

**RESTORE  
4MORE**

# Scaling rangeland restoration in drylands through synergies in the biodiversity-water-climate nexus

**2023 - 2027**





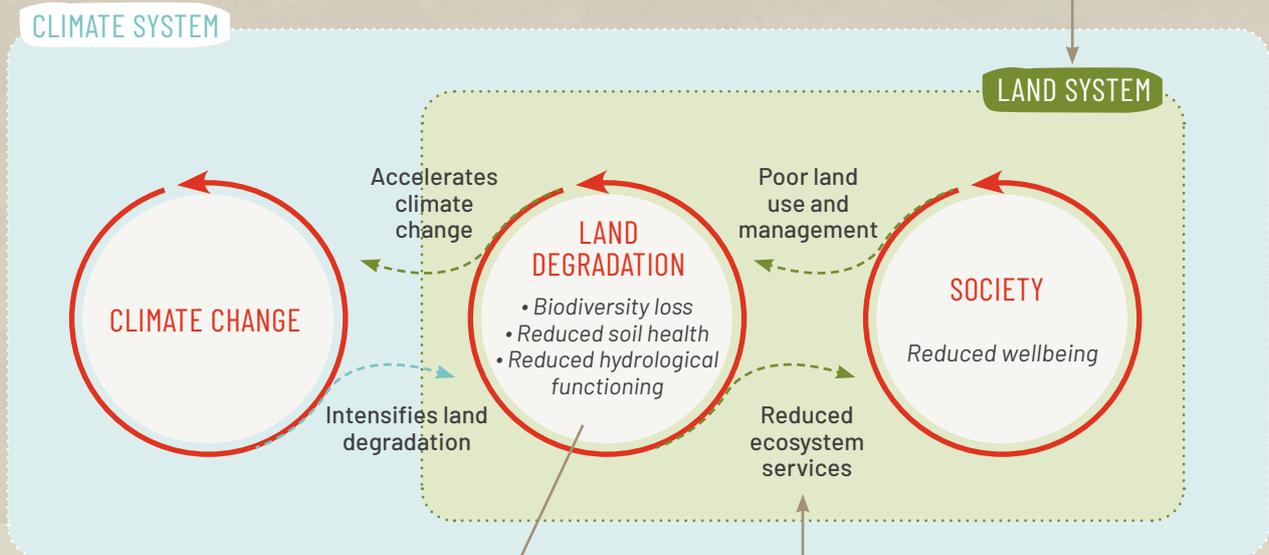
# Addressing interlinked, mutually reinforcing crises

Climate change, land degradation, and biodiversity loss are among our time's most pressing planetary crises and a threat to life on Earth and human wellbeing. These crises are deeply interwoven and mutually reinforcing: climate change is a principal driver of land degradation and biodiversity loss, while land degradation and biodiversity loss further accelerate climate change.

**Water plays a central role in the climate-biodiversity-land degradation crisis,** simultaneously being part of the challenge and the solution. With an increase in the frequency and intensity of extreme weather and climate events, more intense rainfall can exacerbate soil erosion and result in greater peak flows and increased flood risk, jeopardizing water and food security and constraining adaptive capacity to climate change. Concurrent increases in the frequency and severity of meteorological droughts can further exacerbate water security and land degradation.

Land and climate are tightly coupled through complex two-way interactions across temporal and spatial scales, as depicted in the figures below. Climate change and land degradation act as threat multipliers, with mutually reinforcing positive feedbacks between land degradation and climate change leading to an accelerated downward spiral.

