Kenya
Solar Dryers: Investment Brief

Climate Adaptation Market Opportunities
Agriculture & Food Systems

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GLOBAL CENTER ON ADAPTATION
CGAP
PEGASYS
CHANGING LIVES CHANGING WORLDS

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GLOBAL CENTER ON ADAPTATION

ABOUT THE GLOBAL CENTER ON ADAPTATION

The Global Center on Adaptation (GCA) is an international organisation, hosted by the Netherlands, which works as a solutions broker to accelerate action and support for adaptation solutions from the international to the local, in partnership with the public and private sector, to ensure we learn from each other and work together for a climate resilient future.

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ABOUT AFRICA ADAPTATION ACCELERATION PROGRAM

GCA is providing technical assistance under the Africa Adaptation Acceleration Program (AAAP), a joint initiative launched by the GCA and the African Development Bank in 2021.

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CONTEXT

This investment brief is part of a regional analysis undertaken by the Global Center on Adaptation, developed in close coordination with partners including CGAP and GCA's downstream financial institution partners under the Africa Adaptation Acceleration Program, in collaboration with the consulting firm Pegasys. The analysis identifies and operationalizes climate adaptation investment opportunities in agriculture and food systems across Tanzania, Kenya, Zambia, and the Democratic Republic of Congo. Building on these results, the present brief aims to provide a decision-support resource for commercial banks, microfinance institutions, and other lenders seeking to assess and integrate climate-related risks and opportunities within their agricultural portfolios.

Across agriculture and food systems, climate variability is increasingly translating into material credit risk. Erratic rainfall, rising temperatures, and more frequent extreme events affect yields, input efficiency, and post-harvest outcomes. These impacts weaken borrower cash flows and asset values, with direct implications for both clients and lenders, including deteriorating portfolio performance, elevated non-performing loan ratios, and increased volatility in agricultural lending.

The analytical framework underpinning this investment brief series reframes climate adaptation as a risk-adjusted investment opportunity. It identifies discrete, technology-driven interventions across value chains and assesses their bankability through market sizing, borrower segmentation, and business model analysis. Each brief is structured to align with financial sector requirements, including compatibility with existing lending instruments (e.g. asset finance, value chain finance) and applicability across borrower archetypes such as smallholders, cooperatives, and agri-SMEs.

The investment brief series, focused on Climate Adaptation Market Opportunities in Agriculture & Food Systems, aims to support financial institutions in systematically integrating adaptation into core lending operations, with a view to strengthening client and portfolio resilience while capturing emerging market opportunities.

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INVESTMENT BRIEF: SOLAR DRYERS SOLUTIONS IN KENYA

Executive Summary

Climate risk is now a credit risk in Kenya's agri-sector. Erratic rainfall, rising temperatures, and high humidity are driving significant post-harvest losses (PHL), which can reach as high as 50% for certain high-value perishables. This loss is estimated to cost the Kenyan economy over USD 150 million annually in key horticulture value chains, eroding the repayment capacity and collateral quality of over three million smallholder farmers.

Solar drying technology is a proven fix. As a scalable, low-cost, decentralized solution, it cuts drying time by 50%, virtually eliminates contamination/spoilage, and provides a resilience advantage over grid-dependent electrical dryers. The solution shifts the financial case from simple loss mitigation to clear profit generation, enabling farmers to transform perishable produce into high-margin, shelf-stable products that command a 20-50% price premium. This allows the value protected and new revenue unlocked to form the solid foundation for loan repayment.

The market is large, segmented, and financeable. The Total Addressable Market (TAM) for solar dryers is projected at USD 213 million in 2025, rising to USD 303 million by 2030. The immediate Serviceable Available Market (SAM), targeting early adopters and high-value agri-enterprises, is estimated at USD 5 million in 2025, more than doubling to USD 12 million by 2030. Demand spans four bankable archetypes: Small Holder Farmers, Farmer Cooperatives and Groups, Established Agri-MSMEs and Processors, and Commercial Farmers.

Product fit is straightforward, centred on a Pay-As-You-Save (PAYS) financing model[1]:

- Loan Product: Medium-term asset finance (12-36 months).
- Off-taker Guarantee: Three-party agreement where the off-taker/processor commits to purchasing certified dried produce and remitting the loan portion directly to the bank.
- Quality Assurance: Financing is limited to pre-vetted, certified dryer fabricators.

Borrower economics are compelling. For a mid-sized farmer group, a USD 1,500 dryer can realize USD 1,000–USD 1,500 in net additional annual revenue through PHL elimination and price premiums. This incremental revenue comfortably covers a typical loan repayment, leading to a strong Debt Service Coverage Ratio (DSCR > 1.4). Studies demonstrate a compelling Return on Investment (ROI) ranging between 30% and 70% within the first two years.

De-risking is a strategic move. Financing solar dryers is not CSR; it’s a credit risk solution that insulates the borrower's cash flow from climatically-induced spoilage, stabilizing income and potentially lowering the bank's Non-Performing Loans (NPLs) in its agri-portfolio. Concessional finance from institutions, e.g. the GCF, can be leveraged to blend commercial capital and lower the effective cost of lending.

[1] The Pay-As-You-Save (PAYS) model is a financing mechanism designed to eliminate the upfront cost barriers associated with investing in energy-efficiency improvements (e.g., thermal insulation, electric mobility) or renewable energy projects. In this model, a utility company covers the initial costs of the equipment and recoups its investment over time through a fixed charge on the customer's utility bill. (Playbook of Solutions, 2013).

Development and climate dividends are material. Scaling solar drying enhances **food security**, promotes **gender empowerment** by placing processing control with women-led groups, and achieves **climate mitigation** by displacing fossil fuels and reducing emissions from food waste.

Call to action for banks: Financing quality-assured solar drying now to tap into a growing market, stabilize agri-NPLs, and advance ESG targets. This **low-competition, high-impact entry point** reinforces the core agri-finance business and allows banks to diversify into the profitable, value-added processing segment.

