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Ecohydrological nature-based solutions in terrestrial landscapes : opportunities for multiple ecosystem services and environmental stewardship

DAAD Agri-AlumniNet Webinar Series 2025

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JULY 03, 2025

INTRODUCTION

- Today's Anthropocene is characterized by **people** and **nature** being at **odds**, approaching a **catastrophic** tipping point.

- To **reverse** this tide, the need for humanity to urgently **(re)establish** harmonious relationships with nature and **(re)learn** to live in **harmon**y with the environment is ever pressing.

- The contemporary **ecological footprint** has reached **1.75** = implying we need more than one planet to support humanity's demand on earth's ecosystems. = **Living on Credit**: Resource Depletion = **quantitative warning**

= We argue that stewardship is a means to this end.

- **Stewardship =** a positive connection between human and nature

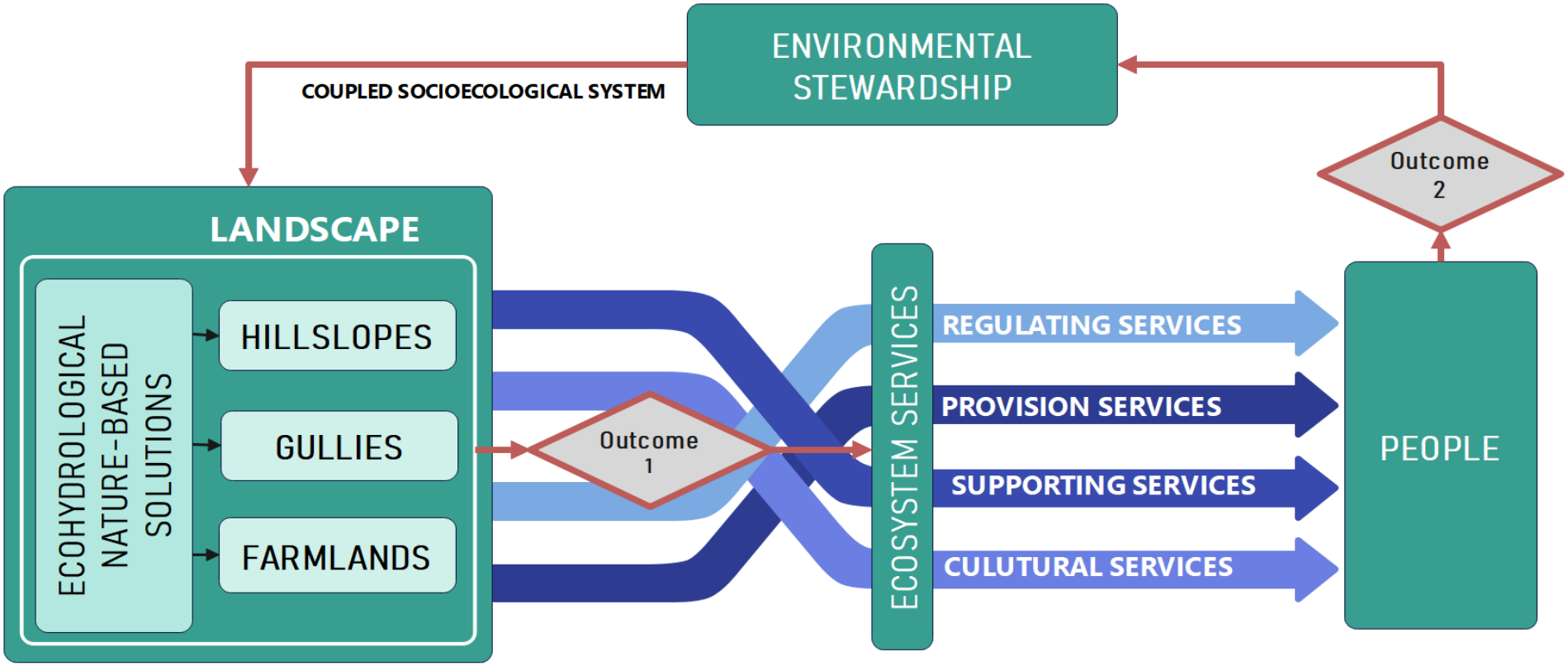
Implication of STEWARDSHIP

- The objective of stewardship is to **bring** the "1.75" **back** down below **1.0**

- Moving from the idea of humans having **"dominion"** over nature and towards the idea that we have a **responsibility to care** for it.

- However, while stewardship is the **philosophical key**, **putting it into practice** is the great **challenge** of our time.

Our basic argument:



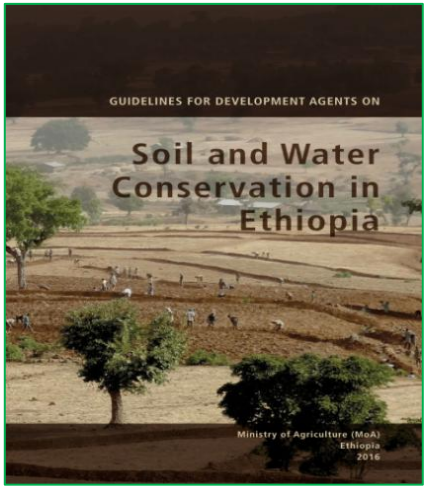
The core idea of NBS is to ask: "How does nature solve this problem on its own?" and then helping it do that work more effectively.