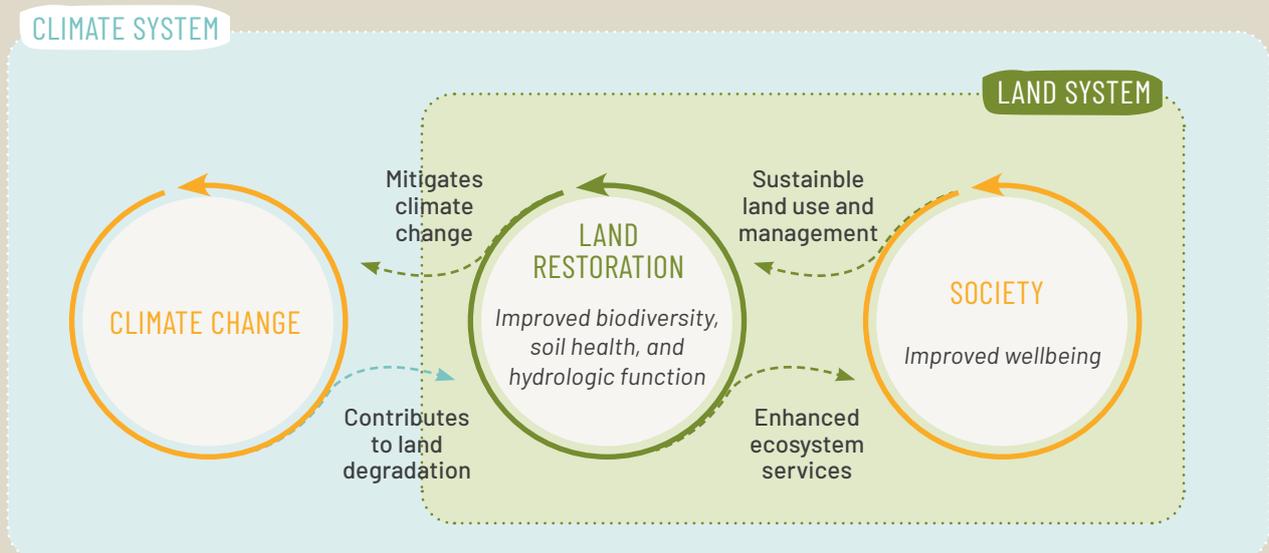
The land system can be viewed as a social-ecological system with a societal (human) component and an ecological (biophysical) component that interact with each other.



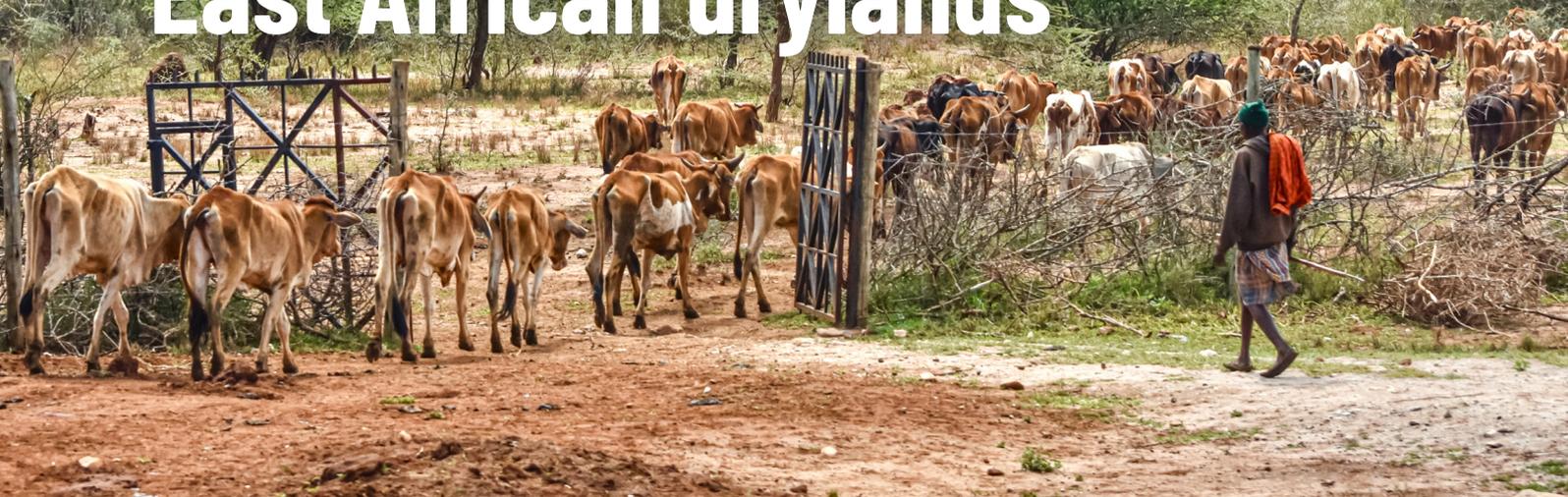
Reduced hydrological functioning involves negative changes in the spatial and temporal distribution of water flows and storages, such as increased surface runoff, reduced soil moisture, reduced dry season flows, and reduced groundwater recharge.

