

ENHANCING KENYAN FISHERIES

OFF-GRID SOLAR COOLING FOR SUSTAINABLE LIVELIHOODS



A market trader and customer of Adili Solar Hubs, selling their fish at the market

JULY 2025

Efficiency for Access Coalition

ACKNOWLEDGEMENTS

This case study was prepared by Liya Bensy Thomas from Energy Saving Trust, co-Secretariat of Efficiency for Access with continuous insights and contributions from Kimani Gichuche, Tracy Langat, Sonja Mettenleiter, Deborah Chepkemai and Sylvia Nzevela from Adili Solar Hubs.

We thank the following Efficiency for Access team members for their inputs and review to improve this case study: Jakub Vrba, Leo Blyth, Chris Beland, Kalina Stormonth-Darling and Mahta Zaker Ameli Renani (Energy Saving Trust) and Veronica Nkooyio (CLASP).

We would also like to thank Sarah Hambly and Kyle Rees (Energy Saving Trust) for their support with copy editing and designing the report.

DISCLAIMER

This research is part of the Low Energy Inclusive Appliances (LEIA) programme, a flagship initiative under Efficiency for Access, funded with UK aid, from the UK Government via the Transforming Energy Access (TEA) platform, and the IKEA Foundation.

This report was funded with UK aid from the UK government; however, the views expressed do not necessarily reflect the UK government's official policies.

Contact: info@efficiencyforaccess.org

CITATION AND COPYRIGHT

Efficiency for Access Coalition, Enhancing Kenyan fisheries: off-grid solar cooling for sustainable livelihoods, July 2025

© Efficiency for Access Coalition, July 2025

CONTEXT

This report presents an innovative business model which integrates both active and passive cooling solutions to close critical gaps in cold chain management within the fish value chain in Kenya. Highlighting the story of Adili Solar Hubs in Lake Turkana, Kenya, the report explores the challenges of fresh fish preservation and distribution in off-grid settings. It explores the key factors contributing to the success of Adili's business model, lessons learned along the way, market challenges encountered, and strategies adopted to address cold chain gaps.

The Efficiency for Access Research and Development Fund has supported Adili Solar Hubs since 2021, providing early-stage financing to pilot the company's concept of integrating cooling into fish value chain. With this support, Adili successfully established a fresh fish cold hub at Long'ech. Building on this foundation, the Efficiency for Access Research and Development Fund has continued to support Adili's expansion efforts, including the development and introduction of passive and active cooling solutions in commercial retail markets and in humanitarian settings. The current project focuses on integrating various technologies into the value chain using a human-centred approach, to address the needs of the community while enhancing sustainability and efficiency.

Efficiency for Access is a global coalition dedicated to advancing access to energy and affordable, energy efficient appliances in underserved communities. It is a catalyst for change, accelerating access to off- and weak-grid appliances to boost incomes, avoid carbon emissions, improve quality of life, and support sustainable development. The coalition is co-chaired by UK aid from the UK government via the Transforming Energy Access platform and the IKEA Foundation.

Efficiency for Access is jointly managed by Energy Saving Trust and CLASP.

CONTENTS

Introduction 4

Challenges and Practices of Turkana’s Fisherfolk. 5

Integrating Cold Chain into the Fish Value Chain in Lake Turkana. 7

Active Cooling Operations in the Cold Chain Hub 10

Fishing Timelines12

Adili’s Economic and Social Impact on the Local Community.....13

Lessons Learned: Supply Chain Management14

Addressing the Cold Chain Gaps and Expanding Operations.....16

Key Takeaways.....18

References19



Lake Turkana as seen from the Gulf of Turkana in Long'ech

INTRODUCTION

Lake Turkana, Kenya's largest inland water body, holds significant untapped potential for the country's fishing industry. Despite its capacity to offer over 30,000 metric tons of fish annually, the actual catch from the lake is half its potential, at 15,000 metric tons¹.

Limited use of Lake Turkana is significant within the broader scope of Kenya's fishery sector. In 2022, the fishing industry in Kenya supported the livelihoods of 1.5 million peopleⁱ and generated a total fish production worth USD 290 million (KES 37.6 billion)². Inland water sources accounted for 67% of this production, with Lake Victoria being the predominant contributor at 42%. In contrast, Lake Turkana's contribution was only 8%, despite its vast potential.³

The primary reason for the underuse of Lake Turkana is its challenging location. Located 400km away from the nearest market, Eldoret, the road from Lake Turkana experiences problems with bandits who threaten the safety and security of fish transported from this region.

Economic and resource constraints also lead to conflict over water and pasture. In addition, the region is largely arid, with limited opportunities to sustain local communities. It is highly vulnerable to the increasing impacts of climate change, evident through the apparent paradox of rising lake water levels and increasing aridity in the surrounding areas.

All these factors make many fish landing sitesⁱⁱ difficult to access for market off-takers. Moreover, the misconception that fish from Lake Turkana is slimy and sandy has reduced its demand in the market⁴. Fisherfolk are forced to sell even high valued fish like Nile Perch at low prices, often 50% lower than those from Lake Victoria⁵. Additionally, due to the high temperatures in the region (over 40°C), fisherfolk incur high post-harvest losses which are worsened by poor road connectivity and lack of reliable access to electricity at the landing sites and within the settlements.

i. This figure includes fisherfolk, traders, processors, suppliers, distributors, and retailers.

ii. Fish landing site is where the catch of the day lands and is inspected, weighed, and distributed for further transportation to the market.



Fishing in Lake Turkana

Source: Jacob Fodio Todd, Modern Energy Cooking Services programme

CHALLENGES AND PRACTICES OF TURKANA'S FISHERFOLK

While they are traditionally pastoralists, many fisherfolk in Turkana consider fishing as a secondary source of income. Most use wooden rowing boats for their fishing expeditions, which can take between 8-24 hours. Without any facilities to store the fish during the trips, fisherfolk store their catch on the floor of the boat under open sun or tie it in nets to let the fish swim in the water. These methods, however, present significant challenges, as outlined below.

“We fish at night and store our catch by tying it on a rope and letting it swim in the water. But many fish die in the net due to congestion.”

A 45-year-old fisherman who has been fishing in Lake Turkana for over five years.

“We get strong winds, and the lake becomes rough. Boats have to be docked at the nearest place and by the time we come back to the shore, the fish have already started decaying.”

A 45-year-old fisherwoman who has been fishing in Lake Turkana for over five years.

“Crocodiles are a threat. They eat our fish and sometimes attack us.”

A 25-year-old fisherman who has been fishing in Lake Turkana for over five years.

