RESILIENCE DESIGN FOR WATER AND LANDSCAPES

THE STORY OF THE SPONGE VILLAGE IN ATEGO

A Primer for Agroecosystem Restoration for Climate Action

DRC DANISH REFUGEE COUNCIL

MINISTRY OF FOREIGN AFFAIRS OF DENMARK DANIDA INTERNATIONAL DEVELOPMENT COOPERATION

USAID FROM THE AMERICAN PEOPLE

SCALE Strengthening Capacity in Agriculture Livelihoods and Environment

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About the Danish Refugee Council (DRC)

The Danish Refugee Council (DRC) is a non-governmental organization implementing humanitarian, development, and peacebuilding activities to ensure a dignified life for refugees, internally displaced people (IDP), migrants and communities affected by displacement. In East Africa and the Great Lakes (EAGL), DRC operates in Burundi, the Democratic Republic of Congo, Djibouti, Ethiopia, Kenya, Somalia, South Sudan, Tanzania and Uganda.

About Danida

Danida is the term used for Denmark's development cooperation, which is an area of activity under the Ministry of Foreign Affairs of Denmark. Danida is responsible for the planning, implementation and quality assurance of Denmark's development cooperation and policy which aims to combat poverty through promotion of human rights and economic growth.

About USAID

In support of America's foreign policy, the U.S. Agency for International Development (USAID) leads the U.S. Government's international development and disaster assistance through partnerships and investments that save lives, reduce poverty, strengthen democratic governance, and help people emerge from humanitarian crises and progress beyond assistance.

About SCALE

SCALE (Strengthening Capacity in Agriculture, Livelihoods, and Environment) is an initiative funded by USAID's Bureau for Humanitarian Assistance (BHA) and implemented by Mercy Corps in collaboration with Save the Children. SCALE aims to enhance the impact, sustainability and scalability of BHA-funded agriculture, natural resource management, and off-farm livelihood activities in emergency and non-emergency contexts. Find out more at www.fsnnetwork.org/scale.

About NURI

NURI (Northern Uganda Resilience Initiative) is one of eight development engagements under the Denmark-Uganda Country Program 2018 – 2022. NURI's objective at the outcome level is enhanced resilience and equitable economic development in supported areas of Northern Uganda, including for refugees and refugee-hosting communities. DRC is the implementing partner for market access roads, rural markets and rural water resources management under the NURI program. This has two main components: climate smart agriculture and rural infrastructure under which the Atego training was conducted.

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Prepared by

Danish Refugee Council and the SCALE Award

Principal Contacts

Natalie Topa
Regional Resilience and Livelihoods Coordinator for East Africa and Great Lakes Region, DRC
natalie.topa@drc.ngo

Kristin Lambert
Program Director, SCALE Award
klambert@mercycorps.org

CONVERSATIONS IN ATEGO

“

Atego Village is not what it used to be when we were younger.

Back then you would step out of your home to be greeted by the rolling hills lush with grazing pasture and the majesty of the verdant forests. The land fed us and cured us: there were beautiful, clean and accessible springs where we drew water and sweet, ripe fruits fell from the traditional trees that dotted the landscape. We hardly had any use for modern medicine; what we ate supplied all the nutrients our bodies needed and if we did get sick, there were medicinal plants all round that could be ground and brewed or chewed to provide relief.

But this is a story of the past.

The Atego of today is nothing like what I remember. Each year now, the valley floods where my village and the neighbouring village cross over to one another. Once this happens we’re each locked on our sides of the valley, unable to commune with one another until the rains subside and the valley bottom, once again, becomes passable. I want to live in the Atego of my grandparents, of my great-great grandparents: an Atego of abundance, a greener Atego where birds, bees, our animals and my people thrive.

Akumu Beatrice
Atego Village.

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INTRODUCTION

This primer is designed to support those working in humanitarian and development contexts by highlighting a design process for increasing community resilience to shocks and stresses ranging from social and economic upheaval to natural disasters such as floods, drought, increased heat and aridity, loss of living soils and biodiversity, and compromised ecosystem services due to degenerative land practices. The design process described in the following pages is based on low-cost, low-tech, process-based solutions that mimic natural processes and ecological cycles.

The application of this approach can open up opportunities for new livelihoods based upon organic food systems, while buffering communities from the impacts of weather and climate-related shocks and stresses.

Climate Resilience is Rooted in Ecological Health

With the unpredictability brought by the climate crisis and widespread ecological degradation, people around the world are experiencing erratic rainfall, extreme temperatures and, unpredictable weather patterns that threaten their crop and livestock production.

Compounding the effects of climate change is land degradation, which severely impedes a landscape's capacity to buffer extremes and contributes to the recurring flood and drought cycles experienced by many communities.

Land degradation, soil erosion and biodiversity loss curtail the ecosystem services – such as hydrological regeneration and soil health - that provide stability and resilience to a landscape, as well as secure living conditions.

Restoring ecosystem services is critical to creating a resilient and long-lasting relationship between people and the landscape upon which they rely.

Through a conscious Resilience Design process, programming within humanitarian and development contexts can positively affect the way that communities experience climate and weather extremes by mitigating land degradation and practically rebuilding their ecological support systems.

Climate Change and the East African Region

Landscapes across East Africa are in a rapid process of degradation and declining ecological health. These conditions are exacerbating natural disasters and extreme weather events which, in turn, are causing destruction to infrastructure, assets, food security and livelihoods.

Communities in East Africa, like people in regions around the world, rely on the ecology in which they live. East African countries from Kenya to Uganda and Ethiopia bear the impact of climate change in their capacity to grow food and access vital natural resources. Shocks and stressors in the local ecology can undermine community stability and security, contributing to conflict and in some cases, forced migration. Through land regeneration, natural cycles can be restored and the ability of communities to claim their socioeconomic rights in a sustained way is protected.

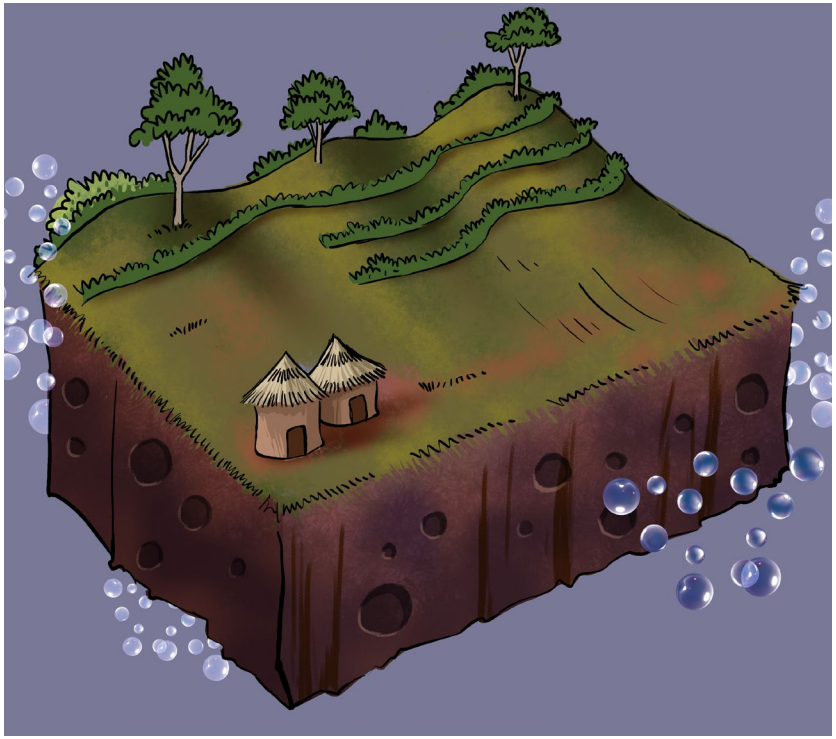
It is our hope that this primer inspires readers to discover how these interventions can be adapted and applied to their own contexts.

WHAT IS A SPONGE VILLAGE?

A sponge denotes an absorbent material with the capacity to capture and store moisture, liquid and other elements. A Sponge Village mimics the function of a sponge: it soaks up the energy and resources flowing through it and stores them for the long-term productivity and resilience of both the land and people.

