In Search of Safer Irrigation Water for Urban Vegetable Farming in Ghana

Irrigated vegetable farming is a common practice in and around many cities in low-income countries. It is also an important means for attaining urban food security and balanced diets, and it provides a livelihood to many urban dwellers. However, increasing contamination of irrigation water sources makes this practice a major risk factor for public health, especially as most vegetables grown are consumed raw. Urban vegetable farmers in Ghana use different water sources for irrigation, depending on the location of their farming sites. Surface water is most commonly used as it is easily accessible and thus most economical. Farmers collect it from streams, stormwater drains and gutters with greywater. However, these water sources are usually heavily contaminated with untreated wastewater.

In Ghana, scientists and urban vegetable farmers are working together in identifying, testing and implementing a number of interventions to make the practice safer. This is being done in Ghana’s three largest cities of Accra, Kumasi and Tamale. One of these interventions is the use of alternative water sources which are perceived to be safer. These alternative sources are the subject of this article.

Urban vegetable farming in Ghana is an informal activity; it is largely unregulated and farmers receive very limited extension support from relevant government institutions. We planned to actively involve farmers and relevant government authorities in the project at all stages. The farmers’ help was needed in developing more appropriate interventions that could easily be adopted. This was in line with findings from many studies on technology development which have shown that innovations from many studies on technology development which have shown that innovations which have shown that innovations are most successful.

This was overcome by clearly spelling out the objectives of the project and explaining the need for their involvement at all stages. For farmers, this was first done through the leaders of their farmers’ associations, who explained it to their members. For government institutions, we presented quantified benefits from urban vegetable farming and showed some interventions from other cities in Africa and Asia that had been successful.

Initially, farmers were not motivated to participate as the local media and authorities had condemned this practice. Farmers were therefore very skeptical about any related “research”. In addition, due to their proximity to academic and research institutions, farmers had already provided so much information with no visible benefit that they were very unwilling to give any more. Thus it was difficult to find farmers who were committed to the project.

Likewise, relevant government institutions wanted first to see tested interventions, since they could not personally visualise any. However, the project was aimed at involving them in developing the type of proven interventions they were asking for.

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**SHALLOW GROUNDWATER AS AN ALTERNATIVE SOURCE**

Treated water (pipe water) was not considered as an alternative as it is too costly and very scarce even for domestic use. There are only a very few places where farmers have access to it, like in Dzorwulu, Accra. Also, treated wastewater is largely unavailable for irrigation as very small amounts (less than 10%) of wastewater is treated in Ghana. In addition, the few existing treatment plants are not located where their effluents can be used for farming.

In Ghana, only two farming sites i.e. La in Accra and Zagyuri in Tamale, use effluent from treatment plants serving nearby military camps used for irrigation. In La, the effluents are poorly treated while in Zagyuri, the treatment plant is broken down.

Groundwater usually has better water quality than surface water. However, the costs for installation, operation and maintenance for infrastructure needed for water lifting increase with depth, so deep groundwater was economically prohibitive for a long time (1). Farmers were left with shallow groundwater, as the only feasible alternative water source to contaminated surface water. The use of shallow groundwater is common along the coastline in...
several West Africa countries and has been successfully used with vegetable farmers in Benin and Togo (Drechsel et al., 2006).

**FARMERS’ INITIATIVES IN USING SHALLOW GROUNDWATER**

It is a common perception among farmers in Ghana that shallow groundwater is “pure” and uncontaminated. Hence, wherever feasible, farmers take initiative to construct and use dugouts (shallow wells) instead of using stream water which is generally perceived as more contaminated. These dugouts are usually less than 1 m deep and with surface area of less than 5 m². They are located very close to vegetable plots which also lessen watering labor due to the lessened distance of carrying watering cans.

However, assessments on water quality from the dugouts currently used in irrigation show high contamination levels, but lower than other surface water sources used. We used participant observations and discussions to find out reasons for high contamination levels on dugouts and ways to reduce it. We observed two kinds of dugouts:

- Shallow wells: These are storage ponds for surface runoff while they also receive groundwater recharge. Some of these ponds are close to the polluted stream allowing water to infiltrate. However, surface run-off carries manure, greywater and other contaminants.

- On-farm ponds: Some farming sites have no chance of getting any shallow groundwater. This was more in Accra and Tamale as the two cities are drier than Kumasi. But farmers make earthen ponds (usually deeper than dugouts to collect surface runoff whenever it rains). In the dry season, some function as intermediate storage pond filled from streams nearby with motor pumps

**WORKING WITH FARMERS TO IMPROVE THE USE OF DUGOUTS**

We first held city level meetings i.e. in Accra and Kumasi where farmers from all main vegetable farming sites gathered in one farming site to identify suitable measures and practices to reduce contamination in dugouts. A wide range of measures were suggested, which were not very different for the two cities. To streamline the measures for field assessments, we conducted suitability analysis

where farmers from different farming sites ranked measures from the most to least suitable. Measures ranked least suitable across farming sites like treating water in dugouts with chemicals were not given further consideration. In these meetings, we also agreed on the criteria for assessing the measures and practices proposed.

In the last three years, we have worked with farmers who use dugouts in different farming sites and tested a number of measures and practices on their plots to reduce contamination in and from dugouts. Assessment was based on laboratory analysis on levels of microbial contamination, perceptions from farmers and socio-economic analysis. Regular feedback was given from farmers and scientists and modification on specific practices done and tested further. To illustrate the process, a typical example is given for Mr. Ofori, a farmer at the Engineering farming site in Kumasi in Box 1.

