Learning brief

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Facilitating inclusive agricultural sourcing practices through access to distributed cold storage

Insights from value chain stakeholders in sub-Saharan Africa

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Executive Summary

With the support of Shell Foundation and the UK's Foreign, Commonwealth and Development Office (FCDO) their CASEE programme, InspiraFarms has been developing market-leading first-mile cold storage solutions for agricultural value chains in sub-Saharan Africa. A primary focus has been to understand and accelerate smallholder farmer involvement and influence within these value chains, directly supporting rural development and climate mitigation. Based on a study that aimed to identify whether small-scale, distributed cold-storage solutions are an effective solution for agribusinesses and smallholders, this report provides key recommendations to accelerate their adoption, drawn from InspiraFarms' experience in the sector.

This research piece has found that the nascent yet growing first-mile cooling sector can give confidence for off-takers to operate more remotely, purchasing products from a wider range of smallholder producers. This is primarily linked to cold storage's ability to increase the volume and value of the fresh produce sourced from smallholders, reduce logistical costs, and to enable producers and distributors to tap into higher value export markets – thereby increasing the commercial viability of this sourcing model. It has also the potential to improve smallholders' revenues by maximising the amount and quality of fresh produce sold and improving their bargaining position, while also giving them more certainty about their sales and revenues.

However, while stakeholders agreed that access to cold storage provides smallholders and agribusinesses with a competitive advantage, the research also highlights affordability and accessibility as key challenges to overcome to enable them to take advantage of the opportunity. Panellists agreed that financing is the main obstacle for smallholders seeking to get access to cold storage facilities. Cooling-as-a-service (CaaS), as well as financing from a provider, off-taker, or partner, according to respondents, are the most feasible ways in which a smallholder can get access to cold storage facilities.

These findings are in line with InspiraFarm's own experience, as our products have showed strong commercial upside for the smallholders, off-takers and InspiraFarms alike. As well as this, our direct experience has provided us with insights on how to best reach the smallholder market. We found that relying on partnerships with local players for distribution improves effectiveness, and that the utilisation rate of the units was a determining factor for the commercial viability of CaaS businesses.

To improve access to cold storage in rural agricultural value chains, stakeholders should thus support the scale-up of last-mile cold storage:

- Governments and development partners should facilitate private sector investments;
- Distributed cold storage distributors should invest in local engagement;
- Multi-stakeholder partnerships should be developed between local agribusinesses, producer organisations, solution providers, governments, and financiers, with the needs of the local actors at the forefront; and
- Further research to strengthen the evidence base of the impact of the technology, and piloting to identify additional value and reduce risk for all value chain stakeholders, should be conducted.

Acknowledgement

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The authors used reasonable skill and care in checking the accuracy and completeness of information in the report. However, the views and information shared in this report are of the authors not those of Shell Foundation or FCDO.

1 Introduction

With the support of Shell Foundation and FCDO through their CASEE programme, InspiraFarms has been developing market-leading first-mile cold storage solutions for agricultural value chains in sub-Saharan Africa (SSA). A primary focus of InspiraFarms support from Shell Foundation has been to understand and accelerate smallholder farmer involvement and influence within these value chains, directly supporting rural development and climate mitigation.

Indeed, smallholder farmers in rural areas are often poorly connected to markets, which limits their ability to generate an income from their production. By linking growers with the end customers, fresh produce off-takers and distributors thus hold a key position within perishable agricultural value chains. Their sourcing decisions have enormous potential to accelerate rural development, energy access, and drastically reduce post-harvest loss. However, agribusinesses interested in sourcing produce from smallholders face a number of obstacles. Sourcing small volumes from farmers spread out over large and remote areas comes with high costs, and often the quality of the products is not good enough to make the endeavour commercially viable.

