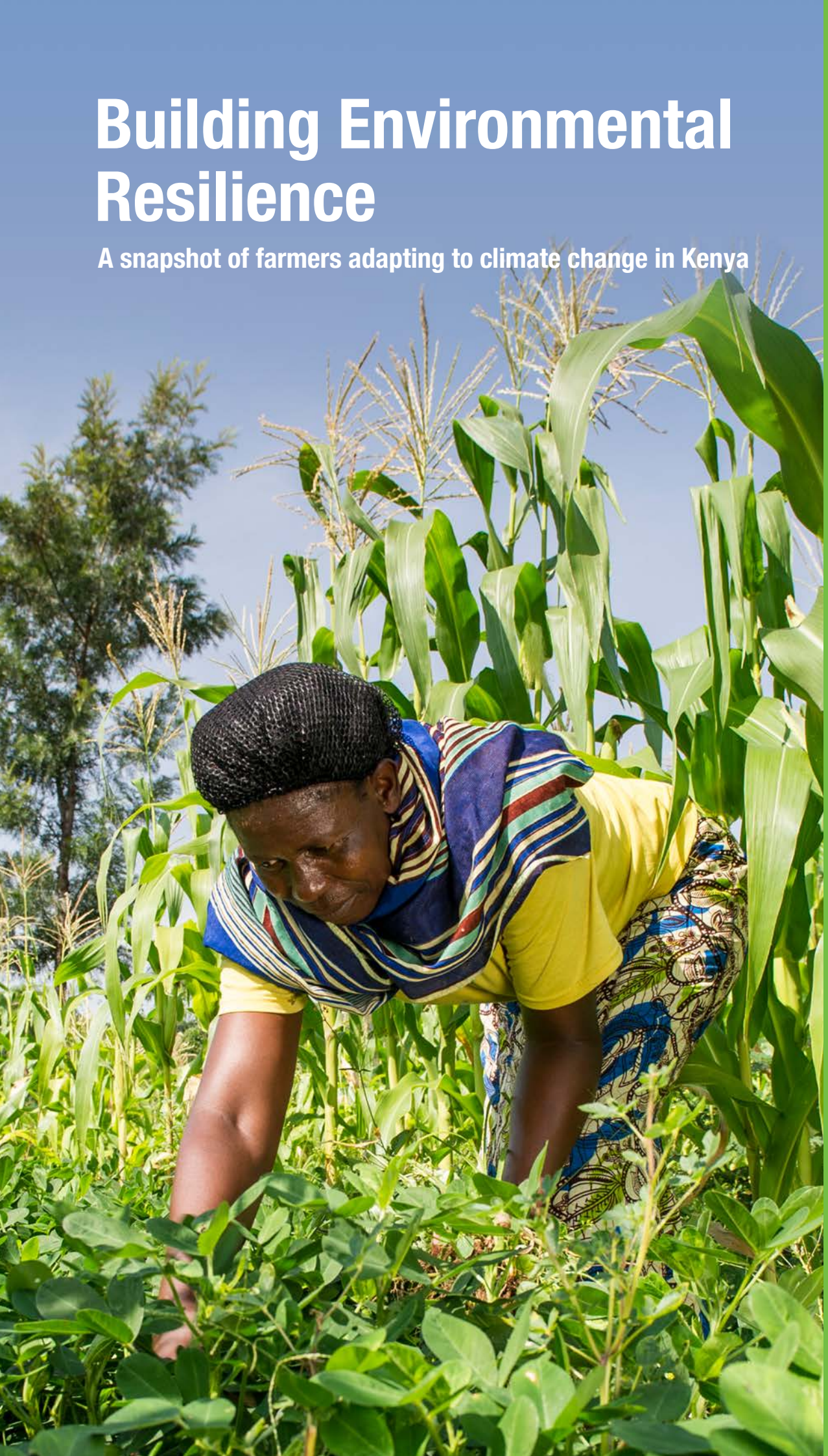
# Building Environmental Resilience

## A snapshot of farmers adapting to climate change in Kenya



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© Greenpeace / Cheryl-Samantha Owen. Prisca Mayende preparing compost. Kenya, East Africa. 2015.

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# Contents



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# Foreword

Predictions abound regarding the many ways in which climate change will affect life around the world, and in the grim contest over who will suffer the most, the people of sub-Saharan Africa may come out on top. By 2050, the population of sub-Saharan Africa will be roughly double what it is today, and this is a region where already about a quarter of the population is undernourished. Avoiding a future of perpetual food crises will require Africans to increase crop production by a daunting 260 percent. This Herculean task must be accomplished in a world where climate change is expected to make droughts in large swaths of sub-Saharan Africa longer and more intense, while in other areas it could do the opposite; unleash a torrent of rainfall that will intensify flooding and soil erosion. Climate change is also expected to increase encounters with crop pests, livestock diseases, and weed infestations. At the same time, increased agricultural production can't come from expanding the area under crops, because that would mean destroying forests, wetlands and grasslands—areas rich in biodiversity and environmental resources. Converting these areas into farmland would not only increase greenhouse gas emissions; we would lose precious resources that many communities and animal species depend on.

Yet amidst the gloom there is a legitimate reason to be hopeful. There are innovative partnerships for promoting climate resilient agriculture in Africa. These partners include the Consultative Group for International Agricultural Research (CGIAR) Centers, the CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS), development organisations, policy makers and national agricultural research stations.

There is need for these partners to support farmers to adapt to climate change through promoting a portfolio of interventions that respond to the risk profile of the community. The interventions help fuel a dramatic increase in food production even as the agriculture environment becomes much more challenging. Equally important, there is the potential to achieve these gains without adding to the global build-up of greenhouse gases. In fact, Africa can serve as an example for the innovations that can help address climate-related food challenges across the tropics and sub-tropics, where the International Panel on Climate Change Fifth Assessment Report (IPCC AR5) tells us yields may fall by 10 to 20 percent by 2050.

This publication provides one of the most comprehensive insights into the organisations and initiatives working to build resilience in agriculture in Kenya. On the basis of the evidence arising from the case studies presented in this report, Greenpeace proposes to put climate change at the forefront of agricultural development and suggest that stakeholders should take into account early action on adaptation with mitigation co-benefits. This report will be indispensable to a wide range of readers, including researchers, development practitioners, extension workers, and farmers who tackle the inextricably linked climate change and food security issues.

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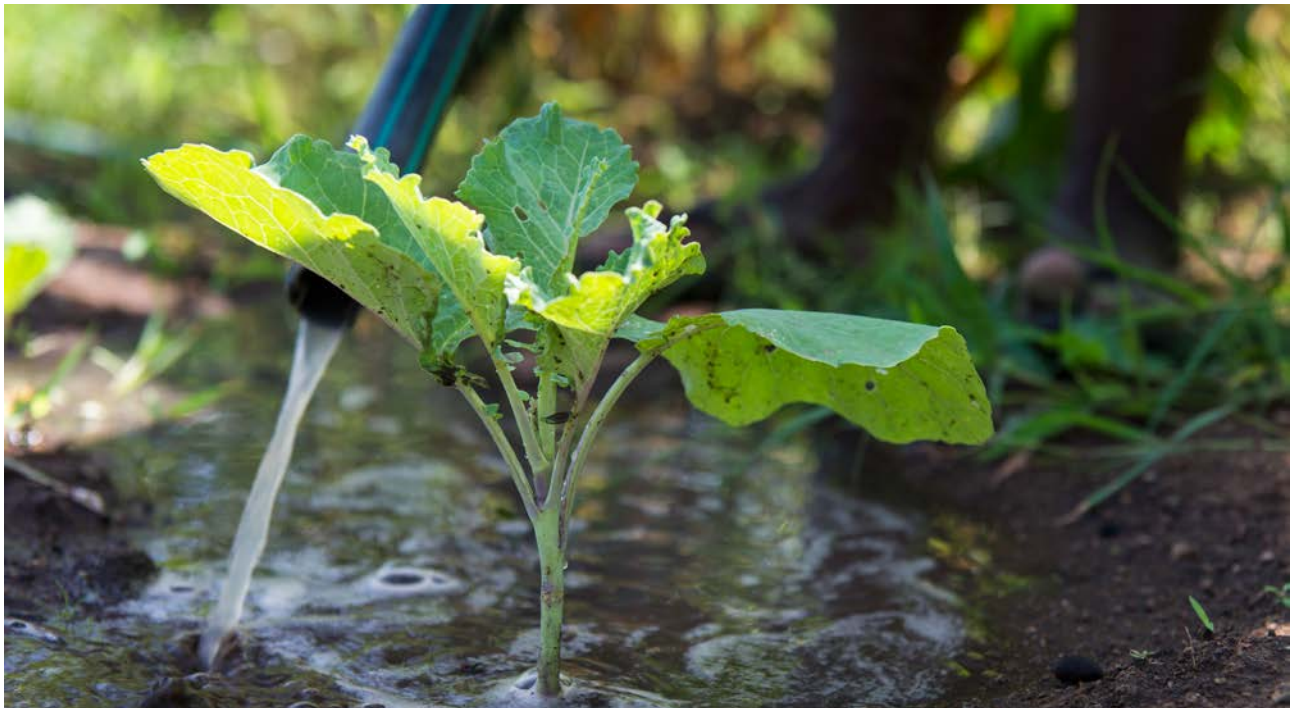


# 1. Summary

Our climate is changing and all over the world we are experiencing more unpredictable and uncertain weather than in the past. Those depending on the weather for their daily bread – farmers and farm workers – are feeling, and will continue to feel, climate change more intensively than everyone else. East Africa has first-hand experience in climate change. It is predicted that long rains will decrease and droughts will be more common, resulting in food insecurity.

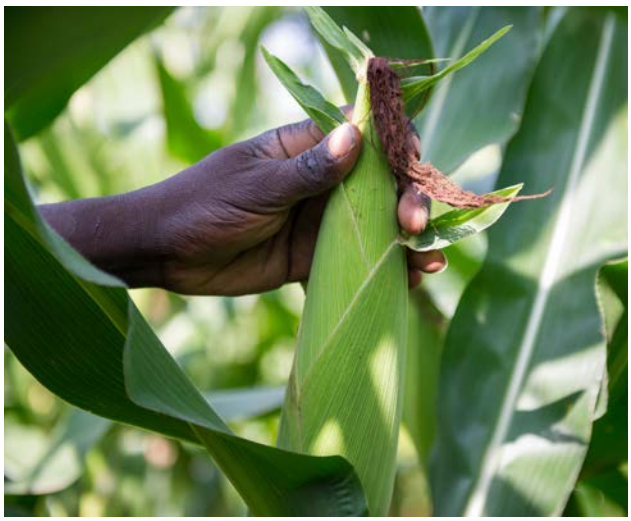
Fortunately, there are ecological farming practices that will increase farmers' capacity to adjust to climate change. These practices will help farmers and their communities cope with, and recover from, climate shocks whilst giving them the ability to further adapt in the long-term to changing weather patterns. The strategies fundamentally build on four key elements that ensure resilience in farming systems: soil, water, diversity and communities.

In October 2014 we interviewed farmers and members of the organisations that support them in West and Eastern Kenya. Our aim was to identify which practices are being used successfully to build resilience, and alternatively which practices increase vulnerability. Kenyan farmers are effectively applying agroforestry, water harvesting, diversifying crops and livestock, investing in community initiatives and many other context-specific practices that are increasing their ability to cope with changes in climate. Unfortunately there are also practices that make farmers more vulnerable to the effects of climate change. These include the use of external inputs such as agrochemicals. A reliance on a single crop grown as a monoculture increases the risk of disease. When these crops fail, farmers do not harvest anything.

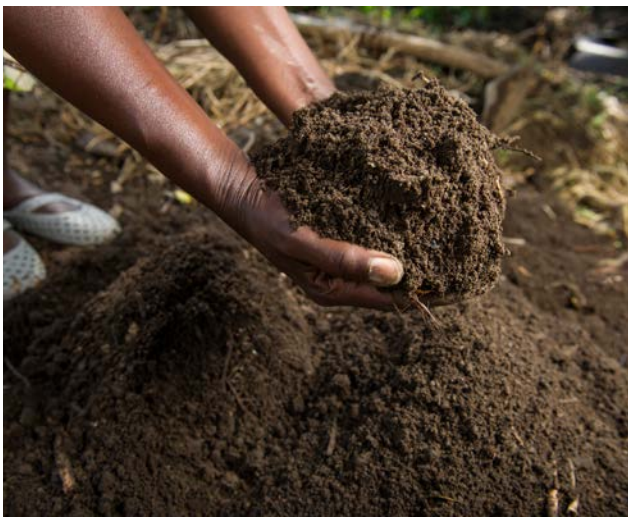
Organisations working to build resilience into agricultural systems are delivering long-term assistance by providing communities knowledge of ecological farming practices. Vi Agroforestry works to integrate fertiliser trees into agricultural systems giving the benefits of providing nutrients and stability to poor soils and an alternative income for farmers. The Institute for Culture and Ecology provides knowledge on how to collect and store water in extremely dry areas of Kenya. Traditional cultural knowledge and seeds are saved before they are lost, empowering communities. The UN research programme on Climate Change, Agriculture and Food Security (CCFAS) facilitates access to alternative income streams, diversity, and farmer-led participatory research. Arid Lands Information Network has connected farmers to global information sources through the installation of *maarifas*, or information centres, where communities can access the internet. Farm Africa is promoting farming practices that increase on-farm diversity, and incomes. Community-led learning, and training 'farmer teachers' whose knowledge will spread throughout a large area has been the approach of Farmer Field School Initiative and the Manor House Agricultural Centre.

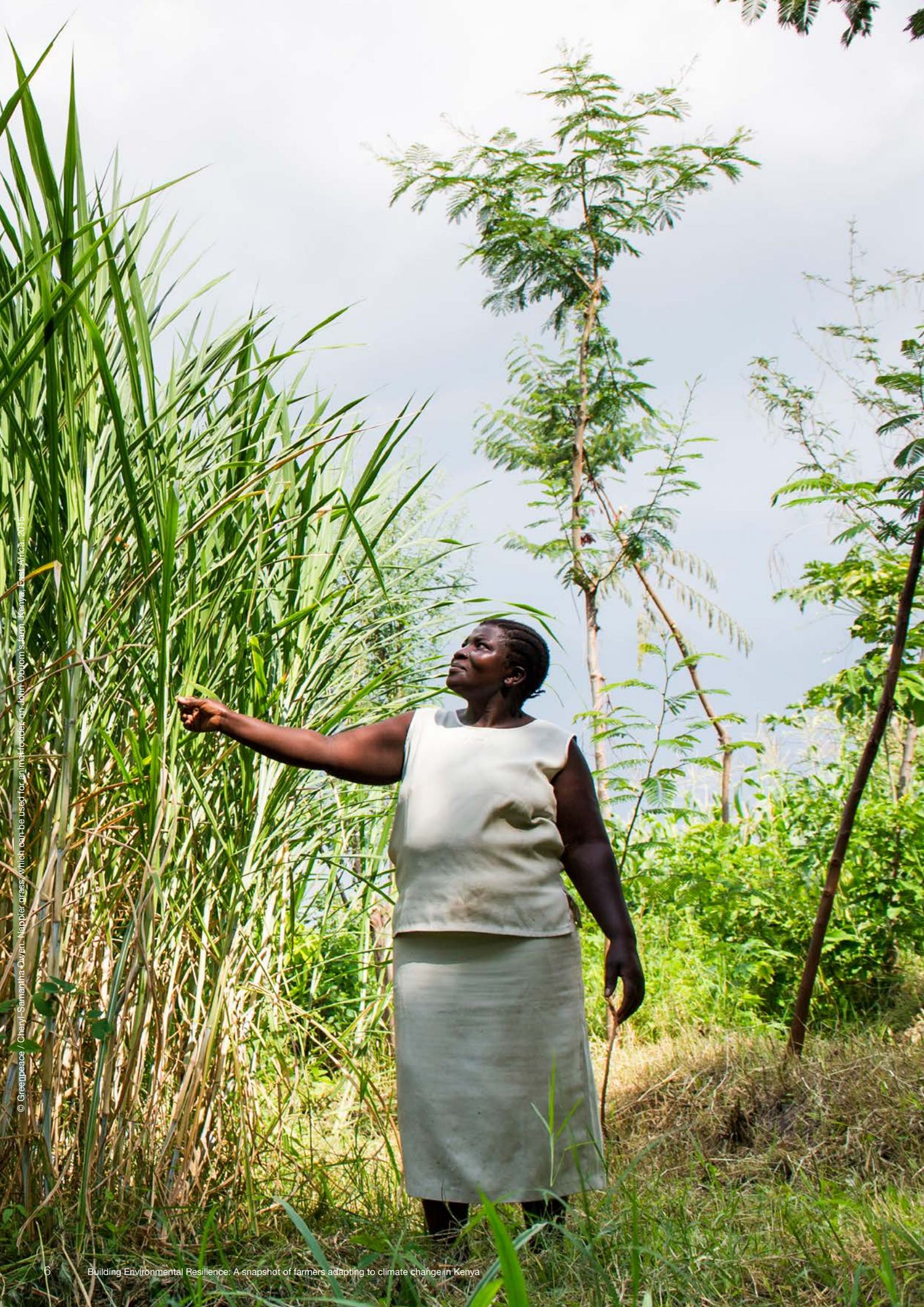
Healthy soils underpin agriculture and therefore, nutritional security.[1] As a limited resource in East Africa, practical strategies that aim to build the biological and physical structure of the soils will, in turn, facilitate better water retention and uptake of nutrients by plants. Soil conservation techniques involve traditional methods using structures such as contours, bunds, terraces, raised beds and other planting strategies. Water harvesting and storage are vital activities for farmers in East Africa, and on-farm diversity is critical in terms of pest control, harvest security, income streams and nutrition. Community learning and farmer-led participatory research were key resilience-building actions.

Many Kenyan farmers are clearly concerned by climate change and are responding to the resulting challenges with innovative approaches that will build their long-term resilience and nutritional security. For these practices to spread, and further sustain communities, we provide a number of recommendations that Greenpeace believes will facilitate these farmers in the long-term (see Page 44).









© Greenpeace / Cheryl-Samantha Owen - Napier grass, which can be used for animal fodder, on John Obuom's farm, Kenya, East Africa, 2015.

# 2. Purpose

Our climate is changing in ways that are unpredictable. This situation makes everyone more vulnerable, and it is particularly risky for people who grow food for a living and depend on the weather for their daily business.

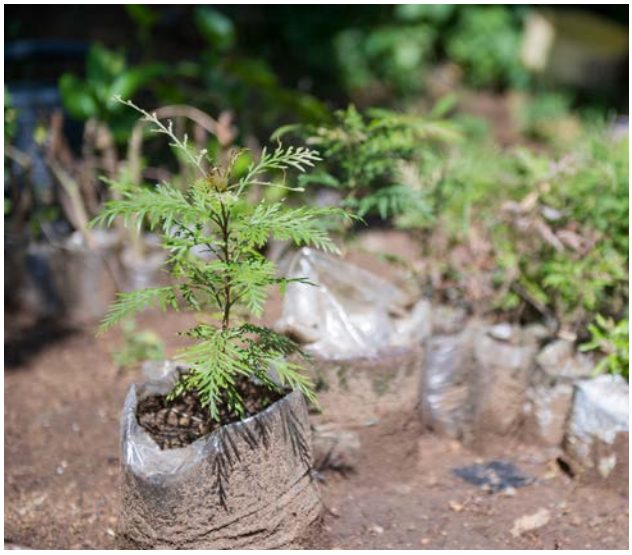
Fortunately, there are ways to make the life of millions of farmers and their families in East Africa less vulnerable to climate change. The way to do this is by building the capacity to deal with change, and recover after it, starting with their own small farms. This capacity is called resilience and our future, and that of millions of farmers in Africa and across the world, depends on it for survival in a changing climate.

Many farmers and organisations are already investing significant effort into building resilience in Kenyan rural areas. We wanted to learn directly from the farmers in their fields about what is working and what not. We wanted to determine where more emphasis is needed, and how our campaign efforts will be more beneficial to farmers.

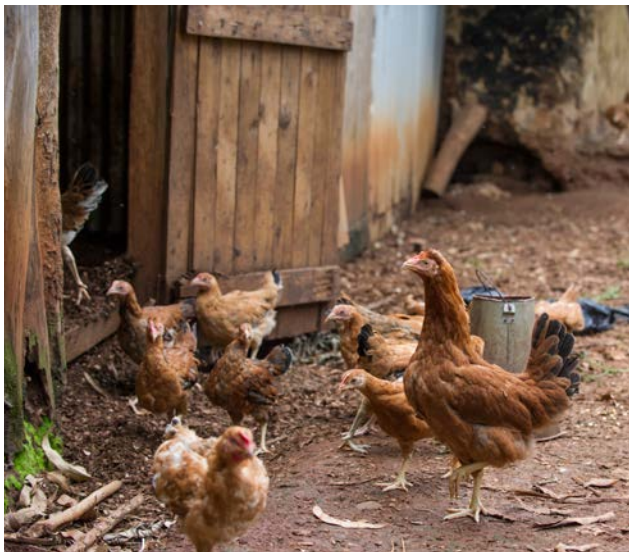
This report provides insight into the organisations and initiatives working to build resilience in agriculture in Kenya. During October 2014, a Greenpeace team (Iza Kruszewska and Reyes Tirado) visited farmers in West and Central Kenya and the local organisations working alongside them.

We interviewed farmers and local institutional partners to better understand the adaptive practices, and reflect on their effectiveness building resilience and improving farmers' livelihoods in the face of changing weather patterns. What follows is a summary of the cases in light of their significance as 'climate-resilient farming', trying to represent farmers' insights into practices that, in their views and based on our reflections, will help them adapt to a changing climate and support their rural livelihoods. Each farmer's case is presented with information on the adaptive practices and the local or community institution that they work in collaboration with (a table listing farm locations and local organisations visited by the Greenpeace team can be found in Annex I).