**FROM DUGOUTS TO WELLS**

As a further improvement to dugouts, the scientists proposed the use of tube wells as they are cheaper in construction and less prone to contamination from surface run-off than dugouts and shallow wells. We planned to use treadle pumps for water lifting so depths were restricted to 7 m. Shallow tube wells have successfully been used also in West Africa like in the Fadama irrigation project in Nigeria and Keta shallot farming in Ghana (Kortatsi et al., 2005). This initiative was fully supported by urban vegetable farmers in Ghana.

Farmers provided labor during test drills. However, the test drills showed that there was no potential to use tube wells. In Accra, the water was saline while in Tamale, the water table was too low and Kumasi had low water yields. We had feedback meetings with farmers where test drills were done and explained to them the outcome. Nevertheless, it was shown from test drills that hand dug wells could yield enough water. But due to the high costs involved (about USD 2000), it was not feasible for farmers in the area. This was explained to farmers. We however agreed to install hand-dug well, fitted with treadle pumps to lift water, for demonstration purposes.

Farmers’ involvement in implementation and assessment of interventions

Farmers provided labor during the installation of the well system and almost all farmers in the farming site participated. However, due to system limitations, only

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**Box 1: Safe use of shallow groundwater in dugouts**

**Background:** Mr. Ofori farms on a 0.2 ha farm. He mainly plants lettuce, cabbage and spring onions all year round. He has five dugouts (shallow wells) in his farm. Our first observations showed that shallow wells had no specific shape and the farmer usually walked into the wells with watering cans scratching the pond beds as he collects water.

**Suggested Interventions:**

- Place an embankment around the dugouts to prevent contaminated surface runoff from entering the pond. The farmer declined as he depended a lot on surface runoff to supplement groundwater recharge. On this, we proposed then that surface runoff be channeled to one entrance on the shallow well where it could pass through a simple filtration system like sand bag to reduce contamination.

- Proper design of dugouts to improve sedimentation of particles and pathogens in water hence improving water quality. Mr. Ofori said he widened dugouts to get more water. We suggested channeling of surface runoff (as in (i) above). The pond bed could also be wedge shaped to allow sediments to collect in one end of the well while the farmer fetches water from the other end.

- Better water collection practices like using a “rope and bucket” system to draw water. To avoid walking into dugouts, he could place a plank of wood across the dugouts or by making steps on the edge of the well where he could step on as he draws water from the deeper parts. He was also advised to collect water with minimal disturbance which is a habit that he could change over time.

**Observed changes:**

- Improved channeling of water into the dugouts and water now has only one entrance to the dugouts. However, the filtration system has not been installed.

- Better shaped dugouts with wooden planks across the dugouts. Though not consistently, we observed him collecting water with minimal disturbance.

- We have had some improvements in water quality and hope as more discussions continue, further improvements will be attained.
two farmers could use the system. These
farmers identified various challenges while using this
system and interestingly suggested ways to
modify the system to make it work better.
An example of this is given in Box 2 on an
issue related to labor.

**Box 2: System assessment issues of concern: Example of labour**

**Strength:** Farmers said that the system lessened labor needed and estimated that they could irrigate 2-3 times more land using the system compared to when watering cans are used.

**Weakness:** The treadle pump system requires two people working at the same time; one
person to pump water from the well, while another person on the other end pulls the hose and
waters the crops. This is a big limitation as farmers usually don’t work in pairs because every
farmer has his own schedule of activities.

**Suggested modifications:** Install an intermediate reservoir or have a big drum where a farmer
could pump water into and then use it when needed.

**CONCLUSION**

It was clear that any intervention should allow for flexibility to be modified to
to better suit farmers. This calls for openness
between scientists and farmers and having systematic feedback meetings. A number of
important lessons were learnt from the
process of implementing and assessing
trials on dugouts, shallow tube wells and
the hand-dug well system with farmers.

But in general, the alternative safer water
sources showed no much potential and
that leaves many farmers to continue using
wastewater. With such limitations on
safer water sources, we are now focusing
on minimizing risks while farmers use
wastewater. While working closely with
farmers, we have identified a number of
interventions that we are currently testing
with farmers while quantifying their risk
reduction potential. These include:

- Measures based on improving water
  quality on farm: Appropriate design and
  use of on-farm sedimentation ponds,
  use of simple filtration systems like slow
  sand filters and fabric filters

- Measures based on irrigation manage-
  ment: Irrigation methods where we
  focus on appropriate use of watering
  cans and change safer irrigation systems
  like simple irrigation kits. We are also
  working on better scheduling in
  irrigation especially withholding irriga-
  tion some days before harvesting of
  vegetables

- Measure along the farm-to-fork
  pathway, in markets and food prepara-
  tion to avoid further contamination and
  support decontamination, e.g. through
  appropriate vegetable washing.

We expect to develop appropriate and
easily adoptable interventions for the
different farming sites to comprehensively
reduce health risks. The aim of this article
was not to suggest universal appropriate
interventions for risk reduction as they
can vary widely depending on local condi-
tions. However, we have shown how such
interventions can be implemented and
the study has shown that some might
work while others fail under certain
conditions. The study showed the need of
working closely with farmers to identify
the measures that are most appropriate,
considering farmers’ local opportunities
and constraints.

**Footnote**

1) It was only recently that the Ministry of Food
and Agriculture subsidised deeper borehole drilling
also on selected urban farming sites, however often
without success.

**References**


Potential impact of large scale abstraction on the
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