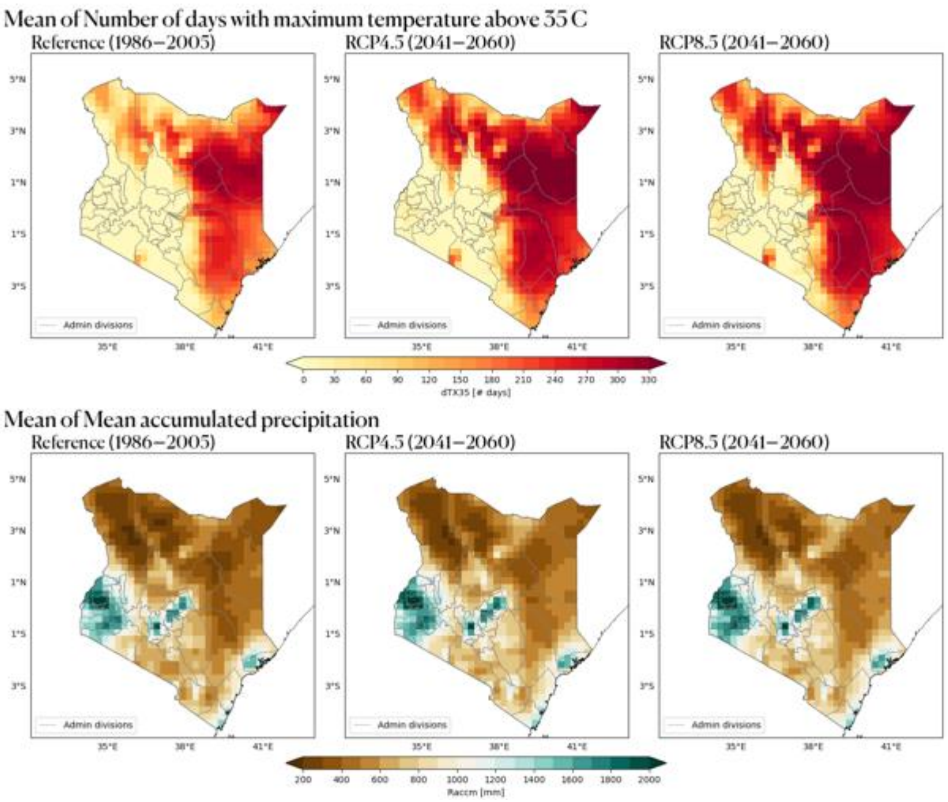
The Adaptation Challenge

The Adaptation Challenge

Kenya's agriculture sector, which contributes significantly to the national GDP (~21%) and employs a vast portion of its population (~40% of the total population and more than 70% of the rural population) (FTMA, 2022), is confronting an accelerating and urgent climate crisis (IFPRI, 2023). Climate change, characterized by increasingly erratic rainfall, rising average temperatures, and prolonged periods of high humidity, is no longer just an environmental issue; it is a fundamental credit risk that threatens the repayment capacity of clients being served by the financial institutions in the agri-sector.

By 2050, Kenya is projected to face severe, regionally differentiated climate hazards dominated by **extreme heat** and **flooding**. Heat will be most intense in the northeastern arid lowlands (Mandera, Wajir, Isiolo), with peak days reaching 45–47 °C, while the western/central highlands will experience the most significant relative warming (up to +2.4 °C). Concurrently, **drought intensity** is set to strengthen to moderate levels across the coast, highlands, and northwest, driven by rising evaporative demand despite localized rainfall increases, necessitating adaptation in newly drought-prone highland areas. The risk of **riverine and flash floods** is heightening due to intensifying short-duration rainfall, particularly in coastal and eastern counties; major river flooding exposure is projected to concentrate in Tana River, Garissa, and Turkana, with Kilifi (249,172 people) and Tana River (29% of its population) facing the highest population risk. Finally, changes in **wind extremes** are projected to be modest overall, with only minor localized increases in the eastern lowlands.

Figure 1: Climate hazard projections for Kenya



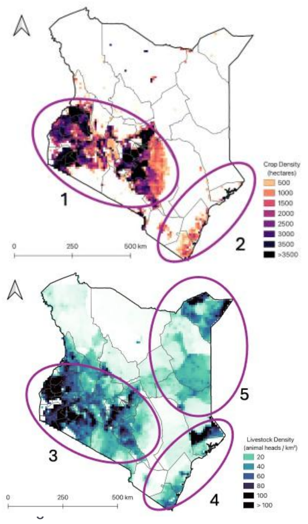
The global context highlights that addressing food loss is a "win-win for food security, climate outcomes, and for commercially driven agribusinesses" in regions facing heightened food insecurity (Wellspring, 2023). The vulnerability is most pronounced in the high-value horticulture and grain chains, where the value of the harvested crop is often destroyed before it can be processed or sold. Between 30 and 40 percent of what is harvested is lost every year" in Kenya, with the country losing at least Sh72 billion (approximately USD 600 million) annually to post-harvest losses. (Linturi, 2024)

Who is affected

The immediate threat is borne by over 4.5 million smallholder farmers (Kenya Ministry of Agriculture , 2019), particularly those cultivating climatically sensitive, high-value perishable crops such as fruits, vegetables, and indigenous herbs (KNBS, 2024). These groups often rely on rain-fed agriculture and lack the capital for high-end processing equipment. The reliance on traditional open-sun drying, which is slow, unhygienic, and vulnerable to sudden rainfall or high moisture, ensures that a significant portion of their income-generating potential is destroyed.

In grain value chains, **maize is typically harvested at a high moisture content** (19% to 25%), which provides ideal conditions for insect infestation and mould growth, **necessitating immediate drying need** to 13.5% or below (Akoko, Degroote, Gathungu, & Ricker-Gilbert, 2021). This is made difficult by high relative humidity and unexpected rainfall in many Kenyan maize-growing regions (Akoko, Degroote, Gathungu, & Ricker-Gilbert, 2021). Furthermore, smallholder grain farmers are highly vulnerable to pests: a study in Eastern Kenya found that **80%** of farmers experienced pre-drying losses primarily due to insects (**48%**), rodents (**40%**), and birds (**39%**) (Njoroge, Baoua, & Baributsa, 2021). This instability is acutely felt by women-led farmer groups and rural Agri-SMEs, who are often responsible for post-harvest management and processing activities (EnDev, 2021).

