Clay Pot Cooler Training in Mali: Outcomes & Impacts

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Introduction

In Mali and other parts of Sub-Saharan Africa where access to food preservation methods is limited, 30-50% of produce is lost during transport or at markets before it ever reaches households.[1] In addition, many households are unable to preserve fresh produce and extend its shelf life before it spoils. Improving storage options for fruit and vegetables is a simple way to increase access to fresh produce while reducing expenditures on agricultural inputs. Clay pot coolers are a simple technology that can improve the shelf life of many fruits and vegetables in arid regions.[2,3,4,5] They are inexpensive and can be made with locally available materials. Functioning through the principle of evaporative cooling, clay pot coolers provide a cool and humid environment to store fruits and vegetables, increasing their shelf life. Clay pot coolers can be made using a clay pot placed in another pot or dish that is filled with wet sand. As the water evaporates, heat is drawn from the inside of the container, which can be cooled by up to 10°C.[6] A schematic of the cooler can be seen in Figure 1 below.

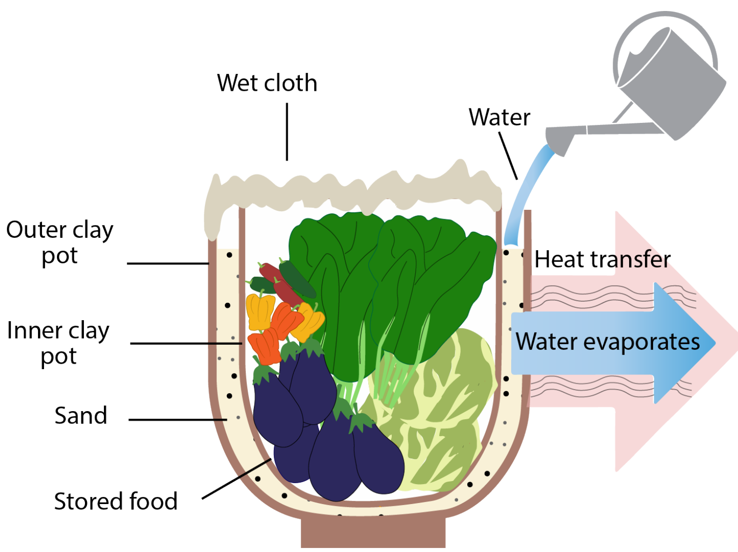

Figure 1. Schematic showing the evaporative cooling principle of clay pot coolers. Water evaporates creating a cool and humid environment inside the inner pot where vegetables are stored. Clay pot cooler schematic based on work by Peter Rinker, Movement e.V. and redesigned by Melissa Mangino.

In order to increase awareness and adoption of clay pot coolers, MIT D-Lab, the World Vegetable Center (WVC), and Institut d'Economie Rurale (IER) developed a training curriculum covering the importance of proper vegetable storage, principles of evaporative cooling, best practices for constructing and using clay pot coolers, and user identification and marketing.[6] The dissemination approach starts by conducting in-depth Training of Trainers (ToT) workshops with agricultural extension agents and clay potters. The trainers then deliver the curriculum to groups of fruit and vegetable vendors, clay pot makers and sellers, farmers, and other community members through streamlined half-day training sessions. The first ToT was conducted in January 2020. In March 2020, the first pilot training sessions were held near Mopti with a total of 37 people.[6] In-depth information regarding MIT D-Lab's work in Mali from 2016 to 2021, including interviews with 33 of the people trained in March 2020 can be found in the following document: Clay Pot Coolers: Preserving Fruits & Vegetables in Mali.

Following the successful completion of the first pilot training sessions in 2020, WVC and IER conducted a second larger ToT workshop in February 2021. From April through June of 2021, 11 half-day training sessions were conducted in the Mopti region of Mali with a total of 289 participants. The objective of the training sessions is to encourage the adoption of clay pot coolers to improve fruit and vegetable storage, reduce postharvest losses at the household level, and create both supply and demand for clay pot coolers. The training sessions aim to give participants an understanding of how to assemble and use clay pot coolers and increase their use throughout the communities. Training participants included clay pot makers and sellers, fruit and vegetable vendors, and producers and consumers of fruits and vegetables.

Interview Approach

Roughly 10 months after the 11 training sessions conducted in 2021, interviews were conducted with training participants to understand:

- Clay pot cooler adoption rates
- How the clay pot coolers were being used
- The impacts of clay pot coolers on food loss, fruit and vegetable consumption, and travel time purchasing produce
- How information about the clay pot coolers was shared beyond the training participants
- Participant's impressions of the training sessions

Participants were contacted via phone and interviewed at their homes. The interviewers were monitoring and evaluation trainees from the National Directorate of Agriculture who had not participated in the training program. Responses from the structured interviews were recorded via KoboCollect on Android devices. Three different sets of questions were given based on the profile of the respondent. The three different groups were:

1) Clay pot makers and sellers
2) Producers and consumers
3) Fruit and vegetable vendors

A majority of the questions were the same for all groups, with specific additional questions asked of clay pot makers and sellers, and fruit and vegetable vendors.