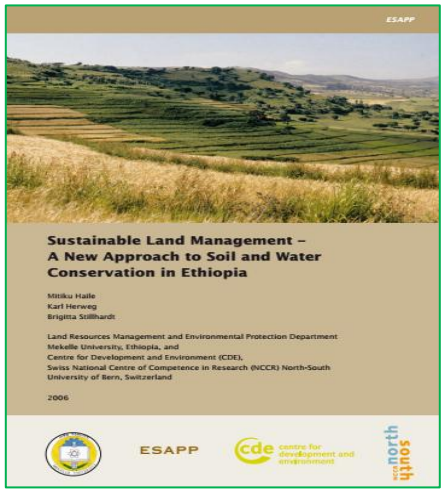
Tangible ecosystem services derived from NBS will ignite stewardship mindset

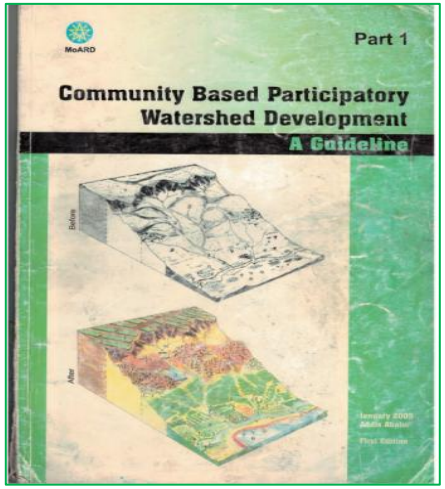
What are some of these interventions near to the heart of the people?

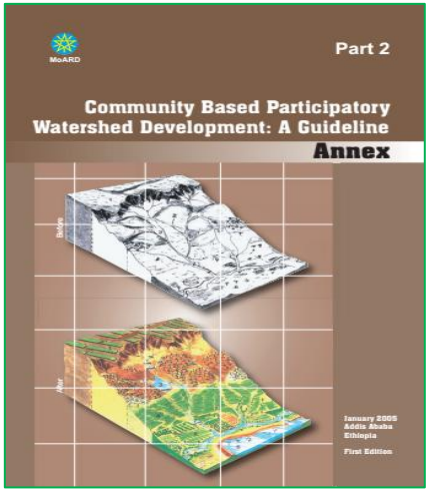
Consideration of socio-ecological factors in the technical design on

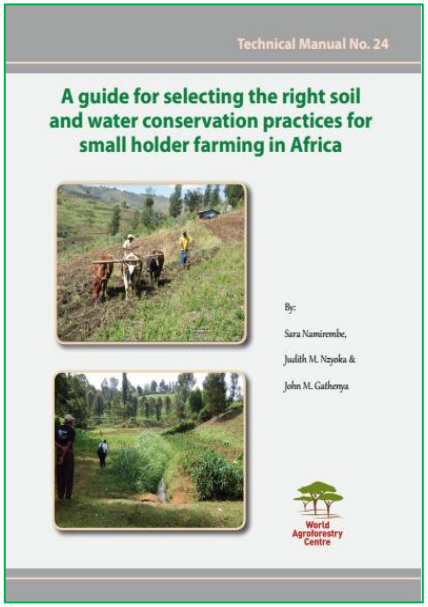
FARMLANDS

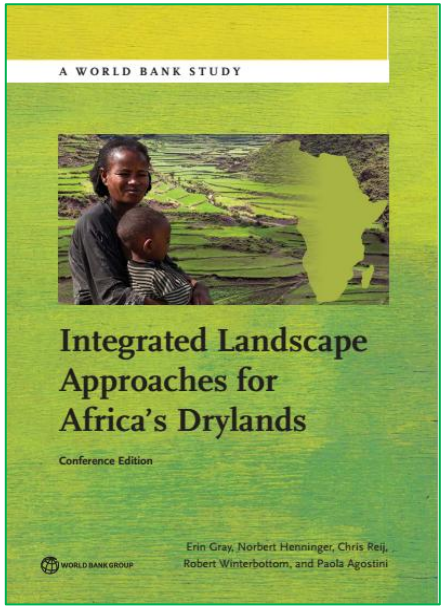

GUIDELINES FOR DEVELOPMENT AGENTS ON
Soil and Water Conservation in Ethiopia
Ministry of Agriculture (MoA)
Ethiopia
2016