Figure 2: Kenya Key crop production and livestock areas



1. **Highlands Food Corridor** – *Maize, beans, banana*
2. **Coastal Agro-Pastoral Belt** – *Banana, maize, cassava*

3. **Highlands Food Corridor** – *Chicken, cattle, goats*
4. **Coastal Agro-Pastoral Belt** – *Goats, sheep, chicken*
5. **Northeastern Pastoral Belt** – *Goats, sheep, cattle*

**Key three crop commodities in order of production value ($) or number of heads (livestock)*

Source: IFPRI -CGIAR, Spacial Production Allocation Model, Lobelia Analysis

Systemic impacts

One way to quantify the systemic impact of climate volatility is in **alarming post-harvest losses (PHL)**. Estimates for horticultural losses in Kenya range as high as **50% for certain perishables** (Kilelu C. , Kalele, Omolo, & Ogutu, 2023). According to the National Post-Harvest Losses (PHL) Management Strategy for Kenya, cereal losses range from 12% to 17%, with quality and quantity losses affecting staple grains that are suitable for drying using solar dryers, such as maize and beans. Fruit and vegetable losses, which include high-perishability crops like mangoes and avocados, are estimated to range significantly, often between 20% to 50%, emphasizing the critical need for drying technologies to extend shelf life and reduce losses (National Post-Harvest Losses Management Strategy, Kenya , 2020). This significant loss of farm-gate value directly destabilizes rural incomes, prevents farmers from accessing higher-value export markets due to quality failure, and exacerbates food insecurity. Furthermore, this systemic inefficiency contributes to greenhouse gas emissions associated with food waste, compounding the initial climate challenge (Kilelu, Omolo, & Okemwa, Opportunities and Challenges for Enhancing the Quality of Solar Drying Technology and Agri-enterprise in Kenya - A Policy Dialogue, 2023).

A challenge of adaptive capacity

The critical constraint to resilience is the lack of accessible, climate-appropriate technology. Farmers are trapped between unreliable traditional methods and unaffordable industrial solutions. Traditional open-sun drying fails to meet the speed and hygiene requirements necessary to cope with climate-driven high humidity, especially for high-value crops. **Conversely, mechanical dryers require significant capital investment and reliable, expensive grid electricity or fossil fuels**. Artificial drying with fossil fuels or electricity is expensive and has been estimated at USD 0.02-0.03/kg of raw produce to be dried or about USD 0.20-0.30/kg for dried fruits or vegetables. The need for acquiring and owning solar dryers among farmers has been growing due to the need to reduce high levels of post-harvest losses using low-cost technologies. (ACTS, 2023) **Solar drying technology offers a scalable, low-cost, and decentralized solution that sits perfectly in this adaptive capacity gap**, making the low adoption rate of quality solar dryers a critical constraint on agricultural resilience.

Market Inefficiencies and Suboptimal Investment Context

The failure to scale solar dryer adoption stems from a confluence of market friction points that impede the flow of commercial capital to this adaptation solution.

- **Structural inefficiencies:**
  The primary structural hurdle is the lack of standardized quality among locally fabricated solar dryers. Many small-scale manufacturers and metalworkers lack the engineering expertise to design dryers that meet optimal thermal performance and durability requirements (Kilelu C. , Kalele, Omolo, & Ogutu, 2023). This inconsistency leads to poor performance, limited product lifespan, and, crucially, a lack of trust among potential farming customers. Without established standards, quality certification, and reliable supply chains for durable components (like UV-stabilised plastic), the market cannot transition from a fragmented collection of low-quality prototypes to a mature, commercially viable sector (Gorjian, Hosseingholilou, & Jathar, 2021).

- **Financial barriers:**
  Despite being affordable relative to mechanical dryers, the price point of an effective small-to-mid-scale solar dryer (USD500–USD1,500) still represents a substantial capital outlay for a liquidity-constrained smallholder farmer or agri-micro-enterprise. Commercial banks, perceiving lending for post-harvest assets as high-risk, fail to offer tailored, low-collateral, medium-term finance products. The resulting **affordability chasm** is the most significant barrier to mass adoption, requiring the creation of specialized micro-finance products that better align repayment schedules with agricultural cash flow cycles (ACTS, 2023).

- **Information and capacity gaps:**
  The perception of solar drying is often limited to *loss avoidance* rather than *value creation*. Farmers frequently lack the necessary information, training, and extension services on how to maximize the commercial benefit of dried produce. This includes gaps in knowledge regarding optimal processing techniques, food safety standards, specialized packaging, and market linkages required to sell premium dried products at a significant price premium (Kilelu, Omolo, & Okemwa, Opportunities and Challenges for Enhancing the Quality of Solar Drying Technology and Agri-enterprise in Kenya - A Policy Dialogue, 2023). This deficit in business capacity limits the perceived and actual return on investment, depressing latent market demand.

- **Underinvestment gap:**
  Current agricultural investment, both from development finance institutions and commercial banks, tends to favour inputs (seed, fertiliser) or large-scale mechanisation. However, this investment preference for mechanisation is limited to large commercial actors, meaning there

are generally few sources of capital for **small-scale, decentralized** farm equipment and machinery. This underinvestment gap means there is a critical scarcity of finance that can bridge the gap between technology supply (local fabricators) and end-user demand (smallholder farmer groups), perpetuating market failure in a key climate adaptation domain. The larger leasing companies like RentCo Africa do offer financing for tractors and processing units, but this requires collateral and strong financial standing so only available to more commercial actors and large cooperatives. (FSD Kenya , 2022)

Market Opportunity

The systemic risk of post-harvest loss in Kenyan agriculture creates a highly targetable, financeable market opportunity, one that turns climate adaptation into commercial viability.