Results and Discussion

Respondent Demographics

Participants were interviewed 10 months after the training sessions, and the questionnaires used were tailored to the profile of the respondent. The three groups were producers and consumers of fruits and vegetables, fruit and vegetable vendors, and clay pot makers and sellers. Producers and consumers grow and/or consume fruits and vegetables and have storage needs for personal use. Fruit and vegetable vendors sell fruits and vegetables at markets and may use the clay pot coolers for both personal and business use. Clay pot makers and sellers have businesses selling clay pots and were interviewed about their personal use of the coolers as well as their experience selling clay pot coolers to others. A summary of the groups of those interviewed, as well as the gender breakdown, is shown in Table 1. A total of 289 people were trained, and 264 of these training participants were reached for the follow-up interview. Overall, 91% of respondents identified as female, and 9% of respondents identified as male.

Table 1. Respondent group by number and percentage of people and gender percentage. All participants in the training sessions were categorized as either clay pot makers and sellers, producers and consumers, or fruit and vegetable vendors.

Group	Number	Percentage	Gender	
Clay Pot Makers and Sellers	54	20%	Female	96%
			Male	4%
Producers and Consumers	194	74%	Female	89%
			Male	11%
Fruit and Vegetable Vendors	16	6%	Female	94%
			Male	6%

Eleven training sessions were held in 10 communes within the Mopti Cercle within the Mopti region of Mali. Two training sessions were held in the commune of Mopti. Because clay potters were recruited from a cooperative located in the commune of Mopti, a majority (93%) of the clay pot makers and sellers are from this commune. A full summary of the ages of participants and the number of respondents per commune can be found in Tables A1 and A2 in the appendix.

Previous Storage Methods and Challenges

In order to understand the previous fruit and vegetable storage habits, participants were asked about the methods of storage they used prior to the training and the issues they had with these methods. A summary of the responses can be found in Tables 2 and 3. Vendors were specifically asked how they previously stored fruits and vegetables at their businesses and home.

Before the training, most respondents in all three groups stored their fruits and vegetables in an uncovered basket, basin, or jar. It is notable that many respondents were using a storage method prior to the training that relies on the principle of evaporative cooling, such as on moistened sand, under a damp cloth, or near a water container. This indicates that participants may have already been directly or indirectly familiar with the principles of evaporative cooling.

Table 2. Locations of where fruits and vegetables were stored by the various respondent groups before training. Vendors were asked separate questions about where they previously stored fruits and vegetables in the home as well as at their place of business. The total number of respondents is listed in brackets. Most respondents gave more than one response to this question.

Storage Method	Clay pot makers and sellers [54]	Producers and Consumers [194]	Vendors at home [16]	Vendors at business [16]
Basket, basin, or jar - uncovered	93%	59%	75%	88%
Basket, basin, or jar - covered with a damp cloth	41%	12%	25%	38%
Near water container	24%	25%	19%	0%
On the floor	30%	23%	0%	0%
On wet sand	22%	21%	38%	0%
In a bag	35%	11%	13%	38%
On top of a bag	33%	0%	0%	0%
Refrigerator	2%	4%	13%	13%
Other	2%	4%	25%	19%

In an arid region like Mopti, exposure of fruits and vegetables to hot and dry conditions can make them spoil faster. In order to gain insight into the current challenges facing the community in Mopti, interviewers posed questions regarding the specific issues they face with food loss. Response rates regarding issues participants experienced with food storage are shown in Table

3. Rot was the issue experienced by the most respondents when storing fruits and vegetables prior to the training sessions. Dehydration, pests, yellowing, mold, and wilting were additional responses that were recorded. Of those who selected "other," issues explained in the narrative responses included theft.

Table 3. Percentage of respondents across all groups who experienced various issues when storing food. Vendors were asked separate questions about food storage issues at home as well as at their place of business. The total number of respondents is listed in brackets. Most respondents gave more than one response to this question.

Issues	Clay pot makers and sellers [54]	Producers and Consumers [194]	Vendors at home [16]	Vendors at business [16]
Rot	94%	87%	88%	100%
Dehydration	56%	64%	88%	75%
Pests	72%	54%	56%	50%
Yellowing	81%	49%	31%	6%
Mold	69%	42%	25%	44%
Wilting	67%	32%	25%	25%
Other	0%	5%	19%	19%

Participants assembling clay pot coolers at a training of trainers (ToT) workshop in Bamako, Mali in February 2021. Photo credit: World Vegetable Center.

Clay Pot Cooler Adoption and Usage

To gain insight on how clay pot coolers were adopted into the community, we asked whether or not participants used the devices and if so, how they used them. Seventy-three percent (73%) of the respondents reported adopting the technology within 10 months after their participation in a clay pot cooler training. The clay pot cooler adoption rates for each of the three groups before and after the training is shown in Table 4 below. Thirteen percent (13%) of the producers and consumers reported having used a clay pot cooler before, while no vendors or clay pot makers and sellers reported personal use of clay pot coolers prior to attending the training session. Prior to the training sessions. 39% of clay pot makers and sellers had made or sold clay pot coolers. Since the training sessions, all clay pot makers and sellers reported selling clay pot coolers.

Table 4. Usage rates of clay pot coolers before and after the training for all three groups. The number of respondents for each group is listed in brackets.

