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Cold Chains, from Net to Fork:
Evidence from Kenya on Livelihoods and Community Resilience

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EXECUTIVE SUMMARY

Small-scale fisheries in Kenya support more than 1.5 million livelihoods but face mounting climate and market shocks that threaten food security and income stability. Research led by Duke University and the University of Nairobi evaluated the Keep IT Cool model—a private enterprise linking fishing communities around Lake Victoria and Lake Turkana to higher-value markets through solar-powered cold storage and logistics. Results show that access to cooling reduced post-harvest losses, improved nutritional diversity, and strengthened households' ability to recover from shocks, though short-term income effects remain modest. The findings highlight the importance of pairing cold-chain technologies with financial tools and policy supports that lower capital costs and make resilience an investable outcome.

FRAGILE LIVELIHOODS AND THE ECONOMICS OF POST-HARVEST LOSS

Livelihoods in Kenya and across wider East Africa are highly dependent on smallholder agriculture and small-scale fishing. Regionally, projections suggest that fishing will employ nearly 21 million people by 2030 (Chan et al. 2021). In Kenya, fishing currently employs about 1.5 million people and provides both income and a critical source of dietary protein. Around Lake Victoria and Lake Turkana—Kenya's largest freshwater bodies, home to about 84% of the country's fish production—households face multiple economic and/or climate-related pressures, including rising temperatures, fish stock declines, and price volatility. These shocks directly affect both income and food security in a country where 35% of the population is reported to be undernourished (FAO 2022).

Post-harvest food spoilage compounds these pressures. Roughly 40% of production—or 9 million tons of food worth $578 million USD—is lost every year in Kenya, including an estimated 34% of total fish catch (Singh et al. 2023; Axmann et al. 2022). Drying and salting fish are widespread preservation methods. Used largely out of necessity, drying practices result in lower-quality and lower-value products, which mostly serve local or regional low-income markets rather than higher-value markets in Kenya's capital, Nairobi. Despite these practices, spoilage rates remain high because traditional methods cannot prevent losses under extreme heat conditions, especially when temperatures exceed 50°C, and because market and transport bottlenecks often delay sales even after preservation.

A well-designed cold chain is a key missing link in rural fresh food value chains. By extending shelf life and ensuring adequate transport conditions, and thus enabling access to distant markets, cooling could help transform fragile, subsistence-based livelihoods into viable commercial activities.

Yet across East Africa, cold storage investments have struggled to achieve financial sustainability due to volatile throughput, unreliable power supply, and high operating costs. Storage units are frequently underused or fall into disrepair within a few years of installation. Analyses find that project economics only begin to make sense when facilities are integrated into multitenant, logistics-linked systems that serve anchor buyers such as processors, exporters, or supermarket chains (Kelekci and Nagasaki 2022; Davidson 2025). Recent assessments underscore that solar and hybrid-powered cold rooms, while innovative, can face similar utilization and cost challenges unless they are tied to broader aggregation and market access solutions (Singh et al. 2023; Open Capital 2023; Jumba et al. 2022).

THE INTERVENTION: KEEP IT COOL'S DEMAND-DRIVEN COLD CHAIN FOR KENYA'S INLAND FISHERIES

Keep IT Cool (KIC) is a Nairobi-based social enterprise providing solar-powered and hybrid cold storage and logistics services for small-scale fishing communities in Kenya. Their business model aims to reduce post-harvest fish losses and link remote fishing communities around Lake Victoria and Lake Turkana to higher-value urban markets.