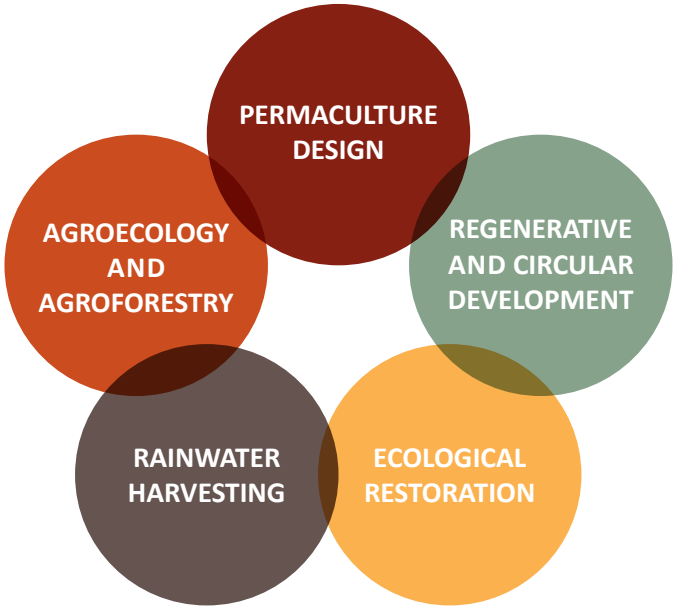
A Sponge Village can be created by designing a landscape such that energy — in the form of water flows, plant debris and other organic matter — becomes trapped and breaks down into the land, thus increasing the land's capacity to retain water and nutrients long after the rains have gone.

The vision shared by NURI and the community is that Atego village and the surrounding landscape (where the program takes place) become a Sponge Village — that is, a place where the water and nutrients flowing through are retained, and the trees and natural features of the land are restored to support the community's long-term resilience.



DESIGNING FOR RESILIENCE

Resilience Design[1] is an interdisciplinary approach for humanitarian and development programming that is primarily based on the permaculture methodology. This design framework strengthens the resilience of communities and their ecological systems to shocks and stresses related to climate change, land degradation and economic factors through: enhancing ecosystem services; increasing energy efficiency; increasing income; contributing to increased nutritional status; and strengthening the skill set, adaptability and confidence of smallholder farmers. It incorporates and is informed by the ideas and approaches noted in the graphic below.



[1] *Mottram, A., Carlberg, E., Love, A., Cole, T., Brush, W., and Lancaster, B. Resilience Design in Smallholder Farming Systems: A Practical Approach to Strengthening Farmer Resilience to Shocks and Stresses (Washington, DC: The TOPS Program and Mercy Corps 2017).*

Permaculture

An interdisciplinary, system-based design science applied to natural, built, social and economic environments and planetary systems

Agroecology

A farming system focused on food production that makes the best use of nature's goods and services while not damaging these resources

Agroforestry

The intentional integration of trees and shrubs into crop and animal farming systems to create environmental, economic, and social benefits

Rainwater Harvesting

The collection, storage, protection and utilization of rain, rather than allowing it to run off of a landscape

Ecological Restoration

The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed

Circular Economy

A circular economy is a systemic approach to economic development designed to benefit businesses, society, and the environment. In contrast to the 'take-make-waste' linear model, a circular economy is regenerative by design and aims to gradually decouple growth from the consumption of finite resources.

FOUNDATIONS OF THE INTERVENTIONS

Resilience Design integrates principles of permaculture, passive water harvesting, agroecology, and agroforestry. The interventions highlighted in this primer are guided by the integration and synergy between these three elements:

GEOLOGY

refers to the soils, stones, landscape features and their mineral elements, as well as the shape that forms the unique topography within a landscape.

BIOLOGY

is the life in and above the soil. It is all the living systems including plants, animals, and soil microbes.

HYDROLOGY

is the current of life in the system. It is the water that passes above and below ground and allows for life above and within the soil to thrive.

6

Important Indicators in the Landscape

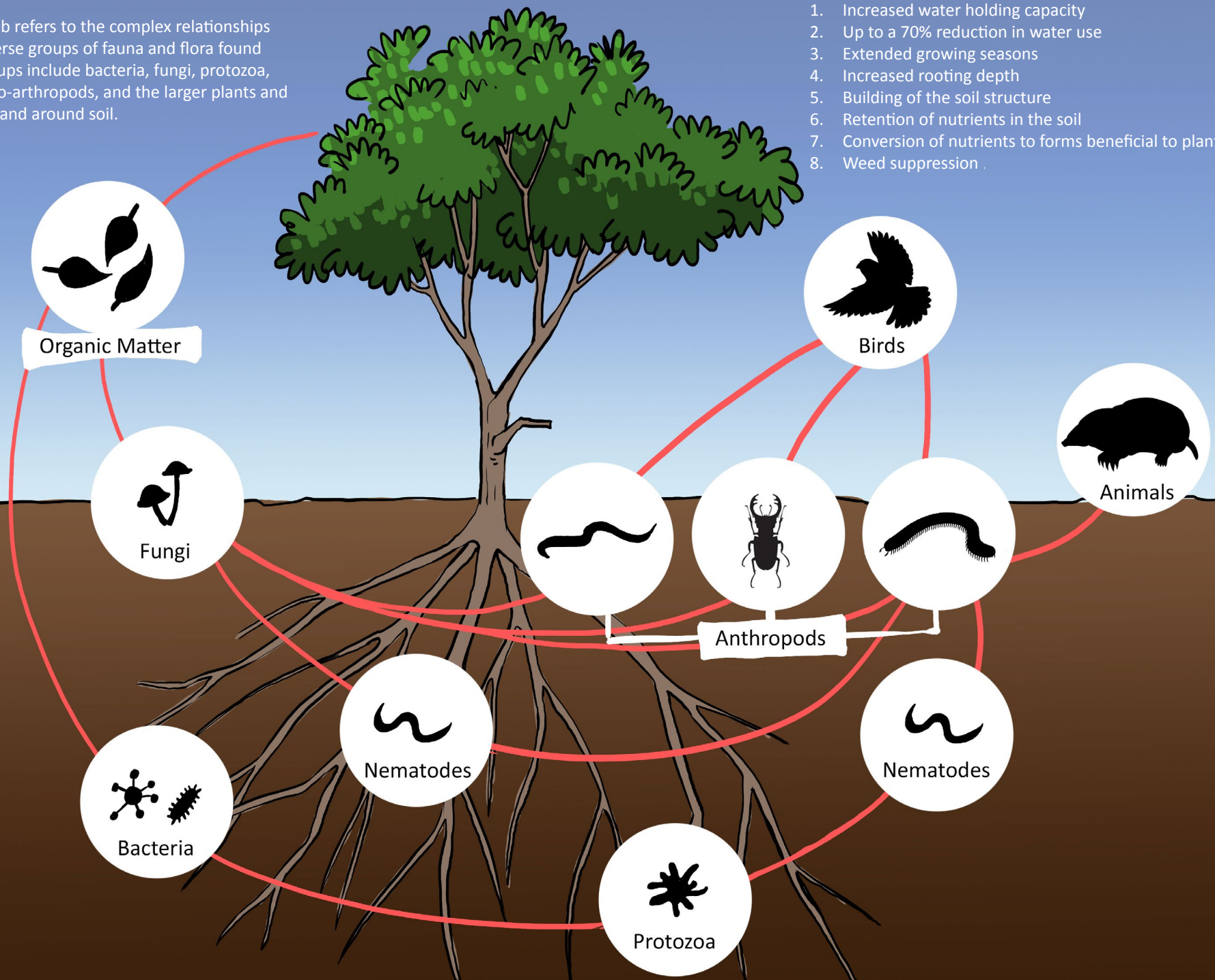
- THE SHAPE OF THE LAND
- THE TYPES OF VEGETATION
- RAINWATER FLOWS AND RECHARGE CAPACITY
- SOIL TYPES
- GEOLOGICAL STRUCTURES AND FORMS
- HUMAN INFRASTRUCTURE

SOIL FOOD WEB

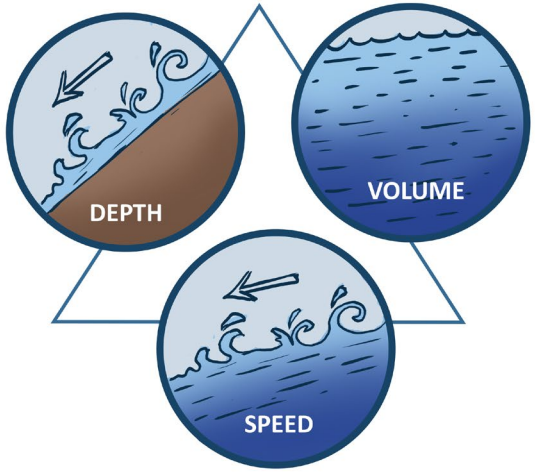
The Soil Food Web refers to the complex relationships between the diverse groups of fauna and flora found in soil. These groups include bacteria, fungi, protozoa, nematodes, micro-arthropods, and the larger plants and animals found in and around soil.