	Clay pot makers and sellers [54]	Producers and Consumers [194]	Fruit and vegetable vendors [16]
Percent that used clay pot coolers before the training	0%	13%	0%
Percent that have used clay pot coolers since the training	94%	70%	50%

The majority (70%) of clay pot makers and sellers made their clay pot coolers themselves either from materials that they owned or materials they purchased. Eighty-seven percent (87%) of producers and consumers reported buying a complete evaporative cooling pot from a seller, and the others reported making it using materials that they owned or had purchased. Vendors were not asked about where they got their clay pot coolers in their interviews. Table A3 in the appendix provides details on where users acquired their clay pot cooler. Clay pot makers and sellers and fruit and vegetable vendors were also asked where they got the materials to make their clay pot cooler. Most pot makers used their own materials or obtained materials from their neighbors. Vendors mostly acquired materials from the local market. Producers and consumers were not asked about where they got the materials to make their clay pot cooler; however, only 4% of them made it themselves. Table A4 in the appendix provides details on where users acquired materials to make their clay pot cooler.

Three types of clay pot coolers are described in the training curriculum: clay pot-in-clay pot, clay pot-in-plastic-dish, and clay pot-in-clay dish. A schematic of the three designs can be seen in Figure 2 below. All types contain an outer vessel such as a larger pot, plastic dish, or clay dish that is filled with sand. An inner pot, where the fruits and vegetables are stored, is placed inside the outer vessel. The sand is then wet, and the device is covered with a damp cloth.

Figure 2. Schematic of three clay pot cooler devices: clay pot-in-clay pot, clay pot-in-plastic-dish, and clay pot-in-clay dish[7].

To gain insight into potential preferences for the types of clay pot coolers, we asked users which types they used. A summary of responses is shown in Figure 3. Clay pot makers and sellers were the most likely to use a clay pot-in-pot cooler design. This may be due to their ability to access clay pots with a range of dimensions, allowing them to identify inner and outer pot pairs that are well suited to use for a clay pot cooler. The clay pot-in-plastic dish design was the most commonly used by producers and consumers, as they may not have access to appropriately sized outer clay pots or clay dishes, whereas plastic dishes are commonly found in a range of sizes throughout the Mopti. Vendors used clay pot-in-clay pot coolers the most, and clay pot-in-plastic dish coolers the least.

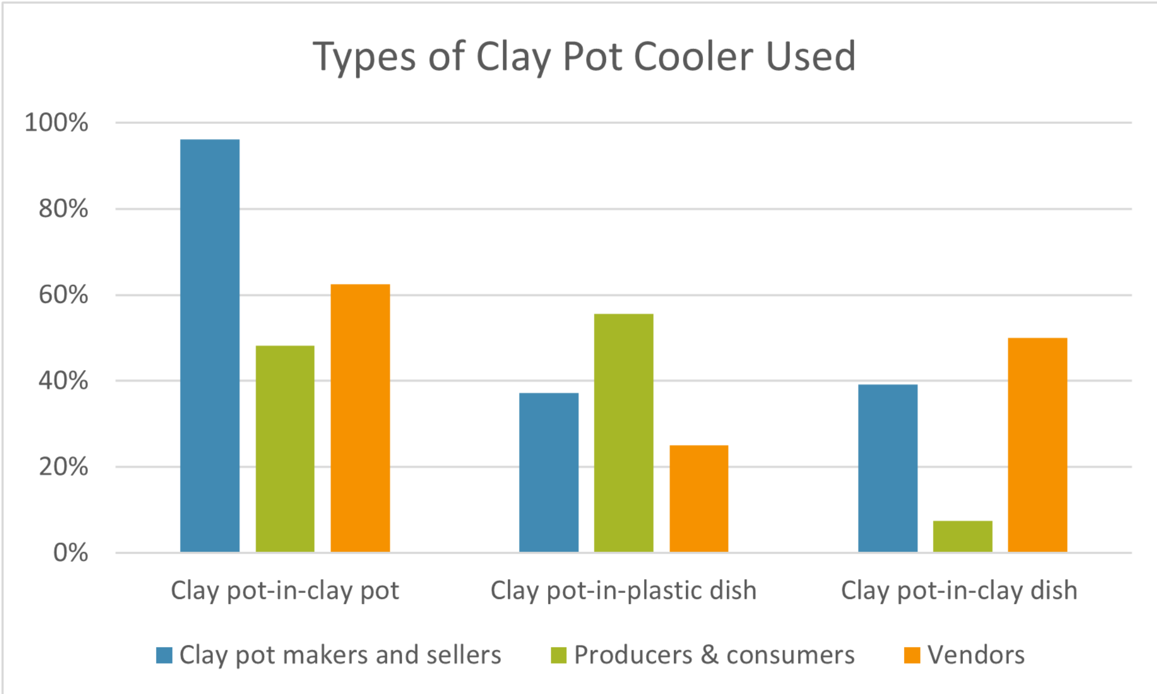

Figure 3: Percentage of users across each group who used each type of clay pot cooler. Fifty-one (51) clay pot makers and sellers, 194 producers and consumers, and 8 vendors who used clay pot coolers were asked this question. Many respondents gave more than one response to this question.

