CHARITY ENTREPRENEURSHIP

Increasing Access to Novel, Low-Risk Loans for Smallholder Farmers

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Ambitious Impact Research Report

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Ambitious Impact (AIM) *exists to enable more effective charities to exist worldwide. We strive to achieve this goal through our extensive research process and Incubator Program. We give talented potential entrepreneurs two months of cost-covered, intensive training designed by founders for founders. Our talented researchers and entrepreneurs identify evidence-based, high-impact interventions and help founders find a co-founder to launch the idea and reach scale.*

Note to readers: *Our research is geared toward AIM decision-makers and program participants. We attempt to find the best ideas for our incubation programs through these reports. Given our commitment to focusing on recommended ideas, reports on those not recommended for incubation can often be less polished.*

For questions *about this research, please contact Morgan Fairless at* morgan@charityentrepreneurship.com.

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Increasing Access to Novel, Low-Risk Loans for Smallholder Farmers / Summary

Description

We review the prospects of incubating a new charity that increases access to finance for smallholder dairy farmers (farmers with 1-3 cows) by working with savings and credit cooperatives (SACCOs) to offer asset-collateralized loans (ACLs) for water tanks. Our modeling describes a hypothetical program in our top priority country, Kenya.

Counterfactual impact

Cost-effectiveness analysis: We model the costs of farmer outreach where we run workshops to explain asset-collateralized loans and to sign up farmers that do not yet have a SACCO account, provide technical assistance to SACCOs to offer loans, and offer default insurance to reduce the risk to the lender. We assume that after providing an asset-collateralized loan, (discounted) milk sales will increase by 9%, increasing incomes by approximately 400 Kenyan Shillings (Ksh) per household per month. This intervention is expected to be cost-effective, creating 82 consumption doublings per USD 1,000, or costing USD 12 per consumption doubling (see here for discussion and here for the model).

Scale this charity could reach: Assuming we can reach 30% of eligible farmers at scale, we will create ~33,000 income doublings annually. We define eligible farmers as smallholder farmers with 1 to 3 cows without a water tank who take out a loan and can pay it back.

Potential for success

Robustness of evidence: We are moderately confident that a new organization can lead change in this space. Precision Development (PxD) is currently running a similar program with 5 SACCOs yielding "similar results" to those seen in studies (see here).

Our key concern for this intervention is its evidence base (especially outside of Kenya). We primarily rely on one study from Kenya (n=1,804 farmers) demonstrating that ACLs can increase milk sales, income, and consumption. This study is fairly old (the study period was over 10 years ago), and its results are only statistically significant when trimming the data (although we think that trimming the data makes sense in this case). However, newer published and unpublished evidence primarily supports its findings. We have adjusted the stated increase in milk sales downward in our cost-effectiveness analysis because of this limited evidence base. We would be surprised if the overall impacts were much lower than modelled, but this is still worth highlighting as a possibility (see here).

Theory of Change: Instead of providing financial assistance itself, this charity aims to convince SACCOs to provide ACLs for water tanks to farmers. To do so, it can leverage the existing evidence base as a proof of concept, provide technical assistance to SACCOs, offer default insurance to SACCOs to reduce the risk to the lender, work with SACCOs to market these loans, and work with farmers to increase take-up (see here). We expect that after a few years (1-5 years) of piloting and engagement, SACCOs will see the benefit of ACLs and continue offering them without charity support.[1]

[1] Note that, to be conservative, in our CEA we assume that the charity provides support for the entire duration.

The theory of change for this intervention is relatively clear and concise with no major bottlenecks. Success will largely depend on the charity's ability to get SACCOs and farmers on board.

Neglectedness

Neglectedness: To our knowledge, no one is working on this idea outside of Kenya. Within Kenya, PxD is currently working with 5 SACCOs, but this is not their core program. We think that there is space for a new organization even within Kenya, as we could work with farmers that will not be targeted by PxD (those without an existing SACCO account).

Geographic assessment: We think that Kenya should be the first country that a new charity works in, as most of the evidence is from this country. It has a system of dairy cooperatives and SACCOs that makes an asset-collateralized loan system relatively easy to implement. Our geographic assessment prioritizes countries that economically depend on agriculture and have a high current and future drought risk. Following our weighted factor model, we expect the intervention to be promising in 15+ other countries (see here for discussion and here for model).

Other

Expert views: Experts largely supported this intervention, although some, unfamiliar with asset-collateralized loans, expected that lenders would be hesitant to offer these loans. They also highlighted that, outside of Kenya, a new charity would need to scope which countries have conditions conducive to program success, including having a strong system of SACCOs (or equivalent) and cooperative dairy farming, as farmers' access to markets is linked to income increases and repayment rates (see here).

Implementation factors: One positive implementation factor to highlight is that we believe this intervention might be able to access counterfactually clean climate adaptation funding. One implementation concern we have is the risks of harm of this intervention. Although we expect repossession to be rare, we do not yet have a clear view of how repossessions would work in practice and their effects on farmers and SACCOs (see here).

Increasing Access to Novel, Low-Risk Loans for Smallholder Farmers / Crucial considerations

How concerned should we be about the impact of this intervention on cows?

On net, we believe that this intervention likely increases animal welfare, though we are concerned about the decreased opportunity to walk for the cows who were previously walked to water sources who now could remain tied up all day.

- **Cows will have more frequent access to a more appropriate or cleaner water source:** Cows are usually walked to water sources or have water fetched for them. Water tanks will allow cows more opportunities to drink throughout the day than they otherwise would have, decreasing thirst and improving their health and survival rates. The rainwater stored in water tanks is more appropriate for cows that would otherwise drink unsuitable saline water from shallow wells or valley bottoms. Water in tanks may also be cleaner than the counterfactual water source as sometimes cows can be walked to water that is contaminated by fecal matter.
- **Cows will no longer be walked to water sources:** With frequent access to water on farms, farmers will no longer need to walk cows to a water source. This has both positive and negative welfare effects. On the positive side, less walking to water sources reduces exposure to diseases and less potential for injury or death. On the negative side, this could mean that cows spend their entire day tied up. The likelihood of this zero grazing system is largely unknown. It could be that cows are able to graze as normal, but now have water access close by as opposed to walking a farther distance.
- **In the main study we reviewed, the proportion of farmers with at least one sick cow fell by 12.9 percentage points in the group with higher take up of the loans for water tanks.**
- **We do not think that more cows will be farmed as a result of this intervention**. We are not concerned that this intervention will lead to more animals being farmed. A 10+-year follow-up study to the original Jack et al. RCT (study period 2011-2012), which surveys a subset of farmers finds “no evidence of changes in aggregate herd sizes” by 2023 (Deutschmann et al., in progress). Even if this intervention did increase the number of cows farmed, we wouldn’t expect this to lead to large, intensive herd sizes as we are targeting farmers which currently only have 1-3 cows.

Will the SACCOs or other credit organizations actually be willing to offer ACLs?

Our current understanding of why these credit organizations are not currently offering ACLs is because ACLs are less common in LMICs and lenders are usually conservative and risk-averse so typically require guarantors.

Our idea is to address this market failure through a demonstration effect. We can show lenders that ACLs are a good, profit generating, idea. To try and determine how strong this demonstration effect actually is, and whether credit organizations would actually be willing to offer ACLs, we spoke with a number of experts. A majority of them suggested ways in which this is likely to happen—we report on these in annex 2.

Should we delay recommendation until more evidence is available?

We are unsure but lean towards recommending sooner as the experts we spoke with suggest that the new preliminary evidence is yielding “similar results” in the loan take up rates found in the Jack et al. (2023) RCT. Another study considering the long-run effects (2012–2022) of the same intervention found that farmers who were offered the nearly fully asset-collateralized loan sold,

on average, 10% more milk than farmers offered the 75% asset-collateralized loan even 10 years after. These farmers also had more water storage capacity, six weeks longer resilience to dry spells, and spent less time fetching water. A pilot program implemented in Rwanda by the J-PAL Africa policy team found 43 out of 160 farmers (27%) took up the loan, with only one default. Lastly, a project by Precision Development has replicated the study in 2021 and 2022 and the findings so far suggest increases in sales in a similar 10-15% range.

How well will this intervention scale?

We might expect increasing marginal costs when expanding to countries other than Kenya where the SACCO and dairy cooperative set-up is not as established as it is in Kenya. However, this could largely be controlled for with strong country selection. We think more research is needed to understand the potential of this intervention in countries other than Kenya and to explore how the program can be adjusted for different contexts, though evidence from Rwanda is encouraging.

There are also other interesting scaling options for this charity such as providing asset-collateralized loans for other assets with low depreciation rates.

How should we think about the potential for crowding out Precision Development?

We are not concerned about this. A new charity should be in constant conversation with PxD when designing their intervention. PxD does not seem concerned about a new charity working in this space, in fact they seem excited.

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1 Background

1.1 Context

Ambitious Impact (AIM) exists to increase the number and quality of effective non-profits working to improve human and animal wellbeing. AIM connects talented individuals with high-impact ideas. We give potential entrepreneurs intensive training and ongoing support to launch ideas to scale. Our research team focuses on finding impactful opportunities.

As part of our 2024 research agenda, we reviewed interventions for increasing income and economic growth. In that context, we researched the potential of providing asset-collateralized loans to farmers to purchase water tanks. We revisited this report in the first half of 2025. This report provides an overview of our findings.

