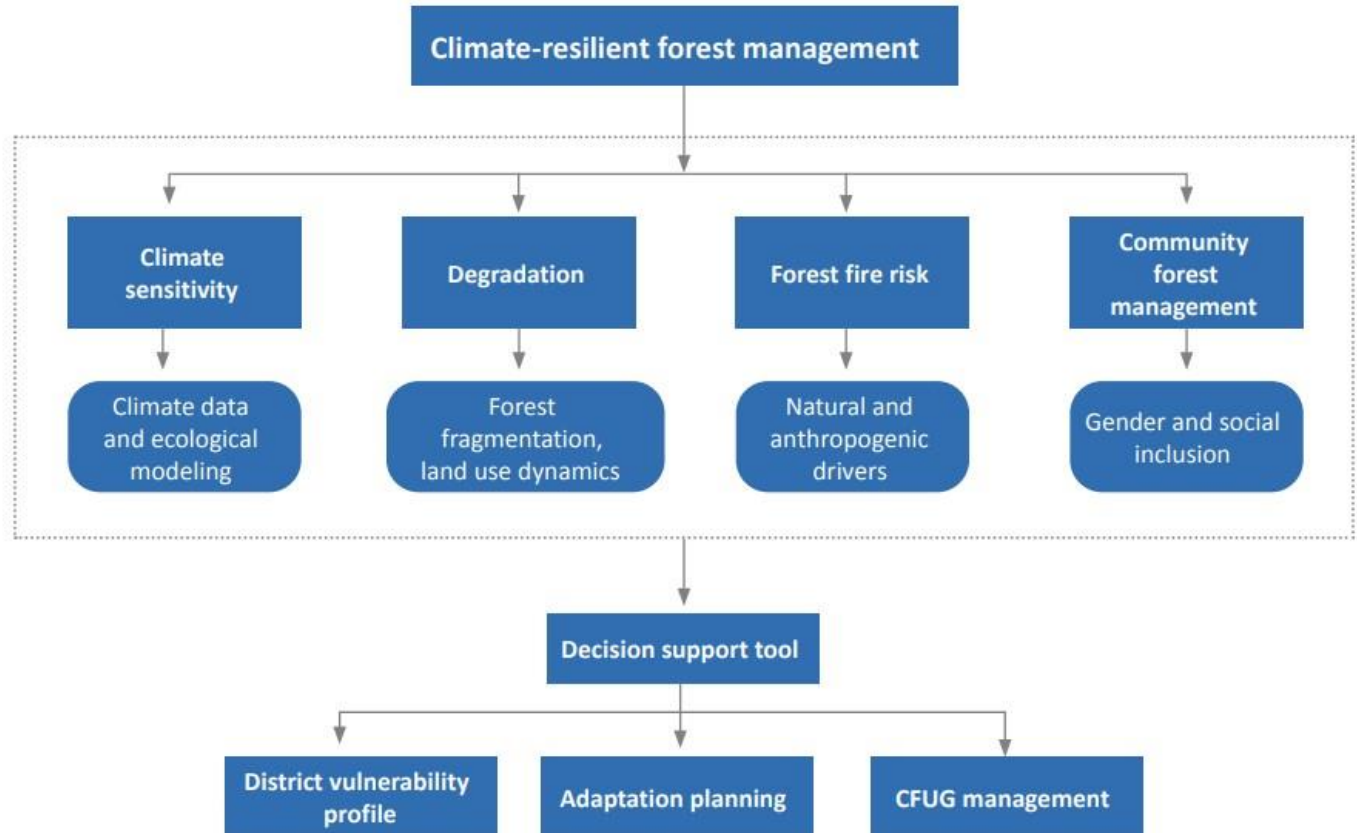
### ➤ Theory of Change





# CRFMS ...

## ➤ Framework



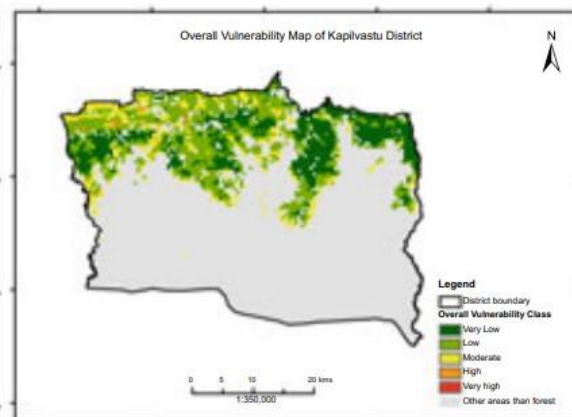
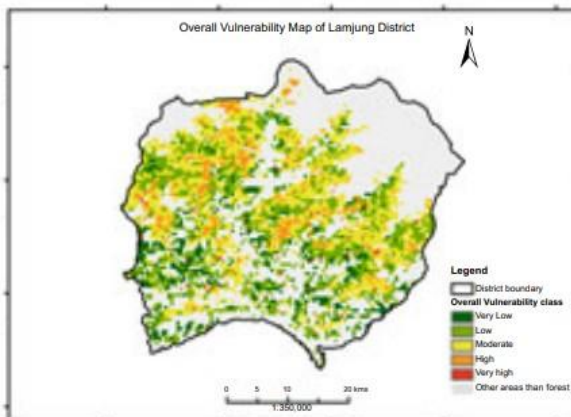
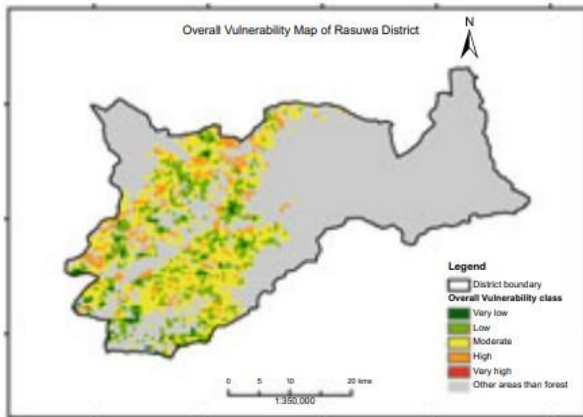
# CRFMS ...

## ➤ Portal

Government of Nepal  
Ministry of Forests and Environment  
Department of Forests and Soil Conservation

Vulnerability Compare Adaptation Tool Vulnerability profile ▾

## Climate Resilient Forest Management System

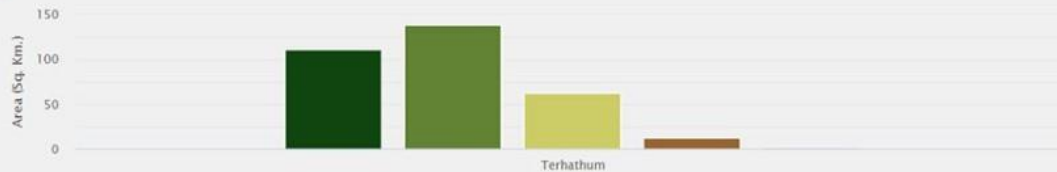


### Useful Links

- Landcover and Landuse Change and Ecosystems
- Nepal Forest Fire
- Regional Database System
- Mountain Geoportal



### Current Climate Sensitivity



### About

The web based decision support tool provides present and future climate sensitivity, forest degradation, forest vulnerability.

[View More...](#)



# Climate Adaptation Impact

- CRFMS framework follows a “Science into Use” approach planing important role enhancing forest management
- Is less data intensive, suitable for extending its operations to countries in and outside the HKH region.



**Thank you**

**Let's protect  
the pulse.**



**A@A Knowledge Network:  
How can innovative  
solutions help close the  
adaptation gap in mountain  
regions?**

# **Analysis of the Machangara River sub-basin under a landscape approach as an adaptive management strategy for water resources and climate change**

**December, 2024**



**Ministerio del Ambiente, Agua  
y Transición Ecológica**



# Landscape Approach

Defined by abiotic and biotic conditions, the social and economic subsystems develop and interact, with the economic subsystem playing a leading role in driving spatial transformation

Landscape = Socio-ecological system

Human beings are an active and integral part of the ecological system, just as the ecological system is an active and integral part of the social system across multiple spatial and temporal scales.



## Landscape Approach: Objectives in the Machángara River Sub-Basin



Analyze the Machángara River sub-basin using a landscape approach to develop technical guidelines for the sustainable management of this socio-ecological system. The aim is to ensure the long-term quality and quantity of water resources to support human activities while enhancing the system's resilience to climate change.

### Specific objectives:

- **Analyze Landscape Dynamics:** Examine the synergies between the spatial and functional configuration of the Machángara River sub-basin's landscape to identify critical areas where targeted actions can maintain ecosystem functionality, with a focus on water production.
- **Enhance Connectivity:** Identify potential connectivity areas to support biodiversity conservation and sustain ecosystem processes.
- **Develop Sustainable Guidelines:** Establish technical guidelines to promote the sustainable development of the Machángara River sub-basin, ensuring water availability for diverse uses while safeguarding ecological integrity.