Of the 27 % of respondents who did not use a clay pot cooler after the training, the most common reasons for not using the technology were that they did not have significant storage needs, the capacity of the clay pot cooler was not large enough for their storage needs, they did not have enough money to buy a clay pot cooler, or their current preservation method was good enough, as seen in Table 5 below. For training participants that responded that they did not have significant storage needs, they are unlikely to adopt the clay pot cooler or any food storage device. However, for those who did not have enough money, could not find the materials, or needed a larger storage capacity, changes could be made to the designs discussed in future training sessions to try and increase the adoption rate. These recommendations will be discussed in Section 4.2. When asked about their storage needs, respondents replied that the average fruit and vegetable storage capacity needed at one time was 6 kg for pot makers, 46 kg for producers and consumers, and 196 kg for fruit and vegetable vendors. It is notable that the groups with the greater storage needs reported the relatively small capacity of clay pot coolers as a factor inhibiting their adoption of clay pot coolers as shown in Table 5.

Table 5. A list of the reasons why respondents did not use a clay pot cooler for each user group. The number of non-user respondents is listed in the brackets. The total number of clay pot cooler non-users is listed in brackets. Some respondents gave more than one response to this question.

Reason	Clay Pot Makers and Sellers [3]	Producers and consumers [59]	Fruit and vegetable vendors [8]	Total [70]
Not enough money to buy a clay evaporative cooling pot	0%	17%	0%	14%
Couldn't find the materials to make the clay evaporative cooling pots	0%	3%	13%	4%
My storage needs (volume) are more than one clay pot cooler can accommodate	0%	12%	75%	19%
I don't have significant storage needs	67%	39%	0%	36%
My current preservation method is good enough / better	0%	22%	0%	19%
Other	33%	49%	50%	49%

The location of a clay pot cooler can have an impact on the device's performance, as the evaporation of water requires a well-ventilated area to prevent an increase in ambient humidity. Additionally, if the clay pot cooler is exposed to direct sunlight, heat will be absorbed by the device and the temperature of the interior storage environment will increase. These points were addressed in the training and guidance provided in the printed training guide.[7] When asked about the location of their clay pot coolers, most (93%) respondents said that they kept their clay pot coolers in a compound outside the house either under a tree or under another shade structure. Only 11% reported locating their clay pot coolers indoors and none reported keeping the clay pot coolers in the sun. These results indicate that the guidance given during the training is being followed by a large majority of the users. Table A5 in the appendix provides more detail on these responses.

Participants were specifically asked the rate the performance of their clay pot coolers, and 98% of all clay pot cooler users rated the performance as good or very good. Two respondents in the producers and consumers group answered that the performance was average. This result is a good indicator that the clay pot coolers worked well within these communities and climate. Participants were asked to explain what their most important considerations were for storing fruits and vegetables in their homes. Common responses included increasing shelf life, reducing the frequency of going to the market, having a large storage capacity, having higher humidity, and the increased availability of fruits and vegetables.

Thirty-four percent (34%) of respondents said that there are changes they would like to make the clay pot cooler. Among the 65 respondents that suggested changes, the most common response (35% of respondents) was a desire for increasing the capacity of the cooler. Other changes desired included adding feet to the device, modernizing the pot, and reducing the cost of the device. Addressing these issues in future training sessions may help increase the adoption rate going forward. Vendors were asked if there were any different considerations for storing fruits and vegetables in their home versus at their place of business. The most common responses were related to the different types and volumes of crops that needed to be stored at home and at their businesses.

Clay pot makers and sellers were specifically asked about their experience making and selling the pots. All clay pot makers and sellers ranked their customers' perception of the pot as very good or good. However, twelve percent (12%) of clay pot makers and sellers had some difficulties making the necessary pots for the clay pot coolers. Some of these difficulties were low-quality clay, pot breakage, and the expense of wood needed to fire the clay pots. Nine percent (9%) of pot makers and sellers reported that they had some difficulties marketing and selling the pots due to not having enough customers or slow sales. The clay pot makers and sellers suggested that their difficulties in making clay pot coolers could be fixed by increasing awareness of the clay pot coolers to attract more customers, receiving financial assistance, having better access to transportation to move the product, and gaining better access to raw materials.

Training Participants' Influence on other Community Members

Other members of the community, beyond those who participated in the training, can benefit from the introduction of clay pot coolers to the community. Clay pot makers and sellers may advertise clay pot coolers to their customers and all participants of the training may talk with other members of the community about attending the training and how the clay pot coolers function. The people who gained awareness of the technology without participating in the training are indirect beneficiaries of the training program. The 54 clay pot makers and sellers report selling a total of 1,999 clay pot coolers since attending a training session, with an average of 37 clay pot coolers sold. Clay pot coolers were sold in a variety of different sizes with a range of costs. The number of clay pot coolers sold is over eight times higher than the number of producers and consumers and vendors trained. This indicates that other members of the community saw the benefit of clay pot coolers and thought they were worth purchasing without attending a training session.

Most (59%) clay pot makers and sellers sold more than one clay pot cooler design. Figure 4 shows the types of clay pot coolers sold. The clay pot-in-clay pot design was the most commonly sold with 94% of respondents selling this design. The clay pot-in-plastic dish and clay pot-in-clay dish were also sold by 54% and 41% of respondents, respectively.