These challenges are exacerbated by the lack of access to cold storage. In fact, with only 3% of fresh produce entering the cold chain in SSA, first-mile cold storage in this geography is almost non-existent.[1] Typically, produce is gathered and sent to centralised collection points and then waits 24-72 hours before reaching the central cooled pack shed. This means, for up to 72 hours, produce remains at ambient temperatures – resulting in high post-harvest losses for smallholders, which can reach 50%. High quality produce deteriorates, and growers are not able to earn a revenue for their hard work to produce "A grade" products.

Access to first-mile cold storage facilities thus has the potential to enhance value chain inclusiveness by improving commercial viability for off-takers and economic outcomes for smallholder farmers. Based on a study that aimed to identify whether small-scale, distributed cold-storage solutions are an effective solution for agribusinesses and smallholders, this report provides key recommendations to accelerate their adoption, drawn from InspiraFarm's experience in the sector.

2 Methodology

The study was based on a Delphi analysis approach which involves administering several rounds of questionnaires to a panel of experts. After each round, respondents are provided with an anonymised summary of the responses provided by the panel and encouraged to revise their earlier answers, in light of the other experts' replies. This process aims to lead the group to converge towards the "correct" answer. A consensus is commonly considered when 75% of stakeholders reach an agreement but can

[1] Kuye, A. The cool solutions to Africa's burning problems. UN SDG Blog

be strengthened throughout the process[2]. In such a nascent industry with a short track record and limited available literature, a Delphi analysis was therefore deemed the most appropriate and feasible approach to develop a body of opinion, insights, and potential action points.

InspiraFarms performed a Delphi Analysis initially targeting 150 stakeholders from the African fresh produce supply chain, within four rounds of questions. Stakeholders surveyed included growers, agribusiness owners, exporters, freight companies, NGOs, consultants, and academic research institutions. As shown Table 1, 45 responded on time in the first round, with 22 responding in the final round. This provided a structured spectrum of opinion and analysis, that can inform key decisions makers within the agricultural cold storage ecosystem. Each statement for the survey was developed from the team's expertise, market intelligence research and phrasing skills. Initial statements, as the main focus of the study, as well as impact and benefits to specific criteria, features and concepts, were enriched with participants, opinions through the different rounds to strengthen the consensus.

Table 1. Delphi analysis sample

	Round 1	Round 2	Round 3	Round 4
Total[3]	**45**	**32**	**24**	**22**
Africa	**80%**	**78%**	**75%**	**77%**
Europe	**16%**	**16%**	**17%**	**14%**
America	**2%**	**3%**	**4%**	**5%**
Asia	**2%**	**3%**	**4%**	**5%**

Findings from the Delphi analysis were complemented and enriched by five Key Informant interviews with stakeholders from Ghana, Kenya, Zambia and Nigeria. The key informants interviewed were diverse, including a consultant, farmers, and an academic researcher.

3 Findings

The study found that distributed cold storage made it more commercially viable for off-takers to source fresh produce from smallholder farmers located in remote rural areas and led to improved outcomes for small scale growers. However, access to finance was identified as a key obstacle to the adoption of cold storage in rural agricultural value chains.

3.1 Distributed cold storage makes sourcing from rural producers more commercially viable

From Round 1 **there was an overwhelming consensus that access to cold storage positively changes sourcing practices** by encouraging off-takers to buy products from smallholder farmers (89%). Indeed, all stakeholders agreed that access to the technology increased the shelf life of the harvested produce (93%). While the extent to which cold storage can extend shelf life depends on a number of factors including crops and climate[4], some respondents reported increases in shelf life of up to 99%. This improved shelf life was linked to a reduction in post-harvest losses (78%) and increased output to be sourced from smallholders (80%), but also to an increase in the quality of the supply (78%). According

[2] Diamond, et. Al. Defining Consensus: A Systematic Review Recommends Methodologic Criteria for Reporting of Delphi. Journal of clinical epidemiology. PY - 2014/04/01.