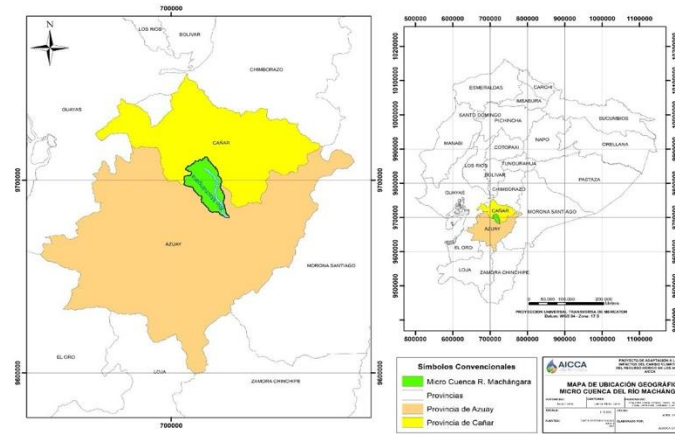
## Landscape approach: Machángara river sub-basin

Machangara river sub-basin  
Provinces: Azuay y Cañar  
Eastern slope

32.544 ha.  
Azuay: 20.251 ha. (62,2%)  
Cañar: 12.293 ha. (37,8%)



Río Machángara

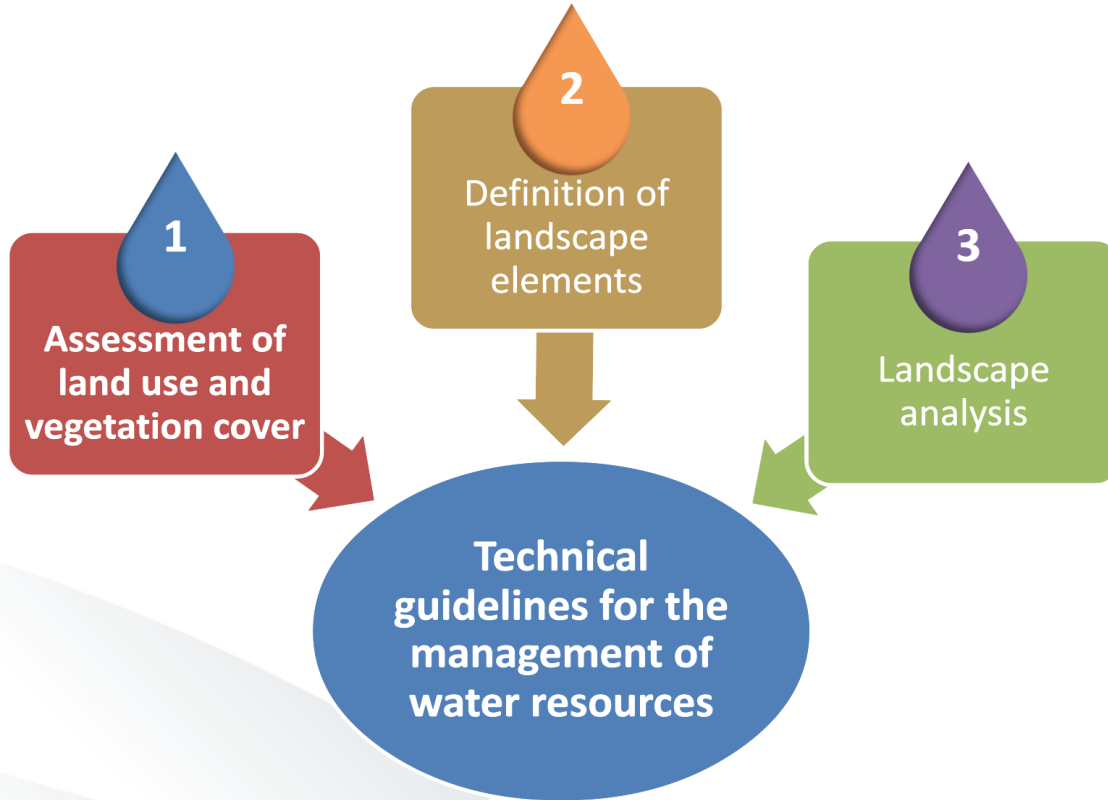


### KEY WATER USES

1. Human consumption: drinking water systems
2. Food production: agriculture and livestock
3. Hydroelectricity production
4. Ecological flow: BVP, RB, ACUS.



