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Low-Cost Technologies Towards Achieving the Millennium Development Goals: **The Case of Rainwater Harvesting**

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I. Introduction

Achieving the Millennium Development Goals (MDGs) remains a daunting challenge for many countries in the face of small state budgets and limited donor support. This Policy Research Brief highlights the contribution of a low-cost water supply strategy to a number of MDGs. It also discusses innovative financing schemes to scale up the implementation of such strategies.

Photo by Raquel Tsukada.

II. The Relationship between Rainwater Harvesting and the MDGs

The MDG of halving the proportion of the population without sustainable access to safe drinking water by 2015 is challenging in several respects. The geography of developing countries—low population density, low degree of urbanisation, long periods of drought and so on—imposes economic barriers to the traditional water-grid provision and calls for alternative solutions for water supply. Half way to the deadline for meeting the MDGs, in countries such as Mozambique, Papua New Guinea, Somalia and Afghanistan, only 42, 40, 29 and 20 per cent of the population, respectively, has access to water from an improved source.

In many areas, rainwater harvesting (RWH) has been a successful coping strategy against water scarcity, especially in periods of drought. Cisterns are the most popular RWH storage technology. Runoff rainwater is diverted from the rooftops of houses via gutters (made of bamboo, plastic or metal) and stored in a closed ferrocement tank or jar with a capacity of 5–50m^3. In Brazil's semi-arid region, a rooftop area of 40m^2 can capture and store 16,000 litres of clean water for a single household. This is enough to satisfy the drinking water demand of a family of five during the long months of drought. In that area it costs about US$800 to build a cistern.

Besides its direct contribution to attaining sustainable access to safe drinking water, RWH also makes some significant contributions to achieving other MDGs.

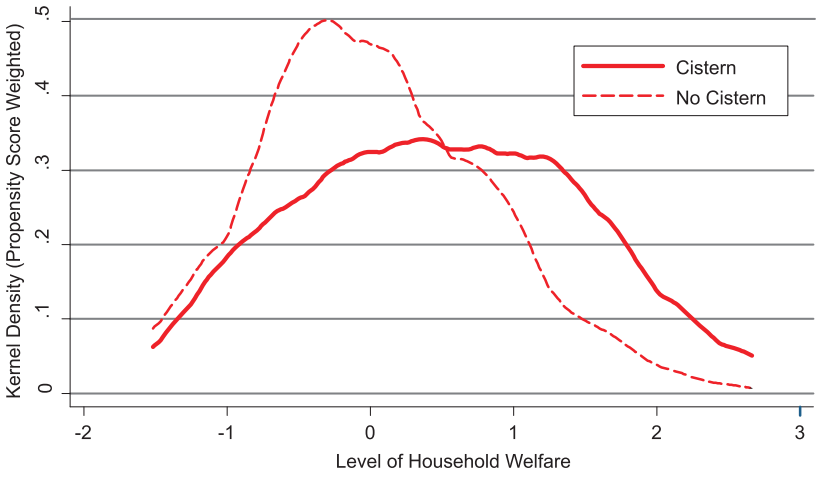
Goal 1. Eradicate extreme poverty and hunger.

Rainwater storage relaxes the time constraint on individuals' pursuit of productive activities. In many rural areas in developing countries, household members spend several hours a day collecting water from distant sources (rivers, ponds, springs and so on). Several family members are involved in water collection, and the burden is greater on women and children. The water captured from a cistern technology installed at the home reduces the demand for water from the distant (and usually unsafe) source, saving the household's time. This allows the household to shift labour supply to other productive activities, such as agricultural and livestock production or work in the paid labour market.

Second, RWH may increase the quantity of water available to the household. In water-constrained households, this additional water is essential for increasing agricultural and livestock production (watering vegetable gardens, raising chickens and goats, and so forth). Poverty is alleviated when this agricultural production is either consumed or bartered at local markets, yielding additional household income and improved nutrition. Third, access to safe and clean drinking water improves health and thus allows greater physical ability to work and higher productivity.

Figure 1

Rainwater Harvesting and Poverty



Source: Tsukada and Lehmann (2009).

Empirically, Tsukada and Lehmann (2010) find that rainwater harvesting is associated with reducing the poverty level of households in Brazil. Figure 1, next page, shows that higher levels of well-being[1] are more frequent in households that have a cistern at the home than are households without one.

