Rain water Harvesting Technology in Kenya and USA; Case Study on the Developed and the developing Countries

For the Greater Edwards Aquifer Alliance, by Rose Wamalwa – December 2014

Introduction

Water is lost from the phase of the earth through several ways, including evaporation, animal and plant consumption and largely through human related development projects. However there is only one way in which water comes back or its regulated back to the earth; through rainfall. Research has shown that rainwater is relatively clean if the right catchment materials/methods are used for harvesting, and the water is well stored.

Water scarcity and quality issues have emerged as a critical concern worldwide. In Africa as elsewhere in the world, the shortage of water and the resulting socioeconomic and health costs disproportionately impacts the grassroots community. Rainwater harvesting is a flexible technology that always gives room for more innovation. It is a hydrological cycle component that is linked to food security and livelihood promotion. There are quite a number of indications for Climate Change in the world today in relation to water, environment and management. The Impact of Climate Change is a global crisis that needs to be addressed in the first and the third world Countries.

Climate Change is evident in the change of precipitation trends that include large annual fluctuation of rainfall and snow fall, thus an increase in erratic rains. This has equal impact on water bodies such as rivers, lakes as well as ground water sources such as aquifers which have reported drastic change of water volume, increase of water of

water temperature and the declining water quality. In general the high demand on water resources for development globally has put water resources under pressure; hence there is an immediate need to urgently find innovative opportunities that will enable development and human well being without undermining ecosystem services.

1.1 Rain water Harvesting Technology in Kenya.

Rainwater harvesting technology is an old established art in Kenya, whose abundant knowledge has not been applied to its full potential, especially in urban informal settlements and its neighbourhoods due to various challenges and constraints experienced by the Government institutions and community based organisations. Observations in most of the urban centres show that rainwater-harvesting structures are not integrated into the building but are added as an afterthought. This is due to the existing by-laws and lack of awareness by planners, policy makers, beneficiaries and many engineers.

The high potential of rainwater harvesting in Kenya lies in three factors namely: reliable seasonal rainfall, the quality of roofing materials, and the high demand for safe water supplies. The housing quality in Kenya based on roofing materials is such that about 84.7% of the housing units in central province, 69.7% in Nairobi, 48.1% in Eastern, 39.8% in Nyanza, 36.9% in Rift valley, 33.1% in Western province, 29.3% in coast province and about 12.4% in North Eastern province are made of iron sheet roofs, asbestos cement sheets, concrete or clay tiles. (CBS 1994). This combined with high costs of conventional water sources makes rainwater harvesting a viable alternative water source particularly in developing urban centres and rural areas. (J Wanyonyi, KRA 1998a).

Sustainability of most of these projects after the donor withdrawal has been found wanting and unmanageable by the beneficiaries particularly in the rural parts of Kenya. In spite of the great efforts in the area of water resources development, with the construction of large water projects, there is still under-provision of water for domestic use particularly in the rural and slum areas of Kenya, as more than 67% of rural household still have no access to clean and safe drinking water. The problems of irregular water supply due to poor maintenance, lack of funds, broken facilities and rapid population increase, among other factors, have now reached a critical state. In Kenya the most common methods of rainwater harvesting is rooftop collection.

1.2 Rainwater Harvesting in the US

Texas is one of the many states in the US that have embraced rain water harvesting as serious water conservation practice and a major step towards domestic water supply. However despite the many efforts towards the promotion of this technology, a few states in the US historically have banned the practice because it is considered as a technology that that impinges upon the rights of the senior water right users**.** Consequently in most parts of the US, Rooftop Rain harvesting is considered NOT safe for human consumption; ultimately it is seen as a very expensive technology that must be incorporated with other relevant water purification processes such as Filtration.

However many environmental conservation organizations in the US are actively advocating and promoting the use of rainwater harvesting at household level in order to reduce pressure on the underground water resources such as the aquifers. According to the **Zero Net Water Blog**,

