Technology and Institutional Innovation on Irrigated Urban Agriculture in Accra, Ghana

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Accra has an annual rainfall of 730 mm and the population in its administrative boundaries is 1.6 million (GHS, 2002). About 80 percent of the population in Accra has access to water and 88 percent has access to some form of toilet facilities. However, waste and wastewater disposal and treatment are still ineffective. SWITCH works in Accra on the use of urban water for agriculture and other livelihood opportunities.

Wastewater (including greywater, stormwater runoff and polluted surface water) from the city remains the major source of water and nutrients for urban vegetable production, which takes place on seven major sites and many smaller ones in the city. It is estimated that about 80,000 m^3 per day of wastewater is generated by 1.66 million inhabitants based on an average per capita daily consumption of 60 litres, and a wastewater return flow of 80 percent. A portion of this reaches the stream and drainage network of the city, which serves as the main source of water for irrigated agriculture. Other identified sources of water for agriculture are streams, drains, pipe-borne water, shallow groundwater and rainfall. The water resources of Accra are distributed from five key water basins consisting of rivers/streams, lagoons, ponds, and storm water: Kpeshie basin, Odaw basin (also known as the Odaw-Korle catchment), Osu Klottey basin, Chemu West basin and parts of the Lafa basin.

Irrigated urban vegetable production in Accra provides up to 90 percent of the city's need for the most perishable vegetables, especially lettuce, which benefits around 250,000 people daily. Moreover it yields an average monthly net income of US$ 40-57 per farm (Drechsel et al. 2006). Nevertheless, it is associated with health and environmental risks from the use of polluted water and attendant contamination of vegetables with pathogens. Local and international initiatives have responded to some of these constraints. Notably are research projects on safer vegetable production as supported by the IWMI Challenge Programme on Water, WHO, IDRC and FAO, as well as the capacity building and multi-stakeholder processes of RUAF-CFF, as highlighted by several articles in the UA Magazine. SWITCH is benefiting from the results of these programmes and building on them by demonstrating new technology and institutional innovations designed to minimise risks associated especially with urban wastewater reuse for agriculture within the context of integrated urban water management.

Irrigated urban vegetable production in Accra provides up to 90 percent of the most perishable vegetable needs of the city
Photo: IWMI Ghana

Multi-stakeholder learning

In Accra the SWITCH programme seeks to engage stakeholders in a Learning Alliance. In an initial scoping exercise the alliance identified as the major challenges in urban water management: improper land use planning and control in urban water management; poor access to safe water and sanitation especially in poor areas; pollution of water bodies affecting downstream users and

SWITCH Accra Learning Alliance

In Accra, the SWITCH Learning Alliance seeks to develop a sustainable and healthy urban water system which will result in improved access to water, sanitation and livelihood opportunities, improved water quality, reduced risk posed by water- and sanitation-related diseases, and reduced effects of flooding and droughts. The members of the Learning Alliance in Accra are supported by scientific and technological research in: (a) the use of urban water (fresh and wastewater) for urban agriculture and other livelihood opportunities; (b) maximizing the use of natural systems in all aspects of the municipal water cycle; (c) governance for integrated urban water management and d) social inclusion. The research will be enhanced through the testing and adaptation of locally relevant innovations such as: on-farm wastewater treatment systems, community-managed water facility, rainwater harvesting and sustainable sanitation.

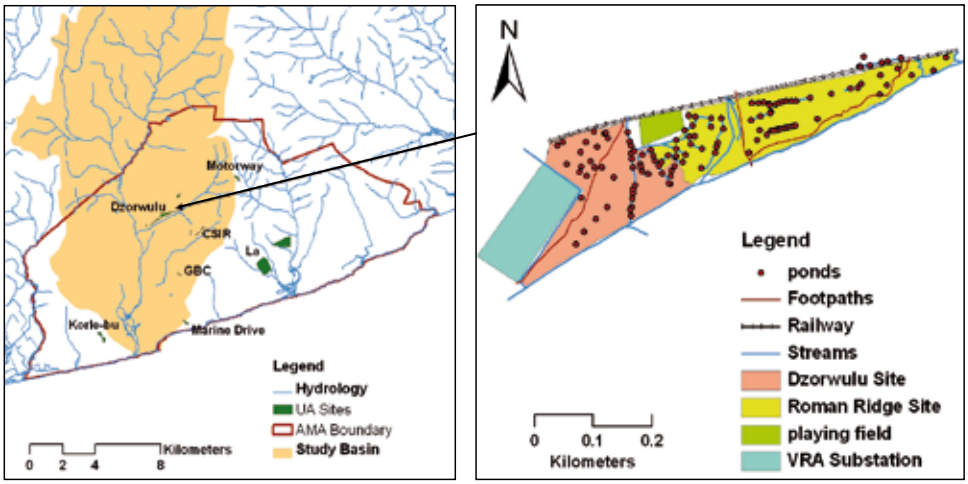

Figure.
The Odaw-Korle catchment in Accra showing rivers and major urban agriculture sites, including Dzorwulu-Roman Ridge farm lay-out.

the environment; and flooding due to poor drainage systems and blocked channels.

