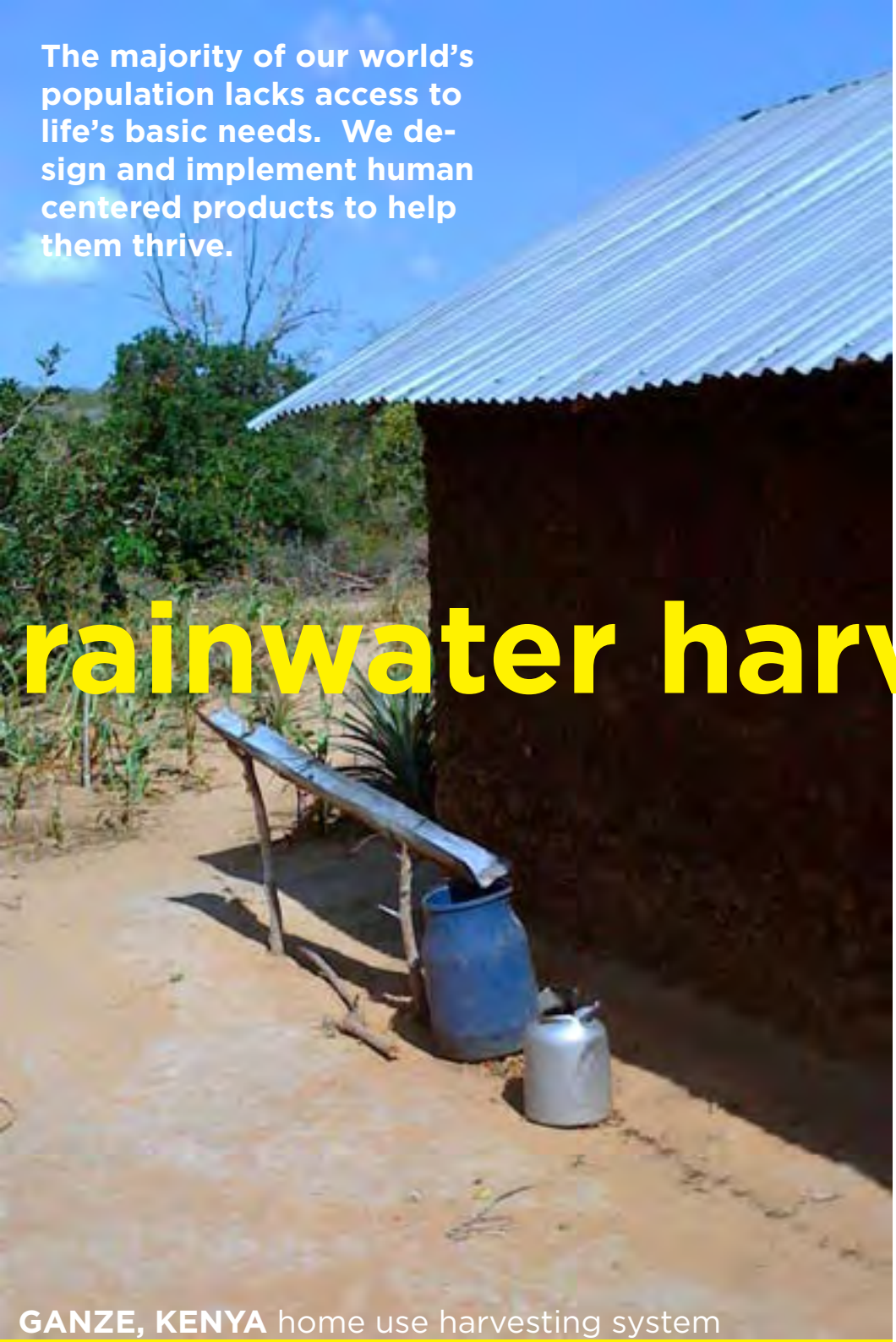
KOMAZA
Rainwater Harvesting
Rapid Exploration



GANZE, KENYA home use harvesting system

rainwater harvesting

Catapult Design a non-profit design firm working with non-profits, social enterprises, and for-profit companies to bring their product ideas and needs to life. Our market: the poor, the underserved, the majority.

