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Supporting farmer innovation to restore

An illustrated five step guide to applying the Options by Context approach to land restoration

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1 Purpose of this guide

A big challenge to restoring degraded land is that ecological, economic, social, and institutional context differs from location to location, village to village and even household to household. No single technology, intervention or practice will suit all situations. What is urgently needed are **locally relevant options** that will work for different farmers and communities in varying contexts.

The Options by Context (OxC) approach responds to this need by matching and tailoring solutions to local conditions. This manual provides restoration practitioners and trainers with a step-by-step guide on how to apply the OxC approach in land restoration efforts and offers practical examples and case studies from eastern Kenya.

HOW TO USE THIS GUIDE

This icon highlights practical information to keep in mind when implementing the OxC approach.

This icon highlights useful questions to ask as you navigate the OxC approach.

Restoring degraded land

Across the world, there is an urgent need to restore degraded land. Land degradation threatens people's livelihoods and food security, contributes to the loss of biodiversity, and exacerbates the climate crisis by reducing the Earth's ability to absorb and store carbon.

A major cause of land degradation is unsustainable land management practices. For example, deforestation, overgrazing, removal of crop residues, limited use of inputs such as farmyard manure, and practices that lead to soil erosion.

These practices lead to an overall decline in the soil's ability to deliver critical services and functions, including storing soil carbon, cycling of nutrients, regulation and purification of water, and reduced agricultural production.

The Global Land Outlook estimates that 50% of agricultural land is degraded.[2] This means that for restoration targets to be reached, efforts to restore degraded agricultural lands will need to be doubled.

Degraded land is defined as the state of land which results from the persistent decline or loss in biodiversity and ecosystem functions and services that cannot fully recover unaided within decadal time scales.[1] Restoring degraded land can include many different types of practices that ultimately restore ecosystem function- some examples include implementing soil water conservation practices, planting the right tree in the right place, increasing above and below ground biodiversity, conservation natural vegetation, amoung many others.

The Global Land Outlook highlights that land restoration has multiple benefits, including "reversing past land and ecosystem degradation while creating opportunities that improve livelihoods and prepare us for future challenges."[2]

1 The IPBES Assessment Report on Land Degradation and Restoration. Copyright © 2018, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). ISBN No: 978-3-947851-09-6

2 United Nations Convention to Combat Desertification, 2022. The Global Land Outlook, second edition. UNCCD, Bonn. ISBN: 978-92-95118-53-9. eISBN: 978-92-95118-52-2

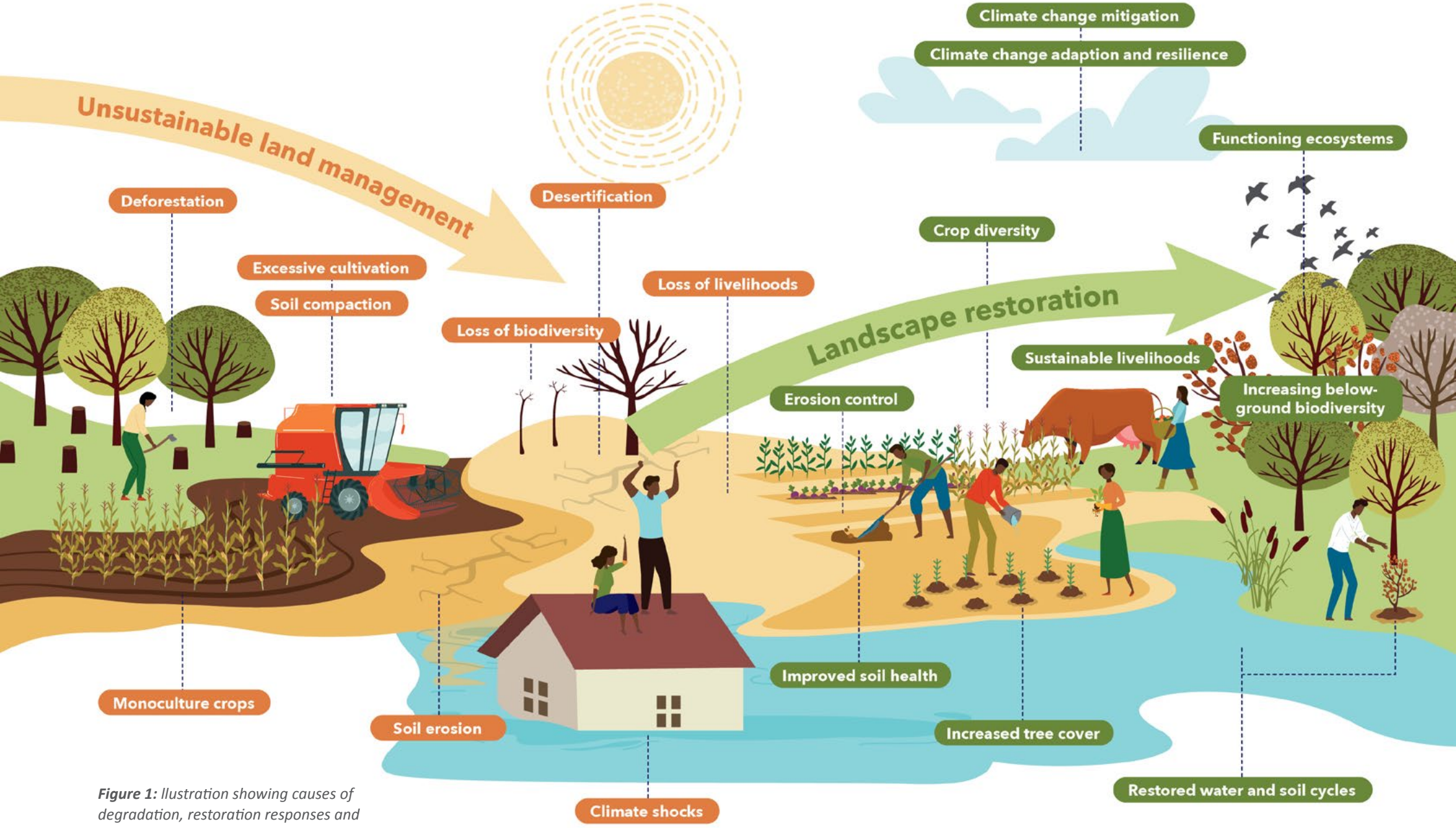


Figure 1: *Illustration showing causes of degradation, restoration responses and outcomes for ecosystem restoration*

Why OxC is important

The Options by Context (OxC) approach[3] to land restoration involves matching and tailoring restoration options to local social and agroecological conditions and farmer circumstances.

An important step in addressing land degradation is having a good understanding of which restoration options work best where and for whom. Smallholder farmers differ in their needs, opportunities, and constraints. To scale land restoration efforts, we need to understand which restoration practices best suit different farming and household circumstances and the potential barriers to adoption.

When projects ignore this diversity of farmer situations and promote a limited number of practices across a large area, farmers are less likely to adopt new practices. Instead, projects need to match and tailor restoration practices to local farming conditions and household needs and offer farmers a range of suitable options to choose from.

3 Sinclair, F., & Coe, R. 2019. The Options by Context Approach: A Paradigm Shift in Agronomy. *Experimental Agriculture*, 55 (S1), 1-13.

4 Winowieki, L. & Sinclair, F. 2020. *Restoration of Degraded Land for Food Security and Poverty Reduction in East Africa and the Sahel*.

2 Why local context matters

Projects, interventions and research programmes related to restoration, climate change and food and nutrition security depend on careful consideration of the **contextual factors** that influence the suitability and performance of different options for a specific location or household.

Contextual factors are the local characteristics that influence the suitability of different land restoration options. They differ from village to village and household to household.

There are likely to be many factors that influence the suitability of restoration options. When identifying which contextual factors are important to consider, it can be useful to group similar factors into general categories.

For example, contextual factors that are likely to influence the suitability of different **farmland restoration options** can be grouped into three broad categories: agro-ecology, socio-economic and production objectives. Socio-economic factors can further be divided into four smaller categories: financial capital, physical capital, social capital, and human capital. Within these categories, factors such as land tenure, labour availability, financial capital, access to tools and equipment, as well as market access are all contextual factors that ultimately influence which options are most likely to be appropriate for a given community or household. These are further explained in Figure 2 on the following page.

KEEP IN MIND

A key question to consider is 'what factors determine the performance and suitability of different options?'