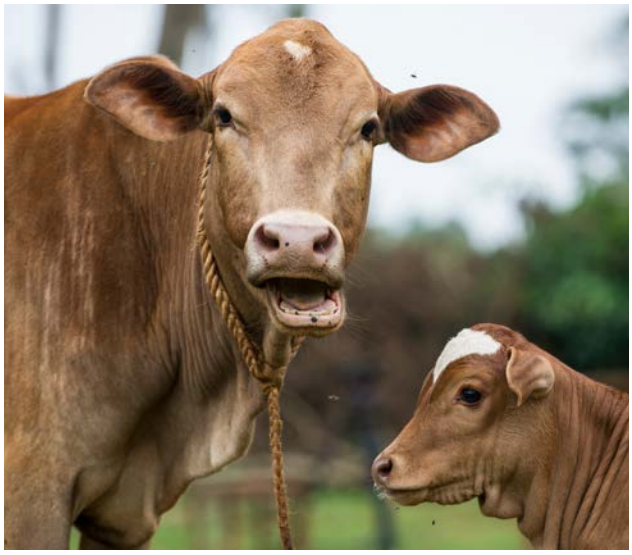
Greenpeace campaigns for an ecological farming system where people and biodiversity are the central elements. Ecological farming ensures healthy food for today and tomorrow, by protecting soil, water and climate and promoting biodiversity without contaminating the environment with chemical inputs or genetic engineering. Our vision of ecological farming is also called agroecology and sustainable agriculture (and many other terms) by others. We try to keep consistency by always referring to ecological farming when the practices in the field we encounter are consistent with this Greenpeace vision.



© Greenpeace / Cheryl-Samantha Owen. Tree nursery at Karen Onyango's farm, selling tree seedlings can help diversify farm income. Kenya, East Africa. 2015.



© Greenpeace / Cheryl-Samantha Owen. Chickens diversify food sources (eggs and meat) and income. Kenya, East Africa. 2015.



© Greenpeace / Cheryl-Samantha Owen. Cows diversify food sources (milk and meat) and income. Kenya, East Africa. 2015.

# 3. Introduction

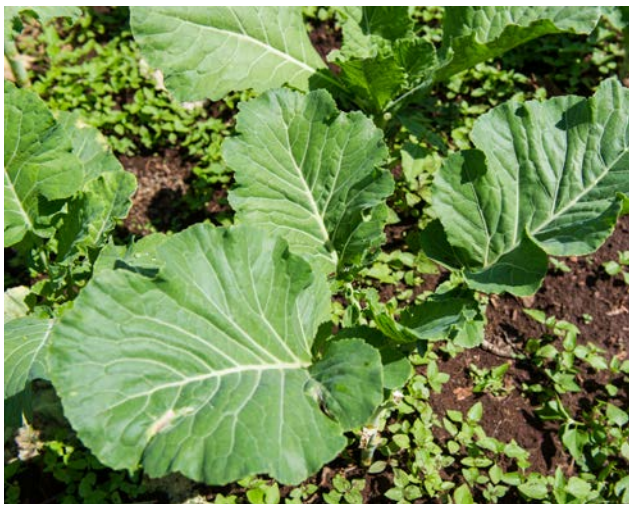
The climate in East Africa is rapidly changing and this is dramatically influencing the ability of communities and farmers to grow food. Rises in temperature and changes in precipitation already occur, and are predicted to continue and worsen in the future. Overall, it is predicted that the short rainy season will extend, but the traditionally longer rainy season will diminish, resulting in the rain being concentrated into short downfalls that will cause flooding.[2,3] In addition, extreme heat is predicted to become more frequent during the dry season. The hyper-arid and arid regions will grow by 3%.[2]

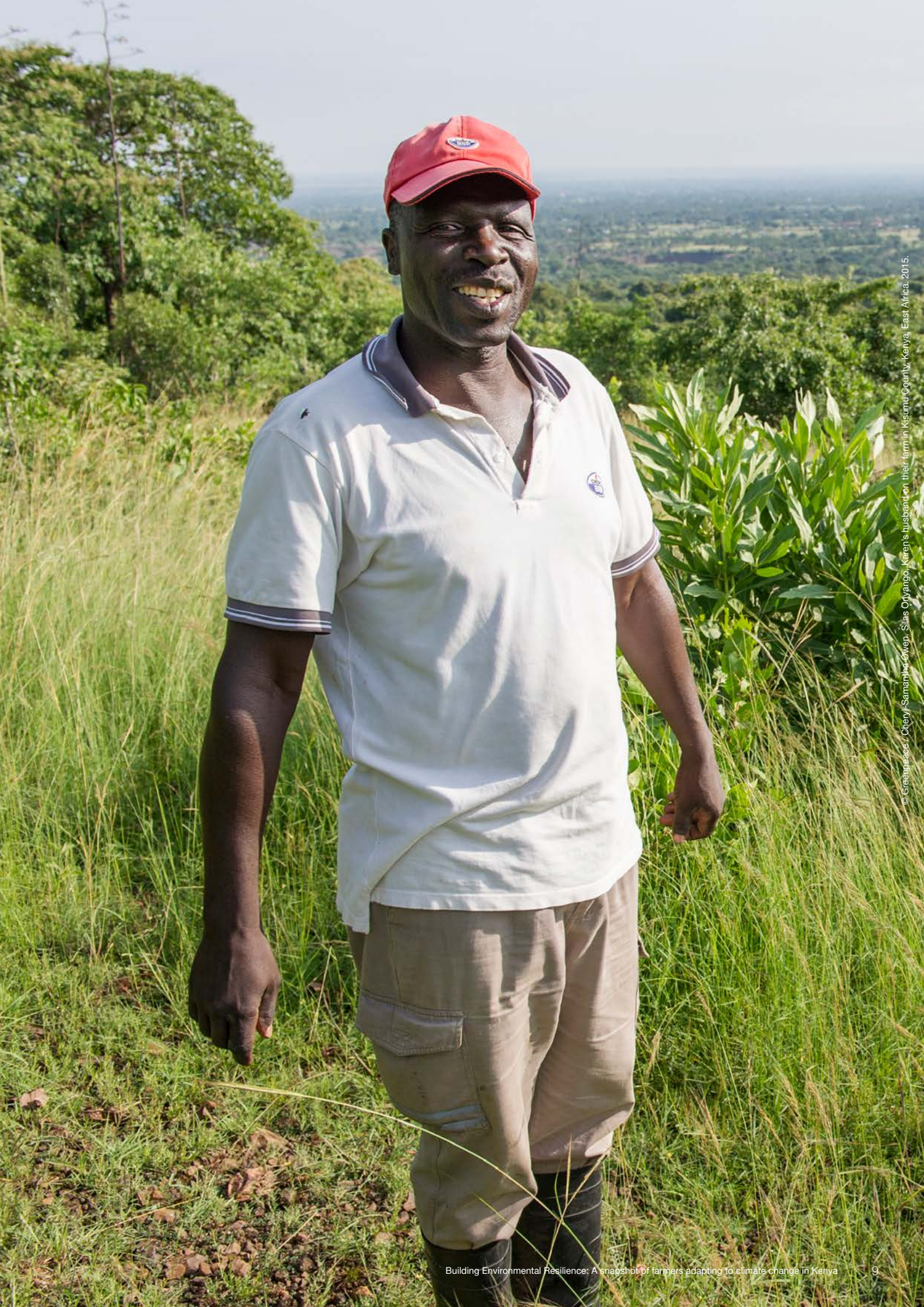
In Kenya, rising temperatures and more unpredictable rainfall patterns are already being observed[2]. Together with a changing climate, Kenyan people have been subject to significant environmental degradation. An increasing population has resulted in the reduction of size in farm holdings to small cultivated plots (*shambas*[4]) of less than 2 acres[5] as settlement expand. Illegal livestock grazing and logging are also more common in these high-density populations. As in most East African countries, over 75% of the total agricultural output of Kenya is produced by these smallholders who form 80% of the working population.[6]

Between the 1960s and the present day, closed-canopy forest cover has fallen from 12% to less than 2%. In 2010 this deforestation was estimated to be proceeding at a rate of 12,000 ha per year and this has severely affected water catchment areas for major rivers and lakes[7,8]. Only 17% of Kenya is arable with the remaining 83% consisting of arid and semi-arid (ASAL) land[9]. Due to climate change and other factors causing soil degradation, the extent of the ASAL land is increasing. The most productive agricultural areas in Kenya are located in the West, specifically the Rift Valley Province, which is considered to be the 'bread basket' of Kenya.[10]

Most of Kenyan agriculture is rain fed[11] and, currently, the main cereal crops grown throughout Kenya are maize, wheat, millet and sorghum and to a lesser extent, some root crops such as cassava, sweet potato and Irish potatoes. Cash crops include coffee, tea, sugarcane and higher value horticultural produce e.g. tomatoes, eggplant, beans and fruit. Various types of bean are grown to feed local communities and also for export to Europe. Much of the livestock is grazed (where 90% of food for animals is derived from pasture and rangelands) or mixed crop-livestock systems (where more than 10% of food for animals comes from other agricultural activities). Cattle, sheep, goats and camels are the most common ruminants kept as livestock, with smaller animals such as chickens, ducks and rabbits also being promoted as low input livestock that yield substantial returns.[12]







© Greenpeace / Cheryl Samantha Owen. Silas Onyango, Karen's husband on their farm in Kisumu County, Kenya, East Africa. 2015.

For East Africa specifically, the impacts of climate change on agriculture will be profound, and will greatly disrupt the farming livelihoods of millions of people. Availability of water may be drastically reduced, prompting more frequent droughts and seasonally dry rivers, increased desertification, receding rangelands that support pastoralists, and decreases in production and exports of some crops (maize, coffee).[13, 14, 15] This means that, to survive, communities will be required to buy more imported food, which they are less likely to be able to afford. Overall, due to the harsher environment, rural populations may move into urban centres, prompting population displacement and migrations.[16] Climate change will severely affect the ability of communities to grow food and families to sustain themselves. Poverty and food insecurity are predicted to increase.

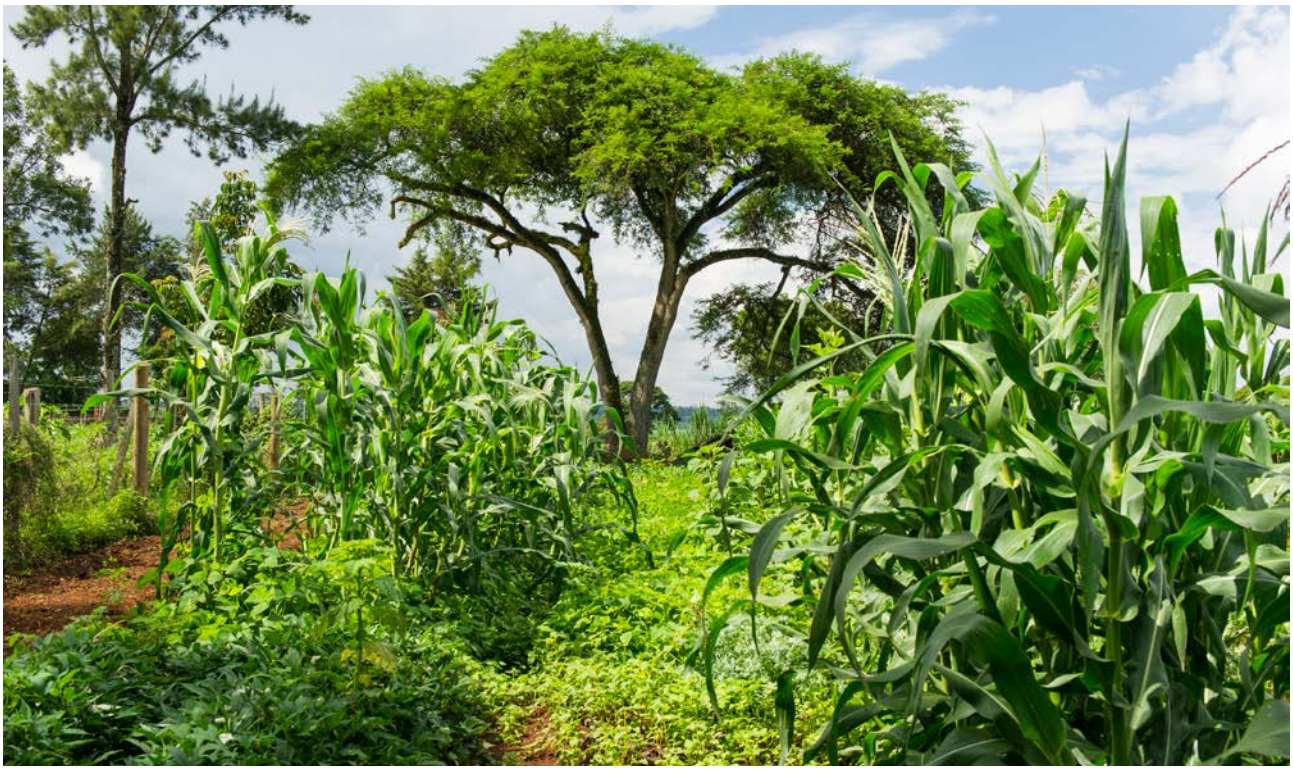
**Under the current climate change scenario, building resilience and adaptive capacity in Kenyan agriculture is imperative and urgent.**

Many experts agree that the best way to build resilience is through sustainable agricultural practices compatible with ecological farming.[17] For example, the CGIAR (Consultative Group on International Agricultural Research) Programme on Climate Change, Agriculture and Food Security (CCAFS) that works with almost 10,000 scientists around the world, acknowledges that very low-tech adaptation and mitigation strategies for farmers are essential in the face of changing weather patterns and climate.[18] Many, if not most, adaptation options can build on existing ecological agriculture practices rather than being entirely new technologies.[19] Practices that incorporate trees in croplands (agroforestry), increase farm diversity, and use traditional plant breeding for drought tolerance are all well-known systemic practices that show promise in developing effective protection strategies against future climate shocks.[20, 21, 18]

To be effective for adaptation this ecological farming needs to be locally tailored and context specific. However, some central tenets of ecological farming, (like the nurturing of soil health), appear as clear critical elements and/or guiding principles in developing successful globally applicable adaptation strategies. For example, in Africa ecological intensification of maize production systems through intercropping with legumes (plants of the bean family) has increased farm income while reducing the risk of crop failure during drought events.[22, 23]

In an accompanying report (Building Resilience in East African Agriculture in Response to Climate Change, Greenpeace Technical Report, 2015) [24] we review the scientific evidence pointing to ecological farming practices that are highly effective for building resilience and sustainability.

The aim of this report was to learn more from farmers, and illustrate examples of robust ecological farming methods that build long-term resilience to climate change within agriculture systems in Kenya. We provide details of mechanisms used by farmers on the ground, and describe ways in which organisations can assist farmers in taking the first step towards incremental adaptation that will build resilience, and reduce vulnerability. These steps also serve to build environmental resilience that will benefit farmers, and communities, in the long-term. This is also a call to donors and governments, to shift their attention, and particularly their funding, away from industrial agriculture practices and towards truly sustainable ecological practices.



# 4. Building Resilience with Ecological Farming

Building resilience into the agricultural systems of rural communities in East Africa requires building and restoring the ability of ecosystems to buffer change. We frame the building of resilience under four key elements:

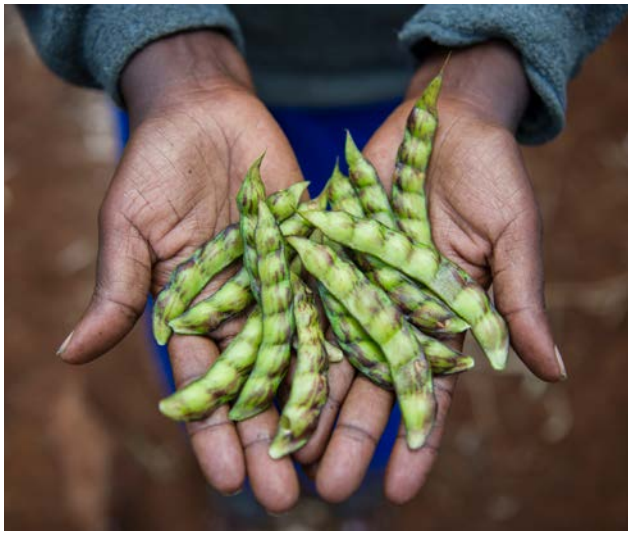
1) SOILS: Improve soil fertility and build long-lasting soil health (with better use of locally available resources).
2) WATER: Increase local water availability for cropping and improve crop water use.
3) DIVERSITY: Diversification across the system, from the seed to the plate, to ensure adaptive ability at farm level and increase nutrition and economic security.
4) COMMUNITIES: Strengthen community support networks, participatory research and learning, access to information, training and finance so as to buffer disruption within communities.

The first three elements relate to the building of natural capital, in the form of fertile soils, increased water availability and investment in diversity. In addition, building social and economic capital requires strong communities.

The table on page 12 (Table 1) summarises the ecological farming practices that build resilience and are framed under the four key elements (although there are obvious interrelations).

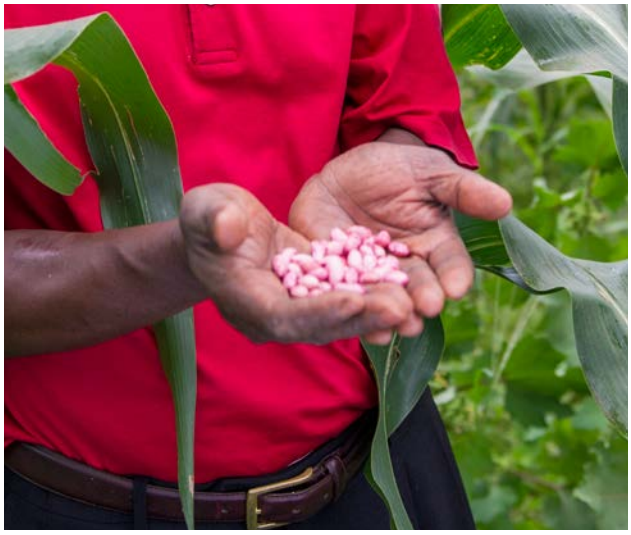
In this section, we present a brief summary of the scientific evidence supporting how each key element builds more resilient farming systems. For further details of these practices, and how each is a building block in forming a resilient agricultural system, please refer to our accompanying report (Thompson et al. 2015, *Building Resilience in East African Agriculture in Response to Climate Change*, www.greenpeace.org/africa/en/ResilienceReports).

We illustrate each key element with examples of farmers implementing these practices, and information gathered during field visits on the ground in West and Central Kenya. In addition, we include examples, under each key element, of organisations working in these areas and their focused approach to building resilience.

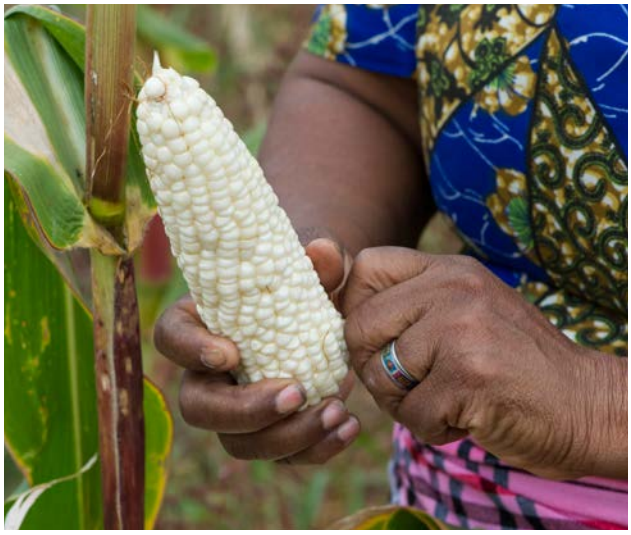


© Greenpeace / Cheryl-Samantha Owen. Francisca Kitheka holding pigeon peas. Kenya, East Africa. 2015.

© Greenpeace / Cheryl-Samantha Owen. John Wambua holding Pumpkin. Kenya, East Africa. 2015.



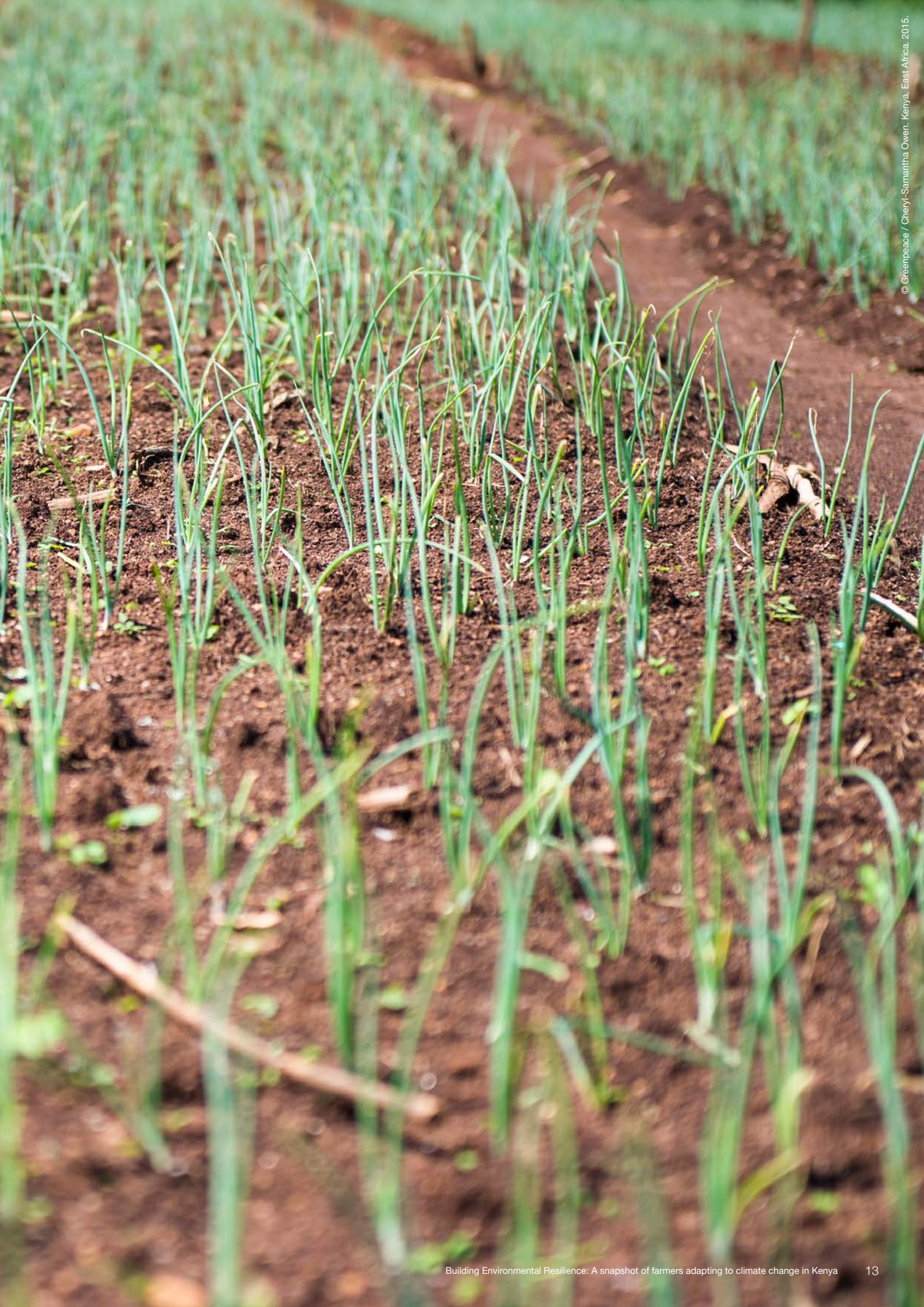
© Greenpeace / Cheryl-Samantha Owen. Augustine Wanyanga holding beans. Kenya, East Africa. 2015.