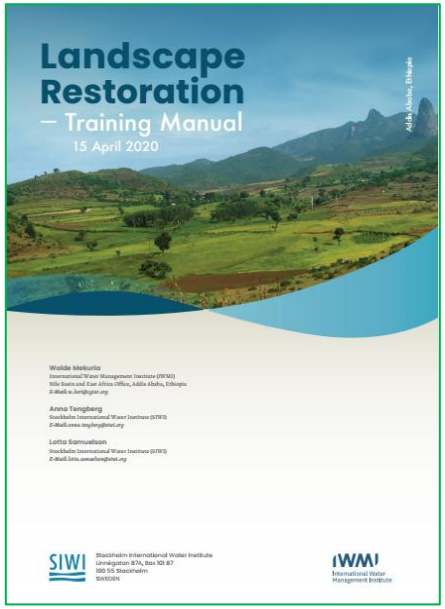

ESAPP
Sustainable Land Management – A New Approach to Soil and Water Conservation in Ethiopia
Mitiku Haile
Karl Herweg
Brigitta Stillhardt
Land Resources Management and Environmental Protection Department
Mekelle University, Ethiopia, and
Centre for Development and Environment (CDE),
Swiss National Centre of Competence in Research (NCCR) North-South
University of Bern, Switzerland
2006
ESAPP
cde centre for development and environment
south north

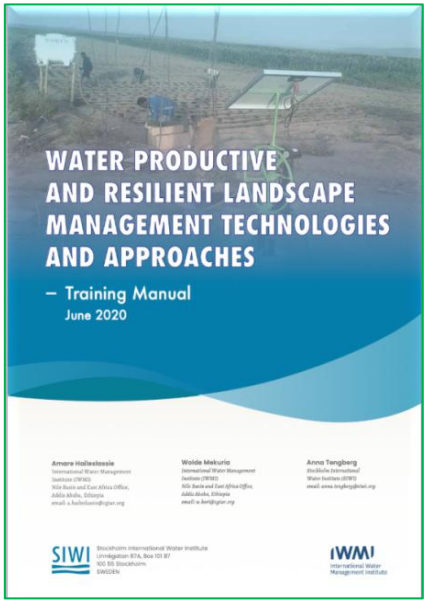

MoARD
Part 1
Community Based Participatory Watershed Development
A Guideline
Before
After
January 2005
Addis Ababa
First Edition


MoARD
Part 2
Community Based Participatory Watershed Development: A Guideline
Annex
Before
After
January 2005
Addis Ababa
Ethiopia
First Edition


Technical Manual No. 24
A guide for selecting the right soil and water conservation practices for small holder farming in Africa
By:
Sara Namirembe,
Judith M. Nzyoka &
John M. Gathenya
World Agroforestry Centre


A WORLD BANK STUDY
Integrated Landscape Approaches for Africa's Drylands
Conference Edition
Erin Gray, Norbert Henninger, Chris Reij,
Robert Winterbottom, and Paola Agostini
WORLD BANK GROUP

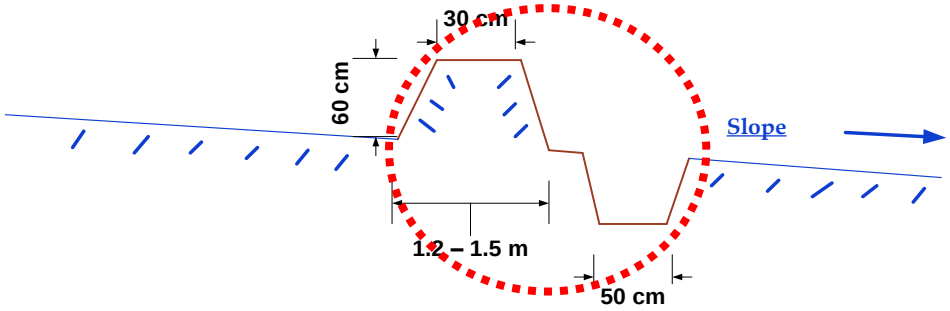

Landscape Restoration
– Training Manual
15 April 2020
Addis Ababa, Ethiopia
Wolde Mekuria
Anna Tengberg
Lotta Samuelson
SIWI
Stockholm International Water Institute
IWMI
International Water Management Institute


WATER PRODUCTIVE AND RESILIENT LANDSCAPE MANAGEMENT TECHNOLOGIES AND APPROACHES
– Training Manual
June 2020
Amare Haileslassie
Wolde Mekuria
Anna Tengberg
SIWI
Stockholm International Water Institute
IWMI
International Water Management Institute

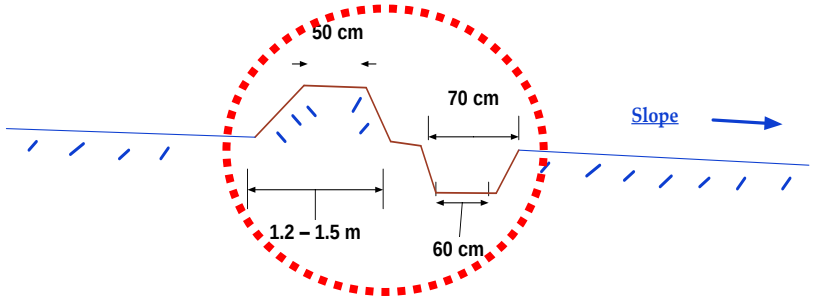
Balancing socio-ecological aspects with technical designs through ecohydrological approach