1.2 Introduction to the idea and problem

Smallholder dairy farming is a large sector in many countries. In Kenya, for instance, over 1.8 million households own between one and three cows, relative to a population of 55 million. These smallholder dairy farmers own over 80% of the national dairy herd (Otieno et al., 2021).[2]

Rural poverty poses a significant development challenge in Kenya and other similar countries. Poor households find it difficult to turn agriculture into a profit because of limited infrastructure, complex land procurement and inheritance, unsustainable farming practices, and a lack of knowledge of climate-smart agriculture. Climate change, which causes environmental shocks such as droughts, makes escaping poverty more difficult (Eichsteller et al., 2022).

[2] For reasons explained in our geographic assessment, this report primarily focuses on Kenya. However, we believe there are over a dozen other countries that would be good candidates for this intervention.

For Kenyan smallholder dairy farmers, access to water is a central challenge. According to the Kenya Integrated Household Budget Survey, 76% of rural households spend over 3.5 hours per week fetching water (Kenya National Bureau of Statistics, 2018, figure 3..11). Climate change poses a considerable burden on water availability and quality, as it can exacerbate water scarcity, increase water requirements for cattle, reduce rainfall, and increase the period of drought. This reduces milk production and quality, increases cow mortality, and reduces reproduction (Tadesse and Dereje, 2018).[3]

Rainwater tanks can benefit household welfare and dairy production. Research suggests that access to water tanks can increase milk production and milk sales in Kenya (Deutschmann et al., n.d.; Jack et al. 2023). Additionally, they could provide rural households with a source of more convenient and cleaner water, freeing up time that (mainly) girls spend fetching water and increasing school attendance (Precision Development, 2022).

Farmers who wish to invest in their farm, for example by buying a water tank, often face barriers to accessing finance (Khan et al. 2024; Odero-Waitituh, 2017), which we discuss in the next section. Based on a randomized controlled trial (RCT) by Jack et al. (2023), we think that working with institutions to offer asset-collateralized loans for water tanks is a promising way to increase access to finance for water storage. These loans require no to very little traditional collateral (such as cash or a land deed) and usually no guarantors. Instead, the sold water tank itself is the collateral on the loan.

Our report discusses the potential of a charity that works with credit cooperatives (SACCOs) to offer asset-collateralized loans for water storage tanks.

[3] We are grateful to Precision Development for pointing out these resources on their website.

2 Theories of change

2.1 Barriers

Upfront costs are a barrier to farmers who could benefit from increased water storage. The costs of installing water storage are typically one-off costs, such as the purchasing costs of a water tank, its delivery, and installation (water tanks cost 34,000-38,000 Ksh, which is equivalent to a total of ~$262-294). Conversely, the benefits of water tanks are spread over all years during which the water storage method is used. While farmers benefit over time, they do not have the liquidity to purchase a water tank at full cost. A loan, which would be repaid using the increased income from the water tank, could be used to overcome the upfront cost barrier.

There are constraints to agricultural finance in remote regions in low-income countries. Farmers often face barriers in accessing agricultural finance because, for example, they lack the required collateral, do not meet the strict eligibility criteria for loans, or cannot pay the high interest rate (Khan et al. 2024). Smallholder farmers are often seen as high-risk borrowers by financial institutions. For this reason, financial institutions often add further barriers to access to finance (Deutschmann; Schinaia; Jack; Salomon, interviews), such as requiring guarantors for a loan.

There are many potential ways to store water and finance solutions to water scarcity. Annex 1 outlines different options.

2.2 Theory of change of this charity

The ToC considered in this report involves a charity that increases access to finance for smallholder dairy farmers by working with savings and credit cooperatives (SACCOs) to offer asset-collateralized loans (ACLs) for water

tanks.[4] For this purpose, the charity delivers advice and technical assistance to SACCOs to offer loans, works with farmers to make them aware of the option and set up their finance infrastructure if needed, and offers default insurance to reduce the lender's risk.

Early research on ACLs for water tanks in Kenya has delivered promising results. Still, this solution appears much more neglected than other water storage solutions, like group lending for water tanks or demi-lunes for catching runoff.

[4] The benefit of working with dairy farmers as opposed to (food) crop farmers is that they have a regular and stable source of income compared to crop farmers with one or several harvests per year. Additionally, dairy cooperatives are common in Kenya, which allows for an easy repayment scheme through dairy cooperatives. This is aided by the fact that milk is a relatively homogenous product that is easy to put a price on.

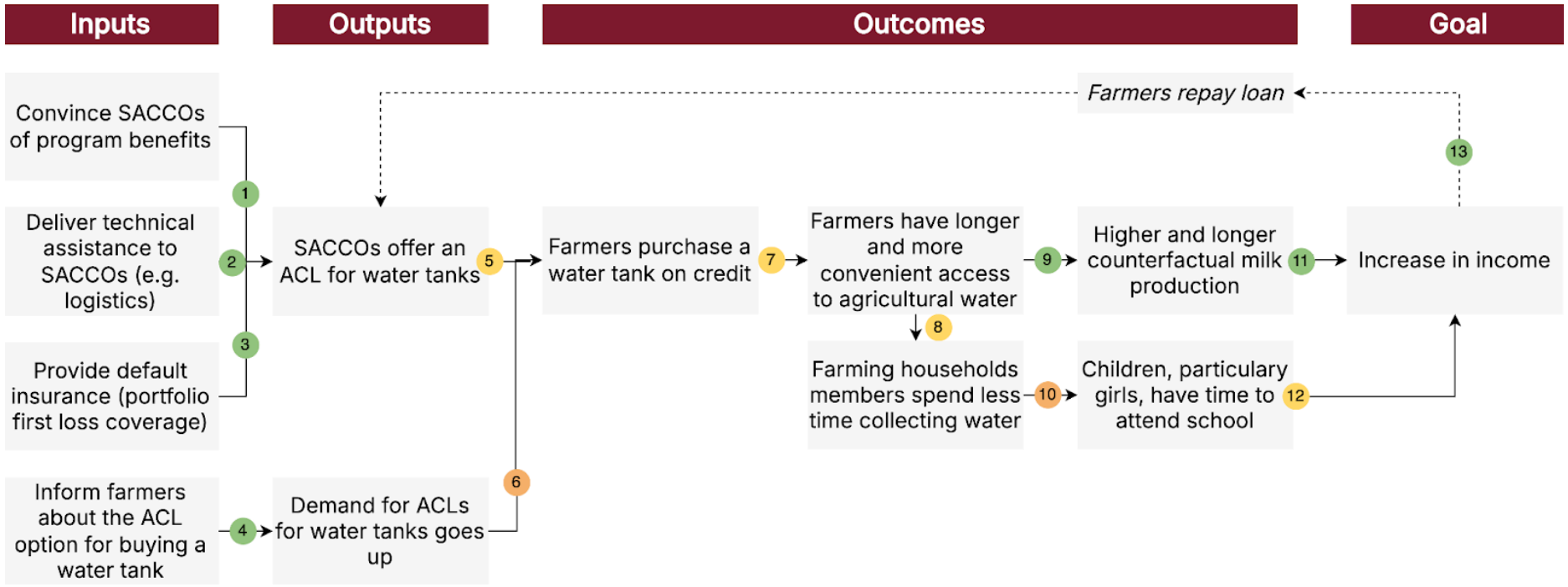

Figure 1: Theory of change for the charity

2.4 Assumptions and key factors

1. **SACCOs see financial and social benefits in offering ACLs. (Low Uncertainty, LU)**

   In a pilot study (Jack et al., 2023), the SACCO continued to offer ACLs after the experiment, indicating that they see it as a viable business opportunity. Replication studies have been successful, too.

2.
   a. **The technical assistance sufficiently reduces logistical and administrative barriers specific to the SACCO's needs. (LU)**

      We expect the technical assistance, such as monitoring and evaluation, partnering with tank suppliers, and facilitating partnering with dairy cooperatives to be quite straightforward. Previous initiatives by Jack et al. (2023) and Precision Development have been successful with technical assistance.

   b. **SACCOs have adequate internal capacity to implement the program with technical support. (LU)**

      Interviewees say SACCOs have sufficient internal capacity to implement a new loan program.

3.
   a. **The credit guarantee sufficiently mitigates perceived financial risks for SACCOs. (LU)**

      Following our cost-effectiveness analysis and the repayment rates in Jack et al. (2023), the charity can offer near full default insurance to the SACCO for initial loans if needed without presenting a significant cost burden to the charity.

   b. **The charity has sufficient access to capital to offer credible default insurance. (LU)**

Following our cost-effectiveness analysis, the capital requirements for default insurance are very small compared to the other variable costs of the charity.

4.

a. **Farmers understand and trust the information about water tank ACLs. (Some Uncertainty, SU)**

   While empirically unknown, a program led by a SACCO could benefit trust, as farmers are members of SACCOs themselves.

b. **Farmers have a correct belief that they would benefit from purchasing a water tank and see the ACL option as advantageous. (LU)**

   While there is no public survey data on understanding and trust from pilot studies, a high uptake rate combined with a high repayment rate (Jack et al., 2023) suggests that farmers considered ACLs to be beneficial and correctly predicted that they could repay.

5. **Farmers' financial circumstances allow them to afford the loan terms. (SU)**

   We expect that a minority of dairy farmers cannot receive a loan, as their milk production is insufficient to offset the loan costs with increased milk sales. The program can account for this by advising farmers not to take the loan if their financial conditions do not allow for repayments. In our cost-effectiveness analysis, net farmer income decreases by ~7% during the loan repayment period (two years). However, note that this model is conservative and errs heavily on low benefits and high costs to farmers.