# Outline of the methodological proposal

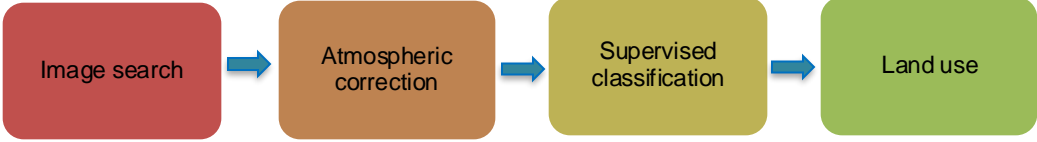


1

# Assessment of land use and vegetation cover

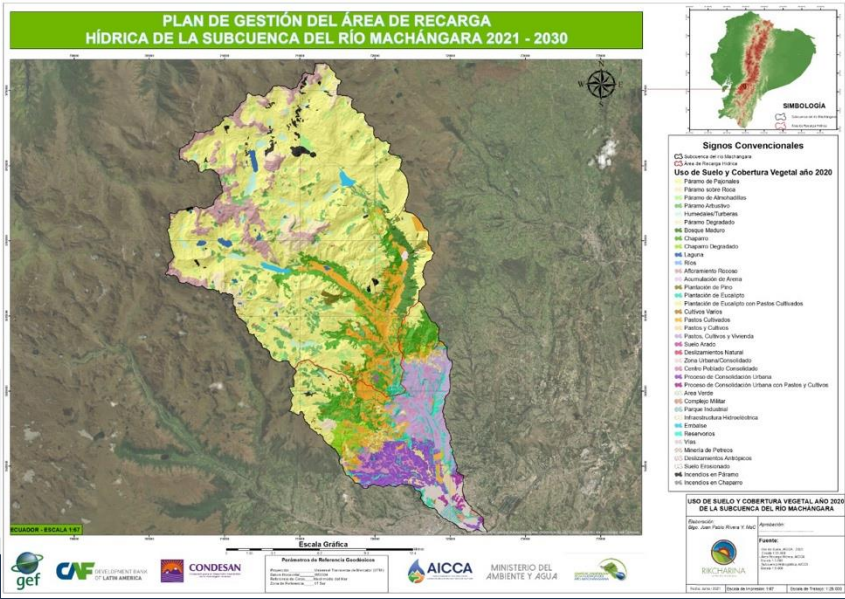


Using remote sensing satellites for land use analysis  
Phases to determine land use and plan cover