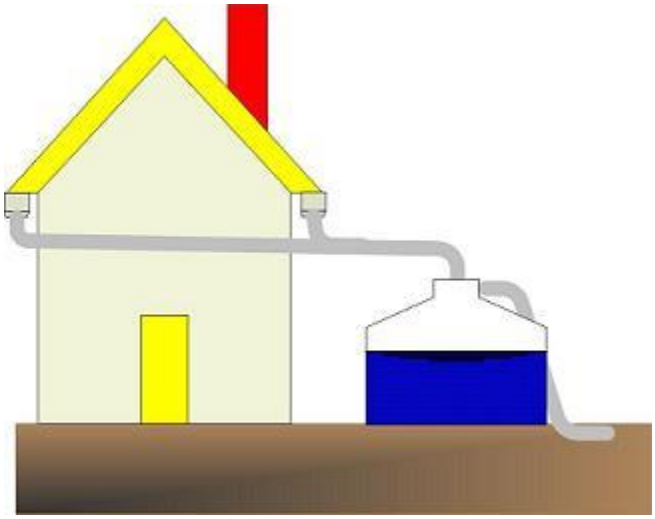
rainwater harvesting technology must be promoted since it minimizes the depletion of local groundwater, and loss of spring flow. That's a very important consideration in some places. It would blunt the "need" to raid remote aquifers, or to take land to build reservoirs, and all their attendant societal issues. Like the water war brewing over pumping down the Simsboro, or in northeast Texas over Marvin Nichols. It's an economically efficient strategy, since you only build, and pay for, the supply that's imminently needed. Additionally it also minimizes public risk. The costs of creating water supply would be largely borne by those who benefit directly from development, rather than by all of Americans through public debt. This is another long-term risk that pointing out to "One more Generation. This is so because the growth projections for the region are *not* manifest destiny. Large water infrastructure projects just have this, if you build it, they will come sort of "justification". But those projections depend on a continuation, acceleration even, of trends over the period on which the projections are based. And that continuation might be disrupted by any number of circumstances. So the question is what if they go ahead and implement the huge projects and sadly No one came to occupy? Or just, not enough to pay for it came? One may think growth is indeed inevitable, and so that's a remote risk, but still it's one that could avoid by shifting to a *sustainable water* infrastructure model; rainwater harvesting. (**Zero Net Water**)

2:0 Models of Rainwater Harvesting in America, (Courtesy of San Antonio Water Systems)

2:1 **Rainwater Harvesting: Wet Vs Dry Systems**

Dry Systems

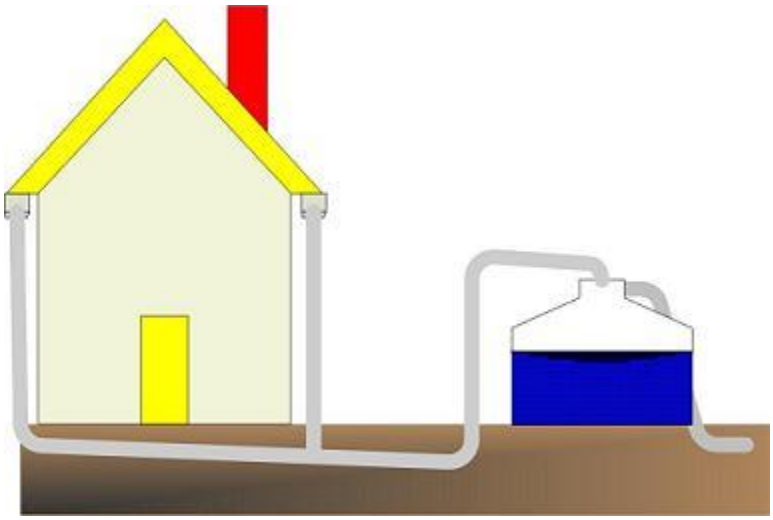
Dry systems are simple systems where water is fed directly into a tank via gravity. All of the conveyance pipes must be above the tank inlet for the system to work. In dry systems, the conveyance pipe run is usually very short and the system involves only one or two downspouts.



Wet Systems

In a wet system, rainwater collected from the roof goes into air-tight PVC downspouts to underground pipes and is channeled back up to the top of the tank via a riser pipe located near the tank. There must be enough of a drop from the gutter to the top of the tank to allow gravity (through water pressure) to fill the tank. These systems are "wet" systems because they must have a drain mechanism to allow water to drain from the pipes after a rain; otherwise, water would remain standing in the downspouts at the level of water in the tank. In wet systems, most of the conveyance pipe is hidden from view; thus they

are more aesthetically pleasing than dry systems. Wet designs are common where the system involves multiple downspouts.



Simple application:
Rainwater is fed directly into a polyethylene tank via gravity (dry system). The stored rainwater is used to water plants nearby. The water pressure for the end use is supplied solely from gravity; no pump is used.

