The Lab
Global Innovation Lab
for Climate Finance

SMALLHOLDER FORESTRY VEHICLE

INSTRUMENT ANALYSIS
SEPTEMBER 2018

Smallholder Forestry Vehicle

LAB INSTRUMENT ANALYSIS
September 2018

DESCRIPTION & GOAL —
The Smallholder Forestry Vehicle establishes a new forestry asset class by aggregating thousands of small-scale forestry projects into one investment vehicle, enabling forestry companies working with smallholder farmers to access long term finance and scale up their operations. Smallholder farmers improve their climate resilience by building long-term savings, diversifying income sources, and restoring degraded land.

SECTOR —
Forestry, smallholder agriculture

PRIVATE FINANCE TARGET —
Institutional investors, private equity investors, impact investors, forestry and conservation investors

GEOGRAPHY —
For proof of concept: Kenya
In the future: Greater East Africa (Ethiopia, Mozambique, Rwanda, Tanzania, Uganda)

The Lab identifies, develops, and launches sustainable finance instruments that can drive billions to a low-carbon economy. It is comprised of three programs: the Global Innovation Lab for Climate Finance, the Brasil Innovation Lab for Climate Finance, and the India Innovation Lab for Green Finance.

AUTHORS AND ACKNOWLEDGEMENTS

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1. CONTEXT

Smallholder forestry can enhance Africa's domestic wood supply, while providing long-term savings and income diversification to farmers and helping countries meet their climate change and land restoration commitments.

700 million hectares of Africa's land are degraded, and three million hectares of forest are lost annually,[1] contributing to a significant proportion of the continent's greenhouse gas emissions and reducing the resilience of communities to drought, flood, and other climate changes.[2] To address these challenges, 30 of 48 Sub-Saharan African countries included land use, land use change, and forestry actions in their Nationally Determined Contributions to the Paris Agreement. The African Union has mandated the restoration of 100 million hectares of degraded land by 2030, with forestry on degraded agricultural land expected to play a significant role.[3]

At the same time, as African economies grow and urbanize, demand for industrial wood products is expected to increase an estimated 5-7% annually (Criterion Africa Partners, 2017). Without accompanying increases in domestic wood production, the continent will need to rely on imports and further exploitation of natural forests to meet its needs. Yet currently, just 10,000 hectares of new industrial plantations are established annually, compared with a need for over 300,000 new hectares each year (Criterion Africa Partners, 2017). Furthermore, the establishment of new plantations is extremely difficult and costly, due to competition with the agricultural sector for land (FIM, 2015) and the potential for conflict over land use rights (Chamshama and Nwonwu, 2004). Finding large swaths of available land is difficult at best (Criterion Africa Partners, 2017).

Increasing the prevalence and productivity of smallholder forestry in Africa presents a critical opportunity to meet the continent's needs. Smallholder forestry is typically conducted on portions of smallholder farming plots, usually marginal or unused land.[4] At less than 20% of the cost of traditional plantations, and with high income potential and development impact (Criterion Africa Partners, 2017), smallholder forestry can also help countries meet targets associated with land restoration and climate change, and improve trade balances.

To date, few examples of smallholder forestry have been deployed at scale. The Smallholder Forestry Vehicle proposes to fill this gap.

[1] http://afr100.org/content/afr100-overview
[2] See, e.g., https://www.brookings.edu/wp-content/uploads/2016/08/global_20160818_cop21_africa.pdf, https://www.unenvironment.org/regions/africa/regional-initiatives/responding-climate-change,
[3] http://afr100.org/content/afr100-overview
[4] See, e.g., https://induforgroup.com/future-trends-in-smallholder-plantation-forestry/.

CONCEPT

2. INSTRUMENT MECHANICS

The Smallholder Forestry Vehicle packages tree production partnership contracts with thousands of smallholder farmers and sells them to investors, providing farmers and forestry companies with access to low-cost, long-term finance while enabling institutional investors to access sustainable forestry investments.

The typical lifecycle of a greenfield forestry investment includes three distinct stages, each carrying different risks:

1. Establishment: This stage includes securing land, seedling procurement (including nursery operations), and planting. A typical plantation investment entails high upfront costs for land purchases, while smallholder forestry entails lower upfront costs, as land use is compensated either through rent or payments at harvest. This is the riskiest stage of a tree's life, as trees have the highest mortality rates for the first 12-18 months from planting.
2. Growth: The bulk of the lifecycle is for the biological growth of the trees, which varies by tree species and environmental conditions, and lasts a minimum of 7-8 years for the fastest growing species. The risks during this period are primarily tree mortality events, such as disease and fire, as well as slow tree growth.
3. Harvest: Once trees reach maturity, they are harvested, processed, and sold to end customers. The biggest risks in this phase relate to the ability of the company that owns the trees to cost-efficiently harvest, transport, and process the trees, as well as market volatility in demand and prices.

The Smallholder Forestry Vehicle proposes to make smallholder forestry in Africa commercially viable by separating the risks from the longest, yet least risky growth stage, from the risks of the establishment and harvest stages, thereby reducing the overall costs of capital. It will do so by establishing a Special Purpose Vehicle (SPV) that will purchase young tree assets from an operating company (the "Company") that originates tree production contracts with smallholder farmers, and then will sell back the tree contracts to the Company prior to harvest (see Figure 1).

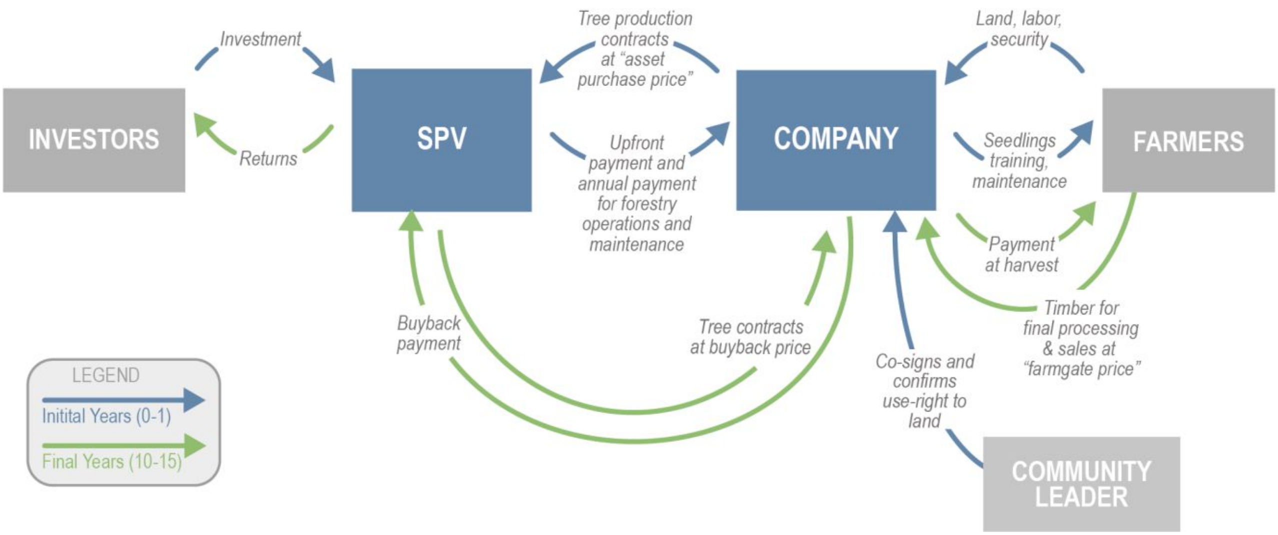
2.1 ESTABLISHMENT

Prior to planting, the Company will work with farmers and their communities to assess land suitability and secure land use rights for tree growing. The land consists of unused, degraded portions of smallholder plots. Once enrolled, farmers contribute land and labor, and are paid a market price for harvested trees. The Company provides training, planting inputs, maintenance support, harvesting services, and a guaranteed market for the trees.

2.2 GROWTH

The Company sells a portfolio of tree production contracts to an SPV after approximately one year of tree growth (after the highest tree mortality period), in exchange for an upfront payment that compensates the Company for its initial investments in the tree production (e.g., nursery, planting, and recruitment of farmers). Each SPV portfolio will

Figure 1: The Smallholder Forestry Vehicle instrument mechanics



comprise 1-3 vintage years of tree contracts. The SPV will be financed by debt and equity investors (see Section 2.4). The proceeds from investors will finance the maintenance of the trees until harvest as well as enable the Company to scale its operations and plant more trees sooner than without the investment. Cash flows are driven by the tree vintages included in the SPV, thinning regime, and harvesting cycles.

The SPV contracts with the Company for the ongoing maintenance of the trees. In addition, to improve tree growth rates, the Company will thin out and sell weaker trees periodically (e.g., once every 3-4 years), creating revenue for both farmers and the SPV. Other impact-related revenues could also be sought to increase interim cash flows, such as the monetization of climate adaptation benefits.

The SPV will be a closed-end vehicle with a duration of 12 years, with possible extension of 2-3 years. The SPV is managed by an Issuer, which will be the Company or its affiliate. The SPV will require a separate accounting system, and the tree assets will be valued by an independent evaluator to determine a fair transfer price. The SPV will also need to pay for independent audits and secure a back-up servicer in case the Company fails prior to the end of the vehicle term.

2.3 FINAL HARVEST AND SALES

The Company will buy back the tree production contracts prior to final harvest using short-term working capital, at a fair price calculated with valuation methods agreed at initial investment. The Company will retain a flexible, three-year window during which to buy back the contracts, either through a single purchase or in several installments to smooth capital needs. The Company is then responsible for harvest, farmer compensation, transport, processing, and final market sales.

Farmer compensation is set by a transparent algorithm that establishes a minimum compensation price, but rewards farmers for better-than-expected tree growth and market prices. In this way, smallholder farmers accumulate wealth similarly to a savings plan, by maintaining tree assets and receiving payments at thinning and harvest. The partnership also helps farmers in semi-arid regions diversify their crop portfolio. By providing non-climate dependent income and diversification, the partnership thus reinforces farmers' climate resilience.

2.4 TARGETED INVESTORS

For the first SPV, the "proof of concept facility", investors will be offered several options for investment (Table 1). The Vehicle's structure allows a broad array of private and public investors to participate according to their risk appetites and impact orientation. In addition, a strategic corporate investor – such as a multinational forest products buyer – will also be targeted, which will help demonstrate a path to market for the final products. Following the proof of concept, SPV size as well as debt and equity returns will increase, thus attracting larger, commercial investors, such as pension funds and commercial banks.