6. **SACCOs (and/or the charity) adequately promote the ACL program to farmers. (High Uncertainty, HU)**

   We expect that the SACCO can and will promote the ACL, as they are connected with the community and have a financial incentive to do so. To account for SACCOs doing too little outreach, we account for the charity

doing a large share of the farmer outreach in our cost-effectiveness analysis.

7.

a. **Water tanks are installed correctly and function as needed. (HU)**

   There is a chance of a principal-agent problem when the company installing the water tanks has no interest in adequately installing the tank, which should be mitigated.

b. **Farmers have access to sufficient water to fill the tanks without negatively affecting other people's access to water. (SU)**

   This depends on the rainfall patterns in the area of operation. We expect water storage to be small compared to overall precipitation in an area.

c. **The tanks can hold useful amounts of water compared to water use. (SU)**

   Assuming lactating cows drink approximately 75 liters of water per day, a 5000-liter tank can sustain three cows for 22 days if water is not used for other purposes, if all cows lactate, and if there are no other water reserves or precipitation. This considerably reduces the duration of a dry season.

8. **Water tanks are regularly filled through rainwater harvesting, or from nearby sources, reducing the need for distant water collection. (SU)**

   When properly installed (assumption 7a), tanks fill automatically during the rainy season.

9. **Cows drink water from the water tank more regularly and longer than the counterfactual. (LU)**

   Cows drink water seven to 12 times per day if they can, which is more often than the number of times they are brought to a water source.

10. **Time saved from water collection is redirected towards educational opportunities for girls. (HU)**

    Jack et al. (2023) found a significant two-percentage-point increase in female school enrollment from a 97.5% control mean, although they did not find evidence that a change in household time allocation drove this. We are more skeptical of these results than the direct income effects, so we have not included them in our cost-effectiveness analysis.

11. **Farmers have access to markets or opportunities to sell surplus milk and increase their income. (LU)**

    The intervention would target farmers with a SACCO account who sell milk to a dairy cooperative, as this is a convenient system for loan repayments. For later expansion, the charity can consider helping other farmers sign up for SACCO accounts in workshops. These costs are included in the cost-effectiveness analysis.

12. **Education leads to girls earning higher income, despite potential cultural homemaking role expectations. (SU)**

    Studies on the returns to education depend on observed income data, which could exclude individuals who do not participate in a labor market. In Kenya, the labor force participation rate is only slightly lower for women (72.2%) than men (75.3%) (World Bank, n.d.). This presents a moderate risk of overestimating the returns to education. Note that we opted not to include the girls' education effects in our cost-effectiveness analysis as they are more uncertain than the direct income increase effects of the ACL.

13. **Farmers repay the ACL. (LU)**

    In an experiment with 96% asset-collateralized loans for water tanks in Kenya, the repayment rate was 99.3% (Jack et al., 2023).

We also think this intervention could have health benefits, but we have not included these in the ToC as they are not the primary outcome of this model, which is focused on increased income. These potential health benefits include:

- Access to cleaner water for domestic use: The stored rainwater may provide safer and more convenient water for domestic use than was previously available. This increased water availability could lead to more frequent washing, drinking, and cleaning with safer water, which could improve health.
- Increased milk production improves nutrition and food security: Households could consume the surplus milk production rather than selling it, which could improve their nutrition. This may also improve food security in food-insecure areas. According to a report by Foresight4Food, food access is a key constraint for Kenyan households because of poverty and food prices, exacerbated through drought. Protein intake is insufficient in 80% of rural households, and dairy consumption is below the target for 50% of all households (de Jong et al., 2024). For dairy farmers specifically, these numbers may be different.

3 Quality of evidence

3.1 Evidence that a charity can effect change in this space

Recent systematic reviews on the specific effects of microfinance on smallholder farmers are lacking. Although microfinance is subject to thorough academic evaluations, systematic reviews on agricultural microfinance are sparse.

The positive and negative effects of microfinance on low-income households depend on the intervention set-up and context. A systematic review of the impact of microfinance on low-income households in Kenya (n=38 studies) found that 14 out of 17 included studies on microfinance on the household level had a positive direction of impact, whereas two studies found negative effects and one study found both positive and negative effects.[5] According to the author, the state of the literature does not allow for conclusive statements on the impact of microcredit interventions on the poor because of inconsistent study design, outcome variables, and context (Shakir, 2022).

Asset-collateralized loans lack many features that academic literature identifies as barriers to effective rural microfinance. A systematic review (n=23 articles) on the impact of microfinance on the rural agricultural sector in developing countries found that high transaction cost risks, uncertain climate and weather patterns, and a lack of collateral assets threaten the effectiveness of microfinance (Silva and Rupasinghe, 2022). In principle, asset-collateralized loans could reduce these risks by (a) working with dairy cooperatives and SACCOs to arrange automatic repayments to reduce transaction costs, as trialed in Jack et al. (2023), (b) reducing uncertainty around climate and weather patterns by offering farmers a water tank, which is a climate adaptation tool, and (c) eliminating the need for pre-existing collateral by offering the tank itself as a form of collateral.

[5] The studies that found positive effects for households measured the outcomes on income savings, household income, consumption, savings, healthcare, and consumption. The studies with negative effects measured debt repayment, household assets, and household income. The study with both directions of impact measured debt management.

3.2 Evidence that the change has the expected effects

While initial research is positive, the academic literature on ACLs for water tanks is small. Most evidence specific to ACLs for water tanks comes from a single RCT (Jack et al., 2023). Preliminary evidence on scaling and alternative borrowing conditions is underway but has not yet been published. This section covers the RCT on ACLs for water tanks in Kenya and the upcoming literature.

A trial of ACLs for water tanks conducted from 2011 to 2012 and replicated in 2012 shows positive results. Farmers from a dairy cooperative in central Kenya (n=1,804) were randomly offered one of four loan options. As shown in Table 3, nearly fully asset-collateralized loans received by far the highest uptake rate, implying that about 95% of those who wished to borrow at the interest rate (1% per month) were unable to because of deposit or guarantee requirements.[6] On average, farmers in the last group had fewer assets and produced less milk than farmers in the other groups.

Table 3: Loan types, take-up rates, and repossessions in Jack et al. (2023)

Group	Loan type	Take-up rate	Repossessions
1	**Standard loans** 33% borrower deposit 67% guarantees	2.4%	0.0% (0)
2	**Mostly asset-collateralized** 75% asset-collateralized 25% borrower deposit	27.3%	0.0% (0)
3	**Mostly asset-collateralized** 75% asset-collateralized 21% guarantees 4% borrower deposit	23.5%	0.0% (0)
4	**Nearly fully asset-collateralized** 96% asset-collateralized 4% borrower deposit	44.3%	0.7% (1)

Despite the relaxed borrowing requirements, there were no repossessions in groups 1 to 3, and only one repossession (0.7% of the sample) in the nearly fully asset-collateralized loan option, with similar results in the replication study. Using

[6] (0.443-0.024)/0.443 ≈ 0.946, assuming that borrowers are rational actors. As discussed later, higher take-up can also be caused by an endowment effect or risk aversion.

administrative data from the dairy cooperative, the authors find that milk sales in the groups offered asset-collateralized loans (groups 2, 3, and 4) went up by 12.8 liters per month (95% CI: [2.741, 22.757], p=0.0125), compared to a 130.7L control mean.[7] The study also finds a two percentage point increase in the school enrollment of girls (up from 97.5%), but did not find evidence that this change is driven by a change in intra-household labor allocation (Jack et al., 2023).

Newer, preliminary evidence primarily supports the earlier findings, but is not publicly available as full text. Jack et al. (2023) note that a similar pilot program was implemented in Rwanda by the J-PAL Africa policy team with 43 out of 160 farmers (27%) taking up the loan, with only one default. A not-yet-published study considers the long-run effects (2012-2022) of the same intervention, and finds that farmers who were offered the nearly fully asset-collateralized loan sold, on average, 10% more milk than farmers offered the 75% asset-collateralized loan even 10 years later. These farmers also had more water storage capacity, six weeks longer resilience to dry spells, and spent less time fetching water (Deutschmann et al., n.d.).[8] Lastly, a project by Precision Development has replicated the study in 2021 and 2022 with two more SACCOs. While this study is still ongoing, the findings have yielded "similar results" in the loan take-up rates, but it is too early to tell what the expected increase in milk sales is (Salomon, expert interview).

[7] Their findings on milk sales are only statistically significant at the p < 0.1 level when 1%, 5%, or 10% of the highest values in linear models are trimmed. We think that trimming outliers is methodologically justified to reduce sensitivity to outliers, which are larger farms that are less interesting when aiming to achieve income doublings. The results in linear models are robust to different trim percentages. The authors find higher and significant estimates when using a logarithmic or inverse hyperbolic function. The authors also consider self-reported impacts on milk sales, but find no significant effects. The estimation featured in the text is a linear estimation with a 5% trim. Note that the study reports two-sided significance, while one-sided significance may be more appropriate when one assumes that offering asset-collateralized loans decreases milk sales.

[8] Based on an abstract on the website of one of the authors.

3.3 Adjacent evidence on reasons for higher take-up

While other studies have not explicitly studied the effect of offering asset-collateralized loans for water tanks, we can learn from adjacent research by drawing parallels.

Increased demand for products under asset-collateralized loans can—in part—be explained through the endowment effect. In a field experiment (n=701) in the same setting as previous research in Kenya, participants were given a randomly selected durable asset.[9] One week later, participants were offered a loan to purchase another asset using their previously given collateral, or the new asset itself (randomly assigned). Participants were willing to pay 9% higher interest on the same-asset collateralized loan, which the authors argue is driven by borrowers underestimating their future attachment to an asset before owning it (an endowment effect; Carney et al., 2022). This partially explains the high take-up rate of asset-collateralized loans and their high repayment rates.