Socioeconomically =10-20% loss of land

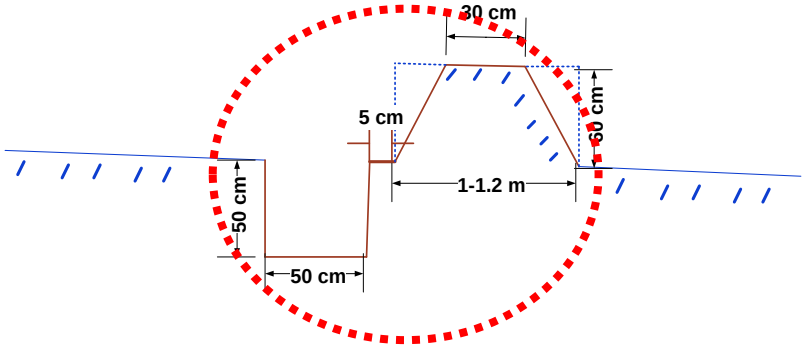
Ecologically = much soil disturbance releases soil organic carbon



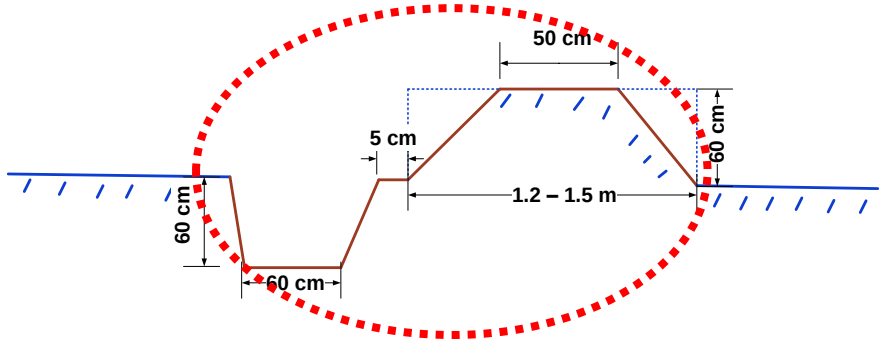
Fanyaa juu design for stable soil



Fanyaa juu design for loose soil

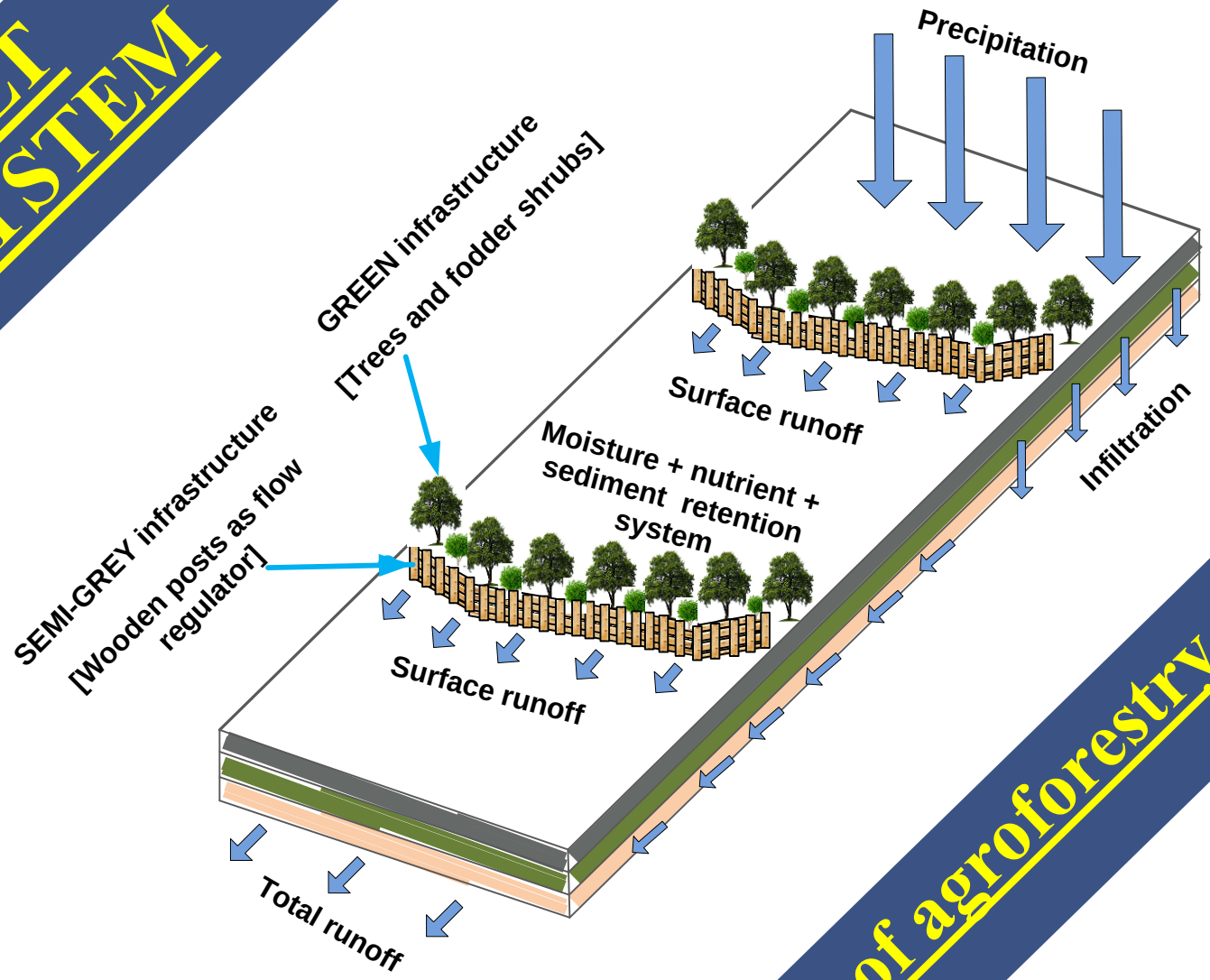


Soil bund design for stable soil



Soil bund design for loose soil

GREEN BELT BUNDING SYSTEM



A variant of agroforestry

The design:

= saves the scare arable land;

= reduces earth work

= is very flexible for design