Table 1: Investment opportunities in the proof of concept facility

Investment Type	Description	Targeted Investors
Debt	Senior debt to target ~8-12% interest rate	Institutional investors especially family offices, Conservation, agriculture, and forestry investors, Impact-oriented funds, Development finance institutions
	Concessional debt or repayable grants to target 0-4% interest rate	Donor agencies, Program related investments
Equity	Mezzanine to target higher risk and returns	Family offices, Conservation, agriculture, and forestry investors, private equity, Impact-oriented funds, Strategic corporate investor
	First-loss equity for demonstration	Concessional donors, Operating Company
Guarantee	Guarantee on debt principal to achieve lower interest rate and demonstration effect	Development agency

2.5 TARGET GEOGRAPHY

The instrument will first be deployed in coastal Kenya in Kilifi and Kwale counties, the site of the Proponent's current operations and one of the poorest rural regions in Kenya (Chen et al, 2008). The frequency and severity of droughts in East Africa, and Kenya specifically, as well as the intensity of extreme precipitation and flooding, are expected to increase (RoK, 2016a). The Proponent's current operations are located in an area of high vulnerability to climate change (see Annex 3 for a map of Kenya's climate change vulnerability). The Proponent plans to increase operations in Kenya, and is also considering expanding into neighboring markets, including Ethiopia, Mozambique, Rwanda, Tanzania, and Uganda.[5] Kenya alone has targeted the restoration of 5.1 million hectares of land by 2030, with 1.8 million hectares identified as suitable for farm forestry (ROK 2016b, see Annex 3 for map).

3. INNOVATION

3.1 THE SMALLHOLDER FORESTRY VEHICLE OFFERS A COMPREHENSIVE SOLUTION TO BARRIERS TO INVESTMENT

The Smallholder Forestry Vehicle is the only investment mechanism that enables private investors to invest in smallholder forestry in Africa, while also reducing capital costs for forestry companies that provide technical support and market linkages to smallholders.

To understand the Vehicle's innovation, the Lab analyst team examined 36 different financing vehicles in agriculture, energy, forestry, and microfinance, including funds, bonds, securitizations, and corporate-financed out-grower schemes (See Annex 1 for detailed list). Specifically, the Lab found the following:

The Vehicle fills a crucial gap in Africa, where extremely limited investment is occurring in forestry. Investments in the forestry sectors in Latin America and Asia are 8-10 times higher than in Africa, with plantation establishment investment essentially negligible in Africa and highly reliant on development finance institutions (Criterion Africa Partners, 2017). Of the forestry financing vehicles the Lab reviewed, there was only one other vehicle serving Africa, the Africa Sustainable Forestry Fund managed by Criterion Africa Partners, a private equity fund focused mostly on brownfield investment in existing plantations and downstream processing companies. While a small number of out-grower schemes are financed by large corporations and publicly funded extension schemes, no other investment approach focuses on scaling smallholder forestry through innovative finance.

The Vehicle improves results through a strong cooperation model between an operating company and farmers. While smallholder forestry is more cost effective than greenfield and brownfield plantation investments, smallholder forestry schemes often fail because they are not developed in cooperation with businesses that provide access to harvesting, transport, value-added processing equipment, technical know-how, and market access, resulting in lower productivity and poorer product quality (Criterion and Indufor, 2017; Maurice et al., 2017; Chamshama and Nwonwu, 2004). The Vehicle is based on such a cooperative model.

The Vehicle reduces transaction costs for investors and reduces some risks of plantation forestry. Because investments in individual smallholder plots are typically too small compared to the due diligence costs required for direct investment (Credit Suisse and McKinsey, 2016), the Vehicle instead permits individual investors to invest in an aggregated vehicle. This approach also allows diversification across a wider geographic area than a single plantation, reducing risk of fire and disease, and reduces the land conflicts that can occur in

[5] Criteria for expansion include NDC alignment, Economic & population growth, Timber shortage (or export opportunity), farmers with surplus idle land, lack of large plots for plantations, stable business climate, access to large markets, potential partnership opportunities, and regulatory/political environment.

plantation forestry.[6] The few similar forestry aggregation investment vehicles that the Lab studied, such as the Tropical Landscape Finance Facility's Sustainability Bond for rubber in Indonesia,[7] were focused on plantation forestry, or were in other sectors with shorter maturities, such as agriculture and energy.

By segregating the risks of the individual tree assets from those of the Company, the Vehicle can achieve a lower cost of capital while attracting a broader diversity of investors to participate, than the Company could achieve through traditional balance sheet finance. This is especially important as there is little low-cost financing available at the long maturities needed for forestry in Kenya and other developing countries (CIF and WBG, 2013).[8] In addition, the lack of sufficient financial track records in most early-stage businesses is a significant barrier to investors (Campanale 2009, Credit Suisse and McKinsey 2016, Winn et al. 2009, Petley 2007, Nolan et al. 2013).

By purchasing the Company's least risky assets (e.g., trees after 1-2 years of growth), the Vehicle can be a lower-risk investment than the Company itself, which may be of particular interest to long-term investors, such as pension funds that are typically more risk averse and seeking to match their long-term liabilities with their assets. As a less risky investment, the Vehicle could also benefit from a lower cost of capital than the Company itself, though this would depend on transaction costs and risk mitigation (Section 3.2). BBOXX, a distributed renewable energy company in Kenya, has been able to raise far greater sums of capital at a lower cost by offering a similar solution to investors.[9]

3.2 CHALLENGES TO INSTRUMENT SUCCESS

To attract private investment at scale, the Vehicle will have to demonstrate that the risks it carries – notably tree growth and operating company risks – can either be reduced or effectively mitigated. Table 2 describes these risks and accompanying management strategies.

Table 2: Challenges to instrument success and suitable management strategies

Challenge	Description	Management Strategy
Tree Growth Risk	Risks that trees do not reach targeted growth due to, e.g., fire, disease, and side-selling.	The Vehicle's proponent has developed the following strategy to align farmer incentives with high tree growth: 1) good contract design; 2) community leader involvement and approval of land use; 3) a strong economic value proposition; and 4) technical assistance. Other risk mitigation strategies could include purchasing fire insurance and over-collateralizing the SPV by including extra trees.

[6] For a case study of conflict, see, e.g., https://www.oxfamnovib.nl/Redactie/Downloads/Rapporten/cs-new-forest-company-uganda-plantations-220911-en.pdf
[7] http://tlffindonesia.org/rlu-transaction/
[8] Banks in Kenya, for example, themselves mostly have access only to short term capital (Miller, 2018) and capital markets are under-developed (Gichuki et al., 2014).
[9] See, e.g., http://www.bboxx.co.uk/bboxx-secures-15million-investment-to-bring-solar-power-to-more-households-in-africa/. While there are important differences to note in the BBOXX securitization, we consider this an important proof point that securitization-type transactions are possible in Kenya and can achieve the objectives sought by the Smallholder Forestry Vehicle.

Operating Company Risk	Risk that the Company is not able to buy back the trees at a fair price	The Vehicle's proponent is focused on maturing their business, for which it is raising corporate finance separately. The development agency guarantee, and first loss equity will help mitigate these risks in the first SPV. The Company will also need to identify a back-up servicer for the SPV to step in, in case of bankruptcy. While the Company and investors will play the central role in coordinating the investment vehicle, it is also important to protect the interests of farmers. In the actual term negotiations, the Company and investors will agree on clauses to protect the rights and benefits of farmers in the case of default. Furthermore, it may also be an option for impact-oriented investors to decrease their share of economic returns to increase farmer payment.

MARKET TEST AND BEYOND

4. IMPLEMENTATION PATHWAY AND REPLICATION

A US$ 35 million proof of concept facility can demonstrate risk-adjusted returns for investors and can be followed up with SPVs of around US$ 50-100 million every 3-5 years.

4.1 PROOF OF CONCEPT FACILITY

The proof of concept facility seeks to raise US$ 35 million to purchase 5,000 hectares of trees, including US$ 21 million in commercial debt, concessional debt, and repayable grants, backed by a full principal guarantee, and US$ 14 million in equity financing comprised of both senior and junior equity. In addition, the Proponents seek US$ 800,000 to fund the SPV set-up costs. The Proponent considers the first SPV to be the highest risk, given the Company's early stage and the nascent domestic timber market.

The tree species purchased by these funds will be *Eucalyptus Grandis Camaldulensisi* and the Kenyan native species, *Melia Volkensi*, the species currently planted by the Proponent. The Proponents expect that a large portion of the final timber products will be utility and construction poles sold into the domestic market. Finally, the SPV could include one small portfolio of earlier vintage of trees (e.g., 8- year old trees) to help prove the concept sooner than the full tree growth cycle. The SPV will be registered in Kenya.

4.2 PHASING OUT PUBLIC FINANCE

Once the concept is proven, the Company will seek to launch follow-on vehicles every 3-5 years, each around US$ 50-100 million in size and covering 7,000-15,000 hectares of planting at a time. Future SPVs will seek to minimize the need for concessional capital and increase returns as tree growth and unit production costs improve over time, risks are reduced, and a track record is established.

4.3 IMPLEMENTATION PATHWAY

Setting up the first SPV can take up to 12-18 months, to implement accounting and monitoring systems, conduct technical due diligence including finalizing the vehicle's structure, and setup the legal arrangements for the first time (Table 3). However, follow-on vehicles will be easier to set up, and can reduce the timeline to about six months.

Table 3: Implementation Pathway

Implementation pathway until launch of SPV	4Q18	1Q19	2Q19	3Q19	4Q19
Hire accounting expert & develop accounting IT system needed to separate out financial flows and assets					
Hire legal arranger & conclude legal structure and business model					
Define the tree portfolio that will be included in the SPV					
Define the buyback pricing mechanism					
Secure additional risk-mitigation measures					
Select a back-up servicer in the case of Company default					
Prepare to collect data needed to establish track record					
Register SPV					
Secure a guarantor					
Secure debt and equity investors					

The Vehicle is under development by Komaza, a smallholder forestry company in Kenya with more than 10 years' experience in partnering with 14,000 smallholder farmers, over half of whom are female, to plant and harvest 3,800 hectares of trees (see Annex 6 for further information about Komaza).