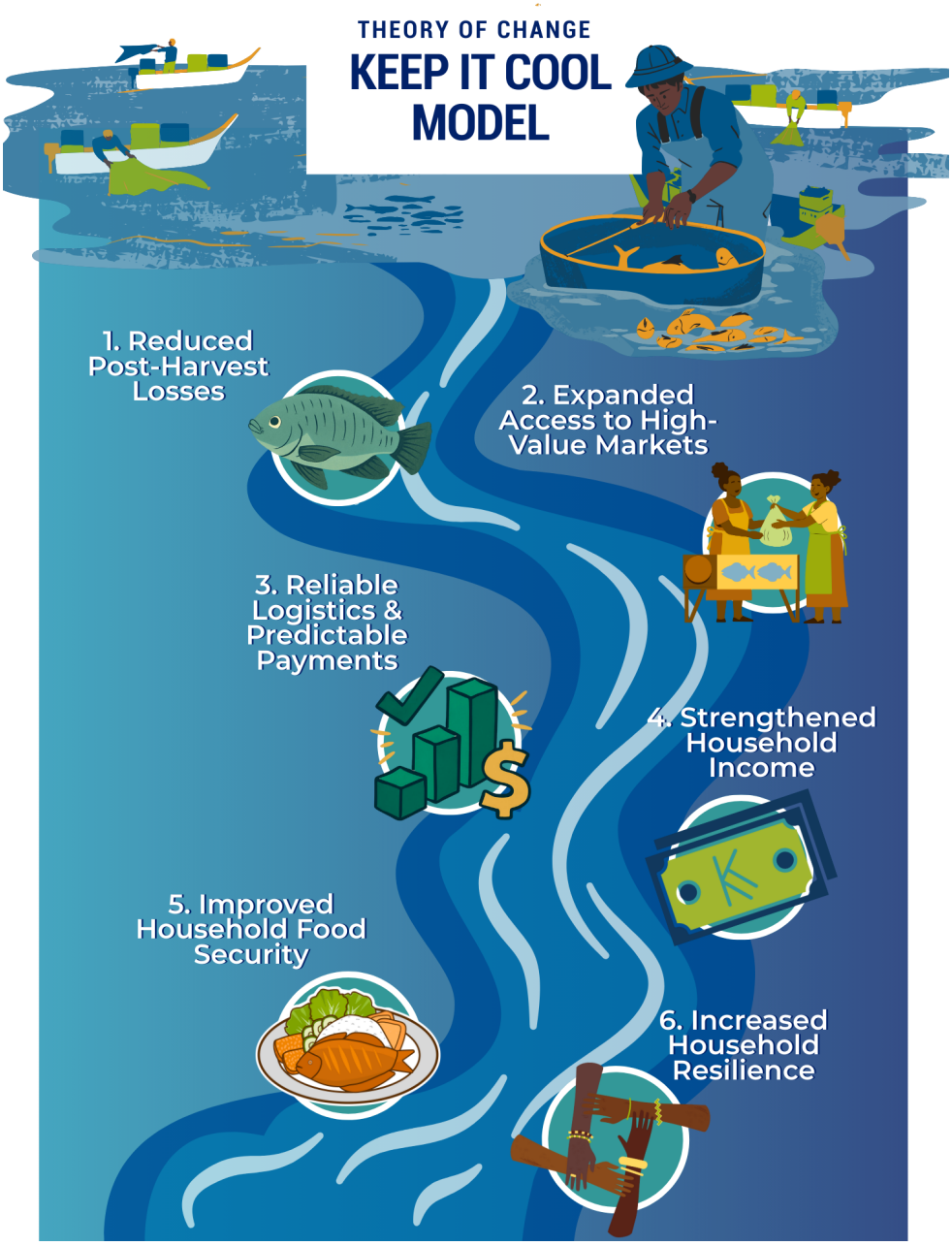
KIC partners with local fisherfolk cooperative groups, known as Beach Management Units (BMUs), that oversee catch landing, market organization, and sustainable resource use. Through these BMUs, KIC coordinates catch collection and market dispatch. Using a digital, demand-based logistics platform powered by Google technology, KIC aggregates orders from urban buyers and matches them with available fish suppliers. Refrigerated trucks are then dispatched to landing sites on a schedule coordinated with BMUs, facilitating rapid mobilization of fresh fish to market through a network of off-grid solar-powered cold rooms, mobile refrigeration units, and on-grid cold storage facilities.