[3] Participants in survey from: Africa (Egypt, Ethiopia, Ghana, Kenya, Morocco, Nigeria, Rwanda, South Africa, Tanzania, Uganda, Zambia, Zimbabwe), Europe (Belgium, France, Netherlands, United Kingdom, Spain), Americas (US), Asia (India).

[4] Cantwell, Marita. Properties and Recommended Conditions for Long-Term Storage of Fresh Fruits and Vegetables. University of California Davis, 2001.

to the panel, cold storage increases off-takers, importers, and clients' confidence in smallholder production as a viable option for sourcing produce (98%).

As shown in Figure 1, the consensus was strengthened in the following rounds. In addition, by Round 4, respondents reached additional agreements which further explained the determining factors behind this increase in confidence and move towards inclusive sourcing practices. In addition to the prospect of being able to source higher volumes from smallholders and reduced procurement costs through economy of scale, panellists settled on the fact that distributed cold storage had the potential to ease logistics (95%) by allowing for increased cooperation among smallholders and aggregation. This further decreases operational costs and increases competitiveness. The experts also agreed that the technology leads to more opportunities for certification (82%), and opens freight options (86%), making it possible for off-takers to explore new, higher value markets (100%), which then enables them to sell products at a higher price. This is in line with the fact that 87% of stakeholders saw the lack of cold chain infrastructure as a main limitation to the export of smallholder production (Round 3).