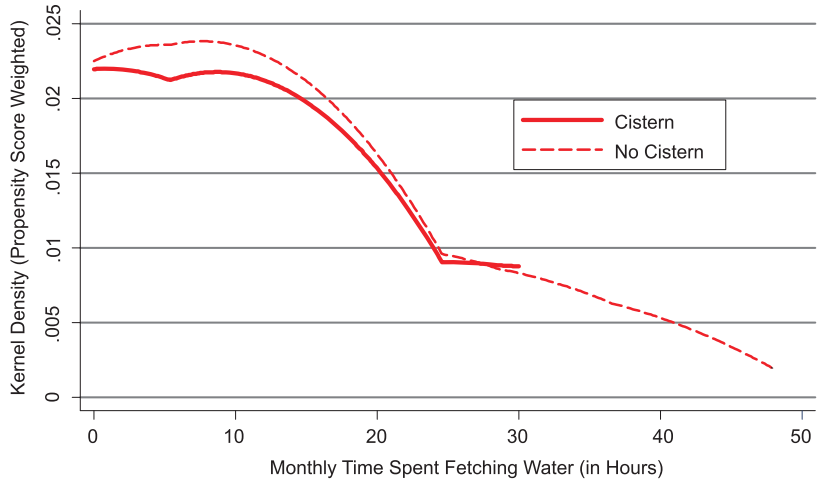
Furthermore, households with a cistern spend no more than 30 hours a month collecting water, whereas a significant share of households without one spend up to 50 hours a month doing so.

Goal 2. Achieve universal primary education.

Achieving universal primary education requires the construction of schools, as well as complementary inputs to ensure that pupils are provided with conditions of learning that meet a minimum quality standard. Apart from teachers and educational materials, important complementary inputs are nutritional support and hygiene facilities. In isolated rural areas, after long walks to school under often exhausting conditions (dust, heat and so on), children arrive hungry and thirsty, with little energy left to pay attention in class.

Figure 2

Rainwater Harvesting and Time Use



Source: Authors' calculation.

A glass of water and a meal revives their concentration. Moreover, in some schools children are required to bring water to the school or to help collect water during school hours so that school meals can be prepared. RWH in schools catches and stores a large volume of runoff rainwater from the school's rooftop. It thus leads to an increase in the effective time children spend in the classroom.

Access to safe and clean water at school improves basic hygiene, lowering the probability of infection with (and transmission of) bacterial diseases such as diarrhoea. More than 50 per cent of the world's schools lack access to water, and about two-thirds lack proper sanitation facilities, circumstances that hinder simple and effective practices such as handwashing with soap. Additionally, captured rainwater can also be used to prepare school meals and to cultivate vegetable gardens. Better health and nutrition increase a child's cognitive capacity to absorb what is being taught and reduce rates of absence due to illness.[2]

Goal 3. Promote gender equality and empower women.
Women are usually in charge of the household water supply. Walking long distances of about 2–15 kilometres a day, women in rural areas of the developing world spend several hours daily collecting water from rivers, ponds or other unsafe sources. The heavy workload limits women's ability to dedicate time to activities that would increase their bargaining power within the household, such as paid work (the less a man is the breadwinner, the more decision-making power a woman usually has). Furthermore, carrying water over long distances inevitably causes physical harm to women, since the loads often weigh more than 20 kilograms. Accessing a distant water source is sometimes dangerous in itself, because women face the threat of physical assault and rape. Moreover, the quantity and quality of water from these sources is often insufficient to meet women's special needs at times of vulnerability (period, pregnancy, post-natal care and so forth). RWH via, for instance, a cistern technology offers water access at the home itself and thus mitigates the adverse effects on women's well-being of collecting water from isolated sites.[3]

Goal 4. Reduce child mortality.
A third of the 1.2 billion people infected or at risk of being infected by soil-transmitted helminthiasis are children. Rainwater, when properly stored, removes the risk of infection by water-borne and water-washed diseases. Washing hands with soap may halve the incidence of diarrhoea, the second leading cause of under-five child mortality.

A high incidence of poverty in the least developed countries is usually accompanied by striking levels of poor nutrition: about 32.5 per cent of children are malnourished. Malnutrition also contributes to the 10.9 million child deaths each year globally. RWH enables a family to cultivate small crops and raise livestock. If potable water is made available, fruits, vegetables, other agricultural and livestock outputs (such as milk) increase children's' calorific intake.

Goal 5. Improve maternal health.
The quantity and quality of water supplied from unsafe sources such as rivers and ponds is often insufficient to meet women's particular needs in the pre- and post-natal period. During and after pregnancy, moreover, women want to avoid physical effort. Carrying heavy loads of water over long distances increases the probability that expectant mothers and their unborn children may be injured during the pregnancy. RWH provides clean water at the home and therefore improves maternal health.