© Greenpeace / Cheryl-Samantha Owen. Jane Wavinya holding a maize cob. Kenya, East Africa. 2015.

**Table 1.** Key resilience elements and practical strategies required in building natural capital within rural farming communities.

| Key Resilience Element | Practical farming strategies |
|---|---|
| **A. SOILS:** Improve soil fertility and build long-lasting soil health (with better use of locally available resources). | • Legumes and agroforestry (e.g. cover crops, green manures, alley cropping)<br>• Manure, rotational grazing, and other options for nutrient management (e.g. composting, eco-sanitation)<br>• Soil (and water) conservation (e.g. contour cropping, terraces, minimum tillage, grass strips, silt-traps, raised beds, drainage systems and sub-soiling)<br>• Restoration of degraded land so that all of the farm is productive |
| **B. WATER:** Increase local water availability for cropping and improve crop water use. | • Rainwater harvesting for storage (e.g. micro- and macro-catchments, ponds with liners, reservoirs)<br>• Increased water infiltration into the soil (and reduced evaporation) (e.g. planting pits, terracing, cover crops, mulching, micro-climates)<br>• Maximised plant water uptake (e.g. soil rich in organic matter, mulching, drip irrigation, drought resistant local crop varieties and resistant livestock breeds) |
| **C. DIVERSITY:** Diversity across the system, from the seed to the plate, to ensure adaptive ability and increase nutrition and economic security. | • A variety of seeds, crops and livestock on each farm for genetic diversity<br>• Changes in the timing of planting, mixed cropping and rotational fallows to give temporal diversity throughout the farm<br>• Fish in rice paddies and fish ponds for alternative protein<br>• Agroforestry for habitat diversity and alternative incomes<br>• Integrated livestock (chickens, rabbits, ducks), beekeeping<br>• Kitchen gardens that use all available land to grow vegetables<br>• Habitat management for pest-predators with an increase in ecological pest-protection using mosaic habitats to improve biodiversity<br>• Drought resistant local crop varieties and livestock breeds<br>• High value crops and tree nurseries for income diversification |
| **D. COMMUNITIES:** Strengthen community support networks, access to information, training and finance so as to buffer change. | • Strengthened community-based networks that can solve problems and build resilience to climate shocks<br>• Farmer field schools and teacher farmers that will spread innovative practices<br>• Farmer participatory research and on-farm testing of drought resistant varieties<br>• Protection of indigenous knowledge and networks<br>• Information centres that link farmers and communities to education, knowledge and each other<br>• Equal education opportunities for women<br>• Technological innovations (e.g. social enterprises, real time market information, climate and weather forecasting)<br>• Community advocacy with the ability to negotiate with national and international organisations<br>• By combining harvests, communities can negotiate a better deal<br>• Access to microfinance particularly for community groups (e.g. investing in food processing and storage, value addition and knowledge) |



# A. Soils

## Improve soil fertility and health using locally available resources.

Healthy soils with sufficient nutrients are essential for good yields and healthy crops.[25, 26] However, soils are also very vulnerable to climate and extreme weather events through the impact of droughts and soil erosion during flooding. Building resilient soils that are able to produce reliable harvests and at the same time withstand a changing climate, requires practices that:

1) Provide nutrients and good soil conditioning that will improve water holding capacity which is crucial during drought spells and simultaneously,
2) Are sustainable in terms of climate and economic changes. Using locally available resources and practices that rely on knowledge, instead of expensive external inputs that are prone to price fluctuations, are a sustainable way to build up resilience in soils, and on the farm as a whole.

Practices that build and sustain resilient soils focus on improving nutrients, physical stability and water retention within the structure of the soil. Examples include the use of nitrogen fixation by legumes, as well as some trees in agroforestry systems. Crops are grown alongside these nitrogen fixers in mixed, or alley, cropping and so yields increase. The legumes themselves also provide nutritional food for people. Green manures ensure that this nitrogen fixation continues during fallow periods and biomass is not removed, but returned to the soil. Livestock manure, household green waste and crop residues are also used to regenerate soils.

Farmer Prisca Mayende (see below) showed us examples of how these adaptive practices can be integrated into farming systems. Her innovative approaches illustrate the kind of benefits farmers will enjoy with regards to yields and the building of adaptive capacity.

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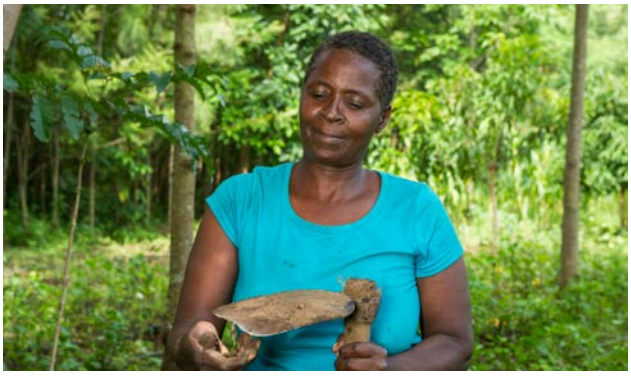
### Prisca Mayende, Bungoma County, Western Kenya





Prisca Mayende

Bungoma County is located in the tropical highlands of Western Kenya on an altitude of 1400 - 1700 m above sea level. The rains are bimodal with a total rainfall of 1200 - 1800 mm per year. Many farmers practice mixed-cropping with some cash crops, such as coffee and sugarcane, and staples including maize, beans, bananas and millet as well as fruit and vegetables. Livestock kept in the area is generally cattle, sheep, goats, pigs, rabbits and chickens.

Prisca is an energetic woman with nine children. Prisca and her children live with her husband on her 3.8 acre *shamba* (farm). Her husband works on another *shamba* owned by the family and Prisca manages the home *shamba* on her own, with the help of her children. Prisca is active in the community and is chairwoman of Naigai community water project, initiated in 2009. Seventeen households (4 men, 13 women) worked together to dig a borehole on Prisca's *shamba* and to start an early childhood education project, also on Prisca's *shamba*. After working with Vi Agroforestry through the Kenya Agricultural Carbon Project and the Naigai community group, in 2010 she decided to adopt ecological farming practices like agroforestry, organic soil fertilisation and crop diversification.

Prisca practices **agroforestry** on her *shamba*. She uses **alley cropping** (planting nitrogen fixing trees between rows of crops) and uses the leaves of the *Sesbania* and *Calliendra* trees as **fodder crops** for her dairy cow that is **an improved breed** and is adapted to regional conditions. Prisca also uses **cover crops** (groundnuts and other beans like soya, macuna/cowpea and lablab, *Desmodium*) that enrich the soil and mulch her crops. **Mulching** increases the fertility and water retention of the soil – in this tropical environment weeds are always a problem. However, it is important to Prisca that her soil has a healthy microbe and earthworm population so she thinks it is better to avoid the use of herbicides, which she feels disturbs the natural balance of the soil.

Prisca prefers not to plough the soils in her *shamba*, and tends to sow directly into the ground. She practices **reduced tillage** and instead of digging the soil through and disturbing its structure she simply cuts the cover crops and uses the leaves as mulch.

As a result of these ecological farming practices Prisca has enjoyed increased yields from her crops and now requires much less fertiliser – particularly as result of her using **manure** and **composting**.

**According to Prisca, ecological farming is not only increasing maize yields on her *shamba*, but it is also**

**saving her a significant amount of money on chemical fertiliser.** Since taking up ecological farming practices, Prisca saves about US$50 per year by not buying urea and reduced use of DAP, despite producing two and half times more maize (Table 2). This is in keeping with the finding of a Greenpeace Africa study, *Fostering Economic Resilience: The Financial Benefits of Ecological Farming in Kenya and Malawi.*[27]

**Table 2.** Prisca's own data on her observations of fertiliser inputs and maize yields before and after she adopted ecological farming practices on her *shamba*

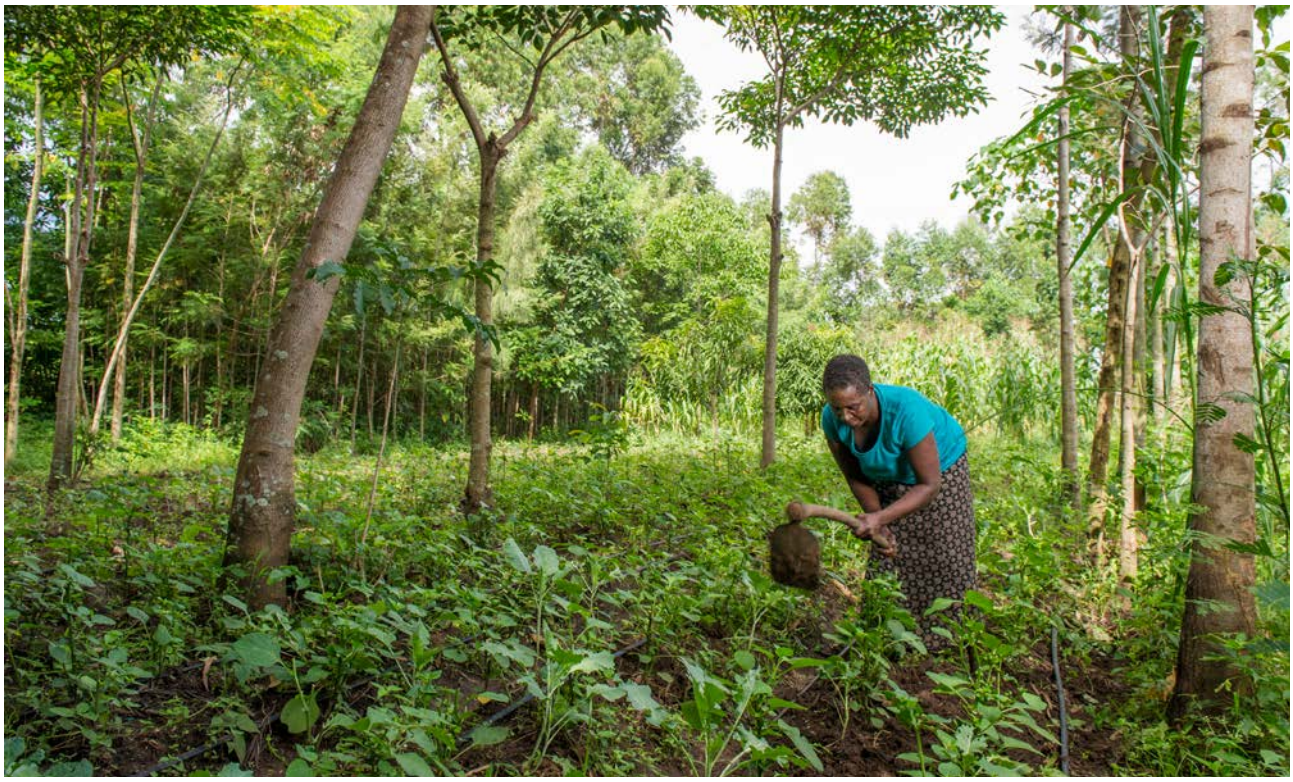
| Farming practices | DAP fertiliser (kg) | Urea fertiliser (kg) | Yield of maize (kg) |
|---|---|---|---|
| Before: Mostly chemical fertilisers | 150 | 150 | 720 |
| After: Composting, mulching and trees | 50 | 0 | 1800 |

On the cassava that Prisca grows, she needs no fertiliser at all, but she is still using some for her fruit and vegetables, particularly the tomatoes and bananas. She has purchased a cow with the income from the maize and bananas and sells cassava and vegetables to pay her nine children's school fees. Her dairy cow produces 12 litres of milk per day and she has a three-month-old calf. She can use this milk to supplement the diet of her children and make yoghurt and cultured milk to sell. Her calf is also a valuable asset to the *shamba* if she needs to realise cash in the future.

Prisca also uses a **Solvatten**[28] (water sterilising solar heater) that is the size of a briefcase and can be filled with 10 litres of water. It has an integral filter so the water inside is always clean and takes around 2 hours to heat to 75 °C. This means that she needs much less firewood to make hot water, and the water does not smell of wood smoke. Because of the filter and the easy availability of hot water, the Solvatten has reduced the incidence of waterborne disease, something that Prisca is very aware of since her son suffered from typhoid.

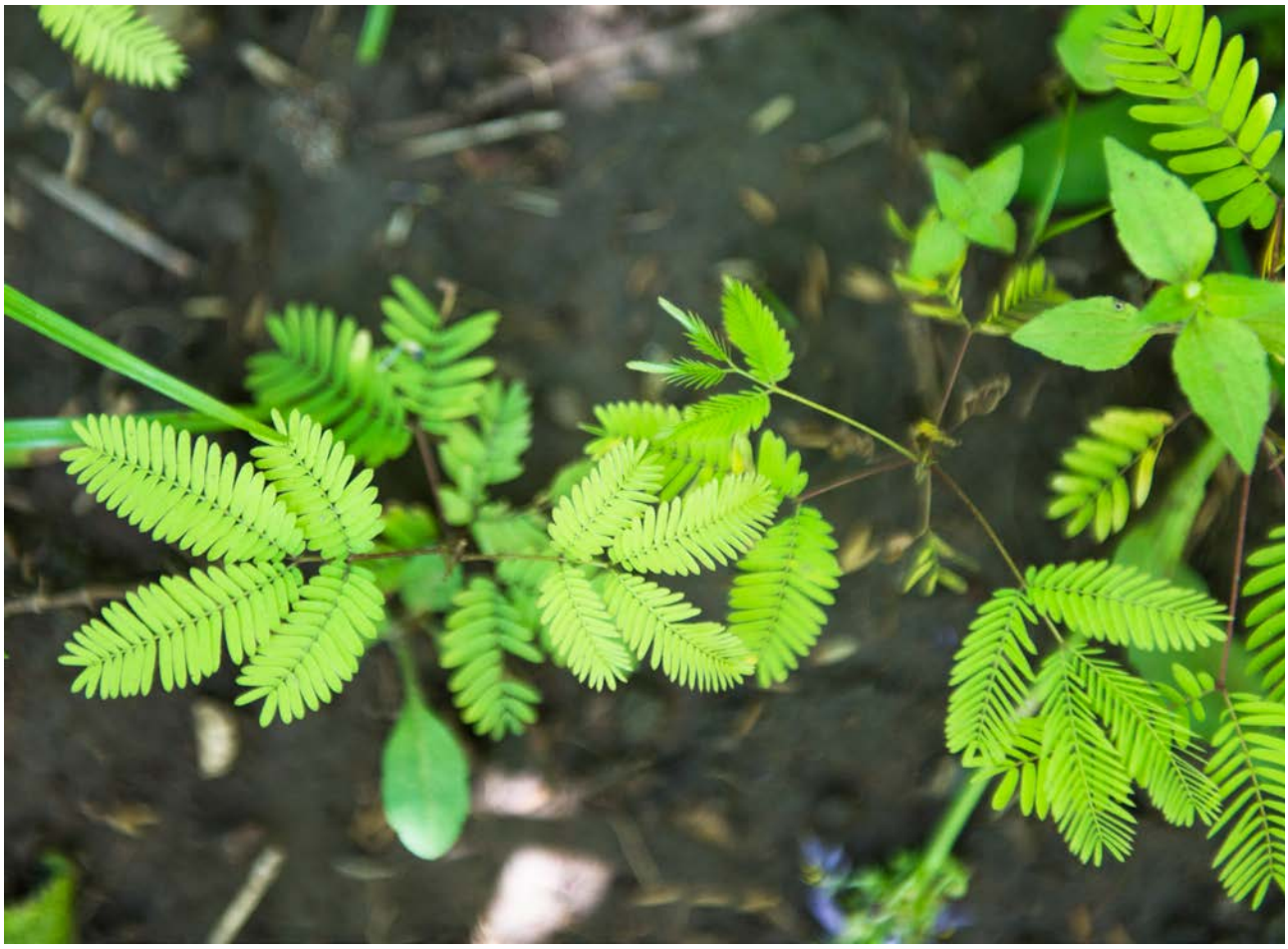
Prisca also uses an **energy saving cooking stove** which reduces her overall use of fuel wood, and smoke emissions. The costs of the new stove and the Solvatten were subsidised by Vi Agroforestry. She also has a borehole that was dug on her *shamba* in 1995. This was subsidised by the Finnish government, which reduced the cost from US$1666 to US$233. The borehole provides her domestic water and drip irrigation on her *shamba*.

Ecological agriculture keywords on Prisca's *Shamba*: **AGROFORESTRY;** ALLEY CROPPING; FODDER CROPS; COVER CROPS; LOCAL VARIETIES; **REDUCED TILLAGE; MANURE; COMPOSTING;** DRIP IRRIGATION; **COMMUNITY BASED ORGANISATION;** BOREHOLE; **CHILD EDUCATION**



© Greenpeace / Cheryl-Samantha Owen. Prisca Mayende weeding her indigenous vegetables, grown under trees. Kenya, East Africa. 2015.

© Greenpeace / Cheryl-Samantha Owen. Kenya, East Africa. 2015.



© Greenpeace / Cheryl-Samantha Owen. Kenya, East Africa. 2015.

## Example of an organisation working to improve soil health

### Vi Agroforestry

*"Vi Agroforestry is a Swedish development cooperation organisation, fighting poverty and improving the environment through tree planting. We do this together with small-holder farming families and farmers' organisations in the Lake Victoria basin in East Africa. The foundation of Vi Agroforestry's work is sustainable agriculture and agroforestry – growing trees alongside crops and livestock. It provides increased access to food, access to sustainable energy sources, more income. Sustainable agriculture contributes to the mitigation of climate change."* Linda Andersson, Vi Agroforestry.

Vi Agroforestry works through local partner organisations to provide expertise on agroforestry to prevent soil erosion and bind carbon dioxide, mostly through tree planting. The organisation also promotes techniques that farmers can use to improve the sustainability of their agricultural practices and adapt to climate change in the region. The aim of the organisation is to **improve Land, Livestock and Livelihoods (LLL) using Sustainable Agricultural Land use Management (SALM)**.[29] The Vi Agroforestry vision is working towards a sustainable environment that enables people in poverty to improve their lives.

Vi Agroforestry's work combines trees and diversification – both cultivation of trees and crops can increase crop production and improve livelihoods for farmers. Recent work has focused on climate adaptation actions – supporting farmers to grow trees and other crops that will reduce vulnerability to drought and strong winds. Organisational development is also thought important, and this is done by strengthening cooperation between farmers and through farmers' groups, community-based organisations and cooperatives.

Some of the practices that Vi Agroforestry use to engage farmers in ecological farming practices include:

1) Planting of tree species to prevent soil erosion, increase water catchment and provide sustainable fuel wood and other benefits (e.g. fruit for sale, fodder for livestock or medicines from tree bark). Training is provided so as to give farmers skills in direct seeding, nursery propagation and thinning after germination.
2) Fencing to prevent over-grazing and allow natural regeneration of vegetation, particularly in semi-arid areas.
3) Providing small-scale farmers (SSFs) with access to tree seeds and training on how to successfully grow them. By providing this technical support and training to farmers' organisations and local groups, the farmers then establish their own nurseries. Continued support to these groups ensures that the seedlings are ready for planting at the beginning of each planting (rainy) season.
4) Organisational development – Vi Agroforestry has been involved in strengthening the capacity of farmers' organisations to improve their efficiency in service provision and giving a voice to their members.
5) Enterprise development – to increase incomes from the farms, Vi Agroforestry encourages farmers to view their farming as a commercial enterprise. With support the farmers can develop their commercial activities and, as a group, strategically plan them based on analyses of the market. Vi Agroforestry provides training to farmers on basic business economics and how to analyse their results. By coming together farmers can negotiate better prices and take advantage of shared gains from joint purchasing of seeds and other necessities.
6) Gender issues and challenges associated with HIV and AIDS are also addressed directly.
7) Kenya Agricultural Carbon Project (KACP) – This is a collaboration with the World Bank to develop a method to estimate the climate benefits of ecological farming practices. The project aims to support SSFs and result in increased crop yields, farm productivity and potentially soil carbon sequestration (and above ground carbon sequestration). The project was initiated on the 1st July 2009 and is to run until 2017 on approximately 45,000 ha in Western Kenya. Particular practices that are promoted by the KACP include residue management, green manure and cover crops and agroforestry.

Agroforestry involves planting trees in the landscapes and increases biomass above and below ground, including building up soil carbon. There are several agroforestry practices that form part of this activity: agro-silviculture where agricultural crops are grown alongside trees (*Sesbania sesban, Markhamia lutea, Calliandra* spp., *Grevillea robusta* etc.); boundary/hedge planting for windbreaks and stabilising the soil; woodlots of approximately 40 trees to serve as woody biomass pools; trees planted for shading; silvo-pastures for production of green manures; banks with trees such as *Calliandra* spp., *Sesbania sesban, Gliricidia sepium, Moringa oleifera* and *Cajanus cajan* that are planted for fodder.

Vi Agroforestry seeks to monitor and evaluate the success of projects through external partners and self-evaluation by the farmers themselves. Improvement in the land is measured through an increase in productivity and soil organic carbon. Vi Agroforestry participates in a number of projects alongside partner organisations, government bodies and community based-organisations (CBOs). In South Bukusa (Bumula zone of Bungoma county), Vi Agroforestry is working with 46 community groups, of which 46% are women's groups, 41% are self-help groups and 13% youth groups, representing 743 households.[30]

# B. Water

## Increase local water availability for cropping and improve crop water use.

For food and agriculture systems to be resilient, it is fundamental that they can cope with water shortages. Access to water is, and will be, a fundamental limiting factor in feeding the world. Experts propose that the best option to sustainably increase food production in water-limited regions is by better use of 'green' water[31] in rain fed agriculture[32]. The use of soil and water conservation techniques to increase the amount of soil water available for plants, can increase yields in a way that is sustainable, low cost, and accessible to small-scale farmers without the need for, often expensive, macro-irrigation equipment or infrastructure. More innovative options are needed for these sustainable 'landscape scale' approaches in rain-fed agriculture[6].