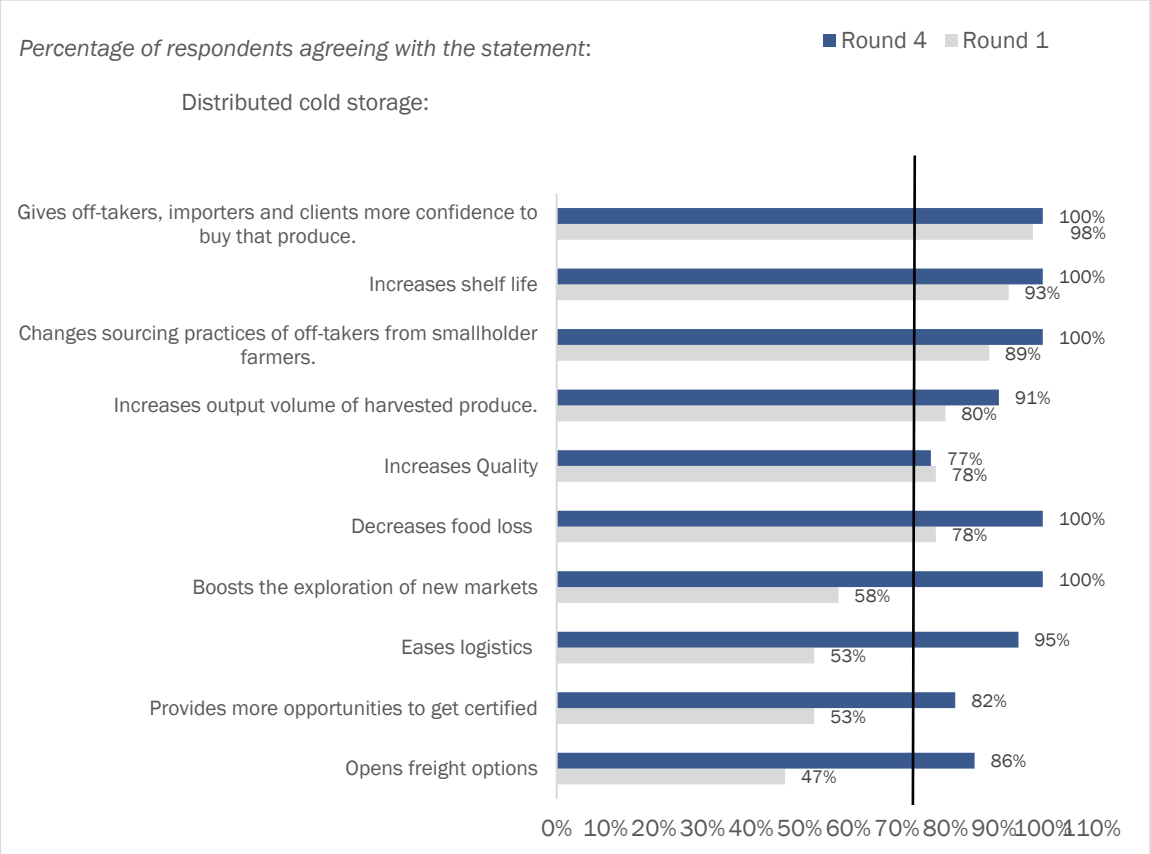
Response snapshot

"Cold storage ensures that you [off-taker] get paid as a product is in top condition. It is a basic requirement."

"The cold temperatures not only increase the shelf life but also maintain the consumer acceptable quality for longer period, which gives off-takers, importers and clients more confidence to but that produce, knowing that the produce will be sound and of high quality."

All of these are important factors taken into consideration by companies to determine commercial viability and explain why the panel eventually unanimously agreed that distributed cold storage increased off-taker confidence and leads them to change their sourcing practices to include smallholders in their supply chain.

Figure 1. Factors of commercial viability



3.2 Cold storage can improve livelihoods for smallholder farmers

Experts also found that access to cold storage improves the livelihoods and resilience of small scale growers in other ways. The decrease in post-harvest losses and increased in quality maximises the value of their production by enabling them to sell greater quantities of produce at a higher price. This increase in volumes sold was corroborated by key informants, who reported that cold storage had enabled farmers to increase the amount of produce sold by 85%. As shown in Figure 2, there was also an immediate consensus among experts that the increase in quality led to changes in the price paid to farmers for each unit of harvested outputs (82%). This is reinforced by the fact that the long shelf life provides farmers with more flexibility on when to sell their product, which puts them in a better position to negotiate and sell to the highest bidder (93%). The increased interest of off-takers in sourcing for smallholders further strengthened their negotiating position by diversifying their potential customer base, enabling them to skip the middlemen and increase their margin.

Response snapshot

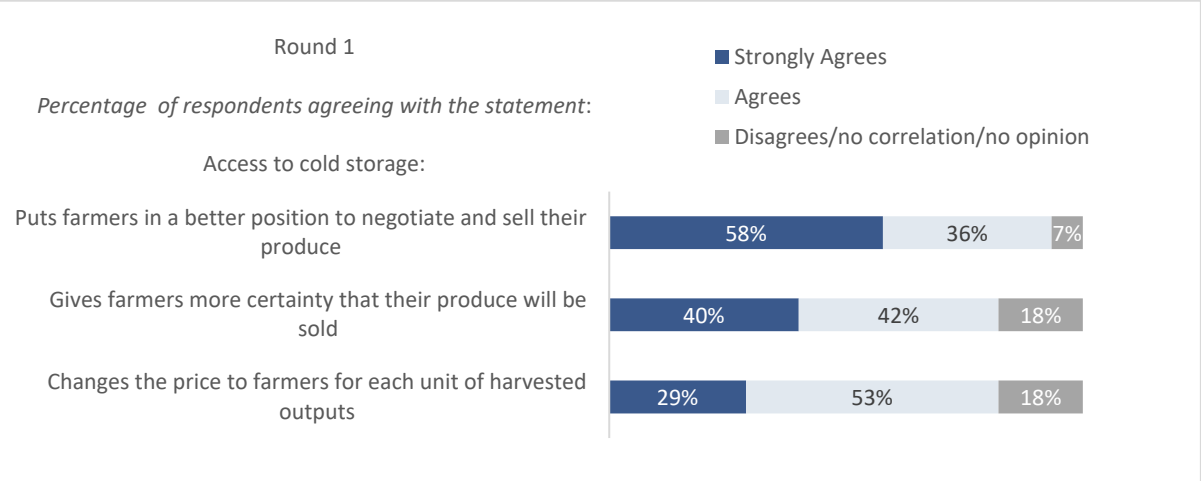
"[Cold storage] helps small scale producers to be able to prolong the shelf life of their products thus increasing the volume that is actually sold for money

"Accessing cold storage facilities gives the farmers more time to wait and come with extra post-harvest activities (cleaning, sorting, etc.) that give a better product shape. That improves the overall supply chain."