This involves an increase in water-related risks and hazards, adversely affecting human wellbeing and contributing to reduced livelihoods, competition for scarce natural resources, outmigration, conflict, reduced adaptive capacity to climate change, and poor land use and management.

**RESTORING DEGRADED LANDS IS CRITICAL TO ADDRESS THESE INTERLINKED CRISES AND ENHANCE HUMAN WELLBEING**



# Focusing on rangeland restoration in the East African drylands



Tackling the climate-biodiversity-water-land degradation crisis requires integrated solutions that reverse land degradation and biodiversity loss, contribute to climate change adaptation and mitigation, and enhance water security while ensuring human wellbeing. Restoration is a key integrated approach that addresses a nexus of sustainability goals.

To date, restoration initiatives and efforts have largely been dominated by the restoration of forest ecosystems. While forests play a critical role in achieving the Sustainable Development Goals (SDGs), an emphasis on forest restoration does not translate in East African countries. For example, in Kenya and Uganda, where drylands cover a large portion of the land area, the **restoration of rangelands and farmlands** is central to enable the countries to achieve their restoration target of 5.1 and 2.5 Mha by 2030.

**Rangelands** cover about half of the global land area, primarily in drylands characterised by water scarcity, and comprise lands in which the indigenous vegetation is predominantly grasses, grass-like plants, forbs and woody perennials that are grazed by livestock and wildlife. With a high biodiversity and providing critical ecosystem services, rangelands support 50% of the world's

livestock and over 2 billion people, mostly living in low- and lower-middle-income countries.

**Rangeland degradation therefore represents a major global challenge with severe negative impacts** on biodiversity, climate change, and water and food security, affecting the livelihoods of millions of people, particularly in the drylands of East Africa. Climate change and socioeconomic changes further exacerbate the situation, with disproportionately negative impacts on disadvantaged social groups such as pastoralists.

**Restoring degraded rangelands is urgently needed to reverse the current negative trends in land degradation, biodiversity loss, water insecurity, climate change and diminishing human wellbeing.** However, significant evidence and knowledge gaps hinder restoration

proceeding at the speed and scale required to address these challenges. Providing the evidence base for policy and implementation support to restore degraded rangelands is critical to address these interlinked crises and enhance human wellbeing in East Africa.

**The entry point of Restore4More is to identify the synergies in the biodiversity-water-climate nexus to accelerate restoration of degraded rangelands** for improved climate change adaptation and mitigation, enhanced biodiversity and water and food security in the drylands of East Africa.

Restore4More will address critical evidence gaps and generate actionable knowledge on the biodiversity-water-climate nexus that can contribute to large-scale, long-lasting, and effective rangeland restoration in the drylands of East Africa.

### RESTORE4MORE'S SCIENTIFIC CONTRIBUTION

Advancing the fields of restoration ecology, (eco)hydrology, functional vegetation ecology, sustainability science, earth system modelling, and land health monitoring to enable **innovative solutions to restore rangelands** for enhanced biodiversity, water and food security, and climate change mitigation and adaptation.

### RESTORATION: A NEXUS SOLUTION WITH POTENTIAL BENEFITS FOR PEOPLE, NATURE, AND CLIMATE

Restoration interventions should aim to **restore multiple functions and generate a range of ecosystem services that benefit multiple stakeholder groups**, from the local to the global level. Unfortunately, many restoration attempts in drylands have failed to do this, compromising water security, biodiversity, and local livelihoods. Such failures are often the result of a lack of understanding of the biodiversity-water-climate nexus. Improving this understanding is critical to ensure quality restoration outcomes.

Restoration interventions that consider and manage **plant-soil-water feedbacks** can accelerate the recovery of key ecosystem functions and related ecosystem services, improving restoration outcomes. The application of knowledge of above-ground below-ground interactions and the links between biodiversity and ecosystem functioning are fast-developing areas of ecological research that could assist in restoration. A better understanding in restoration science of interactions across the larger plant-soil-water nexus is fundamental to effectively restore ecosystem functions and the ecosystem services they underpin, as well as their resilience to environmental change.