Goal 7. Ensure environmental sustainability.
RWH makes its chief contribution to the goal of halving the proportion of the population without access to safe drinking water. Apart from that, once households replace part of the water previously collected from a distant source with that from RWH, the latter reduces the exploitation of ponds, water tables and other natural water sources that are needed to maintain the biodiversity of a particular area. Furthermore, RWH diminishes surface runoff, avoiding soil erosion.

Goal 8. Develop a global partnership for development.
In 2001, Brazil established the One Million Cisterns Project to provide poor households in dry areas with a RWH cistern. The project was inspired by a Chinese government programme and has been successful in reducing rural poverty in Brazil. In 2008, moreover, the International Policy Centre for Inclusive Growth (IPC-IG) facilitated an exchange of experiences on RWH between those implementing the One Million Cisterns Project and government officials from several African countries (IPC-IG, 2008). Key implementers of the Brazilian project are also involved in development partnership networks, presenting Brazil's experience to other countries. These are a few examples of the potential of RWH to create cross-country dialogue towards a global partnership for development.

III. How Can Existing RWH Programmes Be Scaled Up in the Face of Limited Household, Government and Donor Budgets?

Despite their contributions to meeting the MDGs and relatively low implementation costs, RWH strategies have not yet reached a large proportion of the population without safe access to water in the developing world. Poor households are often unable to afford the construction costs from their current income. Displacing any share of their budget means constraining immediate subsistence (mainly, buying food).

Poor households therefore depend on donors and government-funded programmes. Aware of this danger, governments are now pursuing an increasing number of promising RWH projects in developing countries. Because of limited government budgets, however, those programmes are usually small-scale. The challenge is how to scale-up existing programmes in the face of donors' budget constraints, creating sustainable mechanisms for community self-financing.

Households usually face two main obstacles in financing RWH technology. First, the budget constraint of the poor makes it impossible to buy the cistern at once because the money is needed for other immediate purposes such as buying food. Saving is a risky activity for the poor: usually, the little a household might be able to save each month cannot be securely deposited because of a lack of formal financial institutions, and thus theft or value depreciation are prominent threats. Borrowing is extremely difficult, even when there are financial institutions in a community. Banks are usually reluctant to lend to poor villagers. Such households either lack collateral or the requested loan is too small to be feasible for the bank. In this regard, on the basis of microfinance principles, community self-financing schemes may facilitate the funding of RWH technologies, as explained below.

"Merry-go-round" scheme. Households form groups and make regular contributions. The contribution usually remains under the supervision of some community ombudsman who ensures that members cannot withdraw their instalment, and group pressure reduces the risk of moral hazard (default of a group member). For example, in a 10-member group, each makes a monthly contribution of one-tenth of the material costs of a cistern, and one cistern can be built each month. Every month the group votes on who will be given the lump sum, which is enough to build one cistern. No interest rate is charged and most members can have their cisterns built faster than

the 10 ten months it would take if each contributor tried to self-finance their own. If the water captured by each cistern is shared until all 10 have been built, each contributor benefits immediately.

In Uganda, for example, the RWH project in the Oruchinga Valley has constructed 10m^3 ferrocement cisterns for the purposes of domestic water consumption at an average material cost of US$200. The project was initially funded by a non-governmental organisation. Inspired by the experience of programme beneficiaries, non-beneficiary households increasingly organised themselves into savings and credit groups. This "microfinance" approach to enabling the construction of cisterns allowed the programme coverage to expand rapidly. In Kenya (Kusa village, Nyando District), 800 5m^3 ferrocement tanks were built, and beneficiaries bear 51 per cent of the material costs. As with the microfinance scheme in Uganda, the money is raised in a "merry-go-round" system.

Microfinance institutions (MFIs). MFIs can play a key role in helping to scale up existing RWH programmes among the poor. They can provide targeted loans to finance the construction of rainwater storage infrastructure. Water would enable households to engage in productive activities, and the material result of that work allows them to pay back the loan. For example, the time saved on fetching water from a distant source may be spent on income-generating activities (see above), and water allows rural households to grow vegetables or raise small animals and sell their production on local markets.

Scaling up existing RWH programmes may successfully and sustainably help achieve the MDG of halving the proportion of the population without access to safe drinking water, as well as other MDGs, at a relatively low cost. In the presence of household, government, and donor budget constraints, innovative community-driven microfinance strategies are needed to increase RWH coverage and thereby to unleash the potential of this feasible, low-cost strategy that effectively helps improve the lives of the poor.

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1. Household well-being is measured with a multidimensional wealth index (see Tsukada and Lehmann, 2010).
2. See Lourete et al. (2009a) for more on rainwater harvesting at schools.
3. See Lourete et al (2009b) for more on gender imbalances in water collection.

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