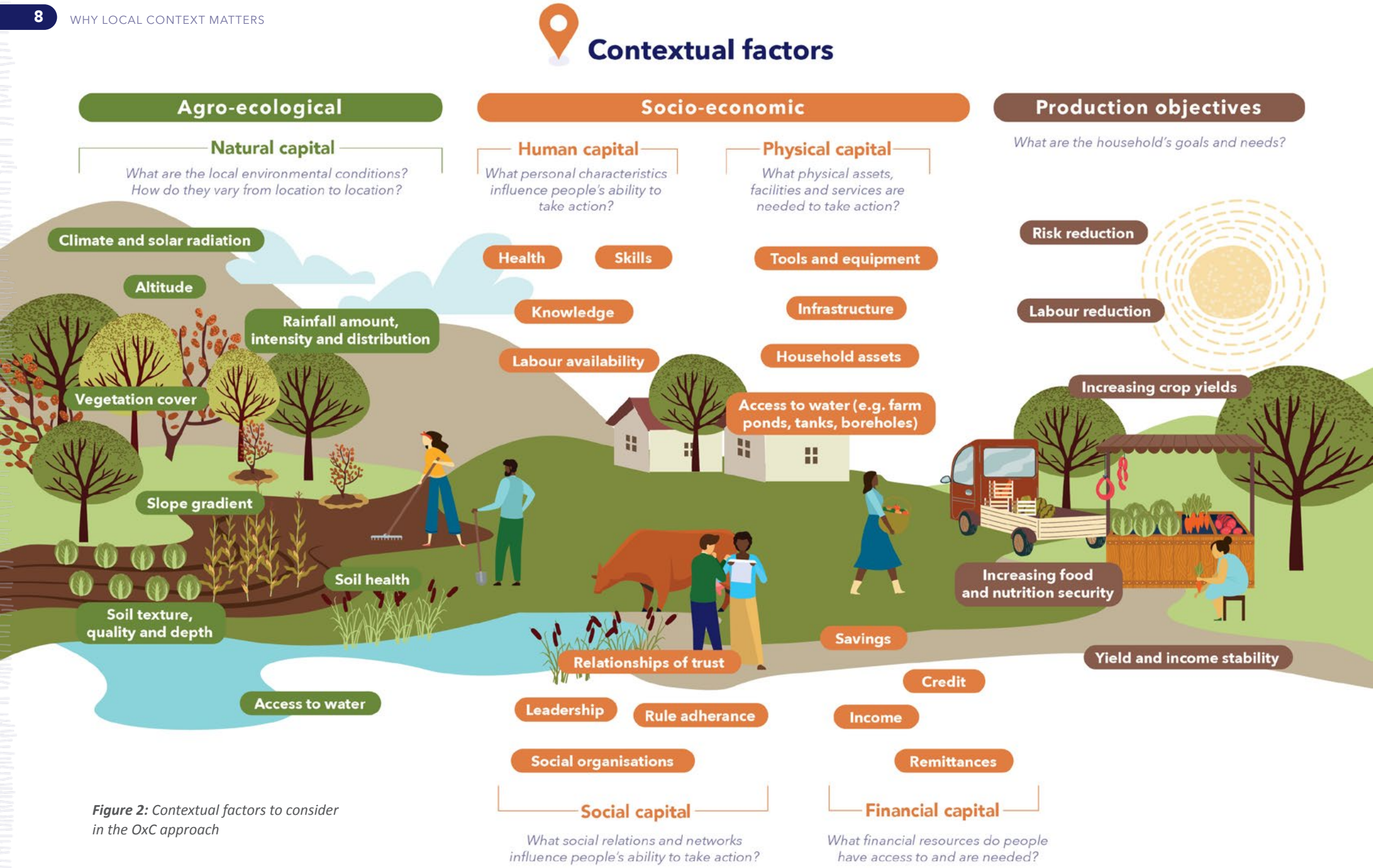


Figure 2: *Contextual factors to consider in the OxC approach*

3 The Options by Context approach

Defining options and context

The OxC approach helps us move away from offering blanket recommendations to farmers and aims to match 'options' to local 'context'.

'Options' refers simply to "things that farmers and farm communities can do differently".[5] Options may include actors at multiple scales (e.g., NGOs, local and national governments), and are not just technological but can include innovations aimed at improving the enabling environment for change (e.g., market interventions, extension systems and policies).

'Context' is the ecological, economic, and social situations in which options are used. Options interact with context to determine their performance.[6] Context includes the characteristics of a location such as soils, climate, household characteristics, policies, markets, and more.

Gaining a better understanding of how local context influences the relevance and suitability of different restoration options can help restoration projects to move from providing generic recommendations to **more specific and relevant suggestions for farmers to choose from**.

5,6 Nelson, R., Coe, R. & Haussmann, B.I.G. 2019. *Farmer research networks as a strategy for matching diverse options and contexts in smallholder agriculture*. Cambridge University Press. 55(51), 125-144. DOI.10.1017/S0014479716000454.

Figure 3: *Key interactions of options and context in the OxC approach, with example factors (identified during a multi-stakeholder workshop held in Makueni County, Kenya).*

KEEP IN MIND

It is important to note that while this guide focuses on applying the OxC approach to land restoration efforts, especially those working with smallholder farmers, the OxC approach can be used in other areas of rural development and natural resource management.

Using the OxC approach is critical to scale locally relevant innovations to address other development challenges, including climate change, conservation, poverty, and social inequality.

OxC as a part of 'Research in Development'[7]

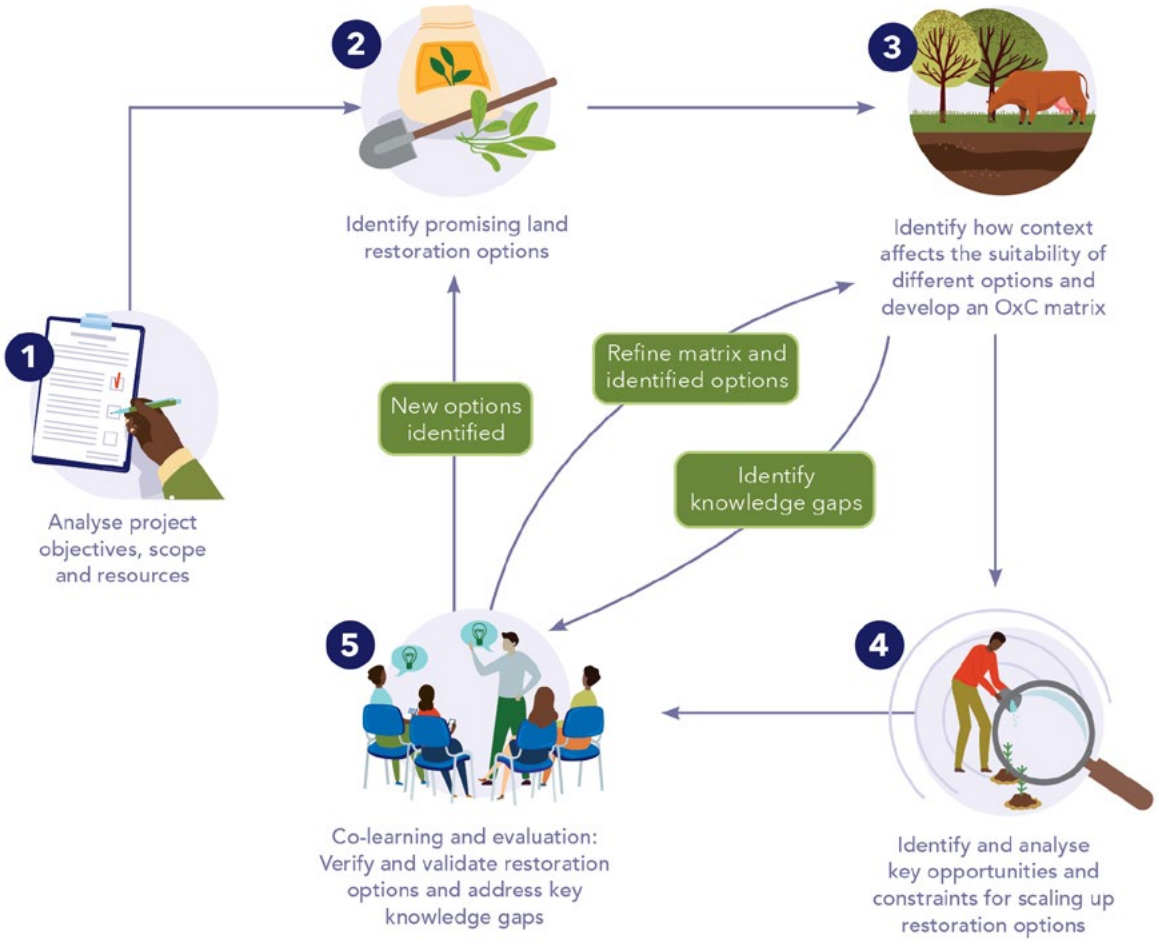
The OxC approach is an important part of the 'Research in Development' (RinD) paradigm, whereby researchers, farmers and development actors collaborate to systematically test promising innovations across a range of social and agroecological contexts to better understand which options best suit different farming and farmer circumstances.