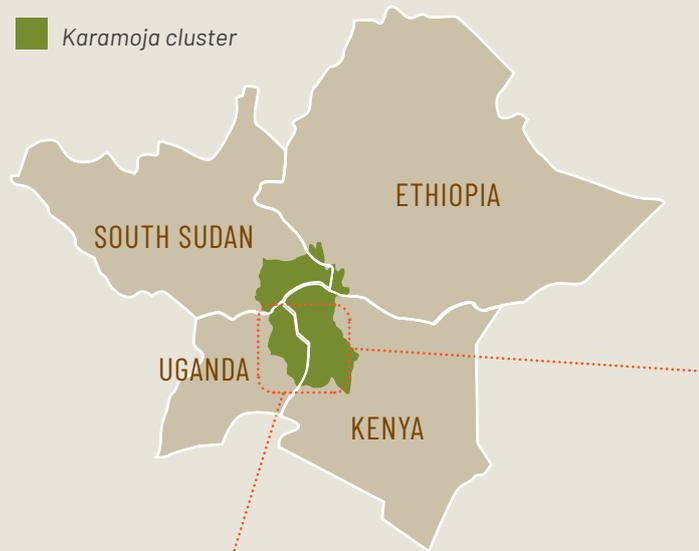


# Project approach

## SCALE

Restore4More operates at two spatial scales:

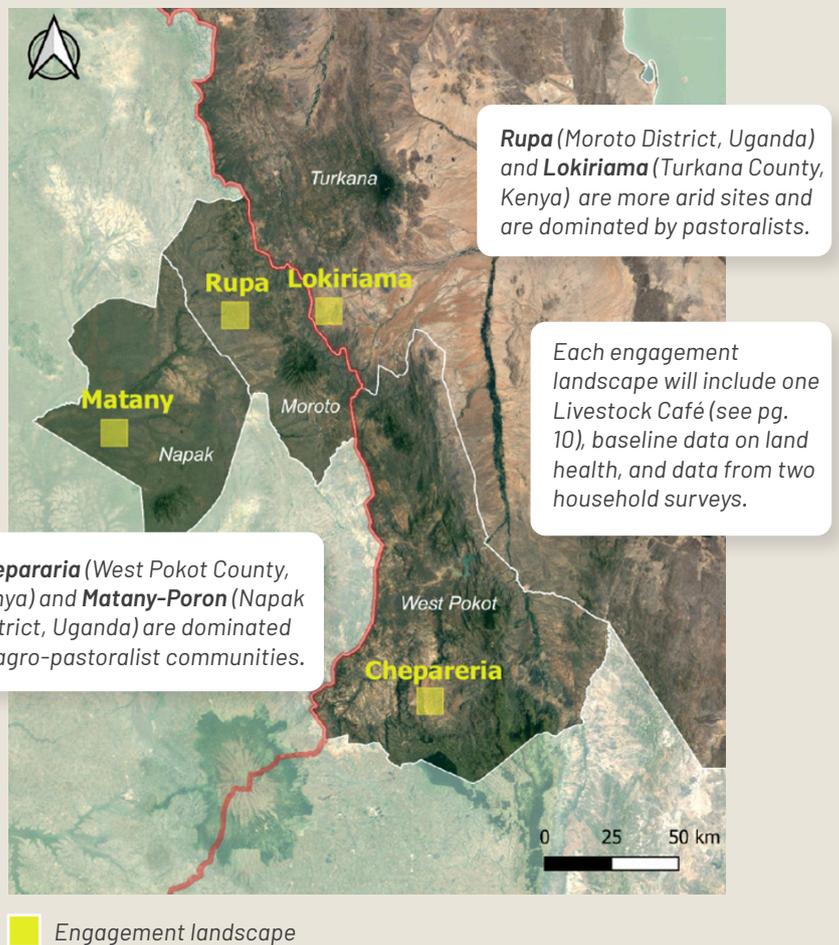
- ▶ **Regional assessments** are implemented in East Africa
- ▶ **Four project engagement landscapes** have been established within the Karamoja cluster, which provides variation in climate (including aridity), vegetation, land use and livelihood strategies, and hence presents an array of challenges and opportunities in the biodiversity-water-climate nexus. In each engagement landscape, the project will interact more closely with local stakeholders and conduct concentrated, long-term transdisciplinary research.