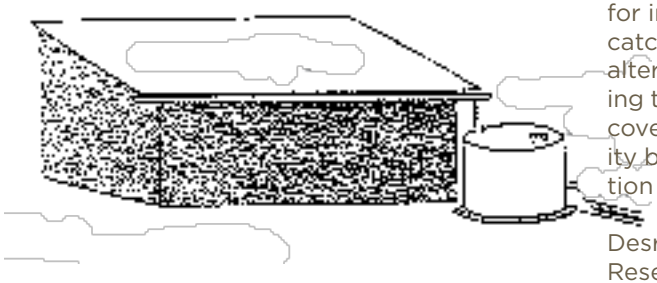
As a team, we've spent the last three years building our own expertise and a network of specialists that will allow us to best serve our clients. Each Catapult team member has several years of experience in product development -- we want to put that expertise into practice through the social missions of our clients.

Catapult engaged with KOMAZA to perform rapid research on water storage systems for KOMAZA's farmers. In this document, we review learnings from implementers and the state of harvesting around the world as a source of inspiration and knowledge for KOMAZA.

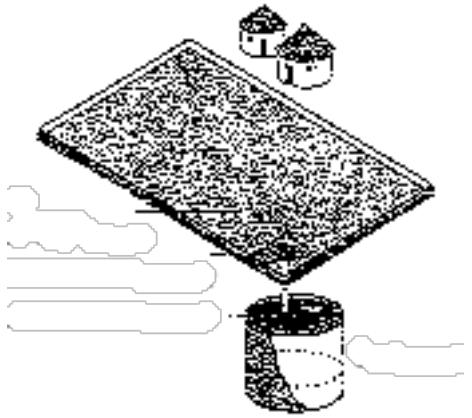
Contents

review of basic harvesting systems

Rooftop Systems
The most basic rainwater harvester collects rain in a vessel at the edge of the roof. It often includes collection of rainwater in gutters which drain to the collection vessel through down-pipes. The amount and quality of rainwater collected depends on the area and type of roofing material. Rainwater can be collected from roofs constructed with galvanized corrugated iron, aluminium or asbestos cement sheets, tiles and slates, although thatched roofs tied with bamboo gutters and laid in proper slopes can produce almost the same amount of runoff less expensively (Gould, 1992). Bamboo, roofs with metallic paint or other coatings are not recommended as they may impart tastes, color, or introduct health risks. Roof systems also require regularl maintenance to remove dust, leaves and bird droppings.



Ground or Surface Systems
Rainwater harvesting using ground or land surface catchment areas involves improving runoff capacity of the land surface through various techniques



such as collection of runoff with drain pipes. Compared to rooftop catchment techniques, ground catchment techniques provide more opportunity for collecting water from a larger surface area. By retaining the flows of small creeks and streams in small storage reservoirs (on surface or underground) created by low cost dams, this technology can meet water demands during dry periods. There is a possibility of high rates of water loss due to infiltration into the ground, and, because of the often marginal quality of the water collected, this technique is mainly suitable for storing water for agricultural purposes. Various techniques available for increasing the runoff within ground catchment areas involve: i) clearing or altering vegetation cover, ii) increasing the land slope with artificial ground cover, and iii) reducing soil permeability by the soil compaction and application of chemicals.

Desriptions by the Global Development Research Center.