Perceived by the community as saving their arable lands

Harmonized with the existing farming system

Perceived by the community as farm boundary

Conversion of gully network into farmlands

Situation after few months of implementation

Hydraulically efficient floor regulator = the first principle of ecohydrology

The conventional designs can not operate this way during extreme flood events

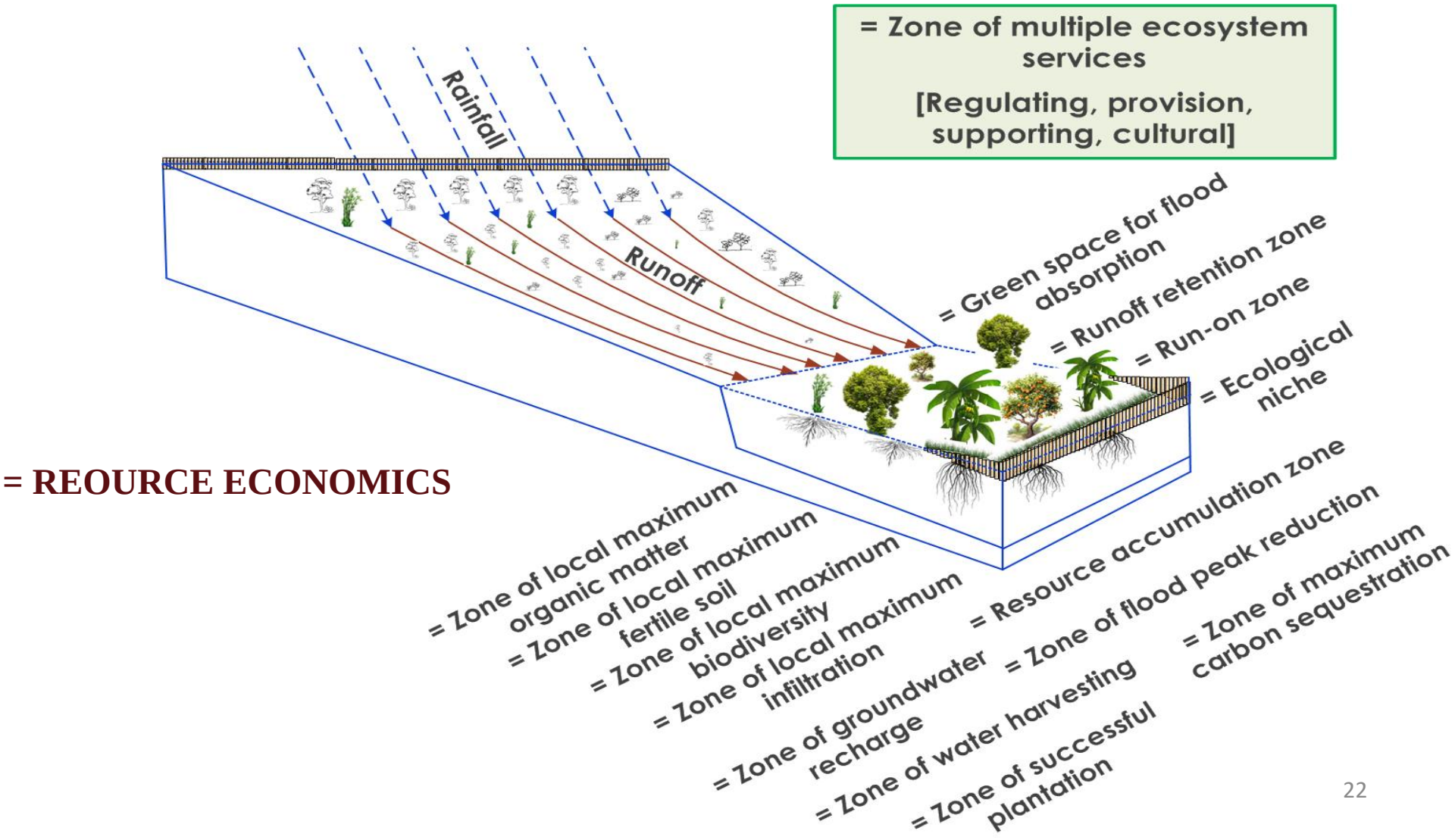
The ecosystem services perceived by the community and motivated them to raise environmental awareness and then stewardship