The four project engagement landscapes

## ACTIVITIES

- ▶ **Conduct transdisciplinary research with key stakeholder groups** using a co-learning and knowledge exchange approach.
- ▶ **Use a unique combination of field data and experiments**, Earth Observation, modelling, participatory action research and mixed methods, and leverage research infrastructure, networks, and projects.
- ▶ Engage with policymakers and restoration practitioners and **provide robust science-based evidence and tools** to support and guide rangeland restoration efforts at scale.



## LEVERAGING EXISTING EVIDENCE, INFRASTRUCTURE AND ENGAGEMENT

In order to contribute to the long-term research needed to generate knowledge on rangelands restoration, **Restore4More** is building on the knowledge, partnerships, research infrastructure and experience from existing research projects, networks and collaborations. Among these is the Formas-funded project '**Drylands Transform: Achieving the SDGs in East African Drylands**', established in 2020.

Restore4More's selection of the engagement landscapes builds off those established by Drylands Transform, allowing for closer and sustained interaction with local stakeholders and conducting more concentrated and long-term research.



Previous evidence and infrastructure from Drylands Transform that Restore4More will build from and apply in the engagement landscapes:



**Systematic assessments of soil and land health** at the landscape level using LDSF (Land Degradation Surveillance Framework) methodology



**Household surveys**, which included interviews with over 900 households and data related to socio-economic, food and nutritional aspects



Established "**Livestock Cafés**", which are experimental sites to study rangeland restoration and sustainable management options that also serve as co-learning and knowledge exchange centres.



# Project structure

Restore4More is structured into **five interlinked Work Packages** (WPs) that are directly aligned with the five project objectives and feed into each other. Work packages are co-led by a diversity of project researchers, with the aim of continuous and iterative integration of findings. Through the WPs, the project will engage with stakeholder groups at multiple levels through different platforms to promote co-learning, knowledge exchange and communication.



## OBJECTIVE 1



Investigate the interactions between vegetation characteristics, soil health, erosion, and water regulation across a network of rangeland sites in the East African drylands and identify synergies and trade-offs in the provision of ecosystem services

Using field and laboratory data from the network of LDSF rangeland sites in East Africa, Restore4More will systematically assess the **impact on the ecosystem functioning** of:

- ▶ woody and non-woody vegetation (species, structure, cover, above-ground biomass, diversity, functional traits)
- ▶ soil inherent properties (e.g., soil texture, pH)
- ▶ land management (e.g., grazing and browsing intensity)

The project will also assess their **impact on the delivery of related/linked key ecosystem services** – including erosion control, water regulation (i.e., soil infiltration capacity), carbon storage, and forage quality and quantity – across contrasting sites and contexts.

Finally, Restore4More will **evaluate synergies and trade-offs between these ecosystem services** related/linked.

## THE LAND DEGRADATION SURVEILLANCE FRAMEWORK (LDSF)

The LDSF consists of a **global network of sites** where the LDSF methodology has been applied systematically to **assess soil and land health**. In Restore4More, we will focus on some of the LDSF sites from this global network that are located in East Africa and are dominated by rangelands.

In the LDSF, data is collected at multiple spatial scales to understand how the various indicators vary across the landscape. The LDSF is built around a hierarchical field survey and sampling protocol using sites that are 100 km<sup>2</sup> (10 x 10 km). Each site is stratified into 16 (2.5 x 2.5 km) tiles. Within each tile, a 1 km<sup>2</sup> cluster is generated. Each cluster consists of 10 sampling plots. Each plot is 1000 m<sup>2</sup> and consists of four subplots, each 100 m<sup>2</sup>. Randomizing the plots is important to minimize biases that may arise from convenience sampling. This sampling design allows for robust statistical analysis of multiple indicators.

The LDSF uses a **robust and consistent set of indicators** that are science-based, readily measurable (quantifiable), specific, and representative of the complex processes of land degradation in the landscape.