Asset-collateralized loans have also been shown to increase access to finance for cookstoves. In a field experiment in Nairobi, households were willing to pay 12 USD equivalent for an energy-efficient cookstove, even though the yearly savings are approximately twenty times larger (Berkouwer and Dean, 2019). Participants randomly selected to be offered an asset-collateralized loan had more than twice the willingness to pay compared to participants who were not. The increased willingness to pay was $12.54 (95% CI: [11.23, 13.85], p<0.0001, control mean $12.12), although this was not compared to loans that had other forms of collateral. There are interesting parallels between this research and Jack et al. (2023), as both pertain to asset-collateralized loans for products that give a return on investment for credit-constrained people.

3.4 Evidence on externalities

The reviewed literature identified two possible externalities.

[9] The assets used were a metal milk can, a cow sprayer, a set of cooking pots, and a large thermos.

There is a risk of harm when a SACCO repossesses a water tank that poor farmers depend on for water security and, potentially, girls' education. During repossession, SACCOs also risk negative publicity within the community. While the published field experiment with water tanks only saw a repossession rate of 0.7%, Jack et al. (2023) report that SACCOs had to balance the negative publicity of repossession and the credibility of the threat of repossession in the case of no repayment. There are no data on the effects of repossession on households.

The intervention likely increases animal welfare. Survey responses from Jack et al. (2023, Table 5) indicate that the proportion of farmers with at least one sick cow fell by 12.9 percentage points (95% CI: [-19.8,-6.0], p=0.00023, control mean=37%) in the group offered a 96% asset-collateralized loan compared to a 100% cash-collateralized loan. Moreover, rainwater will provide a more appropriate water source for cows that would otherwise drink unsuitable saline water from shallow wells or valley bottoms (Njarui et al., 2014). While the intervention reduces the need to take cattle to a water source (which could mean cows will have less opportunity to walk), less walking to sources reduces exposure to diseases, for example, through fecal matter in sources. We are not concerned that this intervention will lead to more animals being farmed as preliminary research by Deutschmann et al. (in progress) shows increases in the amount of milk sold to dairy cooperatives for asset-collateralized loans, but no evidence for an increase in herd size.

There is weak evidence that the intervention reduces the intensity of greenhouse gas emissions from dairy farming. As above, the preliminary research by Deutschmann et al. shows increases in the amount of milk sold to dairy cooperatives for asset-collateralized loans but no evidence for an increase in herd size. This suggests that farmers can produce more milk with the same number of cows and, therefore, with fewer emissions.

4 Expert views

Expert interviews are presented in chronological order.

4.1 Joshua Deutschmann and Giulio Schinaia

Profiles: Joshua Deutschmann is the Evidence Synthesis and Research Lead at the Development Innovation Lab (DIL) at The University of Chicago and is currently working on the project 'Credit for climate change: Promoting and scaling asset-collateralized loans for water tanks' with Kevin Carney, Tomoko Harigaya, and Michael Kremer, together with Precision Development. Giulio Schinaia is a Postdoctoral Scholar at the same institution. Both interviewees collaborate on a project studying the long-run effects of asset-collateralized loans.

The key points from this interview are:

- **Asset-collateralized loans lower entry barriers for farmers by reducing or removing guarantor requirements and allowing the asset itself to serve as collateral, unlike traditional agricultural microfinance, which rarely supports investment in productive assets.** When paired with value chain repayment mechanisms, such as automatic deductions from regular income payments, these loans also reduce transaction costs and default risk, enabling lending at scale. In the dairy value chain in Kenya, farmers regularly deliver milk to a dairy cooperative, and they are paid monthly into a SACCO account. The monthly repayment can be automatically deducted from their monthly income. This seamlessness enables very low default rates. For this reason, the interviewees suspect that an ACL might work well in other value chains with regular income, such as irrigated horticulture and poultry. The benefits of ACLs are less obvious for value chains with one or two harvests per year, and where the farmers' income is too lumpy for regular repayment.
- **Low asset depreciation rates are conducive to program success.** In theory, asset-collateralized loans work well with assets with a low

depreciation rate. Water tanks last a long time, and there is a credible repossession mechanism and a market for second-hand tanks. A SACCO is launching a pilot with biodigesters, which have similar properties as water tanks. The Nyala SACCO has also tried ACLs for chaff cutters, which have been successful for them despite the higher depreciation rate.

- **In Kenya, a charity could consider scaling ACLs for water tanks by delivering technical assistance to SACCOs**. The charity can research and reduce the financial and technical hindrances. For example, the organization can de-risk in the case of farmers defaulting or find external capital to enable more asset lending.

  When prompted, the interviewees suspect that organizational capacity of SACCOs, such as human resources and equipment, should not pose a problem. At the same time, the charity should have staff that can work with smallholder farmers locally. The potential scale of the charity in Kenya is large, and existing organizations are small, which makes Kenya an interesting place for a charity to work.

- **Outside Kenya, the charity should first scope which countries have conditions conducive to program success**. These conditions include a strong system of SACCOs (or equivalent), and cooperative dairy farming.

- **Existing organizations are likely not working on ACLs for water tanks because it is outside their scope.** Most microfinance institutions operate differently by lending short-term, smaller amounts of money. The One Acre Fund, a prominent NGO, mainly focuses on maize.

4.2 Matthew McCartney

Profile: Matthew McCartney is the Research Group Leader for Sustainable Water Infrastructure and Ecosystems at the International Water Management Institute. He leads the 'Built water storage in South Asia' project, which improves water security through better planning of, management of, and cooperation for water storage systems.

The key points from the interview with Matthew McCartney are:

- **To assess the benefits of water storage, it is important to think about the context, what the water will be used for, and the temporal distribution of rain in the target area.** Since five cubic meters is not a lot of water, it cannot support many cows for long. The product makes sense for household water storage and irrigation for small gardens. (Specifically for crops: water tanks can be used for supplementary irrigation to keep crops going during a dry spell for a few days, even in the wet season. Water storage can be used to extend the growing period.)
- **Targeting dairy farmers will not target the poorest of the poor.** Unlike some other farmers, they already have some assets by owning livestock.
- **The advantages of water tanks as a water storage method are that they are simple to set up and have no issues with pollution.** If they are elevated, a water line can be pressurized and drip irrigation can be used.
- **The disadvantages of water tanks are that they don't store large amounts of water.** Their costs are quite high relative to the volume of water. A small pond could have lower per-unit costs.
- **Women often have a harder time accessing water interventions.** It's important to consider whether women in female-headed households can access the intervention. For this purpose, it's important to think about how people know about the schemes – will women show up to meetings? Not being able to show a title deed to your land is an issue that particularly affects women.[10]

4.3 Billy Jack

Profile: Billy Jack is Professor of Economics at Georgetown University and co-director of gui2de—the Georgetown University Initiative on Innovation, Development and Evaluation, which conducts empirical field research on the

[10] The proposed intervention does not require borrowers to show a title deed to their land.

impact and effectiveness of development interventions. He is one of the authors of a paper on asset-collateralized loans in Kenya (Jack et al., 2023).

The key points from the interview with Billy Jack are:

- The intervention evaluated in Jack et al. (2023) was mainly about the credit market: How can we design a credit contract that has a robust repayment scheme but gives better access to finance? Banks are normally conservative and risk-averse, and they believe that lending money to poor farmers is a bad idea. However, in this experiment, access to finance did not cause bad repayment.
- **We do not yet have a clear view of how repossession would work in practice and what the effects would be on farmers and SACCOs.** The experiment in Jack et al. (2023) did not show us the effects of repossession, because it did not happen often.
- **What could be the role of a charity?**
    - **Demonstration effect:** The role of a charity could be to address a market failure. SACCOs weren't doing something that was worth doing, as they had a wrong idea about what the best thing to do was. Asset-collateralized loans are not common in the developing world. A charity could show the market that ACLs are a good idea—a demonstration effect.
    - **Improving targeting:** There is more to learn about how to reach the right people. What was it about the people that had the biggest positive impact from this intervention? Can we learn how to target this credit better? The charity could look for heterogeneous impacts.
    - **Technical expertise: I**mproving administration, finance, and the supply of capital. It is helpful to have a team that can talk to both the people in suits in the banks/credit organizations/SACCOs and farmers in the field.

    - Exit strategy: The role of the charity might not be long-term, but it could try to put itself out of business in the next 5-10 years when banks, credit organizations, and SACCOs step in themselves.

- **The probability of change happening anyway is complex.** While there appears to be a large potential market, there is still a need for more evidence.

- **Competition for capital:** SACCOs don't always have a lot of capital. They can't on-lend capital because financial institutions don't want to collaborate because of the risk.

- **The economic benefit of the water tank is that it keeps milk productivity up for longer, thereby reducing the dry season**. However, these tanks aren't large enough to support farmers during long droughts or the whole dry season. That's okay, though, because we're looking for a way to make people's lives better, not perfect.

    - Farmers may also be able to get a second water tank, though this possibility is outside the scope of our research.

- **Scalability to other areas: You need an area with not too much but also not too little rain.** Northern Kenya might be too dry, but maybe Rwanda already gets too much rain. From an institutional or economic point of view, there are credit markets all over the world, and collateral is a common element in credit contracts. However, in places where savings groups (like SACCOs) do not exist or if there is an underdeveloped financial system, this won't work.