The flow of benefits (ecosystem services) delivered by the interventiosn and enjoyed by the community
Efficient silt trapping
Supporting services
High impact on productivity
Provisioning services
Better integration with the existing farming system
Cultural services
The flow regulating structure is slim enough to save productive lands
Supporting services
Reclaiming formerly abandoned farmlands
Supporting services
Better hydraulic performance during extreme flood events
Regulating services
Minimal earth work
Supporting services
Creating favorable condition due to better vital resource accumulation
Supporting services
Resilient to cattle trampling
Cultural services
Generating co-benefits from the planatation
Provisioning services
Better moisture conservation
Regulating services
Name

Consideration of socio-ecological factors in the technical design on

HILLSLOPES

Renovating the conventional hillside terraces by mimicking the natural “Patch- Interpatch” sequence system on hillslopes



In practice

Land management practices shall derive multiple ecosystem services (ES) as outcomes for better adoption by farmers

In practice

Temporal variation of greening in practice

BASELINE CONDITION

1

Progress # 1: *May 5, 2018 = On-Job training = 10 carpenters + 10 assistants*


Progress # 2
Run-on site= vital resource capturing patch = resource accumulation zone
Run-off site = vital resources displacing (inter-patch zone = resources flow freely


5
Progress # 5


AFTER 1 YEAR


AFTER 1 YEAR

Landscape functionality analysis (LFA) result for site-1 (mine site) before management action (baseline indices)(reference points):

Stability = **30.6%**
Infiltration capacity = **24.7 %**
Nutrient cycling potential = **10.5 %**

Landscape functionality analysis (LFA) result for site-1 (mine site) after one year of management action

Stability = **47.2%**
Infiltration capacity = **32.6 %**
Nutrient cycling potential = **22.5 %**

THE ECOSYSTEM SERVICES

Landscape functionality analysis (LFA) result for site-1 (mine site) before management action (baseline indices)(reference points):

Stability = **44.4%**

Infiltration capacity= **10.4 %**

Nutrient cycling potential = **10.5 %**

Landscape functionality analysis (LFA) result for site-1 (mine site) after one year of management action