The Proponent has already made important steps towards launch, including securing support from The Nature Conservancy for early-concept development and a grant from Partnerships for Forests to fund technical due diligence activities, and being shortlisted in the Green Climate Fund's global request for proposals for a guarantee, concessional debt, and a technical assistance grant. The Company has also begun to compile information on potential arrangers and legal firms.

5. IMPACT

5.1 QUANTITATIVE MODELING

The proof of concept facility will finance the restoration of 5,000 hectares of degraded farmland and provide more than 16,000 farmer households with over US$ 1,200 of climate resilient savings, helping to meet Kenya's Nationally Determined Contributions for climate change and Sustainable Development Goal 15.

To test the financial feasibility and impact of the Vehicle, as well as the value add that public finance can provide, the Lab undertook illustrative modeling. Conservative assumptions were used throughout, due to the long timeframe of the investment and early stage nature of the Proponent's business.[10] The Lab modeled both a proof of concept facility that aims to demonstrate the business case, as well as a scaled-up follow-on Vehicle (see Annex 2 for detailed results and assumptions).

Proof of concept facility

For the proof of concept facility, the Lab modeled a 12-year vehicle financed by 60% debt and 40% equity. As a central scenario, the Lab assumed a 6% average interest rate for debt and a buyback price that is ~30% greater than estimated costs. Some cash flows prior to buyback are generated through thinning in the fourth year as well as the inclusion of a small share of older trees in the facility that are sold in year 3. Based on these assumptions, the facility achieves a gross internal rate of return (IRR) of 11.1% and an equity IRR of 11.4%.

Impact of public funds

The most significant sensitivities to returns of the facility are tree growth rates, the buyback price of trees paid by the Company, as well as the cost of debt. Therefore, the Lab focused on the impact that public funds have on these variables.

Concessional debt and/or repayable grants, and a guarantee for senior debt providers is needed to achieve an average cost of debt of 6% to prove the concept. Commercial debt offered by Kenyan banks is shorter term and averages 16%, which does not allow for equity returns for the central scenario of the proof of concept facility (Tradingeconomics, 2018).

A first loss equity tranche will protect downside risk from low tree growth and a lower-than-expected buyback price. In the central scenario, tree growth can be 23% less than expected, and equity investors will still be able to recover their initial investment. A first loss equity tranche of 50% of total equity would protect other investors from up to 57% lower-than-expected tree growth. Equity investors without a first loss tranche recover their initial investment at a buyback price 25% lower than the central scenario, while a first loss equity tranche of 50% of total equity protects senior equity investors down to a buyback price 35% lower than expected.

Follow-on SPV

The Lab analyzed a subsequent SPV of US$ 105 million with 15,000 hectares planted, which shows a 17% gross IRR for the SPV, with an 18.5% equity IRR for investors. The analysis assumed 16% higher tree growth, 10% lower costs, 10% higher buyback price for investors, and an 8% interest rate on debt. Public finance in the form of a guarantee would likely still be required to achieve the lower interest rate in the near term, which is similar to recent investments such as Climate Investor One[11] and the Sustainability Bond for rubber in Indonesia[12], which have succeeded in attracting institutional investors.

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[10] Pricing assumptions are based on Komaza's empirical studies as well as other external research in forestry economics. While the model assumes a single USD/CBM price for simplicity, Company and investors should consider multiple product lines in reality, which require different size, quality, and thus price of logs. The pricing of tree assets should also be carefully assessed by a third-party auditor.

[11] https://www.climateinvestorone.com

[12] http://tlffindonesia.org/rlu-transaction/

5.2 ENVIRONMENTAL AND SOCIAL IMPACT

The Vehicle has the potential to generate important climate resilience benefits.[13] Kenya's National Adaptation Plan outlines twenty adaptation actions and sub-actions, seven of which the Vehicle addresses directly or indirectly. Most importantly, the Vehicle will enhance climate resilience through two primary routes: first, the Vehicle will increase ecosystem adaptation through the restoration of degraded land. **The proof of concept facility will plant 5,000 hectares of trees on unused, marginal land.** In addition to helping reduce local temperatures and absorb water from flooding, land restoration improves soil quality, water retention, and increases wildlife habitat (RoK, 2016a). The land restoration impacts also closely align with Sustainable Development Goal 15, "Life on Land," which focuses on land degradation and sustainable forest management.[14]

The Vehicle will also improve socioeconomic resilience by helping smallholder farmers absorb the shocks of climate events. **The Lab's modeled results show that the proof of concept facility will reach over 16,000 farming households and provide additional income of over US$ 1,200 per household**, with these numbers increasing to 50,000 households and nearly US$ 1,500 per household, respectively, for the full-scale follow-on SPV.[15]

Box 1: Contributing to knowledge and action on impact

While land restoration and forestry have been clearly identified in Kenya's adaptation, land degradation, and climate mitigation targets, there are to date no protocols or certifications for demonstrating contribution to these targets from smallholder forestry. The Lab looked at a number of different impact frameworks (see Annex 3) and spoke with multiple experts to understand the key issues, and has attempted to describe impact indicators conservatively.

The implementation of the instrument could be an important contributor to establishing clearer protocols and impact indicators that could be replicated by others. In partnership with a research institution or non-profit organization, and with additional technical assistance funding, the project could track the impacts of tree planting on smallholder plot soil quality, water retention, and agricultural productivity, and the impact of different tree species and weather on these variables. The technical assistance funding could also help establish impact protocols that could be adopted by other companies and certification bodies. With the assistance of Lab members, the Proponent has already identified several potential partners for this effort.

The Proponent should also adopt and publish transparent protocols for avoiding negative impact of tree growth – for example, requirements to plant trees a minimum distance from water sources.

[13] The Lab did not consider climate change mitigation benefits for two reasons: As deforestation in Kenya is largely driven by fuelwood needs, and avoided deforestation claims typically require action at the policy and multi-stakeholder level, we did not consider avoided deforestation as an impact of this vehicle. Mitigation from sequestration by the trees and soil is possible, but controversial among impact experts given that the trees are eventually harvested.

[14] https://sustainabledevelopment.un.org/sdgs

[15] This income is comparable to a savings account, one that will continue to grow even in the event of drought and flood and compares to average hectare-weighted annual cash income of US$ 2,819 for smallholder farmers in Kenya (or ~US$ 940 for 0.3 hectare average plot size for the Vehicle). The additional income can be used, for example, for education or other investments. Adjusted for growing periods and plot size, SAPPI, a smallholder

The Proponent's internal modeling suggests: positive IRRs for farmers, even under conservative assumptions including opportunity costs for farmer land and labor; lower volatility for farmers than alternative products, such as maize, especially on degraded land; and direct jobs benefits (the Proponent currently employs 300 local field officers for 3,800 hectares).

5.3 PRIVATE FINANCE MOBILIZATION AND REPLICATION POTENTIAL

The Vehicle has the potential to mobilize private finance through direct mobilization, replication, and scale:

Direct Mobilization: Assuming the proof of concept facility leverages US$ 11 million concessional debt, US$ 7 million first loss equity, and a credit guarantee, to raise US$ 17 million of commercial capital, this represents a ratio of ~1:1 commercial to concessional capital. The Vehicle, in turn, will re-finance an initial US$ 12.5 million of private financing for establishment, and leverage US$ 100 million of private capital for final harvest, processing, and sales. Therefore, **within the lifecycle of the hectares in the proof of concept facility, concessional financing will leverage more than six times the commercial financing**.

Replication and Scale: A 2008 survey across Kenya indicated that 75% of marginal land is unused, with the highest proportions in the Central region (100%) and Coastal region (93.3%) (Senelwa et al, 2008), indicating a high potential to scale the Vehicle. Assuming a new SPV is deployed every three years, and each new vehicle includes 10,000 hectares, by 2030 ~40,000 hectares of trees will have been planted for an estimated establishment cost of US$ 50-60 million. The Lab also analyzed the potential for scale beyond the Proponent's own operations. The Lab has calculated a **market potential for farm forestry on degraded land of ~US$ 20 billion annually by 2030, based on African countries' land restoration targets** (see Annex 4 for methodology). **At US$ 1,500/hectare for establishment costs, this translates to a need for US$ 8.5 billion in initial investment.**

Future SPVs could also bundle contracts from several forestry companies to further diversify risk and reach larger issuances. There are a number of smallholder tree contracting pilots under implementation with international organizations in East Africa, including in Tanzania, Uganda, and Mozambique,[16] which may be able to adopt a similar approach to scale up. Other smallholder forestry projects, such as those run by out-grower programs, conservation funds, and NGOs, as well as intermediaries operating in other sectors, such as agriculture, may also raise financing using this approach. The success and promotion of this mechanism could also help to encourage new private sector intermediaries, as well as improvements in regulation and permitting to facilitate the scaling up of smallholder forestry projects[17] (see Annex 5 for further details on potential scale up pathways).

forestry scheme in South Africa, provided similar income at US$ 800 per household (FAO Family Farming Knowledge Platform: Smallholders dataportrait. At: http://www.fao.org/family-farming/data-sources/dataportrait/income/en/ and Chamshama and Nwonwu, 2004).

[16] Source: Interviews with World Bank and FAO

[17] For example, Kenya benefits from tree cover requirements on agricultural land, and the Proponent was able to negotiate a permit for harvesting across multiple plots of smallholder land, rather than for each plot, a significant barrier.

6. KEY TAKEAWAYS

The Lab's analysis of the Smallholder Forestry Vehicle concludes that it is:

- **Innovative:** The Vehicle is the only one focused on scaling up smallholder forestry investment, and would represent one of the only vehicles for forestry investment in all of Africa, potentially transforming the forestry sector.
- **Financially Sustainable:** The Vehicle will phase out public finance over time as risks become better known, especially as the Proponent company matures and the Vehicle establishes a track record. At scale, the Vehicle could have strong appeal for mainstream investors, including institutional investors. However, the phase out will be relatively slow, due to the long-time horizons required for forestry.
- **Catalytic:** The proof of concept would leverage one dollar of private finance for every dollar of public finance, and six times this amount across the full lifecycle of the trees. Scaling the Vehicle will take time given the early stages of smallholder forestry in Africa and long forestry time scales but can be achieved with focused efforts to support intermediaries, reduce policy barriers, and promote successes.
- **Actionable:** The idea is highly actionable, as the team and operating company are already in place and have begun to identify project partners.