Benefits of having an intact Soil Food Web in your growing systems include:

1. Increased water holding capacity
2. Up to a 70% reduction in water use
3. Extended growing seasons
4. Increased rooting depth
5. Building of the soil structure
6. Retention of nutrients in the soil
7. Conversion of nutrients to forms beneficial to plants
8. Weed suppression



EROSION TRIANGLE



Water gains energy through three main characteristics: speed, volume and depth. These three elements add force that can be destructive and erosive; hence, by reducing any one of these elements, erosion caused by water can be mitigated.

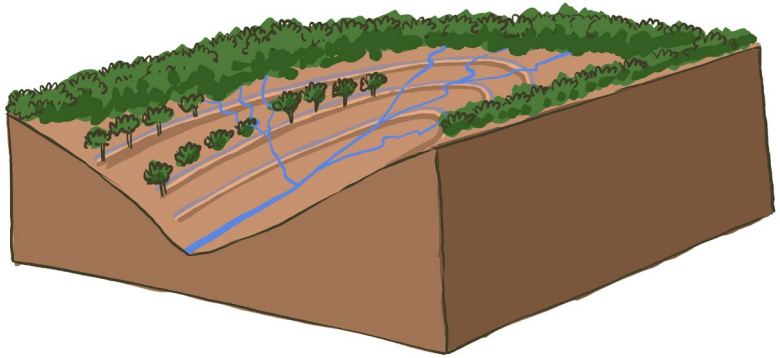
Decreasing the **speed** of water allows more time for it to linger and saturate surfaces that it comes into contact with.

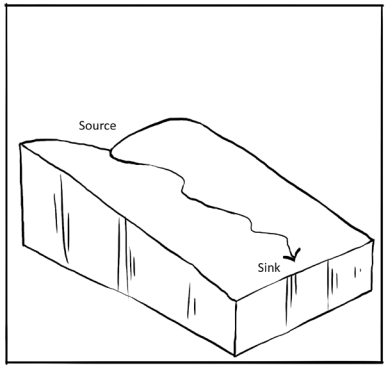
The greater the **depth** of water, the more power it has to erode and carry sediment. Interventions that work towards decreasing the depth of water also, by consequence, reduce its destructive power.

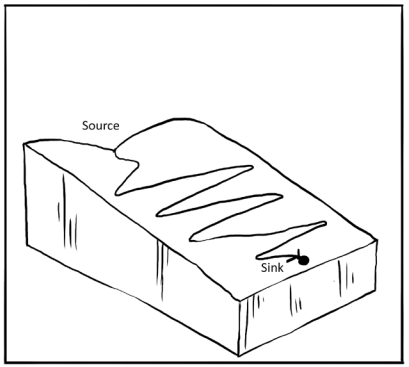
The greater the **volume** of water, the more carrying capacity it has to deliver sediment and debris away from the system.

By slowing, spreading and sinking water into the ground, the water's speed, volume and depth are pacified. This reduces the risk of water causing lasting damage, and instead captures the life-giving properties of water flows.

SOURCE TO SINK







Unimpeded water with a direct path out of a landscape will be rapidly lost. This dehydrates the landscape as water is unable to linger, saturate the soil or feed plant life.

By changing the course of the water such that it has to take the longest and slowest path out of a landscape, the amount of time that water can linger is increased; it has time to quench the soils and feed plant life. Resilience Design functions to identify a circuit that will allow water to remain and hydrate the land for as long as possible, before slowly departing the system.

WHY ATEGO?

Region: Padyere, Nebbi District, Northern Region, Uganda

Latitude: 2° 26′ 8″ N

Longitude: 31° 8′ 45″ E

The Atego community, like many in the region, is directly experiencing the ripple effects of collapsing ecologies, such as extreme water events, massive soil loss, drought, increased aridity and higher temperatures. These changes have led to a lack of arable land and safe, clean water to support families, their livestock and their livelihoods even while competition is rising over the dwindling resources.

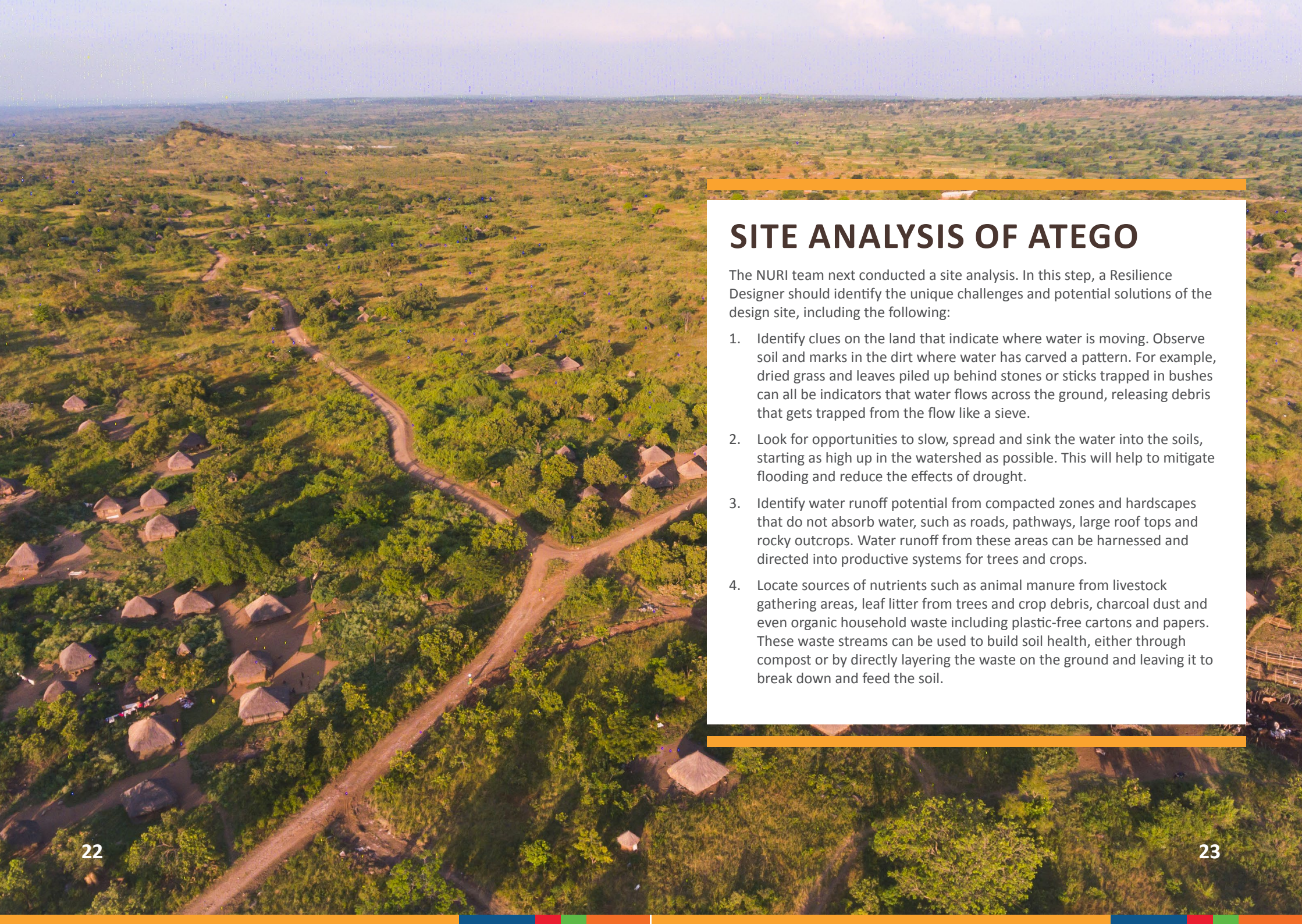
When the NURI team introduced the opportunity for a Resilience Design training, the Atego community members responded positively. They were eager to learn new perspectives and skills, and to work side-by-side with staff and local government engineers to implement strategies that would improve their landscape. Community leaders were likewise quick to mobilize and motivate families to join in the vision of restoring the vitality of their landscape.