The majority (93%) of clay pot makers and sellers also sold clay pot coolers to many different members of the community including producers, fruit and vegetable vendors, pot sellers, and households. Figure 5 below shows which groups within the community bought clay pot makers from sellers. When clay pot makers were asked about how they identified potential customers, they answered by saying they communicated with the customers, knew the customer participated in the training, or followed customer requests. Ensuring the clay pot makers have a market beyond those who participated in the training makes the project more sustainable, as sales and adoption of the technology can continue to grow beyond the initial training sessions.

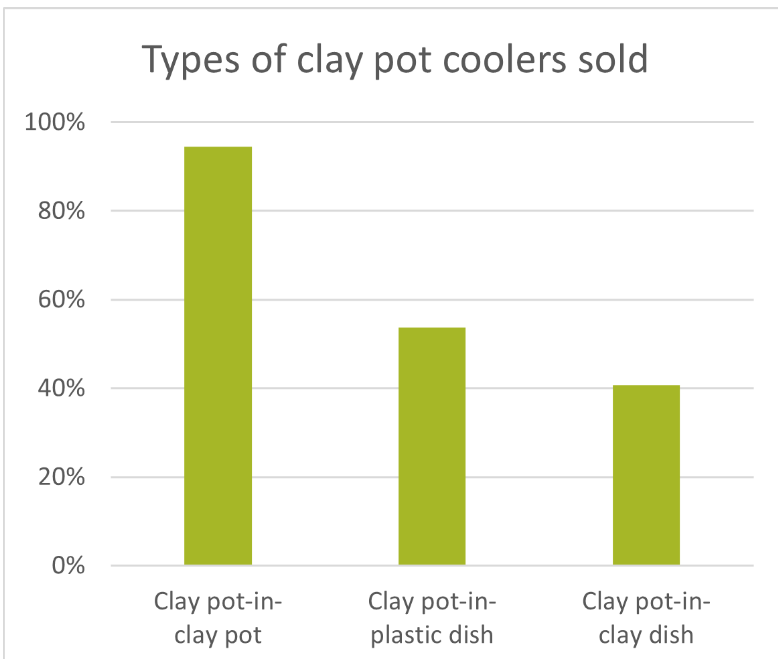

Figure 4. Percentage of clay pot sellers who sold each type of clay pot cooler — clay pot-in-clay pot, clay pot-in-plastic dish, and clay pot-in-clay dish. All 54 clay pot makers and sellers sold at least one type of clay pot cooler. Many respondents gave more than one response to this question.

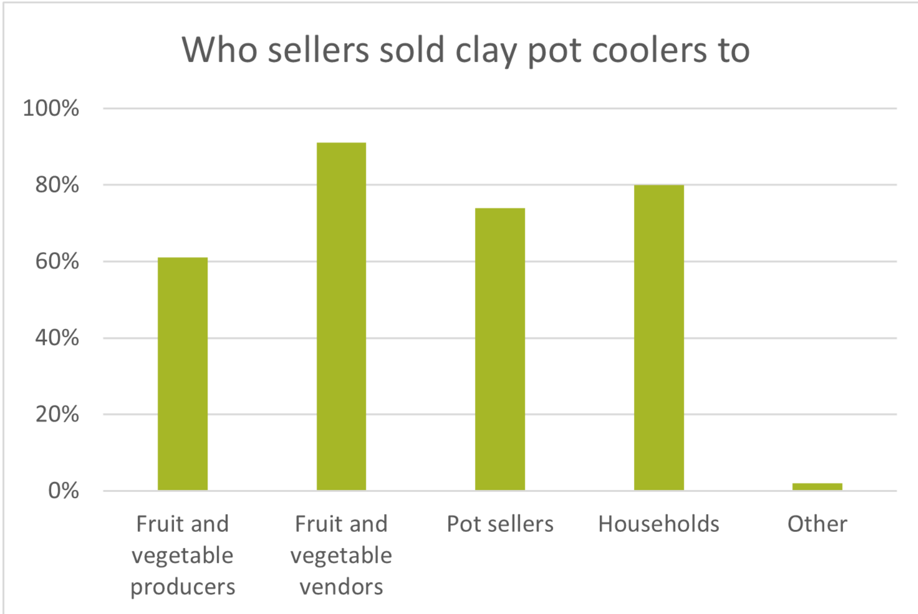

Figure 5. Percentage of clay pot sellers who sold clay pot coolers to different community members — producers, fruit and vegetable vendors, pot sellers, and households. A total of 54 clay pot sellers sold clay pot coolers. Most respondents gave more than one response to this question.

Participants were asked about their confidence in communicating about clay pot coolers, and 97% of respondents reported feeling confident in sharing information with others about the clay pot coolers. This confidence in communicating allowed 94% of respondents to share information about the clay pot coolers with others in their community. This means that an additional 21% of participants who did not adopt the technology themselves, still shared information about it with others. These respondents shared information about the clay pot coolers with a total of 4,396 people, an average of 17 people being told per training participant. Among those who shared information about clay pot coolers, 95% reported that the people with whom they shared the information found it useful, i.e., they reported using and liking the technology. Table 6 details the profile of the community members with whom training participants shared information about clay pot coolers. Respondents shared information primarily with family members, neighbors, fruit and vegetable vendors, and clay pot coolers who also shared information with their customers.