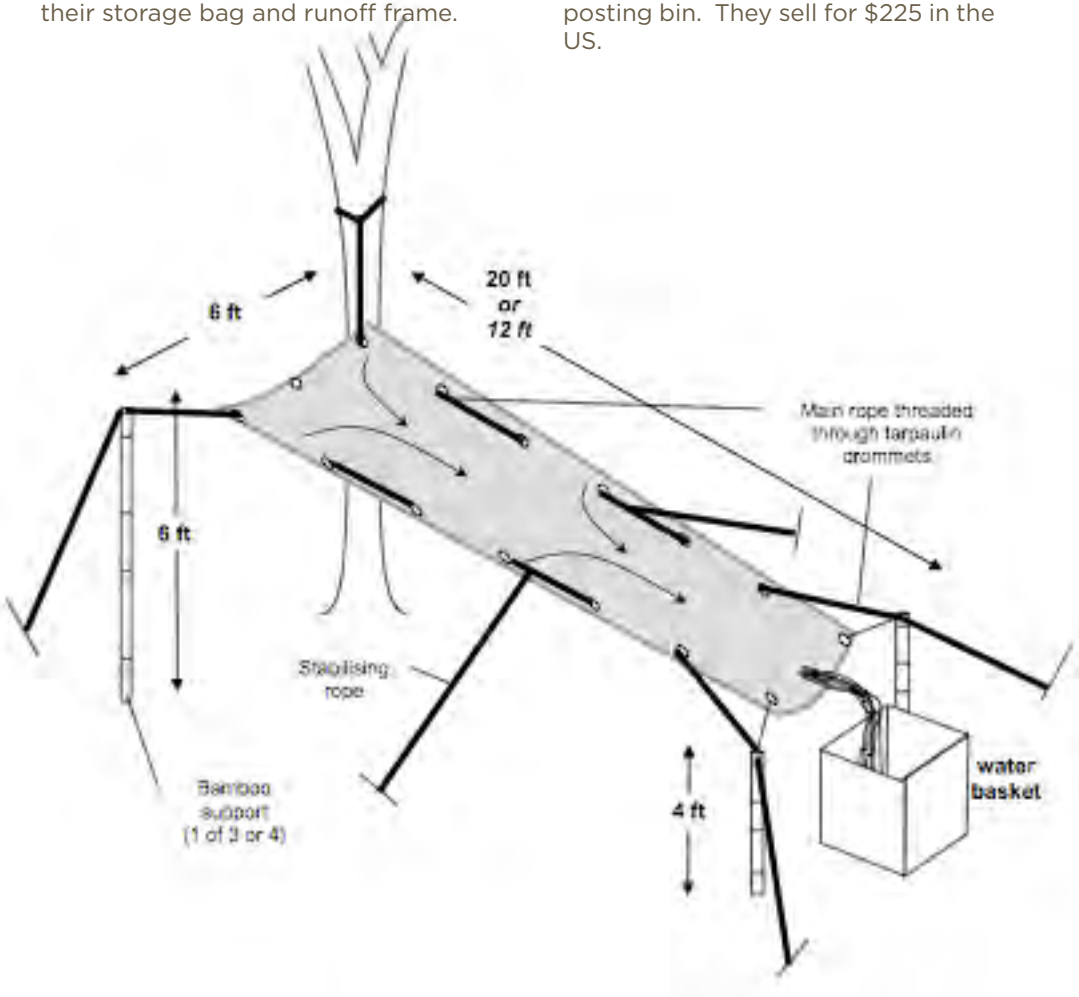
harvesting system case studies

IDE-Myanmar's tarpaulin system uses bamboo framing to suppport their storage bag and runoff frame.

Novelty composting harvesters hold 47gallons of water below a composting bin. They sell for $225 in the US.

Bladder tank 3000 liter in bamboo construction: 0.6 Taka per liter construction cost, and incl. supply chain profit
WHO, 2002

A variation on IDE-Myanmar's tarpaulin system. The tarpaulin systems were developed in response to emergency and natural disaster scenarios.



Construction plans and specs for IDE-Myanmar's tarpaulin system. The water basket used in the diagram is the same water bag explored in week one.

Found in western Rajasthan, kuis (or beris) are 10-12 m deep used to harvest rainwater in areas with meagre rainfall. The mouth of the pit is made very narrow. This prevents the collected water from evaporating. The pit gets wider as it burrows under-under the ground, so that water can seep in into a large surface area.

Small-scale rainwater catchment in Rajasthan, India abandoned by community members. The implementing organization also tried lining the surface of the dish with reflective material in an attemp to distill the water for drinking.

“Pillow tank” is a fabric storage system sold in the US to accomodate under-the-deck storage and easy transporting. A 300gallon system is sold for $465.

Modular harvesting system sold in the UK and the US. Modular systems imply a decreased purchase price, giving the farmer the option of adding to the system when he/she has more money to invest.

IDE-Bangladesh’s sheetmetal tank (3000L) is cheaper and easier to construct than ferrocement tanks. They are largely prefabricated in the workshop. On site the craftsman unrolls the sheet metal, places it on a concrete foundation and rivets the sides of the tank in place.

In Rajasthan, kundis, are unique structures which look like huge concrete saucers on the landscape. These are used for collecting rainwater to meet the needs of the local people and animals.
WHO, 2002

Rain barrels are standalone systems designed to hold 50-400 gallons of water. They include a spigot for accessing the water and range between $100-$450 in the US.

Save the Rain in Tanzania installs rooftop harvesting systems on schools. The pictured installation cost $45,000 for the ferrocement system. It holds 70,000 gallons, yields 250,000 gallons per year and was built in 40 days.

Rainwater harvesting system utilitzed in Bangladesh. Traditional rainwater collection was very simple and was usually done by tying an old saree or a sheet to four posts in the yard and collecting the water in a traditional earthenware pot, a Motka.
WHO, 2002

issues crtical to rainwater harvesting

Acceptability
Acceptability of rainwater harvesting by the user is the foremost critical factor. The user must see a clear benefit in acquiring and using a system. These considerations are often linked to convenience and cost, and perceived seasonal advantages, rather than with health.