4.4 Andrew Kabucho

Profile: Andrew Kabucho is Investment Manager Africa & Middle East at Kiva, a non-profit with a mission to expand financial access to underserved communities, including farmers. The organisation works with microfinance institutions which post profiles of capital-seeking entrepreneurs on the Kiva website, which lenders can browse and supply capital to via local organizations.

Andrew Kabucho was skeptical about the willingness of lenders to use assets purchased with the loan as collateral. The key points from his interview are:

- **A financing structure exists where microfinance institutions and banks have received funding from development finance institutions and other investors specifically to on-lend for WASH**.[11] This is typically provided as an auxiliary product alongside other loans that the clients are servicing.
- **Lenders might shy away from using assets purchased with the loan as collateral**. Same-asset collateralization is the key difference between this intervention and common microfinance. Since water tanks are a movable asset with no active secondary market, lenders would shy away from using this as collateral. Most WASH loans are secured by other hard collateral or provided under the group lending methodology. Lenders generally do not value unconventional collateral, and water tanks would fall under this category. Therefore, the loans would need other forms of credit enhancements such as a group guarantee or personal guarantee.
- **Capital is always a constraint for lenders**. There is also not much funding available to WASH-related sectors, so any additional sources are always welcome.
- **Loan product design is useful in ensuring its uptake**. Having a repayment structure that matches the farmers' cash flows is also essential. Tenor is determined by the loan size and farmers' disposable income. It usually ranges between 12 and 24 months. Group lending is the best in eliminating barriers to access, as most farmers do not have access to conventional collateral.
- **Geographical prioritization:** With changing climatic conditions, this model would be most valuable in rural settlements with below-average rainfall and countries for which agriculture accounts for a large portion of employment and economic production.

[11] WASH: Water, Sanitation, and Hygiene

- **Gendered aspects:** Rural women tend to be the biggest beneficiaries as they are the ones tasked with most farm work including fetching water for the homestead. They are also the largest participants in group lending hence this would improve their wellbeing and promote equality.

4.5 Hedwig Siewertsen

Profile: Hedwig Siewertsen is the Head of Inclusive Finance at AGRA. AGRA is an African-led organization that promotes agricultural innovations that enhance the productivity, income, and food security of smallholder farmers cultivating food crops. It focuses on addressing the unique environmental and agricultural challenges African farmers face, aiming to support sustainable production growth and improved market access. AGRA's work seeks to transition smallholder farming from subsistence to a viable economic activity.

The key points from the interview with Hedwig Siewertsen are:

- **Farmers' access to markets is important to program success**. Farmers can only pay back a loan if they are linked to a market. For some of AGRA's programs, the purchase contracts stipulate specific production methods for food crops to increase productivity. Hypothetically, periodic repayments in the dairy sector are relatively easy to arrange because of continuous demand and the use of scales and periodical payments to farmers. However, if farmers have to repay from their sales to a dairy purchaser, there is a risk that the informal market for dairy grows.
- **For AGRA, awareness-raising has been an important method**. In most countries, the government's provision of agricultural information is insufficient. AGRA does demonstration projects with agricultural advisors who are farmers themselves but are more educated.
- **Speculatively, involving the provider or manufacturer of the water tanks can contribute to program success**. Scaling up water tank loans increases the market for water tank providers, so in return, they could take on a part of the default risk or lower prices. Giving water tank companies an interest in

the program's success also reduces the risk of low-quality water tanks. The charity or SACCO could do a call-for-interest to see what water tank companies are able to offer when supplying at scale.

- **Carefully consider whether the water storage quantity and the water needs line up**. When there is no rain, the water tank can supply water for "three days maybe". The benefits of a few days of extra milk is not very large.
- **There is a chance that the financial benefits do not weigh up against the costs and interest, but that farmers still want a water tank for their quality of life**. For example, if it is convenient or because rainwater is cleaner than surface water, even if most water gets boiled for tea.
- **Public governmental water initiatives in Kenya might compete with water tanks**. The Kenyan government is digging water holes for community-based grazing as a community-based grazing project. This reduces the private needs for a water tank for grazing for farmers, but still makes the product interesting for restaurants, lodges, and hotels.
- Advising SACCOs about water tanks and asset collateralization might not be a promising approach, as SACCOs might already know about these products.
- **Providing technical assistance for impactfully spending concessional funding earmarked as 'green finance' or 'climate-relevant measures' could be a promising approach to expanding finance**. There is no strong taxonomy for sustainable investments in many African contexts, and if all goes well, there will be a large sum of climate funding available in the future, such as loss and damage funds. For example, a Kenyan public bank recently received a 'green finance' credit line from IFAD that they need to on-lend via SACCOs. An NGO that could advise on what is 'green' or 'climate-smart'.
- Concessional funding is a more interesting approach to bringing in finance than the private sector because large investments from, for example, the African Development Bank go to financial institutions and have a high

interest rate. Additionally, the foreign exchange risk between the Dollar or Euro and the Kenyan Shilling presents an additional risk to foreign private actors.

4.6 Abraham Salomon

Profile: Abraham Salomon was a Senior Program Manager at Precision Development (PxD) in Kenya and led their scale-up program for asset-collateralized loans for water tanks for dairy farmers in Kenya. PxD is expanding work with multiple SACCOs and iterating on the experiment by Jack et al. (2023) to validate results and improve the loan structure.

The key points from the interview with Abraham Salomon are:

- **There is a small number of SACCOs that serve the majority of dairy farmers.** Working with the SACCO of a dairy cooperative is helpful for repayment and easy to set up, but it is not how the majority of SACCOs work. There are a lot of dairy cooperatives that work with multiple SACCOs. PxD now aims to work with 10 SACCOs in this immediate market to serve a target audience that is easy to reach: dairy farmers who are members of dairy cooperatives that make monthly payments to SACCO accounts. The next steps are to grow the target audience or enter different value chains.
- **PxD's approach is to work with SACCOs to offer products that they consider risky**. Normally, the SACCO would require guarantors who are also SACCO members. Very few SACCOs are willing to drop this requirement and use asset collateralization instead. PxD offers risk sharing and sometimes performance grants to start portfolios for several hundred loans. PxD also offers technical assistance for co-design, marketing, and evaluation. They expect a team of a few people to be able to serve 6 to 10 SACCOs in different stages at one time, each for about one to two years.
- **When expanding over time and to different countries, a charity could expect increasing costs to scale**. Kenya is likely a unique place with its SACCO and dairy structure. SACCOs already have much of the

infrastructure, and dairy cooperatives make repayments easier. To expand to different areas, a charity would need research to understand where this could be cost-effective and how to expand to different target audiences, like farmers without a SACCO account.

- **PxD is open to working with another charity in this area**. A new charity could be doing work to understand scaling in Kenya or exploring expanding to different countries. PxD is primarily focused on agricultural advisory rather than loans, and the ACL project helped them build relevant relationships. A new charity could allow PxD to focus more of its core tasks. However, this would need to be discussed with PxD's strategy team.
- **A more detailed country prioritization could reveal which countries are promising to work in**. Ethiopia has a less developed SACCO structure, but dairy farming is very important. Uganda has weaker cooperative structures, although this is different in some regions.
- **While low depreciation rates make for easy collateralization of assets, this is probably not much of a concern because repayment rates have been very high.** This opens up the possibility of offering ACLs for assets with a higher depreciation rate, such as chaff cutters or water pumps.
- **While more research on water use is needed, Mr. Salomon expects that water storage benefits most borrowers.** Most farmers have one to three cows, not all of which produce milk. A 5000 liter water tank should give farmers about one to two months of additional water supplies if they are only using it for dairy. This increases the productivity of cows when water is more difficult to get, as farmers normally give less water to cows. He sees the largest productivity gains after one to two months after the rains. Most of these benefits come after the loan is repaid, while farmers approximately break even during the loan repayment period compared to before.
- **Larger SACCOs that PxD spoke to indicated that the supply of capital is not a concern, although some are at full lending capacity.** Their concern with ACLs is the risk, not the capital requirement. Smaller SACCOs can get wholesale funds from a larger SACCO and on-lend them. On-lending money

from larger institutions abroad is expensive because of the foreign exchange rate risk.

- **In principle, women should have better access to ACLs than other loans because no existing collateral is required.** However, PxD sees that most people who take up the loan are men because of the social environment.

5 Additionality and geographic assessment

This section discusses our considerations of additionality and our review of locations where this idea could be delivered in light of the burden, tractability, and potential additionality.

5.1 Neglectedness

Actors delivering this intervention

To our knowledge, nearly all development work for asset-collateralized loans for water tanks has been conducted in Kenya. The original study from Jack et al. (2023) took place in the Rift Valley in Kenya, and Precision Development (PxD) has built on this work in the same country.

We have low concerns about crowdedness in the space a charity would operate in. Overall, asset-collateralized loans for water tanks appear to be neglected by funders (like SACCOs), microfinance institutions, and charities, especially outside Kenya. Even within Kenya, there is still a lot of work to be done.

Funding

Funding from funders in the AIM network

We think this area suits funders in the AIM network keen to focus interventions in global health and development that appear cost-effective and neglected. Our expected cost-effectiveness prediction is well above AIM's bar for incubation, and the charity would operate in an uncrowded space where founding a new charity likely makes sense.

Broader funding sources

Other funding sources that the charity could consider are:

- Existing grantmakers in the global health and development space.
- Funding for climate change adaptation, such as from international development agencies like USAID, FCDO, or GIZ, foundations, and international organizations.
- Funding for loss and damage, depending on whether future loss and damage funds are meant to be used for climate change adaptation.