## OBJECTIVE 2

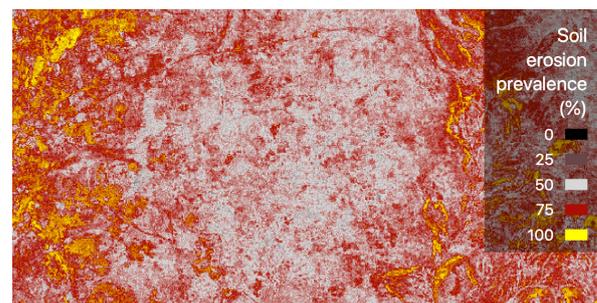
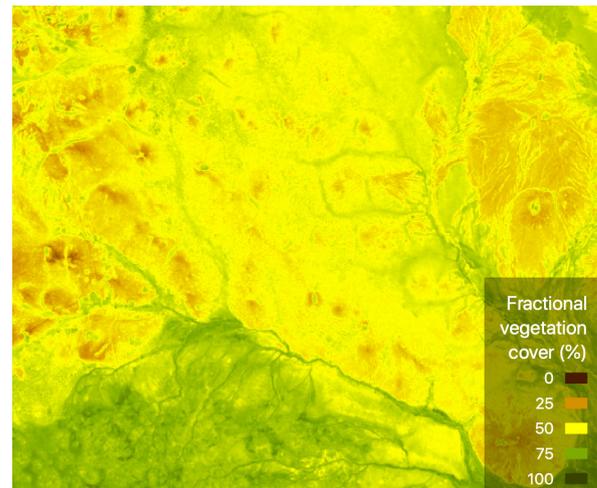


Conduct an integrated regional assessment of rangeland health and explore historical dynamics in rainfall, vegetation, and land degradation and restoration using Earth Observation

Developments in Earth observation and machine learning offer a great potential to assess the extent and status of rangelands at larger spatial scales, inform the spatial targeting of restoration efforts, and track restoration and degradation processes over time, contributing to filling current critical gaps in knowledge and understanding of land degradation and restoration.

We will:

- ▶ **produce time-series indicator maps** at high spatial resolution at the regional scale
- ▶ **perform time-series analyses** to understand the historical dynamics in rainfall, vegetation, and land degradation
- ▶ **identify patterns of land degradation**, and assess the current rangeland degradation status in relation to historical assessments
- ▶ **pinpoint locations** where restoration efforts could have the greatest impact.



## OBJECTIVE 3



Contribute to further development and use of an app for assisted citizen science data collection to track and inform rangeland restoration practices on the ground

Citizen science provides a unique opportunity to gather data for restoration monitoring while promoting wider public engagement in restoration. Restore4More will innovate in **testing citizen science tools** that work for fluid rangeland systems.



#### OBJECTIVE 4



Test innovative rangeland restoration and management options together with local communities and scaling partners in knowledge-sharing hubs (Livestock Cafés) across four contrasting engagement landscapes and track their effectiveness

Livestock Cafés (LCs) are knowledge-sharing hubs for rangeland restoration and sustainable water and land management. Different practices and technologies are co-developed and tested together with local communities. These include seed collection, soil and water conservation practices, tree nurseries, and value addition of

grasses and other local products. The LCs also function as experimental sites, demonstration and training sites, and meeting places. In the image above, taken 10 months after the establishment of the LC, the positive impact of restoration interventions on grass cover is clearly visible.

#### OBJECTIVE 5



Engage stakeholders at different levels to explore if and how changes in stakeholders' awareness and understanding of the biodiversity-water-climate nexus lead to changing decision-making contexts around rangeland restoration and management

**Restore4More is demand-driven and responds to the knowledge needs of restoration actors at multiple levels through context-specific co-learning and knowledge exchange.** The project will provide restoration practitioners, farmers, livestock keepers and other actors (including policymakers, local authorities and NGOs) with robust science-based evidence and tools to support and guide rangeland restoration efforts in the drylands of East Africa, improving

their capacity to plan, implement and monitor restoration activities and practice adaptive management.

**Capacity development** will be supported through demonstration sites, training of trainers, stakeholder workshops, policy dialogues, and facilitation of community-based organizations. Addressing these needs is imperative to achieving effective rangeland restoration at scale.



## FORMAS

Restore4More is funded by Formas – the Swedish Research Council for Sustainable Development – within the National Research Program on Climate and the National Research Program on Oceans and Water.

 <https://www.slu.se/restore4more>

### CONTACT:

**Aida Bargués Tobella** (Project Lead)  
Swedish University of Agricultural Sciences (SLU)  
[Aida.Bargues.Tobella@slu.se](mailto:Aida.Bargues.Tobella@slu.se)

Produced by KANDS Collective  
[hello@kandscollective.com](mailto:hello@kandscollective.com)

# RESTORE 4MORE

