



Farmer picking tea, Upper Tana River Basin, Kenya
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Upper Tana River Basin Foodscape

Innovate technical solutions for market-oriented smallholders



LOCATION: North of Nairobi, Kenya
SIZE: 1 million hectares

KENYA

SYNOPSIS

The Upper Tana River Basin foodscape in Kenya is a diverse, high-elevation smallholder production landscape that is an important source of food for the 9 million inhabitants of the greater Nairobi area. Farmers in the Upper Tana also export their crops — mostly to Europe — making this a smallholder farming landscape that is simultaneously crucial for local food demand in one of the most important urban centers in Africa, and a key supplier to international markets.

In addition to food, the watershed also provides drinking water for those 9 million people, as well as 50% of Kenya's electricity supply through a series of hydropower dams along the Tana River. But while Nairobi's place downstream from the Upper Tana means the city is relatively close to an important food supply, it also means that soil erosion within the watershed damages the hydroelectric and drinking water infrastructure that also supplies water and electricity to people in the greater Nairobi area.

UPPER TANA

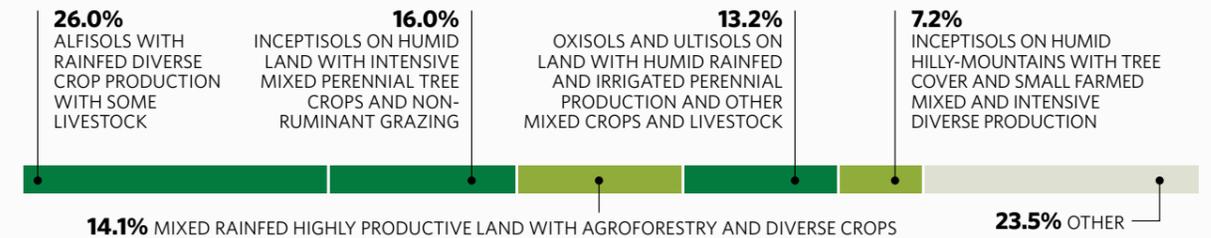


FIGURE 1. Map of Upper Tana River Basin foodscape. The bars represent the most extensive foodscape classes within the foodscape. The color of bars indicates the intensity groups corresponding to those classes: intensive production dominant (dark green) and mixed mosaic food cultivation (light green). The other category includes the classes that each made up <5% of the foodscape area.

This urban proximity offers an opportunity to reap the benefits of planning at the foodscape level because connecting nearby urban consumers of food and water with upstream suppliers can create economic opportunity while supporting sustainable land management within the watershed. In fact, one such market-based approach is already at work in the basin.

The Upper Tana-Nairobi Water Fund, an existing public-private partnership, shows how the right policies, conditions, and alignment of incentives can support changes in land management practices

that reduce erosion. Briefly, a water fund is a mechanism to connect suppliers and consumers in ways that benefit both. In a water fund, downstream commercial and industrial water users invest in upstream conservation to lower sedimentation rates.

Water funds, like the one in the Upper Tana River Basin, show that market-based approaches are most effective when paired with innovation from the private sector and strong enabling conditions - policies and social norms, for example - that allow benefits to be shared equitably.

A silty Tana River, caused by erosion of agricultural soils, as it crosses the Chania Falls in Thika, Kenya
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ABOUT THE FOODSCAPE

The Upper Tana River Basin foodscape, just north of Nairobi (FIGURE 1), is a classic example of a diversified, highland cropping system. The foodscape is composed of thousands of homesteads (shambas) – most smaller than 2 hectares – that typically include a small house, some outbuildings, and a patchwork of fields interspersed with coppices of trees that provide shade, firewood and fruit.

Farmers produce cereals, vegetables, fruits, coffee, tea, and livestock products such as milk and eggs on small parcels of land with relatively little mechanization and few agricultural inputs, and they export green beans, pineapple, coffee and tea mostly to Europe.

Life on the shamba moves with the rain: robust long rains followed by sporadic short rains, with dry spells in between, dictate when food can be grown. While some food is grown for a family's consumption – especially white maize, the key ingredient in ugali, a Kenyan staple – a good portion is sold in local markets, including in Nairobi.

In recent years, traditional subsistence crops, including maize, beans and tubers, are giving way to higher-value cash crops such as peppers, tomatoes and avocado, driven by demand in Europe and Nairobi. Tea and coffee have historically been the major cash crops in the higher elevation areas and remain widely cultivated.

CHALLENGES

“Maji ni uhai” – “water is life” in Swahili – and in the Upper Tana, water is a blessing that must be carefully managed. As rainfall varies, so does the Tana River, with downstream users concerned about maintaining a steady supply of clean water. For hydropower operators, the sediment

that washes into the river from fields, roads and steep slopes threatens electricity production. For farmers, loss of topsoil also reduces crop productivity. As with most rainfed farming, dry years and longer dry spells associated with climate change cause crop losses.

Increased focus on market-oriented production creates economic opportunity but also exposes farmers to price volatility and creates disparities among farmers depending on their access to agricultural inputs, technical training and resources. Farmers, especially those in underrepresented social groups, such as women, lack crucial resources for market-oriented production. They may plant crops at the wrong time, without enough nutrients for optimal crop growth, or lose precious irrigation water to evaporation. Some farmers benefit from technology, such as mobile credit and digital agronomy, to support their farm enterprise. Yet others remain disconnected from improving techniques, technologies and other resources.