The large number of people who were told about the clay pot coolers and the large number of clay pot coolers sold beyond those who participated in the training are great indicators of the success of the technology in the region. If information about the utility of clay pot coolers in storing fruits and vegetables can be spread via word of mouth, more people can benefit from the technology. The impact of using clay pot coolers on those who participated in the interview is discussed in the next section.

Table 6. Percentage of respondents across all three groups who shared information about clay pot coolers with various members of the community — customers, neighbors, family members, and group/cooperative members. The total number of respondents is listed in brackets. Most respondents gave more than one response to this question.

Group information was shared with	Clay pot makers and sellers [54]	Producers and consumers [194]	Fruit and vegetable vendors [16]
Customers	87%	21%	81%
Neighbors	98%	63%	69%
Family members	94%	82%	69%
Group/cooperative members	35%	39%	50%
Other (comment)	0%	2%	0%

Impact

To understand the impact of clay pot coolers on the lives of participants, questions were asked about changes in lifestyle, food storage challenges, and food storage habits. In addition to the 73% of respondents who used a clay pot cooler, an additional 8% of respondents (22 people) did not use clay pot coolers, but reported other changes in the way they store fruits and vegetables. The changes these non-users reported include separating their produce based on ethylene compatibility guidelines provided in the training and covering a basket with a damp cloth. One-hundred percent (100%) of clay pot cooler users said the performance of the clay pot cooler is better than their previous method of fruit and vegetable storage at home. Additionally, 41% of non-users perceived the clay pot cooler as better than their previous method of storage before the training. These responses indicate that clay pot coolers are favorably viewed as a food storage solution among those who participate in the interview.

Increasing the shelf life of fruits and vegetables for people can have further impacts, including reductions in food spoilage, saving time and money, and improved nutrition. Figure 6 shows impacts reported by clay pot cooler users. Over 3.6 million people in Mali struggle with food insecurity yearly on average — with the Mopti region being particularly affected.[8] Fruits and vegetables contain essential micronutrients, which are especially important for vulnerable populations such as children under five years of age and pregnant and lactating women. With 88% of clay pot cooler users eating more fruits and vegetables compared to before the training, a positive impact on their nutrition is being made. The majority of users (95%) also reported spending less time traveling to buy fruits and vegetables. The task of buying produce often falls to women, who can spend hours traveling to and from the market multiple times per week.

Longer shelf life allows for more fruits and vegetables to be bought at once, reducing the number of times needed to go to the market. This reduces the time burden on women and girls, who can then spend more time on other activities such as attending school, working, and engaging with family and the community. Ninety-eight percent (98%) of users also report less food waste, directly supporting two UN Sustainable Development Goals (SDGs): Zero Hunger (SDG 2) and Responsible Production and Consumption (SDG 12). If fruits and vegetables spoil, it wastes the money, time, and energy spent to get that food to the consumer. Less waste will also make more food available for the consumer, so clay pot coolers are a tool that can help reduce food insecurity in the region.

With increasing global temperatures, food waste is likely to grow in the hot and dry climate of Mali. Clay pot coolers can improve resilience to the negative impacts of climate change through better food storage. Additionally, global food loss and waste generate 4.4 Gt CO_2 equivalent annually, accounting for about 8% of total anthropogenic greenhouse gas emissions,[9] which is comparable (87%) to global road transport emissions.[10] Less food waste reduces carbon emissions from decomposing fruits and vegetables. Furthermore, by reducing the amount of fruit and vegetable production needed by having more food reach consumers before spoiling, greenhouse gas emissions and other environmental impacts of the agricultural sector can be reduced. Therefore, in arid areas where clay pot coolers work best, and where people are struggling with food loss, this simple technology that can increase fruit and vegetable shelf life can also have a positive impact on not only the lives of users, but the greater community and the environment.

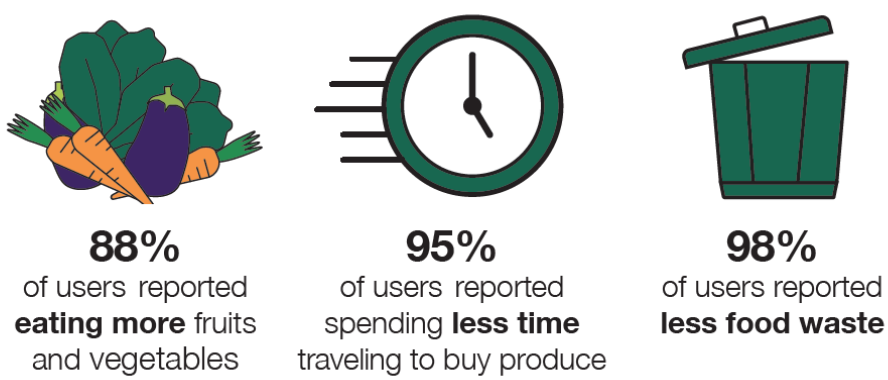

Figure 6. Impacts on fruit and vegetable consumption, waste, and time spent traveling to buy fruits and vegetables were reported by 194 clay pot cooler users.