From climate challenge to financeable demand

In Kenya, **inadequate drying infrastructure is a major driver of crop spoilage and value loss**, especially for horticultural and cereal value chains. Studies estimate that **poor or delayed drying contributes to more than USD 150 million in annual losses** across maize, cassava, groundnuts, and horticultural produce (Horticultural Crops Directorate (HCD, 2024)). In horticulture alone, as much as **20–30% of produce is rejected at aggregation or export points** due to moisture-related fungal growth, colour degradation, or microbial contamination, issues that originate from uncontrolled open-air drying during humid harvest periods. Similarly, for cereals and pulses, moisture retention beyond safe storage thresholds (>13%) fuels mold and aflatoxin formation, directly depressing farm-gate prices by **10–20%** (KALRO & KEPHIS, 2022)

Solar dryers as the adaptation and market solution

Solar dryers directly address this loss driver, enabling uniform drying and significantly reducing **post-harvest losses in target crops like maize, cassava, and groundnuts** even during wet or overcast conditions. The value preserved, an estimated USD 150 million annually, represents the recoverable "hidden margin" that solar drying can capture and convert into a stable repayment base for lenders.

Beyond preventing loss, solar dryers unlock new revenue streams by allowing farmers and cooperatives to transform perishable produce, such as mango, tomato, and banana, **for which there are growing domestic and export markets**, into shelf-stable, high-value products. **The economic justification for dryers on low-value crops like maize and cassava is primarily through the prevention of significant quality and quantity losses (e.g., from aflatoxins and pests) and access to premium/formal markets with stricter quality standards, where wet-harvested grain is rejected** (Houssou, 2020). Processors using solar dryers report price premiums of 20–50% compared with fresh produce, and shelf-life extensions of up to six months. (Wanzala & Wamalwa, 2023)

This dual benefit, value protection and value creation, turns solar drying infrastructure into a financeable adaptation asset, where every dollar invested preserves multiple dollars of marketable output while improving creditworthiness and cash-flow stability across Kenya's agri-lending portfolios.

Solar dryer typologies and market segmentation

Solar dryers can be categorized into two primary operational typologies: **passive systems**, which rely entirely on natural convection and solar radiation without mechanical assistance or auxiliary energy inputs, and **active systems**, which incorporate fans, auxiliary heating sources (such as hybrid thermal units), or other mechanical components to enhance drying efficiency and control. Within these categories, **three main dryer types serve distinct market segments** across East Africa's smallholder and commercial farming landscape. **Cabinet-type dryers**, typically small passive or minimally augmented systems, offer individual farmers affordable, compact solutions making them accessible to resource-constrained producers. **Greenhouse-style dryers** represent the most versatile and widely adopted typology, functioning effectively as passive systems for smallholders and cooperatives while remaining scalable to agri-MSME and commercial operations through the addition of auxiliary heating and airflow control. **Hybrid solar dryers**, which combine passive solar collection with active heating augmentation and mechanical ventilation, serve commercial-scale operations and high-volume processors requiring consistent product quality and rapid drying cycles, with capacities exceeding 500–1,000 kg daily. This graduated technology spectrum enables market segmentation based on production volume, capital availability, and operational sophistication, with greenhouse dryers serving as the practical midpoint representing the average technology investment across diverse farmer segments.

Among these, **greenhouse solar dryers (GHDs)** are regarded as the best and most versatile solution due to their controlled microclimate, which enhances drying rates, ensures product hygiene, and maintains nutritional quality, making them suitable for diverse crops and livestock like fruits, vegetables, and fish. GHDs operate effectively under both natural and forced convection, allowing scalability from smallholder to commercial levels. Recent innovations in Kenya focus on integrating photovoltaic-powered ventilation and biomass hybridization to address intermittency and improve thermal performance. Biomass hybridization refers to integrating a biomass furnace (burning agricultural residues such as maize cobs, rice husks, or wood waste) as a backup heat source alongside solar collectors to enable continuous drying during periods of low solar irradiance, night hours, or inclement weather. Despite challenges like high initial costs, skill gaps in fabrication, and inconsistent quality standards, GHDs provide favourable economic returns with payback periods often within two years, making them a sustainable and economically viable technology for post-harvest loss reduction and value addition in Kenya's agricultural sector (Gorjian, Hosseingholilou, & Jathar, 2021) (Kilelu C. , Kalele, Omolo, & Ogutu, 2023)

Figure 3: Comparison of three solar dryer typologies: hybrid (left), greenhouse-style (centre) and cabinet-type (right)