In contrast to the more traditional approach research 'for' development, where innovations are typically developed on research stations before scaling to farmers' fields, research 'in' development embeds research within development activities and supports the testing of innovations by farmers on farmer's fields (*see pg. 19*). This allows for increased understanding of what works best where and for whom in terms of both agro-ecological and socio-economic outcomes, while bringing options to farmers at scale.

7 Coe, R., Sinclair, F. and Barrios, E. (2014). Scaling up agroforestry requires research 'in' rather than 'for' development. *Current Opinion in Environmental Sustainability* 6:73–77.

Five steps to implementing the OxC approach

The OxC approach involves cycles of assessing promising options, interrogating where and for whom they are likely to work best, and identifying and filling the gaps in our knowledge. Each of these steps can be carried out as a collaborative and co-learning process between multiple stakeholders (farmers, community groups, extension actors and local government officers).



Step 1

Begin with identifying your project's objectives, scope, and available resources – all of which will govern the suitability of different restoration options.

Step 2

Identity promising land restoration options. This includes options already being used and promising options that have not yet been implemented but which may be suitable for your site. These initial options can be identified using multiple sources of information, from books and reports to past restoration projects and through conducting participatory co-design workshops with local communities and stakeholders.

KEEP IN MIND

In some cases, there may be limited existing knowledge of suitable options. Assumptions may therefore need to be made about which options are potentially suitable.

USEFUL QUESTIONS
when identifying options

- Where are restoration efforts needed? (Farmland, communal grazing land, forests, wetlands)
- What restoration options are already being used?
- Who is involved in implementing restoration options? (Farmers, villages, community groups)
- Who benefits the most from these options? (Men, women, youth, landless, wealthy households)

Step 3

The next step is to identify how contextual factors influence the **suitability and performance of each restoration option**. Again, this information can be drawn from multiple sources, including participatory multi-stakeholder workshops. The information gained can then be used to create an **option by context matrix**. These matrices display information on different options and the key contextual factors that affect their performance and suitability.

3A Create a table (similar to the example provided in Table 1) and write down all the contextual factors across the top row.

3B In the same table, write down all the identified options in the far-left column.

3C Complete the matrix, working with each option across the contextual factors, filling in as much as you can.

Option by context matrix:

An OxC matrix is simply a table summarising current knowledge on how different contextual factors influence the performance of different options. In the table, contextual factors are listed along one axis and promising options along the other axis. The cells of the table contain information on how each factor affects the performance of each option.

Table 1: *OxC Matrix Template*

Options (for restoration, climate adaptation, etc.)	**Contextual factors**						
	Agroecology	Labour availability	Land size & tenure	Access to equipment/ market	Livestock ownership & management	Production orientation	Cultural & social norms
Option 1							
Option 2							
Option 3							
…							

KEY QUESTIONS
upon completion of the matrix

- What do you think are the most important contextual factors?
- What are the main gender considerations you identified?
- Where are the biggest knowledge gaps?

KEEP IN MIND

Key knowledge gaps should be identified throughout this process and be used to guide further research (see Step 5).

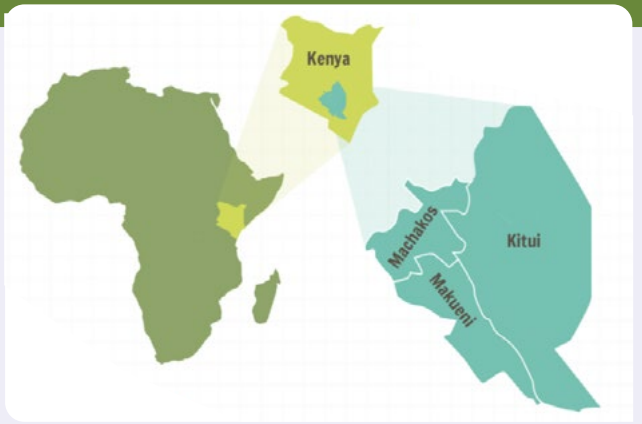
Considering gender

Personal characteristics of farmers such as gender and age are important and cross-cutting factors to consider when creating an OxC matrix. Due to cultural norms and attitudes, a person's gender and age can influence their access to and control over capital and resources. Failing to consider social factors such as gender and age in land restoration can limit uptake and risks worsening social inequality.

STEP 3 CASE STUDY

Planting basins as a land restoration intervention in Makueni County[8]

The following case study provides an example of what the information collected under Step 3 could look like for a specific option and location. The case study draws on information collected from past restoration efforts in Makueni County, primarily that of the IFAD- EC funded Dryland Restoration project: "Restoration of degraded land for food security and poverty reduction in East Africa and the Sahel: taking successes in land restoration to scale (2015- 2020)" and focuses on the use of planting basins. This information was used to develop an OxC matrix (see Appendix 1).



1 Agroecological conditions

Rainfall, soil texture and slope are key biophysical factors known to influence the performance of planting basins. Basins are best suited to arid and semi-arid conditions, in sites with well-draining medium-textured soils (e.g., sandy loams) receiving 300-800 mm of rainfall per annum and on gently sloping land with gradients between 1-15%. Rocky or extremely shallow soils can make digging and maintaining basins difficult and are not well suited. Under heavy rains and on poorly draining soils, using basins can result in waterlogging and depressed crop yields. To avoid these issues, farmers may need to remove excess water following heavy rain, divert surface run-off from basins using additional trenches, and back-fill basins with soil. Such modifications require additional labour and timely action following heavy rainfall.

2 Farm size

Farmers report that households with small farm sizes are more likely to benefit from planting basins. Using planting basins intensifies maize production and allows farmers to maximise the use of their land. Households with small farms may also have greater labour availability for digging and maintaining basins.

3 Land tenure

Planting basins are temporary structures and are suitable for farmers who own land and those who rent land. Nevertheless, insecure tenure agreements may still deter farmers from investing in digging basins. Young people often lack access to and control over land, reducing their opportunities to engage and invest in agriculture and practices such as planting basins. In Kenya, women's land rights are often restricted by customary practices whereby women rarely inherit land and typically gain secondary use rights through their husband.

Planting basins:

Planting basins are a simple soil and water conservation technique where small pits are dug, usually in a grid formation, filled with farmyard manure and crops planted within them. These basins reduce surface run-off and soil erosion and increase water infiltration. They can help bridge intra-seasonal dry spells and increase crop yields.

8 Crossland, M., Magahu, C. & Winowiecki, L., 2021. *Developing options by context (OxC) matrices for land restoration options in Makueni County, Kenya.*

4 Labour availability

Digging planting basins is labour intensive and typically done by hand using a hand hoe. Lack of labour for digging basins is one of the main barriers to adoption. The initial labour cost of digging large numbers of basins may be prohibitive for many households, especially those lacking labour or the cash to hire labour. Some farmers, especially women, have chosen to form labour exchange groups to help each other dig basins and overcome labour constraints.

Adoption of basins can shift the labour burden from men to women, with women becoming more involved in land preparation (an activity traditionally carried out by men). Given that women are often responsible for childcare and household chores, increases in their farm work risk increasing their already heavy workloads. Nevertheless, women may gain greater autonomy over land preparation (*see 'Tools and equipment'*). Farmers also report that basins can reduce the time spent planting and weeding (an activity women are heavily involved in) and help spread labour demand throughout the year since basins are dug throughout the dry season.

Example of digging a planting basin using a hand hoe.

5 Tools and equipment

Farmers may lack access to appropriate tools for digging basins. Capital may be needed to purchase or hire such tools. However, using planting basins may reduce farmers' reliance on the use of borrowed or rented ploughing equipment. This may be beneficial especially for women farmers since they typically have lower access to resources and ploughing equipment. Using basins could benefit women by reducing their dependence on borrowed equipment and helping avoid planting delays.

6 Livestock

Households without livestock may lack access to farmyard manure for use with basins. Households with livestock may need to protect basin structures from damage from free-grazing livestock during the dry season.

7 Production objectives and aspirations

Basins can reduce the chance of crop failure in low rainfall conditions, providing a safety net in terms of food security. Maintaining a small area of basins could help buffer vulnerable households against climatic shocks and yield failures. Households who are more food secure and market-orientated, however, may be less interested in using basins for subsistence crops such as maize and may prefer to use basins for higher-value crops such as vegetables. Households who have off-farm income sources may be less interested in labour-intensive options such as planting basins. Yet, households with off-farm income may have access to cash for hiring labour to dig basins.