Strategies to combat drought make best use of available 'green' and 'blue' water[33], and involve:

1) The collection of rainwater for storage, (e.g. rainwater harvesting techniques and storage in micro- and macro-catchments)
2) Techniques that increase the infiltration of water into the soil (and reduce evaporation), (e.g. terracing, cover crops, mulching) and,
3) Those that maximise plant water uptake and use (e.g. soil that is rich in organic matter, mulching, drip irrigation, drought resistant local crop varieties and livestock breeds).

Below we illustrate field-level examples of how two farmers from contrasting environments practice farming techniques that enhance water resilience. John Wambua in Machakos County, Eastern Kenya, farms in a very dry and harsh environment. John Obuom in Kisumu County, Western Kenya farms in a more productive environment that has some dry spells, the impact of which, he tries to minimise with low-cost strategies. Both are implementing an array of practices, adapted to their local conditions that will improve their ability to cope with water limitations. The Institute of Culture and Ecology, based in Eastern Kenya, works with farmers in Machakos County and provides an example of an organisation focusing on improved water resilience, while having a very systematic approach to farming and rural communities (see below).

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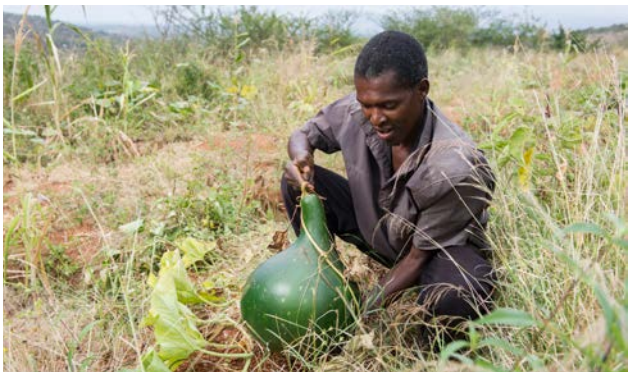
### John Wambua, Machakos County, Eastern Kenya





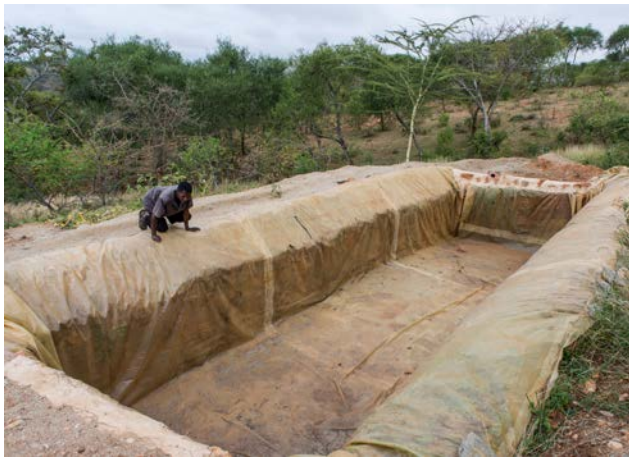
John Wambua

Machakos County is located within the semi-arid agroecological zone in Eastern Kenya. Farming in this region is very harsh and livelihoods are tough. Rainfall, though bimodal, is limited to 750 - 1250 mm per year and can be sporadic. Population density is low and though farms are larger than in other regions, resources are drastically limited. Soils are very infertile and poverty is widespread. Farmers need to focus on water collection and storage, as well as avoiding soil erosion and improving the soil so that rain permeates and nourishes the crops. Farmers plant in pits and mulch to reduce evaporation and are turning to drought resistant varieties of crop and livestock. Soils here are very prone to erosion and degrade easily; improving use of water is crucial in promoting plant cover as an erosion-prevention strategy.

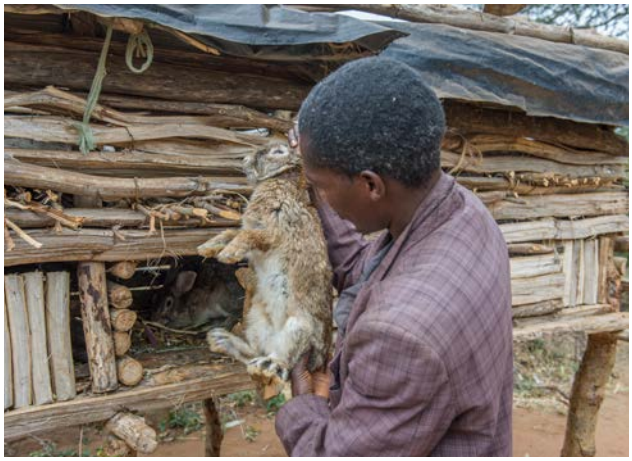
Farmer John Wambua lives on his *shamba* with his wife and four children. He works hard and is trying to provide a better living for his family. He has a small mango **tree nursery**, growing seedlings that he can sell at market. When he plants his trees or crops, he always plants them in ***zai* pits** alongside **beans** that will improve the soil through nitrogen fixation and conserve water for the tree. John has started plans to rear rabbits for meat and for sale, and has dug his own **water reservoir** in a rocky and sloped part of his farm. Like other farmers in the area, he must invest a considerable amount of money (about US$270) to line his reservoir with plastic to prevent the water from seeping away soon after the rainy season.

John's *shamba* is **terraced**. His parents had an ox with which they used to cultivate the terraces. Today John cannot afford an ox, so the terraces lie fallow. He is working with the Institute for Cultural Ecology to learn new farming practices and improve his livelihood.

Ecological agriculture keywords on John's *shamba*: AGROFORESTRY; TREE NURSERY; DIVERSIFICATION; HIGH VALUE TREES; **WATER HARVESTING; *ZAI* PITS;** SOIL CONSERVATION; CHICKENS; **CONTOUR**

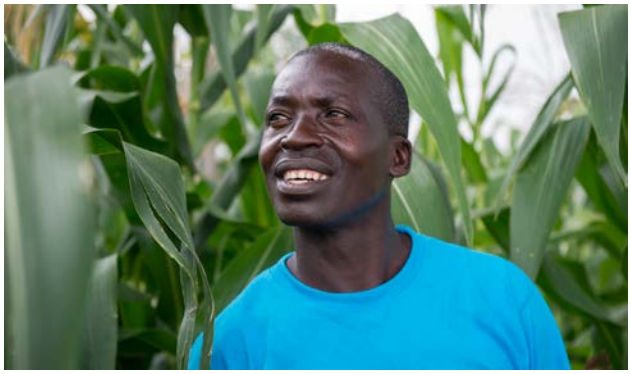


© Greenpeace / Cheryl-Samantha Owen.John Wambua shows off his lined water reservoir. Kenya, East Africa. 2015.



© Greenpeace / Cheryl-Samantha Owen. John Wambua plans to rear rabbits for meat and sale. Kenya, East Africa. 2015.

## John Obuom, Lower Nyando, Kisumu County, Western Kenya



© Greenpeace / Cheryl-Samantha Owen. 2015.

John Obuom

Lower Nyando has a humid to sub-humid climate and primarily mixed rain-fed crop-livestock farming system. Farm sizes are small (36% have *shambas* less than 1 ha, 58% have *shambas* between 1 and 5 ha) and the area has low and erratic rainfall patterns. Many areas suffer high levels of poverty and there is serious environmental degradation – declining tree cover, soil erosion and declining soil fertility. Only 1% of households are food-secure all year long, and 81% suffer 1–2 months of food insecurity every year. Surveys also suggest that nearly 88% of Nyando households have faced a climate crisis (drought or flood) in the previous five years and 39% receive financial assistance, mainly from government agencies.[34]

John Obuom lives with his wife and 8 children on his four-acre *shamba* in the village of Kowalla. On his *shamba* he uses 2.5 acres for horticulture and the remaining 1.5 acres for grazing his cows and goats. In 2000, John and his family returned from Nairobi in search of work and a better life. He initially planted sorghum on the family *shamba* but the yields were poor and he began to look for some way of improving the productivity of the *shamba*. A local World Agroforestry Centre (ICRAF) project was providing advice and tree seedlings and John took advantage of the opportunity.

John began by planting **trees** (*Grevillea, Casuarina, Gliricidia* and *Calliandra*) and through good advice, he was able to start a small nursery and generate some income from selling seedlings. He also began to attend training from other organisations such as Vi Agroforestry and CARE Kenya[35] on the use of **high value trees** such as papaya and mango. John began by planting papaya

© Greenpeace / Cheryl-Samantha Owen. Pauline Obuom irrigating vegetables with water from a foot-powered pump. Kenya, East Africa. 2015.

© Greenpeace / Cheryl-Samantha Owen. Beehives on John Obuom's farm. Bee keeping can be a lucrative diversification strategy for farmers as honey can fetch high prices. Kenya, East Africa. 2015.

that fruit over 10 years, and then mango trees that fruit throughout their 100-year lifetime.

In 2011 the CCAFS[36] programme was launched in John's area and, together with partner research and development organisations, it introduced a number of key innovations. He started raising resilient Galla[37] goats that are suited to John's *shamba* conditions. The Galla goats are able to withstand heat stress, better utilise low quality herbage, cope with disease and recover from drought with faster compensatory growth, therefore maturing to market weight in shorter rearing periods compared to the local breeds. He also began to diversify his crops to those more suited to his area like cowpeas and green grams that are **drought tolerant** and mature within 65 days, and a resilient hybrid variety of sorghum that matures in 75 days. In some areas of the *shamba*, the crops are rotated with a **green manure** crop, Tithonia. John saves seed from his legume (bean) plants and although he still needs to buy the cereal seeds from the local agrovets he would like to **save seed** from all his crops.

The most important factor in John's *shamba*, as far as he is concerned, is **diversification** and this means that the income for the family is much more secure. Currently, on the *shamba* he grows a range of trees for wood, fruit trees (papaya, mango and banana), cassava, maize, and integrates his vegetables with the mango trees. The vegetables he grows are tomatoes, kale and indigenous vegetables like nightshade, spider plants and cowpeas. John now has two breeds of goat; the Galla goats for meat and Alpine goats for dairy production. He is hoping to invest in a dairy cow so that he can generate more income from selling dairy products that will cover the cost of his daughter's education. To help with these costs, John has also diversified his income through keeping local varieties of chickens and ducks.

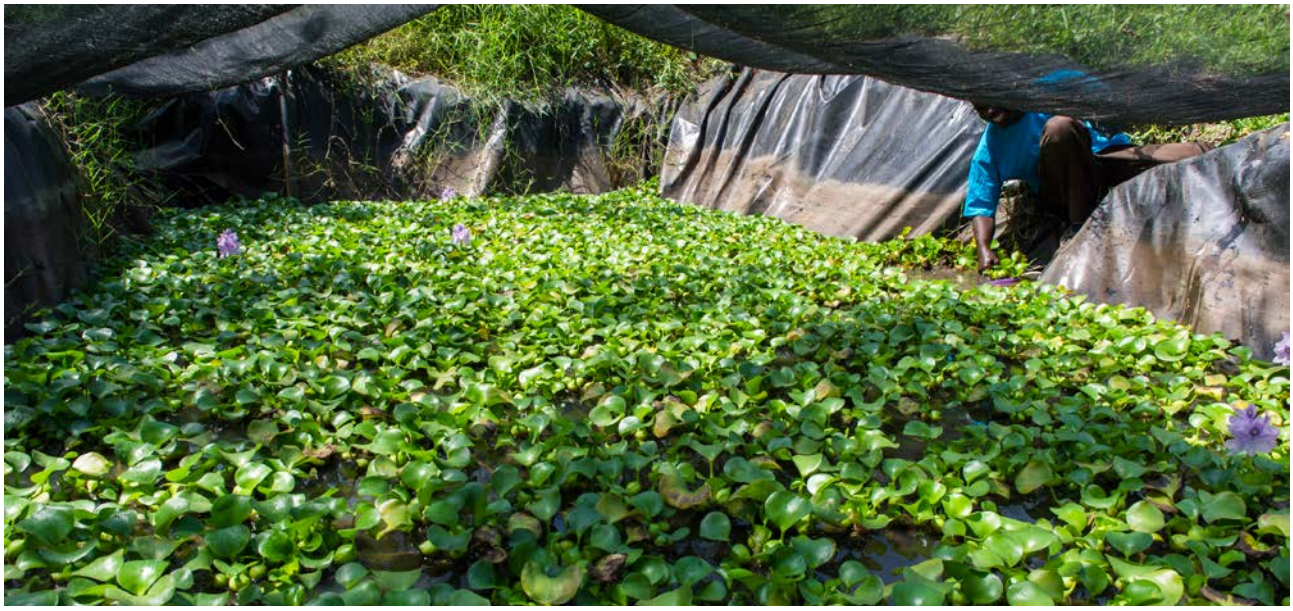
John's annual gross income from the commercial crops on his *shamba*:[38]

- Papaya – US$870
- Kale – US$220
- Timber – US$160
- Chickens – US$110
- Ducks – US$45
- Cowpea (leaves) – US$85
- Goats – US$540

John also produces around 30 kg of honey from his Langstroth beehives every year, although in the year we visited him he had not sold any honey. Honey can fetch very high prices in Kenya[39] and can be a secure diversification strategy if farmers can get a fair price.

Since the 1996-97 El Nino year, John feels that the climate has become drier and it is difficult to predict the annual rains. To counter this, John concentrates on creating **micro-catchment water reservoirs** on his *shamba* and has two water harvesting pans with the capability of supplying water for six months. The pans are lined with dam liners (plastic sheets) to prevent seepage. He uses a 'MoneyMaker'[40] pump that he powers with his feet to water his vegetables and papaya, and sometimes this means pumping with his feet for four hours a day. Although this is very arduous work, he feels it is necessary to maintain his income. In the future, John would like to invest in micro-irrigation for the whole *shamba*, and in a mechanical pump to irrigate the crops without the arduous inefficient labour of the foot pump.

Ecological agriculture keywords on John's *shamba*: AGROFORESTRY; **DROUGHT RESISTANT** VARIETIES; COVER CROPS; LOCAL VARIETIES; **DIVERSIFICATION; MICRO-CATCHMENT; DAM LINERS; IRRIGATION;** GREEN MANURE; BEE HIVES; GOATS; POULTRY.



© Greenpeace / Cheryl-Samantha Owen. John Obuom's lined pond. Kenya, East Africa. 2015.

## Example of an organisation working on building water resilience

### The Institute for Culture and Ecology (ICE)

*"ICE works with communities, mostly in rural areas, to harness and use indigenous knowledge to protect and rehabilitate their environment and promote sustainable livelihoods … for example, by reviving the tradition of seed saving, bringing back traditional ways of food storage and protecting trees by hanging beehives off the branches."* Gathuru Mburu, Programme Officer, Institute for Culture and Ecology.

The Institute for Culture and Ecology (ICE) is a national non-governmental organisation created in 2006 to promote indigenous knowledge for environmental conservation and to enhance the livelihoods of local communities towards sustainable development.

There are four main programmes aligned with ICE objectives:

1) Environmental conservation (environmental resilience) – this underpins ecosystem functioning so as to provide for food security, human health and economic development and as a means to address climate change.

2) Food sovereignty and community livelihoods (social and cultural resilience) – these are seen as the social determinants of community wellbeing. ICE promotes increased understanding of indigenous foods and food security by the recovery of indigenous seeds, promotion of family farming and crop diversification. ICE also aims to create market linkages and promoting economic empowerment of communities (economic resilience).

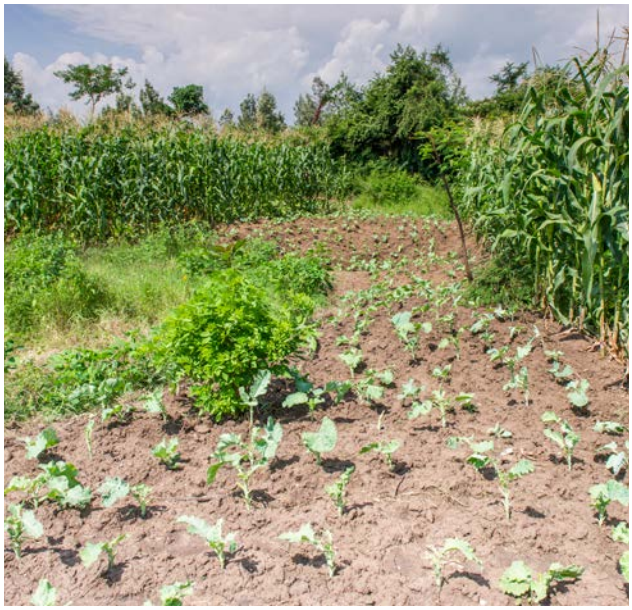
3) Advocacy work – ICE engages in campaign, lobbying and advocacy so as to influence economic, socio-cultural and political policies that impact on the lives of people in communities. There are some indigenous laws that govern the environment and ICE is lobbying to extend and strengthen these.

4) Institutional development – the aim of this programme is to expand the capacity of ICE by both reviewing and improving the way of working and building the capacity of staff, leaders of community groups and field contact persons/volunteers.

ICE is pioneering an initiative called the **Indigenous and Community Conserved Areas** (ICCAs) where communities identify particular 'sacred' sites or critical ecosystems that are considered important to their culture or critical to their livelihoods, and collaborate with ICE in their conservation or rehabilitation. ICE also promotes the **preservation of indigenous seeds**. A number of varieties of indigenous seeds have been revived and multiplied through community sharing, and many communities have established community seed banks.

**Soil management** is of particular focus in the Meru Region where farmers suffer from severe soil degradation and many techniques have been shared with various communities and self-help groups in the region. The two main climate adaptation strategies used a focus on water conservation and soil enrichment. ICE works with farmers to give them access to information on how to collect water and create micro-catchments on their farms. Practices used are planting Napier grass and trees on terraces to give stability and also establishing contour terraces e.g. using stones. Climate change adaptation also includes indigenous practices such as intercropping, using dryland farming techniques like terracing, water harvesting, composting and the use of manure on the farm and agroforestry. When planting, farmers often plant in pits (like *zai* pits) filled with manure and other organic material, where water will collect and be retained for longer availability to crops.

© Greenpeace / Cheryl-Samantha Owen. Papaya trees at the back of an intercropped field. Kenya, East Africa. 2015.



© Greenpeace / Cheryl-Samantha Owen. Intercropping on John Obuom's farm. Kenya, East Africa. 2015.

# C. Diversity

## Diversity across the agricultural system, from the seed to plate, ensures adaptive ability at farm level and increases nutritional and economic security for communities.

Building on-farm diversity ensures stability and resilience by making use of biological diversity at a genetic and species level. This allows local ecosystems to absorb shocks and to adapt to change.[41, 42] It can be accomplished by maintaining diversity in soils, crops types, seed varieties, and populations or species that are beneficial to agriculture or functional diversity (including natural pollinators such as bees) that act as natural pest control. Maintaining functional biodiversity also requires curbing practices that impact on these species, such as use of toxic pesticides and chemical fertilisers.

Adaptive practices that integrate sequential plantings and multiple cropping give temporal diversity for farmers, both in terms of nutrition and income. If one crop fails due to an extreme weather event, another may still produce food. Diversity of income streams will also ensure farmers have access to food during times where growing conditions are difficult.

Agricultural diversity can be achieved in many different ways, through a number of locally specific strategies. From our field visits it was clear that diversifying farms and farming landscapes is possibly the most distinctive trait of farms that are working to build resilience. Many farming aspects benefit from diversity (water use, soils, communities, economic resilience, nutritional security etc.) and hence it is present in all the examples we illustrate in this report. The two farmers showcased, Karen Onyango from humid Western Kenya and Jane Wavinya Mwanzia from the extremely dry Eastern Kenya, integrate diversity at various levels. These farmers are motivated by their personal realisation of the many benefits that biodiversity brings into their farming livelihoods.

The CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS) includes many approaches to building resilience, and diversity seems the integrating theme across this multidimensional programme. Arid Lands Information Network has developed information centres, or *maarifa*, throughout Kenya that are used to connect farmers with a diversity of global information sources, and each other, through affordable internet access. Farm Africa is working to build a diversity of drought resilient crops and livestock and income sources into Kenyan farms.

---

### Karen Onyango, Kisumu County, Western Kenya



Karen Onyango

Karen Onyango is married to Silas and lives with their 10 children on a five-acre *shamba* in Kagure village in Nyakach sub-County, Kisumu County. Karen, along with the help of her older sons (her youngest is five years old), works the *shamba*. She is also the Secretary of the community-based organisation Onyuongo Focal Area Farmers Group. On her *shamba*, Karen has concentrated on ways to **diversify** her crops, livestock and income so that she can provide for her family even in times of uncertainty and change.

The first step Karen took to diversify was to concentrate on horticulture and a tree nursery. She gathered information on horticulture from KALRO[43] and now plants tomato, kale, watermelon, cowpeas and other **indigenous greens** such as nightshade and spider plants. She practices **intercropping** by planting maize alongside green gram (and other beans) and amaranth. With the first tomato harvest she was able to buy an ox for ploughing the fields. This cost her US$110. She was so proud of this achievement and, realising the impact of such diversification, Karen wondered how else she could invest in her *shamba* so as to provide more income for the future. She has no extended family to support her, therefore she has to be completely self-reliant. This has led her to think further about other **innovations** that will feed her family and pay for her children to go to school.

She now keeps five resilient Galla goats, five locally bred cows and her ox. She also has four sheep for meat and income.