The NURI team also chose Atego because the challenges it faces typify the challenges facing communities around the globe. As a result, NURI knew that the strategies demonstrated through the training could easily be replicated and cascaded into other communities.

ATEGO LANDSCAPE: A BIRD'S EYE VIEW

The Atego Resilience Design training began with a site assessment. There are a few key characteristics a Resilience Designer should look out for when completing this step:

- "Highways" and "parking lots" of water: Highways refer to pathways of water flow, such as erosion scars and gullies where water clearly drains out of the system. "Parking lots" refer to the places where water stops. This is where moisture and organic matter settle, creating rich fertility in the soil and recruiting vegetation through trapped seeds. These areas, in turn, become thriving stations for soil life and other wildlife.
- Topography and Tree Cover: How is the landscape shaped? Which direction does the slope face in relation to the sun? Is there adequate tree cover for healthy hydrological processes?
- Infrastructure: Where are the houses, the shops, the schools, and the roads located?



SITE ANALYSIS OF ATEGO

The NURI team next conducted a site analysis. In this step, a Resilience Designer should identify the unique challenges and potential solutions of the design site, including the following:

1. Identify clues on the land that indicate where water is moving. Observe soil and marks in the dirt where water has carved a pattern. For example, dried grass and leaves piled up behind stones or sticks trapped in bushes can all be indicators that water flows across the ground, releasing debris that gets trapped from the flow like a sieve.
2. Look for opportunities to slow, spread and sink the water into the soils, starting as high up in the watershed as possible. This will help to mitigate flooding and reduce the effects of drought.
3. Identify water runoff potential from compacted zones and hardscapes that do not absorb water, such as roads, pathways, large roof tops and rocky outcrops. Water runoff from these areas can be harnessed and directed into productive systems for trees and crops.
4. Locate sources of nutrients such as animal manure from livestock gathering areas, leaf litter from trees and crop debris, charcoal dust and even organic household waste including plastic-free cartons and papers. These waste streams can be used to build soil health, either through compost or by directly layering the waste on the ground and leaving it to break down and feed the soil.

INTERVENTIONS IN ATEGO

The following section presents how regenerative thinking and a principles-based approach can help to heal the ecological base for survival, vitality and resilience of communities in East Africa. The primer shares methods and activities in one training conducted by the Danish Refugee Council under the DANIDA NURI program. It highlights methods and activities from one training conducted by the Danish Refugee Council under the Danida-funded NURI program.

INTERVENTION DESIGN FOR ATEGO

AERIAL VIEW OF ATEGO

HAND-DUG DAMS

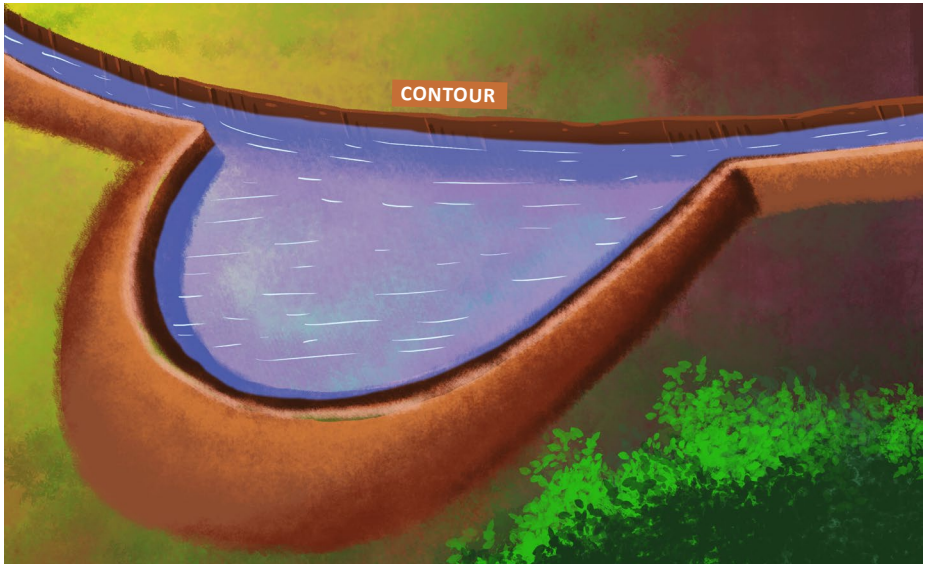
Hand-dug dams can be a great intervention when surface water is needed for livestock water or irrigating crops. These dams are smaller in size and labor-intensive to build, but ultimately cost-effective and can be integrated throughout a landscape. Constructing surface water retention systems can strengthen a community's livelihoods base while also buffering them against the effects of climate change.

Why this intervention?

To create surface water storage for livestock watering, brick building, irrigation of crops and other essential uses using only hand tools and labor.

Location Within the Landscape

1. Ensure proximity to the village, farm or livestock kraals for access, efficiency and ease of use.
2. Locate in an area safe from flooding that is not in the pathway of major water events. In the Atego Sponge Village model, an interconnected "spill and fill" system linked water retention systems (surface level dams) with infiltration systems (bioswales on contour) to spread and sink water into the landscape. This modest hand-dug dam was strategically connected through bioswales to increase the dam's catchment and potential for capturing water. Overflow of the dam either spills out into back flood swales that continue to hydrate the land or spills out gently through strategically placed spillways.

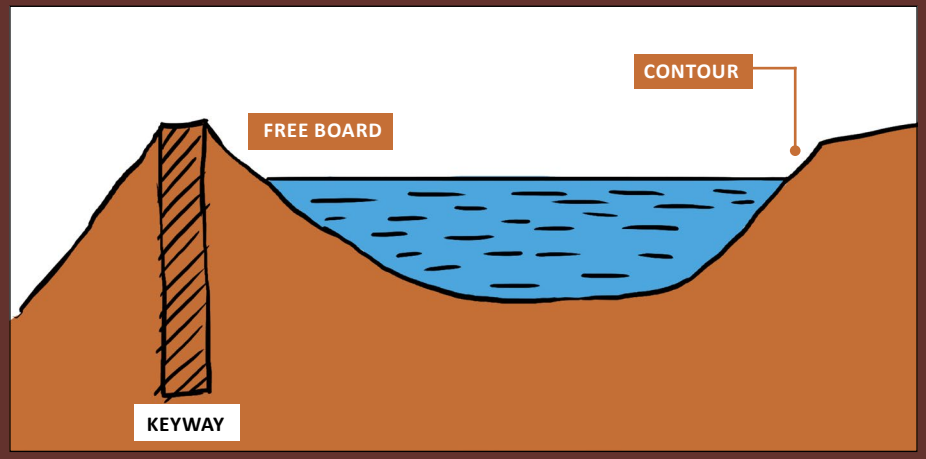


Design Steps

1. Ensure the dam is located close to where it is needed, while also protected from heavy water flow and extreme water events.
2. Clay is key to creating a safe dam that can hold water long-term. Ensure there is clay content in the soil so that it can be sealed through compaction using locally made hand tools.
3. Determine the size of the dam based on the landform and what will be feasible given the time and energy required to dig and form it adequately.
4. Decide on the best shape to maximize water storage with the least effort. In the case of Atego, a contour dam was constructed based on the natural slope of the land and was connected to another dam along the same contour.
5. Determine where the water line is. This is the level that water will fill up to before it exits through the spillway or back flood swale. The water line should be mapped out across the entire inner wall of the dam to visualize the depth of water when at capacity, and to ensure consistent height of the freeboard (the proportion of dam wall above the water line).
6. Follow standard earthen dam-building protocols[2] to ensure the dam's integrity.