5.2 Geographic assessment

Link to our model[12]

Our geographic assessments seek to identify priority countries, which are then explored in depth by the entrepreneurs who take the ideas and put them into action.

We expect water storage interventions to be most important in large countries that economically depend on agriculture and have a high current and future drought risk, as these criteria together represent a large expected negative value from droughts. We also expect that progress is easier (more tractable) in stable countries with a low agricultural value added per worker, as poorer farmers benefit more per dollar than richer farmers. Lastly, our weighted factor model prefers countries that are more neglected in agricultural assistance programmes and have little existing access to farm equipment, as we assume that development interventions have diminishing returns to scale.

Table 4 provides what we think are top candidate countries for this work.

Table 4: Top 20 countries from our geographic weighted factor model

Rank	Country	Z-Score
1	Niger	0.774
2	Rwanda	0.724

Rank	Country	Z-Score
11	Togo	0.560
12	Pakistan	0.557

[12] Reported as of 29.07.2025—-note the models are live and may be subject to tweaks or (in rare occasions) large changes that may not be reflected in the text if carried out after publication.

Rank	Country	Z-Score
3	India	0.712
4	Uganda	0.695
5	Malawi	0.612
6	Bangladesh	0.599
7	Guinea-Bissau	0.589
8	Timor-Leste	0.576
9	Burundi	0.569
10	Moldova	0.566

Rank	Country	Z-Score
13	Nepal	0.550
14	Indonesia	0.543
15	Uzbekistan	0.528
16	Morocco	0.521
17	Tajikistan	0.501
18	Kenya	0.491
19	Benin	0.440
20	Cambodia	0.421

Table 5 describes the criteria used and weights assigned.

Table 5: Criteria used in our geographic prioritization

Weight	Criteria
10%	**Scale:** Population
25%	**Scale:** Drought Risk Index (baseline)
5%	**Scale:** Drought Risk Index (2050)
15%	**Scale:** Share of GDP from agriculture
10%	**Scale:** Share of the labor force employed in agriculture
5%	**Neglectedness:** Agricultural assistance received (USD) (inverted)
10%	**Neglectedness:** Farm machinery (hp) (inverted)
15%	**Tractability:** Agricultural value added per worker (USD) (inverted)
5%	**Tractability:** Fragile States Index (inverted)

Qualitative considerations specific to asset-collateralized loans

We think that a charity working on asset-collateralized loans for water tanks should consider starting work in Kenya. This is because Kenya has a system of dairy cooperatives and SACCOs that makes an asset-collateralized loan system relatively easy to implement. Additionally, the evidence base for the benefits of asset-collateralized loans is relatively high in Kenya. Moreover, a new charity could also benefit from working with PxD.

6 Cost-effectiveness analysis

Link to our model[13]

6.1 Results

Overall, we expect this intervention to be cost-effective, creating 82 consumption doublings per $1,000 USD ($12/consumption doubling), equivalent to $30 per DALY averted. We outline the cost-effectiveness estimates in Table 6.

Table 6: Cost-effectiveness estimates for asset-collateralized loans for water storage

	Kenya
Total number of households reached	375,619
Total number of consumption doublings	413,271
Total costs	$5,017,106
Cost-effectiveness ($/consumption doubling)	**$12**
Cost-effectiveness (consumption doublings/$1,000)	**82**

6.2 Modeling choices

We employed a conservative estimation approach as there is no cost data on large-scale work on asset-collateralized loans for water storage. This approach evaluated whether the intervention easily meets the cost-effectiveness threshold. In our CEA, we use Kenya as the model country.

[13] Reported as of 29.07.2025—-note the models are live and may be subject to tweaks or (in rare occasions) large changes that may not be reflected in the text if carried out after publication.

Costs

We model the charity to have fixed costs for staffing and operations, and variable costs for farmer outreach, technical assistance to SACCOs, and default insurance.

Some costs associated with this intervention are also paid for by the farmers directly rather than the charity, such as transport and delivery costs for the water tanks.

Fixed costs

The overhead costs are assumed to increase in the first few years and remain constant afterwards. The start-up and ongoing fixed costs are based on default values ($130,000 for fixed costs in the first year and $280,000 for ongoing annual fixed costs when at scale) used in most reports by Ambitious Impact to allow for better comparability.

Farmer outreach

We conservatively assume that the charity would cover the majority of the costs (75%) of workshops to explain asset-collateralized loans and to sign up farmers that do not yet have a SACCO account. In practice, we think it is realistic that most of these costs will, at least in the long run, be taken up by SACCOs themselves as it is a profit-generating activity. We find variable workshop costs of $6.07 USD per loan based on the local cost of charity workers[14] and assuming that a workshop takes 3 days to organise for 15 attendees.

Technical assistance to SACCOs

For technical assistance to SACCOs, such as helping with loan set-up, marketing, and evaluation, we assume that a team of two people can work with up to 8 SACCOs full-time for approximately 1.5 years, based on a ballpark estimate from an interview with Precision Development. For salary costs, we use a high-end salary estimate for a financial analyst role in Kenya ($2,308 USD per month), as financial advisory salary estimates are unavailable.

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[14] The cost per worker also includes an estimate of travel costs for attending workshops. We assume that these travel costs will be $500 annually which may be an underestimate.

Default insurance

To reduce the (perceived) risk of loss from default by a borrower to a SACCO, we conservatively assume that the charity would cover 50% of the default risk for the first 25% of the loans. The costs of default insurance ($0.16 USD per loan) are negligible compared to the costs of farmer outreach and technical assistance.

Costs paid by farmers

Farmers pay back the loan amount (36,000 KSH) over two years. They also pay 1% interest on this amount per month. In the first repayment, we model that farmers also pay for the installation costs of the water tank (these are the transportation and delivery costs for the water tank). Installation costs are 3,400 KSH. The charity could have paid these installation costs themselves, but this would decrease the cost-effectiveness of the intervention and farmers in Jack et al. (2023) paid for these installation costs themselves, so we believe that farmers are willing and able to pay this.

Effects

We expect multiple positive effects from asset-collateralized loans for water tanks: increased consumption due to higher milk yields, improved girls' education due to less time spent fetching water or herding, and improved access to clean water for household use.

Effect on consumption

Jack et al. (2023)'s lower end estimate of the effect of being offered an ACL on milk production is 15%. We apply a -25% internal validity adjustment because of the low robustness of the results (results are only statistically significant when trimming the data) and a -20% external validity adjustment since the study was conducted more than 10 years ago. This results in an income increase of approximately 400 Kenyan Shillings (Ksh) per household per month. As this was an intention-to-treat (ITT) analysis, we calculate the local average treatment effect

(LATE)[15] of the water tank loan itself by dividing the ITT estimate by the difference in take-up rates in the treatment and control arms. The ITT estimates in Jack et al. (2023) also included partially asset-collateralized loans with guarantors that had a lower take-up rate. Since the authors find evidence that farmers who take up nearly fully asset-collateralized loans had lower mean assets and lower milk production, we expect that the benefits for these loans are higher, as it is easier to double the consumption of a poor farmer (p. 3169).

$$LATE = \frac{ITT}{\Delta take\text{-}up\ rate}$$

In our model, farmers pay back the loan in constant monthly principal payments with 1% monthly interest on the declining balance over two years. Assuming that the useful life of a water tank is 30 years, we calculate the net income effect, consisting of the income gain from the water tank minus principal payments and interest. Based on the pre-intervention income, we calculate monthly income doublings for each month. As a rural Kenyan household supports multiple people, we multiply the number of income doublings with an extrapolated value for the household size in the given year.[16]

To arrive at the number of yearly income doublings per household, we calculate the Net Present Value of all monthly income doublings and divide by 12. Since poor families tend to consume - rather than save - the majority of their incomes, this should highly correlate with the number of consumption doublings (Meyer and Sullivan, 2003).

Effect on school enrollment for girls

In the randomized controlled trial (Jack et al., 2023), the school enrollment rate of girls went up by 2 percentage points, from an initial enrollment rate of 97.5%. We assume that the average number of girls in rural Kenyan households is 1.135, since the average household size is 4.27 of which we assume two members are parents, and half of the remaining children are girls. Per water loan, this means 0.023 new school enrolments for households. Based on the mean remaining duration of

[15] Also known as a Complier Average Causal Effect (CACE).
[16] We extrapolate the household size using an exponential decline function in the CEA model provided.

school and the private returns to primary and secondary education, we expect that one water tank loan yields an NPV of 0.283 income doublings for a girl after she leaves school.

We ultimately decided to exclude these education effects from our endline cost-effectiveness estimate as these impacts are more speculative than the direct income effects. This modelling can still be seen in our cost-effectiveness analysis model so it can be added back in if deemed appropriate.

Effect on clean water availability

We did not find reliable estimates of the effect of water tanks on reduced water-borne illnesses compared to groundwater. It is also unclear whether households would use this water themselves or just leave it for their cows or other farming uses. For this reason, we assume that the water tanks do not generate health benefits.

Scaling

The cost-effectiveness analysis models that the charity will scale up to farmers in Kenya only. Because of considerable fixed costs, our cost-effectiveness model has increasing returns to scale. To be conservative, we assume that the charity needs six years to arrange loan offers to 30% of eligible farmers, which is defined as the number of smallholder dairy farmers (farmers with 1 to 3 cows) in Kenya without a water tank. Accounting for the expected loan take-up rate, these assumptions imply that the charity will arrange ACLs for approximately 30,050 farming households per year when at scale.