8 Basin size and management

Hole size also influenced the performance of planting basins under different rainfall conditions. Farmers reported that small basins (e.g., 30x30 cm) can be difficult to dig due to their small size and fill in with sediment quickly following high rainfall. Larger basins (e.g., 60x60 cm and 90x90 cm) were said to be easier to dig and maintain. If basins are used in combination with manure, additional labour will be required for collection and application. Some farmers reported that using mulch and manure can attract termites. Suitable pest control options may be needed when using basins with manure. Combining basins with manure is likely to be particularly important in heavily degraded sites with soils low in organic matter and soil organic carbon.

Step 4

Identify and analyse **key opportunities and constraints for scaling up land restoration options**. Collectively reflect on what you think are some of the main barriers to scaling up the options you have identified and brainstorm possible interventions for addressing these constraints.

Table 2 illustrates how ideas that emerge from brainstorming potential opportunities, constraints, and solutions can be organised. This table is an example of the opportunities, constraints, and potential interventions for supporting the scaling of planting basins and tree planting.

Domain	Opportunities and constraints	Potential interventions
Cultural norms	• Cultural norms and attitudes discourage women from strenuous activities such as digging basins. • Women often lack access to and control over resources such as land, capital, and labour. • Joint decision-making in households can lead to more successful and sustainable restoration efforts – projects need to involve couples at training events and encourage the transfer of knowledge to other household members after training. • Only one member attending training can present a barrier to uptake of restoration options as other members have not seen practice in action and may be sceptical.	• Use gender transformative approaches to training and dissemination. • Encourage joint decision-making and knowledge sharing. • Cultivate greater awareness of women's rights and role on farms. • Encourage on-farm experimentation.
Human capital	• Using basins requires knowledge, skills, and access to training events. • Tree planting requires knowledge of which trees do well where. Women often move to their husbands' villages so lack such knowledge. • Planting basins are labour-intensive	• Use innovative and cost-effective approaches to extension such as farmer-to-farmer learning, field schools and 'trainer of trainer' (ToT) scaling models • Provide training in tree care, species selection and ensure participation by women farmers. • Look for ways to mechanize labour intensive options such as planting basins. • Support formation of labour exchange groups.
Financial capital	• Money may be needed for hiring labour or buying tools. • Women may lack access and control over money and lack access to micro-credit.	• Support formation of labour/tool exchange groups • Use gender transformative approaches that challenge disempowering gender norms and cultivate greater awareness of the need and benefits of gender equality for households and farming
Physical capital	• Lack of availability/quality of germplasm and markets. • Large distance from nursery.	• Support establishment of tree nurseries. • Improve access to markets for high value crops.
Policy & institutions	• Limited land rights and ownership among women.	• Promote greater awareness of women's land rights.

Table 2: *Opportunities and constraints to scaling up planting basins and tree planting and potential interventions (identified during a multi-stakeholder co-design workshop held in Makueni County, Kenya).*

HELPFUL TOOL: The Problem Tree Analysis[9]

An interactive activity to undertake as part of Step 4 is the Problem Tree Analysis. Depending on the group size, the estimated time for this activity is 25 minutes.

1 In your group, identify a rapporteur and facilitator.

2 Place the **challenge/constraint** (as identified in Step 4) in the centre of your page as the 'trunk' of your tree.

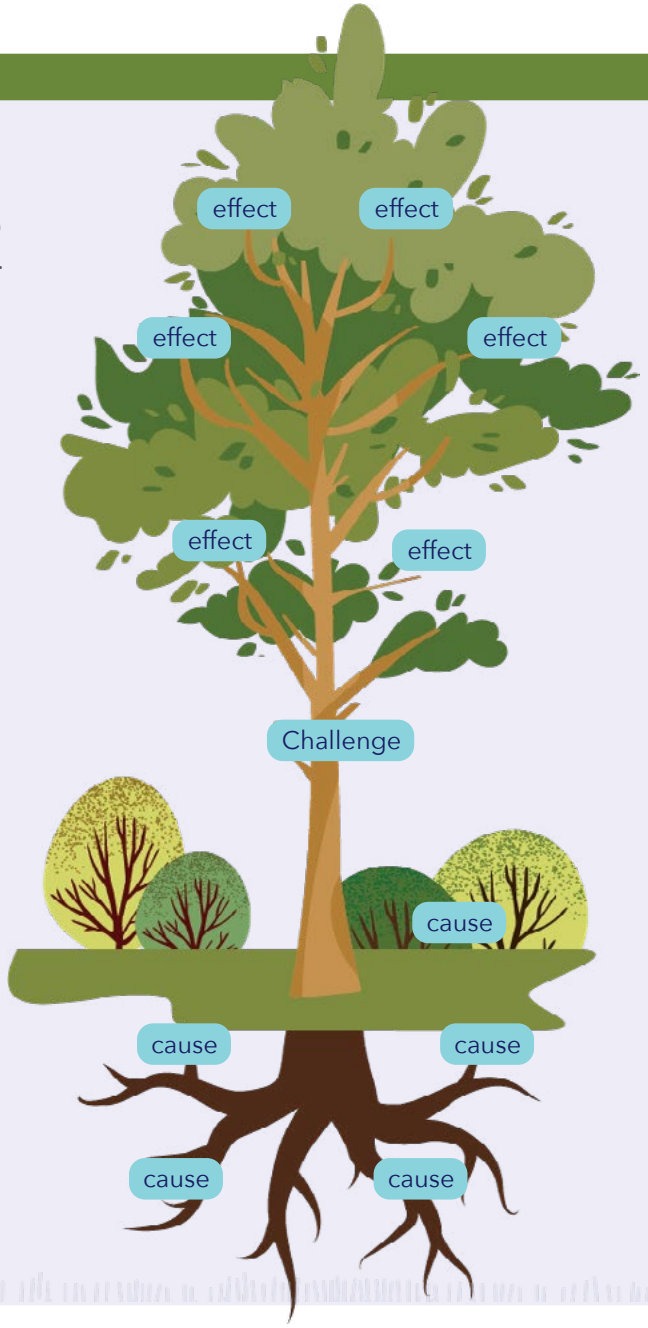
(e.g. Challenge: soil between crops is left bare and loses water holding)

3 Thinking across social, cultural, environmental, economic and political/institutional **causes**, ask yourself 'Why does this problem exist? What are the situations or factors that have caused this barrier?'

(e.g. Cause: limited use of mulching)

4 Capture these ideas on sticky notes surrounding the roots of the tree.

5 Keep digging deeper to consider the "**causes of causes**"–the multiple layers of factors that contribute to a problem.



6 Then turn to the leaves of the tree – the results that are created by the problem. Consider the **multi-layered effects**, or "effects of effects," that can arise when a problem goes unaddressed. Always ask: "Then what happens?"

(e.g. Effect: loss of soil nutrients and moisture)

7 Identify potential **solutions** while reflecting on your problem tree.

- What might be needed to overcome the barrier and its causes?
- Who do these solutions involve?
- What actions would be needed? And by who?

8 Write these ideas on sticky notes and organise on another flipchart or if there is space add to your problem tree. All of these ideas can be captured in a table (see Table 2).

9 CIFOR-ICRAF, 2021. Options by Context Workshop Presentation. Hosted at Kusyombungo Hotel, Makueni County on October 27 2021.