"The longer the farmers can keep the product without getting deteriorated early, the more time it offers for them to find a better and willing off-taker."

Finally, the panel agreed that access to cold storage not only increased smallholders' revenues, but also gave them more certainty that their product would be sold (82%). This can be linked to the reduction in post-harvest losses, but also to the opportunity to enter into off-take agreements with commercial agribusinesses, distributors, and exporters, which ensures that their production will be bought at an agreed price. This greater certainty can contribute to enabling farmers to invest in their farming business and increase their production, which could further increase their income.

Figure 2. Outcomes for smallholder farmers



3.3 Access to asset financing remains the main obstacle to the adoption of cold storage in sub-Saharan Africa

The panel agreed that distributed cold storage can lead to a win-win situation for commercial off-takers and smallholder farmers. Overall, 96% of experts agreed that access to cold storage provided a competitive advantage. However, respondents identified a number of obstacles to the adoption of the technology. As shown in Figure 3, these included the low levels of production which limited profitability for individual farmers, the lack of road infrastructure, and lack of access to grid electricity The latter point highlights the potential of off-grid solutions, and is backed-up by previous Shell Foundation

supported research involving InspiraFarms which found that off-grid energy systems designed around cold storage provision are more likely to be commercially viable.

But **there was a consensus that the key challenge to the adoption of cold storge in rural agricultural value chains was access to finance** (96%). Indeed, small scale growers have very little access to finance to invest in their own infrastructure and limited land available on which to build. The median monthly income among smallholders in Kenya is only $28, and 69% of farmers own less than two acres of land[5] which makes it difficult for them to save enough money to afford an off-grid refrigerator, the cost of which is up to $2,400[6]. Without appropriate interventions, this restricts the viability of increasing the typical smallholder share within agribusiness off-takers.

As shown in Figure 4, when asked to identify the most feasible financial mechanisms to enable smallholders to access small scale, first-mile cold storage facilities, stakeholders did not reach a consensus. However, 71% of respondents considered that **one of the most feasible ways to provide small scale growers with access to the technology was CaaS**. This corresponds to a business model in which a service provider such as a cooperative or entrepreneur allows farmers to store fresh produce in their cold storage unit for a fee, based on their needs and payment ability. In addition, a majority of respondents considered that rent-to-own schemes, either directly from an off-grid cold storage provider (63%) or an off-taker (58%), were among the most viable options to tackle the financing challenge. Conversely, self-financing (33%), loans from a banking institution (21%), were among the cited solutions, reflecting smallholders' limited access to capital and financial services.