Market access and storage issues further compound these challenges. Fisherfolk often incur high losses from fish spoilage, sometimes losing fish worth up to KES 30,000 (USD 230) at onceⁱⁱⁱ, due to the lack of buyers, poor market access and lack of cold storage facilities. To avoid these losses, they are forced to sell their catch to the first buyer at the landing site for much lower prices. For instance, fresh tilapia, which sells for KES 350 (USD 3) per kilogram in the market, is often sold for as little as KES 50 (USD 0.39) at the landing site.

As a result, the supply chain of fish in the region caters predominantly to the dry value chain, relying on drying the catch in the sun using traditional methods. This method significantly reduces their market value, with dried tilapia selling for as little as KES 80 (USD 0.62) per kilogram in the market (KES 20 in the landing site), compared to KES 350 for fresh tilapia.

“There are no cooling facilities at the landing site, so fisherfolk have to sell their catch to the first buyer. Many fisherfolk dry their catch while still on the water to get the most out of their fishing expeditions, especially when fishing on the other side of the lake. They dock at the nearest shore, salt and dry the fish over couple of days and return days later with a boat full of dried fish.”

Kimani Gichuche

Executive Director of Adili Solar Hubs

More than 80%^{iv} of the catch around Lake Turkana is dried and stored for self-consumption or sold to local merchants. Some of it is exported to the Democratic Republic of Congo where dried fish is a staple for many communities along the lake regions.

Only about 20% of the fish is sold fresh in the market by the traders. This is primarily because of the limited availability of cooling facilities and the high cost of electricity. A mere 25% of the merchants^v in the area have access to cooling facilities, such as refrigerators, shared cold rooms, and freezers. These are either solar-powered or connected to the national grid. Monthly electricity tariffs for this grid-connected cooling appliances range between KES 18,000 — 20,000 (USD 138 — 154). These high operational costs discourage traders from storing and selling fresh fish, driving most traders to preserve fish by drying.

“If I get cooler boxes, I will shift to the fresh fish business because it is profitable.”

A trader selling fried fish in Kitale, Mbale and Lugulu market.

“Good market and more storage facilities can help this business to grow.”

A trader who has a refrigerator and has been selling fresh fish in Lodwar market.

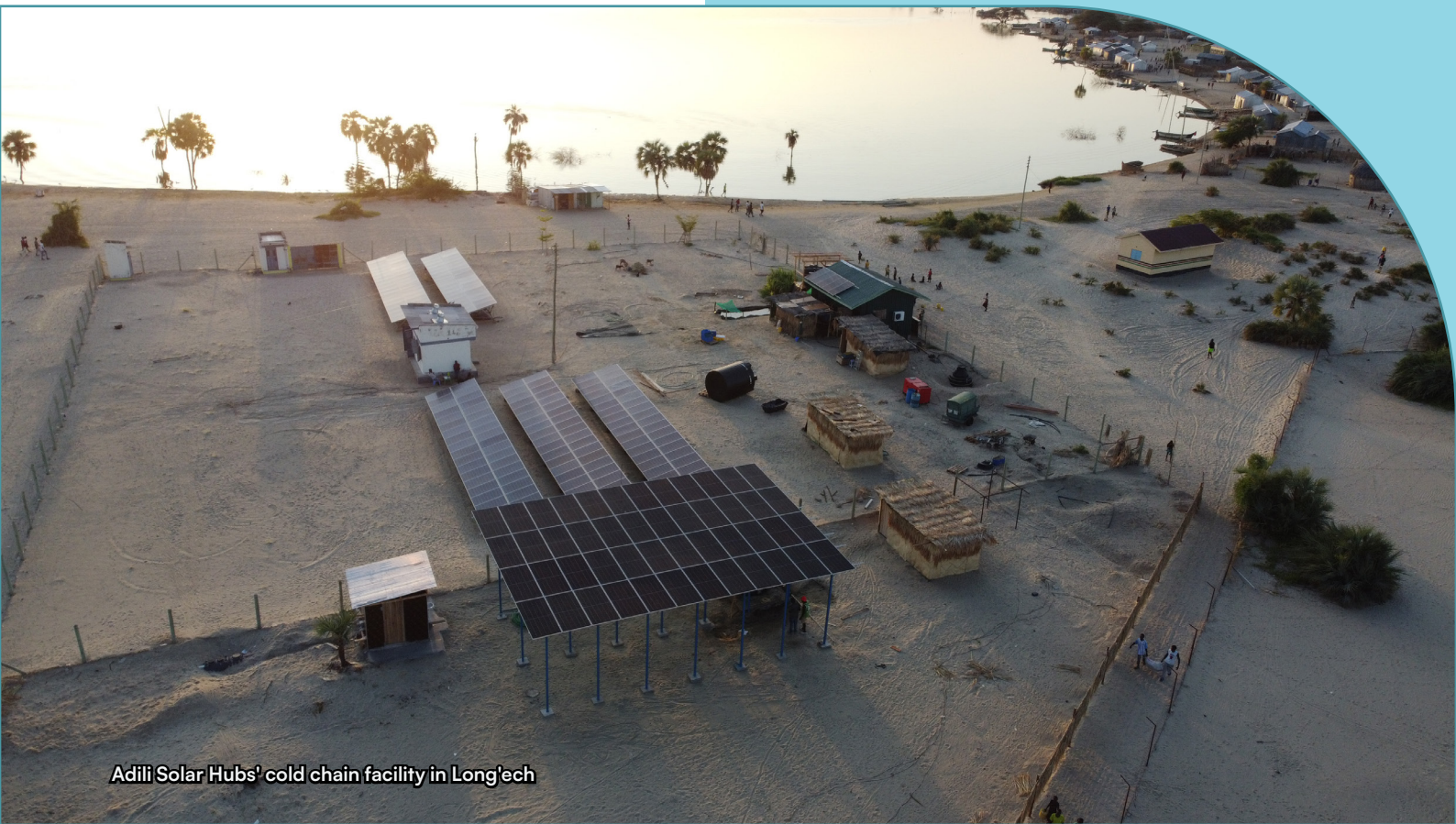


A fisher of Lake Turkana, gutting, salting and drying his catch with traditional methods