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8. ANNEX 1: COMPARATIVE INSTRUMENT ANALYSIS

8.1 COMPARATIVE INSTRUMENTS REVIEWED

The Lab reviewed the following financing instruments and schemes relevant to the development of the Smallholder Forestry Vehicle:

Instrument name	Sector	Fund/ Asset Manager	Securiti -zation	Bond	Corporate -Financed Outgrower Scheme
Indonesia Rubber Plantation Sustainable Bond	Agriculture			■	
Certificado de recebíveis do agronegocio, Certificates of Agribusiness, CRA	Agriculture		■		
Drokasa/ Agrokasa	Agriculture		■		
Prudential Securities	Agriculture		■		
Livestock Securitization	Agriculture		■		
One Acre Fund	Agriculture				■
Kim's Poultry Care Centre, Nakuru	Agriculture				■
Clean Energy Investment Trust	Energy			■	
SCTY (Solar City Group Distributed Solar Securitization)	Energy		■		
HASI SYBs (Hannon Armstrong asset-backed Sustainable Yield Bonds) With Carbon Count	Energy		■		
Japan Mega Solar Bond Trust	Energy		■		
Tesla Solar Securitization	Energy		■		
AES DE (AES Distributed Energy)	Energy		■		
Green Bond South Africa Solar Project	Energy			■	
Off Grid Electric's Million Solar Homes Fund	Energy		■		
Green FIDC	Energy		■		
BBOXX/OikoCredit Solar Loans Securities	Energy		■		
Loan Portfolio Securitization Fund I	Microfinance		■		
IFC Forests Bond	REDD+			■	
SAPPI "Project Grow"	Timber				■
MONDI "Khulanathi" small grower scheme (now Khulanathi Forestry Ltd)	Timber				■
India Tobacco Company Paperboards and Specialty Papers Division (ITC-PSPD)	Timber				■
West India Match Company (WIMCO)	Timber				■
Natal Cooperative Timbers	Timber				■
Swiss Lumber Company	Timber				■
Kilombero Valley Teak Company and New Forests Company	Timber				■
Lignum Fund	Timber	■			
Phaunus Timber Fund	Timber	■			
Sveaskog Green Bond	Timber			■	
Arcel Finance Ltd/Aracruz Cellulose S.A.	Timber		■		
Hancock Timber Resources	Timber	■			
Green Wood Resources	Timber	■			
TimberStar	Timber		■		
Tropical Asia Forest Fund	Timber	■			
F.I.T. Timber Growth Fund	Timber	■			
New Forests	Timber	■			

8.2 STRUCTURES OF OTHER BLENDED FINANCE VEHICLES

To inform the financial modeling scenarios for the Smallholder Forestry Vehicle, the Lab looked at several existing blended finance vehicles to understand current structuring practices. The following table describes in detail the Lab's understanding of several of them.

Blended equity fund waterfalls:

Step	GEEREF Waterfall[18]	Danish Climate Investment Fund Waterfall[19]
1	Repay commercial investors	Repay all investors
2	Preferred return 4% to commercial investors	Disproportionate amount of preferred return of 6% to commercial investors
3	Repay concessional investors	Disproportionate amount of next 6% to concessional investors
4	Preferred return 6% to commercial investors	Distribute other returns 80/20 (commercial & concessional investors/fund manager)
5	Distribute other returns 80/20 (commercial & concessional investors/fund manager)	

Blended debt/equity structure (Climate Investor One Construction Fund)(Tonkonogy et al, 2018):

Tier	Type	% total fund (~$500m)	Expected returns	Investors
1	Junior equity/first loss-tranche	20%	2%	Concessional
2	Subordinated equity	40%	20%	Pension funds, development finance institutions
3	Senior fixed income with credit guarantee	40%	8%	Pension funds, bilateral export credit agency guarantee

Blended debt structure (Indonesia rubber plantation Sustainability Bond)(TLFF Offering Circular, Singapore Stock Exchange, 2018)

Class	Type	Principal Amount of Notes	Tenor (years)	Interest rate (p.a.)	Investors
A	Senior debt	USD30m	15	4.136%	Retail/institutional investors
B1a	Mezzanine debt	USD20m	15	9%	Retail/institutional investors
B1b	Mezzanine debt	USD15m	5	8.375%	Retail/institutional investors
B1c	Mezzanine debt	USD15m	7	8.875%	Retail/institutional investors
B2	Junior debt	USD15m	15	2%	Sponsors (JV)
	Guarantee	~33%		n/a	USAID Development Credit Authority

[18] *Source: slide 15 of* *http://www.iccgov.org/wp-content/uploads/2014/05/2014-05-09_Canu.pdf*

[19] *Source: p. 10 of* *http://www.sida.se/globalassets/global/partners/naringsliv/presentationer-fran-22-okt-2014/final-report-from-meeting_mobilising-institutional-investment-in-africa.pdf*

9. ANNEX 2: MODELING METHODOLOGY AND DETAILED RESULTS

The Lab's financial modeling outputs relied on discounted cash flow modelling of the unit economics and the SPV. The unit economics model tested how underlying timber prices, harvest outcomes, and costs affect unit returns and the SPV model simulates how different financing scenarios and sensitivities impact returns and distribute losses. The unit economics assumptions were provided by the proponents, and the assumptions on SPV costs were collected via interviews and literature.

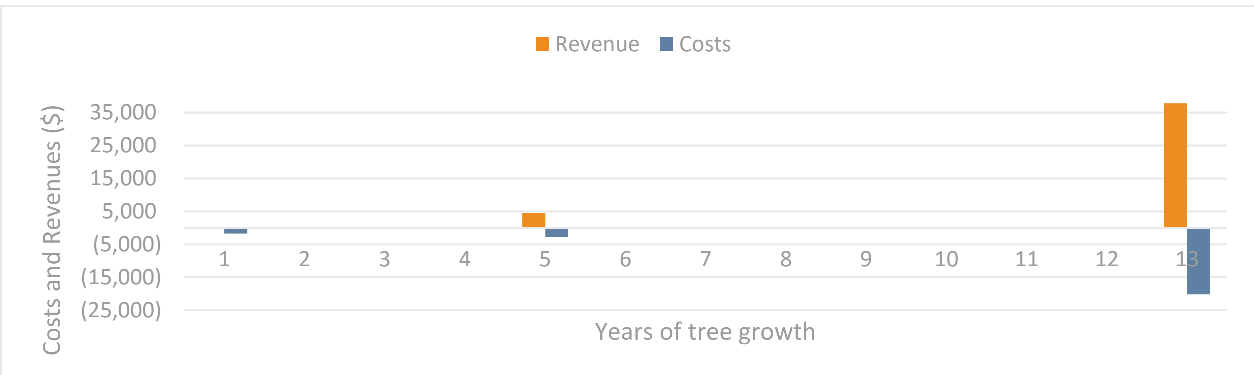
9.1 UNIT ECONOMICS CASH FLOW MODEL

The unit economics model examined cash flow patterns, cost drivers, and financial sensitivities. Specifically, the following inputs were considered:

- Market price for timber[20]
- Planting cost
- Forestry operation and maintenance cost
- Harvesting cost
- Farmer income
- Wood processing costs
- Sales cost
- Tree growth per hectare
- Thinning trees
- Tree survival rate
- 12-year period

Main findings from the unit economics cash flow analysis
The analysis found that most costs are generated during year twelve by harvest, processing, and payment to farmers, when the bulk of the trees are harvested. This is also when most of the revenues are generated. There are also some of these costs and revenues in year four, but they are comparatively small (see figure 1).

Figure 1: Unit economics cash flow



[20] Pricing assumptions are based on Komaza's empirical studies as well as other external research in forestry economics. While the model assumes a single USD/CBM price for simplicity, Company and investors should consider multiple product lines in reality, which require different size, quality, and thus price of logs. The pricing of tree assets should also be carefully assessed by a third-party auditor.

We tested the unit economics for sensitivities to (1) market price for timber, (2) tree growth, and (3) business model. The business model considered whether the company sells processed or unprocessed trees.

- The most significant driver of unit economics IRR is the market price for timber. The data on timber market prices in Kenya is very limited and the price for timber depends on the quality of the timber from the trees. This creates significant uncertainty.
- The second most important driver of IRR was the tree growth. The more trees grow, the more efficiently the fixed costs (such as planting, maintenance, and operation costs) are utilized and the more timber can be sold into the market. Most of the tree failure takes place in the first one to two years after planting.
- The least significant factor to unit economics IRR was the business model. Selling processed trees creates more revenue as a higher price can be achieved, however the variable processing costs are significant as well, especially in the beginning. However, economies of scale can drive the profit margin for this factor and the operating company has significant influence over the costs, which limits risk and uncertainty from this factor.

Take away from unit economics modelling

1. Separating out the lifecycle of the timber business into three stages with different risk and return profiles enables creating a financial product that can be more targeted to investors. The main purpose of the SPV is to provide long-term low-cost finance. Therefore, the two high risk stages, the first year after planting the trees and the final two years in which harvest and processing takes place should be separated out from the SPV to reduce risk for investors while meeting the needs for long-term low-cost financing.
2. Separating out the last stage of the tree lifecycle – the harvesting, processing, and sales – also reduces the need to raise significant amounts of financing for these costs within the SPV. Investors do not like to finance assets in which the ability to create returns depends on their ability to raise even more finance in the future and they do not like to raise finance for vehicles that will not draw them down soon. This is specifically important for equity investors, where returns are based on drawn down capital. Further, taking on debt in the beginning of the vehicle that won't be used until year twelve increases the cost of finance and voids the purpose of the vehicle. All costs need to be covered by the Assets under Management raised by the first SPV. Selling back the tree contracts to the originator before harvest at a pre-agreed price solves this challenge.
3. Market price risk is removed by selling the tree contracts back to the originator before harvest at a pre-agreed price. This creates a more debt-like vehicle that has overall lower risk and lower returns which enables the Vehicle to meet the goal of accessing long-term low-cost debt for forestry.

9.2 SPV CASH FLOW MODEL

9.2.1 PROOF OF CONCEPT FACILITY

For the proof of concept facility, the analysis considered a $35 million SPV with an annual management cost of US$100,000. The SPV is made up of a 60% debt tranche and a 40%

equity tranche. The debt tranche receives interest on debt provided, with average interest targeted at 6% (Table 1).