Counterfactuals

We conservatively assume that in any given community, there is a 5% chance per year that asset-collateralized loans for water tanks are offered regardless, reducing the overall cost-effectiveness estimate.

6.5 Reasons for error

There are many reasons why the CEA could overestimate or underestimate the intervention's actual cost-effectiveness. We list these in Table 7.

Table 7: CEA considerations

Reasons this intervention could be more cost-effective than modeled, all else equal.	Reasons this intervention could be less cost-effective than modeled, all else equal.
• The water tanks last longer than their 30-year modeled lifetime. • We use an updated number for the cost of water tanks (from Abraham Saloman) but not an updated number for the price of milk. The price of the water tank has increased from 24,000 Ksh to ~36,000 Ksh since the Jack et al. RCT so we may expect milk prices to have increased by a similar amount. • Water tanks deliver higher or more benefits than modeled, such as higher income gains or real clean water benefits. • SACCOs require less technical assistance than modeled (1.5 years at ⅛ FTE)[17] or technical assistance is cheaper. For example, by covering assistance with the fixed cost budget. • The charity needs to do fewer workshops with farmers, or a larger share of these costs are covered by a SACCO. • The girls' education effects are real and significant. (They are not currently included in our model by default).	• The water tanks last shorter than their 30-year modeled lifetime. • Water tanks deliver lower benefits than modeled, such as lower income gains. • SACCOs require more technical assistance than modeled (1.5 years at ⅛ FTE), or salaries for technical assistance are more expensive. • The charity needs to do more workshops with farmers, or a smaller share of these costs are covered by a SACCO. • There are considerable increasing marginal costs once ACLs for water loans are expanded to different SACCOs, areas, and people. • Repayment rates are worse/repossession is more common at scale than in the Jack et al. RCT. • The marginal benefits of water tank loans are decreasing with the same-asset collateralization rate. For example, if farmers that only take up a loan with a high asset-collateralization rate see few water resilience benefits, but

[17] FTE: Full-Time Equivalent

Reasons this intervention could be more cost-effective than modeled, all else equal.	Reasons this intervention could be less cost-effective than modeled, all else equal.
• The marginal benefits of water tank loans are increasing with the same-asset collateralization rate. For example, if farmers that only take up a loan with a high asset-collateralization rate have lower income (which is easier to double) or are more vulnerable to drought. • Charity costs can be reduced. For example, a new charity could potentially partner with the provider or manufacturer of the water tanks. As part of this partnership the provider/ manufacturer could take on a part of the default risk or lower prices (as scaling up this program increases the market for water tank providers overall).	for whom repayment is a considerable financial struggle. • Positive spillovers - Once this charity has worked with many SACCOs and successfully introduced ACLs, we may expect some of the other lending companies to start offering them even without active assistance.

7 Implementation

This section discusses implementation factors that we think are of relevance for both 1) deciding whether we should recommend the ideas, and 2) the entrepreneurs considering taking the idea to scale.

7.1 What does working on this idea look like?

Figure 2 notes how we'd characterize this proposed idea along an explore-exploit continuum.[18]

We expect that founding and working for an organization expanding access to asset-collateralized loans for water tanks will include the following work:

- **Providing technical and operational assistance to SACCOs.** This would involve showing SACCOs the benefits of asset collateralization for both farmers and the SACCOs themselves and assisting with marketing, promotion, and monitoring & evaluation. If needed, this would also include setting up an (automated) financial infrastructure between SACCOs and dairy cooperatives, helping with the financial aspects of a new type of loan, and the logistics of delivering water tanks at scale.
- **Fieldwork with farmers.** This workstream would involve organising workshops for farmers to inform them about asset-collateralized loans and help them decide whether it is an option that would work for them. Depending on the strategy of the charity, this could also involve helping farmers set up SACCO accounts. The charity's monitoring and evaluation strategy might also require doing fieldwork in farming communities.
- **Research and relationship-building for scaling up.** This would involve building relationships with manufacturers and suppliers of water tanks to deliver at a good price, at scale, and/or while taking on risk. If the charity

[18] Our recommendations can be characterized along a spectrum between exploration and exploitation— ideas closer to exploration require more research and design, and involve riskier bets and wider confidence intervals; ideas closer to the exploit side of things usually have narrower confidence intervals and rely more on replication/expansion of well-developed and concrete interventions.

finds that SACCOs are capital-constraint, this workstream would involve increasing the supply of (cheap) capital to SACCOs. For expansion to other countries, the charity staff needs to do research about how to set-up a similar system successfully in another context.

- **Monitoring, Evaluation, and Learning (MEL):** To better understand the effects of the loan offer, the charity needs to ensure that it can measure the financial and real outcomes against a control group. This workstream requires setting up (pseudo-)RCTs, and the collection and analysis of data to deliver recommendations for program improvements.

Figure 2: Explore-exploit

7.2 Key factors

This section summarizes our concerns (or lack thereof) about different aspects of a new charity's implementation of this idea.

Table 8: Implementation concerns

Factor	How concerning is this?
Talent	Moderate Concern
Access to information	Moderate Concern
Access to relevant stakeholders	Moderate Concern
Feedback loops	Moderate Concern
Execution difficulty/Tractability	Moderate Concern

Talent

The following backgrounds, skills or profiles would likely be useful for the co-founders or early hires in this organization.

We think that financial knowledge and experience with advising would be a strong plus for at least one founder. For instance, experience from the banking or management consulting sectors could be highly beneficial. **In addition, experience with or willingness to work in rural areas in LMICs would be valuable.** If founders do not have these skills, it would be important to find an early-stage hire with these skills. Less important but still beneficial skills would include experience with microfinance or agricultural credit, experience with fundraising grants earmarked for climate change or climate-smart agriculture, stakeholder management, and the ability to speak relevant languages like Swahili. Preferable skills include experience with drought management or climate adaptation.

We expect advantages to having a local founding team, as this could make it easier to receive funding earmarked for local initiatives (such as loss-and-damage funds). A local founder team also benefits from a better understanding of the local contexts.

Access to relevant stakeholders and information

We have moderate concerns about having access to stakeholders. A risk to the tractability of the charity idea is whether relevant SACCOs are open to collaborating with the charity, and whether cooperation works well. Likewise, getting easy access to groups of farmers to organize workshops and, if needed, help with SACCO account set-up makes charity operations more efficient. Knowing which farmers to approach and being able to reach them with information and support is important for charity success.

For the same reasons, we have moderate concerns over access to information. A successful charity in the field of ACLs for water tanks requires knowledge about which SACCOs currently offer similar loans, which ones would be open to offering asset-collateralized water tanks, and which ones have sufficient capital to start offering this product. This information requires strong ties with local organizations, as these data are not readily available.

Additionally, the charity needs to have access to information for MEL, such as the number and size of loans paid, repossessions, income effects, and real effects,

with a proper control group. The charity should make agreements with SACCOs, farmers, and cooperatives for a set-up that allows for data-sharing and causal identification.

Feedback loops/Monitoring and Evaluation

We have moderate concerns over the availability of useful feedback loops for MEL. Even if the charity has access to data for MEL, useful data on costs and benefits takes time to become available. Loans are expected to be fully repaid after approximately two years, which makes tweaking the loan structure a slow process. Additionally, our cost-effectiveness analysis expects most benefits to occur between the loan's repayment and the end of the water tank's useful lifespan.

Tractability

We have moderate concerns about the tractability of the intervention. Cooperation from relevant SACCOs is key to the success of the program, as they are modeled to operate the loan program and provide capital. Pilots and initial scaling work in our evidence review suggest an openness from SACCOs to collaborate on ACLs. One interviewee, however, indicated that they offer default insurance and performance-related grants when working with SACCOs on ACLs (Salomon, interview). Anecdotally, Jack et al. (2023) report that the SACCO that they worked with has continued to offer ACLs after they stopped working together, and that several SACCOs have started offering similar financial products.

Complexity of scaling

We expect that scaling within Kenya can be done straightforwardly and fast. One interviewee indicated that only a few SACCOs serve most dairy farmers (Salomon, interview). SACCOs and dairy cooperatives are prevalent components of Kenyan rural society, which allows for a similar approach with multiple SACCOs and cooperatives. Even for beneficiaries that do not have a SACCO account, the

existing SACCO infrastructure can be used to create one. Additionally, water tanks are movable assets that do not depend on the local geology for water storage.[19]

We expect that expanding to (or starting in) different countries might require a different approach. Conditions that enable a successful approach within Kenya, such as the prevalence of dairy farming, SACCOs, and cooperatives, might be different in other countries. We think more research is needed to understand the potential of this intervention in countries other than Kenya and to explore how the program can be adjusted for different contexts.

Risk of harm

We have moderate concerns over the risk of harm to beneficiaries. Mandatory repayments with interests can add a financial burden to farmers when the economic benefits are less than the costs during the repayment period. While this did not appear to be a major concern in Jack et al. (2023) and subsequent research, the charity should consider whether the rate of defaults, repossessions, late payments, and burdens of repayment can increase with scale.

7.3 Remaining uncertainties

Our remaining uncertainties include:

- **In which countries other than Kenya would this, or a similar approach, be effective?** While Kenya appears to be a highly tractable country because of its strong SACCO institutions, dairy cooperatives, and need for water storage, other countries may have similar favorable conditions.
- **How many people can the charity reach in Kenya without diminishing returns to scale?** A small number of SACCOs serve the majority of dairy farmers (Salomon, interview). We expect that working with smaller SACCOs or reaching farmers that do not have a SACCO account has higher variable

[19] However, the charity should consider whether water tanks make sense as a water storage method given the local climate, climate change, and water needs.

costs. In our cost-effectiveness analysis, we have modeled outreach to small SACCOs and have assumed that the charity needs to do workshops with local communities, which could involve setting up SACCO accounts.