39 land uses and vegetation cover across 4 levels of analysis

Scale 1: 25.000



2

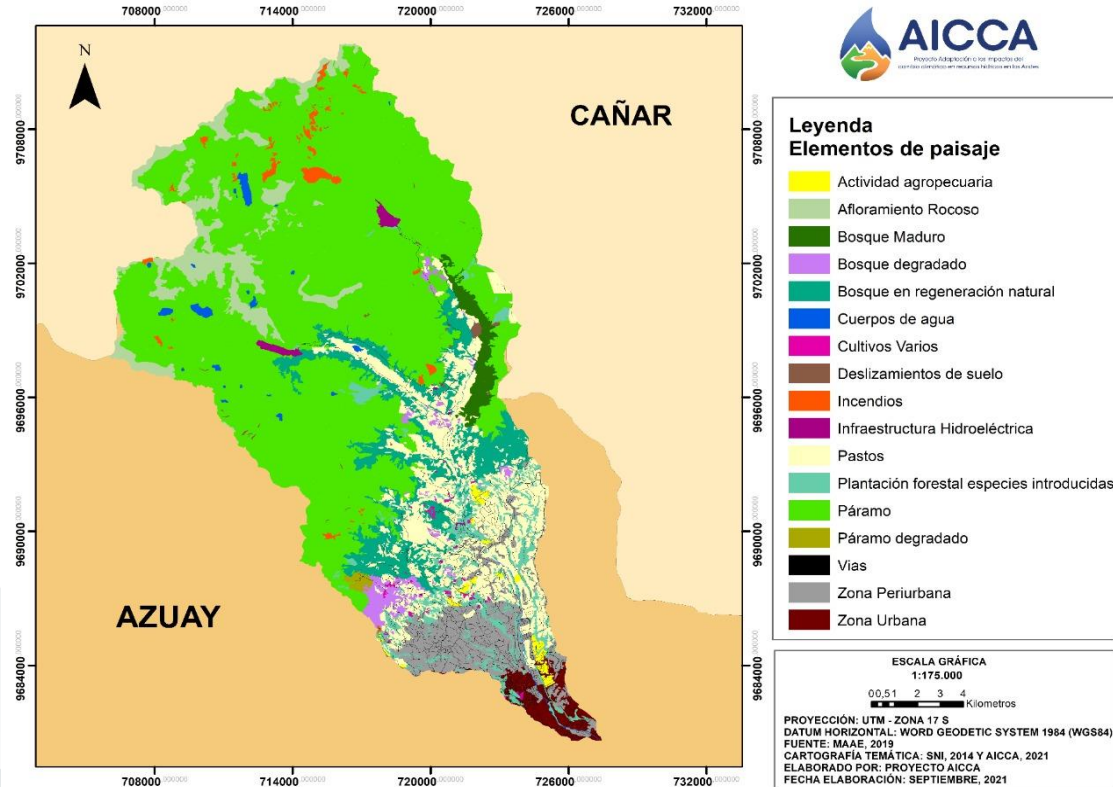
## Definition of landscape elements

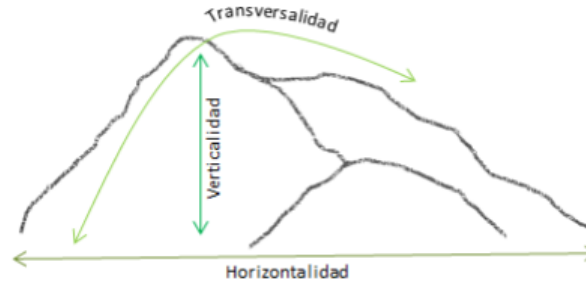
Of 39 land uses and  
vegetation covers



17 landscape  
elements were  
defined

ELEMENTOS DE PAISAJE DE LA SUBCUENCA DEL RÍO MACHÁNGARA





#### Analysis of the vertical dimension

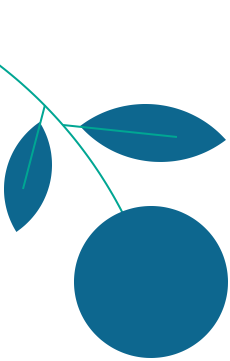
- Topographic profile of a watershed that enables a comprehensive characterization of its functional zones

#### Analysis of the horizontal dimension

- Spatial configuration and composition at the class level
- Connectivity and isolation at the class level

#### Analysis of the transversal dimension

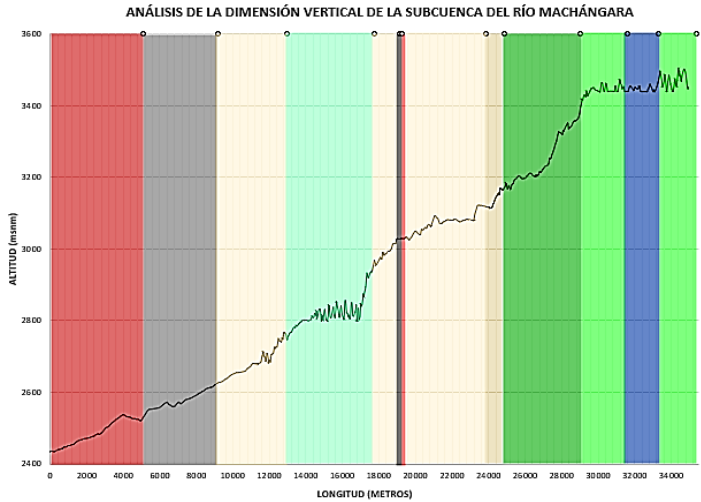
- Direct drivers of change on natural landscape elements
- Managements – related indirect drivers of change



# Vertical dimension Machangara River

Topographic profile of Machángara River from 4400 masl. to its mouth in the Cuenca River at 2400 masl approx.

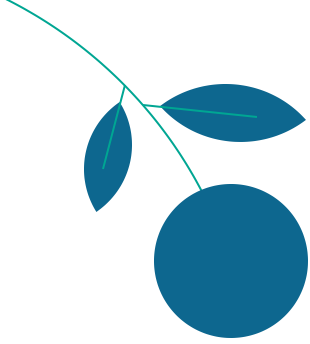
- Based on the Global Digital Elevation Model (DEM) of the ASTER satellite (Satellite Sensor Specifications) version 3, spatial resolution approx. 30 m horizontal position in Ecuador.
- Cartographic information processed in ArcGIS version 10.5 and its analysis and processing toolbox.
- Verification with Digital Globe images from Google Earth 2018.



## LEYENDA

\*\*Elementos del paisaje y agregación entre ellos

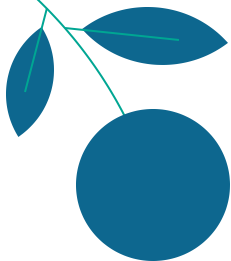
- Zona urbana
- Zona Periurbana, pastos, actividades agropecuarias y plantación forestal especies introducidas
- Bosque en regeneración natural (Chaparros en regeneración), Bosque degradado y pastos
- Plantación forestal especies introducidas
- Intersección del río Chulco
- Central Hidroeléctrica Saucay
- Deslizamiento de suelo Soroche
- Bosque Maduro, bosque en regeneración natural, Bosque degradado, pasto
- Páramo
- Represa del Chanlud (Infraestructura Hidroeléctrica)



## Horizontal dimension

Studies the organizational patterns of landscape mosaics, focusing on the composition and configuration of landscape elements, as well as the connectivity and isolation between them (fragmentation).