The 12-year Proof of Concept Facility has three vintages: (1)10-year old trees that are harvested and sold around year three, (2) 2-year old trees that are sold back to the originating company in year 11, and (3) 1-year old trees that are sold back in year 12. Revenues are generated at thinning in year 3 and 4 and at final sale of tree contracts to the Company (years 3, 11 and 12). The proceeds from the first thinning and sale are kept in the SPV to cover costs in the following years. The older vintage is taken into the SPV to improve IRR and to enable proof of concept before the full lifetime of the SPV.

9.2.2 FULL-SCALE SPV

For the full-scale SPV, the analysis considered a $105 million SPV with an annual management cost of US$100,000. The full-scale SPV is also made up of a 60% debt tranche and a 40% equity tranche. The debt tranche receives interest on debt provided, with average interest targeted at 8% which is a move towards more commercial debt cost (Table 1).

The 12-year full-scale SPV has two vintages: 1-year old and 2-year old trees that are sold back to the originating company in year 11 and 12. The other factors are as in the Proof of Concept Facility.

Table 1 below provides the assumptions the Lab used to model the base case scenario for the Proof of Concept Facility and the full-scale SPV. The base case scenario inputs related to the timber business specifically were provided by the proponent and are based on in-depth analysis of their historical and expected costs and revenues and reflect a conservative scenario. The Lab modeled an indicative transaction using numerical assumptions that help to demonstrate the potential for the instrument, but these assumptions would need to be revisited in additional detail by the proponent and partners as the instrument progresses towards implementation.

Table 1: Model assumptions for the base case scenarios

Assumption	Value: Proof of Concept Facility	Value: Full-Scale SPV	Comments
Hectares	5,000	15,000	
Timber growth/ hectare	122 cubic meters	139 cubic meters	Tested in sensitivity analysis.
Buyback price/cubic meter	$100/ cubic meter	$110/cubic meter	Tested in sensitivity analysis. The buyback price is set based on certain product breakdown assumptions and can vary according to the product mix strategy as well as quality/size/vintage of trees harvested.
Total cost of trees over SPV lifetime	$5,400/ hectare	$4,900/ hectare	
SPV lifetime	12 years	12 years	Based on expected tree growth.

SPV Setup costs	$0.8m	$0.8m	
SPV management costs (p.a.)	$0.1m	$0.1m	
Leverage	60%	60%	
Debt interest rate	6%	8%	Tested in sensitivity analysis.
	Impact Assumptions		
Payment to farmer per cubic meter	$35	$35	The farmer compensation will be determined by contract based on the market price, which Komaza expects to vary between USD 20 and 40/CBM according to the quality of trees.
Average farm plot size	0.3 hectare	0.3 hectare	

9.3 FUNDING SCENARIOS

We compared the business as usual funding scenario via corporate finance to financing via the instrument:

Table 2: Funding scenarios

Type	Scenario A: No public capital	Scenario B: Public capital used to decrease risk for private investors
Senior tranche (debt)	60 % at 10% coupon	60% at 6% coupon
Guarantees		Guarantee protects senior principal
Mezzanine tranche (equity)	40% company equity	20%
Junior tranche (equity)		20% First loss equity

9.4 ANALYSIS AND RESULTS FOR PROOF OF CONCEPT FACILITY

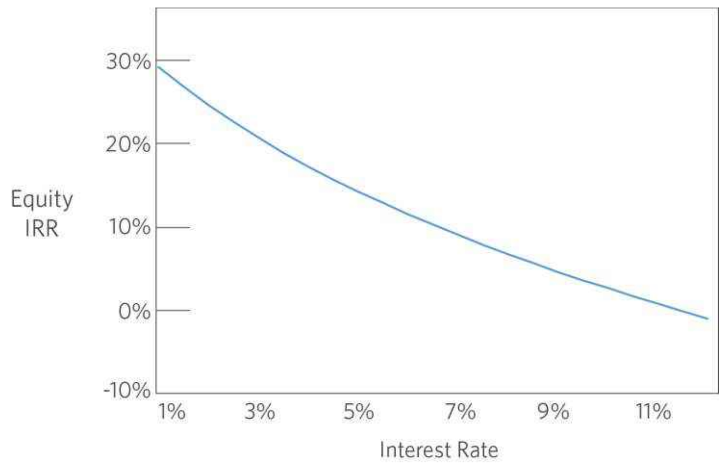
Based on the planned Proof of Concept SPV structure and the assumptions outlined in Table 1, the proof of concept achieves a fund gross IRR of 11.1% and an equity IRR of 11.4% in the central (base case) scenario. The Lab repeated the sensitivity analysis created for the unit economics model and examined IRR sensitivities to (1) tree growth, (2) cost of debt, (3) and buyback price.[21]

9.4.1 SENSITIVITY ANALYSIS

Due to the long timeframe of the growth period, returns are highly sensitive to the cost of debt. Concessional senior debt at a cost of 6% will enable an equity return of 11% in the central (base case) scenario.

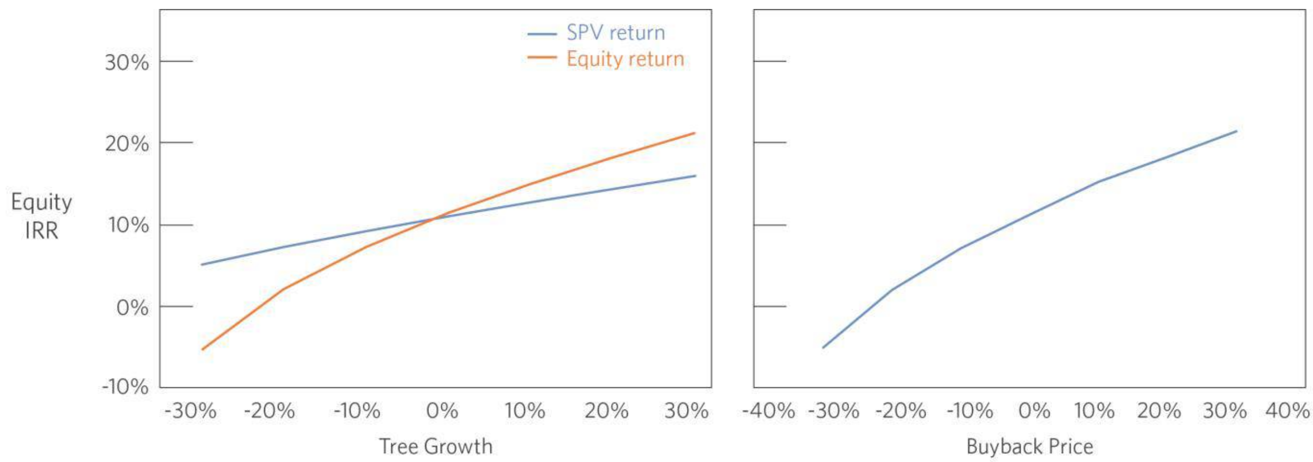
[21] The Lab did not consider currency risk in its analysis. This will need to be considered in the next phase of development.

Figure 2: Equity returns vs debt interest rates



Returns are most sensitive to tree growth. Mean annual increment (MAI) measures the expected tree growth curve from year one to harvest. The central MAI for the Proof of Concept Facility enables the harvest of 122 cubic meters of timber per hectare. This is a conservative growth curve and growth upside could enable returns to increase to 15%.

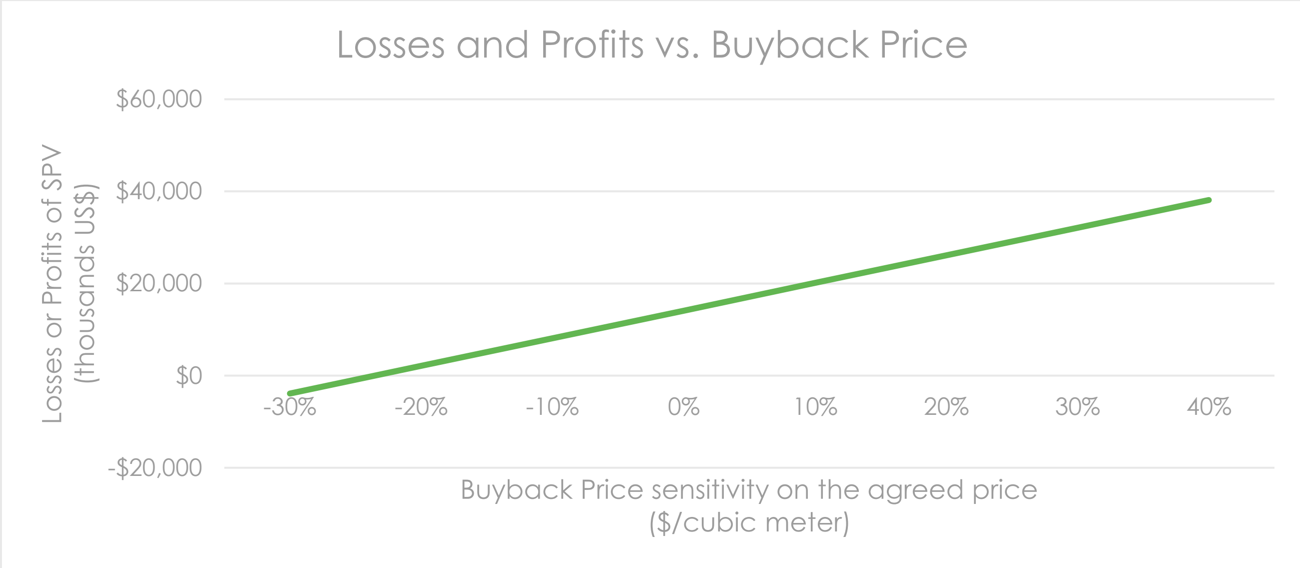
Investor returns are highly sensitive to the buyback price that the Company can pay per cubic meter. The buyback price will be negotiated by the Company and the SPV before the SPV purchases the tree harvest contracts.



9.4.2 RISK MITIGATION

While agricultural insurance can protect investors from events such as fire, a more general principal guarantee can reduce a broader range of risks for debt investors and enable a lower cost of debt. Further, a first loss equity tranche can also be used to protect other equity investors from lower than expected returns. For example, equity investors without a first loss tranche recover their initial investment at a buyback price 25% lower than the central scenario, while a first loss equity tranche of 50% of total equity protects senior equity investors down to a buyback price 35% lower than expected.