Wet system

Consisting of a small galvanized tank with first flush filtration at the downspouts. In a wet system, rainwater collected from the roof goes into an air-tight PVC pipe connected to underground pipes and is channeled back up to the top of the tank via a riser pipe located near the tank. There must be enough of a drop from the downspout to the top of the tank to allow gravity (through water pressure) to fill the tank

Galvanized tank connected to an irrigation system. The system has a roof washer to filter the rainwater before it enters the tank. The rainwater system is integrated with the irrigation system. It has make-up water capability, conforming to TCEQ cross connection rules, which automatically adds municipal water to the tank when water in the tank falls below a specified level. When the irrigation controller's timer calls

for irrigation, a relay starts power to the pump, and floats inside the tank check to see if municipal water needs to be added to the tank.

Two 2,500 gallon connected polyethylene tanks hidden from view of the house by the land contour. This topology is ideal for a wet system with only minimal trenching required to bury the pipes

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Potable rainwater harvesting systems use UV light to sterilize the water.

A pump pressurizes the water for use inside the house or for non-potable landscape use. Filters remove sediment from the rainwater before it enters the pump. Check valves and pressure gauges protect the pump.

FILTRATION process

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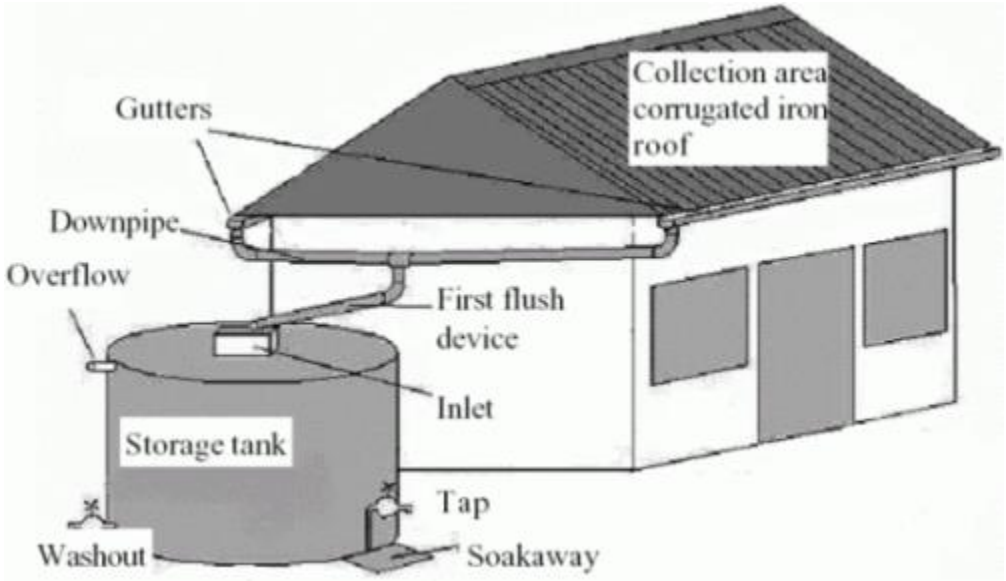
A 30,000 gallon galvanized tank being assembled.

Rainwater Systems/methods in Kenya

Typical Domestic Rooftop water Harvesting System in Kenya



Catchment area: Most roofs are covered with impervious materials such as corrugated galvanized iron (GI) sheets. The size of the catchment area determines the quantity off water to be collected.

Conveyance: The guttering system is used to convey the precipitation from the roof to the storage tank. Gutters are often the weak link in the rainwater harvesting system, which not only causes functional failure and fewer yields, but can also become a health hazard. Since poor installations allow water, leaves and other debris to enter and remain in the gutters, good workmanship and proper maintenance are crucial. This helps to safeguard the water quality and reduces the risk of creating mosquito-breeding places.

Storage tanks: Storage is necessary, since rain does not always fall when it is required. The water demand and the amount of precipitation determine the required storage capacity for a given reliability. Since the

tank is generally the most expensive part of the system, special attention has to be turned on its design and construction. However, rationing schedules and management strategies are essential to save capacity volume and cost of the system.