iii. Baseline data collected in May 2024

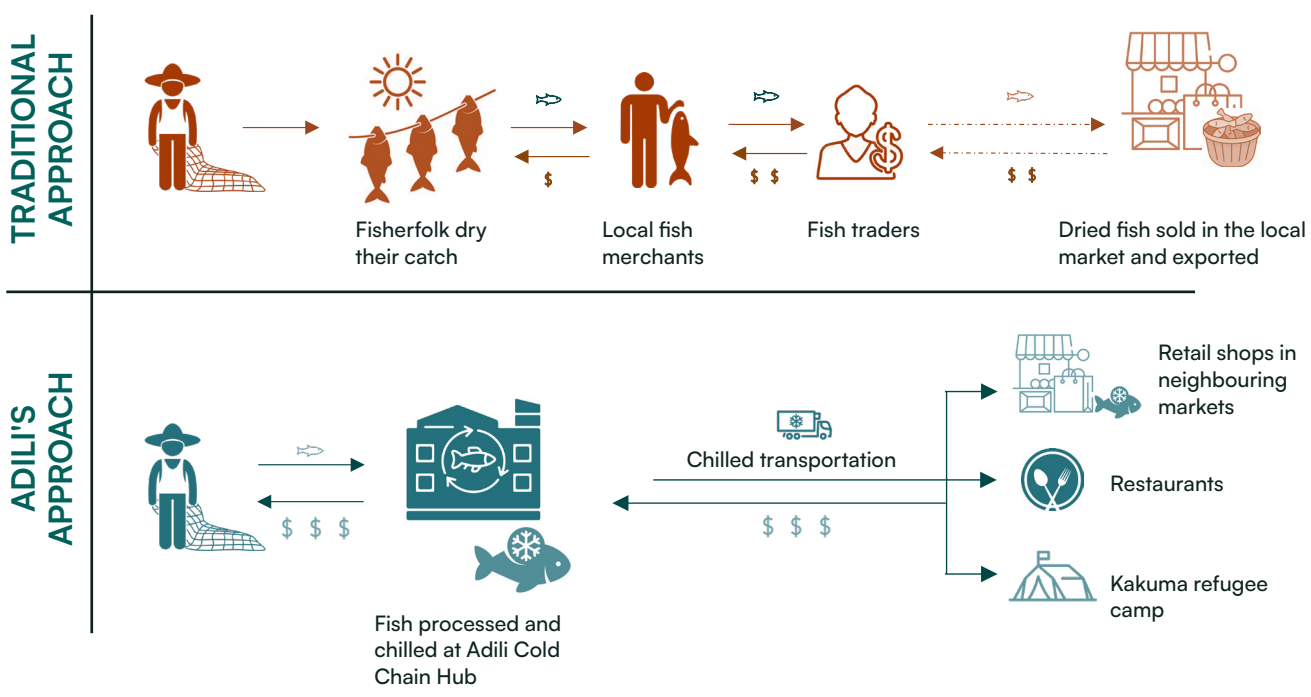
iv. Ibid

v. Ibid



INTEGRATING COLD CHAIN INTO THE FISH VALUE CHAIN IN LAKE TURKANA

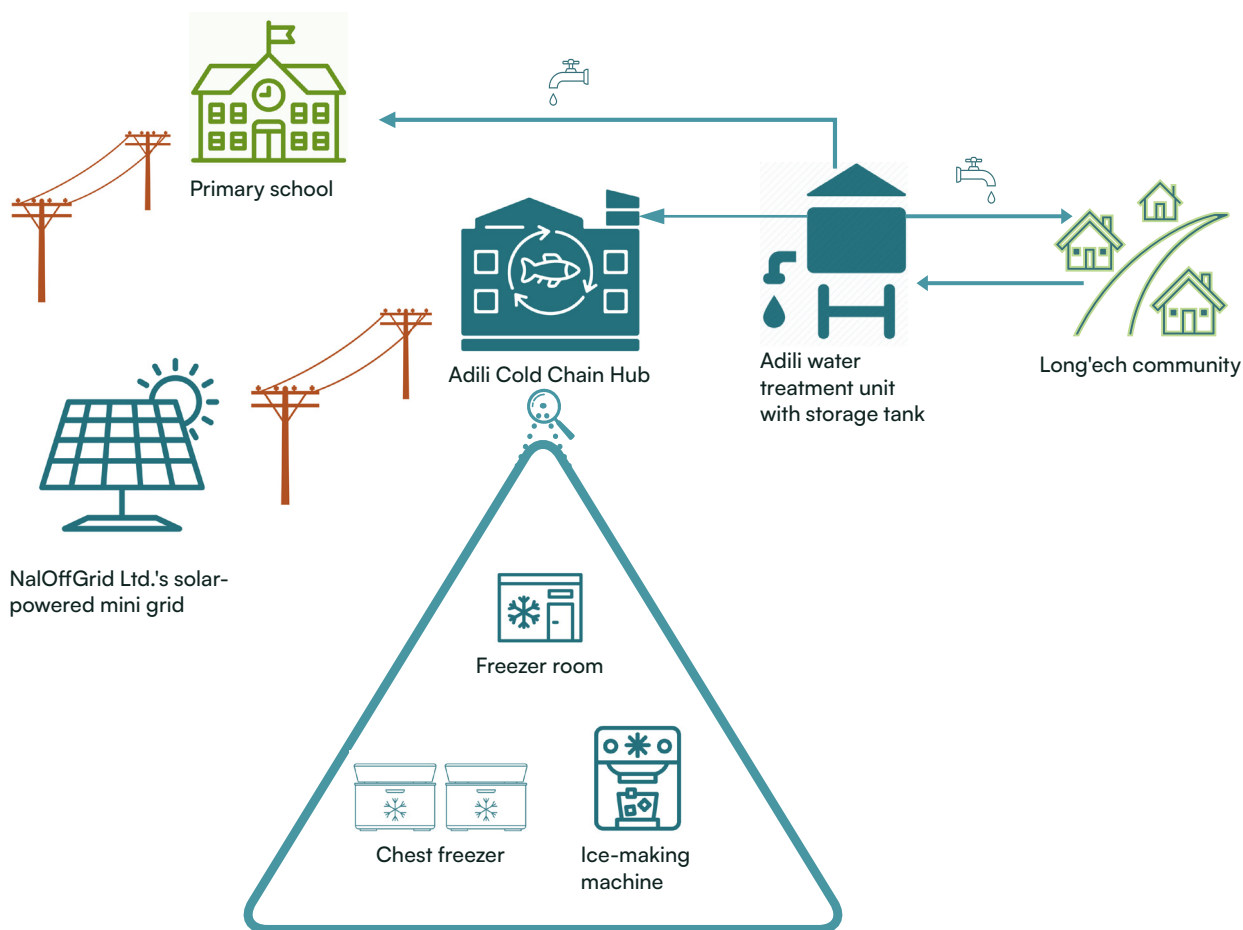
Figure 1: Adili's cold chain approach in fish value chain, Lake Turkana



Founded in 2020 in Turkana, Kenya, Adili Solar Hubs (Adili) is a social enterprise dedicated to transforming the fish value chain in the region, increasing local incomes, and improving the sustainability of the lake's fisheries ecosystem. Despite the high yield potential of Lake Turkana, infrastructural and market limitations in the region have restricted livelihood opportunities for those dependent on the fish value chain. To extend the shelf life of the catch, fisherfolk traditionally preserve fish by salting and sun-drying it in the open. The dried fish is then sold to local fish merchants, who aggregate it from multiple fisherfolk before distributing them to traders in Lodwar, Eldoret, Busia and export markets such as the Democratic Republic of Congo (see Figure 1).

