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Constraints to domestic roofwater harvesting uptake in Uganda: An assessment

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The constraints that affect the immediate take-up of roofwater harvesting in Uganda were; the limited availability of roofing of suitable type and adequate area per capita, the 'excessive' cost of RWH components and systems in Uganda and the absence of a supply chain for providing RWH systems for those who want them. The rural roofing constraint is severe and must be either accepted biasing the technology somewhat away from the poorest households or attacked via trials of rival ways of bypassing this constraint. Means of achieving reductions in costs include training, the promotion of the very concept of technology choice, experimentation with rival models for delivering RWH and the use of public/NGO purchasing to encourage more efficient forms of production.

Introduction

Domestic roofwater harvesting (DRWH) is of growing interest in Africa but there is rather little known about how large a role it might play in water supply and what constrains its uptake. The Southern and Eastern Africa Rainwater Network (SEARNET) based in Nairobi therefore commissioned the Uganda Rainwater Association to study its scope and constraints in Uganda under the title of 'Policy Study'. This paper summarises the main findings of that part of the Study (completed March 2004) concerned with identifying and ranking the constraints. It became clear during the Study that care had to be taken to distinguish various alternative styles of roofwater harvesting. In particular neither 'main-source DRWH' nor 'sole-source DRWH' should be considered the normal style of using the technology, since both are economically less attractive than other styles of DRWH.

Current manifestations of DRWH in Uganda

The collection and storage of rainwater during the rainy season is an ancient practice that has been passed on from one generation to another in many parts of Uganda (Ngigi et al., 2003). The decisive change however has been the steady growth since 1970 of corrugated iron roofing and rectangular houses, replacing in much of the country the traditional circular thatched house. Almost every rural household with a hard roof practises *opportunist* DRWH (where no permanent equipment is employment). Whenever it rains these people use whatever containers they have at hand to collect roof runoff. These containers include kettles, saucepans, jerrycans, basins of capacities 2 to 25 litres and clay pots. The yield from such *opportunist* RWH is however rarely more than 40 litres on a typical rainy day, (with say 10mm of rain) due to absence of guttering and the very limited water storage facilities.

An early form of *opportunist DRWH* – which preceded the arrival of iron roofs - is runoff collection from trees. This is still practised by a small minority, usually elderly people living alone. Where banana fibres used to be used to direct water into pots, small spouts of metal or plastic are now more common.

Informal RWH (where minimal but permanent storage is employed) is also quite widely practiced, mainly using oil drums of various sizes combined with tiny gutters (a couple of meters of metal, plastic or banana culm). In a few cases the building plan is Tee-shaped, resulting in a concentration of run-off where two perpendicular sections of roofing meet over a 'valley' and the possibility of avoiding guttering entirely. The means of storage and of subsequent water abstraction from storage is not very satisfactory. The drums rust and silt up; their open tops give rise to rapid deterioration of the water; they are readily obtainable and portable but not very cheap. Drums, like other containers are usually 'hidden' behind houses rather than located in front, although whether this is for aesthetic or 'safety' reasons is not known.

Formal DRWH (where at least 400 litres of storage is installed) is practiced by some rural households with hard roofs, mainly in the Southern part of the country, for example in Mbarara (a dry district), Rakai (a district of especially poor groundwater) and Kabale (a mountainous district). Isolated large houses, for example the rural bungalows of prominent citizens, often employ galvanised iron or concrete tanks to achieve such *formal RWH*. Otherwise its practice is very uneven, reflecting the limited geographical focus of past RWH promotion programmes. The storage facilities employed include underground dome tanks, stabilised-soil block tanks, tarpaulin-lined pits and ferrocement jars (Rugasira, 2002).

The main constraints on DRWH uptake

The six constraints that were short-listed after a discussion with RWH activists included;

1. DRWH is not economically viable (even at best-practice prices)
2. actual systems in Uganda cost markedly more than best practice indicates they should
3. the skills and components needed to create RWH systems are absent in many locations
4. there is ignorance of water harvesting techniques amongst relevant professionals, moreover RWH is not treated as generously as other water sources (of comparable performance) by funding agencies
5. there is only a small health benefit expected from introducing RWH
6. roofing is of inappropriate quality or inadequate area.

This study was designed to examine these constraints that prevented or have prevent the widespread take-up of RWH in the Uganda and propose steps by which they might be reduced.

Materials and methods

Excluding sparsely-populated parts, Uganda has a relatively uniform climate, with bimodal rains and an annual rainfall in the range 800 to 1500 mm. Field data was obtained from two Ugandan Districts selected out of the 56 in the country, namely Nakasongola and Tororo Districts. Three Sub-counties were visited in Nakasongola District, 120 km north of Kampala, (1000 mm rainfall and a low population density) and two Sub-counties in Tororo District, 200 km east of Kampala on the Kenyan border (1400 mm rainfall, more developed and with a higher population density). Those five sub-counties were chosen to be fairly representative of the whole country in terms of rainfall pattern and rural economic development. Moreover neither of these two Districts had been subject to intensive RWH promotion in the past.