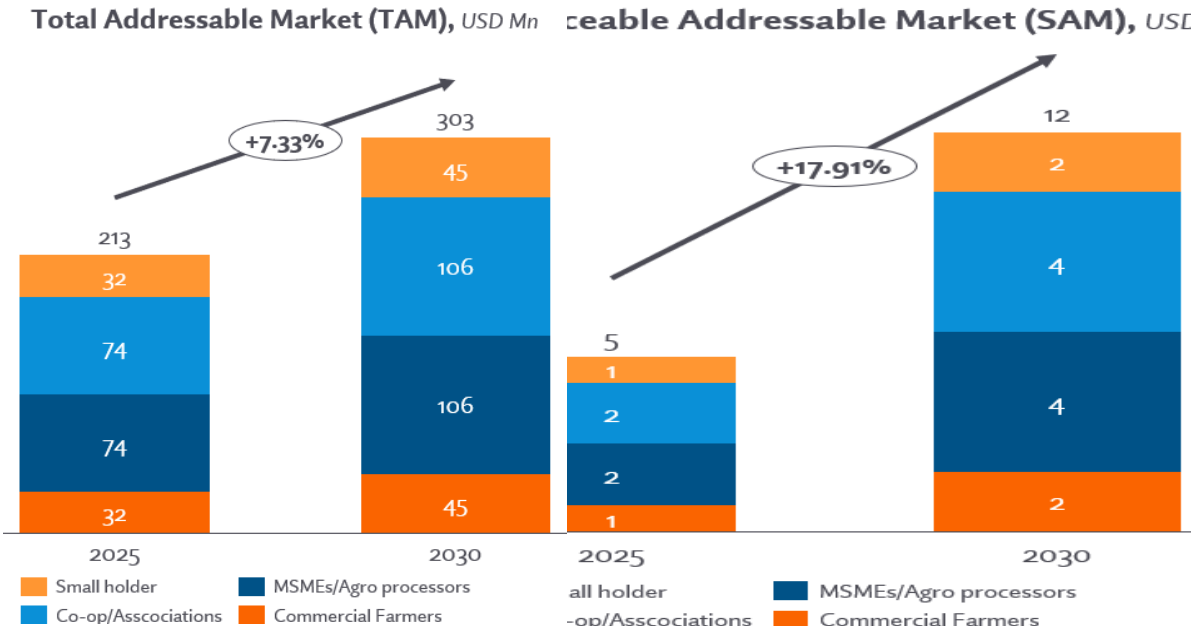
	Hybrid	Greenhouse-style	Cabinet-type
Profile	• **Design & Heating:** Advanced system that combines solar collection with a biomass furnace or electric fans for forced-air circulation, enabling 24-hour operation. • **Capacity & Performance:** Capacity & Cost: Provides the highest throughput (100–1,000 kg) with prices ranging from KES 135,000–1,500,000 (USD 1,038–11,538). • **Operational Trade-offs:** Requires the highest capital investment, has complex maintenance needs, and necessitates a consistent external supply of biomass fuel or electricity.	• **Design & Heating:** Large, transparent, tunnel-like structure that uses passive solar heating combined with natural air circulation. • **Capacity & Scalability:** Offers a medium-to-high capacity (50–180 kg) and costs KES 75,000–250,000 (USD 577–1,923) depending on size. • **Operational Trade-offs:** Initial investment is higher than cabinet models, and drying speed remains weather-dependent with no heating backup.	• **Design & Heating:** Compact, enclosed box-like structure that operates purely on solar or electric passive heating. • **Capacity & Affordability:** Suitable for small batches (10–30 kg capacity) and priced between KES 30,000–100,000 (USD 230–770). • **Operational Trade-offs:** Lacks backup heating, making it highly dependent on sunny weather, which leads to slower drying on cloudy days.

Market sizing and financeable potential

The economic and technological viability of solar dryers translates into a tangible financing opportunity. A preliminary market sizing exercise, modelled using established post-harvest loss data, projects the **Total Addressable Market (TAM)** for solar dryers to reach **USD 213 million in 2025**, rising to **USD 303 million by 2030**. The immediate **Serviceable Available Market (SAM)**, targeting early adopters and high-value agri-enterprises, is estimated at **USD 5 million in 2025**, more than doubling to **USD 12 million by 2030**.

This immense opportunity is underpinned by the critical role of moisture control in post-harvest preservation. While broad **estimates of post-harvest loss (PHL) in Sub-Saharan Africa (SSA) range between 35% and 50%,** a significant and addressable portion occurs during the handling, drying, and storage phases due to insufficient moisture removal and fungal contamination, factors which solar dryers directly mitigate. Crucially, the economic viability of solar drying is highest in high-value value chains, such as Kenya's horticultural sector, where weight losses (often related to spoilage) can peak at 50%. This high loss rate, combined with the high economic value per unit, justifies the investment in solar technology. However, even for low-value staple crops like **maize**, rapid and proper drying is **critical for food safety and public health**, as insufficient moisture control leads to the proliferation of *Aspergillus* fungi and subsequent **aflatoxin contamination**, a major cause of economic loss and health issues in SSA.

Figure 4: Solar Dryer Market Size



Segmenting the opportunity

The market can be segmented based on scale and off-take capabilities:

1. Small Holder Farmers : Targeting home-based value addition for products. (Wanzala & Wamalwa, 2023). This segment requires micro-finance structures bundled with technical assistance and direct off-take agreements to minimize lending risk. Cabinet-type and small greenhouse-style solar dryers with daily capacities of 5–50 kg are most appropriate for individual smallholder farmers, offering affordable entry points (USD 100–500 / KES 10,000–50,000) (ACTS, 2023) with minimal ongoing costs and simple operation requiring no electricity grid connection. Small greenhouse models represent the typical choice for this segment due to their balance of affordability and usable drying space, enabling farmers to dry lower grade produce for value addition without significant upfront capital investment. Aggregate TAM: USD 30-35 million and Aggregate SAM: USD 0.5-1 million (Pegasys estimates)

2. Farmer Cooperatives and Groups: This segment requires mid- dryers for collective use. Greenhouse-style and medium-capacity hybrid dryers with daily drying capacities of 200–500 kg (costing KES 150,000–400,000 / USD 1,250–3,300) (Energypedia , 2022) are optimal for farmer cooperatives and groups, enabling cost-sharing, service provision to members at reduced rates, and sufficient volume to generate revenue through community drying services. The greenhouse model has emerged as the standard typology for cooperatives, offering proven operational simplicity and reliable performance compared to more complex hybrid systems, while maintaining adequate capacity for sustainable revenue generation. They offer reduced individual risk, pooled collateral, and the ability to aggregate volume to meet off-taker demands. The Serviceable Obtainable Market (SOM) for these units is projected to exceed 50,000 units by 2027 (KEREA, 2022). Aggregate TAM: USD 72-76 million and Aggregate SAM: USD 1-3 million (Pegasys estimates)

3. Established Agri-MSMEs and Processors: These clients have existing market linkages and require robust, debt-financed solutions to scale up their production capacity. Hybrid solar dryers and larger greenhouse-style systems with capacities of 500–1,000 kg daily (costing KES

750,000–1.6 million / USD 6,000–13,000) (ACTS, 2023) are best suited for agri-MSMEs seeking to establish commercial drying and value-addition operations. While hybrid systems offer superior consistency through auxiliary heat sources, greenhouse dryers represent the most cost-effective and versatile option at this scale, enabling MSMEs to process volume efficiently while maintaining quality control and generating sufficient revenue to support debt servicing on financed equipment. **Aggregate TAM:** USD 72-76 million and **Aggregate SAM:** USD 1-3 million (Pegasys estimates)