## Transversal dimension

In the transversal dimension, the relationships between various landscape elements are analyzed. Specifically, we aim to identify the connections that influence biodiversity and ensure the long-term maintenance of water production, both in quality and quantity, to support the sustainable development of human activities dependent on these resources.



### Direct change drivers:

- Change of land use for livestock
- Change of land use for agriculture
- Direct exploitation of organisms (Wood extraction)
- Opening of roads
- Plantations with exotic species (pine and eucalyptus)
- Forest fires as a consequence of poor production practices

### Indirect drivers of change:

- Land tenure
- Conservation strategies
- Authorizations for the use and exploitation of water
- Machangara multipurpose water system

# Prioritization of intervention areas in the sub – basin of the Machangara River

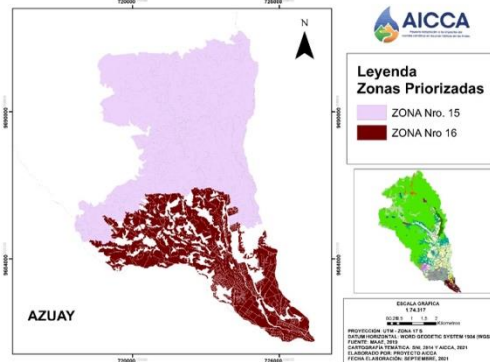


## Criteria:

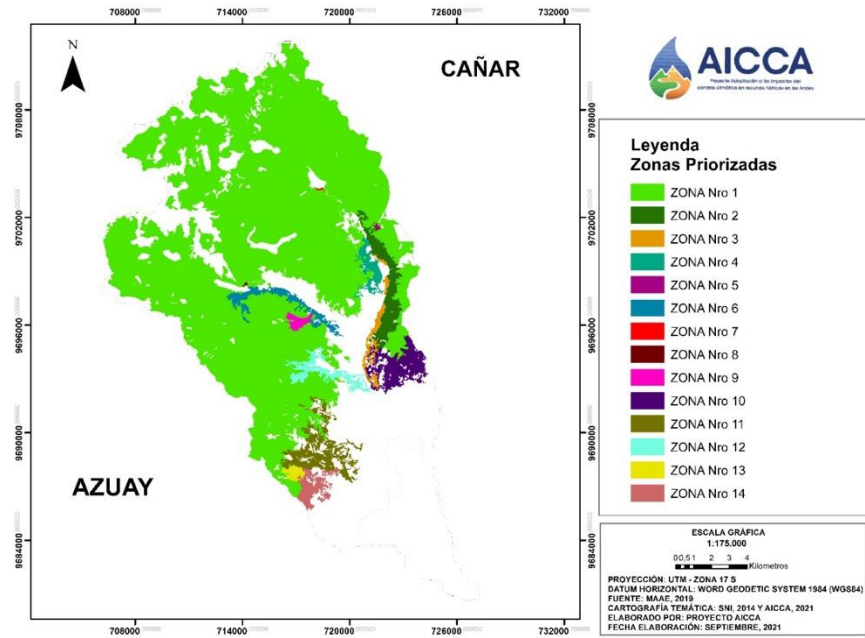
- Key areas for connectivity
- Proximity to water resources
- Proximity to paramo
- Proximity to mature forest patch size
- Pressures from anthropogenic landscape elements
- Pressures from anthropogenic landscape elements
- Synergistic effects of drivers of change

16 areas were prioritized, each one fulfills an ecosystem role and has different particularities

ZONAS PRIORIZADAS PARA GESTIÓN, SANEAMIENTO Y SENSIBILIZACIÓN AMBIENTAL EN LA SUBCUCIENA DEL RÍO MACHANGARA



ZONAS PRIORIZADAS PARA MANTENER O RESTABLECER LOS SERVICIOS ECOSISTÉMICOS EN LA SUBCUCIENA DEL RÍO MACHANGARA





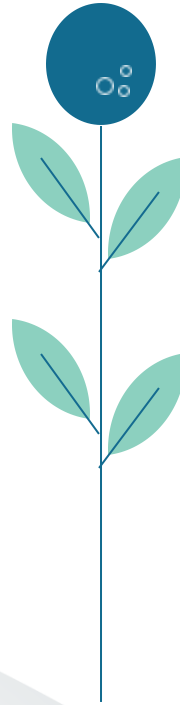
# Examples of sustainable actions based on adaptation and mitigation to climate change