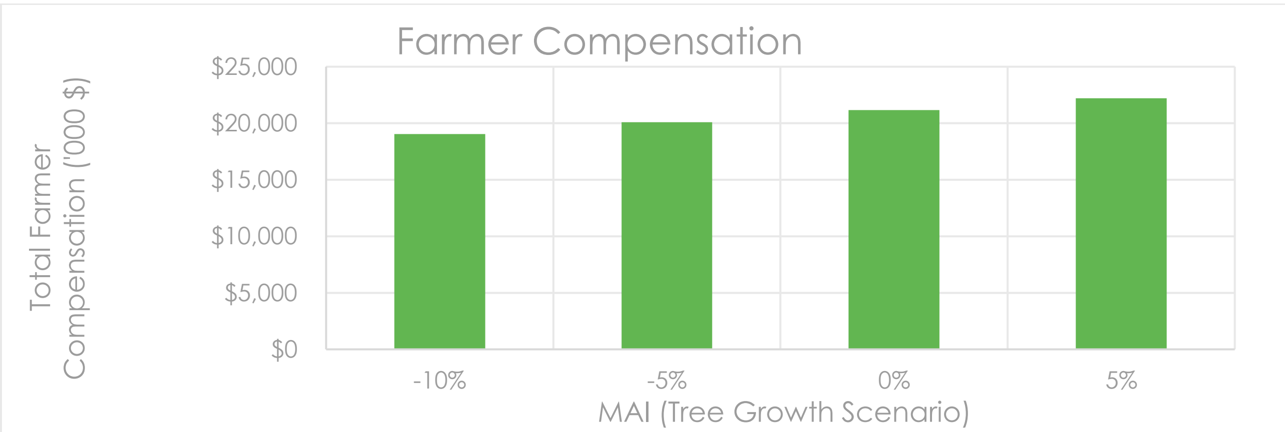
Losses and Profits vs. Buyback Price



9.4.3 FARMER IMPACT

A farmer compensation of $35/cubic meter would provide farmers with an aggregate income of USD 21 m. Farmer compensation is most sensitive to tree growth ("MAI").

Farmer Compensation vs. MAI Growth Scenario



9.5 RESULTS FOR THE FULL-SCALE SPV

Based on the planned Full-Scale SPV structure and the assumptions outlined in Table 1, the SPV achieves a gross IRR off 17% and an equity IRR of 18.5% in the central (base case) scenario up from 11% in the Proof of Concept Facility. Farmer income would reach $73 million, supporting 50,000 farmers with US$1,469 each. This would increase average farmer income from trees by 15% compared to the Proof of Concept Facility.

10. ANNEX 3: IMPACT FRAMEWORKS REVIEW

To understand the potential impact of the instrument and to work towards an appropriate set of impact indicators for the Vehicle, we reviewed (1) global development frameworks, (2) forestry specific certifications schemes, and (3) project level impact indicators for forestry and adaptation.

- **Global development frameworks,** namely the Sustainable Development Goals and the Paris Agreement, have hundreds of individual goals and targets, and success is mostly measured on a national level. This means that individual projects need to determine the appropriate project level indicators that align with the macro targets. A benefit of these macro level frameworks is that they provide guidelines to the types of relevant impacts for a project to track and measure (IAEG-SDGs, 2016 and UNSTATS, 2015) and UNSDKP, 2017 and RoK, 2017a and World Economic Forum, 2015 and RoK, 2015a and RoK, 2016a and RoK MENR, 2017b).
- **Forestry specific certification schemes**, specifically Reducing Emissions from Deforestation and Forest Degradation (REDD+) and the Forestry Stewardship Council (FSC), provide insights into good governance and best practice of forestry projects that (1) avoid deforestation in natural forests and/or (2) increase the sustainable management of forests for commercial use. While certifications within any of these schemes might not be viable for the Smallholder Forestry Vehicle at this point due to the size of the smallholder plots and the cost of certifications, it will be relevant for climate and sustainability impacts to keep the instrument's investments in line with these forestry standards (SierraClub, 2014 and FSC 2015 and Imaflora 2010), and possibly to work with these certification bodies to develop standards that can be used for smallholder forestry specifically.
- **Project level impact indicators**, for example World Bank adaptation indicators (WBG, 2010), BMZ adaptation indicators (BMZ, 2014 and BMZ, 2017), and the Land Degradation Neutrality indicators (UNCCD 2017a and UNCCD 2017b) help to access the impact of a single project. These indicators can be used to evaluate the contribution of one project to any of the global development goals.

The instrument's relevance to these frameworks

75% of Kenya's national greenhouse gas emissions are attributed to agriculture, land use, and forestry, and the vast majority of its emissions abatement potential is related to forestry (Republic of Kenya, 2015, Second National Communication to the UNFCCC). The country's Nationally Determined Contribution targets 100,000 hectares of agro-forestry and 10% tree cover, up from 6.99% today, by 2030. In addition, Kenya has high vulnerability to drought and flooding, especially for the poorest who are reliant on natural resources for their livelihoods. Agro-forestry, sustainable land use, and providing employment opportunities have all been identified as key components of Kenya's National Adaptation Plan (Republic of Kenya, 2016, National Adaptation Plan 2015-2030). Finally, as part of the AFR100 land restoration initiative, the country has committed to 5.1 million hectares of land restoration by 2030, with 1.8 million hectares of this total expected to come from cropland forestry (Republic of Kenya, Ministry of Environment and Natural Resources, Technical Report on the National Assessment of Forest and Landscape Restoration Opportunities in Kenya, 2016).

The benefits of increasing tree cover on agricultural land go beyond carbon sequestration and tree-related income. Changes in the moisture regime (e.g. drought or heavy precipitation) significantly influence crop productivity. Soil conditions such as moisture content, temperature and nutrient levels have dramatic effects on bacteria in the soil which are vital for soil fertility, which is a controlling factor influencing agricultural productivity and both regional and household food security (Zomer et al., 2016).

Impact measurement
The Lab reviewed several impact frameworks to understand what types of indicators would be most relevant to the Smallholder Forestry Vehicle.

Table 1 Reviewed Impact Frameworks and Applicability to the Instrument

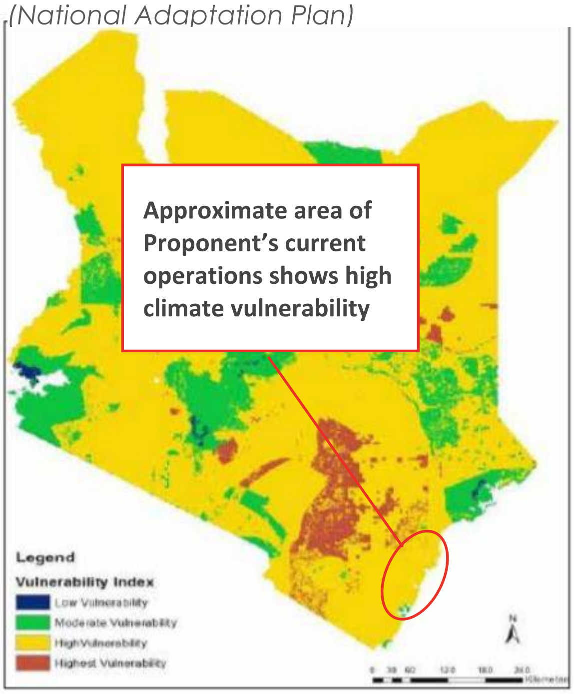
Type of Framework	**Framework**	**Application to the instrument**	**Limitations**
Global Development Frameworks	Sustainable Development Goals Paris Agreement/ UNFCCC/ NDC	Support understanding of the types of impacts that the instrument can have when implemented with the right environmental, social, and governance standards. Provide insight on what types of indicators will be most important to measure.	National level indicators, which means that individual projects still need to define their own impact indicators.
Forestry Specific Best Practice Frameworks	FSC (Forest Stewardship Council) REDD+ Criteria	Support an understanding of the environmental, social, and governance standards that the instrument should meet and the type of activities that can be undertaken to meet them.	The principles and criteria are more of a list of 'do' and 'don't' and up-front requirements rather than indicators that can measure the quantitative impact of a specific project.
Forestry & Land Use Indicators	World Bank Adaptation Indicators BMZ Adaptation Forestry Indicators UNCCD Land Degradation Neutrality indicators	High applicability due to the large number of specific indicators that help measure impact from a project.	The indicators help to define the type of adaptation impact that a project has but they don't define which threshold a project must reach to be considered adaptation. There is no certification of the project.

Measuring Adaptation Impact of the Instrument

Adaptation is a very broad concept and highly context specific. According to a group of multilateral development banks (IDB et al., 2016), a project is relevant for adaptation if it (1) sets out the climate change vulnerability context of the project, (2) makes an explicit statement of intent to address climate vulnerability, as part of the project, and (3) articulates a clear and direct link between the climate vulnerability context and specific project activities.

Climate vulnerability in Eastern Kenya that the instrument aims to address

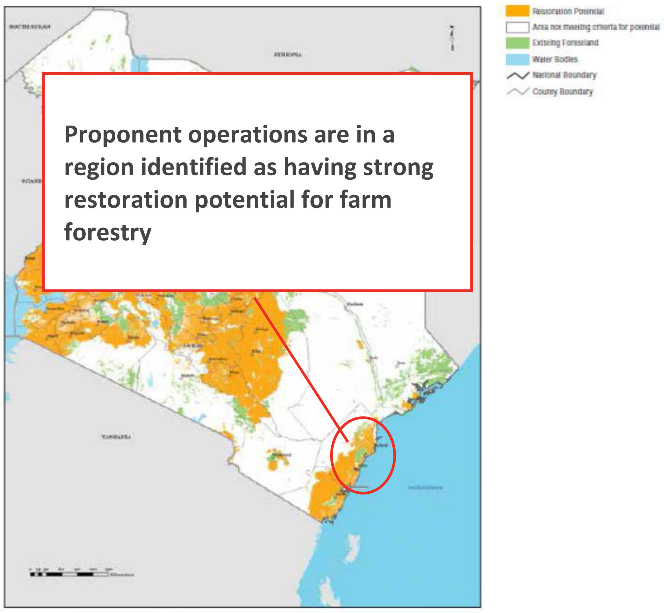
Figure 1: Kenya's Vulnerability Index (National Adaptation Plan)



Ecosystems: Eastern Africa, and Kenya specifically, is very vulnerable to drought and flooding. The frequency and severity of droughts in the region is expected to increase, as is the intensity of extreme precipitation and flooding (RoK, 2016a, National Adaptation Plan 2015-2030). Global Climate Modelling (GCM) data indicates that the mean annual temperature is projected to increase by up to 1.5°C by 2030 and up to 3°C by 2100 (Met Office 2011 in RoK, 2016a). For precipitation, GCM data indicates that there will be a possible increase in average rainfall by the 2060s. However, the proportion of annual rainfall that occurs in heavy events will increase by up to 11 per cent by 2060, which will likely increase the number of floods by an equal amount (Met Office 2011 in RoK, 2016a). The combination of drought and floods leads to increased soil erosion and desertification.