Figure 3. Factors limiting access, round 3

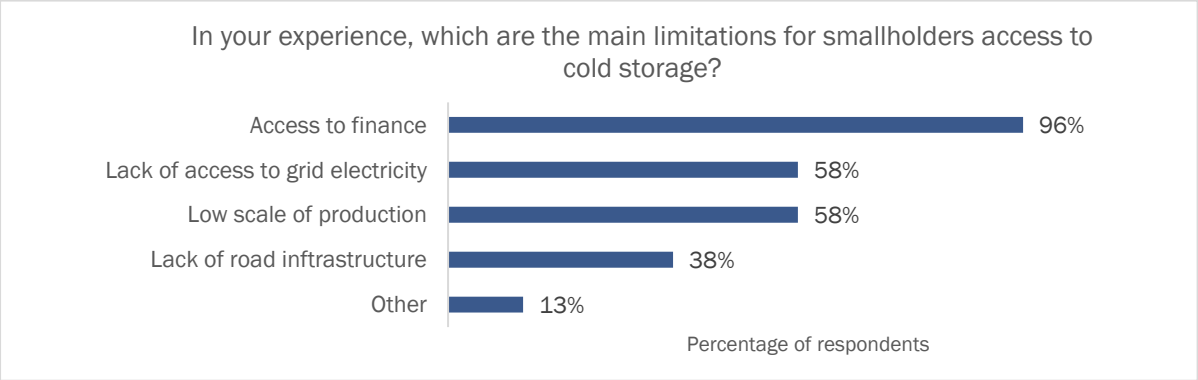
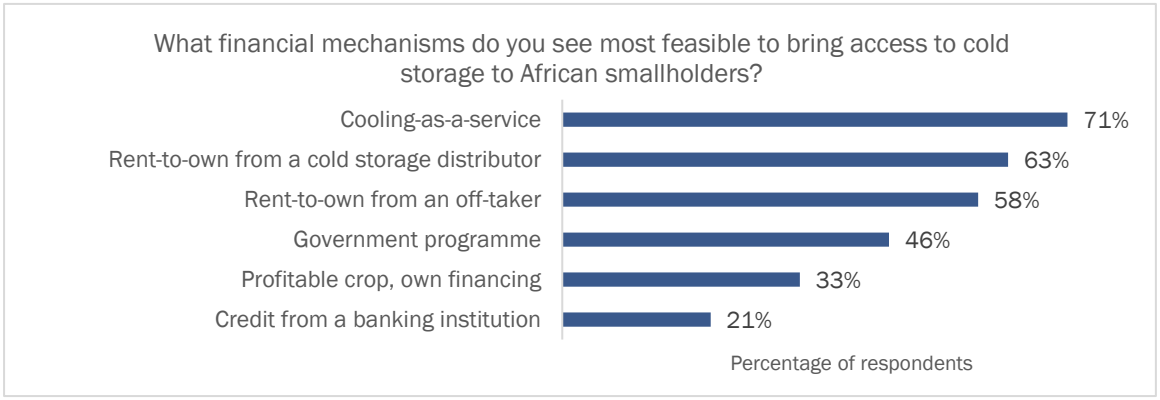


Figure 4. Financing mechanisms, round 3



[5] Karlyn, Andrew. Comparative Analysis of Smallholder Farmers in Kenya, Zambia and Tanzania. Mercy Corps, 2018.

[6] Efficiency for Access. Refrigerators: Solar Appliance Technology Brief, 2021

3.4 Smallholder cold storage in action: the example of InspiraFarms

Alongside this study, InspiraFarms itself has been providing off-grid and high efficiency cold storage to smallholders in various markets in SSA. **In line with the study's findings, our 1000-2000kg capacity Mobile Power Unit has shown strong commercial upside for the smallholders, off-takers and InspiraFarms alike.** In addition, our direct experience has also provided us with additional insights on how to best reach the smallholder market.

Since the market is still nascent, InspiraFarms has been testing various business models, including CaaS, which was highlighted by the study participants as the most feasible way to bring access to cold storage to African smallholders. Under InspiraFarms' CaaS model, the Mobile Units are accessed by smallholders through our partnerships with established agribusinesses and cooperatives, who purchase the units to then make them accessible to smallholders for a fee.

One of the main advantages of the partnership model is that it allows to capitalise on pre-existing relationships and structures. Commercial player partners know their outgrowers and the markets better than any others and are best placed to optimise logistics, communication with and sourcing from outgrowers, and quality control of produce. They can also provide additional support through their existing private, public, and third sector networks to smallholders. The added value of taking advantages of existing knowledge and relationships saves time and reduces the costs associated with expanding into a new, last-mile market.