Consumers either buy the dried fish in its original form or dried fish that is fried for immediate consumption^{vi}. To increase income generation opportunities for local communities and enhance the fish value chain in the region, Adili Solar Hubs envisioned a solution involving innovative solar-powered cooling appliances and technologies. This includes fisherfolk selling their fresh catch to Adili, which is cleaned, chilled and stored at its Cold Chain Hub in Long'ech. Some of this fish is frozen and the rest chilled before being transported to restaurants and retailers in Lodwar, Eldoret, and Kakuma refugee camp (see Figure 1). Chilled fish is stored at temperatures just above freezing for retailers who plan to use it the same day. Fish stored at sub-zero temperatures is primarily supplied to retailers who need to store it for longer periods.

Figure 2: Adili's operation in Long'ech in the Gulf of Lake Turkana



Adili Solar Hubs' business model began with setting up a cold chain hub in Long'ech Island, off Ferguson's Gulf of Lake Turkana in 2021 with the support of the Efficiency for Access Research and Development Fund. The fund enabled Adili to acquire a one-ton freezer room^{vii}, two 500L chest freezers and a 500kg ice-making machine. This cold chain hub was set up to sort, clean, process, chill, and freeze the fresh fish for sale to hotels, private schools, and other markets.

Adili constructed its cold chain hub near an existing solar mini-grid in the region. This mini-grid, installed by NAL OffGrid Limited has a generation capacity of 50kW and an energy storage capacity of 100kWh. It supplies power to the entire community, including Adili's cold chain hub and the primary school in Long'ech.

vi. Local eateries and retailers sell dried fish which is fried and served as a small platter for immediate consumption.
vii. This freezer room enables the fish to be stored in negative degree temperatures.

Adili pumps water for its hub from a neighbouring well using a 1.6kW solar water pump. Water in the region is highly saline and contains elevated levels of chloroforms, fluoride and magnesium. To ensure water and ice used for cleaning and storing fish is free from contaminants and impurities, and to prevent damage to ice-making machines from corrosion and excessive wear, Adili has set up a solar-powered water treatment system. This system processes 500L of water per hour through a combination of microfiltration, sand filtration, carbon filtration, reverse osmosis and UV light. In addition to meeting the hub's operational needs, the treated water is made available to the neighbouring school and community^{viii} (see Figure 2) due to the local lack of access to potable water. However, the community's water needs often exceed the plant's processing capacity.

Adili's approach has involved partnering with seven Beach Management Units (BMUs)^{ix} to secure trade access for purchasing fish directly from fisherfolk. This partnership has been built on a business model that ensure BMUs would not incur any financial losses.

Typically, fisherfolk are required to pay a small fee (less than KES 10) to their registered BMU for landing their catch at designated sites, but BMUs often struggle to collect these payments. Adili offered an alternative approach that benefits the BMUs, fisherfolk and Adili alike by offering to buy the fresh catch from the fisherfolk directly at Adili's cold chain hub in Long'ech. By recording every fish landing at Adili's site and sharing detailed records with each of the seven BMUs, Adili ensured transparency. Additionally, Adili ensures payment to BMUs of KES 10 per kilogram for every fish bought from the fisherfolk, ensuring a more reliable and efficient payment process.

By guaranteeing to buy the catch fresh, Adili offers the fisherfolk a market for the fresh fish which didn't previously exist. This intervention can significantly boost fisherfolk's income, increasing their earnings by five times, from a mere KES 50 (USD 0.15) per kilogram to a substantial KES 250 (USD 1.93) per kilogram.



A community member buying clean water from Adili's water treatment facility

viii . Treated water is sold to the community for 1 KES per litre, and provided for free to the neighbouring primary school

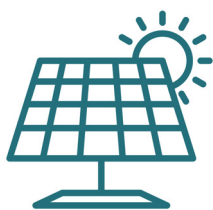
ix. Beach Management Units are civic bodies authorised by the Fisheries Department of Kenya to manage each fish landing site along the coast. It brings together fisherfolk, boat owners, traders and other stakeholders. Any person directly or indirectly dependent on fishing for their income or livelihood becomes a member of the BMU.



An Adili worker moving ice generated by a solar-powered ice maker into a cooler box

ACTIVE COOLING OPERATIONS IN THE COLD CHAIN HUB

Figure 3: Technologies and appliances at Adili's cold chain hub in Long'ech



Mini-grid

Maximum generation capacity: 50 kW
Energy storage capacity: 100 kWh



Adili Cold Chain Hub

Power consumption: 700 kWh per week
Max fish processed: 3.5 tons per week



Adili water treatment unit

Filtration capacity: 500 litres per hour
Water tank capacity: 3000 litres



Freezer room

Capacity: One ton



Chest freezer

Capacity: 500 litres



Ice-making machine

Capacity: 500kg per day

Due to the mini-grid's limited capacity, Adili can only draw power until 4.00 pm daily, consuming around 100kWh per day. After this cut off, the cold chain hub switches to a diesel generator to keep the cooling appliances operational overnight. While retailers need a supply of seven tonnes of fish per week from the hub, current energy limitations restrict its processing capacity to just 3.5 tons of fish weekly. This energy shortfall means the hub cannot meet its ice production demands.

Currently, the hub produces 250kg of ice per day, maintaining a 1:1 ratio of ice to fish, where 1kg of ice is used to process and transport 1kg of fish from the hub to the market. However, to effectively support the fisherfolk, this ratio needs to increase to 3:1. This would enable Adili to sell ice to fisherfolk to preserve fish during transportation from the lake to the hub, in addition to using it for processing at the hub and transportation to the market. Currently, fisherfolk must travel distances ranging from 20km to over 50km to bring their catch to the hub without any cooling.

SUSTAINABLE WATER MANAGEMENT AT ADILI SOLAR HUBS IN LONG'ECH

Adili Solar Hubs is a hub for innovative practices that ensure sustainability and resource efficient solutions, and it goes beyond its cooling initiatives. One such example involves using reject water from the water treatment plant in an integrated aquaculture-agriculture system. As the water pumped from the well goes through the reverse osmosis process, 50% of wastewater is produced.

This wastewater is redirected into a small aquaculture pond with tilapia. Nutrient-rich spillover from the fishpond is subsequently channelled into a nearby watermelon patch, creating a closed-loop system that minimises waste.



Water filtration unit rejects 50% of water as unfit water for consumption.



Water rejected by the treatment plant is pumped into this fishpond which houses Tilapia.