Livelihoods: Farmers specifically are highly vulnerable to these climate impacts due to their reliance on natural resources for their livelihoods. Further, increased soil erosion and desertification makes it more difficult for farmers to grow crops successfully and sustain themselves. In extreme cases this can lead to displacement of farmers.

MAP 3A: RESTORATION POTENTIAL FOR AGROFORESTRY ON CROPLAND



How the instrument addresses climate vulnerability in Eastern Kenya

First, the instrument plants trees on unused and degraded farmland which slows down and prevents soil degradation and desertification. Additional tree cover has several positive effects on soil quality. Trees enable soil to store more water during precipitation events, they also prevent water runoff and the runoff of fertile topsoil. Further, trees can slow down and prevent desertification by protecting dry soil from wind.

Second, the instrument provides a climate resilient income source to farmers, enabling them to build savings that can help them to become more resilient to climate shocks. When crops fail, farmers' income is severely affected. This is especially devastating for the poorest, as they often need to sell some of their assets at below market prices to make up for the loss. This creates a continuous cycle of poverty that is difficult to escape from. Trees are much less vulnerable to droughts and can survive several dry summers. Once harvested, the tree income can be invested in further activities that improve resilience, such as education or non-agricultural business activities. Further, savings from tree harvests can bridge income losses from drought and flooding, thus preventing farmers from selling valuable assets at below-market price.

Measuring impact of the instrument towards climate adaptation goals

The indicators in the below table can be used to track the instrument's adaptation impacts.

Table 2 Impact Indicators

Type of Impact		Relevant Impact Frameworks						
Type of Impact	Indicator	SDG	Kenya's NDC	FSC (Forestry Stewardship Council)	REDD+	WBG adaptation indicators	BMZ/ GIZ/ IISD Forestry Indicators	Land Degradation Neutrality
Adaptation (ecosystems)	Temperature changes (mean temperature changes, # of hot days)							
	Precipitation changes (mean precipitation changes (liters/m3, # of extreme precipitation events)							
	Water quality: salinity, other							
	Soil quality: state of erosion at planting, after five years, after 10 years/ level of nutrients in soil							
Adaptation (of people) & Poverty	Income from tree harvest ($)							
	# farmers trained in sustainable forestry and silvicultural practices							

Measuring Carbon Sequestration
Measuring carbon sequestration for farm forestry is challenging. Among other things, the amount of sequestered carbon varies based on soil chemistry, precipitation, quantity of trees planted per hectare, diameter of trees and tree growth, tree species planted, and the mix of tree species (Knapp, 2012 and Juntheikki, 2014 and Gorte, 2009). Sequestration also varies by afforestation and reforestation projects (EPA, 2015 and USDA, 2004 in Gorte, 2009). This makes it difficult to estimate the carbon sequestration potential of 5,000 hectares of farm forestry in Kenya for the species *Eucalyptus Grandis Camaldulensisi* and the Kenyan native species*, Melia Volkensi*.

Further, as the average plot size of Komaza farmers is currently 0.3 hectares, it makes it difficult to claim any sequestration under an international framework.

Nevertheless, the Lab reviewed articles on agroforestry to get a better overview on the potential the instrument could have. Further, globally, trees on agricultural land area store 36.29 Pg C across 22 million square kilometers. This translates to 21.4 tons of carbon per hectare. While stored carbon from trees on agricultural land increased globally by 4.57% from 2000 to 2010, Africa's storage capacity across the continent decreased. There was only one other region outside Africa – Central Asia – where this happened (Zomer et al., 2016). Overall, studies indicate that agroforestry can be a viable approach to recover degraded agricultural land by improving chemical, physical, and biological soil conditions and increasing carbon sequestration (Torres et al., 2017).

Table 3 Example studies on carbon sequestration from agroforestry

Study	**Carbon Sequestered**	**Source**
Eucalyptus forest plantations carbon sequestration potential in Uruguay	Eucalyptus plantations can sequester 2.48 tons CO2e/hectare/year[22] excluding benefits from stored carbon in wood products from harvested trees. Afforestation increases the soil carbon in 10-year rotation plantations by 34%.	(Juntheikki, 2014)
State of the World's Forests	Typical sequestration rates for afforestation/reforestation, in tonnes of carbon per hectare per year in Africa are 3.2 to 10 tonnes. The sequestration potential for agroforestry practices is even more variable, depending on the planting density and production objectives of the system.	(Brown et al., 1996 in FAO, 2001)
Carbon sequestration by agroforestry systems using eucalyptus in Brazil	Carbon storage in aboveground trees ranges between 54.6 and 5.9 tons C ha−1. The study looked at a total of four different systems with different tree MAIs, soil treatments, and crop mix. The other two systems achieved 11.4 tons and 25.7 tons of c ha-1.	(Torres et al., 2017)

[22] Calculated based on 1,757,847 Mg C for 707,674 hectares

Global average carbon sequestered by agroforestry	Global average, 21.4 tons of carbon storage per hectare of agroforestry in 2010.	(Zomer et al., 2016)
Tree planting for carbon sequestration in the US	Afforestation of crop or pasture land is estimated to have the potential to sequester between 2.2 and 9.5 metric tons of CO2 per acre per year. Reforestation is estimated at 1.1 to 7.7 metric tons of CO2 per acre per year	(EPA (2005) and USDA (2004) in Gorte, 2009)

11. ANNEX 4: CATALYTIC IMPACT METHODOLOGY

To understand the catalytic impact of the instrument, the Lab considered the market potential for forestry on agricultural lands in African countries, in contribution to national land restoration targets. Specifically, the Lab looked at the 25 countries that have committed to the African Union's AFR100 land restoration target of 100 million hectares by 2030.[23]

Of these 25 countries, nine have committed to numerical restoration targets for their country AND have identified farm forestry as a way to meet them. These nine countries are Burundi, Cote d'Ivoire, Ethiopia, Kenya, Malawi, Niger, Republic of Congo, Rwanda, and Uganda. Of these 9, Kenya's are the most clearly defined: of a target of 5.1 million hectares restored by 2030, an estimated 1.8 million in a conservative scenario could come from farm forestry (RoK 2016b).

The Lab, therefore, assumed a similar ratio of cropland forestry to total restoration for the other countries, conservative price and tree growth assumptions from external research, and a 2/3 discount to account for that not all farm forestry will be timber (some may be, e.g., shade trees). The Lab therefore estimated:

1. 5.6 million hectares could be restored through timber farm forestry
2. Total forest potential of 103 million cubic meters (using 18.4m3 per hectare, a number calculated by Criterion and Indufor (2017) for smallholder forestry annual productivity)
3. USD 20.6 billion market size (using USD200/m3 price, lower than most reported prices)
4. USD 8.4 billion upfront investment required at USD 1,500 planting costs/hectare

Of course, many other African markets may be excellent candidates for the deployment of the Smallholder Forestry Vehicle, including Tanzania and Mozambique, which both have had pilot initiatives focused on smallholder forestry. As more countries make commitments under AFR100, the above numbers can be updated.

Beyond this, the Lab has also considered the criteria for markets that would make particularly strong candidates for timber-based cropland forestry. Due to a shortage of data on smallholders and forestry in most countries, we did not evaluate markets against these criteria, and recommend in-depth scoping studies to be developed.

- NDC and AFR100 alignment
- Economic & population growth
- Timber shortage (or export opportunity)
- Farmers with surplus idle land
- Lack of large plots for plantations
- Stable business climate
- Access to large markets
- Potential partnership opportunities
- Regulatory/political environment

[23] http://afr100.org/

12. ANNEX 5: REPLICATION AND SCALE STRATEGY FOR SFV

Globally, smallholder farmers own 26% of 272 million ha planted forests, while corporate enterprises only manage 15%.[24] The smallholder presence is even stronger in planted forests for productive functions, accounting for 32% of 205 million ha. [25] The same applies to Kenya; while plantations only supply 5% of wood and are expected to grow only 2.6% per annum, PwC and Gatsby Foundation points out that farmer forestry has the potential to feed up to 47.5% of Kenya's sustainable wood supply by 2030. [26]

Komaza's smallholder forestry model offers a scalable and sustainable solution to African forestry together with significant social impact to farmers. However, as a forestry business dealing with deep "J-curve" of investment, smallholder forestry projects such as Komaza still struggle to access funding to reach its full potential just like any other African forestry peers. Forestry financing in Africa has been a challenge for the industry. According to Preqin, unlisted timberland investment funds raised a total of USD 19 billion between 2006 and 2015. African focused funds, however, account for only 1% of the total capital raised, significantly smaller than North America (66%), Australia (15%), and South America (13%). Meanwhile, Microfinance Institutions and commercial banks find it difficult to provide farmers with 10+ year duration loans for forestry projects, unlike much more popular annual cash crop lending programs. From the climate investors' viewpoint, grant-based conservation projects are not economically sustainable in the long term, while direct investments into smallholder-based businesses such as Komaza require venture capital expertise with which most conventional forestry investors are unfamiliar.

The SFV will fill this gap between a scalable forestry model and access to capital by carving out existing forestry assets and accommodating a wide array of investors with varying risk-return appetites. The SFV has the potential to bring catalytic impact to both public and private investors as well as smallholder forestry projects.