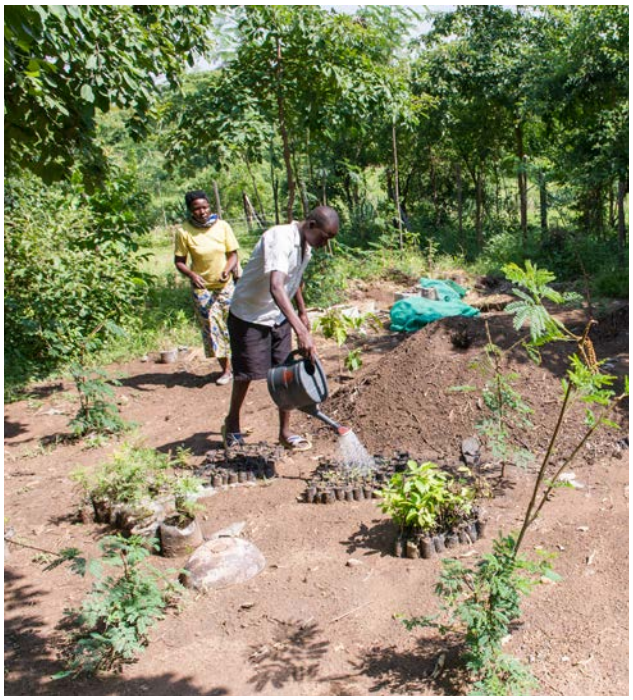
Ten years ago Karen began to concentrate on **water harvesting** through creating micro-catchments on her *shamba* – both for domestic use and for her animals. Now the *shamba* has three water pans: one specifically for the

tree nursery; one that provides water for her household and the community; and one for her livestock. Currently the water pans are unlined and she loses water as it seeps away. Karen is waiting for CCAFS to help her with this and they have promised to provide lining material for the pans for free.

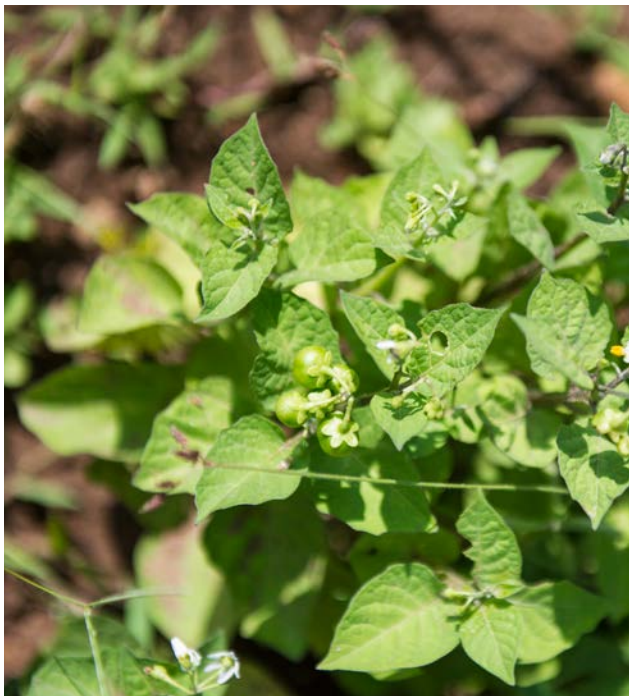
Karen does use some chemical fertilisers, mostly for the maize and green gram crops, and it depends on the fertility of the soil they are planted in. She spends around US$55 per year on fertiliser. Generally she used 50 Kg of DAP at planting time and then 50 kg of CAN as a top dressing for tomato, watermelon, maize and butternut squash.

Vi Agroforestry supports Karen in implementing ecological farming practices by visiting often with tree seeds and offering training, assistance with capacity building and running field days for the farmers of the community.

Ecological agriculture keywords on Karen's *shamba*: AGROFORESTRY; **INDIGENOUS** VEGETABLE; **INTERCROPPING**; LOCAL VARIETIES; DIVERSIFICATION; INNOVATION; WATER HARVESTING; MACRO-CATCHMENTS, **GALLA GOATS; CATTLE; SHEEP;** MIXED FARMING SYSTEM COMMUNITY BASED ORGANISATION.



© Greenpeace / Cheryl-Samantha Owen. Watering saplings in a tree nursery. Kenya, East Africa. 2015.



© Greenpeace / Cheryl-Samantha Owen. Black night shade, an indigenous vegetable. Kenya, East Africa. 2015.

© Greenpeace / Cheryl-Samantha Owen. Maize intercropped with groundnuts. The groundnuts are a legume that fix nitrogen in the soil, which is then available for the maize. Kenya, East Africa. 2015.

© Greenpeace / Cheryl-Samantha Owen. Dairy goats. These goats produce more milk than other varieties, meaning more is available for the family or for sale. Kenya, East Africa. 2015.

# Building Environ

## A snapshot of farmers adapti

**Biogeography for John Obuom and Karen Onyango**

| | |
|---|---|
| **Location** | Kisumu County |
| **Agroecological Zone** | Tropical highlands: mid-altitude derived savannah |
| **Altitude (metres above sea level)** | 1000 - 1500 |
| **Type of rain (bimodal/ unimodal)** | Bimodal |
| **Long rains** | February – June |
| **Short rains** | November - January |
| **Total rainfall (mm/year)** | 1250 - 1750 |
| **Crops grown** | Maize<br>Sorghum<br>Beans |
| **Livestock** | Goats<br>Chickens |

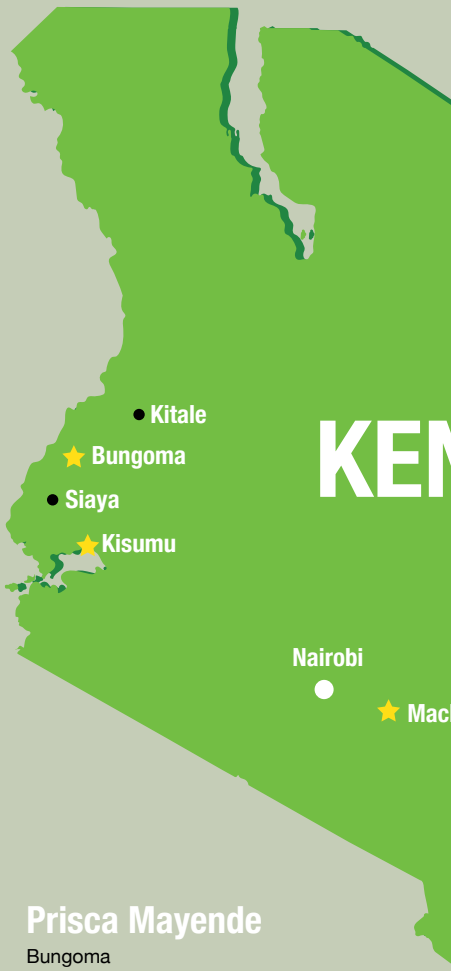
**Biogeography for Prisca Mayende**

| | |
|---|---|
| **Location** | Naigai, South Bungoma |
| **Agroecological Zone** | Tropical highlands |
| **Altitude (metres above sea level)** | 1422 – 1700 |
| **Type of rain (bimodal/ unimodal)** | Bimodal |
| **Long rains** | April – August |
| **Short rains** | September – January/ December |
| **Total rainfall (mm/year)** | 1200 – 1800 |
| **Crops grown** | Maize<br>Beans<br>Cassava<br>Irish potatoes<br>Sweet potatoes<br>Sugar cane |
| **Livestock** | Cattle<br>Goats<br>Chickens |

**Karen Onyango**
Kisumu
DIVERSITY

**John Obuom**
Kisumu
DIVERSITY

**Prisca Mayende**
Bungoma
SOIL



# mental Resilience

## ing to climate change in Kenya


**John Wambua**
Machakos
WATER

**Francisca Kitheka**
Machakos
COMMUNITIES

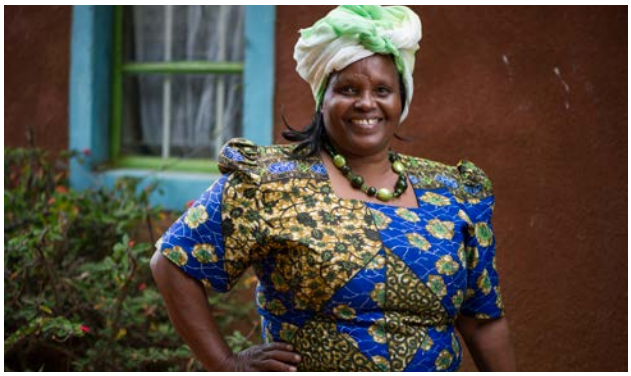
**Jane Mwanzia**
Machakos
DIVERSITY

**Biogeography for John Wambua, Jane Mwanzia and Francisca Kitheka**

| | |
|---|---|
| **Location** | Machakos County |
| **Agroecological Zone** | Semi-Arid: mid and high altitude Guinea Savannah |
| **Altitude (metres above sea level)** | 1000 - 1600 |
| **Type of rain (bimodal/ unimodal)** | Bimodal |
| **Long rains** | April-May |
| **Short rains** | November - December |
| **Total rainfall (mm/year)** | 750 - 1250 |
| **Crops grown** | Maize<br>Sorghum<br>Millet<br>Beans<br>Coffee<br>Honey |
| **Livestock** | Goats<br>Sheep<br>Chickens<br>Cattle |

## Jane Wavinya Mwanzia, Machakos, Eastern Kenya





Jane Wavinya Mwanzia

Jane Wavinya Mwanzia farms 10 acres in the dry, Eastern Kenyan area of Machakos. She is married with 10 children and her family is reliant on the produce from the farm for survival. She has two cows, some goats and chickens. On her *shamba* she plants beans, maize, cowpeas, pigeon peas and green grams. Jane is very aware of climate change. She has noticed that the crops she used to grow now fail and she feels this is as a result of too little rain. She is innovative, and has decided to change with the times, accepting that the climate is changing and she must adapt. She no longer plants these crops and has changed to more drought resilient varieties. She started rearing chickens and harvesting runoff water from the road and directing it into the farm and onto the food crops. She plants fruit trees like papaya and mangos, and drip-irrigates the seedlings using plastic bottles to direct water to each tree.

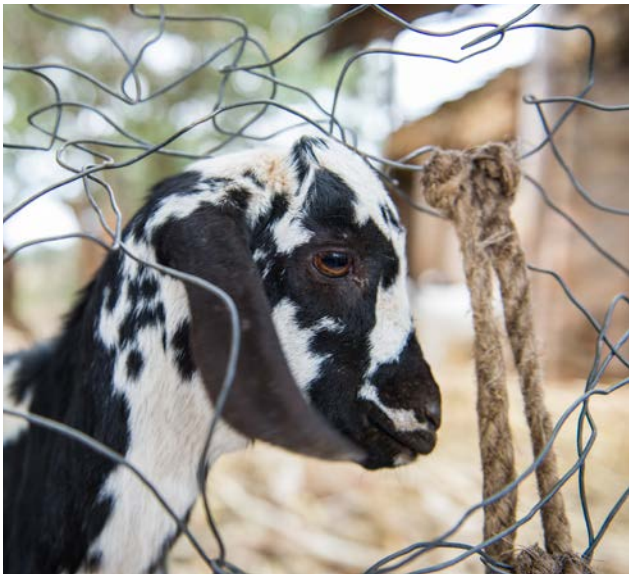
She says that she used to farm according to how her parents taught her, but these days, after joining a community group, she has learned new planting techniques that make the best of the conditions on her farm. She now plants in *zai* pits, at the onset of the rainy season when the soil is loose, and she therefore enjoys a better harvest than before. She has also received training on how to store her produce and avoid post-harvest losses. She has a valuable store of grain – a good harvest that she has only enjoyed since she started using these new practices. She notices the benefits of these diverse practices throughout the farm and feels that even during the dry spells, the farm is greener, with the soil holding more moisture. When she plants cowpeas now she gets a good harvest, unlike before when they only dried up and died sometime after planting.

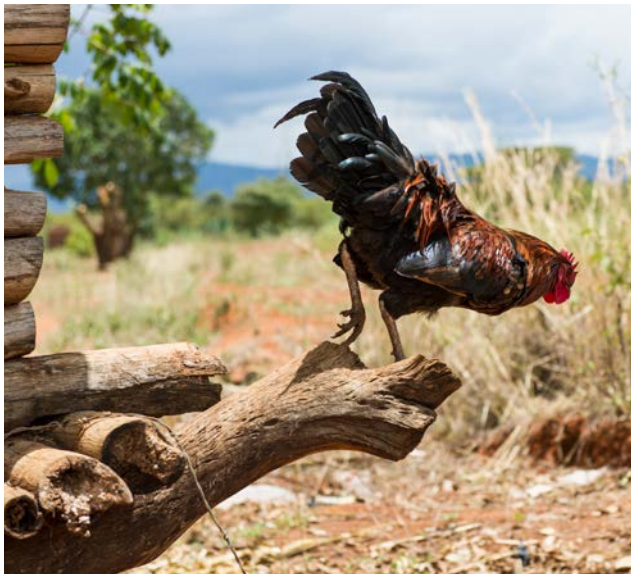
She uses knowledge that she learned from the elders to give her a hint that the rainy season is near. Jane tells us, *"...this tree [Jacaranda] – when it starts producing purple flowers, I know the rains are near and immediately I start preparing my seeds".*

In Machakos, Jane says the main issue farmers face is lack of water. She has built terraces to conserve soil, and water, but when the season is very dry the crops still fail. She is worried that the drought tolerant indigenous varieties that used to grow under these conditions are disappearing. Jane has tried to dig a reservoir to trap rain water, but when it collects, it quickly disappears through seepage. If she could store the water, in her opinion, she could adequately supply food for her family.

Ecological agriculture keywords on Jane's *shamba*: **INDIGENOUS** VEGETABLES; INDIGENOUS **KNOWLEDGE;** LOCAL VARIETIES; **DIVERSIFICATION;** INNOVATION; WATER HARVESTING; PLANTING PITS, **GOATS; CATTLE;** COMMUNITY BASED ORGANISATION.





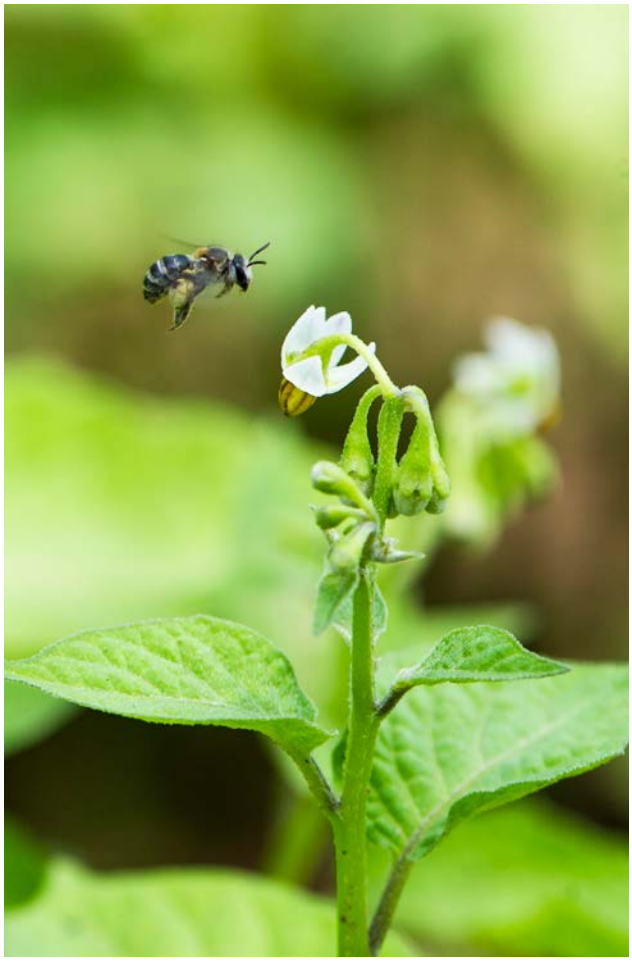


## Examples of organisations working on improving diversity

### Climate Change, Agriculture and Food Security (CCAFS)

*"The unpredictability of short rains in Kenya is due to climate change"* John Recha, Participatory Action Researcher at CCAFS, Nairobi.

The CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS) addresses the increasing challenge of global warming and declining food security on agricultural practices, policies and measures through a strategic collaboration between CGIAR and Future Earth[44]. Led by the International Center for Tropical Agriculture (CIAT), CCAFS is a collaboration among all 15 CGIAR research centres and coordinates with the other CGIAR research programmes. CCAFS aims to bring together researchers in agricultural science, climate science, environmental and social sciences to identify and address the most important interactions, synergies and trade-offs between climate change and agriculture. The programme is carried out with funding support from governments and aid agencies, both through the CGIAR Fund and bilaterally. CCAFS is defining and implementing an innovative research programme that addresses agriculture in the context of climate variability, climate change and uncertainty about future climate conditions.





## Is Climate Smart Agriculture always smart?

In 2010, the FAO coined the term 'climate smart agriculture' at the Hague Conference on Food Security[45], when trying to answer the question: how can smallholder farmers achieve food security under a changing climate? 'Climate smart' agriculture was then used to refer to practices that would not only contribute to adaptation by increasing yields and building resilience, but also mitigate climate change by reducing emissions and therefore enhance food security.

Many approaches and practices promoted under the 'climate smart' banner are significant advancements toward climate resilience, like the reduced- or no-tillage in conservation agriculture, the use of drought-resistant varieties of seeds developed by conventional breeding or the promotion of agroforestry.

It is worth noting, however, that nowadays the term 'climate smart agriculture' carries an imprecise meaning; one that doesn't seem to reflect the actions needed to address food and climate change issues. The term has become so loose, that it is used to describe activities on many fronts. For example, Monsanto encourages 'climate smart farming' across the world, in what seems another way to promote their own seeds and agrochemicals.[46] This is just an example, of many out there, on how 'climate smart' is also used for profit-driven interventions, no matter what their impacts are on climate or small-scale farmers.

*"It may have a clever name, but there is nothing to ensure that the term climate-smart describes practices that are actually smart for the climate or for agriculture"* Teresa Anderson, Action Aid (2014).[47]

Greenpeace, therefore, prefers not to use this term, but instead refer directly to the specific practices involved, or to climate resilient practices.

The CCAFS programme launched activities in 2011 in test villages in West Africa, East Africa and South Asia. All the villages are in high-risk areas suffering from a changing climate, and where local partners had established links. Women are encouraged to participate, and in Kenya of the 1100 households that joined groups established by the project 70 – 85% of the active members are women.[48]

In Kenya, there are 'Climate Smart Villages' located in two sites, Nyando and Wote. The site in Nyando consists of an approximately 10 km$^2$ area including sites in the Counties of Kisumu and Kericho. The activities are undertaken in collaboration with Vi Agroforestry, World Neighbors, the Kenyan Ministry of Agriculture, Livestock and Fisheries, KALRO, and some of the CGIAR Centres. The activities are undertaken through a participatory process with local farmers that are usually members of umbrella CBOs.

The two main adaptation strategies used by CCAFS are:

1) Diversification – mainly using horticulture, agroforestry with fruit trees, resilient crops and resilient livestock.
2) Water harvesting – micro-catchments using small water pans on *shambas*, efficient water storage (with plastic sheeting dam liners, shading, etc.) and other various rainwater harvesting techniques.

## Arid Lands Information Network (ALIN)

*"We use information centres to link communities… in Kyuso, a project working with non-chemical pest management has meant that, despite the rain failure in 2006, the small-scale farmers are happy not to have spent their money on pesticides. [Instead]… they use new innovations, indigenous varieties and biodiversity conservation."* Noah Lusaka, Projects Manager, Arid Lands Information Network.[49]

ALIN uses information centres, or maarifa, that are modified shipping containers used as a local hub for information. These maarifa centres are equipped with internet access, computers and other information resources such as publications, digital media and research reports. Maarifa centres also provide access to M-PESA, a Kenyan mobile-phone based money transfer and microfinancing service. Revenues earned are then put back into the running of the Maarifa centre. ALIN collaborates with the AgriCultures Network (www.leisa.info) to produce the quarterly magazine BAOBAB so as to disseminate practical development information on agricultural and environmental matters.

Knowledge of climate change is specifically discussed through Joto Afrika, a series of briefings and online resources that communicate climate change adaptation strategies to sub-Saharan Africa. The series is produced in partnership with the Institute of Developmental Studies (IDS) of the University of Sussex and Africa Adapt, which is a five year research programme jointly funded by the UK Department of International Development (DFID) and the International Development Research Centre (IDRC) whose aim is to facilitate the flow of climate change adaptation knowledge for sustainable livelihoods between researchers, policy makers, civil society organisations and communities who are vulnerable to climate variability and change across the continent.[50] ALIN's role in this programme is to facilitate communities' awareness of climate change and strategies for adaptation.