Training Feedback

During the half-day training sessions, the following topics are covered during the training include:

- How evaporative cooling works
- Importance of proper fruit and vegetable storage
- Types of clay pot coolers and how to assemble them
- Fruit and vegetable compatibility
- Best practices for using clay pot coolers

To gather feedback on the training, they were asked about which topics they retained information about, which topics they appreciated the most, and which topics they thought could be improved. A full summary of responses can be seen in Table 7 below. Across all three groups interviewed, the topics retained by respondents the most were the importance of fruit and vegetable storage (90%), followed by the principles of evaporative cooling (78%). The topic retained the least by all three groups were the rules of fruit and vegetable ethylene compatibility.

Most respondents (81%) said they appreciated the aspects of the training regarding the importance of fruit and vegetable cooling and preservation, followed by the principles of evaporative cooling and types of evaporative cooling devices (78%). While the importance of fruit and vegetable cooling and preservation was the aspect appreciated the most by producers, consumers, pot makers, and pot sellers; no vendors selected this topic as one they appreciated. When asked to explain the most beneficial aspects of the training, common responses were that the technology was easy to understand, it provided the benefit of improving fruit and vegetable shelf life, and the information provided in the training was clear. Some commented that the least beneficial aspects of the training were that they had greater storage needs than the clay pot coolers could provide and some wished that the training provided them with a clay pot cooler. The team conducting the training has chosen not to provide clay pot coolers to participants to encourage the independent adoption of the technology in the area.

When asked about what could be improved in the training, 43% of fruit and vegetable vendors, producers, and consumers reported that they had no suggestions for improvements. The areas of the training participants that participants thought could be improved were: principles of evaporative cooling (41%), types of evaporative cooling devices (31%), and manufacture and assembly of evaporative cooling devices (29%). Sixty-three percent (63%) of vendors answered that the good user practices aspect of the training is in most need of improvement. Other suggestions for improvements to the training sessions include a longer training session duration, a follow-up training session, and more training sessions. This feedback has been taken into consideration as revisions to the training program have been made.

Table 7. Number and percentage of respondents who retained, appreciated, and wanted improvements on the various topics taught during the training. The total number of respondents was 264 and the number of responses for each topic is listed in brackets. Among the fruit and vegetable vendors, producers and consumers, 43% [113 participants] reported that they had no suggestions for improvements. Most respondents gave more than one response to this question.

Topics	Percentage [Number] of respondents who retained topic	Percentage [Number] of respondents who appreciated topic	Percentage [Number] of respondents who thought topic could be improved
Importance of cooling vegetables	90%	81%	18%
Good user practices	62%	63%	29%
Manufacture and assembly of evaporative cooling devices	67%	58%	31%
Principles of evaporative cooling	78%	78%	41%
Rules of ethylene	43%	41%	5%
User identification and marketing	24%*	34%	11%
Other	1%	6%	38%

*Only clay pot makers and sellers were asked whether they retained the topic of user identification and marketing. The percentage is out of 54 clay pot makers and sellers.

Conclusion

The results from the interviews indicate that the training sessions were successful in stimulating the adoption of clay pot coolers within the communities. Not only did 73% of participants adopt the use of clay pot coolers, nearly 2,000 clay pot coolers were sold by training participants. This indicates that a food storage need in the community is being addressed by the use of clay pot coolers. In addition, clay pot makers and sellers were able to expand their businesses to sell clay pot coolers and meet the demand of this new market. Additionally, participants shared information about clay pot coolers with over 4,000 people, indicating that participants like using the clay pot coolers enough to tell others in the community about the technology. Participants report experiencing less food loss, eating more fruits and vegetables, and spending less time traveling to purchase produce. These results indicate that the increased shelf life of fruits and vegetables enabled by using a clay pot cooler can lead to better nutrition for populations vulnerable to deficiencies. Clay pot coolers also help reduce the time burden for women to purchase produce at the market, allowing them to engage in other activities. The reductions in food loss experienced by clay pot cooler users can increase fruit and vegetable availability in local communities and lower greenhouse gas emissions associated with food production and waste. How to best improve and scale up the program to expand the positive impacts of clay pot coolers will be discussed in the next section.

Recommendations and Next Steps

MIT D-Lab is looking to continue working with organizations in Mali and other suitable regions that are well positioned to implement a clay pot cooler training program and scale up the dissemination of clay pot coolers.

Adaptations to the existing training plan and curriculum are planned based on the participants' feedback given during the interviews described in this paper. The most important and consequential feedback was the need for devices with larger storage capacity expressed by many participants. This feedback came both as a reason that people did not decide to adopt the technology, and as the most common suggestion from clay pot cooler users when asked how the technology could be improved.

While clay pot cooler capacity is limited by the size of the largest clay pot currently available locally, efforts can be made to increase the supply of materials for larger pots and to provide users with guidance to construct or purchase larger clay pot coolers. Before undertaking these efforts, MIT D-Lab conducted heat transfer modeling and laboratory testing to confirm that larger clay pot coolers would be able to provide a storage environment similar to the clay pot cooler designs already being promoted. This testing indicates similar results, with larger devices taking longer for initial cooling, but providing a more stable temperature across multiple days. If users have storage needs greater than 100 kg of fruits and vegetables, multiple clay pot coolers or other devices such as brick evaporative cooling chambers should be considered.