[2] *Brad Lancaster, Rainwater Harvesting for Drylands and Beyond (Arizona: Rain source Press Pub, 2019).*

HAND-DUG DAMS



BEFORE

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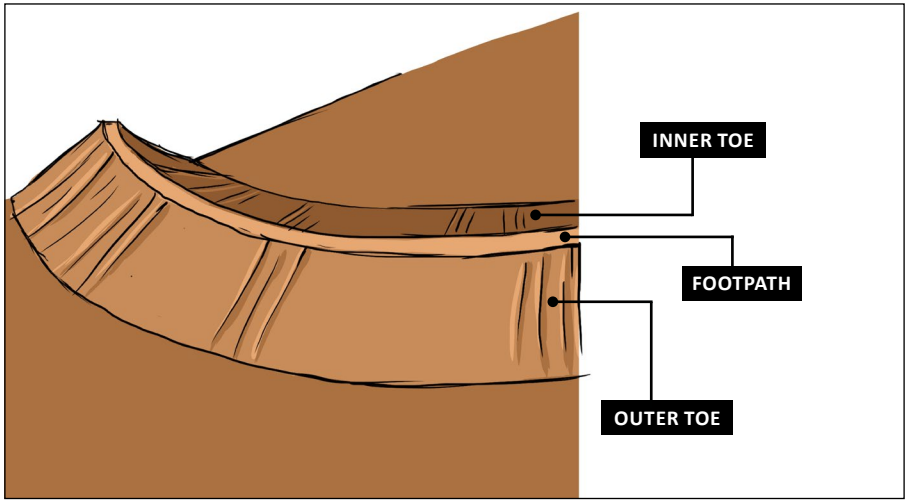


MACHINE-DUG DAMS

Two types of machine-dug dams were constructed in the Atego Sponge Village based on the natural contours of the landscape. The bioswales constructed on either side of the dam act like arms that reach out and capture more water to fill the dam. Additionally, they allow an exit point for water which fills back into the swales before sinking back into the soil. The two machine-dug dams were:

- A **valley dam** which takes advantage of the holding shape of a valley. Though valley dams are often located in the valley floor, placing them higher in the landscape can catch and reduce water volumes before they cause large water events.
- A **contour dam** whose shape is determined by the land contour and can take on a half-moon or oblong shape depending on soil type and amount of material available.

Why this intervention?

A machine-dug dam is larger than a hand-dug dam and is intended to address several needs:

- Ensure access to surface water which is needed for essential human domestic needs, groundwater recharge, irrigation of crops and trees, aquaculture development and livestock watering.
- Bank water for extending agricultural growing seasons.
- Mitigate flooding.

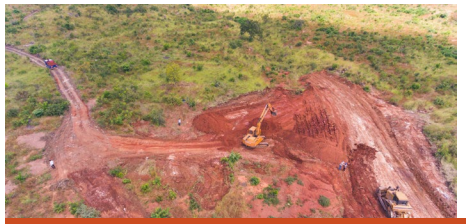
Location Within the Landscape

1. Determine the best location of the dam in relation to landform, water flows and catchment areas. Identify sites that can be connected to adequate water catchment yet protected from flood flows. Generally we DO NOT locate valley dams low in the watershed where they are susceptible to flood flows.
2. Different types of dams include contour dams, saddle dams, ridge dams, key point dams and valley dams (the most common type).
3. Contour, ridge, saddle and keypoint dams can all be paired with water harvesting bioswales to increase their catchment areas and give opportunities to locate the spillway far away from the dam wall which reduces the chance of undermining the integrity of the dam during flood conditions.

4. We recommend looking at the Permaculture Designer's Manual[3] for more information on dam planning and construction and connecting dams with bioswale structures

Design Steps

1. Conduct excavations where the dam material will be drawn to determine if the soil make-up has adequate clay content to hold water.
2. Consider the sun aspect and its effect on the water surface, as this will influence the rate of water evaporation.
3. Determine the water lines which will influence the best placement of the dam wall in relation to the catchment bioswales and overflow spillways.
4. Calculate the inner and outer toes of the dam wall, which would be 3x the height of the wall from grade for the inner toe and 2.5x the height of the wall for the outer toe, as this will determine how far the dam wall will extend out from the center of the machine-compacted wall and give the dam its structural integrity.
5. There are many other critical steps in the process of building an earthen dam. Please follow the standardized engineering protocols for earthen dam building[4] to ensure the structure's integrity.




VALLEY DAM


CONTOUR DAM

[3] *Bill Mollison, Permaculture: a designers' manual (Australia: Tagari Publications 1988)*
[4] *Brad Lancaster, Rainwater Harvesting for Drylands and Beyond (Arizona: Rain source Press Pub, 2019).*

ROAD WATER HARVESTING

Road water harvesting is a practical way to divert runoff waters and nutrients from roads (and pathways) into nearby downslope farms and garden systems. This is referred to as stormwater 'run-on' versus 'run-off' as water is actively brought into the system.

Why this intervention?

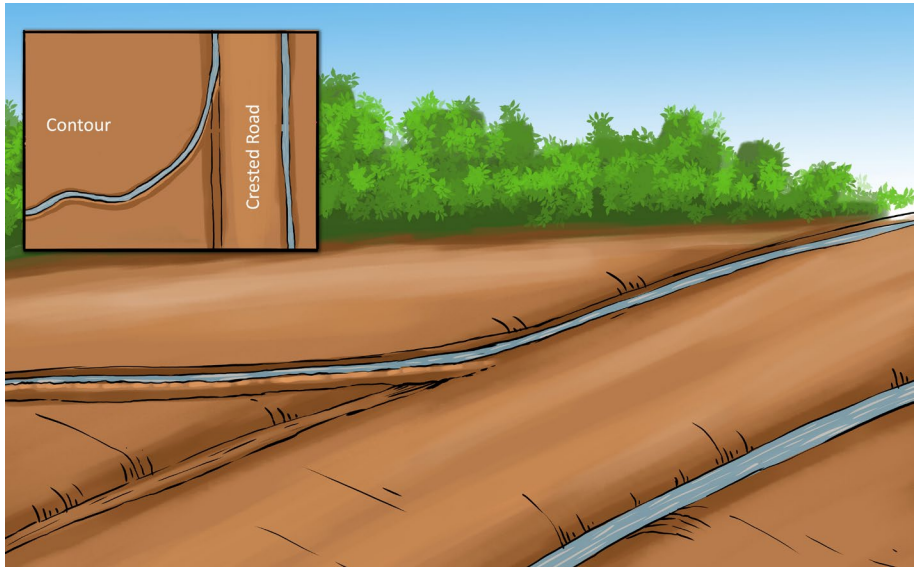
1. To reduce damage to roads from flooding.
2. To reduce the water that contributes to large floods lower in the watershed.
3. To convert erosion caused by road run-off into food production.

Location Within the Landscape

1. Locate rainwater harvesting structures at key points in the drainage along the road.
2. Look for places where flooding occurs and where best to divert that water into production.

Design Steps

1. Determine what to connect the road water to, such as a garden, farm or dam and select which contour line connects the destination of the water with the road or water source flow.
2. Determine what growing areas downslope from the capture points could benefit from additional water and nutrient resources.
3. Utilize strategies like rolling berms, water bars, 3% road drains connected to out-sloping to effectively direct the water off the road and reduce sedimentation, ensuring the water flows into its associated siltation traps and water infiltration structures.
4. Direct water from small culverts into rainwater harvest structures feeding forestry and agricultural systems where appropriate.



FOOD FOREST

A food forest is a planting strategy to rehabilitate a damaged landscape, create an area of water banking and recharge, and provide a stable system of production for perennial food, fuel, fodder, fiber, fertility, and pharmaceuticals.

A food forest should be anchored by indigenous wild tree species and integrated with tree crops. The trees species selected for the food forest were based on the desire to bring species recovery and biodiversity security to the community. The training demonstrated how strategically blending indigenous, wild and traditional trees with responsible exotics and market-oriented products, one food forest can support a community's needs for food, fodder, fiber, fuel, fertility, pharmaceuticals and finance.

Conversations with the community emphasized the need to restore the traditional and historic diversity of trees that were commonly found in the landscape just a generation ago. The Food Forests of Atego featured local, indigenous trees enhanced through pruning, water harvesting and natural fertility, as well as newly planted trees for food and timber crops for home and market. Together, the food forests will stabilize the land and hydrology while increasing nutrition and income.

Beyond the forest products, the function of a food forest is to harvest, sink and store water.

Why this intervention?

1. To reduce erosion by slowing the spreading and sinking water into the landscape for year-round growth.
2. To develop food security in a rapidly changing climate.
3. To build a spongy forest floor that holds water and moisture, and is a reserve for critical soil life, fertility, and resilience of the land.

