PRACTICAL ACTION
Technology challenging poverty

EVAPORATIVE COOLING IN GAMBIA

The Experience of Qasid Safir

In July 2008 Qasid, a mechanical engineer student at Swansea University in the UK, following a year of teaching maths in Gambia contacted Practical Action about an idea to set up a project to introduce groundnut oil extraction that he was setting up in Gambia.

He had seen a video of groundnut oil extraction on the Practical Answers website along with the technical brief and thought that the technology would be suitable for income generation and so contacted Practical Action in the UK to ask for more detailed information on the subject.

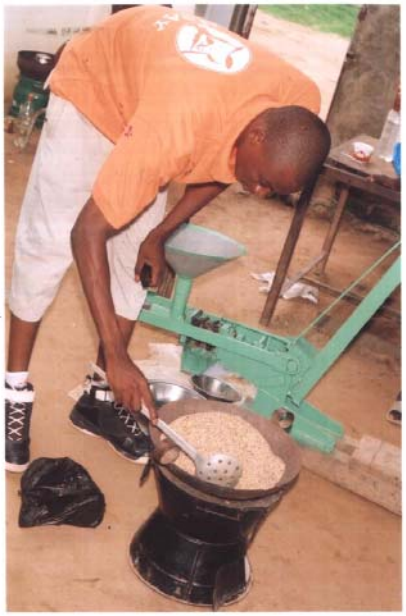

Figure 1: trails of the ram press.

Qasid explained "…due to the lack of local industries, where there is unbelievable unemployment rates and basic food products are too expensive for the common man to live comfortably. I hope this project with your help will go some way in reversing this trend."

One of the contacts provided by Practical Answers, Enterprise Works in the US was very useful. They said they also were no longer involved in cooking oil pressing but provided a contact for a manufacturer and supplier of manual ram presses in Dakar, Senegal. Qasid sent a friend, Amadu, from Gambia to visit the contact in Senegal, Assaine. He was shown the press in action, how to operate it and maintain it.

Although the technology proved to work well Qasid reported that "Small scale production techniques struggle to compete with mass produced imports undermining local business initiatives. This makes it important to accurately assess the economic and market aspects of technology innovations rather than dealing with technology issues in isolation." The economics of the oil processing project were not favourable and consequently Qasid moved onto the desert fridge concept. Evaporative cooling designs have been around for many years and the pot-in-pot design was developed by Mr Mohammad Bah Abba a teacher in Nigeria who went on to win the Ashden award.

Qasid said, "The genius of the idea is in its simplicity and the availability of the materials to the people who need it. The desert fridge is made from two clay pots, one inside another, and with a layer of wet sand between the two, which insulates the inner pot. When the water evaporates, it acts much like human perspiration, and lowers the temperature of the inner pot." For a description of evaporative cooling see.

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Qasid linked into Students in Free Enterprise - SIFE that helps students with ideas for enterprising projects. The desert fridge project was accepted, and he was put in touch with Corina Edwards, the Entrepreneurship Development Officer at the University of Swansea – who helped him get the project off the ground and provided him with access to important resources.

Initial contact was made to Practical Action in the United Kingdom and later on as the project developed Qasid talked with Practical Action Sudan staff as they had experience in pot-in-pot (Zeer) evaporative coolers.

The clay refrigerator project was first initiated by Practical Action in 2001 following research conducted by Practical Action Country Director Mohammed Majzoub who had heard about the idea being promoted by Mohammed Bah Abba.

Figure 2: Cold tomatoes: The University of The Gambia science club examine the tomatoes kept in the desert fridge.

Practical Action Sudan was able to provide the Clay Based Technologies [link] manual and provide information on some of the technical aspects of the evaporative coolers. The Sudan team advised him to contact a local Earthenware Manufacturing Group (EMG) and to train a few members on how to make a small number of refrigerators following the instructions provided and then test it with a variety of vegetables. It is important to involve the EMG and to let them feel part of the process for implementing the technology. The team also recommended that the idea should be explained clearly to them and to encourage them to suggest any further improvements or better ways of manufacturing it from their end.

Qasid also linked up with the University of Gambia to carry out tests on the effectiveness of the clay coolers.

Samples of the tested clay coolers were then distributed to the local market sellers for further practical testing and to feed back any comments on their appropriateness. These experiments demonstrated that the Desert Fridge extended the life of perishable products such as tomatoes from a few days to 18 days.

The pilot project was carried out in January 2009 and recorded in the video "Desert Fridge Project Promo"

Encouraged by these results, local pot makers in Gambia were commissioned to produce more of these Desert Fridges and these units were distributed to farmers, market sellers and housewives.

Farmers using the Desert Fridge reported that they have reduced food wastage and were now able to sell their produce on demand due to the Desert Fridge. The housewives who were given the Desert Fridge greatly benefited from having a storage facility at their homes.

Qasid explained that a major consideration was how the desert fridge is used “despite the excellent results it seemed to me that the Desert Fridge was not being correctly used. I had

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noticed that some users were keeping it indoors or in enclosed spaces. I would imagine that due to way it works by evaporation of the water it should be raised up and kept out in the open to ensure it receives as much fresh air as possible to maintain a higher water potential gradient from the moist sand to the air."