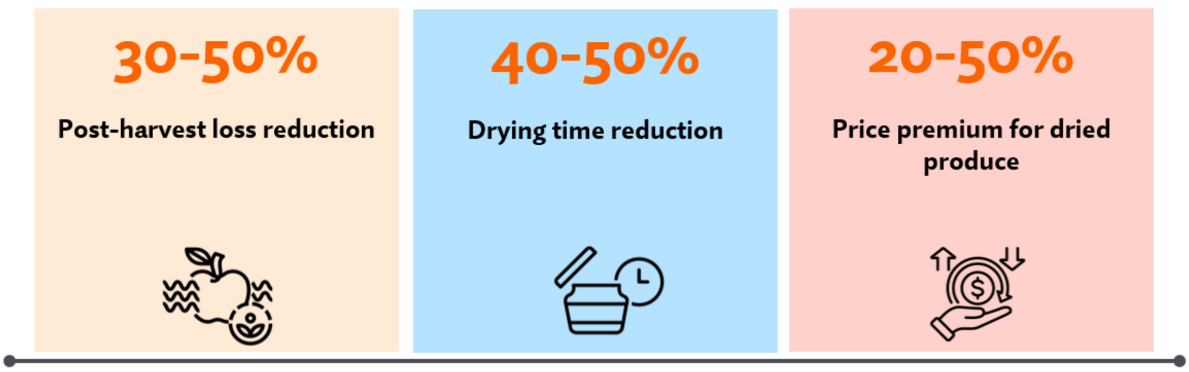
4. **Commercial Farmers:** Requiring large-scale to industrial solar-hybrid or greenhouse dryers for industrial, year-round operation. Large-scale dryers with capacities exceeding 1,000 kg daily, complemented by large greenhouse variants with ancillary heating systems, represent solutions for commercial farmers seeking automated controls and integration with processing and export supply chains. While hybrid systems justify the highest capital investment through superior consistency, large greenhouse dryers remain a viable, cost-efficient alternative for commercial operators processing substantial volumes of dried products for premium market access and rapid capital recovery. These farmers aim to serve both domestic and international export markets and require consistent input volumes and quality. **Aggregate TAM:** USD 30-35 million and **Aggregate SAM:** USD 0.5-1 million (Pegasys estimates)

Technical and Commercial Viability: A Proven Solution, Not a Pilot

Solar drying is a technically mature solution in tropical environments. The investment focus is not on piloting the technology, but on professionalizing its fabrication, standardizing its quality, and providing accessible finance for its deployment.

- **Competitive Positioning**
  Solar dryers possess a decisive competitive advantage over alternatives in rural Kenya. Compared to open-sun drying, they **cut drying time by 50%** and virtually **eliminate contamination and spoilage,** consistently achieving quality standards necessary for premium or export markets (Romuli, Schock, Nagle, Chege, & Müller, 2019). Compared to **mechanical dryers, the key competitive edge is the near-zero operating cost** and the inherent **resilience against power grid failures and volatile fossil fuel prices**, making it the most sustainable and economically viable solution for decentralized, rural processing.

Figure 5: Competitive Positioning of Solar Dryer Technology



- **From value protection to value creation**
  The true commercial viability lies in the technology's ability to facilitate a market shift. For cassava farmers in Busia, for instance, solar drying enables the production of high-quality, aflatoxin-free chips or flour that attract significantly higher prices and open doors to commercial markets previously inaccessible due to quality concerns (Wanzala & Wamalwa, 2023). This capacity to

extend shelf-life from days to months allows farmers to strategically hold products until off-peak demand seasons, achieving substantial price premiums. By leveraging these premiums, smallholder farmers increase income by up to 50% with solar drying adoption. (ACTS, 2023) Studies on high-value produce have demonstrated a compelling Return on Investment (ROI) ranging between 30% and 70% within the first two years of adoption (Juma, Lwambok, & Ochieng, 2022).

Business Model and Value Proposition for Financial Institutions

The optimal path to scale involves embedding solar dryer finance within a structured value chain approach, leveraging group borrowing to manage risk.

Target Client Segments

The primary initial targets should be well-organized Farmer Cooperatives and Aggregator SMEs that already have verifiable cash flow and established market channels. Priority value chains should focus on high-demand, high-export-potential commodities, such as certified cocoa, maize, and high-value horticulture. These commodities demonstrate robust global market demand, offering reliable returns.

For instance, an Aggregator SME specializing in certified cocoa for European markets provides a model with easily verifiable, strong cash flow, which directly reduces lending risk (AfDB, 2023). In Kenya, examples of successful farmer organizations that fit this model include the Mwendi Kurima Cooperative Society, which collectively grows and markets carrots, cabbages, and peas under contract with multiple exporters like Sereni and Flamingo, securing premium prices for its 350 members (Daily Nation, 2020). Similarly, Abossi Top Hill Cooperative Society demonstrates strong market linkages through off-take agreements for high-iron beans (PABRA, 2022).

These clients provide a collective guarantee, shared collateral, and an immediate, verifiable increase in throughput volume, which translates to a reduced lending risk. Secondary targets, particularly women-led micro-enterprises, can be accessed through micro-finance channels with strict off-take agreements acting as synthetic collateral (EnDev, 2021).

Business Model: Solar Dryer Finance

The most effective approach is a Pay-As-You-Save (PAYS) financing model, where loan repayment is explicitly linked to the income realized from the value-added dried product.

- Loan Product: Asset finance loan with a medium-term tenure (12-36 months).
- Off-taker Guarantee: Loan structure includes a three-party agreement where the off-taker/processor commits to purchasing the certified dried produce, remitting the loan portion directly to the bank via mobile money before paying the farmer the residual income.
- Quality Assurance: Financing is strictly limited to pre-vetted, certified dryer fabricators who provide a comprehensive warranty and technical training, mitigating asset quality and performance risk (Kilelu C. , Kalele, Omolo, & Ogutu, 2023).