ALIN uses diverse methods to engage communities, particularly young people. Song for example is useful in extension learning:

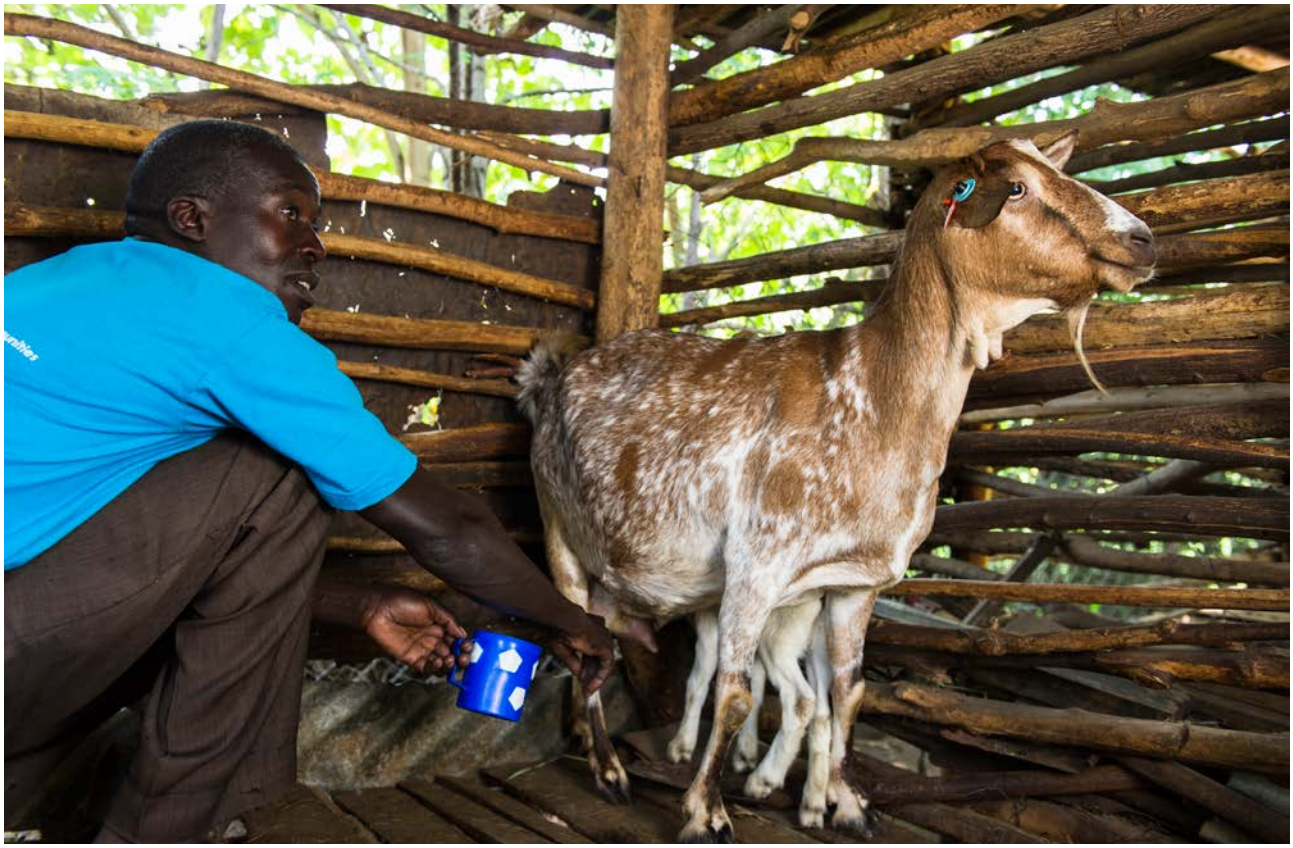
1) Water harvesting and creating micro-catchments – one farmer with a 6 m deep pond grows water hyacinth which reduces evaporation from the pond. She harvests the hyacinth for fibre and fodder for her cows (and hence the nutrients are used again in the soil through the manure).
2) Irrigation – e.g. The Eldume Irrigation Project channels water from the River Molo and redirects it via gulleys to *shambas* where it is stored in ponds or tanks and is used for on-site irrigation via solar pumps. Solar energy can be used for drip irrigation of one acre plots that are used to grow high value crops such as tomatoes and onions in three Counties: Baringo; Laikipia and Kajiado.
3) Indigenous varieties – a resource to SSFs; various varieties of sorghum have been promoted, as well as Bambara nuts, a legume that is indigenous to Africa. ALIN is promoting these vegetables and spreading information on how to grow, harvest, store and cook them – information that has been lost through the generations.
4) Technological innovations – Sokopepe Limited is a social enterprise company initiated in February 2014. The two main services provided are Farm Records Management Information System – Kenya (FARMIS-Kenya) (www.farmis.co.ke). FARMIS-Kenya uses *shamba* records to identify productivity trends and profitability of different enterprises with the aim of providing a decision-making tool for farmers. It is designed to give farmers the ability to project income potentials, link with other farmers so as to aggregate produce enabling them to sell in bulk and develop joint farm activity calendars. The other service provided by Sokopepe Limited is SOKO+ that is a digital commodity trading and information system (www.sokoplus.sokopepe.co.ke). It is designed to link small-scale farmers to end retailers or bulk purchasers, by-passing the numerous brokers in between. SOKO+ provides real time market information, tips on agriculture practices and bulk SMS alerts on agriculture including longer-term climate and short-term weather forecasts. The idea is that the system will provide a knowledge base of major crops and livestock including suitable varieties for different agro-ecological zones, diseases, pests and post-harvest handling advice.

## Farm Africa

The main aim of Farm Africa is conservation agriculture in arid and semi-arid areas and this includes promoting practices that increase climate resilient farming.[51] Ecological farming has been shown to increase yields by 30% per year in these areas, although farmers require good quality sorghum and green gram seed. In Farm Africa demonstration farms the increase in yields can be even higher.

The specific projects that Farm Africa are currently involved in are:

1) Climate resilient farming – promoting drought tolerant crops by the provision of seeds, training on building ridges and *zai* pits for capturing rainwater (the knowledge is then passed onto other members of the community). This project mainly works in the Kitui area and uses sorghum as a main crop and the website states that it is reaching around 9,000 people. They collaborate with African Medical and Research Foundation (AMREF) and the British Society of Plant Breeders (BSPBS).
2) 'Aquashops' – community centres aiming to diversify incomes and provide protein for communities. They provide technical advice, training on marketing and selling produce with the aim for farmers to develop a franchise model that can be rolled out across the country and throughout Africa.
3) Sorghum and green gram – building long term resilience by supporting farmers to grow drought tolerant sorghum and green gram and providing training in postharvest handling and business skills.
4) Cassava farming – specifically focusing on increasing yields for a crop impacted upon by disease.
5) Farming opportunities for young people 18-35 years old – introducing fast-growing horticultural crops to ensure fast returns for impatient youth.
6) Mango farming – working with around 800 women farmers, the aim is to provide better quality mango varieties that will ripen throughout the year and encourage farmers to form associations to sell collectively.
7) Passion fruit farming – working with around 3,000 women farmers to increase earnings from passion fruit farming by teaching improved orchard management and the introduction of better seed varieties that increase yields by up to five times.
8) Poultry farming and marketing is the focus of a project where farmers receive training in improved poultry rearing techniques and are encouraged to form associations to establish market links.
9) Dairy goat farming – particularly the Alpine breed crossed with local varieties.
10) Sidai – social enterprise network that aims to provide high-quality veterinary services and runs all over rural Kenya.



# D. Communities

## Strengthen community support networks making use of farmer participatory research and providing access to information, training and finance so as to buffer change.

For communities to deal with climate shocks and solve problems, both social and economic systems must be able to integrate new ideas that will be successful in a local context. Community groups can lead these innovations and develop intrinsic resilience within local agricultural systems.[52] A few, of many, examples that could be potentially scaled up include: Government procurement of local produce, the promotion of local farmers markets and community supported agriculture programmes that directly connect consumers to farmers. Farmers' initiatives can also link hospitals with local farmers, and farms to school feeding programmes.

Other community initiatives include:

1) Linking farming to disaster preparedness of the farming communities. For example, establishing secure local seed systems (possibly through community seed banks or networks of household seed 'banks') or seed stocks can allow for quick distribution of locally appropriate seeds following a disaster.
2) Building on local/farmer place-specific knowledge systems (indigenous knowledge) to reduce risks and uncertainty. Community groups can engage the knowledge of the elders in lost techniques, and seeds, that are particularly resilient to local conditions.

We now firstly present an example of a farmer, Francisca Mbuli Kitheka, who farms in the semi-arid area of Machakos. She has initiated a community seed bank storing seeds from drought resistant varieties that were traditionally grown by her grandparents. We also present examples of two organisations working in Western Kenya, Farmer Field Schools Initiative and Manor House Agricultural Centre that are working to build knowledge in communities by training teacher farmers who then empower communities.

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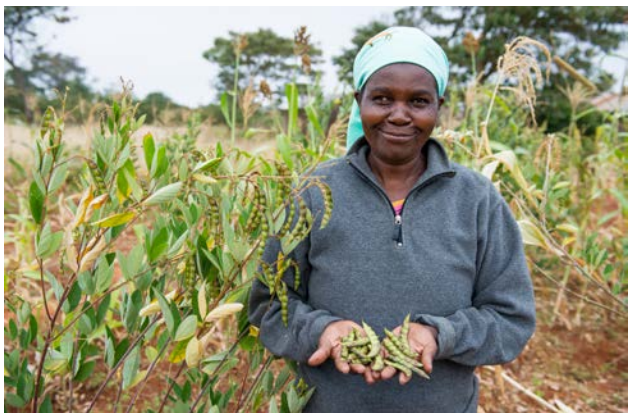
### Francisca Mbuli Kitheka, Yatta, Machakos County, Eastern Kenya





Francisca Mbuli Kitheka

Francisca Kitheka is a farmer in Kikesa, Yatta, and contact person for the Institute for Culture and Ecology (ICE) and the community in Yatta. Working with ICE, she trains farmers on water harvesting, how to store indigenous seeds and other practices that will help farmers get the best from their farms. Francisca was first a member of her local farmers' community group and ICE approached her to be their contact farmer when they discovered the innovations she was using on her own *shamba*.

Francisca focusses on training the community in water harvesting, digging effective trenches and making compost out of manure. This means the farmers will not need to buy chemicals that degrade the soil.

Francisca tells us, *"We are training them to keep the seeds in the way that we were taught by our elders; we went to the eldest women and we asked them how it was before climate change. They showed us the seeds that they had on their farms, and they gave us small amounts of seeds that we planted on our farms"*.

As a representative of the ICE, she makes sure that those who have been given seeds manage to plant them. She also ensures that some of these precious seeds are saved in a dedicated seed-store. The farmers in Francisca's community view this seed-store as a valuable asset that will bring gains in the future. They feel that many of the indigenous varieties have already been lost due to the recent unpredictability of the rains.

On her *shamba*, Francisca is not just a trainer, but also a model farmer and a mother. In her family, there are four children and herself. Her *shamba* is around 4 acres and she uses 2.5 acres to grow crops and the rest to graze goats. She keeps 15 chickens that supply eggs every day to feed her children. The food that she grows on her farm is not enough to feed her family and sometimes she needs to buy food.

She digs *zai* pits as a way to harvest water for the growing plants. She plants five seeds in every pit because those

that are planted in this way are most likely to survive and grow. Francisca has constructed terraces on her *shamba*, in another method to harvest water and conserve soil. In the retention ditches she grows mangos and she feels that the water harnessed ensures that these trees don't dry out.

Francisca has a small water tank that she harvests water for household use. The tank isn't big enough to supply water for the *shamba*, but she does use it for cooking, washing dishes and bathing her children.

Francisca knows that climate change is changing the weather patterns, making her *shamba* much drier than it used to be. She thinks everything has changed and she is forced to be very careful to conserve water in every way, otherwise she will run out. The rivers too have started to dry up. Her community in Yatta has noticed that the timing of the onset of rainy seasons seems to have changed too, with sometimes the rains coming early, or much later than they used to. Sometimes it rains a lot, other times it only rains for two days and then stops.

Francisca tries to train all the farmers in the community in the techniques that she uses successfully on her farm. If farmers can use *zai* pits and harvest water when they can, she feels that everyone will be able to grow something, even if it is not much. She is telling farmers, everyone, that if it is possible to have a water tank in their homes when the rains come, even if it is only for 2 days, they will have some water that will help them.

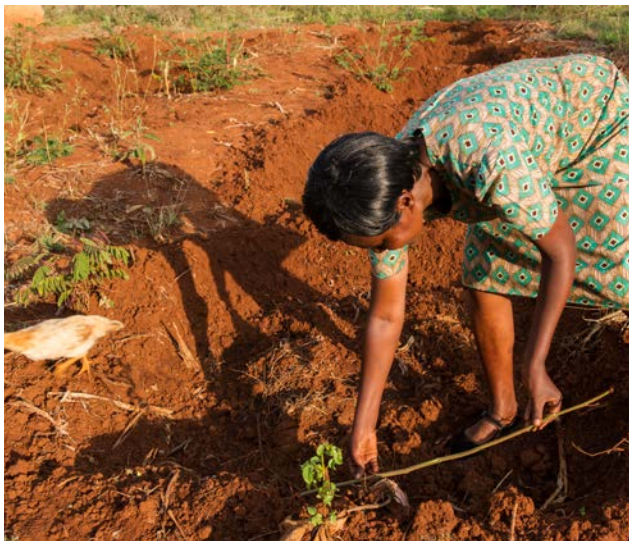
The problem for Francisca's community is that many people cannot afford to buy water tanks, or liners for small pans or dams. Farmers also use lots of different farming methods, some of which do not promote resilience to climate change. She feels that more training on climate adaptation methods are needed. Francisca is currently working with 15 farmers, a group that grew initially from only three farmers. She says that when farmers observe the successes of the group they request to be a part of the initiative. ICE gives them training and material support ( no direct funding, but this knowledge is critical).

Ecological agriculture keywords on Francisca's farm: WATER HARVESTING; PLANTING PITS; CONTOUR TERRACING; INDIGENOUS SEED SAVING; LOCAL VARIETIES; MICRO-CATCHMENTS; **COMMUNITY GROUPS; TRAINING AND TEACHER FARMERS.**

© Greenpeace / Cheryl-Samantha Owen. Francisca Kitheka's seed bank. Kenya, East Africa. 2015.

© Greenpeace / Cheryl-Samantha Owen. Francisca inspects her pigeon pea crop. Kenya, East Africa. 2015.

© Greenpeace / Cheryl-Samantha Owen. Francisca harvests rainwater for household use. Kenya, East Africa. 2015.



© Greenpeace / Cheryl-Samantha Owen. Francisca Kitheka, Machokos County. Kenya, East Africa. 2015.

## Examples of organisations working on improving community resilience

### Farmer Field Schools Initiative (FFSI)

*"Demonstration is good, but for farmers to replicate what they learn, they need financial help and incentives from the Government, research institutions and international funding."* Tom Nyabundi, Director Farmer Field School Initiative, Bondo, Western Kenya.

Tom Nyabundi leads the FFSI work by listening to the community to find out what farmers need to make their families more food secure. He sets out practices for farmers to test in school, using a 'learning by doing' approach. FFSI works with partners such as the FAO and though FFSI focuses on participatory learning on ecological farming practices, it also covers other areas such as gender violence, HIV/AIDS and biodiversity.

Generally, at one *shamba* in the community the FFSI will set up a small demonstration plot where the "teacher-farmers" will display the crop cycle from sowing and cultivation to harvest. Farmers attend every week, working together to implement different practices and they themselves decide on what practices to experiment (and how to face possible issues such as disease and pests). The process can involve any crop, or livestock, for example creating a chicken 'enterprise'. The farmers learn by doing the cultivation themselves and, when required, FFSI will bring in a new researcher or expert to help.

The farmers can then take the knowledge they have gained back to their own land, and replicate the good practices they have learned. This knowledge is then accessible to their neighbours and the whole of their community.

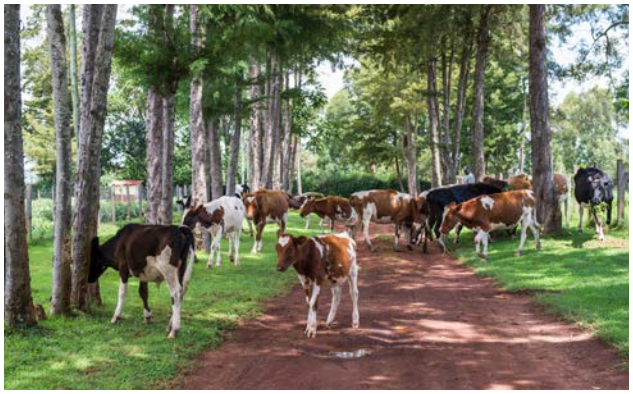
Tom feels that the negative effects of climate change are already occurring. At the time of the visit from Greenpeace, Bondo had been enduring drought conditions for the previous 10 months. This has been an increasing burden for women as they are forced to seek water from farther and farther away.

The ecological farming practices that the FFSI use that are specific to climate change include:

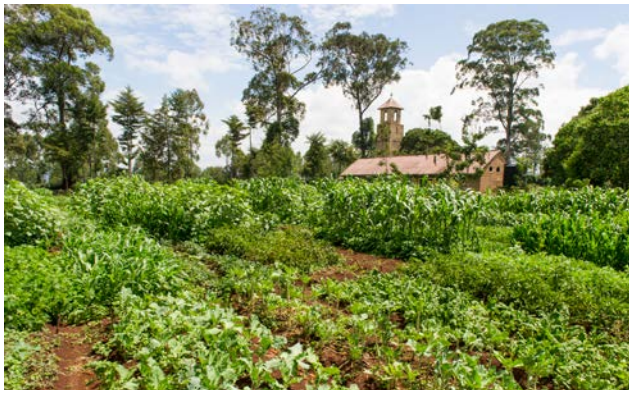
1) Water harvesting techniques.
2) Diversification with the promotion of livestock, particularly goats and beekeeping.
3) Soil conservation and enrichment techniques – conservation terraces, cover crops (e.g. sweet potato), intercropping with legumes (Desmodium, cowpeas, green gram) for soil improvement and food security.
4) Agroforestry – tree planting and tree nurseries. The FFSI includes tree planting in every initiative they teach. FFSI keeps a tree nursery in Bondo and they provide seedlings to farmers. Tom believes the area of Siaya has the lowest tree cover of any district and FFSI is working to remedy this. They also have a programme that plants trees in schools specifically to teach children of the benefits of trees to the community.
5) During FFSI lessons, they introduce the concept of climate change and how to increase the resilience of the crops the farmers grow. When possible, they try to bring in a climate change expert, however, one limitation to this is that there are few experts on climate change at both the community and local/regional government level.
6) Junior FFSI targets 12 – 18 year olds, within school hours, to add specific curriculum about ecological farming for young students.

Farmers Field School Initiative discourages the use of chemical fertilisers and pesticides, though many farmers do still buy them. Tom believes that if the farmers learn to use more ecological methods to increase their crop yields they will try to avoid these expensive chemicals. Currently, many farmers only compost their kitchen gardens, and more knowledge is needed on how to upscale the practices of organic fertilisation and biomass composting to include the whole *shamba*.

Tom says that many families find life difficult with many children to support, often including orphans from other families. For most people the main priority is trying to achieve basic food security year round. Financially, people struggle and with no outside funding the FFSI is also struggling to keep running. Tom's inspiration keeps the FFSI work going. He is working hard to provide a network imparting knowledge and training on ecological farming to Kenyan farmers. His vision is for these communities to achieve their own rewarding livelihoods that will feed their children.







## Manor House Agricultural Centre (MHAC)

*"Over 75 % of Kenyans make their living from farming, and over 75% of these farmers are small-scale, with an on average 1.1 ha sized farm. Despite this, government policy has focused on the development of cash crops destined for export."* [53]

MHAC acts as a training centre to show farmers GROW Bio-intensive methods (developed at Ecology Action in Willits, California) as well as livestock management, nutrition, small business management, appropriate technology, beekeeping and agroforestry. GROW Bio-intensive methods are akin to what Greenpeace terms ecological farming. These methods aim to increase crop yields from small *shambas* by recycling nutrients and water and focusing on biodiversity. The general yield increase under bio-intensive agriculture is thought to be 2-4 times higher than using conventional methods. Yields 2.5 and 4 times superior have been observed for the maize variety "namba nane' and kales respectively (personal communication, MHAC).

MHAC ecological farming practices include:

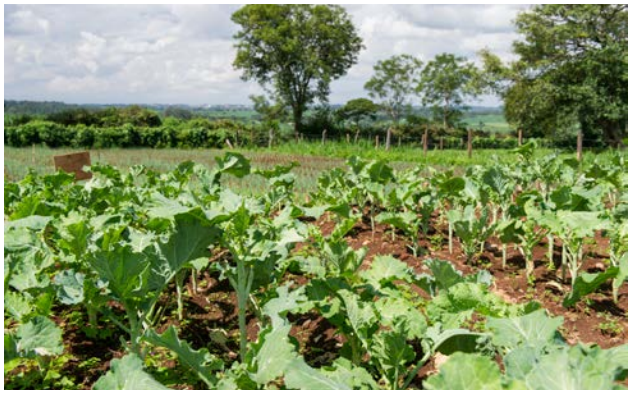
1) Double-dug, raised beds.
2) Composting.
3) Intensive planting – seedlings are planted in a hexagonal spacing pattern so that as they mature the leaves touch and provide a shaded "mini-climate" that retains moisture, retards weeds and facilitates higher yields.
4) The use of open-pollinated seeds.
5) Companion planting – push-pull technology, where particular planting combinations will repel pests and simultaneously attract beneficial insects and spiders.
6) Carbon farming – by planting approximately 60% of the growing area in dual-purpose seed and grain crops that produce a large amount of carbonaceous material per unit area that is then used to build compost. These crops also produce significant amounts of calories e.g. corn, wheat, amaranth, millet and oats. The aim is to recycle nutrients within the *shambas* to make a "closed-system".
7) Calorie farming – by planting 30% of the growing area to special root crops such as Irish potatoes, sweet potatoes, salsify, burdock, garlic and parsnips that produce a large amount of calories per unit area.
8) Farming for vitamins and nutrients by planting 10% of the farm to vegetable crops that have high vitamin content but little biomass or calories, such as onions, tomatoes, peppers and chilies.
9) Whole-systems gardening method – all components must be used together to assure that the soil is not rapidly depleted due to the intensive planting methods.

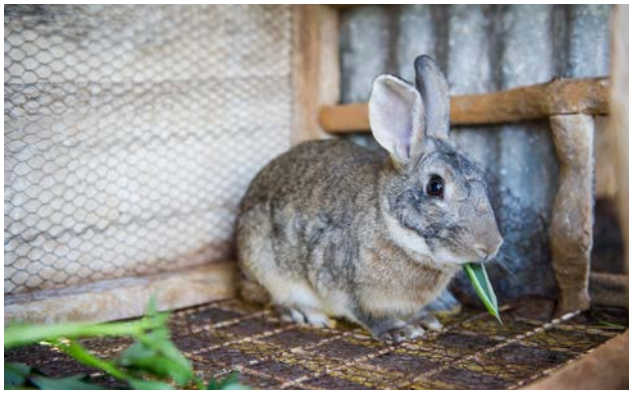
Most practices are aimed at building resilience to climate change, particularly drought conditions. MHAC believes that their work has a hugely positive impact and is improving food security for small holders regionally, and nationally. Training programmes are attended by many farmers throughout the country and from other countries such as Uganda. By 2015, more than 570 students have graduated from MHAC's two year diploma and certificate courses and it has been estimated that, overall, their training courses have reached around 2 million people. In collaboration with the Kenyan Weather Bureau, MHAC have developed an SMS service to provide farmers with weather and farming information.