A key point is also the security the water system brings to the household with respect to control over the availability of water.

The Action Research project executed by NGO Forum in the context of the WPP programme, has shown that a rainwater harvesting system was favoured by the consumers over dug well and several arsenic removal techniques, but that an arsenic free tubewell still had first preference.

Private versus public
Use and management of stored water can be managed well in a household or extended family situation. Here convenience and water security may lead to substantial interests and willingness to invest in a system that cuts down water collection time and enhances control over the water store.

In public systems as in schools or for a cluster of households, the management of water distribution is a critical element of continued functioning. In controlled environments such as a school or a mosque, water can measured and delivered at certain times of the day. A management structure can be put in place to ensure that water is available to the user while at the same time conserving water as necessary.

In public supply situations it is often not easy to put adequate management systems in place and so RWH systems fall in disrepair due to conflict, or they become the user right of some.

Quantity
An adequate collection surface with sufficient periodic rainfall will give sufficient water during the rainy period and some time beyond. The size (and cost) of storage and the capability to capture rain even when there is only an occasional shower (guttering) will determine the amount of water that will be available for consumption during the dry period. Management of the stored water, and management of other acceptable water sources available to the household will determine how long the supply will last. Households are often quite clever in managing their water especially when occasionally an alternative water source can be tapped.

Quantity is an issue in public supplies, where control over the stored may be problematic. It should not be a problem in private systems. At the same time however, the technical design of the water collection from the storage should be such that no inadvertent waste or leakage of the stored water is likely!

Costs
Rainwater harvesting systems are often depicted as the most expensive system in a comparison of water supply systems. However, the comparison is often incorrect as tank designs in text book are often outdated and over designed. Also, at times system elements are included that a household may already have and thus should not be counted again, e.g. a G.I.sheet roof.

The cost of a rain water harvesting system is basically dependent on four elements:

- Roof catchment
- Guttering
- First flush filter
- Storage Tank

Of these the roof and the tank are critical in terms of costing. As most people will have a roof on their house this may not immediately be the biggest cost except when it is necessary to improve the roof for water quality reasons.

On the other hand the cost of a tank is often high. Partly this has to do with the application of design standards that are fit for public systems but do not necessarily have to be followed when designing private systems. Recently Warwick University, Lanka Rainwater Forum and IDE have successfully been working on cheaper storage solutions. It now gradually becomes possible to consider storage capacities at Tk. 1-1.20 per liter. The aim however would be to duck underneath the cost of Tk. 1.0 per liter of construction cost.

Quality
Quality of any water is determined by the quality of the source water, the exposure to contaminants during the production process (collection, treatment, storage) and when it reaches the consumer. Rainwater is generally bacteriologically safe, has low mineralization, but may be acidic, contain lead, traces of pesticides, etc. depending on locality and prevailing winds. Contamination occurs when rain falls on to the roof, collects dirt, dissolves some zinc or lead in case of metal surfaces and then flows into storage. In storage it may increase in alkalinity in ferro cement tanks or dissolve chemicals from paints used.

Study in Africa by Thomas indicates that first mm rainfall is highly dusty with high level turbidity. Turbidity is reduced considerably at 2.5 mm rainfall. The correlation between turbidity and bacteria was examined. Studies by P. Vasudevan from India also showed that there is a progressive decrease in the amount of bacteria over 1st mm to 2.5 mm rainfall.

Diversion of first flush and use of filters are hence important to DRWH design. The problem with various first flush devices are cost, user's convenience (manual versus automatic) and loss of water (amount of first flush to be rejected).

In general rainwater is of good bacteriological and chemical quality when adequate precautions are taken and a good design is followed. In Bangladesh the risk of mosquito breeding is great in tanks that are not well sealed. In such an instance aedes mosquito may breed and cause the spread of dengue.

Source: WHO

KARHEDA, INDIA rainwater harvester on a school

rainwater harvesting in Kenya

In Kenya today the key players in rainwater harvesting include the following government ministries: Ministry of Water Resources Management and Development, Ministry of Environment, Natural Resources and Wildlife and Ministry of Agriculture. Several NGOs and other Community-Based Organizations at national and local levels have played a major role in putting rainwater harvesting in the limelight. Through Southern and Eastern Africa Rainwater Network (SearNet) established with the assistance of International Rainwater Catchment System Association and the support of the Regional Land Management Unit of UNEP, Kenya has been able to exchange information on rainwater harvesting with other countries in the east and southern Africa sub-regions. At the local levels, church organizations and women groups have been very active in this field.