## Adaptation

### Biodiversity

- Increase the number of protected areas
- Improve representation and replication within protected area systems/networks
- Improve management and restoration of existing protected areas to facilitate resilience
- Design of new natural areas and restoration sites
- Incorporate anticipated impacts of climate change into management plans, programs and activities
- Manage and restore ecosystem function
- Incorporate good practices in the fishing sector
- Territorial planning
- Focus resource conservation on species subject to extinction
- Relocating endangered species
- Establish populations of species in captivity
- Reduce independent pressures of climate change on species
- Improve existing laws, regulations, and policies
- Protect biological corridors, refuges and walkways
- Improve monitoring programs
- Develop Dynamic landscape conservation plans
- Enduring the needs of wildlife and biodiversity



## Mitigation

- Clean Development Mechanisms (MDL)
- Actions to implement the use of renewable energy
- Measures for energy efficiency and emissions reduction through renewable sources
- Solid and liquid waste management
- Management of landfills
- Green credits
- Reforestation programs
- Application of a carbon tax
- Mechanisms to reduce emissions due to deforestation and forest degradation (REDD)
- Forestry projects for GEI mitigation
- Improvement programs for urban public transportation
- Payment of environmental services
- Car replacement programs and road infrastructure improvement
- Payments for services for CO2 mitigation
- Offsetting GEI /GHG emissions from hydroelectric plants
- Voluntary actions for GEI /GHG mitigation in the energy and transportation sectors
- Programs to promote the use of biofuels
- Application of taxis for fuel and electricity
- Plans to promote the use of renewable energies
- Application of tax on the use of vehicles and fertilizers
- Strategies to change the energy matrix.

# Sustainable management measures implemented by AICCA Project in the Machangara River



## Lessons Learned and Future Directions





# AICCA

Proyecto Adaptación a los impactos del  
cambio climático en recursos hídricos en los Andes

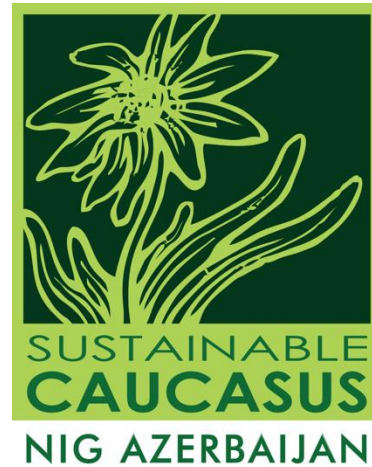
# MUCHAS GRACIAS



Ministerio del Ambiente, Agua  
y Transición Ecológica

# Tackling Water Scarcity: Gajimarda Village Rehabilitation Project

## Sustainable Solution for Climate-Induced Challenges in Azerbaijan



“How can innovative solutions close the adaptation gap in mountain regions?”

By Fuad Bagirov

11 December 2024

# What is the Issue?

## Geographical Context:

Azerbaijan has diverse climate zones:

- humid western mountains, arid eastern lowlands, and warm Talish Mountains.

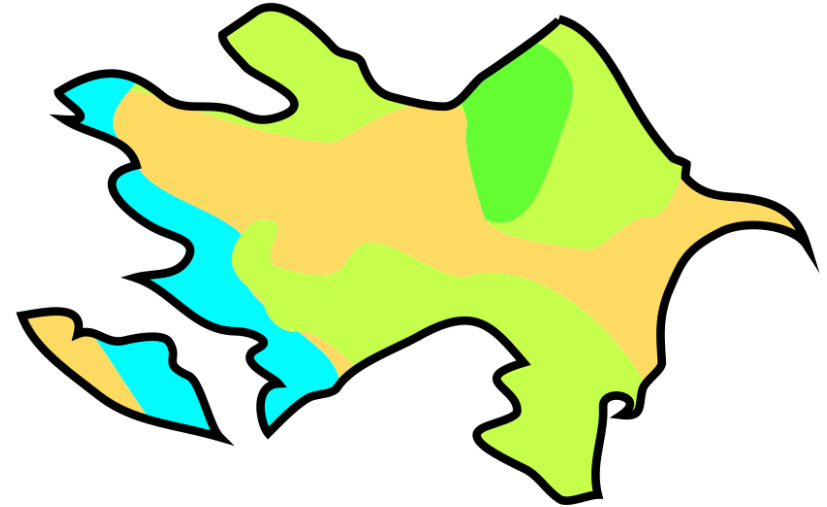
## Climate Change Impact:

- Warmer summers, prolonged dry spells.
- Heavy rainfall affecting citrus yields.

## Challenges:

- Aging irrigation systems.
- Frequent water shortages impacting horticulture.