For future training programs, we will make modifications to the curriculum to provide more detail on the various sizes of clay pot coolers that can be assembled, and will use larger pots in demonstrations and/or specifically inform participants that they can use pots that are larger than the ones being used in the demonstration. Furthermore, we will provide clay pot makers and sellers with information about the demand for larger clay pot coolers to encourage them to make devices that can meet this demand.

The cost of clay pot cooler materials was a concern for participants, for both those that did and those that did not adopt the technology after the training. Because the training program does not engage directly with the sourcing of materials, there are limitations on how much an implementer can influence the cost of clay pot coolers. Given the high rate of adoption with the current program structure, subsidies for the cost of materials for participants would not be recommended as this could disincentivize other community members from adopting the technology without a subsidy. Our recommendation is for program implementers to dedicate time to identifying the most cost-effective local suppliers of materials that are suitable for clay pot coolers. This will allow implementers to direct participants to these lower-cost suppliers.

Some participants requested that they be provided with funds to cover their cost of transportation to attend a training, and depending on the specific context where a training program is being implemented, providing a transportation stipend to participants for attending the training could be feasible and beneficial.

Additionally, there were requests for a refresher to the training at a later date to reinforce the content. The first step is providing participants with information on clay pot coolers after the training to make sure that participants have access to the printed training guide. This guide is currently available in English, French, Bambara, Spanish, Swahili, and Hindi. For programs that conduct follow-up interviews with participants, these points of contact could be an opportunity to reinforce key pieces of content from the training. MIT D-Lab, World Vegetable Center, and Institut d'Economie Rurale are exploring options for disseminating and reinforcing content about clay pot coolers through rural radio, SMS communications, and low-bandwidth videos that will increase the reach of information about clay pot coolers.

Lastly, more evidence is needed to encourage governments, aid agencies, and implementers of development programs to invest in replicating this clay pot cooler training program in new regions and at larger scales. Additional impact evaluations need to be conducted to gain a better understanding of how clay pot coolers can help provide better fruit and vegetable storage for more communities. The team is looking to replicate this program at larger scales coupled with more rigorous impact assessments in order to probe more deeply into the impact of the program on fruit and vegetable consumption, time savings, and food loss for users. Furthermore, given the large number of indirect beneficiaries (1,999 clay pot coolers sold and 4,396 people that learned about the technology from the 289 participants), there may be a need for a quasi-experimental or randomized impact evaluation to capture the impact of this training program on communities.

Participants and facilitators at the completion of a clay pot cooler training of trainers (ToT) workshop in Bamako, Mali in February 2021. Photo credit: World Vegetable Center.

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Appendix

Table A1. Average, minimum and maximum age of respondents. The total number of respondents is listed in brackets.

	Clay pot makers and sellers [54]	Producers and consumers [194]	Fruit and vegetable vendors [16]
Average age	35	39	34
Minimum age	18	17	25
Maximum age	57	82	50

Table A2. Summary of which commune respondents were from. Eleven training sessions were held in ten communes in the Mopti region. Two training sessions were held in the commune of Mopti. The total number of respondents is listed in brackets.

Commune name	Clay pot makers and sellers [54]	Producers and consumers [194]	Fruit and vegetable vendors [16]	Total [264]
Doundou	0	30	0	30
Fatoma	0	21	4	25
Konna	1	19	6	26
Korientze	1	24	0	25
Mopti	50	9	2	61
Ouro Modi	0	25	0	25
Sendegue	0	19	0	19
Sevare	2	14	1	17
Soufroulaye	0	17	3	20
Soyed	0	16	0	16

Table A3. How respondents acquired a clay pot cooler. This question was only asked to clay pot makers and sellers and producers and consumers. The total number of users is listed in brackets. Some respondents gave more than one response to this question.

	Clay pot makers and sellers [51]	Producers and consumers [135]	Total [186]
I made it myself from materials I already had	51%	3%	16%
I made it myself from materials I purchased	71%	7%	24%
I bought a complete clay pot cooler from a seller	29%	87%	72%
Other	0%	4%	3%

Table A4. Where respondents acquired materials to make a clay pot cooler. This question was only asked to pot makers and sellers and fruit and vegetable vendors. The total number of respondents is listed in brackets. Some respondents gave more than one response to this question.

	Clay pot makers and sellers [135]	Fruit and vegetable vendors [8]	Total [143]
Used own materials	21%	13%	20%
From local market	7%	63%	10%
From clay pot sellers in the city	13%	25%	13%
Other (comment)	1%	13%	1%
From the neighbor(s)	21%	0%	20%

Table A5. Locations where respondents across all groups kept their clay pot cooler. The total number of users is listed in brackets. Some respondents gave more than one response to this question.

	Clay pot makers and sellers [51]	Producers and consumers [135]	Fruit and vegetable vendors [8]	Total [194]
In the room/ bedroom	10%	11%	13%	11%
In the compound of the house (outside a room/ bedroom) under a shed	61%	70%	88%	68%
In the compound of the house (outside a room/ bedroom) under a tree	92%	26%	38%	44%
Under a shed in the market	N/A	N/A	50%	2%
Within the confines of the house (outside a room) left out in the sun (no protection to create shade)	0%	0%	0%	0%

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