In the case of the market sellers who were using it there was a very good reason for this. They did not have enough space around there market table to put the Desert Fridge out and were afraid if they were to put it on there table it could be knocked over. Therefore they kept it under there table, which is enclosed from 3 sides.

In the case of the farmers some would keep it under there veranda and others would keep it inside there homes.

The way people used the cooler linked to another concern, during the implementation stage they were not consistently getting the temperature inside the cooler as low as the experimental temperatures.

Of particular interest was

- Comparison of a refrigerator kept indoors to one kept outdoors.
- Comparison of a refrigerator standing on the floor and one raised up on a stand.
- Comparison of one out in the open and one out but enclosed.

Figure 3: Bufaloto Villagers: The group gather around the desert fridge along with the volunteer team.

This led Practical Action Sudan to carry out a series of further experiments to see what the difference would be between having a cooler indoors or having outside on the floor or raised up on a stand to provide the best possible ventilation. The testing was useful but it was also important to have real life experience for comparison with the situation in Gambia.

As well as the experience in Sudan, Qasid contacted Practical Action in the UK about an evaporative cooler project that Emily Cummins had started through the Sustainable Design Award and had gone on to trial in Namibia. Additional information was acquired from Mr Mohammad Bah Abba indicated that similar efforts had been made in Nigeria, Cameroon and Brazil. Gambia was approaching the rainy season. During this season humidity reaches above 70% and it was not clear weather the desert fridge would work in these conditions. Humidity never reaches this high in Sudan but a comparison with the Desert Fridge in Rwanda where humidity is always above 70% could provide some useful insights and Practical Action Sudan had some links into Rwanda.

This real life experience was coupled with more academic investigation into the fridge's performance; there was collaboration with the University of Glasgow to research into improving/ optimising the Desert Fridge / Clay Refrigerator by using thermodynamic/ finite element computational modelling methods.

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Impressed by the results of this project; The Department of State for Community Development decided to incorporate the Desert Fridge into their training programmes.

The Gambia National Radio broadcast episodes about the Desert Fridge project and received many calls of interest from their audience nationwide.

The local pot makers started producing Desert Fridges for themselves and were eager to start selling them to other in markets.

Local Gambian volunteers working with Humanity First Gambia have initiated a plan to introduce the Desert Fridge into villages in every region of Gambia.

Qasid informs us that "Regarding the Desert Fridge Project, it gives me great pleasure to inform you that as of January 2010 I will be working with Humanity First to roll out the Desert Fridge project from Gambia to Ghana, Ivory Coast and Mali. I must thank you on behalf of all the beneficiaries as we could not be where we are today without the ongoing support of Practical Action."

Links and contacts

http://www.youtube.com/mubahilshakir#p/a/u/1/92fpnUfRt1A
http://www.swan.ac.uk/research_innovation/News/GambianFarmersBenefit/
http://gm.humanityfirst.org/index.php?option=com_content&view=article&id=1:hf-news&catid=2:news-articles&Itemid=6
http://observer.gm/africa/gambia/article/desert-fridge-project-launched-for-nbr-women
http://www.swan.ac.uk/news_centre/NewsArchive/2009-2010/Headline,40690,en.php
http://www.thisissouthwales.co.uk/news/Student-dreams-cool-desert-gadgetarticle-940026-details/article.html

Refrigeration in Developing Countries Practical Action, Technical Brief
Evaporative Cooling Practical Action, Technical Brief
Evaporative Cooling - The Ceramic Refrigerator Practical Action, Technical Brief
Evaporative Cooling - The Clay Refrigerator Practical Action, Technical Brief
Evaporative Cooling in India Practical Action, Stories of Change

SIFE

SIFE is an international organisation that mobilizes university students around the world to make a difference in their communities while developing the skills to become socially responsible business leaders.
www.sife.org

Humanity First

Humanity First is an international aid agency that provides aid and assistance to those in need irrespective of race, religion or politics from registered offices now in 28 countries. HF has been working on projects in 35 countries across 6 continents. www.humanityfirst.org.uk

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Appendix 1

UNIVERSITY OF THE GAMBIA SCIENCE CLUB DESERT FRIDGE EXPERIMENTAL PROJECT.

I. Experimental Site:

The University faculty building premises was the site for the experiment. This place is about 5km from the Atlantic Ocean. The temperature and humidity is relatively lower in this part of The Gambia.

II. Materials:

Two clay jars and a lid, sand, a piece of cloth, water, two thermometers, fresh tomato fruits and a small clay pot.

III. Procedure:

Fresh tomatoes fruits were obtained from a vegetable garden in Abuko village about 15km from the University faculty offices. The tomatoes were harvested between the hours of 12:00 to 13:00 on Friday 26th of December, 2008. By 14:30 of the same day, the experiment was already set up as follows: some sand was put in the bigger clay jar just to cover the bottom. Then the smaller clay jar was gently put into the bigger clay jar, and then the space was carefully filled with sand. The sand in between the two clay jars was carefully watered. Some fresh tomatoes were then put in the clay jar. A thermometer was also put in to measure the daily internal temperatures. The piece of cloth was wet, then squeeze and was spread over the mouth of the clay jar. The clay lid was then used to cover the mouth of the clay jar. The second thermometer was put on the outside to record the daily external temperatures.