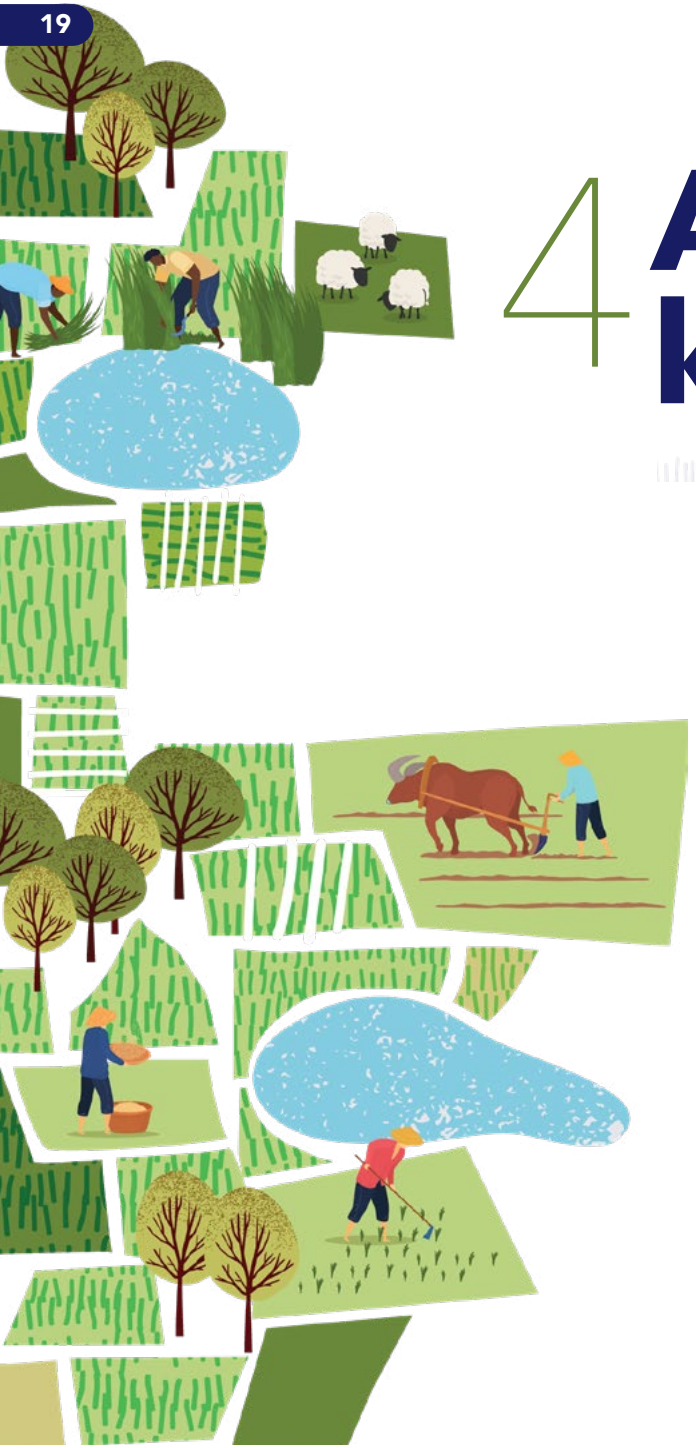
Step 5

Verify and validate the restoration options and address key knowledge gaps.

Having identified an initial set of promising restoration options, an important step is to validate these options with local farmers and communities (especially if their involvement in previous steps was limited).

This can involve a series of consultations with farmers and local community groups to verify and validate the OxC matrices and identify remaining knowledge gaps and any additional restoration options.

Using this knowledge, revise and refine the OxC matrices, and discuss with farmers and communities which options are the most appropriate for their needs and circumstances, and which ones they might like to try.



4 Addressing knowledge gaps

Encouraging farmers to try out different options and experiment with different ways of doing things can lead to a wealth of learning and help farmers, communities and researchers better understand which restoration options work best where and for whom. This is especially true when collaborative methods such as **planned comparisons** are used.[10,11]

The planned comparison method encourages farmers to experiment and innovate on their farms. Each farmer chooses the options that he/she would like to implement and compare on their own farm. Researchers, extension officers and development actors then work with farmers and communities to monitor the performance of these options and gain a better understanding of which options work best where and for whom.

Planned comparisons can be used to address knowledge gaps identified during the development of OxC matrices and revise and refine OxC matrices.

Likewise, OxC matrices can be used by farmers and communities to identify promising restoration options to try out.

Planned comparisons:

Participatory trials where farmers and local communities work together with researchers and development actors to test and compare the performance of promising options.

10 Coe, R., Hughes, K., Sola, P. and Sinclair, F. (2017). *Planned Comparisons Demystified*. Working Paper No. 263. Nairobi Kenya

11 Magaju, C.; Winowiecki, L.; Crossland, M.; Frija, A.; Ouerghemmi, H.; Hagazi, N.; Sola, P.; Ochenje, I.; Kiura, E.; Kuria, A.; Muriuki, J.; Carsan, S.; Hadgu, K.; Bonaiuti, E.; Sinclair, F. Assessing Context-Specific Factors to Increase Tree Survival for Scaling Ecosystem Restoration Efforts in East Africa. *Land* 2020, 9, 494. https://www.mdpi.com/2073-445X/9/12/494

Key aspects of a planned comparison

Planned comparisons are a farmer-centred method. Farmers implement the planned comparisons on their farms with technical support, choose which options they want to test and how performance should be evaluated, and are encouraged to experiment and innovate to see what works best for their farm.

Participatory identification of the current challenges facing farmers

Participatory identification of an initial set of potentially promising options as well as the current questions remaining about the viability of these options

Development of a planned comparison protocol that aims to answer these research and implementation gaps

Continual review and refinement of the options and protocols together with farmers to address the locally relevant challenges and contexts

Monitoring of the performance of each of the options to produce rigorous evidence of the constraints and conditions for implementation and the variables of success for specific restoration options

Aims to scale relevant management / restoration innovations to many farmers by demonstrating the performance and impact of the innovation in specific contexts

An innovative way to embed research into development by reaching large numbers of farmers and having high farmer participation

Facilitates a 'deep' participatory process with farmers, as well as partners and additional stakeholders to encourage co-learning, knowledge sharing and innovation

Conducting a planned comparison for an agricultural setting

1. **Establish farmer's roles** in implementing planned comparison:
   - Conduct focus group discussions and brainstorming with farmers to identify promising options.
   - Farmers select which restoration options they want to test
2. **Farmers volunteer** to test one or more options on their farm.
3. Scientists, farmers, NGOs, and other partners design **on-farm planned comparisons**, including monitoring protocols, to validate which restoration options are suitable for different contexts.
4. **Technicians train farmers** on how to set up on-farm planned comparisons.
5. **Farmers establish an area** within their fields for the experiment.
6. Scientists and technicians work with farmers to **implement the planned comparison** on their farms.
7. **Farmers manage the experiment** (conduct sowing, weeding, harvesting, etc).
8. **Farmers assist with data collection on key indicators** (for example, biomass, yields, cost) with assistance of technicians (research, institutions, NGO staff).
9. **Farmer profiles:** Implement household surveys to provide information on farmer and household characteristics.
10. **Farmer profile data is combined with the planned comparison monitoring data** to assess socio-economic factors influencing restoration success.
11. **Co-learning across farmers:** farmers who successfully implement an option serve as trainers to other farmers in the village and other villages.
12. **Results and lessons learned are shared through structured and documented co-learning processes** (e.g., workshops) amongst farmers, researchers, extension officers and other actors.