Azerbaijan map of Köppen climate classification



Cold semi-arid climate (BSk)

Warm continental climate/  
Humid continental climate (Dfa)

Warm oceanic climate/  
Humid subtropical climate (Cfa)

Temperate oceanic climate (Cfb)

# The Gajimarda Village

An aerial photograph of a village nestled in a lush, green valley of the Talish mountains in Azerbaijan. The landscape is characterized by terraced citrus orchards, with rows of trees visible on the slopes. In the background, a small reservoir is visible, surrounded by dense forest. The overall scene is a mix of natural beauty and agricultural activity.

## **Main Activities:**

Horticulture, primarily citrus fruits (mandarins, oranges, lemons, feijoa).

## **Reliance:**

Reservoir (240,000 liters capacity) for irrigation.

## **Impact of Water Shortages:**

Decline in productivity and economic setbacks.

# Rehabilitating the Irrigation System

Cleaned and repaired the reservoir to ensure water tightness.

Replaced metal pipelines with plastic ones, added 23 new water distributors.

Built a tap point for drinking water access.

Trained Community Development Council for maintenance and sustainability.



Top: Inside the 240,000-litre concrete reservoir. Bottom:



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## Ensuring Sustainability Through Participation

- Financial contributions by the community.
- Training by the Astara Rayon Irrigation System Department.
- Sense of ownership fostered among community members.



*Bakhishiyev and Billura Ikham, a family beneficiary of the project* ©Sustainable Caucasus

A photograph of a man in a white long-sleeved shirt reaching up to pick lemons from a tree. The tree is heavily laden with yellow lemons and green leaves. The background is a clear blue sky. The image is partially obscured by a semi-transparent white box containing text on the right side.

# Impacts on the Community

## Direct Benefits:

- 2,146 residents from 180 families.
- Revived horticultural productivity and local economy.
- Empowerment: Women actively engaged in agriculture and market activities.
- Families benefit economically, improving access to education and healthcare.

# Lessons and Replicability

## Key Takeaways:

- Rehabilitated irrigation systems reduce water scarcity and leaks.
- Inclusive management ensures long-term sustainability.

## Replication Potential:

- Mountain municipalities in Azerbaijan.
- Other regions with similar climate challenges.



# Building Resilience Together

## Importance of modernizing infrastructure.

- Role of partnerships between communities and authorities.
- Sustainable solutions empower communities to adapt to climate change.



A dense thicket of green foliage, including various leafy plants and vines, serves as the background. The text "THANK YOU!" is overlaid in the center in a bold, gold, sans-serif font. The text is arranged in two lines: "THANK" on the top line and "YOU!" on the bottom line. The gold color of the text contrasts with the various shades of green in the background.

**THANK  
YOU!**

# How to get involved:

## 1. 'Climate Change Adaptation in Mountains' theme on weADAPT



Theme

### Climate Change Adaptation in Mountains

Mountains are highly vulnerable to climate change. They also provide numerous essential services. This theme explores how mountains and mountain communities can be made more resilient.

136 Members 110 Articles 23 Case studies

Join

Share

Agriculture in Mountains

Biodiversity and Ecosystem Services

Data and Knowledge for CCA in Mountains

Mountain communities

Water stress and hazards



weADAPT Knowledge Manager Published a Case-study

### Climate change, agriculture and internal human mobility in the Bhutan Himalayas

This case study examines the effects of climate change on agriculture and human mobility in Bhutan, the adaptation strategies, prevalent barriers and lessons learned.

2nd Dec 2024 6 min read



## 2. A@A Solutions Portal

The screenshot shows the A@A Solutions Portal interface. At the top, there are three main navigation buttons: "About the portal", "Contribute a solution", and "Join the community". Below these is a search bar with a "Search" button and a "Reset" button. To the right of the search bar is a "Sort by:" dropdown menu set to "Newest". Below the search bar are two checkboxes: "Full Solution" (checked) and "Short Solution". There are four filter dropdown menus: "Scales", "Ecosystems Types", "Solution Types", and "Impacts Addressed". Below the filters, there are three solution cards, each with a thumbnail image and a "Detailed Solution" link. The first card is titled "Increasing agricultural viability and climate resilience through...", the second is "Using Allo to transform local economies and build climate...", and the third is "Saving lives and property – The fight against yearly flash floods in...".



# The Adaptation at Altitude programme

**Objective:** increase the resilience and adaptive capacity of mountain communities and ecosystems to climate change



**CONDESAN**  
Consejo para el Desarrollo Sostenible  
de la Ecorregión Andina

**ICIMOD**



**UNIVERSITÉ  
DE GENÈVE**



Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra

Swiss Agency for Development  
and Cooperation SDC



**ADAPTATION  
AT ALTITUDE**

Taking Action in the Mountains