Location Within the Landscape

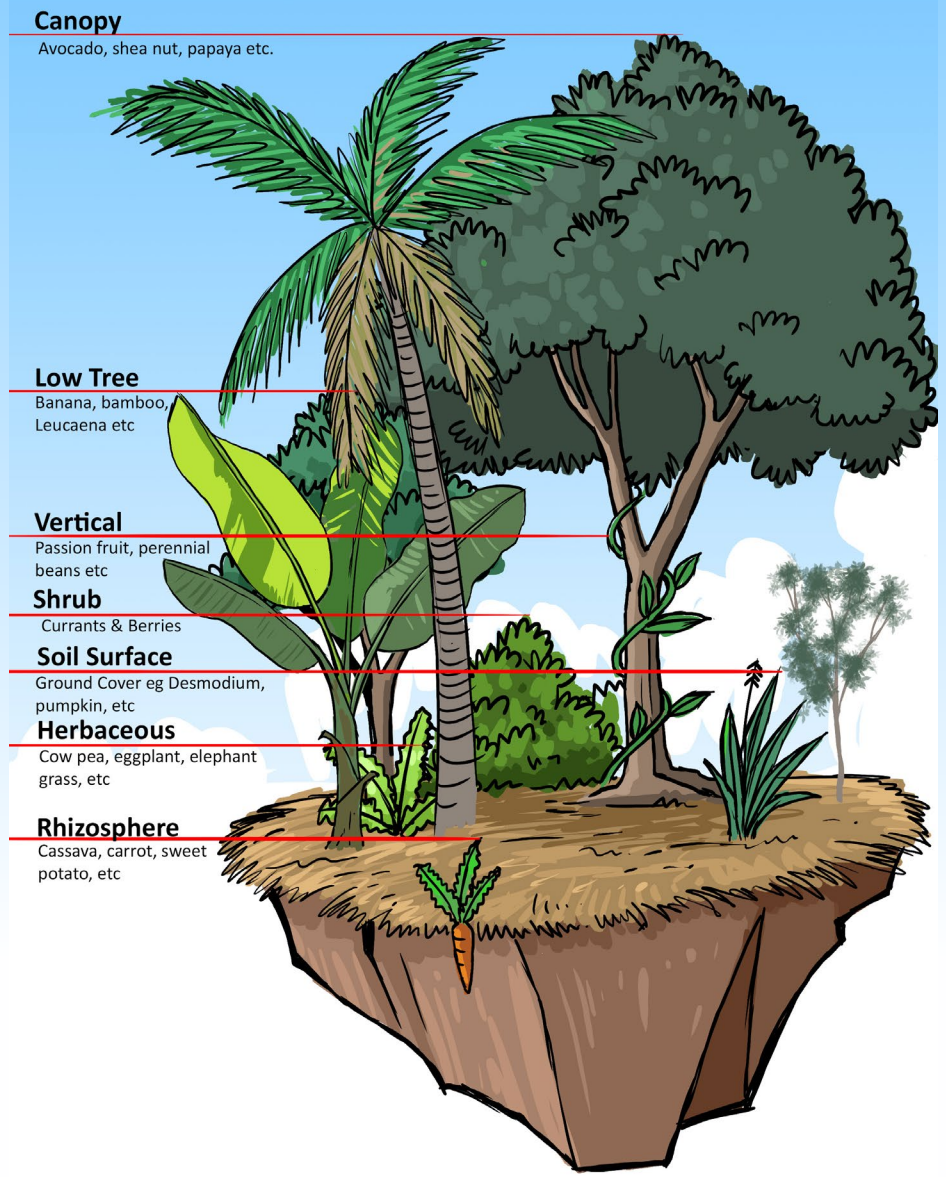
1. Areas that could contribute to the mitigation of flooding downstream.
2. Close to the community for tending and harvest on a regular basis.
3. Where existing vegetation can be integrated and constructively pruned.

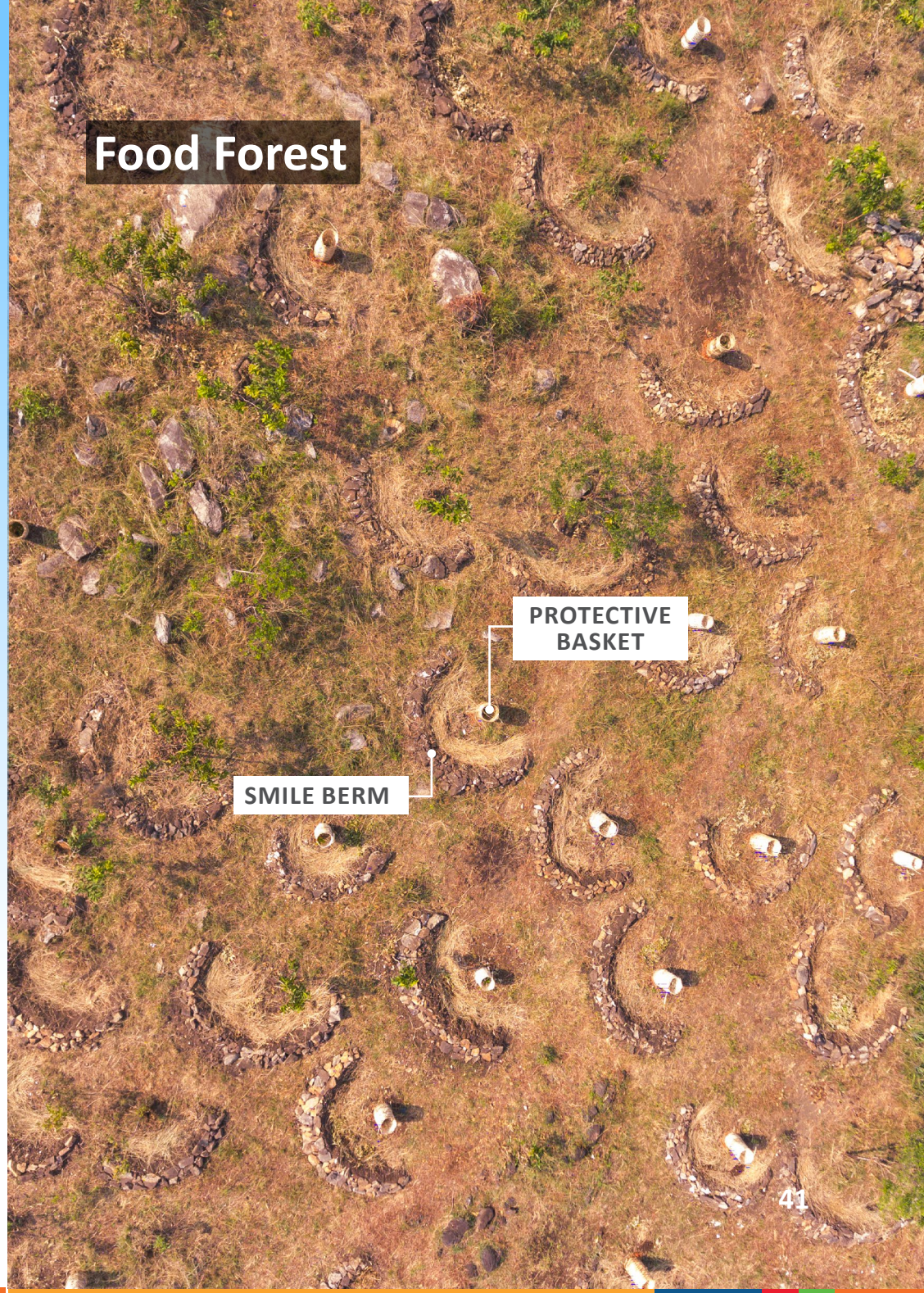
Design Steps

1. Consider the advantages and disadvantages of the solar aspect of the site and the effects of wind.
2. Situate it close to the community for ease of harvesting.
3. Choose existing indigenous vegetation species to introduce and start developing the food forest.
4. Create water harvesting structures and patterns to best utilize rainwater and nutrient flows for each tree/plant. Strategies such as bioswales and smile berms in a net and pan pattern would be ideal for this.
5. Follow protocols for developing a food forest.[5]

[5] *Patrick Whitefield, How to Read the Landscape (England, Permanent Publications, 2015).*

7 Layers of a Food Forest





FARMER-MANAGED NATURAL REGENERATION (FMNR)

Farmer-managed natural regeneration (FMNR) is a low-cost, sustainable land restoration technique used by different communities to restore vegetation cover at reduced costs. It involves the systematic regeneration and management of trees and shrubs from tree stumps, roots and seeds, and can lead to increased food and timber production as well as enhanced resilience to climatic extremes.