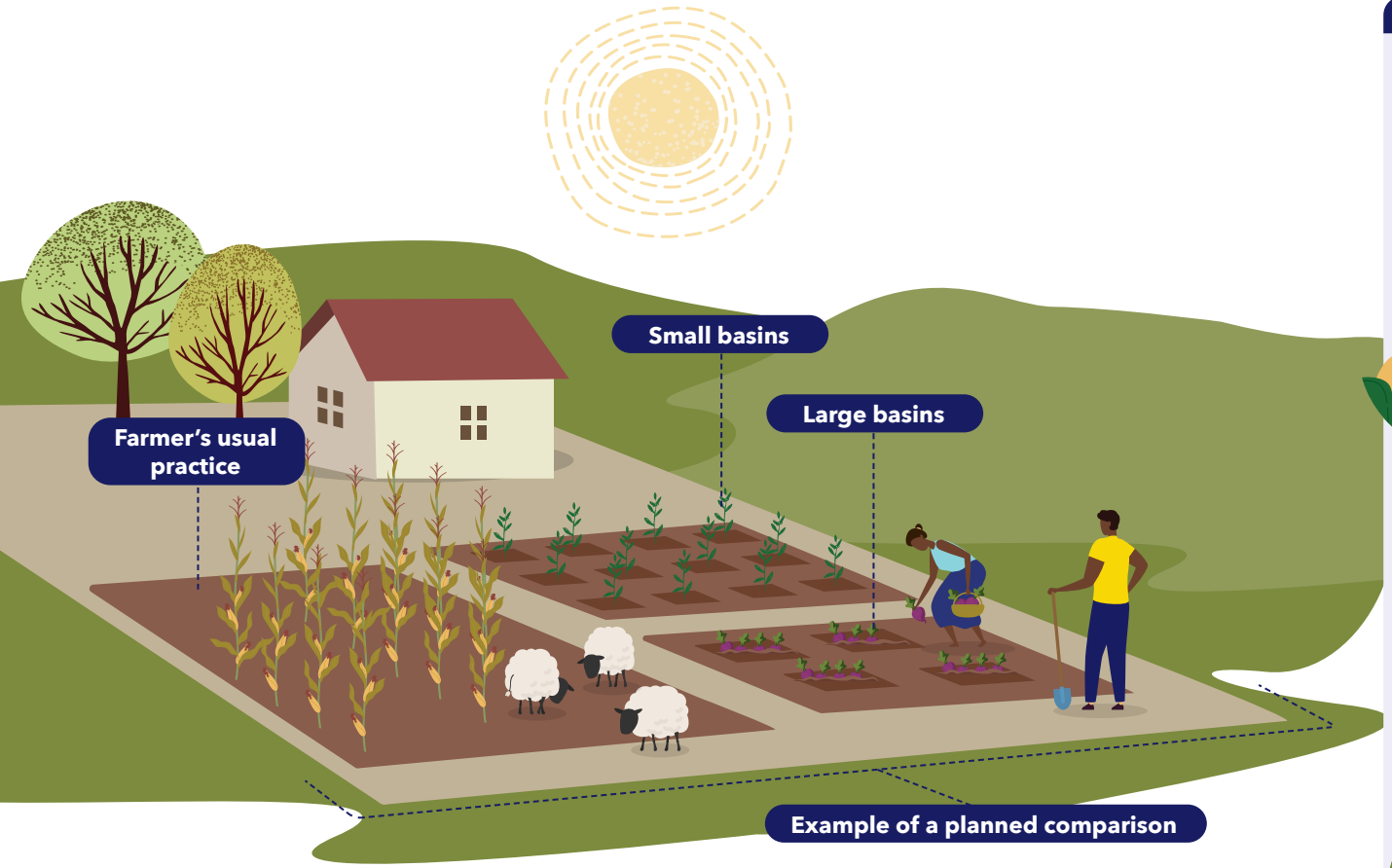


Figure 4: *Under the IFAD-EC Restoration project, farmers compared the performance of different sizes of planting basins for growing crops against their usual farming practice. Farmers allocated a small area of their farm to try out the planting basins, as illustrated above.*[12]

KEEP IN MIND

FARMERS

Be available for the monitoring of performance, as well as keep records on the variations of each of the options they are employing. This will allow for analysis and comparison of the performance of the options.

RESEARCHERS

- Be flexible in the design of interventions, to allow farmers to innovate to meet their needs
- Innovate data collection methods, as thousands of farmers will be engaged and traditional methods may no longer be feasible
- Close the learning loop by sharing research results in a timely manner to allow development and government partners to incorporate the learnings into their programmes (for example not just sharing results at the end of the project)
- Adopt new ways of communicating the results that make sense to the various stakeholders

DEVELOPMENT AND GOVERNMENT ACTORS

Be open to operating differently. For example, implementing planned comparisons requires a shift in traditional development implementation to allow space for monitoring and co-learning. Farmers will need to be introduced and trained on the various options.

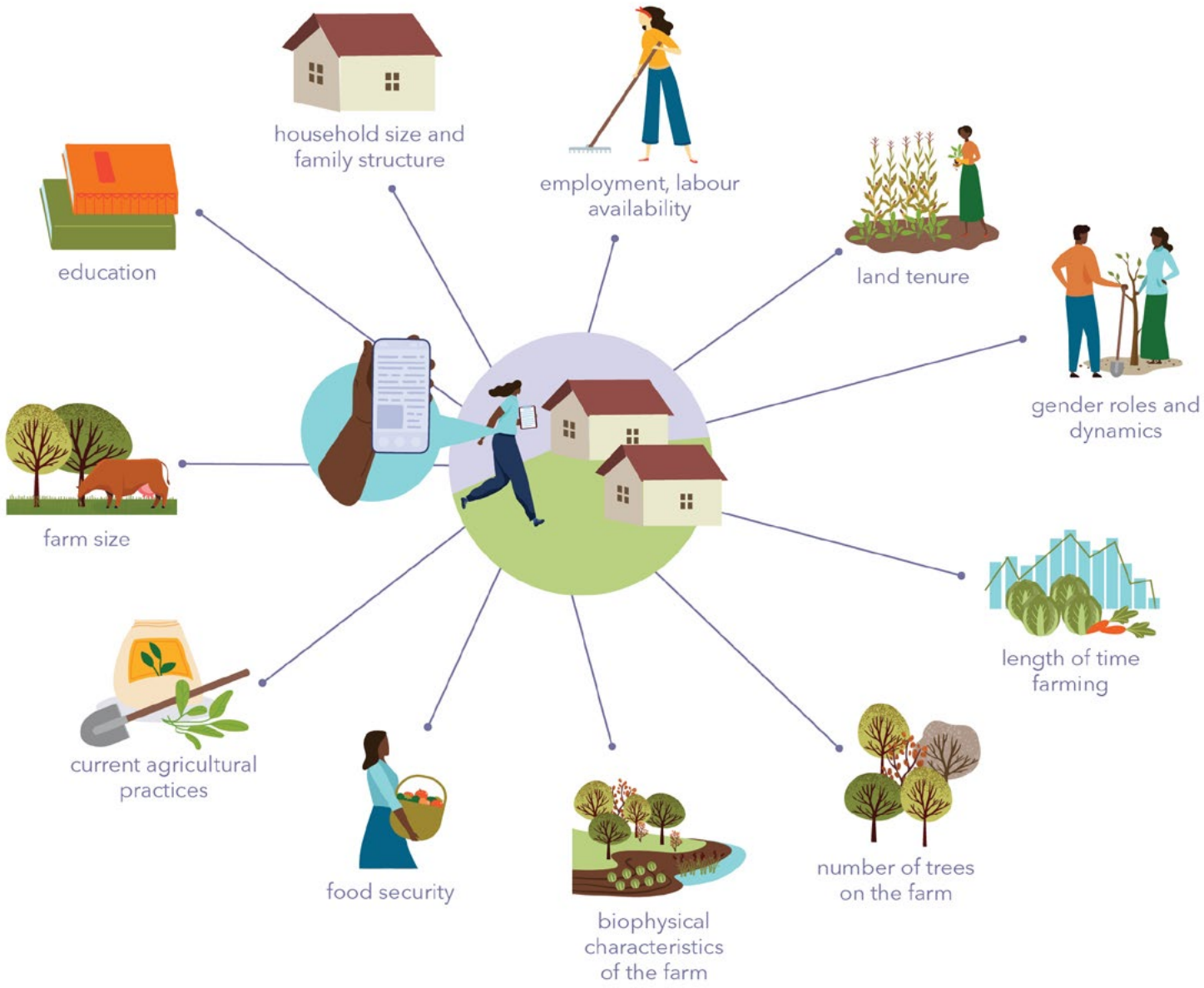
COMMUNICATION

Communication is very important throughout the entire process. For example, protocols for the various options need to be co-developed and properly communicated to encourage smooth implementation on the ground.

12 Winowiecki, L., Crossland, M., Magaju, C., Bado, V., Maithya, S., Mbuvi, C., Muendo, S., Musyoki, M., Muthuri, S., Mutua, F., Chesterman, S, and Sinclair, F. (2020). Restoration of degraded land for food security and poverty reduction in East Africa and the Sahel. Employing a farmer centred approach in Ethiopia, Kenya, Mali and Niger. Nairobi, World Agroforestry (ICRAF).