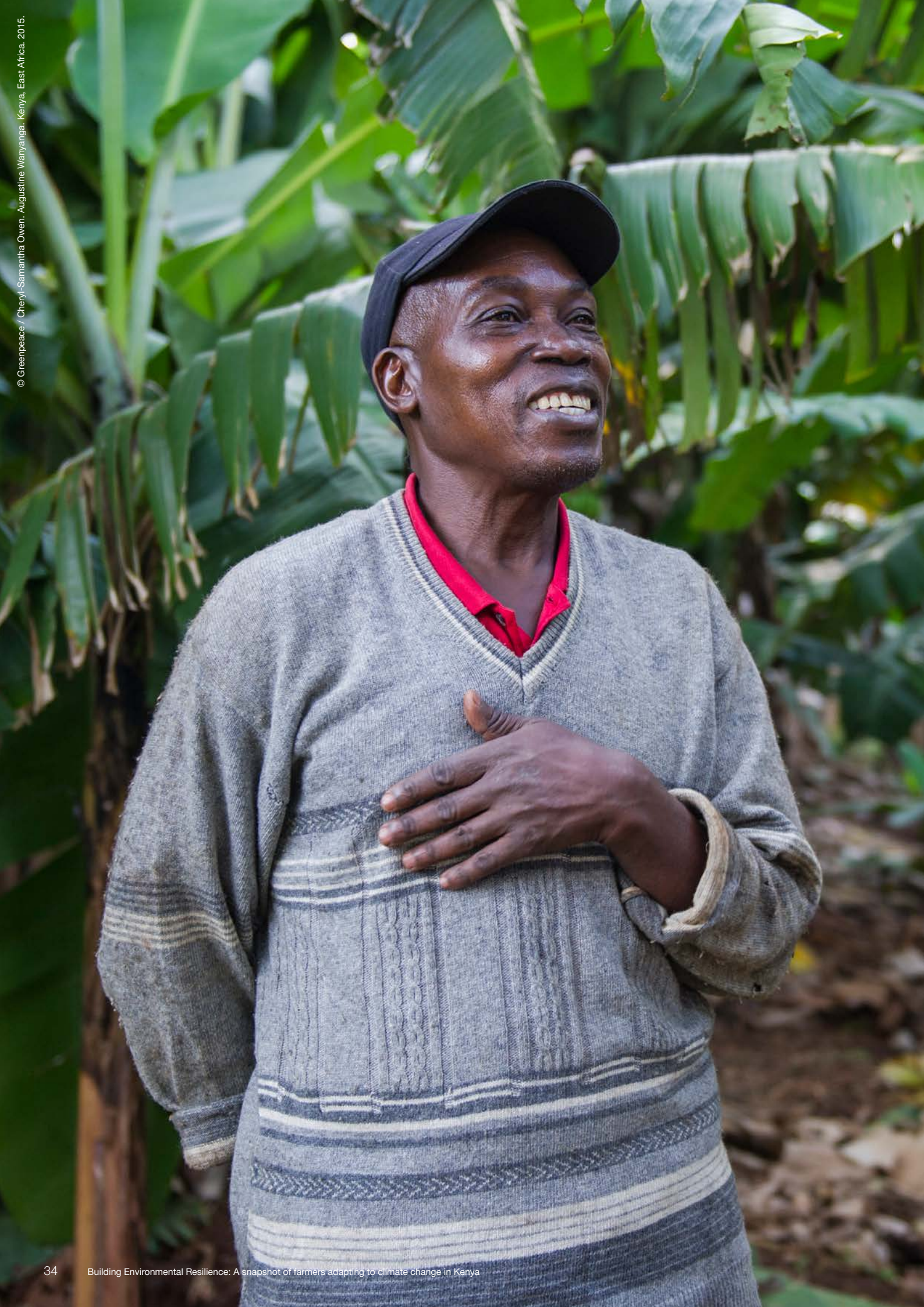
On-site and on-farm research is conducted in collaboration with universities such as Wyoming University, USA, among others, and focus on experimental trials of different tillage systems, and disease control using Rhizobium to improve productivity in legumes.[54] MHAC also promotes agroforestry for carbon sequestration and seeks to conduct more research on effective adaptations to build resilience to climate change.

MHAC's work includes dissemination of ecological farming practices into the community. One local school now has a productive horticultural area on its grounds. These children will learn the ecological farming techniques used in their highly productive garden and will benefit directly from its production in their school lunches.









# 5. Reflections on Vulnerability: Millennium Villages Project in Sauri and FAO-Funded Rice Irrigation Project in Siaya

In our time in Kenya we included visits to projects where, though initially focused on building food security and achieving wider sustainability goals, the long-term strategies developed have not, in our view, succeeded in building resilience for farmers, now or for the future. In our opinion, these approaches build intrinsic vulnerability into farmers' futures. This vulnerability comes from approaches that:

1) Create dependence on external inputs that are too costly for farmers and bring along other environmental or soil quality issues (e.g. subsidies that create dependence, soil degradation by imbalanced use of nutrients, potential health impacts) and,
2) Rely on utilising resources that are unsustainable, and do not address predicted environmental changes (e.g. use of drinking water for irrigation, expansion of rice cultivation and irrigation plans in a water-limited location).

Below we present two examples of such approaches that, in our view, are not consistent with building resilience in farming communities. We visited these projects to learn from the experience of the main actors involved: field officers and farmers. Our impressions and the testimonies of farmers are illustrated below.

One example of a project that may have improved some areas of the lives of villagers, but has not improved food security or resilience to climate change, is the Millennium Villages Project in Sauri, where we visited farmers Isaac Atuk and Augustine Wanyanga. The other example is a FAO-funded Rice Irrigation Project in Siaya. Both cases, albeit well-intended, could bring more vulnerability to those farming communities when they are faced with changes and uncertainty (be it climatic or economic).

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## Millennium Villages Project in Sauri: subsidies for chemical inputs

The Millennium Villages Project (MVP) was initially developed to help achieve the Millennium Development Goals in the poorest regions of rural Africa by furthering industrial farming practices in these areas. At present there are 14 sites (80 villages) in Africa with two in Kenya. Dertu in East Kenya has mostly pastoralist communities and Sauri in Western Kenya is a remote cluster of farming communities near Yala, Siaya County. Sites were selected in areas where there was already a World Agroforestry Centre (ICRAF) presence for benchmarking local conditions and research. These areas were also previously designated as hunger hotspots, with documented disease burdens and where the biophysical conditions would allow replication to other areas of the world. MVP is currently at the end of the second phase of development, with an end date during 2015. Although agriculture has been one of the features of the project, it also has attempted to include education, health, infrastructure and other community issues.

Work in schools (35 schools and 20,000 pupils) to improve infrastructure in buildings and in kitchens for school meals, plus improvement of sanitation facilities have proved extremely successful. School attendance has increased and scholarships have enabled around 70 students from the area to attend tertiary education. Targeted malaria-fighting efforts have also been significant. The question remains on how these achievements will be maintained once the organisation leaves and hands responsibility to the local community.

The agriculture focus of MVP in Siaya was to achieve quick successes by providing subsidised chemical fertilisers and hybrid seeds to farmers. Initially, MVP provided chemical fertilisers (50 kg DAP, 50 kg urea) for free to each farmer. Then, in year two the subsidy covered 75% of the fertiliser value (farmers had to pay 25%), increasing to farmers paying 75% of full cost in year three. As the fertiliser subsidies were phased out, loans were offered by MVP to farmers to buy fertilisers at market prices. In 2014, 50% of MVP households were buying fertilisers at market prices without MVP subsidies. However, MVP continued to provide additional support for purchasing chemical fertilisers to 700 of the most impoverished households.

According to the MVP personnel we talked to, during the duration of the subsidy on chemical fertilisers, yields of maize increased in some areas to 3 tonnes per hectare, but in later years dropped as farmers were less likely to apply the unsubsidised fertilisers. No training on composting or mulching, or any other organic fertilisation techniques, was provided by MVP.

The provision of improved seed that is adapted to local conditions was restricted to maize varieties. Hybrid seeds were certified against disease (particularly leaf necrosis). Seeds of other types of crop were not provided by the programme. Diversification was promoted in the

form of shifting towards more high value crops, namely monocultures of tomatoes grown in greenhouses and high yielding banana varieties.

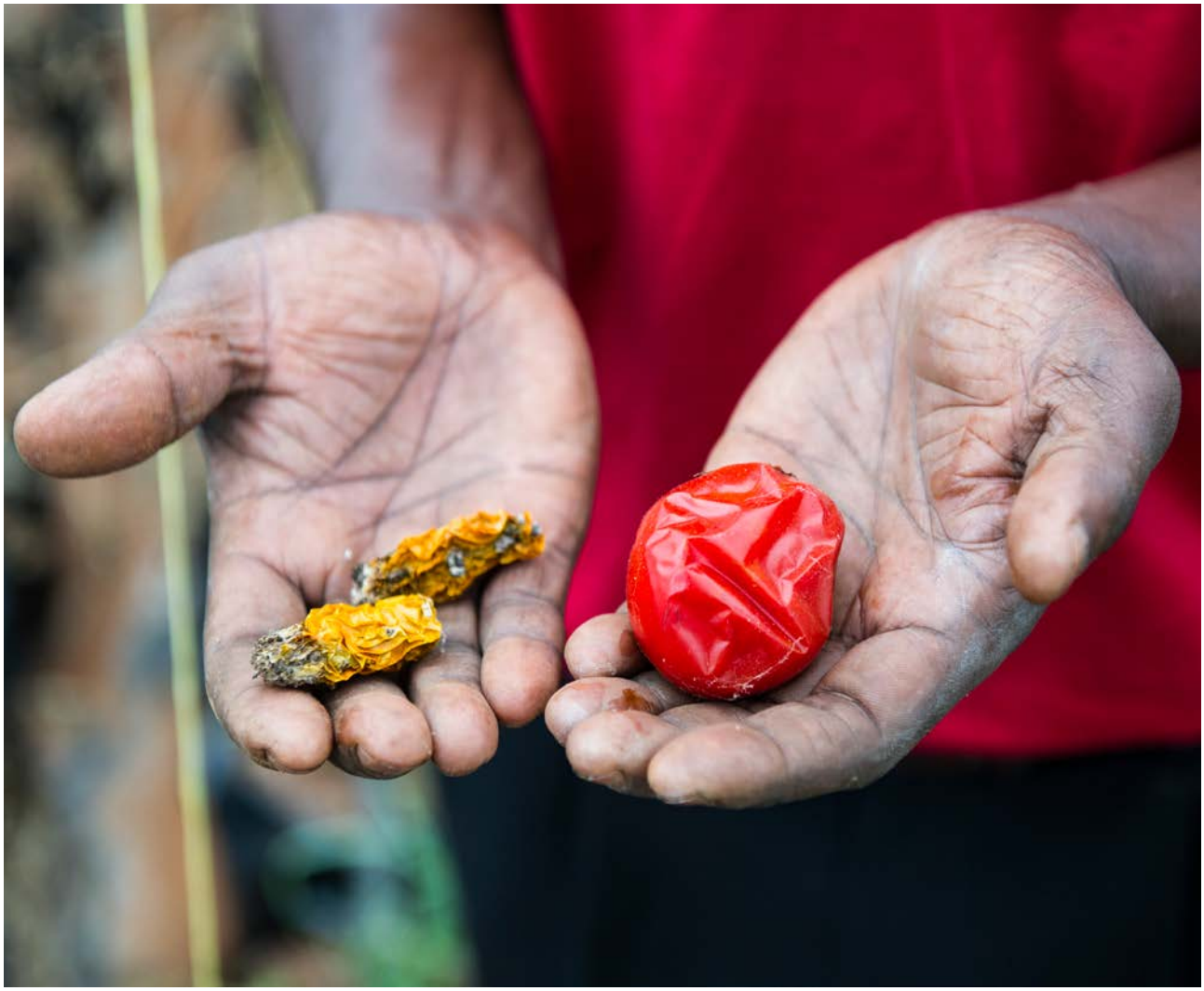
A focus of MVP has been on irrigated agriculture on *shambas* situated near water sources such as springs, boreholes or even urban tap water used to irrigate greenhouses. In areas without access to water resources there were few MVP projects that promote water harvesting and conservation. In Sauri, some emphasis has been made on helping farmers sell their horticulture produce. The project set up a Market Centre, where farmers can sell horticulture produce to a wholesaler who is an employee of the farmers and also an expert in marketing.

Though there have undoubtedly been many positive features of the MVP initiative there has been some criticism of the global MVP agriculture project in that it creates a dependency on external inputs for farmers such as chemical fertilisers and hybrid seeds that cannot be saved from one season to the next.[55, 56] These farmers may not have access to these inputs after the project terminates and this is seen by many as introducing additional risk to farmers that are already vulnerable to climate change.

Likewise, hybrid maize varieties developed for high-input systems seem to underperform when farmers return to their traditional farming practices. Strategies like planting monocultures of tomatoes in greenhouses fail when diseases strike and farmers are not able to cope (as we were told is happening currently with a serious bacterial wilt that is forcing farmers to let the tomatoes rot, after investing in expensive steel greenhouses).

**Overall, it seems that the MVP's considerable 10-year effort, and funder investment, in Siaya will unfortunately not have a very significant long-term positive effect. The prevailing strategy seems very risky for resource-poor farmers, particularly in times of uncertainty under the current changing climatic conditions in the region.** Some gains in the short-term when conditions were optimal (with heavy subsidies on chemical fertilisers and free hybrid seeds) might have left resource-poor farmers in a worse-off situation in the long-term, and unable to cope by themselves with limited lasting local resilience and lack of adaptive capacity.

Farmers Isaac and Augustin gave us their insight to the MVP programme on their farms.



© Greenpeace / Cheryl-Samantha Owen. Augustine's rotting tomatoes, grown in his greenhouse. Kenya, East Africa. 2015.

## Isaac Atuk, Sauri, Siaya County, Western Kenya

Isaac lives on the outskirts of Sauri, where he grows his grain and vegetable crops and rears animals. He has one acre of horticultural land where he grows kale, watermelon and tomatoes in a greenhouse.

The tomatoes are grown in pots and were being sprayed with foliar feed and preventative fungicides when we visited (the soil has become too infected with bacterial wilt to allow direct soil planting). Tomatoes are drip irrigated in the pots for water saving. However, this has proven costly for Isaac as he uses tap water at a flat fee of US$6.50 per month. Isaac grows Anna F1 tomato variety and sells them to the Market Centre wholesaler. Each kilogram of tomatoes fetches around US$0.90 wholesale prices, and is then sold at US$1.10. He plans to grow onions in the dry season.

For his maize and bean crops, he uses saved seeds but buys 10 kg of fertiliser for his maize. He also uses organic compost that is derived from leaves mixed with manure from his two cows and one sheep. These animals are fed on Napier grass and banana leaves. They supply milk to the local cooperative. He also keeps 50 broiler chickens. Isaac is studying and hopes to be a teacher and complete a Master's degree in horticulture. When asked about composting and use of manure he said that he had learned the method through his own innovation.

Key issues: **MONOCULTURE**; DISEASE; **RISK; EXPENSIVE TAP WATER;** MONETARY INVESTMENT; CHEMICAL FERTILISER; FUNGICIDE; EXTERNAL INPUTS.

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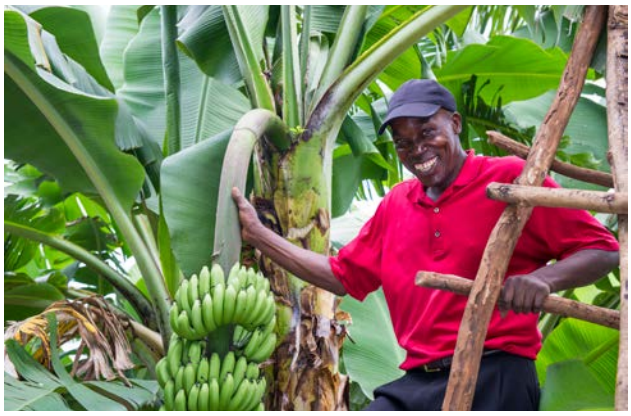
## Augustine Wanyanga, Sauri, Saiya County, Western Kenya





Augustine Wanyanga

*"If I had planted hybrid maize, I would have nothing after the drought. But I planted yellow local maize, and it recovered from the drought and gave me 15 bags. With the hybrid, I'd have had zero"* Farmer Augustine, Sauri, Siaya County.

Augustine Wanyanga owns a 4.4-acre *shamba* with various crops and grows bananas in a quarter acre section. He has planted bananas in big holes to retain water and protect against moles, an innovation that he proudly "invented" himself. Augustine keeps two cows, one Friesian dairy cow and one local variety that has a calf. At one point, he kept 300 chickens but sold them and now has 150 Kenbrew chickens that produce both eggs and meat.

Augustine grows both yellow and white open pollinated variety (OPV) maize, and since working with Millennium Village Project he also grows the hybrid maize that the project provides. He prefers to grow both hybrid and OPV maize as when there is drought the hybrid maize "will produce nothing", whereas OPV local maize "will still produce something".

Augustine has one greenhouse planted with a particularly disease-vulnerable variety of tomatoes which he is leaving to rot and will not harvest this year. He will switch to a different variety, Tonto F1, in the next season. He also hopes for a second greenhouse to be provided and erected by Millennium Villages Project.

Key issues: **MONOCULTURE; RISK;** MONETARY INVESTMENT; CHEMICAL FERTILISER; FUNGICIDE; DISEASE, LACK OF GENETIC DIVERSITY.



## FAO-funded Rice Irrigation Project

The Rice Irrigation Project was first initiated in 2009 when several farmers in Siaya acquired funding from the FAO in order to rehabilitate and expand an irrigation scheme and build capacity for sustainable rice intensification (SRI). Rice was promoted as both a cash crop and a food security crop. The SRI approach aims to increase rice yields whilst decreasing the total amount of land area and water used. The scheme initially covered 105 acres under rice and is located near a small river. There are currently 110 farmers who have formed a cooperative. The farmers on this land have been growing rice for 20 years and water for the crop has been harvested from the river through a gravity fed system.

The project grows basmati rice in addition to some local varieties. The fertilisers used by the project were primarily ammonia and urea and pesticides against rice rust, other fungi and some insects such as grasshoppers. The cooperative also used funds from Japan Aid to install their first rice mill and then later used grants from the FAO to install a second mill. A third rice mill was self-funded. Capacity building has been in the form of a demonstration plot on one of the farms and with the help of Government officers, the farmers follow the whole cycle of rice production. Due to limitations on the access to water, the demonstration plots have had varied success.

Water scarcity is a big problem for the rice growers. The cooperative would expand production but are restricted by their access to water and they would like to build a dam in the future. At present, the whole cooperative has 120 acres under rice production and each acre produces 2.7 tonnes of rice. At full capacity the three rice mills can process a total of 9.9 tonnes of rice every day and, if there are no breakdowns, the whole harvest can be milled in 32 days. This means that the mills are often idle.

The mills are costly, both in terms of upkeep and operation (they either use electricity or sources of fuel), and they frequently break down. The cooperative invested in the three mills to assure that there will always be one operating. However, this considerable investment means that the farmers are often not maximising their efficiency or using the resources they have to their full benefit.

**As access to water is limited and the rice crop is low, the farmers are not able to achieve high yields or command high prices for their crops. The farmers told us that 4 years ago FAO funded the building of a dam, but there was insufficient water. In the last season, water shortages caused a 25% reduction in the production of rice. With such a focus on rice production, it will take time to diversify to other more suitable crops, and the farmers feel trapped.** They are hoping that in the future, there might be some options to adapt the mills to process other more drought tolerant crops such as millet. There may also be some hope of planting groundnuts or other crops during the fallow season.

Unfortunately this initiative highlights the need for strategic planning for climate change adaptation and diversification. Funding organisations must take a long-term view in assessing the suitability for a particular practical solution in agriculture. **In the case of this particular SRI project, funding was provided in a location where there was little potential for rice in the long term because of water limitations. The project was highly focused on a monoculture with large investment in expensive external inputs and little capacity for diversification or for building resilience.**

Our assessment is based on interviews with a number of farmers from the cooperative and their summation of how their lives have changed since the onset of the rice irrigation project. However, on review of our findings, FAO provided a number of statements from project leaders refuting our impression that this initiative serves to increase vulnerability for farmers. In the view of the FAO SRI project leaders, throughout the project there has been a reduction in the total cost of production, alongside an increase in productivity which FAO estimates to have resulted in substantial increases in household incomes.

The farmers we talked to did not provide this information about yields and costs of production. And whilst these figures may indicate an increase in income for families over the short-term, this may not increase long-term resilience and nutritional security in future conditions of climate change. A reliance on a monoculture that is particularly water-dependent and therefore vulnerable to fluctuating rainfall patterns is, in our view, not building resilience in the local agriculture system.

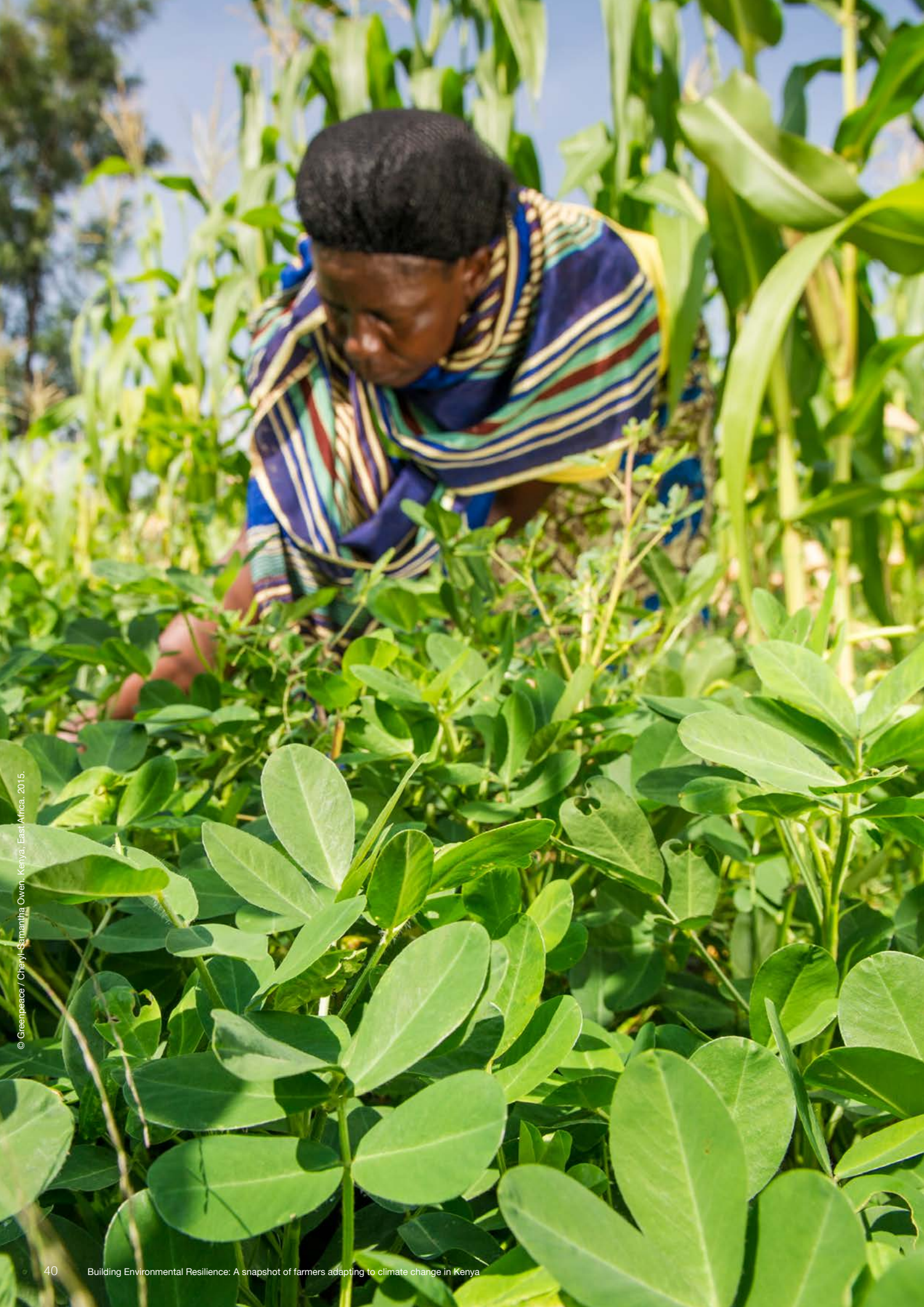
Further, FAO stated that their diversification strategy was to encourage farmers to grow high value vegetables such as tomatoes that are grown after harvesting the rice. Although the growing of high value vegetables can be a successful strategy in building diversity in incomes, our experience during farmer visits was that when cultivated as a large scale monoculture this brings vulnerability to disease and, therefore, crop failure. During our visit and interviews with farmers in October 2014, the farmers and cooperative president stated that they would want to diversify with other crops outside the rice season, but had not been able to do so yet. They wished to build a water reservoir as a climate change adaptation strategy. Outside the rice season, their fields were fallow and used for grazing.