Ferro cement tank constructed in rural Kenya (Photo courtesy of Kenya Water for Health Organization)

Rainwater Harvesting tank in Kakamega Kenya (Photo courtesy of W-ECAN)

Rose Wamalwa is the Founder and Program Director of Women in Water and Natural Resources Conservation. As Director, Rose focuses on writing grant proposals, acts as a trainer and facilitator for women/youth groups, as well as supervises and oversees the Training in Water, Sanitation and Hygiene (WASH) projects for Global Women Water Initiative (GWWI) in Kenya, Tanzania and Uganda, a program that provides quality water and sanitation services, environmental conservation awareness, social entrepreneurship and leadership to communities. Following the CSP fellowship, Rose intends to enhance the participation of the grass-roots community in environmental conservation and social entrepreneurship through setting up a training center. While in the U.S., Rose plans to learn more about climate change adaptation, water resource management and gain social entrepreneurship skills.

A complete RWH system

4:0 Water Policies and Regulations in Kenya

In Kenya the Water Resource Regulatory Authority is an agent of the National Government that regulates the management and use of water resources. Every water resource is reviewed in and is held by the National Government in trust for the people of Kenya.

Water quality Regulations (2006) (legal notice No 721)

Apply to water used for domestic Industrial, agricultural and recreational purposes as well as fisheries and wildlife purposes. These regulations provide protection of all water resources including natural and artificial water sources. The objective of the regulations is to protect human health and the environment. These regulations provide guidelines and standards for the discharge of poisonous toxins, noxious, radioactive waste or other pollutants into the water sources and the Environment at large. Water quality regulations for domestic uses works towards prevention of water pollutions and standards for sources of domestic water, water quality monitoring and bans, as well as restriction on use of water sources. In general Kenya's Water Policy takes into account all relevant water issues including water Conservation, and quality preservation.

In many instances community based organizations, non-governmental organizations, government departments and even some donor agencies lack policy guidelines in support of rainwater harvesting. Those that have are generally inadequate, and unsuitable to the prevailing local conditions. For example the Ministry of Water resources in Kenya have no mechanism of approving the construction of a Ferro cement tank or water jar since they do not have design standard drawings. The city council by-laws only allow for effective disposal of rainwater from roofs

to avoid dumpiness and drainage problems but not to collect for beneficial purposes. Thus, most of the rainwater harvesting projects, particularly in Central, Eastern, Coast and Nyanza provinces evaluated by the Kenya Rain Water Harvesting Association are faced with multiple challenges:

- Inadequate legal advice in projects formation and outlined objectives as per relevant constitutional framework;
- Limited policies and by laws in funds and fundraising strategies to allow for effective project implementation and management;
- Lack of collaboration and networking amongst stakeholders;
- Limited community mobilization policy for water related activities;
- Low rate of community participation and contribution to project development;
- Inadequate water quality improvement structures, control and usage;
- Limited training and technological transfer in rainwater harvesting at project level;
- Lack of operation and maintenance guidelines for rainwater infrastructure such as gutters, tanks catchments and fittings

Women and water issues in Kenya

Issues concerning management and conservation of water resources are of great importance in Kenya now. With increasing human pressure on land, riparian areas and wetlands, areas, which were normally sparsely populated, are now settled. There is therefore an increasing concern on impacts particularly on current and future provision of clean water as well as of conservation of wetlands as habitats for wetland related biodiversity. Women are the main collectors and users of water in rural Kenya. They have to decide where to collect water, how to

draw, transport and store it, how much water to draw, how many sources of water to exploit and for what purposes {drinking, kitchen and other domestic use}. In some cases where women can afford tanks, rain- water becomes a major source for drinking and other domestic use. In most areas, especially dry areas, women still depend on wells, springs, streams and rivers for water supply.

In this case, practices that compromise water from streams, underground and rivers directly affect the welfare of women. To have a steady supply of water in streams and rivers, all catchment and riparian vegetations need to be conserved. This ensures that the hydrological cycle to continue, with feedbacks that involve evaporation, condensation, rain and runoffs. Stream and river sources should be conserved, as would be a cold source. This means that all agricultural practices {as they involve deforestation and replacement of natural vegetation} need to be discouraged in riparian and catchment areas. Draining of wetlands or farming them for agricultural practices {such as planting of rice} should be discouraged if they will affect water quality, Quantity, distribution and supply. Women should be educated in the importance of conserving wetlands, riparian zones and catchment areas to ensure clean and reliable water supply for their current domestic use and future supplies. With increasing number of women groups and their unique self-help projects, clean water availability and access is becoming the biggest item on women related-projects.