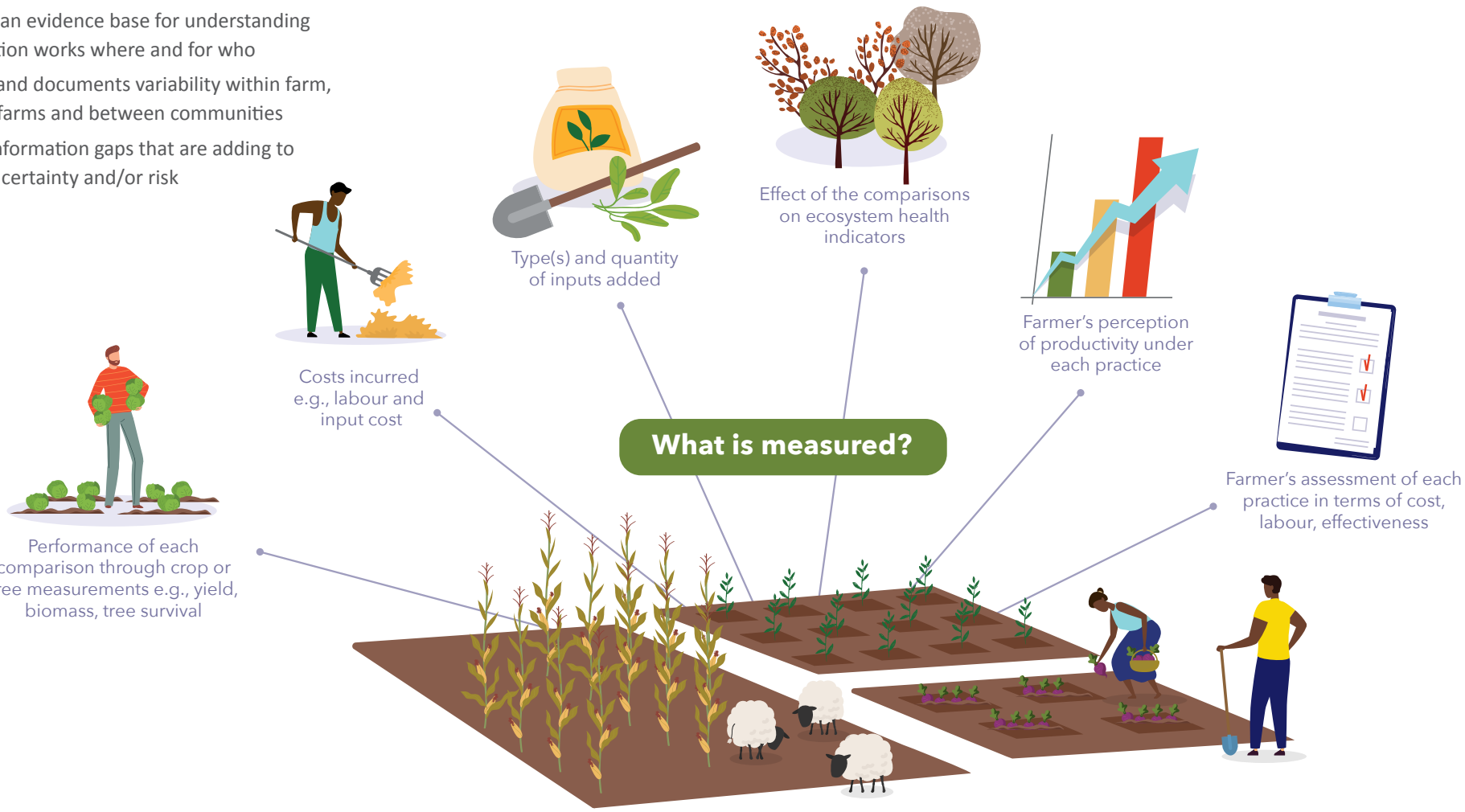
The value of farmer profiles

Household surveys are instrumental in providing information on farmer characteristics and help to understand which options work where, and for different types of farmers and households. Here are some of the key contextual factors that are measured in farmer profiles.



The value of monitoring planned comparisons

- Demonstrates the performance and impact of the options in specific contexts
- Produces an evidence base for understanding which option works where and for who
- Assesses and documents variability within farm, between farms and between communities
- Fills the information gaps that are adding to farmer uncertainty and/or risk

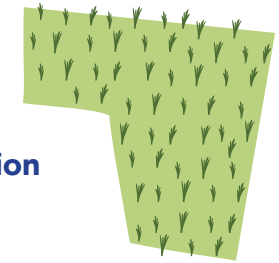


Farmer case studies from Makueni County

The following case studies illustrate some of the restoration practices already being used in Makueni and how several farmers have taken an OxC approach, adapting practices to their household needs, and experimenting with different restoration options to work out what works best for their farm.

Gedeon Kituku Nzioka

Innovations: Pasture and grass seed production



Gedeon was a trained teacher by profession before he ventured into commercial farming. Initially, he was based in Makindu before he moved to his 3.5-acre farm in Kibwezi, a much drier and hotter climate. He focuses mainly on grass production, but he also keeps chickens and bees and grows a variety of trees and food crops for his family. He also has one dairy cow that provides milk for the family and manure for the farm.

In the past, Gedeon only planted food crops such as maize, pigeon peas and cowpeas. But following several failed harvests and inadequate rains, the family decided to take farming seriously as a business and look for ways to produce income from their farm, rather than only food. They decided to try grass farming and sell the seed and fodder to other farmers.

It was not easy for Gedeon and his family to switch from crop to grass farming. People questioned their motive and even asked why they were planting grass given that it cannot be eaten by the family as food. Some even thought they were bewitched. Gedeon's wife was also unconvinced. Before embarking on the project, Gedeon and his wife did an experiment. On one part of the farm, his wife planted food crops and on another, Gedeon planted grasses.

They then compared the cost of production, and both agreed that it was more profitable to plant grasses.

Obtaining grass seeds was also challenging at the beginning. He eventually managed to get the drought-resistant variety of Boma Rhodes seeds from the Kenya Agricultural Livestock Research Organization (KALRO). He then used the suckers from the grasses to multiply the grass on his farm.

Today, even in a poor rainfall season, the family harvests approximately 50 kilograms of grass seed which they then packet and sell at Ksh 4,000 per kilogram. Together, Gedeon and his wife discuss and decide on how to use the income generated from the sale of the grass seed. The earnings are also used to purchase other food items such as vegetables and help boost household nutrition.

Locally, there is now high demand for grass seeds and Gedeon has trained several community groups on how to start grass farming. Gedeon wishes to continue training more people in pasture farming and believes it will help ensure local livestock have adequate feed during the dry season, boost the local economy and help to restore degraded land.

Bridgit Mulinge

Innovations: Planting basins and tree planting

Bridgit is part of the Kithito Kyaka Changamwe Self-Help Group comprising women who have come together to uplift the welfare of their families. Over the years, World Agroforestry (ICRAF) and other organizations have trained the group on restoration practices, including the construction of gabions, planting basins (Zai pits) and sunken beds. These activities have helped prevent soil erosion and improved their harvest. In the past, Bridgit's farm was unable to produce enough for her family, forcing her to buy additional food from the market. She used to harvest less than one bag of maize each season but after adopting these new farming practices this has gone up to three bags.

She initially started with 30 planting basins but now has 270. This was achieved with the help of hired labourers. Her two children also help with farming and other domestic activities when they are on holiday from school.

'In the planting basins, manure is added, and the soil is well mixed. The soil retains moisture for longer enabling the crop to grow well' - Bridgit

Bridget has also planted trees in her homestead mainly neem, melia, and moringa. The mature baobab tree (Adansonia digitata) on her farm is also a source of fruit, especially during the dry season. She adds the powder from the baobab fruit to enrich the flavour of her porridge. The trees on her farm also provide shade and medicine for her family and livestock and firewood.

'It is important for farmers to incorporate trees on their farm for various benefits and improve the micro-climate' - Bridgit

Francis Mutava Maithya

Innovations: Planting basins, rainwater harvesting and tree growing

Among his friends and family, Francis has earned the name "one and a half man" for his dedication and hard work in transforming his 3-acre farm and becoming food secure. He strives to put into action everything he learns from the seminars he attends and the training he receives. His farm also serves as a demonstration and learning site for local farmers and groups.

In the past, Francis used traditional farming methods. But after gaining knowledge of new farming practices, he has made many changes to his farm and now uses diverse crop rotations, rainwater harvesting, planting basins and makes and applies compost made from animal dung, ash, crop straw and fallen leaves.

"Even when we go for meetings, I encourage people to leave the traditional farming methods and change with time. What is more important is embracing the new farming techniques. Also, it is good to use manure, especially in this area where the soil is less fertile" – Francis.

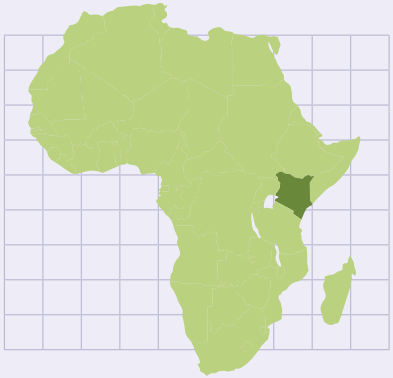
Francis has experimented with different sizes of planting basins for growing trees and crops on his farm. He initially tried small basins (2ft by 2ft) but now uses larger basins (2ft by 4ft and 2ft by 6ft) because they are easier to dig and remove the soil from the hole and they accommodate more seeds. He also leaves adequate space between the basins for easy movement when weeding, watering and harvesting.

Francis grows fruit trees such as pawpaw, oranges, and mangos. These trees provide shade and nutrition for his family and pruned branches are used for firewood. He has a tree nursery and sells seedlings as well as timber from the mature trees. A big challenge to growing trees has been termites, but Francis has discovered that the application of biochar (charcoal and ashes) repels these insects.