Data was collected via (10) household interviews from one village per sub-county, community focus-group discussions, market visits and direct observation in all five locations. In addition relevant local and national water professionals were interviewed

Findings and Discussions

The survey showed that three of the six constraints listed above were likely to affect the immediate take-up of roof-water harvesting in Uganda. These three were:

(a) the limited availability of roofing of suitable type and adequate area per capita,
(b) the ‘excessive’ cost of RWH components and systems in Uganda and
(c) the absence of a supply chain for providing RWH systems for those who want them.

However, in the longer term water-quality uncertainties may pose a barrier. The reduction of constraints such as these may be addressed imaginatively – one can visualise steps to reduce them. Whether these imagined steps would be successful is very difficult to assess. There are few examples in Uganda of constraints like these being overcome in areas other than water supply that might be taken as models of how to proceed. Looking at RWH experiences in other countries might offer some guide to which measures are effective. Unfortunately such experiences are not well or openly documented.

Lack of suitable roofing

According to Uganda National Household Survey 2003 the fraction of households still having thatched roofs is 41% rural and 8% urban, a fraction that is falling at around 2% per annum. There is considerable regional variation however with the North of the country lagging far behind the rest. Moreover a significant fraction of those *with* hard roofing have insufficient roof area to support say *Adaptive RWH* (meeting a 20 lcd demand in the wet months but only potable water demand in the dry ones), let alone *Main-source RWH* which requires a large tank, often placed underground, and a roof large enough that 90% of reasonable annual water needs can be met by RWH. The average area of the roofs of the 50 (all ‘hard-roof’) households interviewed was 5 m2 per inhabitant. However 34% of hard roofs were under 3 m2 per inhabitant and were therefore definitely too small for meeting an average household’s (WHO standard of 20 lcd) demand.

Options: The main options for handling this constraint are to:

(a) Wait until hard (e.g. iron) roofing is more common. It could be almost universal by say 2024.
(b) Concentrate on areas where hard roofing is already almost universal, e.g. in the hills of SW Uganda.
(c) Promote types of RWH that are compatible with almost all actual hard roof sizes, for example Wet-season-only DRWH (where storage is large enough to span up to 1 week between rainfall events and still meet all household water needs). Jars of 600 to 1200 litres capacity are typical of this style. During the wet season when agricultural labour demands are high and paths are slippery the household will make no use of point sources but draw on roofwater instead.
(d) Construct new roofs on houses within a DRWH programme.
(e) Construct communal artificial RWH roofs.
(f) Use the roofs of large buildings like schools and churches.
(g) Employ such collection surfaces as rock faces, cemented ground or vertical nets.

Option (a) is too slow: it is tantamount to accepting the constraint is effectively irremovable.

Option (b) is quite attractive but raises issues of regional imbalance.

Option (c) is likely to be unattractive to water authorities. That RWH can only provide core water in dry seasons is already a significant limitation; the propagation of technology giving NO dry-season water might be very unpopular. The restriction of RWH to those (quite many) somewhat-richer households who do have adequate roof area would effectively move RWH away from a general water-supply technology to a technology used for private provision only.

Option (d) is unusual but not inconceivable. There are communities for which even the addition of say $80 roofing per household to the ca $65 per household required for a minimal *Adaptive RWH* system would *not* make RWH more expensive than other ways of achieving such a supply objective as 'annual mean return distance to fetch water is not to exceed 1 km'. However a hard roof has other benefits than just enabling water harvesting, so its provision has potential to generate resentment / jealousy. Providing free roofing to some households and not to others (for example those who already have hard roofing) may prove contentious and require an overt repayment arrangement.

Option (e) – creating artificial roof surfaces for RWH - has been used in a few situations, including a handful of locations in Kisoro District, a mountainous region of south west Uganda. The technique is expensive (since corrugated iron roofing offers almost no economies of scale, even though the associated water storage does), does not reduce fetching distance as much as household roofing would and requires quite elaborate management to allocate the limited water.

Option (f) has been discussed in international fora and actually implemented in a few places (including Ethiopia). Generally the institutional roof area is quite inadequate to provide RWH for all the households around that institution and the management of the water is particularly difficult. Moreover fetching water from an institutional roof may entail substantial carry distances, undermining the principle advantage of domestic RWH. The grave management problems associated with school-based RWH do not bode well for using either schools or places of worship as sources of roofwater. However it would be instructive to experiment with different forms of management, such as highly partitioned roofs rented to individual families or otherwise assigned to named households or the operation of water vender services from institutional roofs.