Stability = **58.3%**

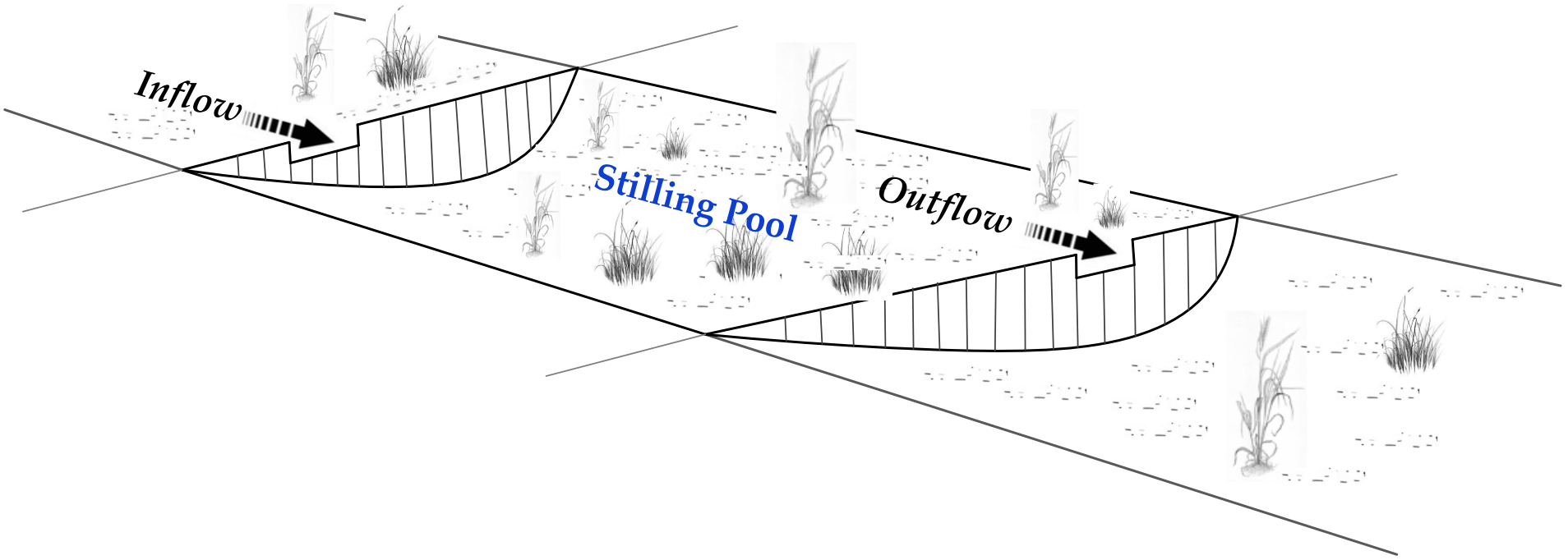
Infiltration capacity = **25.1 %**

Nutrient cycling potential = **25.6 %**

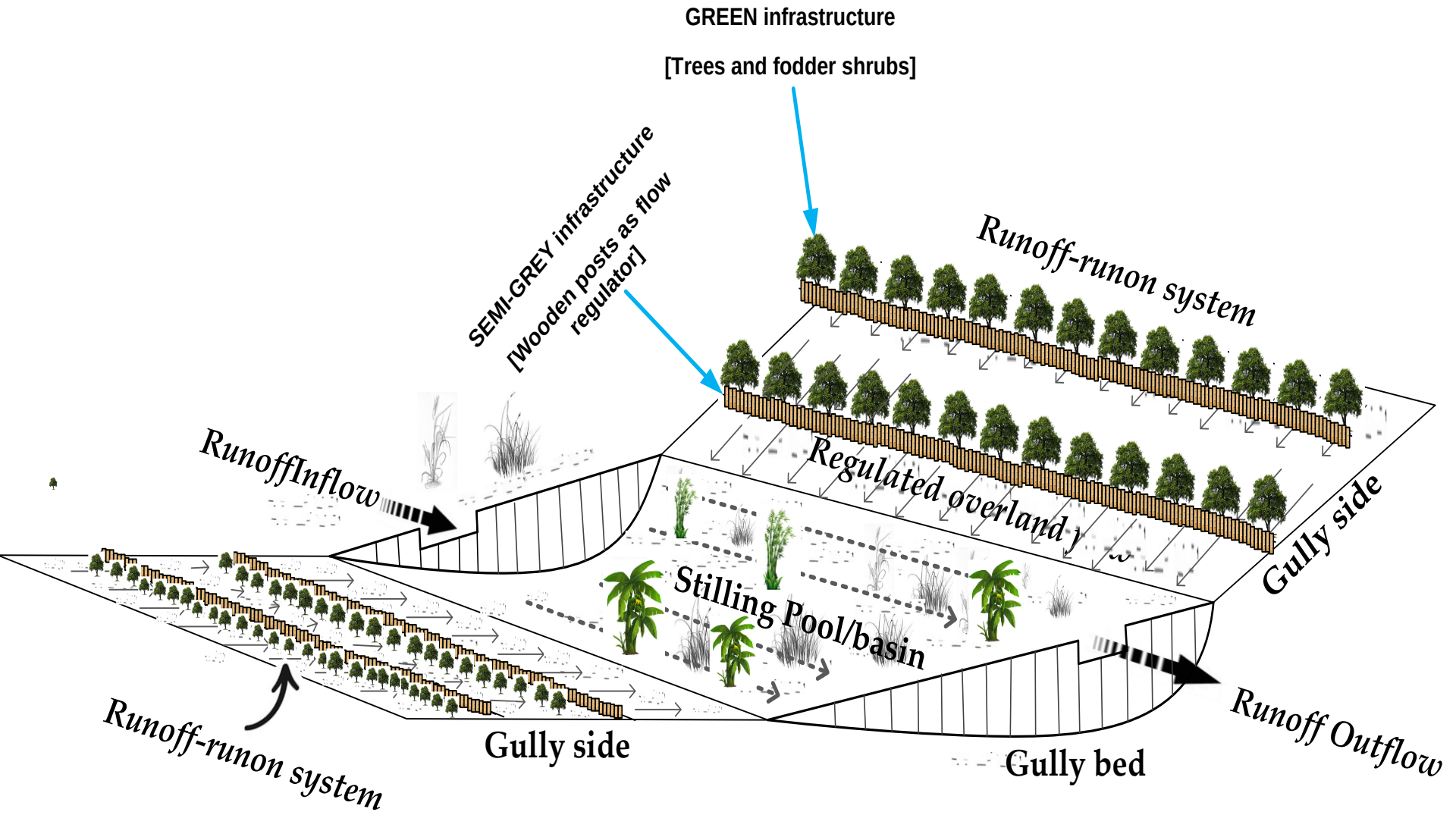
Consideration of socio-ecological factors in the technical design along

GULLY NETWORKS

Renovating the conventional check dam system by mimicking the natural step-pool system



Renovating the conventional check dam system by mimicking the natural and stable system of “Step-Pool” sequences for gully beds and green belt for gully banks



Here, the farmer is getting more productive land to produce elephant grasses!