According to the FAO, County governments of Kisumu and Siaya are assisting rice farmers in providing equipment to bale and store rice straw that will be used as livestock

fodder. Whilst this may be a positive step towards using straw as a fodder resource, and improving local storage facilities, in our view, this investment would be better distributed throughout the community in direct investment into building long-term resilience in agriculture through a more systemic approach. This would involve investment in all four key elements, and the practices they entail, that we present in this study.

Key vulnerability issues for farmers: MONOCULTURE; RISK; EXTERNAL INPUT; INEFFICIENCY; MONETARY INVESTMENT.

© Greenpeace / Cheryl-Samantha Owen. Augustine Wanyanga with his unharvested tomato plants. Kenya, East Africa. 2015.



© Greenpeace / Cheryl-Samantha Owen. Kenya, East Africa. 2015.

# 6. Conclusions

Climate change adaptation in agriculture is clearly a concern for many farmers in Africa. In the case studies reviewed in this report, adaptive strategies aim to address issues of environmental degradation and drought through building soil fertility and focusing on water capture, retention and storage.

Fertile soil is a limited resource that underpins agriculture.[57] In Africa, soils are degraded as nutrients are exported with harvested crops and are not replenished. This, as well as wind and water erosion, acidification, compaction and salinization has led to decreasing yields that do not sustain communities, especially in this time of climate change. Healthy soils are better at retaining moisture and water conservation strategies must also focus on increasing the soil's organic matter as well as harvesting the water in the first place. In this way, soils play a key role in climate change adaptation and in mitigation, in the form of carbon sequestration.

For those farmers who suffer seasonal food shortages, diversification in crops, livestock and income sources can assist them in growing food or generating additional money to spend at the local markets.

The case studies we present here show practical ways in which farmers are adapting to climate change. Ecological farming practices show great potential in building environmental, economic and community resilience. Reliance on external inputs such as chemical fertilisers and pesticides are too costly for smallholder farmers who can't afford them. Successful strategies should focus on long-term development and use of self-reliance (e.g. by using local resources) to increase yields.

International and government institutions and development organisations, as well as other non-government organisations have achieved varied success through projects that aim to support farmers. The most successful projects have taken a long-term approach by building capacity in communities and putting climate change adaptation as a top priority. These projects use existing community networks and organisations in a working relationship that will provide practical solutions and build resilience that has no end date.

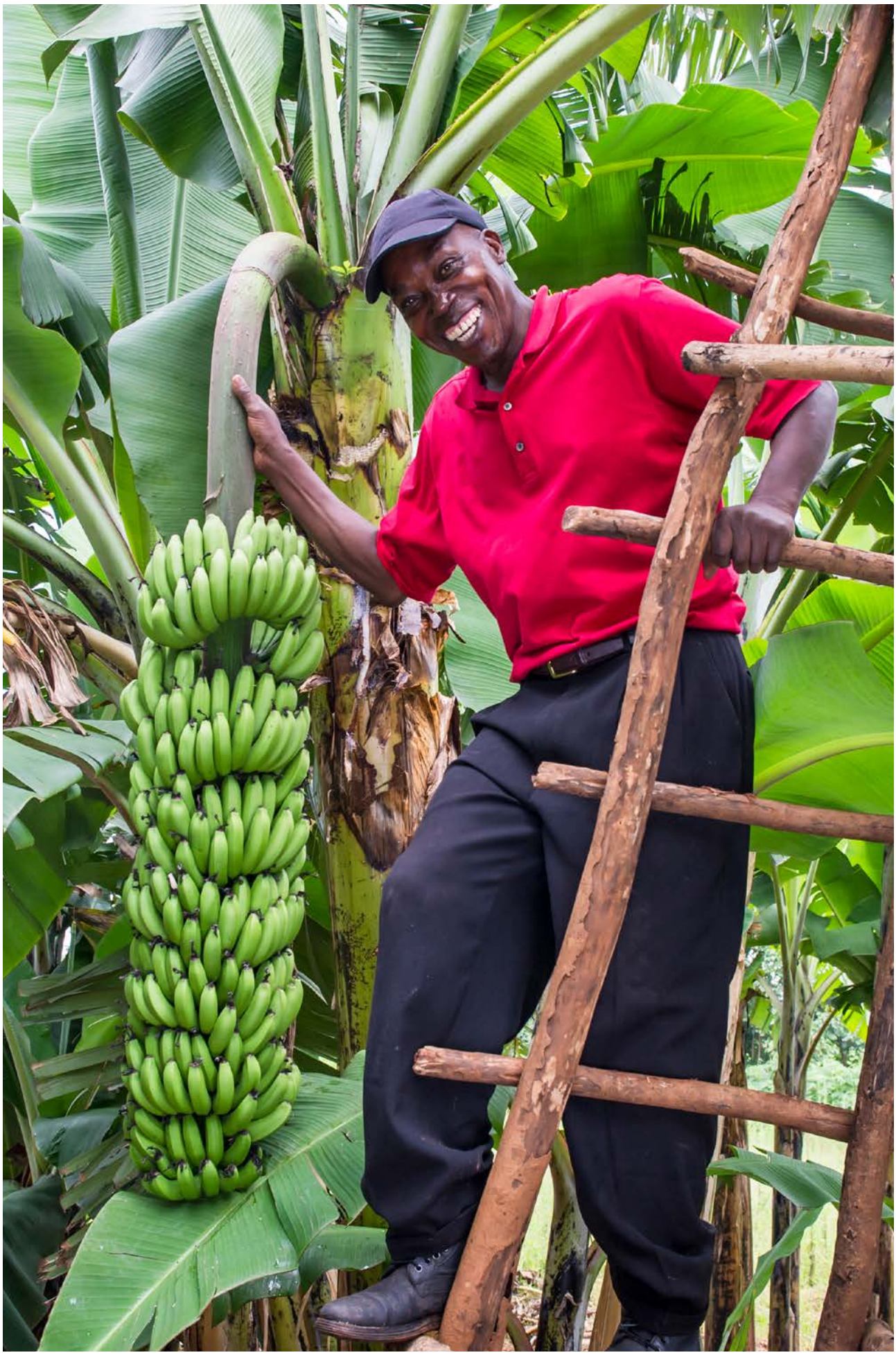
Currently, the proportion of funding allocated to ecological farming as a climate adaptation strategy is far outweighed by the vast amounts of money going to fund research into expensive, short-term solutions such as those using expensive external inputs like fertilisers. Farmers are still waiting for these short-term strategies to deliver robust results. However, in January 2014, East African agricultural scientists released 10 lines of conventionally bred, drought tolerant maize varieties in response to shifting weather patterns in the region. The development of the drought tolerant maize varieties, whose research started in 2007, was carried out in collaboration with the African Agricultural Technology Foundation under the Drought Tolerant Maize for Africa Project.[58] Plant breeders at the International Center for Tropical Agriculture (CIAT) have also made recent progress using modern, non-GE genomic plant breeding approaches to improve the drought and heat tolerance of commonly grown beans in several countries around the world.[59] Some varieties have also been bred to increase their iron content and disease resistance, but without recourse to genetic engineering.

Learning from farmers and the grassroots organisations working with them, we were able to identify key elements around which practical solutions are helping farmers to achieve higher resilience within food production and, therefore, nutritional security. With additional resilience building in community networks, those in the hunger 'hotspots' of the world can have better access to nutrition through sustainable diets. We have ranked the organisations we visited in the field and provided information on the practices they are promoting in East Africa (Table 3). We did this ranking based on our appreciation of how much potential each programme seems to have in terms of increasing resilience, by assessing whether each programme integrates a systemic approach to sustainability along the four key elements identified: **soil, water, diversity and communities.**

We can conclude that ecological farming incorporating a multi-dimensional focus on **soil, water, diversity and communities,** while tailoring practices to specific conditions, will secure a better life for millions of farmers in East Africa, now and into the future.

**Table 3.** Adaptive ranking of projects and organisations working in Kenya that aim to build resilience within agriculture and increase food security in the face of climate change. Criteria for rankings depend on how many of these adaptive strategies identified and targeted the four key elements (soil, water, diversity and communities) and whether there is long-term sustainability built into the scheme.

| **Lead organisation and region** | **Main adaptation strategies** | **Adaptive ranking, based on the inclusion of the four key elements in a sustainable way**<br>**(4 highest and all elements, - 4 lowest and no elements )** |
|---|---|---|
| **CCAFS**<br>Nyando | Diversification, rain water harvesting | Water, diversity, soils, communities (4) |
| **Vi Agroforestry**<br>Bungoma | Diversification, agroforestry, soil regeneration, multi-cropping | Water, diversity, soils, communities (4) |
| **Manor House Agriculture Centre**<br>Kitale | GROW BIO-INTENSIVE (intensification with low external input technologies) | Water, diversity, soils, communities (4) |
| **ICE**<br>Central and Eastern Kenya | Capacity building, extension support to SSF, indigenous knowledge and seed diversity, soil conservation, terracing, diversification, rainwater harvesting | Water, diversity, soils, communities (4) |
| **FFSI**<br>Bondo | Capacity building and participatory learning | Diversity, soils, communities (3) |
| **Farm Africa**<br>National | Market-led approach with conservation agriculture, micro-irrigation, and drought tolerant varieties. | Diversity, water (2) |
| **FAO Rice and Irrigation**<br>Siaya | Irrigation scheme, marketing, monocultures, little attention to soil, water and diversity. Community building. | Communities (-3) |
| **MVP**<br>Bar-Sauri | Intensification with subsidies for high external inputs; focus on hybrid maize varieties and irrigation using water from highly unsustainable sources. | Communities (-3) |



© Greenpeace / Cheryl-Samantha Owen. Augustine Wanyanga and his prize banana harvest. Kenya, East Africa. 2015.

# 7. Recommendations

On the basis of the evidence arising from the case studies presented in this report, Greenpeace proposes that to build resilience in African agriculture, the following are critical:

**1. Donors, governments and international organisations should increase overall financial, research, and technical support to ecological farming**, using four primary channels as effective conduits for upscaling:

a) Academic and public research and training institutions
b) Community seed banks and exchange networks
c) Public procurement schemes and
d) Producer organisations and cooperatives.

Other channels should be explored to help to scale up successful local ecological farming initiatives. The four channels have been highlighted within a separate Greenpeace report (*Financing Ecological Farming in Africa: A guide for International Donors,* May 2015[60]). Local ecological farming food production must take priority over export crops in order to promote nutritional security in the context of food sovereignty.[61]

**2. County and national governments should increase investment in, and create policies that promote ecological farming, particularly for small-scale farmers.** These should include: rebuilding extension services to support ecological farming and adjusting taxation policies to discourage chemical use and intensive livestock and incentivise support for ecological farming. While small-scale farmers need the most public support, to truly build resilience, ecological farming is essential across the entire agricultural sector. Government policy needs to provide market-oriented incentives to encourage all agriculture and food businesses to use ecological farming practices routinely in growing and sourcing produce that will be sold within Africa and internationally.

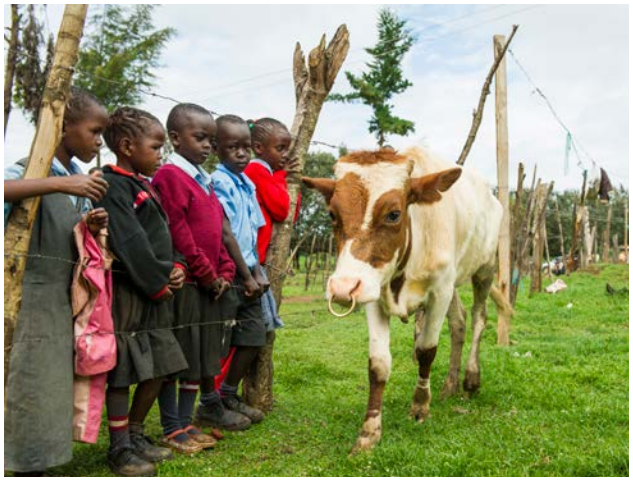
**3. Private companies and public institutions (e.g. local hotels, schools, hospitals, restaurants and supermarkets that directly supply consumers, or food manufacturing companies targeting wider domestic, regional or international markets) interested in procuring ecologically grown produce should link up with small-scale farmer associations.** Local and regional governments should put in place incentives for these direct connections to develop.

**4. Better monitoring and assessment of resilience building:** Research, development and governmental organisations should perform better evaluation of the improvements in livelihoods as a result of adaptive resilience-building strategies. This entails providing training on record keeping from the beginning of any adaptation trajectory so that farmers, and policy makers, have information on baseline data and how these strategies have changed farmers' livelihoods.

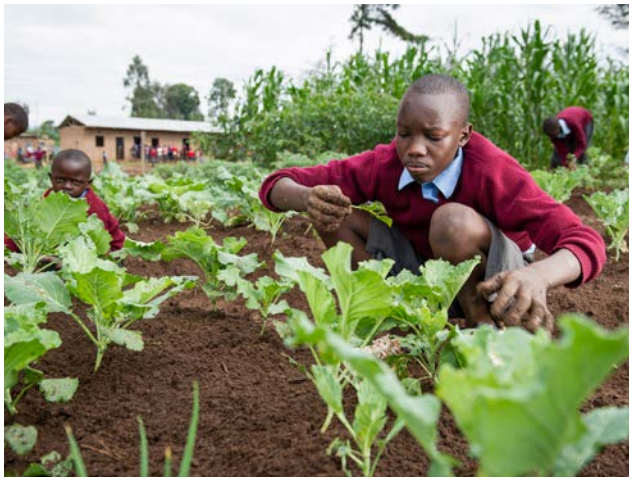
**5. Farmer participation: Research and development projects should ensure participation of the relevant communities, particularly small-scale farmers and women.** Participatory approaches should be included in the design, implementation monitoring and evaluation of projects to ensure the projects meet and respond primarily to the needs of the local community.

**6. More coordinated policy making:** Governments should use ecological farming initiatives as a strategic opportunity to develop synergies between various development goals, e.g. between nutritional security goals, climate adaptation measures, environmental protection aims, disaster risk and rural poverty reduction objectives. This can be done through creation of an Ecological Farming Strategy.

**7. Use farmer field schools: Government agricultural programmes and research institutions should encourage and support farmer field school approaches** as an effective means of supporting training in ecological farming methods, as well as the co-generation of new knowledge. This for example, could be integrated into government agricultural policy extension programmes.



© Greenpeace / Cheryl-Samantha Owen. Kitalale Township school pupils, through collaboration with Manor House Agricultural Centre, these children will learn ecological farming methods. Kenya, East Africa. 2015.



© Greenpeace / Cheryl-Samantha Owen. Kitalale Township school pupils putting into practice what they have learnt through Manor House Agricultural Centre. Kenya, East Africa. 2015.

# 8. Acknowledgements

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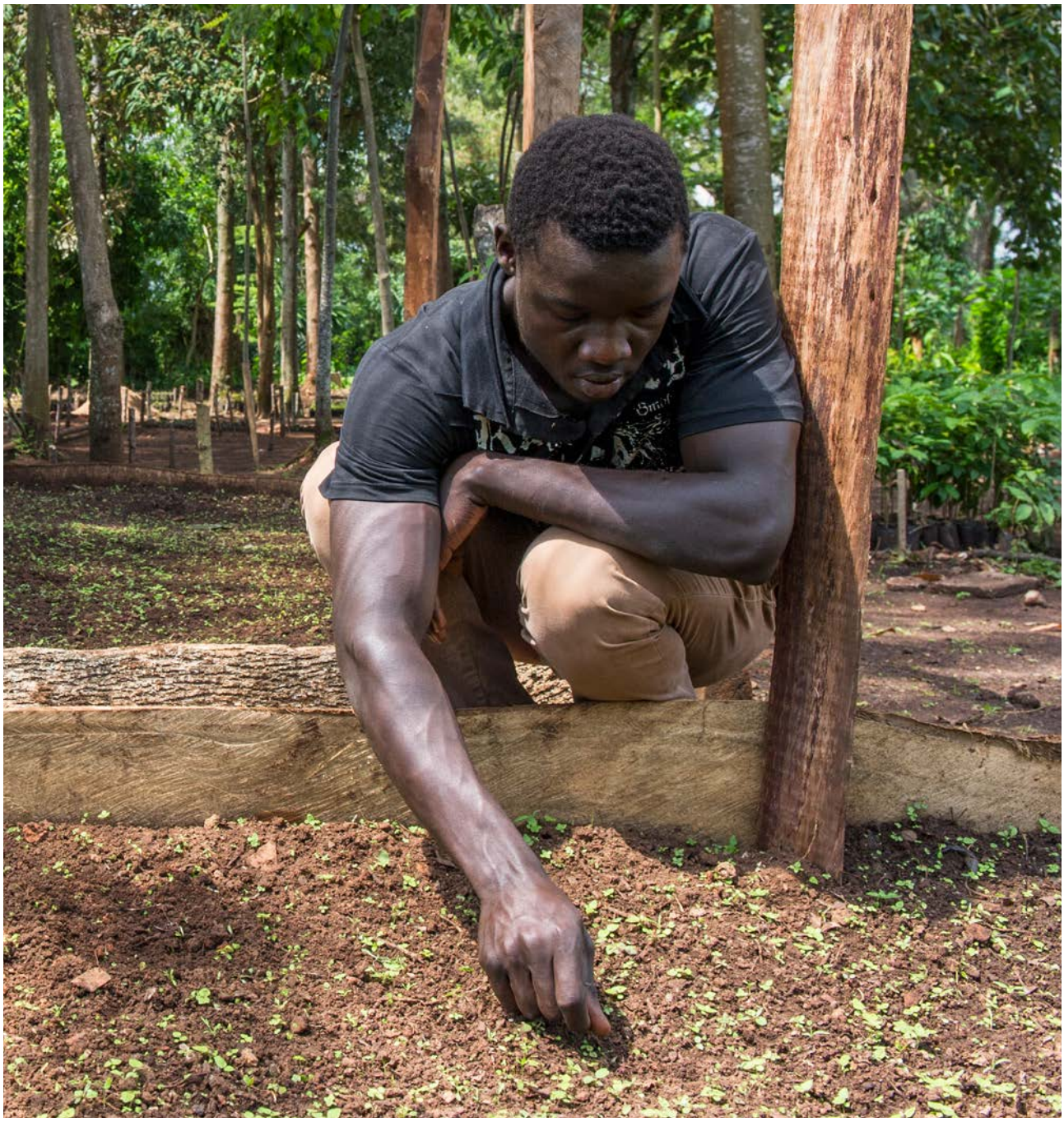

# 9. ANNEX

**Table A1.** Farmers and projects in Kenya visited by Greenpeace Team during October 2014.

| Day | Project | Main Adaptation Strategies |
|---|---|---|
| **Day 1** | CCAFS (CIAT), Lower Nyando | Diversification, rainwater harvesting |
| **Day 2** | Farmers Field Schools, Bondo | Participatory learning and community capacity building |
| | FAO Rice and Irrigation, Siaya | Irrigation, marketing, monocultures |
| | Millennium Village Project, Bar-Sauri | Intensification, high external inputs |
| **Day 3** | Vi Agroforestry, Bungoma | Diversification, agroforestry, soil regeneration, multi-cropping |
| | Manor House Agricultural Centre, Kitale | Grow BIO-INTENSIVE – intensification with low external input technologies |
| **Day 4** | CCAFS | Brings together researchers in agricultural science, climate science, environmental and social sciences to identify and address the most important interactions, synergies and trade-offs between climate change and agriculture |
| | International Centre for Research in Agroforestry (ICRAF), World Agroforestry Centre | Conservation agriculture with trees, agroforestry, diversification |
| | Farm Africa | Market-led approach – conservation agriculture, micro-irrigation, drought tolerant varieties, diversification |
| | Arid Lands Information Network | Community capacity building, participatory learning, information technology, solar micro-irrigation, rainwater harvesting, SMS service for weather forecasts and marketing information |
| **Day 5** | Kenyan Agricultural and Livestock Research Organisation (KALRO), Thika | Experimental trial on organic vs conventional |
| | Institute for Cultural Ecology (ICE), Thika and Machakos | Community capacity building, extension support to SSF<br>Indigenous knowledge and seed biodiversity conservation<br>Terracing and diversification<br>Rainwater harvesting |
| | GIZ - EcoSan | Eco-sanitation (human health, water pollution, bioenergy, soil fertility) |

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Greenpeace has been working in Africa to end environmental destruction and fighting for the right of Africans to a healthy environment since the early 1990s. Our campaigns focus on climate change, halting the destruction of tropical forests, supporting ecological farming and preventing the degradation of marine ecosystems.