Unit Economics and Cash Flow Models

Consider a mid-sized farmer group purchasing a solar dryer for approximately USD1,500. By eliminating 30% PHL on a high-value crop and achieving a 20% price premium through better quality, the group can realize a net additional revenue of USD1,000–USD1,500 annually (Juma, Lwambok, & Ochieng, 2022). A 24-month loan at a commercial agri-interest rate of 15% would require monthly payments of roughly USD72. The monthly repayment obligation is easily covered by the incremental revenue generated by the asset, leading to a strong Debt Service Coverage Ratio (DSCR > 1.4) and a net positive cash flow for the farmer group from day one.

Strategic and Commercial Rationale for Banks

Financing solar dryers is not a peripheral Corporate Social Responsibility (CSR) activity; it is a strategic maneuverer that reinforces the bank’s core agri-finance business by fundamentally addressing climate risk.

- A Credit Risk Solution Disguised as an Adaptation Investment
  Climate volatility is destabilizing farm income and driving up Non-Performing Loan (NPL) rates in the agri-sector. By financing solar drying technology, the bank is financing a tool that insulates the borrower's cash flow from climatically-induced spoilage. The investment, therefore, serves as a crucial risk mitigation strategy for the bank's entire agri-portfolio. It stabilizes the borrower's income stream, creating a more predictable repayment environment and potentially lowering overall NPLs (IFPRI, 2023).

- Profitability and Portfolio Diversification
  Solar dryer finance serves as an effective entry point to capture a loyal, high-growth client segment, the newly resilient Agri-SME. Once a farmer group transitions from a PHL-afflicted model to a profitable value-added processor, they graduate to requiring more sophisticated financial services, including working capital loans, insurance products, and long-term expansion finance. This initial investment allows the bank to diversify its portfolio into the higher-margin, value-added processing segment, moving beyond traditional input financing.

- Alignment with Green and ESG Finance Mandates
  The technology directly contributes to global climate goals: adaptation (reducing loss from climate change) and mitigation (displacing fossil fuels and reducing emissions from food waste). This dual impact makes solar dryer financing highly attractive for leveraging concessional finance from institutions like the Green Climate Fund (GCF) or accessing dedicated Green Bond funds. Banks can therefore use this product to blend commercial capital with cheaper development finance, offering competitive interest rates while fulfilling rigorous Environmental, Social, and Governance (ESG) reporting requirements.

- A Low-Competition, High-Impact Market Entry Point
  The market for dedicated solar drying finance is currently underserved and fragmented. A commercial bank that develops and scales a proprietary, quality-controlled, value-chain integrated finance product will secure a first-mover advantage. This high-impact intervention provides a tangible, visible commitment to climate resilience, enhancing the bank’s brand and attracting strategic partnerships with development organisations seeking to scale clean technology in Kenya.

Development and Climate Impact Benefits

Kenya's agricultural sector, the backbone of its economy, faces critical challenges posed by climate variability and high post-harvest losses, which can account for up to 40% of the food produced. These losses directly undermine national food security and erode farmer incomes. Investing in decentralized, clean-energy solutions, specifically solar drying technology, represents a vital and immediate intervention. This technology offers a robust, sustainable pathway not only to mitigate waste and improve nutritional outcomes but also to achieve broader goals related to economic empowerment, market stabilization, and climate resilience.

The deployment of solar drying technology generates broad-based socio-economic and environmental returns that justify the support of blended finance and Technical Assistance (TA).

- Enhancing Food Security and Reducing Post-Harvest Losses
  Solar drying directly addresses the primary pathway of food loss in Kenya. By rapidly reducing moisture content and preventing contamination, the technology safeguards nutritional value and reduces the prevalence of mycotoxins like aflatoxin, thereby improving public health and providing a year-round supply of high-quality food products (Romuli, Schock, Nagle, Chege, & Müller, 2019).

- Gender Empowerment and Inclusive Growth
  Women bear the brunt of post-harvest labour and are the primary agents of food processing in rural settings (EnDev, 2021). Solar dryers reduce the time and physical drudgery associated with traditional drying, freeing up women's time for other income-generating activities or education. Crucially, by placing the processing technology directly under the control of women-led groups, it gives them control over the high-margin revenue from the dried, value-added products, leading to clear, measurable economic empowerment.

- Economic Efficiency and Market Stability
  The technology extends the market window for high-value perishable goods, allowing farmers to sell during off-peak demand seasons when prices are highest. Effective drying has enabled farmers to triple their incomes when selling dried fruits and vegetables. (Africa Business Communities, 2025) This strategic market access stabilizes farm-gate prices and smooths the seasonal income fluctuations, building greater household economic stability and resilience against supply shocks (HCD, 2024).

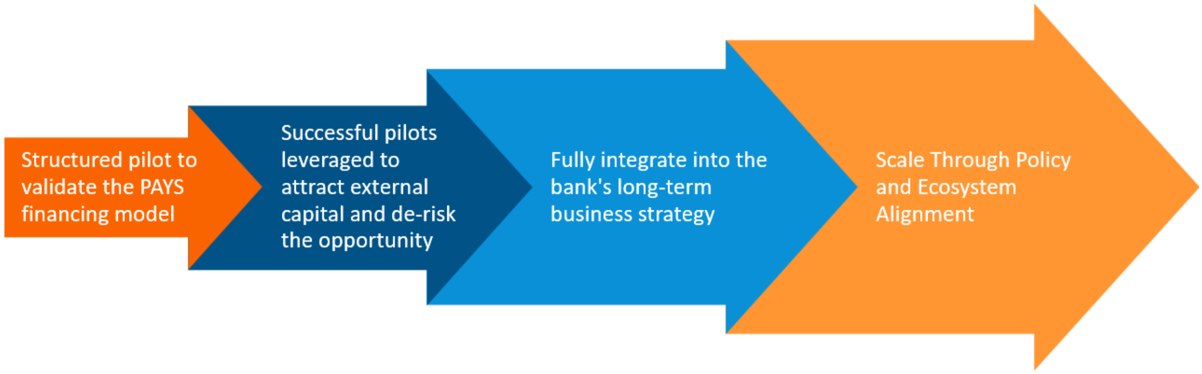
- Environmental and Climate Co-Benefits
  By exclusively utilizing solar energy, the technology displaces the use of fossil fuels (diesel or kerosene) often required for mechanical drying, resulting in a direct reduction in carbon emissions (Kilelu, Omolo, & Okemwa, Opportunities and Challenges for Enhancing the Quality of Solar Drying Technology and Agri-enterprise in Kenya - A Policy Dialogue, 2023). The reduction in food waste also cuts down on emissions associated with the decomposition of discarded crops, contributing meaningfully to climate change mitigation.