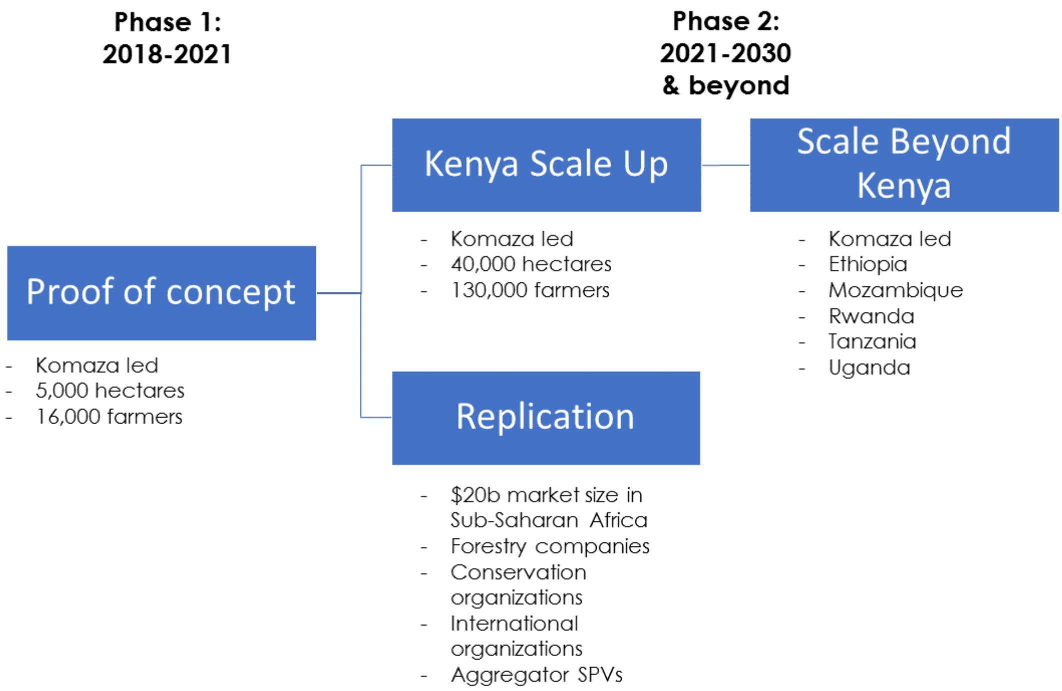
The SFV's scale-up strategy is illustrated and described on the following page.

[24] http://www.fao.org/docrep/010/a1346e/a1346e15.htm

[25] Ibid.

[26] Meeting the wood supply challenge: The need for commercial forestry in Kenya, PwC/Gatsby Foundation, May 2014

SFV Replication and Scale Strategy



Replication and Scale beyond Komaza

Today, only a limited number of organizations are capable of implementing large-scale smallholder forestry projects like Komaza. However, the Lab has identified a number of existing entities that may be able to either carry out a replication, or participate in a replication, once the concept is proven. These organizations include **other forestry companies**, of which there are both plantation forestry companies such as MONDI in South Africa which manages smallholder forestry plantations alongside its more typical plantations, as well as Criterion Africa Partners, a private equity fund that invests in forestry plantations to improve their productivity. There are also younger forestry companies, such as Obtala in Mozambique, [27] that are looking at bringing together agriculture and forestry investments into agro-forestry projects. Similarly, there are **other smallholder agricultural hybrid non-profits** that have historically relied on grants, such as One Acre Fund and MyAgro, who conduct agro-forestry operations and may also adopt the SFV mechanism.

In addition, both **conservation organizations and international organizations** are carrying out large scale tree contracting demonstrations. For example, in Uganda FAO is supporting smallholder forestry through the SPGS incentive scheme. [28] Indufor[29] notes that in Tanzania smallholder tree farmers are forming their own savings and loan groups. While these efforts are nascent in Sub-Saharan Africa, other regions and countries, including Brazil and China, have had successful track records of small scale timber production. [30]

Getting from the proof of concept, assuming it is successful, to replication will require concerted efforts on several fronts:

[27] http://www.obtala.com/forestry-sustainability.html
[28] https://kampalapost.com/content/environment/commercial-tree-planting-fao-eu-plant-over-30000-hectares-uganda
[29] https://induforgroup.com/future-trends-in-smallholder-plantation-forestry/
[30] See, e.g., https://www.profor.info/sites/profor.info/files/WPS8462.pdf

1) **Raising awareness about the success of the proof of concept** through, for example publications and conferences. While the Lab is planning further research into this pathway, we are aware of this pathway being critical in the replication of the Energy Savings Insurance mechanism, the video for which has been viewed more than 4,400 times. [31] For off-grid solar securitization, a key publication has been that of GOGLA, the off-grid solar energy industry group, which focused on how this works in the sector.[32]

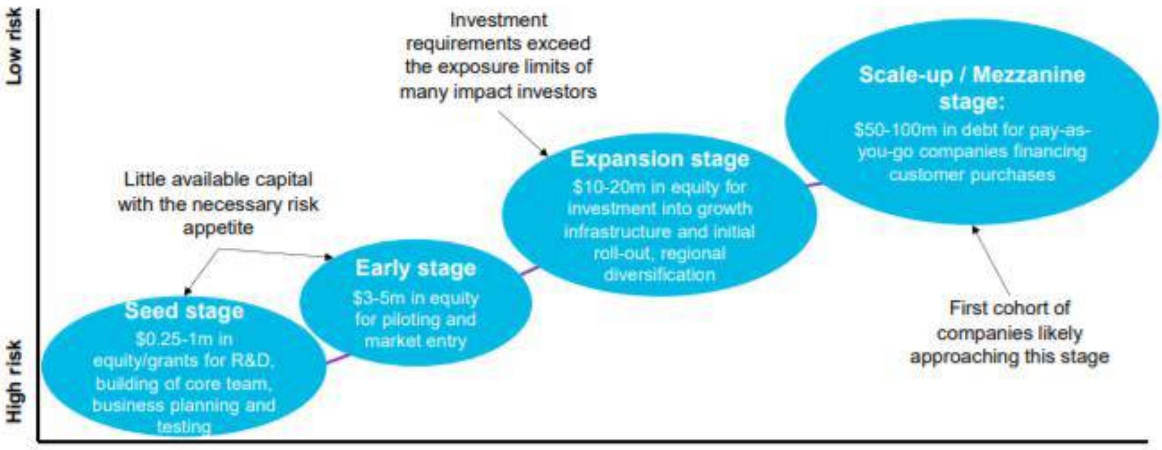
2) **Monitoring and evaluation of the proof of concept**, including its investment and impact track records. This will be critical for convincing investors – both returns-first and impact-first – that the approach has validity, and for providing nascent forestry efforts a clear pathway to success. Box 1 in the main paper describes in particular the efforts and partnerships that would be needed to develop an impact evaluation framework.

3) **Encouraging new entrants into the field of smallholder forestry**. As a capital intensive investment opportunity with extremely long time horizons, it is likely not as easy to scale this industry as what we have seen in, for example, the off-grid solar industry. Yet there is an opportunity here, with critical needs for technical assistance and incentive schemes such as Uganda's SPGS project to create more opportunities for commercial forestry.[33] With more of these types of efforts, we can envision that both individual companies may adopt similar scale up pathways to Komaza, employing the SFV, or that boutique investment firms may develop special purpose vehicles in which they aggregate investments across multiple companies, as has occurred in the renewable energy sector.[34]

Finally, as alluded to above, this type of scale up strategy has already been successful in the renewable energy and energy efficiency sectors. Below is an example of how this has occurred in the off-grid energy sector, where companies such as BBOXX have made it to the right-most, Scale stage. The goal of the SFV is to assist the smallholder forestry sector to reach similar heights.

[31] https://www.youtube.com/watch?v=8tX-MZNSgqw
[32] https://www.gogla.org/sites/default/files/recource_docs/securitization_-_unnecessary_complexity_or_key_to_financing_the_desco_sector.pdf
[33] http://www.fao.org/uganda/news/detail-events/en/c/434208/
[34] See, e.g., the Lab's Green FIDC model developed by Albion Capital: https://www.climatefinancelab.org/project/green-receivables-fund-green-fidc/

Figure 2: Financing needs across an off-grid solar start-up development cycle



Source: Bloomberg New Energy Finance [35]

[35] https://www.bbhub.io/bnef/sites/4/2016/10/BNEF_WP_2016_10_07-Pay-as-you-go-solar.pdf

13. ANNEX 6: KOMAZA'S BUSINESS MODEL

This Annex provides additional details about Komaza's business model, and was provided by Komaza.

Komaza's Operating Model

The Business Model

Komaza, whose operational headquarters are in Kilifi, Kenya, has planted 3,800 hectares of trees with over 14,000 farmers since 2008, making Komaza Kenya's largest commercial tree planter. Komaza employs over 400 staff and is currently scaling its operations and staff.

Komaza partners with rural farmers to plant woodlots that they manage collectively as a "virtual plantation." Farmers contribute land and labor and are paid a fair price for harvested trees. Komaza provides training, planting inputs, maintenance support, harvesting services, and a guaranteed market into their wood processing and sales operations.

Komaza is a forestry business specifically designed to get small-scale farmers out of poverty. Funded by equity capital and (eventually) the Smallholder Forestry Vehicle, the company is planning to expand within and outside Kenya in the coming years.

Komaza's Farmer Contract

In order to enforce Komaza's partnership model with farmers, each Komaza farmer signs a contract outlining the long-term relationship between the farmers and the Company. The major obligations of each party, as outlined in the contract, are:

- The farmer will provide land and labor for tree planting and weeding
- Upon signing the contract, farmers are required to pass Komaza's site selection criteria, complete land preparation, and sign a form certifying that they are the legitimate owner/user of the land in question. The form will be co-signed by chiefs, Kenya's government officers representing the central government in each locality.
- Farmers also provide security for Komaza's trees
- Komaza agrees to provide the farmer with high-quality seedlings, training and a guaranteed market for trees, paying the farmer a fair market price for any trees Komaza removes from the farm

The contract covers 15 years, requiring Komaza to pay the farmer for any trees and coppices (trees that re-grow from the original root network) that are harvested over the fifteen year period. Pricing of harvested trees is determined each year by a formula outlined in the farmer contract, which is based on prevailing market prices and incurred expenses. Throughout the life of the contract, Komaza maintains full ownership of the trees as well as the harvest rights associated with those trees.

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