IV. Results:

The system was watered twice a day. Temperatures were taken on daily basis at about 13:00. Tables 1 and 2 give the daily volumes of water used and temperatures respectively.

Table: 1. Daily volumes of water used

Date	Time of First watering	Volume of Water in liters	Time of Second watering	Volume of water in liters
26-12-08	14:30	3	17:00	1
27-12-08	09:05	1	13:10	¾

28-12-08	09:10	1.5	13:11	3/4
29-12-08	09:00	1	13:15	½
30-12-08	09:15	1	13:20	½
31-12-08	09:06	1.5	13::00	½
01-01-09	09:08	1	13:20	¼
02-01-09	09:13	½	12:58	¼
03-01-09	10:00	¾	13:12	>1/4
04-01-09	09:02	¾	13:11	>1/4
05-01-09	09:01	¾	13:12	¼
06-01-09	09:14	½	13:01	½
07-01-09	09:10	½	13:09	¾
08-01-09	09:20	1	13:10	¼
09-01-09	09:30	½	13:20	>1/4
10-01-09	09:02	½	13::11	¼
11-01-09	10:00	½	13: 30	>1/4
12-01-09	10:10	½	13:20	-

Table: 2. Temperatures readings.

Date	Time of Reading	External Temperature (°C)	Internal Temperature (°C)	Variance	Remarks
26-12-08	14:30	-	-	-	
27-12-08	13:10	35	24	11	
28-12-08	13:11	34	24	10	Tomatoes in the control clay pot starts to deteriorate.
29-12-08	13:15	31	22	11	

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30-12-08	13:20	31	20	11	
31-12-08	13::00	33	19	14	Tomatoes in the control clay pot deteriorated completely on the 31-12-09
01-01-09	13:20	35	23	12	
02-01-09	12:58	33	23	10	
03-01-09	13:12	33	24	9	
04-01-09	13:11	34	23	11	
05-01-09	13:12	31	23	8	
06-01-09	13:01	31	22	9	
07-01-09	13:09	32	22	10	
08-01-09	13:10	34	22	12	
09-01-09	13:20	30	22	8	
10-01-09	13::11	32	20	12	
11-01-09	13: 30	31	22	9	
12-01-09	13:20	34	23	11	
AVERAGE		32.58824	22.23529	10.47059	

V. Interpretation:

As indicated in table 1, the average daily temperature recorded during the period was 32.58 oC and the average internal temperature of the desert fridge over the period was 22.2°C. There was a significant average temperature variance of 10.47°C. These figures are a clear indication of the effectiveness and potency of the desert fridge as a means for preserving fruits and vegetables particularly in the rural communities where there is little access to electricity couple with the inability of rural farmers to purchase refrigerators. Putting into account the type of climate that prevails in the greater Banjul Area – that is the costal part of the country, the desert fridge will work perfectly well in the up country where average daily temperatures measure at least 35°C and coupled with low humidity.

As indicated on the remarks column of table 1, on the 28th of December, 2008, the tomatoes in the control clay pot started to show clear signs of deterioration and on the 31st of December, 2008 they were completely deteriorated.

On the other hand, the tomatoes in the desert fridge continue to be to be fresh for a long period. Until the 12th of January, 2009 they are fit for human consumption.

VI. Observations:

On the 31st of December 2008, some fungal growth was observed on the wooden support of thermometer inside the system and on the 5th of January 2009, some fungal growth was observed on two of the tomatoes on which the wooden support of the thermometer usually rest. The fungi must have been introduced into the system by hands while reading the daily temperature of the system. Although no fungicides were applied, only two tomatoes were affected the rest were ok. The poor spread and virulence of the fungi could be attributed to the constant low temperature of the system, as fungal optimal activity is generally favored by relatively high temperatures. Water was also observed in the inner jar although this does not seem to have any significant impact on this experiment.

VII. Recommendations:

- The fruits to be stored in the desert fridge must be in good condition and free from any form of infection.
- Once the desert fridge if filled with fruits, frequent opening should be avoided as much as possible in order to maintain low temperatures of the system.
- The content of the desert fridge should never be touched with bare hands, unless they are ready for sale, this is to avoid contaminating the content of the desert fridge.
- Once the content of the desert fridge is emptied, it should be properly disinfected before putting a new stock.
- The porosity of the inner clay jar should be made as low as possible in order to prevent water moving into the stored fruits when external temperatures are low such as during the night.

VIII. Conclusion:

Going by the results of this experiment, there is a clear indication of the effectiveness of the desert fridge as a means for preserving fruits and vegetables and hence improve their self life. If this facility is maid available in the rural communities, it will go a long way in improving the lives of peoples in the rural communities, as this system is both environmental friendly and sustainable as well.

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