UNEP and other UN agencies have conducted pilot projects and workshops in Kenya to promote rainwater harvesting at national and local levels. Some bilateral development partners have also supported the use of this technology. The private sector has been instrumental through manufacture of components needed to implement rainwater harvesting projects such as gutters, roofing material, concrete and water tanks.

The most important lesson learnt in the implementation of rainwater harvesting is the need to take serious consideration of environmental impact assessment before conducting any major rainwater storage project. The implication of various interventions to the entire basin must be taken into account, projects must be developed with the beneficiary community, and the community must be allowed time to understand and internalize new technologies for their acceptance. In all projects undertaken, it has been vital to train the community in the initial stages of the project so that at the end of the project time skills are left behind to serve community members who may be keen in adopting the technologies.

Source: Minister for Water Resources Management and Development and by Kenya Rainwater Association (KRA

references

Rainwater Gossip

MIT's D-Lab has a student team looking at low-cost rainwater harvesters as a student project this year.

Architecture for Humanity is building "The Rainwater Court", a full-court basketball court with an integrated rainwater collection, near Nyeri, Kenya. The harvesting system incorporates UV purification and solar panels to power the water system and night lighting. The full-court configuration has a 4,850 sq ft playing surface covered by metal roof and guttered to collect an estimated 90,000 liters of water per year.

KRA and UNEP installed two harvesting systems in Kasaye and Machakos that they claim were so successful that they have been replicated by surrounding communities.

East Africa RWH Organizations

Kenya Rainwater Association (Nairobi)
Kenya Rainwater Association (KRA) is a professional, on-profit and non-political national membership organization, which brings together individuals, institutions and organizations actively involved in enhancing rainwater harvesting and utilization.

Save the Rain, Tanzania and Uganda
Save the Rain is a non profit organization committed to ending the water crisis through rain water harvesting. We achieve our goal by teaching people living in water deprived areas to catch, store, clean and use the rain as a sustainable water supply.

Alternatives to Harvesting

Katumani Pitting
Small, interlocking mini-catchments using a pitting and ridging technique coupled with reseeding with native grasses and legumes.

Pitting starts at the top of an eroded slope below a cutoff drain which intercepts runoff from above. Pits are dug to form interlocking catchments, each about 2x2 meters in area, varying in shape with the micro topography.

Final embankments should be about 30 cm high, around crescent-shaped trenches, 15 cm deep and 20 cm wide. Cow peas, or other ground cover crop, should be sown on the ridges, and cattle excluded, during the first growing season to allow vegetation cover to establish and soil to compact.

They are used in Kenya in areas with rainfall of between 350-600 mm.

Source: UNEP

UNEP statistics on Rainwater Harvesting and Kenya

Kenya, whose current population is estimated at about 33 million people, had enough rainfall to supply the water needs of six to seven times that number.

Kenya has rainwater harvesting capacity of 12,300 cubic metres against its annual renewable water availability of just over 600 cubic metres. The country's capital, Nairobi, has the capacity to provide for the water needs of a population of 6-10 million, supplying each one with 60 litres a day if rainwater were efficiently harvested, the study noted.

Links

rainwaterharvesting.org
for an overview ofurban and rural systems in India

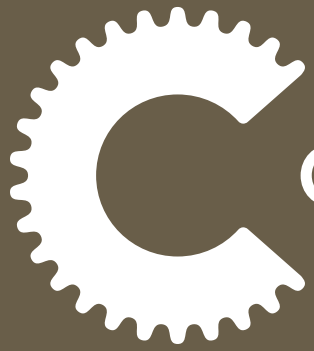
rainwater-toolkit.net/
toolkit on sizing a rainwater harvesting system

practicalaction.org/practicalanswers/
tips on selecting a location for rainwater storage tank consruction

fadr.msu.ru/rodale/agsieve/txt/vol2/8/art3.html
list of institutes researching desert/drylands/arid agricuture

icarda.org/Facelift.htm
International Center for Agricultural Research in the Dry Areas

cababstractsplus.org/abstracts/Abstract.aspx?AcNo=19886767558
data highlighting the significant potential for developing sustained productive fuelwood plantations in arid and semi-arid regions relying entirely on runoff water. [for purchase]



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