- Alignment with National and Global Goals
  This investment is in direct alignment with Kenya's ambitious climate targets outlined in its Nationally Determined Contribution (NDC), which emphasizes clean energy and climate resilience in the agricultural sector. It also supports the government's food security agenda and key pillars of the Agriculture Sector Development Programme (ASDP-II) by promoting value addition and commercialization.

Implementation and Scaling Pathway

This document outlines a four-phased Strategic Implementation Plan designed to revolutionize post-harvest financing by integrating the Pay-As-You-Save (PAYS) model for solar drying equipment. The primary goal is to establish solar dryer finance as a core, de-risked asset within the bank's agri-lending portfolio, thereby enabling measurable climate adaptation for small and mid-sized farmers. The strategy progresses systematically from initial pilot validation and technical training (Step 1), through securing co-financing and quantifying climate impact (Step 2), to finally achieving full product integration and favourable policy alignment (Steps 3 & 4), ensuring sustainable scale and positive environmental outcomes across the national ecosystem.

Figure 6: Scaling pathway for Solar Dryers in Kenya



Step 1. Pilot Lending and Demonstration Projects

The first phase must be a structured pilot to validate the PAYS financing model.

- Action: Launch a nine-month pilot in 3-4 high-potential counties (e.g., Busia, Kitui, Machakos) that targets established farmer groups for 100-150 certified, mid-sized solar dryers.
- Requirement: Partner with certified local fabricators and a specialized non-governmental organization (NGO) or Business Development Service Provider to provide bundled technical and business skills training, ensuring product quality and market linkages are established *before* the loan is disbursed.

Step 2. Aggregation and Co-Financing Partnerships

Successful pilot results will be used to attract external capital and de-risk the portfolio.

- Action: Coordinate with concessional finance providers (e.g. GCF, AfDB) to secure a co-lending or first-loss guarantee facility that covers initial scaling risk and lowers the effective cost of capital.
- Requirement: Quantify the climate impact (tonnes of PHL avoided, carbon savings) using a transparent measurement and reporting system to meet the mandates of climate-focused investors and attract green capital inflows.

Step 3. Embed Adaptation Lending in Core Agri-Finance Products

The product must be fully integrated into the bank's long-term business strategy.

- Action: Mainstream solar dryer finance as a standard, eligible asset within the bank's existing green finance, MSME, and agricultural asset loan categories.

- **Requirement:** Update the bank's internal credit scoring to positively weight the installation of certified post-harvest technology, recognizing it as a direct credit risk mitigation tool and allowing for better, risk-based pricing.

Step 4. Scale Through Policy and Ecosystem Alignment

Sustained scaling requires a supportive national ecosystem.

- **Action:** Advocate for the development and enforcement of mandatory quality standards for solar drying equipment through the Kenya Bureau of Standards (KEBS) to protect consumers and enhance market trust (Kilelu C. , Kalele, Omolo, & Ogutu, 2023).

- **Requirement:** Leverage alignment with national development plans (such as the ASDP-II) to secure public-private partnerships that may involve tax incentives or subsidies for certified solar drying equipment, drastically reducing the final price point for farmers.

Impact Tracking Integrate key KPIs into lending programs, loss reduction (%), repayment rate (%), and value preserved (USD), to measure adaptation impact and attract green capital inflows. The effectiveness of adaptation investments must be measured not only by initial uptake but by tangible outcomes linked to financial stability. To address this, key performance indicators (KPIs) for lending programs must integrate A&R outcome measurements that the bank can directly link to both credit risk reduction and customer resilience.

A&R Outcome Measurements for Financial Institutions:

Resilience Component	Outcome Metric (Customer Resilience)	Financial Translation (Bank Risk Reduction)
Reduced Sensitivity	**Loss Reduction (%):** Decrease in yield/asset loss from climate shocks (e.g., drought, flood) compared to a control or baseline, demonstrating reduced operational sensitivity.	**Reduced Probability of Default (PD):** Stabilized borrower cash flow, leading to improved repayment rate (%), lower default risk, and fewer restructured loans.
Increased Adaptive Capacity	**Value Preserved (USD):** Increase in market value of collateral or productive assets (e.g., livestock, equipment, harvested crops) due to protective measures (e.g., cold storage, irrigation).	**Reduced Loss Given Default (LGD):** Higher recoverable value of collateral and faster post-shock recovery time, minimizing potential loan losses.
Systemic Stability	**Access to Services (%):** Percentage of customers retaining access to critical services (e.g., digital advisory, energy, water) immediately following a major shock.	**Portfolio Stability:** Lower covariance of defaults across the portfolio during climate events, reducing systemic risk concentration.

Integrating these key A&R outcome measurements, such as **Loss Reduction (%)** and **Value Preserved (USD)**, into lending programs is essential. This not only allows the bank to internally track de-risking benefits but also serves as the necessary evidence base to attract concessional or green capital inflows from external investors who require demonstrable climate impact. This approach aligns with frameworks from organizations like GOGLA, which emphasize measuring the positive adaptation and resilience impact of investments to drive scale.

RESOURCES

This brief directly builds on the following technical reports:

- GCA (2026), Market Study to Identify and Quantify Adaptation Investment Opportunities in Agriculture and Food Systems: Tanzania, Kenya, Zambia, DR Congo. Developed in cooperation with partners including CGAP, and consulting firm: Pegasys.

Relevant bibliography and selected resources used for these technical reports include:

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