Excess water from the fishpond is directed to a small watermelon patch.

FISHING TIMELINES

Fishing in Lake Turkana is carried out using various techniques, influenced by seasonal changes, fish migration patterns, and community practices. Depending on the technique used, the time spent in the lake varies. Amongst the most commonly used methods are purse seining and set gillnet fishing.

Purse seining is typically used during peak seasons when fish are abundant and schooling near the surface. A net is deployed around a school of fish and then drawn closed at the bottom, trapping the catch. Set gillnet fishing is a technique effective for catching different species throughout the year. It involves setting stationary nets in specific locations, allowing fish to swim into them. Adili's cold chain hub is open 24 hours per day, seven days per week, to enable fisherfolk to come and sell their catch fresh.

Purse seining schedule of William, a small-scale fisher



Day one

5:00am — 6:00am

William starts early, checking his fishing gear and preparing his nets.



6:00am — 7:00am

He rows to the first fishing point, a 15 minute — one hour journey.

8:00am — 11:00am

If the catch is good, he repeats two — six times. If not, he rows to a new site and tries again, continuing this process until the nets are full or he is exhausted.



7:00am — 8:00am

William deploys the net in this spot, pulls it in and collects the fish.

11:00am — 12:00pm

William rows back to the landing site with his day's catch.

12:00pm — 6:00pm

William delivers the fish to Adili Solar Hubs, where it is weighed, graded and he is paid. The fish is cleaned, gutted, descaled and filleted by Adili Solar Hubs, before storing in the freezer room to maintain its freshness until transport.



Final day

6:00am — 10:00am

Cleaned and chilled* fish is packed with ice in cooler boxes and transported from the hub by boat to the nearest road access point in Kalokol.



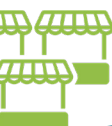
10:00am — 11:00am

At Kalokol, cooler boxes with fish are loaded on to privately operated local transport services.



11:00am — 2:00pm

The local transport service delivers the fish to retailers like Josephine in Kakuma and Kalobeyei markets.



2:00pm — 8:00pm

Josephine fries a portion of the fish delivered for same-day sale and stores the rest in the solar refrigerators.



John's set gillnet fishing schedule



Day one

6:00pm — 6:30pm

John prepares for the night, checking his boat, inspecting his gillnets for any damage.

6:30pm — 7:30pm

He rows to prime fishing spot where fish are expected to pass.



7:30pm — 8:30pm

John casts the nets to trap fish overnight.

8:30pm — 5:00am

John stays on the boat overnight, monitoring the nets and preventing predators from attacking them, while others rest or return to shore.



Day two

5:00am — 7:00am

John pulls in the gillnets, removing fish caught overnight. If the catch is large, another boat transfers the catch to shore, so John can keep fishing.



7:00am — 3:00pm

John delivers the fish to Adili Solar Hubs, where it is weighed, graded and he is paid. The fish is cleaned, gutted, descaled and filleted by Adili Solar Hubs, before storing in the freezer room to maintain its freshness until transport.



Final day

6:00am — 10:00am

Cleaned and chilled* fish is packed with ice in cooler boxes and transported from the hub by boat to the nearest road access point in Kalokol.



10:00am — 11:00am

At Kalokol, cooler boxes with fish are loaded on to privately operated local transport services.



11:00am — 2:00pm

The local transport service delivers the fish to retailers like Josephine in Kakuma and Kalobeyei markets.



2:00pm — 8:00pm

Josephine fries a portion of the fish delivered for same-day sale and stores the rest in the solar refrigerators.



x. For consumers who would like to eat it fresh on the same day.

ADILI'S ECONOMIC AND SOCIAL IMPACT ON THE LOCAL COMMUNITY

Adili's activities around Lake Turkana have significantly improved the earnings of fisherfolk in the area, enhanced market access, and contributed to the long-term sustainability of the fishing activities in the region.

ENHANCED INCOME FOR FISHERFOLK: IMPACT OF ADILI SOLAR HUBS ON FISHERFOLK EARNINGS



MARKET CREATION AND INCREASING DEMAND FOR LAKE TURKANA FISH

By supplying cleaned fish from Lake Turkana, Adili helped dispel the perception that fish from the lake are slimy and sandy. As a result, demand for fish from the area has grown significantly. This increase in demand has not only benefited the fisherfolk, but also traders, transporters, and small-scale processors, who are now part of a more structured and profitable value chain.

ACCESS TO CLEAN WATER

Beyond economic benefits, Adili has also improved access to potable water in the community. Through its water treatment system, Adili provides clean and affordable water to the community at KES 1 per litre, seven times less than other sources. Additionally, Adili supplies treated water to the primary school free of cost.

ENCOURAGING SUSTAINABLE FISHING PRACTICES

With increased demand for fish from Lake Turkana, the local county government has begun improving fish stock management policies. There is growing awareness of sustainable fishing practices, as higher earnings provide fisherfolk with more incentive to adopt responsible fishing methods rather than engaging in overfishing.

Additionally, Adili actively promotes sustainable fishing practices by discouraging the capture of juvenile fish. To reinforce these efforts, the company regularly engages with Beach Management Units (BMUs) to discuss strategies for reducing the catch of juvenile fish.



Adili staff weigh and grade Nile perch

LESSONS LEARNED: SUPPLY CHAIN MANAGEMENT

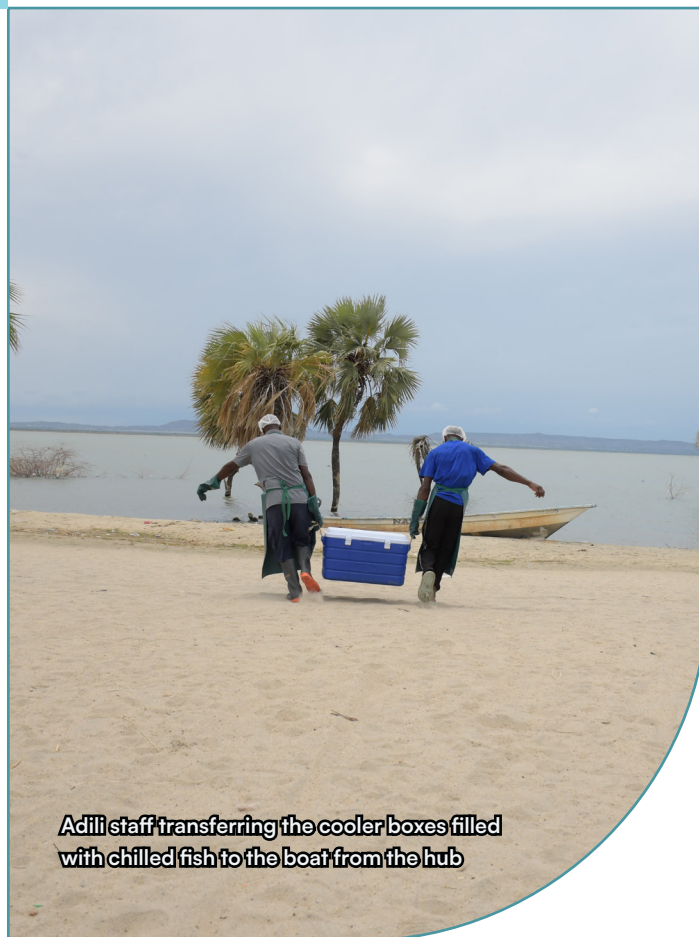
Adili's four years of piloting and operating in Lake Turkana have been a continuous journey of learning and evolution:

TRANSPORTATION

- **Cooler boxes:** Initially, Adili relied on cooler boxes to transport fish and used a third-party courier service to deliver fish to the market. Fish packed in ice was dispatched in cooler boxes at 5pm for overnight travel. However, delays from courier services meant packages only left the courier office at 3 am, causing the fish to reach retailers at noon, missing the lunch peak and compromising quality. Due to these challenges, Adili restricted the use of cooler boxes to nearby markets.
- **Refrigerated vehicles:** Adili experimented with third-party refrigerated vehicles to transport fish from Long'ech to retailers in Eldoret market. Frequent vehicle breakdowns led to reliability issues and losses. To mitigate this, Adili invested in its own refrigerated vehicle.

However, the vehicle's smaller capacity (one ton) restricted transportation to a maximum of two — three tons per week, especially for long trips like the 800km round trip to Eldoret or the 1600km round trip to Nairobi.

- **Fish loss at lake:** Some fisherfolk typically leave to catch fish at 5am, returning eight — 10 hours later (sometimes longer), during which freshness of the fish deteriorates. To reduce this, Adili plans to pilot the supply of cooler boxes to fisherfolk, helping preserve fish quality during these long trips.
- **Tricycle mounted refrigerators:** To sell fresh fish in the Kakuma refugee camps, Adili collaborated with specialist solar refrigerator suppliers^{xi} and youth groups, equipping them with tricycle-mounted solar refrigerators and supplying fresh fish. However, the camp's uneven terrain often caused the tricycle to topple, making navigation difficult and inefficient.
- **Improved transportation:** Transporting whole fish, such as Nile perch, which are larger (averaging 4-4.5 feet), with 50% composition of bones and head, is inefficient.



Adili staff transferring the cooler boxes filled with chilled fish to the boat from the hub

To maximise space and optimise ice, Adili is testing the market demand for fillets, aiming to improve economic viability by transporting only usable parts of the fish.

MARKET SUPPLY TO MARKET DEMAND

- **Supply capacity:** Big retailers in Eldoret, Nairobi and Kitale require a minimum buyable volume of seven tons, but the current capacity limitations of the appliances only allow 3.5 tons of fish to be channelled out of the hub weekly.
- **Retailer network:** There were no ready nearby retailers for fillets and value-added products. Adili's primary clients were market stall retailers, while demand for value added fish products like fillets was limited to supermarkets catering to middle- and higher-income shoppers and international schools.
- **Cash flow:** A significant cash flow was necessary because fisherfolk required immediate payment for their catch, while Adili's off-taker clients made payments over a 60-day credit period.

xi. Technology supplied by SunDanzer under the IFAD grant, implemented by Africa GreenTec.

INFRASTRUCTURE CHALLENGES

- **Retail infrastructure:** Most of the retailers Adili collaborated with did not have cooling sources, so Adili had to equip them with solar-powered chest refrigerators to store the fish. Ownership of these cooling appliances remain with Adili until these retailers source 12,000 kilograms of fish from Adili. The cost of the refrigerators is incorporated into the price of the fish. For instance, if Adili sells one kilogram of fish at KES 330 (USD 2.55), then an additional KES 10 (USD 0.07) is added to the price to cover the cost of the appliances. In the case of a solar refrigerator, the retailer would pay back the total cost of the refrigerator, which is an estimated KES 120,000 (USD 927) in about 18 months.
- **Mini-grid capacity:** The current capacity of the mini-grid only enables Adili to operate its cold chain hub until 4pm. After this time, the hub has to be powered with a diesel generator.

COMMUNITY ENGAGEMENT

- **Local power structures:** Gaining the support of community leaders can be challenging, as some expected monetary compensation to allow the project to proceed. It requires a lot of meeting and negotiations with the leaders to get them to see the value of the project and the long term benefits it would bring the community.
- **Inclusive business approach:** In remote areas, close-knit communities can be apprehensive of outsiders. To build trust, we need to actively engage with the community through public meetings, ensuring transparency and encouraging community participation. Incorporating community input where possible can help strengthen local buy-in and ensure long term viability of projects.

For a comprehensive analysis of cold chain infrastructure across fish and other value chains in Kenya, refer to the 'Assessment of the Cold Chain Market in Kenya'⁶ report by Efficiency for Access.