8 Conclusion

Overall, our view is that boosting access to ACLs for smallholder farmers is an idea worth recommending to future charity founders. There is a lot of work to be done across many LMICs to introduce ACLs as a finance intervention and this intervention is expected to be very cost-effective and has a promising emerging evidence base supporting it.

Annex 1: Potential theories of change and financing methods

Types of water storage

Water can be stored in natural systems, such as wetlands, soil moisture, and aquifers, or in built systems, like ponds, tanks, and reservoirs. Built systems have higher capital, environmental, and social costs than natural systems, but they also have several benefits over natural systems.

- Natural wetlands like lakes and swamps can store large amounts of water, but are limited to select geographies.
- Soil moisture volumes are large globally, but limited and quickly depleted in any given location. There is a global increased interest in water retention and soil infiltration, such as by reducing tillage or by digging basins like demi-lunes.[20]
- Aquifers with groundwater have the benefit of little to no evaporation of water. If geology allows it, water can be pumped directly into or out of the aquifer.
- Water tanks and cisterns store small (but often vitally important) amounts of water for individuals or communities. Household tanks are generally small and capture runoff from roofs or intermittent piped water sources. A significant benefit of these water storage systems is that they can work in any location, regardless of the geology. This makes them a scalable approach to water storage.
- Ponds are generally larger than household tanks and rely on surface water runoff. They can also be built anywhere, but have more specific landscape requirements than tanks or cisterns.

[20] Ambitious Impact has considered focusing on demi-lunes or semi-circular bunds in its water storage research, but is now focusing on asset-collateralized loans for water tanks because of its higher neglectedness.

- Reservoirs are water stored behind a dam. They can store more water than ponds and tanks, but are limited to the existence of streams and rivers and can experience high evaporation.[21]

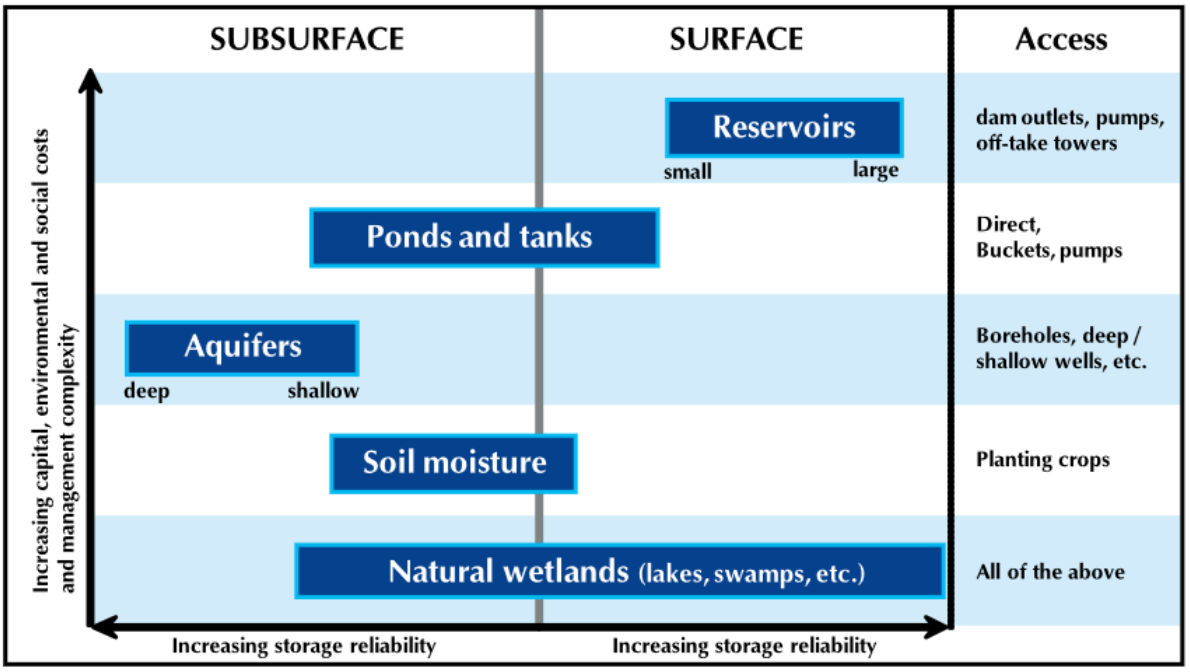

Figure 1: Conceptualization of the physical water storage continuum (McCartney and Smakhtin, 2010, page 5).

Ways to finance water storage

A charity can take multiple approaches to increase water storage capacity in drought-prone areas. One option would be directly financing water storage solutions by giving away tanks. However, for 5,000L tanks that cost around USD 300 each, reaching only 1 million farmers would cost USD 300 million, excluding overhead and logistics. Advocating for water storage policy could be a more promising alternative, but this could still present considerable costs to the government. Additionally, in some drought-prone countries like Kenya and India, agricultural policy is devolved to regional administrations, limiting the scale of the policy change.

[21] Note that some reservoirs can also be created in dugouts.

Since water tanks deliver economic benefits to farmers, loans could be a promising option for water tanks, as economic benefits offset their costs. As discussed in section 2.1, farmers face considerable barriers accessing finance, such as a lack of collateral, but some innovative lending schemes could increase access to finance. For example, microfinance institutions can replace the need for collateral with group lending with joint liability (Postelnicu et al., 2014) or with third-party guarantees (Ledwell, 2024). Another approach is to sell an asset under credit, in this case a water tank, where the asset itself is the collateral on the loan. The lent asset can be repossessed if a borrower does not repay the loan. Water tanks are a great collateral source as they are movable assets with a very low depreciation rate (Jack et al. 2023).

Annex 2: Views on demonstration effects

Expert views

See section 4 for expert profiles.

Billy Jack believes that the demonstration effect is sufficient, especially if you provide the credit organization with technical assistance.

Andrew Kabucho was skeptical about the willingness of lenders to use assets purchased with the loan as collateral. He thought that because water tanks are a movable asset with no active secondary market, lenders would shy away from using this as collateral. We are unsure about this as we note that because water tanks do not really depreciate, lenders could just repossess the water tank and give it to someone else. However, we think that his concern around leaders not valuing unconventional collateral could be a valid one.

Abraham Salomon said that to convince SACCOs to offer ACLs PxD offers risk sharing and sometimes performance grants to start portfolios for several hundreds of loans. PxD also offers technical assistance for co-design, marketing, and evaluation. We have modeled this same approach for a new charity.

Paul Nuthu noted other credit organizations face some barriers in offering ACLs:

1. It is not usual to offer the asset given as a loan as collateral (and SACCOs are risk averse)
2. Lack of existing partnerships with dairy cooperatives and/or lack of marketing to farmers
3. Technology challenges such as lack of ICT infrastructure. These challenges can be overcome by helping them with institutional capacity building.

Other sources of evidence

We are also encouraged by various proofs of concept that lenders can be encouraged to offer ACLs:

- In the Jack et al. RCT they worked with one SACCO to offer ACLs in Kenya. They worked with the SACCO of one dairy co-operative (Nyala) which has continued to scale ACLs since the end of the study with its own funds (~4,000 more tanks distributed since 2012) and has also introduced ACLs for assets other than rainwater harvesting tanks.
    - Other proof of concepts from this RCT: "Thirteen other SACCOs have chosen to implement similar programs without subsidies... A local Kenyan bank also entered the market, making asset collateralized loans for water tank purchases, although the program was discontinued when the government imposed extremely stringent interest rate caps on bank loans in September 2016 (while exempting SACCOs) to far below market rates"
- In Kenya, PxD is currently successfully working with five SACCOs and one additional dairy firm which is offering ACLs through internal lending.[22]
- J-PAL Africa ran a similar pilot program in Rwanda with the Rwandan Agriculture Board (~2015-2017) and successfully worked with one SACCO
- They also seemed to run workshops for SACCOs to convince them to offer ACLs for water tanks (Kremer et al., 2017, page 15-18). As of May 2017: 53 SACCOs attended the workshops, 13 SACCOs signed a contract with a tank company, six SACCOs are actively offering ACLs, and 93 additional tanks have been sold.
- J-PAL Africa also noted that the Rwanda Natural Resources Authority offered asset-collateralized water tank loans from 2014-2016 and that this project provided 5,000 tanks for farmers (Kremer et al., 2017, page 15-18).

Josh Deutschmann from the Development Impact Lab told us that five SACCOs (who collectively serve about 150,000 members) are now offering ACLs.[23] Two of these started early in 2025 (one of those is also piloting loans for bio-digesters

[22] They are running an RCT with two dairies and one SACCO now offering ACLs, which is currently in the phase of monitoring loan performance. They are also concurrently working with two larger SACCOs as part of their ACL scaling initiative to scale ACLs to their full customer base as a commercial product (not an RCT).
[23] As of June 2025.

alongside water tanks). Along with those five, they have conducted two training workshops with another four SACCOs who collectively serve about 400,000 members, but they have not yet had the resources to pursue more in-depth technical assistance or other support.

Josh said that there is potential to make immediate inroads starting with those partners and that this is an “area where AIM getting involved would definitely be additional and could get some quick wins.” He also suggested that DIL and AIM could collaborate closely on deploying this new organization.

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