BENEFITS AND VALUE OF NATURE-BASED SOLUTIONS IN THE UPPER TANA RIVER BASIN FOODSCAPE

Nature-based solutions to the challenges in the Upper Tana River Basin foodscape fall into two categories: agronomic solutions to improve crop productivity, such as soil fertility management, and landscape solutions that minimize soil erosion and capture rainwater.

Though most erosion here comes from unpaved roads, incentivizing and encouraging farmers to adopt practices such as terracing, water collection basins (water pans), and agroforestry can help slow the movement of water and stabilize soils and keep them in place.





A farmer holds raw coffee beans

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Terracing and the use of forage grasses such as Napier also help stabilize steeper slopes. Such high-quality forages also help boost milk yields in dairy cows, contributing to greater household income. Across broader areas, such erosion control measures could reduce erosion rates by up to 3 tons per hectare per year in high erosion areas of the foodscape. In some areas, the benefits could include up to 50% increases in crop yields.

Some practices provide both agronomic and erosion-reducing benefits. Water pans, which are collection basins to harvest runoff from roofs and roads, provide water for irrigation and drinking water for livestock while also reducing erosion. Irrigation allows farmers to grow higher-value horticultural crops during the dry season. Adding irrigated horticultural crops and agroforestry to an existing cash crop system could increase farm net income from around \$800 to up to \$2,000 per year in Muranga's County, which is one of several counties in the Upper Tana River Basin (Supplementary Material,¹ Archetype B).

The Upper Tana Nairobi Water Fund has supported the installation of 14,000 water pans on 200,000 farms across the watershed. Looking at the same area from the holistic perspective of the foodscape also shows that reallocating more of the farm landscape to horticulture, by converting some timber, coffee and maize fields, could provide almost \$400 in additional income per year per farm (Supplementary Material,¹ Archetype C).

Such crop switching to higher value crops creates an opportunity for targeted agronomic guidance across the foodscape around soil fertility and agronomy. Advances in soil testing and digital

extension services have made it possible to tailor soil fertility and crop protection amendments to each field, removing technical constraints for optimizing for the highest value crops. Bringing these advances to the Upper Tana River Basin foodscape could enable farmers to move off the least productive, most unstable slopes, freeing up land for the rich biodiversity in the region and the return of native trees and shrubs that provide important habitat and further guard against erosion. In fact, incorporation of trees and shrubs into the foodscape provides multiple benefits, enabling farmers to capitalize on growing demand for fruit and timber, while sequestering carbon, reducing erosion and potentially providing additional habitat for biodiversity.

The Upper Tana is home to the Hinde's babbler (*Turdoides hindei*), whose global range is confined to the Upper Tana. *T. hindei* depends on shrubby vegetation on slopes for nesting habitat. With the loss of native habitat, the bird uses the invasive *Lantana camara*. Agroforestry and soil stabilization measures, including selecting the right plant species, can provide necessary habitat for this at-risk bird and may support greater biodiversity in the region.

The economic value of agroforestry is also important. Farms that convert half of coffee to fruit trees and timber

agroforestry could increase income by around \$1,000 per hectare per year (Supplementary Material,¹ Archetype A). The Upper Tana Nairobi Water Fund has already planted more than 3 million trees throughout the foodscape. Overall, the economic benefits of potential land-use transitions across the foodscape are significant (FIGURE 2).

At the scale of Murang'a County, which is a subset of the Upper Tana, incorporating more diversified crops into the existing maize/coffee/tea system could lead to \$578 million per year of increased on-farm benefits. Even accounting for the cost of the public investment necessary to implement such land use transitions at the Murang'a County level, net benefits would be \$326 million per year.

Many of these nature-based solutions – soil fertility management, crop diversification, and agroforestry – have been promoted for decades. Accelerating and broadening adoption rates has required efforts that combine economic incentives, shared benefits, public investment and enabling policies, and ongoing technological innovations, such as improved fertilizer blends targeted for soils in the region.

Efforts that combine public sector and private sector momentum, such as the

Upper Tana-Nairobi Water Fund, are an important catalyst for adopting new behaviors and practices. The collaboration has specifically shown the value of outreach to underrepresented farmers such as women who traditionally lack access to material and technical resources.

AGGREGATION OF ARCHETYPES TO THE FOODSCAPE LEVEL



FIGURE 2. Summary of economic analyses for the Upper Tana River Basin foodscape. Disaggregated costs & benefits toward \$326 million net benefits from several farm archetypes: Starting with baseline current farm profits (grey, far left), the diagram shows proposed future on farm benefits and costs (dark blue), totaling farm net benefits of \$US 578 million (light blue, middle). Additional public off farm benefits and costs (light green) added to and subtracted from farm net benefits equals \$US 326 million total net benefits (light blue, far right). Other impacts are qualitative assessments of other ecosystem service benefits. The change in area of nature-based solutions associated with the farm archetypes is represented in the boxes. See Supplementary Material for a description of methods.¹

This is a case study excerpted from the report *Foodscapes: Toward Food System Transition*. Please access the entire global report at [nature.org/foodscapes](https://www.nature.org/foodscapes).

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