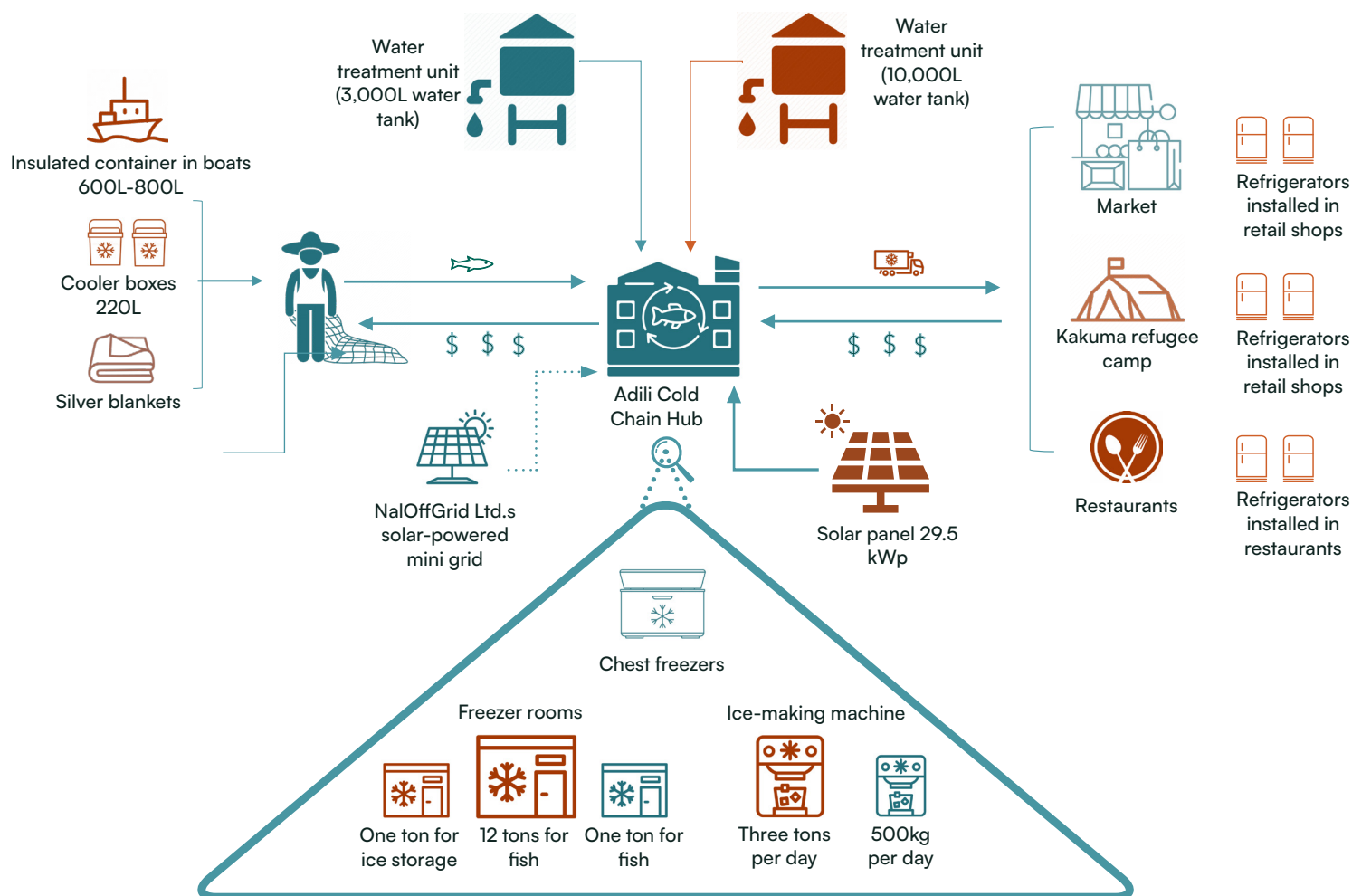
A market trader storing Adili's fish in her chest refrigerator at home

ADDRESSING THE COLD CHAIN GAPS AND EXPANDING OPERATIONS

Adili's initial interventions revealed the significant market potential of Lake Turkana's fresh fish. However, these efforts also exposed critical gaps in the fresh fish value chain that are limiting the scalability of their operations. To address these challenges and expand their operations, Adili has a range of passive and active cooling solutions to make its operations more energy-efficient and effective.

Below is a detailed outline of Adili's expansion efforts at each stage of the supply chain, illustrated in Figure 4.

Figure 4: Adili's current operations (in blue) and its expansion plan (in orange)



COOLING AT THE ORIGIN

The most effective point to reduce spoilage in the value chain is while fish are still on the boats, before the catch reaches the landing sites. To help address this, Adili is piloting low-cost appropriate passive cooling solutions. These include providing fisherfolk with silver blankets to cover the fish stored on the floor of the boats.

A more advanced, though slightly more expensive, approach involves providing cooler boxes with a 220L capacity to individual fisherfolk with smaller boats, and installing insulated containers with 600-800L capacity permanently on larger boats. In addition to testing the effectiveness of these two different capacity cooler boxes designed by the Adili team, this pilot will also test the business model of integrating the cost of the cooler boxes into the price of ice that fisherfolk purchase.

ENHANCING OPERATIONAL CAPACITY

To meet the potential for increased supply from fisherfolk and meet market demand for cleaned fresh fish, Adili is scaling its cold chain hub by adding two additional freezer rooms with 12 ton and one ton capacity to store fish and ice respectively. In addition to the 500kg ice making machine, Adili is equipping the hub with a three-ton ice making machine.

To meet the increased energy generation and storage demands for these new additions, Adili is disconnecting from the NaOff Grid mini-grid and setting up an independent solar energy system, comprising a 29.5 kWp solar PV array integrated with 38.4 kWh of lithium-ion batteries and phase-change materials (PCM). This setup will enable the hub to remain operational overnight. Additionally, Adili will increase the water storage capacity from a 3000L water tank to a 10,000L water tank. These water tanks will be insulated with charcoal coolers and fixed under a shade to reduce the temperature of the water to make the cooling appliance in the cold chain hub more energy-efficient.

EXPANDING RETAIL OUTLETS

Realising that there are no established retailers for fillets and value-added fish products, Adili is establishing its own outlets for selling fillets. While demand for fillets remains low, Adili plans to market one kilogram of Nile perch fillet for KES 800 (USD 6.17), compared to KES 400 (USD 3.09) per kilogram for whole fish. Since half of a Nile perch consists of bones, tails, and the head, selling fillets at this price would not generate any immediate margin for Adili. However, in the long run, cost savings from more efficient transport and the potential for price adjustments will improve profitability.

Additionally, Adili is equipping small restaurants and retailers with solar-powered refrigerators so that they can maintain a steady stock of fish, increasing the volume and consistency of their purchases.

EXPANDING TO HUMANITARIAN SETTINGS

Adili's scale up plan includes tapping the market in the neighbouring Kakuma refugee camp and Kalobeyei integrated settlement⁷. To test the potential of this market, Adili used a tricycle-mounted refrigerator to sell cleaned fresh fish to Kakuma refugee camp through the Vijana Twaweza Youth Group in the camp. This pilot showed promising results with more than KES 600,000 (USD 4,638) worth of fish sold in a year.

Building on this success, Adili partnered with women retailers in Kakuma, equipping them with solar-powered refrigerators and supplying them with fish. Between February and May 2025, this initiative achieved monthly sales of up to KES 500,000 (USD 3,853), with demand consistently outpacing supply.