Why this intervention?

Many plants and shrubs growing in the landscape are, in actuality, baby trees that are unable to grow tall as they are fed on by livestock. As a defense mechanism, they grow many smaller branches. By strategically trimming these branches, the tree can use its energy to grow into a taller tree which can provide shade to the soil and slow down the energy of harsh rainfall which erodes living soils.

Location Within the Landscape

All locations with desirable trees are appropriate for FMNR as it is a strategy for existing trees to mature and rapidly improve health.

Design Steps

1. Select a tree and examine the branches. Identify the 2 or 3 primary branches that seem to be the main tree trunk branches.
2. Use an A-Frame survey tool to make a water harvesting smile berm. Begin with creating a contour by starting with one foot of the A-Frame on the spot where the tree will be planted then find the corresponding contour mark on either side of where the tree will be. Use the A-Frame to then connect the two contour marks with a semi circle on the down-slope side which makes the "smile" then dig the trench along that line and make the berm on the downslope side of the excavation. Be sure the berm height is higher than the original two contour marks.
3. Using hedge clippers or a panga, and without damaging the main parts of the tree, chop branches at the base of the tree until only the 2-3 primary branches remain. The leftover woody matter can be chopped small to deter removal for use as firewood.
4. Place the chopped branches, stick, twigs and leaves inside the smile berm so that they can break down and build soil to feed the tree as they decompose.
5. Follow the recommended design steps for FMNR.[6]

[6] *Bill Mollison, Permaculture: a designers' manual (Australia: Tagari Publications 1988)*

PERMAGARDEN

A permagarden is a biointensive garden design that makes use of local organic resources and has deep soil preparation. By design, a permagarden creates a microclimate that is conducive to the growth of healthy plants. The design includes nutrient integration, rainwater banking, wastewater integration, biodiversity, and protection from animals, pests, disease, and other negative external influences.

A permagarden is anchored by trees and shrubs that can provide perennial stability to the garden and act as an engine for biomass needed to build the garden soil. The permagarden at Atego was specifically designed to address seed insecurity in the community and the loss of indigenous crops which were previously found throughout the valley. To create a community seed source, the garden emphasizes neglected and underutilized or orphaned crops with seeds that can be locally adapted, saved, and planted again and again for true seed security and resilience.

Why this intervention?

1. To build food, nutrition, and seed security.
2. To integrate local varietals, indigenous and wild plants, anchored by permanent trees and shrubs.
3. To minimize or eliminate costs of external inputs, especially petrochemicals such as pesticides and fertilizers that harm soil life.
4. To utilize biointensive planting methods to grow more crops in unused spaces.
5. To demonstrate how to create a more sustainable, organic food production system that brings nutritious foods close to home in uncertain times.
6. To demonstrate how flood protection for roads can go hand in hand with agroecosystem development.

Location Within the Landscape

Permagardens are ideally located close to homes or villages and downslope from major nutrient sources such as a cattle kraal, chicken house, or concentration of nitrogen-fixing trees. This allows gravity and rainwater to naturally wash those nutrients into the water and production systems.

PERMAGARDEN

Design Steps

1. Identify external influences, such as sun, wind and potential water flow from the slope of the land and consider how to harvest and optimize the beneficial elements of those, while minimizing any negative impacts (such sun exposure, high winds, etc.). Existing structures such as houses, fences and large trees can provide protective shade from the harsh west sun. This means that the east side of large structures can often be ideal for placing a permagarden.
2. Engage the community in identifying resources for building soil health. These can be "brown" (carbon) materials such as dried leaves, sticks, twigs, dried grass, dried crop debris, paper and carton waste, and "green" (nitrogen) materials such as food waste, manure and green leaves. Charcoal dust can be added and a modest amount of ash. These materials will feed soil microbiology, enrich the soil, and create nutritious crops.

3. Locate the permagarden near the house or village so it can be tended and harvested daily.
4. Determine the flow of water over the landscape. Where there is space, use an A-Frame survey tool to identify the natural patterns and contours of the land. In small spaces, a small A-Frame can be used instead.
5. Determine the number and size of water harvesting bioswales and their overflow spillways that will allow space for the garden beds.
6. Dig bioswales on contour which will harvest water and hydrate the soil that will feed the garden beds. The bottom of the swale can be mulched as well. Swales should be covered in an upright growing trellis installed to provide shade to the water and moisture collected inside. The trellis can be planted with vines, preferably perennials such as climbing beans, chayote squash and passion vine which reduce wind and protect the garden from harsh direct evening sun.
7. Using string, measure out the garden beds downhill from the bioswale, oriented along the same contour line as the bioswale. Ensure there is at least one meter between the garden beds and the berms (bumps) of the bioswale, and between other garden beds. This allows space to maneuver around the beds even if they are fully grown with big leafy greens that fill in the space.
8. Garden beds should be marked on contour, so the length of the bed is parallel to the bioswale. The beds can be long and rectangular in shape, but they should not be wider than 1 meter, such that people can access the center of the bed without stepping on either the bed or the prepared soil.
9. Before planting the garden beds, design a living fence that will protect the garden from grazing animals and distinguish the area as a production zone.
10. Prepare the top of the garden bed by adding dried manure, massaging the soil, and breaking up clumps to ensure that the soil is as fine and soft as possible.
11. Finally, plant the garden in a biointensive manner and follow the guidance found in the Permagarden Technical Manual.[7]

[7] *Bill Mollison, Permaculture: a designers' manual (Australia: Tagari Publications 1988)*

PERMAGARDEN

Seed Security

Our living planet is replete with complex biodiversity that has evolved over billions of years. This has created the rich agrobiodiversity that has fed human communities for hundreds of thousands of years. This natural diversity ensures a foundation of food, seed, and nutrient security that is naturally adapted to all bioregions of the earth, shaping human cultural diversity. With the introduction of modified seeds and the global promotion of market-oriented crops, poor communities worldwide have experienced weakened agroecosystems. Many places now have both traditional seed systems and formal seed systems, the latter of which may promote the use of hybrid seeds which are not able to regenerate. They quickly lose viability, meaning they can not be locally adapted, saved, shared, stored, and regrown. This has resulted in the deterioration of heritage food cultures and food sovereignty, and increased reliance on formal market seed systems.

According to a 2015 FAO report, over 75% of global crop varieties have gone extinct due to a shift from farmer-led to corporate-led seed systems. With this in mind, DRC prioritizes support to farmer-led seed systems and the right of farmers and communities to regenerate their traditional seed stocks from one generation to the next to ensure long-term resilience to food, soil, and seed insecurity. In Atego village, the Permagarden works as a seed bank to preserve and protect under utilized, orphan, and neglected crops that hold the local historical food culture. The Permagarden varieties were selected in direct response to community feedback on the issues of loss of diversity in traditional foods and seeds. This will facilitate the community's ability to save, store and regenerate traditional crops from year to year, protecting nutritious organic foods that celebrate and protects the local food culture. Ancient grains such as millet and sorghum, leafy green vegetables, diverse fruits, beans, pumpkins, gourds, nuts, and seeds make up the traditional plate of Atego and have contributed to the historical resilience of the people here.