Fisherfolk receive immediate cash payments at pre-agreed prices, bypassing intermediaries and the need for on-site storage or drying. The operation reduces spoilage and provides higher-value tilapia and Nile perch to urban consumers, where fresh fish sells at a significant premium over dried product.

By integrating cold storage, transport, and guaranteed market offtake, the KIC model has the potential to stabilize incomes and strengthen resilience among subsistence-based fishing households, particularly during hot seasons when post-harvest losses are high. The research, based on household-level data collected between August 2023 and November 2024 by the University of Nairobi and Duke University, evaluated how this private-sector service delivery model affects fisherfolk income, food security, and adaptive capacity. The study compares outcomes between fishers in treated BMUs partnered with KIC versus control BMUs through a difference-in-difference approach with fixed effects at either the BMU or household level. The study also offers insights into the conditions for financial sustainability and scalability of decentralized cold-chain systems in East Africa by deriving locally relevant measures of willingness-to-pay for resilience through using the contingent valuation method.

How the Model Creates Impact

The theory of change underlying the KIC model is that by reducing post-harvest losses and expanding access to high-value markets, small-scale fishers can increase and stabilize their incomes while strengthening household food security. Cold storage, reliable logistics, and predictable cash payments improve liquidity and planning, which reduces the pressure to sell immediately at low prices or resort to low-value drying. Over time, these income and food security gains enhance household resilience to climatic and economic shocks by enabling savings, dietary diversity, and investment in productive assets.



KEY FINDINGS FROM THE EVALUATION

In general, access to cold storage and logistics through KIC was found to enhance food security, improve perceived income stability, and strengthen resilience among fishing communities. While the short-term effects on measured income remain modest, the results indicate meaningful progress toward reducing losses, diversifying livelihoods, and increasing adaptive capacity, all of which are important for building long-term climate resilience and advancing economic empowerment.

1. **Economic outcomes.** KIC's cold-chain services significantly reduced post-harvest losses and improved revenue expectations among fisherfolk. Although no statistically significant increase in measured monthly household income was detected during the one-year evaluation window, households in treatment BMUs reported both higher income diversification and higher expected annual fishing revenues in both average and good years. These effects suggest that access to cooling reduced uncertainty and increased optimism about income-generating potential. Further data gathering in 2026 or beyond could test whether these operational gains translate into measurable income growth as adoption deepens and seasonal cycles normalize.
2. **Food security and nutrition.** KIC participation was associated with greater nutritional diversity. Treated fisherfolk households purchased food from a broader range of categories. Food insecurity, as measured by the UN Food and Agriculture Organization's Food Insecurity Experience Scale, decreased modestly (but this result was not statistically significant). These results imply that while households continued to face food access challenges amid broader climatic and economic stressors, improved cash flow and reduced spoilage likely enabled more diverse and stable diets.
3. **Fishing practices and environmental outcomes.** The intervention did not lead to higher total catch volumes. It did produce a significant decline in spoilage and post-harvest loss, confirming the intended operational effect of KIC's cooling services. The decrease in fish spoilage entails environmental co-benefits through reduced wastage-related greenhouse gas emissions. Households with access to cold storage also increased investments in fishing, with increased ownership of fishing equipment and increased rates of ownership or co-ownership of fishing vessels. Similarly, households in treated BMUs significantly increased their labor allocation to fishing. Jointly, these changes suggest a shift toward more stable, commercially oriented activity.
4. **Social capital and adaptive behavior.** While treated households decreased membership in local groups and informal networks, they reported a significantly higher ability to access small amounts of emergency funds (1,000 KES[1]). This combination of results suggests that fisherfolk households are concentrating their engagement in a smaller number of stronger informal networks, allowing them to

[1] Kenyan shillings.

depend on these ties for improved financial stability. Respondents also reported greater awareness of climate-related risks and a shift toward proactive adaptation, such as monitoring weather patterns and diversifying income sources.