Option (g) Cemented rock surfaces are mentioned in the literature and indeed are the basis of water supply in, *inter alia*, the city-state of Gibraltar. They have also been used in Mbarara District of Uganda. Paved courtyards have been used for RWH in China but mainly to supply (dirty) water for irrigating kitchen gardens. Rock surfaces and cemented ground are difficult to keep clean, the former are only occasionally available in convenient locations and again need communal management. Past experiments in which thatch roofs have been covered by tarpaulin sheets (costing $0.5 per m2) have resulted in the grass quickly rotting – possibly new experimentation could establish a solution to this problem.

Comparison of Options: Of the seven options (a) to (g) above, the first three comprise living with the constraint of inadequate roofing, whilst (d) is the only likely way of supplementing the roof area.

Excessive cost of RWH components in Uganda

Comparison of the prices in Uganda and other development countries showed that RWH components and systems in Uganda cost 50% to 100% more than they 'ought', and that in some cases this could compromise economic viability. This excess is not surprising in such a young industry and could be expected to reduce somewhat as the industry matures. It could be reduced by:

(a) Instigate mass or at least 'local factory' production of 1,000-2,000 litre mortar jars coupled with development of better means for their local delivery.
(b) Training in production and popularisation of use of 12,000 litre underground tanks and associated VLOM (village level operation and maintenance) handpumps.
(c) Streamlining the delivery of RWH systems by NGOs and the granting of micro-credit for RWH (under 'house improvement loans').
(d) Improving technology choice (including introducing less durable but very-low-cost tank designs) by establishing regional demonstration and training centres.
(e) Establishing national or principal-town manufacture of specialist items like inlet screens / filters, plastic 3" gutters and gutter clips etc.
(f) Creating a quality accreditation scheme for RW goods that would both assist private users and support tendering for RWH installation contracts at say District level.

The return on householder investment (capital payback time) in *Adaptive DRWH* appears to be a rather marginal 18 months at current (high) prices. From the survey data for a typical rural household, we calculated that the storage supplies a family of 5 people, 4860 lcd in the wet season for a duration of 8 month and 854 lcd in the dry season of 4 months, and the value of water was $0.0025 per litre in the wet season and $0.003 per litre in the dry season. The return on *Informal DRWH* is better (shorter than 18 months) and on *Main-source DRWH* is worse. A fall in prices would therefore certainly accelerate take-up.

Even at current prices, however, to meet the long-term objective of reducing collection time to say 200 hours per person per year (roughly corresponding to constantly using a source 500m from the house) it is usually cheaper to install partial DRWH in all houses over 500m from sources than to increase the number of protected point sources.

Absence of Supply Chain

This constraint overlaps the last one. The actions rehearsed in the section above are part of creating a RWH-goods supply chain. However a more critical absence is that of an accessible service for potential private RWH users. Some such users may have the ability to organise the delivery of components bought in a District town to their homes and their subsequent assembly there, but most do not. These latter require instead the services of an installer, accessible from within their own say Sub-county, who can make recommendations concerning tank-sizing and technology choice, can assist with the procurement and delivery of components, can install those components and can provide some maintenance services. Such a RWH Supplier might be an individual mason, some sort of partnership (e.g. tank-builder, gutter-installer, tank-cleaner, pump-repairer), a Community Based Organization (CBO), a self-employment group, a mutual-help group or conceivably a franchised subsidiary of a national business.

The creation of such enterprises in every sub-county of Uganda (representing at least 2000 jobs) might take some years and require considerable training or other encouragement. Clearly the viability of such businesses requires demonstration and they should begin in the areas of most market promise.

The national supply of components is slowly growing. The three organisations (Bakyala Kwekulakulya Women Group in Rakai, ACORD and Kigezi Diocese) are currently able to supply/build tanks or multiple RWH systems in any part of the country and might be encouraged to grow in number by for example regional displays of competing hardware.

Conclusions

Given the present mild encouragement of RWH by water authorities in Uganda and the accumulating local experience, RWH provision may be expected to slowly grow. However the rural roofing constraint is severe and must be either accepted (biasing the technology somewhat away from the poorest households) or attacked via trials of rival ways of bypassing this constraint. For reasons of its relative novelty, lack of grasping economies of scale, high-cost management and poor technology choice, RWH in Uganda costs substantially more than it might. Means of achieving reductions in costs include training, the promotion of the very concept of technology choice, experimentation with rival models for delivering RWH (communal, subsistence, governmental and commercial) and the use of public/NGO purchasing to encourage more efficient forms of production.

With a modest input of promotional resources, it should be possible within 5 years to achieve the state where (a) RWH systems of sensible cost and adequate quality are readily purchasable by households and (b) such technology can be employed in public or NGO water-supply programmes in the many particular locations they appear to offer a cheaper way of improving access to safe water than using other technologies.

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