Experience also showed a key factor for commercial viability of the CaaS model to be the utilisation rate, similar to a capacity factor of a power station: the average volume of produce storage, over the maximum capacity. The breakeven point for utilisation is approximately 70%. Initial pilots in Kenya are witnessing a utilisation rate of approximately 95%.

4 Conclusion and Recommendations

This research piece has found that the nascent yet growing first-mile cooling sector can give confidence for off-takers to operate more remotely, purchasing products from a wider range of smallholder producers. This is primarily linked to cold storage's ability to increase the volume and value of the fresh produce sourced from smallholders, reduce logistical costs, and to enable producers and distributors to tap into higher value export markets - thereby increasing the commercial viability of this sourcing model. It also has the potential to improve smallholders' revenues by maximising the amount and quality of fresh produce sold and improving their bargaining position, while also giving them more certainty about their sales and revenues.

However, while stakeholders agreed that access to cold storage provides smallholders and agribusinesses with a competitive advantage, the research also highlights affordability and accessibility as key challenges to overcome to enable them to take advantage of the opportunity. Panellists agreed that financing is the main obstacle for smallholders seeking access to cold storage facilities.

The market is still nascent, and various financing mechanisms need to be tested across multiple countries and value chains, since no single business model may be feasible or optimal in all settings. However, although a one-size-fits all approach is not appropriate, stakeholders identified CaaS, as well as financing from a cold storage distributor or off-taker, as particularly key to explore.

To improve access to cold storage in rural agricultural value chains, stakeholders should thus support the scale-up of first-mile cold storage solutions:

1. **Unlock capital for distributed cold storage solutions:** Whether CaaS, rent-to-own, or another financing mechanism, agribusinesses are keen to accelerate the deployment of first-mile cold storage solutions. Governments and development partners should facilitate private sector investments by providing capacity building and financial instruments such as first loss cash reserve for local financial institutions, which could increase local currency lending and risk profiling. The Renewable Energy Partnership and Efficiency (REEEP)'s SOARING programme in Tanzania and Zambia is such an example.
2. **Distributed cold storage distributors should invest in local engagement:** InspiraFarms has built relationships with hundreds of agribusinesses, governments and investors with experience across

the continent, allowing for a broad analysis of the factors impacting commercial viability of their operations and that of the smallholders they operate in, developed and tested the integrated technical and financial solution. The experts engaged by InspiraFarms within this exercise know in depth their market, smallholder suppliers and customer requirements and have years of experience operating and growing their businesses and developing the necessary infrastructure. The insights provided by this study thus showcase the importance of being familiar with the dynamics of the local markets and the advantages of investing in local engagement.

3. **Multi-stakeholder partnerships should be developed:** While the study focused on barriers faced by agribusinesses and smallholders in accessing cold storage rather than on the hurdles faced by distributed cold storage distributors, InspiraFarms' experience has shown that the deployment of off-grid, CaaS solutions is not straightforward. Effective partnerships between local agribusinesses, producer organisations, solution providers, governments and financiers, with the needs of the local actors at the forefront are fundamental to develop the technology and the knowledge base, communicate impact, and catalyse investment. To develop a quality pipeline of distributed cold storage projects, further impetus by developers, investors and public sector institutions ought to be given, coordinating the actors to pilot and deploy such innovations in the coming years.
4. **Further research and piloting should be conducted:** On the technical side, there is a need to explore various business models to determine how return-on-investment and additional value can be optimised for all value-chain actors. Similarly, the most adequate payment mechanisms and modalities to manage risk, seasonal variations and operating costs are still to be identified. Finally, additional research should be conducted to establish the potential of the technology to reduce greenhouse gases emissions, create jobs, and benefit different demographic groups, such as women and young adults, and producers across various value chains. Finally, to strengthen the evidence base, these initial insights obtained through expert consensus should be confirmed through primary data collection.