To overcome the challenge of water scarcity, Francis has dug a farm pond with a capacity to store 250 m^3 of water. The family uses the water both for farming and domestic use. Once filled during the long rains, the water can last up to 3-4 months. Francis plans to construct a bigger one that will provide water year-round. Before the farm pond, he relied on rainwater for farming and had to buy vegetables from the market but nowadays, with the improved water supply, there is sufficient produce from his farm to feed the family.

Appendix 1:

OxC matrix summarising the main contextual factors influencing the performance and suitability of identified restoration options in Kenya



On the following page is an example of an initial OxC matrix. This matrix was developed using multiple sources of information, including data from planned comparisons conducted under the IFAD-EC funded project, “Restoration of degraded land for food security and poverty reduction in East Africa and the Sahel: taking successes in land restoration to scale (2015-2020)”, and a co-design workshop in Makueni County with multiple stakeholders conducted by the UK PACT project “Promoting nature-based solutions for land restoration while strengthening national monitoring technical working group in Kenya”.
As you can see, knowledge of the suitability of some restoration options is more detailed than others and there are still many knowledge gaps to address.

Land restoration options	Contextual factors						
	Agroecology	Labour availability	Land size and tenure	Access to equipment/market	Livestock ownership and management	Production orientation	Cultural and social norms
Planting basin	Rainfall, soil texture and slope are key biophysical factors influencing basin performance. Basins are best suited to arid/semi-arid conditions, in sites with well-draining medium textured soils (e.g., sandy loams) receiving 300-800 mm of rainfall per annum and on gently sloping land (gradients of 1-15%). Under more humid conditions and on poorly draining soils, basins can result in waterlogging and depressed yields. Farmer adaptations can reduce risk of flooding under high rainfall. These include removing excess water, diverting run-off from basins using additional trenches and refilling basins with soil. Rocky or extremely shallow soils can make digging and maintaining basins difficult.	Basins are typically dug by hand and are labour-intensive. Lack of labour and suitable tools for digging basins are one of the main barriers to adoption. The initial labour cost of digging large numbers of basins is likely prohibitive for many households. Even when returns justify hiring of external labour, lack of cash upfront to pay labourers and lack of labourers to hire may be challenging for some households and in certain locations. Uptake of basins can lead to a shift in labour burden from men to women, with women becoming more involved in land preparation – an activity traditionally carried out by men. Nevertheless, women may gain greater autonomy over land preparation. Although basins increase time taken for land preparation, they have been reported to reduce the time needed for weeding. Basins also help spread labour demand throughout the year since they can be dug throughout the dry season. Farmers, especially women, have formed labour exchange groups to help each other dig basins.	Planting basins are temporary structures thus suitable both for those who own land and those who rent land. Nevertheless, insecure tenure agreements may deter farmers from investing in digging basins. Households with limited farm sizes maybe more likely to invest in and benefit from the use of planting basins. Using planting basins intensifies maize production and allows farmers to maximise the use of their land. Households with small farms may also have lower land-to-labour ratios and greater labour availability for digging and maintaining basins. Land is typically acquired by men through inheritance upon marriage. Women's land rights are often restricted by customary practices whereby women rarely inherit land and typically attain secondary use rights through their husband. Young people often lack access to and control over land, reducing their opportunities to engage and invest in agriculture.	Farmers may lack access to appropriate tools for digging basins. Capital may be needed to purchase or hire such tools. However, using planting basins may reduce farmers' reliance on the use of borrowed or rented ploughing equipment. This may be beneficial especially for women farmers since they typically have lower access to resources oxen and ploughing equipment. From our analysis we see that households where only women were involved in ploughing often relied on the use of borrowed equipment and had the lowest rates of plough ownership. Using basins could benefit women in these households by reducing their dependence on borrowed equipment and helping avoid planting delays.	Households with livestock may need to protect basin structures from damage from free-grazing livestock during the dry season.	Basins can reduce the chance of crop failure in low rainfall conditions, providing a safety net in terms of food security. Maintaining a small area of basins could help buffer vulnerable households against climatic shocks and yield failures. Households who are more food secure and market orientated, however, may be less interested in using basins for subsistence crops such as maize. Households who have alternative livelihood activities may be less interested or have less time to invest in farming. Similarly, households or farmers with aspirations to move out of farming may be less interested in labour intensive options such as planting basins. Households with sources of off-farm income (e.g., members who earn off-farm income, remittances) may have access to cash for hiring labour to dig basins. Young people may not see farming as a desirable livelihood.	Men typically have greater authority over land and agricultural enterprises that generate high revenues. Despite women's increased involvement in workshops and uptake decisions, it is evident that asymmetries in decision-making authority persist. Women's ability to implement innovations across the farm largely depended on some form of pro forma consultation with their husbands and even women with absent husbands were often still obligated to consult their spouse. Older women likely better able to negotiate access to land, influence decisions and have more free time to attend agricultural workshops than younger women living with their in-laws. Young people may also not see farming as a desirable livelihood. However, conversely, households who have alternative livelihood activities may be less interested or have less time to invest in farming. Similarly, households or farmers with aspirations to move out of farming may be less interested in labour intensive options such as planting basins. Households with sources of off-farm income (e.g., members who earn off-farm income, remittances) may have access to cash for hiring labour to dig basins.

Land restoration options	Contextual factors						
	Agroecology	Labour availability	Land size and tenure	Access to equipment/market	Livestock ownership and management	Production orientation	Cultural and social norms
Different planting basin dimensions	Given their role in capturing run-off, basin design influences performance under different agroecologies. Some evidence suggests larger sized basins (e.g., 90x90cm) are better suited to higher rainfall conditions. Small basins (e.g., 30x30cm) perform poorly in comparison to larger basin (60x60cm, 90x90cm). Smaller basins are prone to backfilling with sediment following heavy rains and quickly lose their ability to capture surface water run-off.	Small basins (i.e., 30x30cm) can be difficult to dig and fill in with sediment quickly following high rainfall. Larger basins (i.e., 60x60cm and 90x90cm) are thought to be less labour intensive to dig and maintain.					
Combining planting with farmyard manure	Using basins in combination with farmyard manure improves their efficacy, especially when rainfall is adequate. However, use of soil amendments such as mulch and manure can attract termites. Addition of manure is particularly important in heavily degraded sites with soils low in organic matter and soil organic carbon.	Additional labour may be required for collecting and applying manure.			Households without livestock may lack access to farmyard manure for use with basins.		
On-tree farm planting	Local agroecological conditional will influence the suitability of different tree species. Rainfall, altitude, soil type are all important factors to consider when selecting suitable species. In very dry areas, seedlings may require watering and/or shade during establishment.	Tree planting can be labour intensive (although less so compared to other options such as planting basins). Trees require weeding during establishment and protection and pruning.	Farm size can influence the suitability of different arrangements. Woodlots are better suited to those with large farms. Boundary planting and planting near the compound may better for those with smaller farms. Given the permanence of tree planting, planting trees on rented land or where tenure is unsecure may be challenging. Early maturing species preferable for households with insecure tenure.	Lack of access to seedling through nurseries and good quality germplasm can be challenging. Suitable tools for planting and tree care are also needed. Cash may also be required to purchase inputs (pesticides, processing equipment etc.). Poor roads make transportation access to markets for perishable produce difficult (e.g., fruits).	Tree seedlings require protection from free-grazing livestock. Species that can be used as tree fodder may be preferable to those with livestock.	Species preference may vary with production orientation. Higher value species such as mango and Melia may be better suited for market orientated households. Papaya good for those who want quick returns and Moringa preferred for home use due to lack of market for products.	Tree growing, especially fruit trees practices, are likely to have strong gender dimensions to their uptake, management, and benefits. Men tend to exercise greater control over decisions regarding activities that generate high revenues and involve more permanent, long-term investments such as tree planting and high-value fruits. Decisions over tree planting and felling are primarily a men's authority space.

Land restoration options	Contextual factors						
	Agroecology	Labour availability	Land size and tenure	Access to equipment/market	Livestock ownership and management	Production orientation	Cultural and social norms
Reseeding pastureland	Soil texture and depth are important factors. Reseeding steeply sloping land may be challenging. Challenges also include termite destruction by grasses and fire.	Lack of participation by youth and men		Storage facility Tools and equipment Financial capital Market availability			
Aforestation and reforestation	Water availability and climate variability is important for tree seeding survival and tree species selection. Soil texture and fertility will also influence species suitability.	Large scale tree planting can be labour intensive. Less labour-intensive options might include natural regeneration but requires that there are sufficient seed/stumps to regenerate. High labour cost Inadequate skilled labour for tree planting may also be a challenge.		Proper tools Source of capital	Protection where free grazing	Land restoration Increased tree cover Food security water availability (farm and household) Increased household income	Leadership Capacity Policies and regulations Monitoring

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