5. **Resilience and willingness to pay.** Households with access to KIC services reported higher self-assessed resilience, as measured by the Ability to Recover index (Al-Mashat et al. 2024). Controlling for BMU characteristics, households perceived themselves as better able to withstand and recover from economic and climatic shocks. Furthermore, a novel willingness-to-pay experiment found that respondents strongly value resilience-enhancing interventions, clearly recognizing and appreciating the benefits of increased stability and reduced risk.
6. **Climate impacts and perceptions.** Fisherfolk reported experiencing an average of five to seven major shocks per year, most commonly fish stock decline, rising food prices, extreme heat, and drought shocks. These were both climate-related (drought, flood, extreme heat) and economic (price volatility, reduced catch, illness, equipment loss). Nearly 99% of respondents perceived that climate change was occurring, with most pointing to rising temperatures, prolonged droughts, and unpredictable weather. Many also reported declining fish stocks and increased competition, underscoring the dual stressors of environmental change and economic precarity. Limited financial resources, inadequate information, and weak institutional support emerged as the most frequently cited barriers to adaptation.

Key Findings

Empowered Fishing Communities

Access to Keep IT Cool's cold storage and logistics improved well-being of fishing communitites around Lake Turkana across many indicators.

Vulnerable Rural Communities

5-7 Shocks
Fisherfolk experience per year, including economic and climate shocks

Improved Food Security and Nutrition

Enhanced Economic Outcomes

6%
Reduction in post-harvest losses

15%
Increase in fishing revenue

Greater
Income diversification

Enhanced Social Capital and Climate Awareness

Greater
Awareness of climate change and associated risks

Higher
Ability to access emergency capital

Greater Resilience and Adaptive Behavior

Higher
Self-assessed resilience

Higher
Willingness to Pay for related interventions

More Efficient, Commercially-Oriented Activity

Greater
Labor allocation to fishing

Greater
Investments in fishing equipment

RECOMMENDATIONS AND NEXT STEPS

This research highlights a need to strengthen the adaptive capacity of small-scale fishing communities facing increasing climate and economic shocks. Households around Lake Turkana (and similar locations) experience frequent and compounding disruptions each year. In this context, limited access to finance, preservation technology, and market information continue to constrain their ability to prepare and recover from shocks. Ecosystem actors should consider measures to support the following:

1. **Lower the cost of capital and build market certainty for resilience-building enterprises.** Cold storage and logistics services such as KIC's deliver clear public-good benefits, contributing to community resilience and mitigating against climate change. However, high upfront costs and uncertain utilization represent barriers to scale. Governments, development partners, and impact investors should prioritize efforts to lower the cost of capital for private enterprises providing these resilience services. Early concessional investment, paired with results-based financing and risk-sharing instruments, enable local businesses to expand without prohibitive borrowing costs.
2. **Pair technology investments with demand-side financial and capacity-building tools.** Cold-chain interventions should be complemented by credit lines, savings and insurance products, and technical training that enable fisherfolk and small enterprises to better manage cash flow, invest in productive assets, and plan for shocks. Access to finance and improved financial literacy can help sustain gains in income, resilience, and market participation.
3. **Improve the measurement of resilience outcomes and the economic valuation of those outcomes.** This study provides early evidence that beneficiaries can distinguish and place value on resilience improvements. Future research and policy should build on this by developing stronger, more consistent methods to measure and compare resilience impacts across models and interventions. This includes better understanding how households, governments, and private enterprises each perceive and value resilience gains, whether through improved income stability, more resilient supply chains, or lower long-term social costs. Pairing these metrics with longitudinal income tracking can capture lagged earnings effects as reduced losses and diversification materialize. Emerging tools such as the Ability to Recover metric offer practical ways to capture these perceptions at scale and across differentiated resilience interventions and portfolios, enabling policymakers and investors to more easily compare, prioritize, and target such interventions (Bekele et al. n.d.). A convergence toward such a cross-cutting metric would help guide public investment, inform private-sector business models, and make resilience a more visible and investable outcome.

Together, these steps point toward a next generation of adaptation investments that treat resilience as both measurable and investable, with the private sector serving as a critical delivery channel for reaching last-mile communities.

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