Afforestation of gully networks

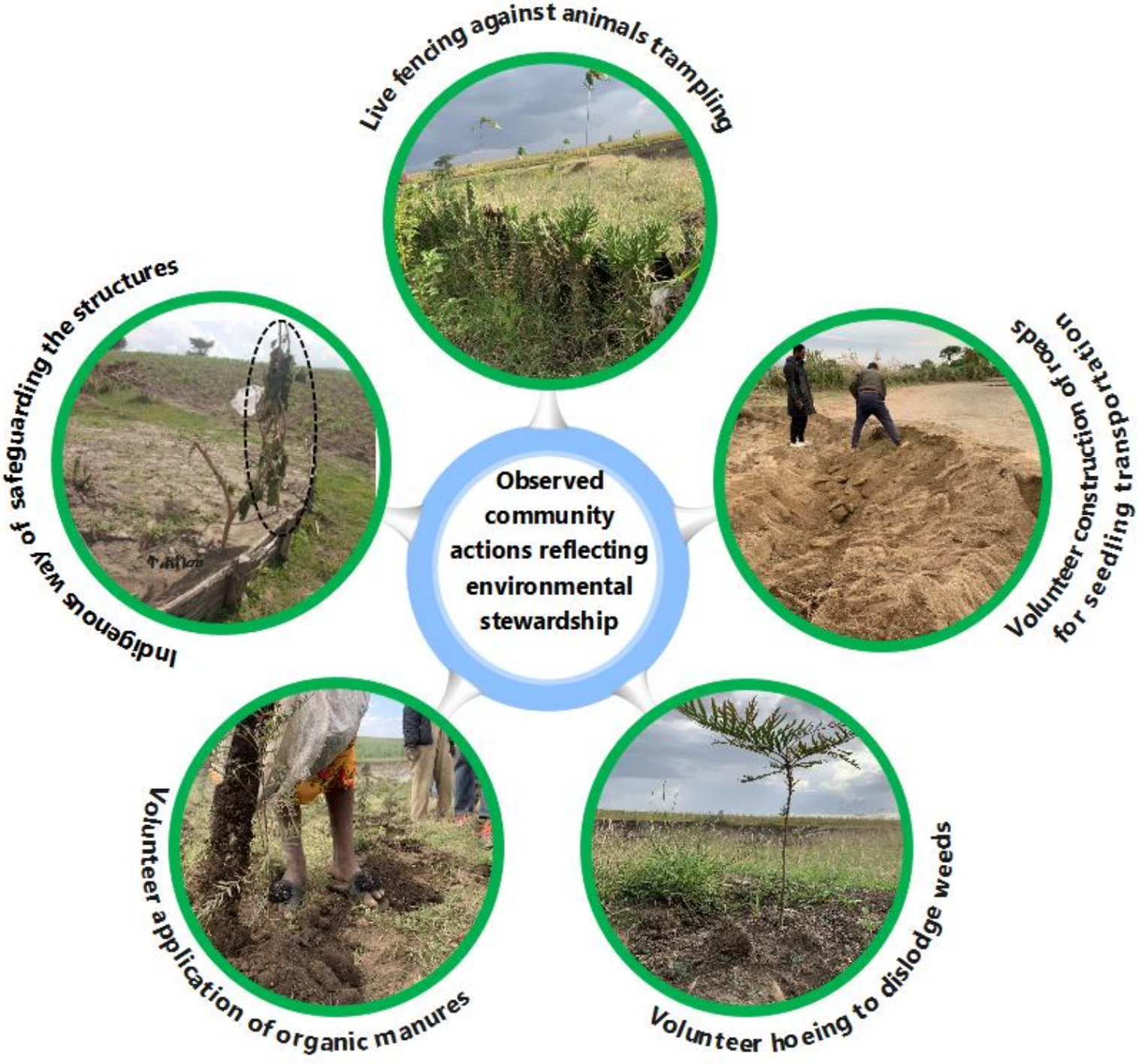
Afforestation of gully networks

Conversion of gully networks into production sites:

Conversion of gully networks into production sites:

Conversion of gully networks into production sites:

Community engagement in environmental stewardship: key proxies


Live fencing against animals trampling
Volunteer construction of roads for seedling transportation
Volunteer hoeing to dislodge weeds
Volunteer application of organic manures
Indigenous way of safeguarding the structures
Observed community actions reflecting environmental stewardship


CHALLENGE

In poor rural community, theft is likely happened to the products resulting form the ecohydrological interventions:

1

Illegal cut of trees for firewood!

2

The accumulation of sediments and sand behind the ecohydrological structures is a key success of the intervention, contributing to land restoration and improved water retention. However, these valuable deposits often attract illegal sand miners, whose extraction activities undermine the environmental gains and risk returning the area to its degraded, pre-intervention state.

Project durations are often shorter than the time needed to observe meaningful impacts of interventions on landscape restoration

In some cases, degraded landscapes are located far from communities, making participation, ownership, and long-term stewardship more challenging

THANK YOU