ADDITIONAL INTERVENTIONS

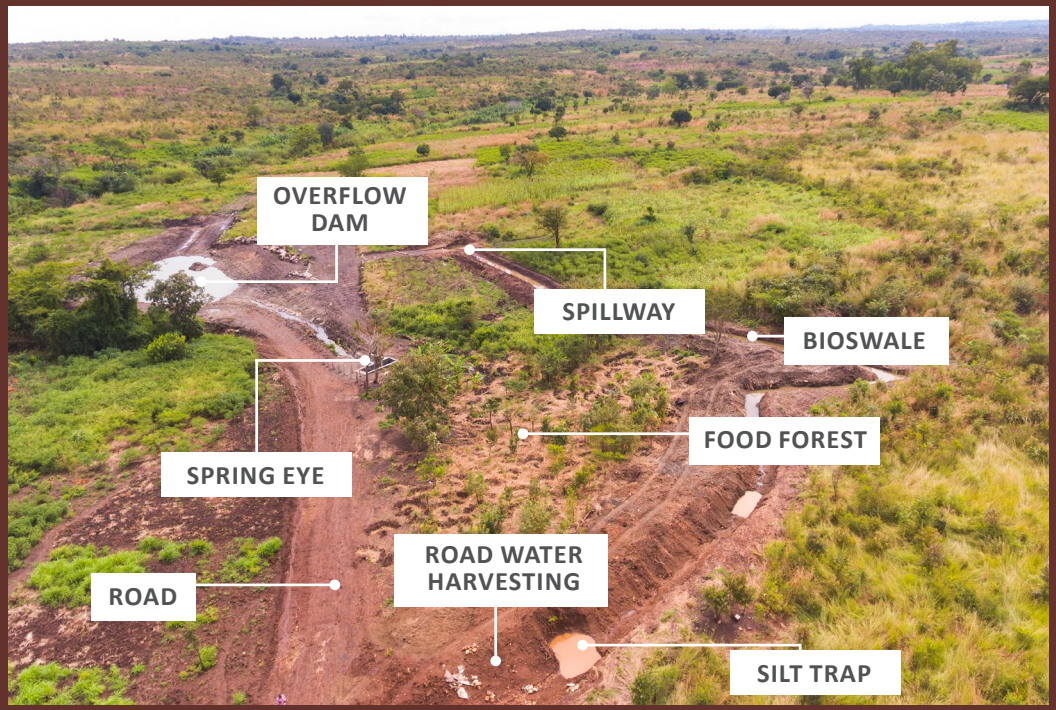
These interventions were not implemented in Atego, but were successfully carried out in the northern Ugandan communities of Nebbi and Arua as part of previous Resilience Design training programs.

SPRING RECHARGE

Spring recharge strategies are appropriate in places where the ecology supporting the spring lines has been degraded, water flows have dried up or the spring has ceased to produce.

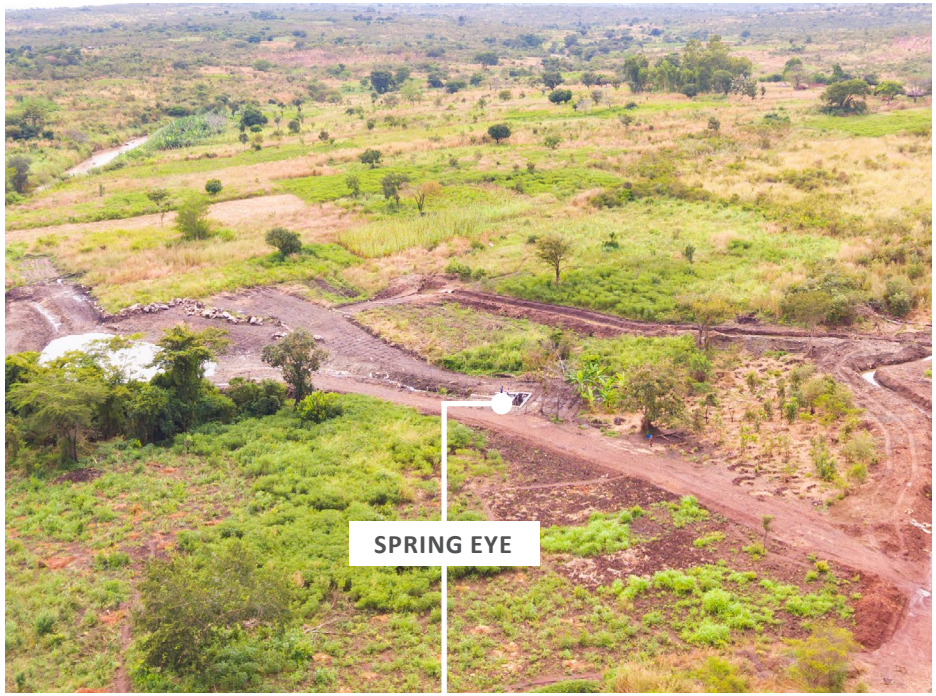
Location Within the Landscape

1. In the catchment area upslope from the eye of the spring where the underground water surfaces. Springs are often found in places where the natural curves of the landscape shift from convex to concave. This is where spring eyes often appear naturally.
2. Where restoration of the hydrological cycle is possible with rainwater harvesting structures and plantings.



Design Steps

1. Identify the spring catchment.
2. Look for opportunities within the spring catchment to trap and infiltrate as much water as possible with interventions such as earthworks and stone works. This can include bioswales, smile berms with tree plantings, rock check dams and leaky weirs that slow, spread and infiltrate water into the ground where the spring line is located.
3. Look for areas of stormwater run-on such as roads, footpaths, erosion scars and gullies that can be captured into bioswales to increase the volume of water that can infiltrate into the spring recharge catchment.
4. Conduct FMNR-style pruning of existing trees (see page 43) and fit them with water harvesting smile berms as illustrated on page 42.
5. Determine where upslope trees can be planted with water harvesting smile berms to assist in the long-term filtration of rainwater deep into the spring line.
6. Eliminate all soil erosion in and around the intervention site using earthworks as well as stoneworks. Plant them with perennial grasses such as Napier, vetiver and reeds, as well as annual grasses to reduce flow of water out of the spring catchment area.
7. Ensure the entire catchment area is shaded or mulched to reduce evaporation of water that would otherwise sink deep into the soil.


SPRING EYE


BEFORE
30 min.
AFTER
1 min.
From 30 minutes to 1 minute to fill a jerry can after using a spring eye!

BOREHOLE RECHARGE

Borehole recharge planning is necessary to ensure the replenishment of rainwater into the active recharge areas within the system. Many boreholes are in areas of landscape degradation where rainwater no longer enters the groundwater. Over time boreholes will dry up seasonally and sometimes permanently. If new boreholes are planned, they should only be installed with an ecological recharge plan to ensure more water moves into the systems as opposed to flowing out.

The design steps are similar to a spring recharge. *(As seen on Page 53)*

BUILDING LASTING RELATIONSHIPS

COMMUNITY ENGAGEMENT

The way a new initiative is introduced in a community can make or break the effort, cause conflict in families and communities, and even put an agency's presence and program at risk. For this reason, every Resilience Design effort should involve community members from the earliest stages and honor their expertise, wishes and goals.

Resilience Design is an inherently participatory process. It relies upon the active involvement and engagement of representative community members from diverse groups such as men, women, elders, the youth, as well as government leaders at the community, local and regional levels.

It is imperative to understand local protocols, lines of authority and locally appropriate ways to engage. It is doubly important to remember that local governance structures and decision-making processes need to be respected and expectations should be carefully communicated and managed. Transparency, honesty and accountability are paramount. Learning is a two-way street and communities have deep and extensive knowledge and experience which provides the basis for understanding the context, challenges, and existing strengths on which to build.

LAND AND CONFLICT

A key part of the community engagement process is understanding the local dynamics concerning land ownership and the community and cultural norms that govern how land is used and managed.

Organizations wishing to implement Resilience Design should always consult customary leadership structures and public sector representatives to develop an appropriate level of understanding of the sensitivities and policies regarding natural resource use and ownership. Whether land holdings are customary or statutory, it is important to approach community dynamics with a lens of conflict sensitivity to avoid missteps that may affect the goodwill and trust the community has in the organization.

Ultimately, local knowledge and experiences drive the success of the Resilience Design process. Any tension or conflict that arises during this journey should be managed by community leadership.

MONITORING AND EVALUATION

For an agroecosystem to be regenerative and, ultimately, resilient it needs to incorporate feedback loops into its ongoing management and design. This ongoing monitoring and evaluation (M&E) process supports farmers to gather the information needed to improve their growing systems and yields and to determine how programs can best support them in those efforts (see the Resilience Design Measurement Toolkit here[8]). Through ongoing feedback and informed adjustments, the farming system will evolve to create the greatest benefit possible. For smallholder farms or permagardens to be called Resilience Design or regenerative, they should meet certain minimum standards.

[8] *Mottram, A., Carlberg, E., Love, A., Cole, T., Brush, W., and Lancter, B. Resilience Design in Smallholder Farming Systems: A Practical Approach to Strengthening Farmer Resilience to Shocks and Stresses (Washington, DC: The TOPS Program and Mercy Corps 2017).*

AND A BIG THANK YOU TO…

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