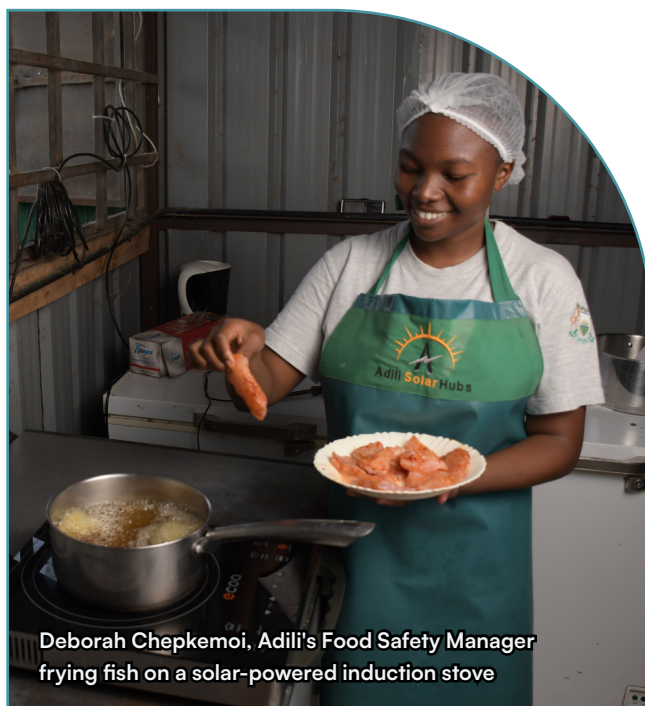
However, expanding into new markets is not without challenges. Adili lost 50% of its sales in June 2025 when a buyer began sourcing directly from local fishers. Adili is now designing strategies to address supply chain gaps and prevent future business losses.

EXPANDING INTO COOKED FISH SALES

There is a strong market demand for fried fish. To meet this demand, Adili is partnering with local retailers and restaurants in Lodwar town to provide them with refrigerators to store chilled fish that can be fried and served to consumers on demand.

Beyond Lodwar, Adili is expanding to Kakuma, where partnerships are being formed with retailers already selling fresh fish. Additionally, Adili is exploring Western Kenyan markets such as Kitale, where butcheries with existing meat storage infrastructure could integrate solar-powered refrigeration to diversify their offering to fish.

Adili is also exploring clean cooking solutions including energy-efficient deep fryers to establish a demonstration centre where fresh fish will be fried and supplied to hotels who use it for stews and other dishes. Further details on Adili's solar e-cooking plans can be found in a blog co-written by Modern Energy Cooking Services and Efficiency for Access⁸.



Deborah Chepkemai, Adili's Food Safety Manager
frying fish on a solar-powered induction stove

KEY TAKEAWAYS

For Entrepreneurs

- **Build Trust:** Partner with key stakeholders such as county governments, BMUs, traders and fisherfolk from the beginning to ensure smoother operations, stronger local support, and better long-term adoption.
- **Invest in Supply Chain Analysis:** Identify critical gaps and develop a phased business model that allows for gradual market entry and adaptation. Adopting cooling solutions in traditionally dried fish value chains requires patience and strategic market building.
- **Apply Financial Models:** Use flexible payment models like lease-to-own schemes or pay-as-you-store to help small-scale retailers and fisherfolk access cooling solutions easily.
- **Introduce New Products Gradually:** New and value-added products should be introduced gradually to the value chain, allowing time to build trust, assess demand, and ensure market readiness before scaling up.
- **Optimise Technical Configurations:** Choose appliances, energy storage solutions, and system designs carefully considering the demand of your operations. Before investing in solar cooling appliances, consult with businesses that have successfully implemented similar operations to gain insights and make informed decisions.

For Investors

- **Invest in Parallel Infrastructure:** Prioritise supporting the development of basic infrastructure, such as establishing cost-effective power source, clean water supply, and efficient transport systems, in addition to securing cooling solutions. While results may not be immediate, addressing supply chain bottlenecks can create a robust and efficient cold chain system.
- **Introduce Long-Term Financing:** Mitigate risks with long-term financing structures and contingency planning. Abrupt funding disruptions can severely impact operations, businesses, communities, and value chains



For Funders and Development Partners

- **Provide Early-Stage Support:** Provide sustained funding to initiatives like Adili Solar Hubs. The Efficiency for Access Research and Development Fund's four years of support has greatly assisted Adili in scaling, developing key partnerships, and refining its business model.
- **Increase Advocacy:** Influence government support and infrastructure development to help create a stronger enabling environment for cold chain expansion.
- **Empower Local Economies:** Invest in regions lacking cold chain infrastructure, like Lake Turkana, to enable economic opportunities for local communities.

Next Steps for Adili Solar Hubs

Adili Solar Hubs continues to refine and expand its innovative cold chain solutions. It is actively seeking financial support to establish five commercial cold storage facilities at remote fish landing sites along the shores of Lake Turkana. These facilities will play a critical role in reducing post-harvest losses, improving fisherfolk livelihoods, and strengthening the local fish supply chain.

[For a closer look at Adili's operational landscape, watch the video here.](#)

To hear insights from Kimani Gichuche, Executive Director of Adili Solar Hubs, [read the interview here.](#)

REFERENCES

- 1 KMFRI (2023). The status of Kenya fisheries: Towards sustainable exploitation of fisheries resources for food security and economic development. Available at: https://kefs.go.ke/sites/default/files/2024-09/FISHERIES%20ANNUAL%20STATISTICS%202023_.pdf
- 2 KEFS (2022). Fisheries statistical Bulletin. Available at: <https://kefs.go.ke/sites/default/files/Fisheries%20Annual%20Statistic%202022.pdf>
- 3 KEFS (2022). Fisheries Statistical Bulletin. Available at: <https://kefs.go.ke/sites/default/files/Fisheries%20Annual%20Statistic%202022.pdf>
- 4 Efficiency for Access, Efficiency for Access Research and Development Innovator Series: Bridging the Gap for the Fish Cold Chain in Lake Turkana, 2024 (United Kingdom: Efficiency for Access). Available at: <https://efficiencyforaccess.org/publications/adili-solar-hubs-improving-fishing-income-without-major-energy-consumption/>
- 5 ENVIU (2023). Review of Fishing Industry in Kenya. Available at: <https://foodflow.enviu.org/blue-horizons-enviu-partnerships-vision-for-sustainable-fishing-in-kenya-unearthed/>
- 6 Efficiency for Access (2023). Assessment of the Cold Chain Market in Kenya. Available at: <https://efficiencyforaccess.org/wp-content/uploads/Assessment-of-the-Cold-Chain-Market-in-Kenya.pdf>
- 7 Efficiency for Access (2024). Empowerment through Appliances: Insights from the Humanitarian Energy Sector. Available at: <https://efficiencyforaccess.org/wp-content/uploads/Empowerment-through-appliances-Insights-from-the-Humanitarian-Energy-Sector-1.pdf>
- 8 Modern Energy Cooking Services and Low Energy Inclusive Appliances Programme (2024). Empowering Turkana: How Adili Solar Hubs Is Helping to Drive Food Security and Economic Growth. Available at: <https://mecs.org.uk/blog/empowering-turkana-how-adili-solar-hubs-is-helping-to-drive-food-security-and-economic-growth/>



CONTACT US

 efficiencyforaccess.org

 info@efficiencyforaccess.org

 [@Efficiency for Access](https://www.linkedin.com/company/efficiencyforaccess)