Under the SWITCH work package on urban agriculture, a working group was first formed to guide this component, undertake research, and link with the Learning Alliance members. This working group identified the need for research and demonstration on water use in urban agriculture and for development of guidelines on how to minimise health risks and provide institutional support based on the role of urban agriculture in livelihoods. Issues emerging from the deliberations of the working group included the need to treat wastewater for agriculture, consider groundwater as an alternative water source where possible, and also to harness rainwater for domestic and other livelihood activities. Institutional networking and collaboration were stressed as paramount in order to avoid re-inventing the wheel as well as create awareness and educate the public on how to minimise water pollution. To concentrate the study and its findings, a sub-basin within the Accra Metropolitan Area – the Odaw-Korle catchment – was chosen as the study site.

Research at two levels

The research of work package 5.2 operates at both catchment and plot levels and demonstrations take place at plot level. The main goal of research and other activities at the catchment level is to understand the interrelationship between livelihood activities, stakeholder interventions and institutional responses. The programme investigates the impacts these have on urban water quality, and analyses options for improvement. This will provide feedback for the Learning Alliance members and the urban water planning process in the city.

The Odaw-Korle catchment (see figure), sometimes called Korle-Chemu, covers an area of 250 km^2. It is the major urbanised area in Accra and drains about 60 percent of the city (Boadi and Kuitunen, 2002). The main stream that drains the catchment is the Odaw River and its tributaries. Many of the drainage channels are not well developed and maintained, which results in erosion, siltation and flooding during heavy rains and causes loss of property and sometimes lives. The stream water is of very low quality (Boadi and Kuitunen, 2002). The faecal coliform levels are high, ranging between 103 and 108/100ml (Amoah et al. 2005, 2006). A public health risk assessment of the water system in this catchment compared potential water-borne disease exposure routes including recreational swimming in the ocean, flooding of the Odaw drain, open drainage channels, food contamination due to use of polluted water for irrigation, a faecal sludge disposal site, contaminated water distribution system and errors in the water treatment processes (Ibrahim 2007).

Demonstration

The action research and demonstration at plot level take place with farmers at the Dzorwulu-Roman Ridge site. Working group members conducted field visits and considered a number of sites, using pertinent questions as criteria for site selection. Together with research on social inclusion (see the next article), action research aims to test and adapt locally relevant innovations on farm-level wastewater treatment systems and on sustainable sanitation.

Covering an area of 8.3 ha, the Dzorwulu-Roman Ridge site is one of the largest urban agricultural sites in Accra. The area is cultivated by about 50 farmers (half of whom are members of an association). The site is bounded by an electricity sub-station and railway line to the north, by a stream to the south and by a sewage drain to the east, all draining into the Odaw river (see figure). The landscape is divided into two sections: Dzorwulu and Roman Ridge, with two separate farmers' groups. The farmers have access to two sources of water for irrigation: the drain and stream, polluted by domestic wastewater (greywater contaminated with excreta) and pipe-borne water. The polluted stream and greywater are classified together here as wastewater. Shallow ponds are extensively used to store wastewater and pipe-borne water for irrigation. They are filled from the tap by hose or from the drain in part with pumps to reduce the walking distance when using watering cans for irrigation (see the article on page 27). These ponds are farmer innovations for intermediate water storage and improving accessibility, and are therefore located very close to farm plots. The farmers also use the ponds to 'clean' the water for crops through the introduction of duckweed. There are 128 small ponds at the site, 21 of which are used for storing pipe-borne water while the remaining ones are used for wastewater. Average surface area of each pond is 7.5 m^2 with a capacity of 4 m^3. In some cases, farmers use sand bags to block wastewater flow and then collect water from the pond.

During the baseline study conducted at this site, farmers commented that the stream was clean in the past, but is now

polluted as a result of human settlement and activities along the stream. Most of the farmers are willing to accept any suitable on-farm water treatment intervention. While some (at Dzorwulu) prefer trenches and ponds with aquatic plants to purify the water, others (at Roman Ridge) are more inclined toward acquiring alternative water sources, especially treated pipe-borne water. These farmers complained of the difficulty of carrying water with watering cans from the stream to the field and their suggested improvement is to dig more ponds and sewage trenches for storing water closer to farm plots. In addition, the farmers would love to learn more about proper maintenance of soil fertility and simpler irrigation methods.

Against this background, the SWITCH working group on urban agriculture has initiated participatory action research and demonstration on on-farm water treatment integrated into farmers' institutional setting and supported by appropriate capacity building and awareness.

IWMI has generated substantial knowledge in the past few years on simple irrigation methods Photo: Olaleye Olutayo

On-farm water treatment options

Action research focuses on further improvement of farmer innovations, using dugout ponds. Based on the principle of sedimentation and the use of multiple ponds and macrophytes, improvement in treatment is developed in a farmer field school setting. Research with farmers focuses on improvement of irrigation water quality and volume, as well as on appropriate crop management and social-economic implications. Treatment options are evaluated for microbial pollution reduction and nutrient recovery. The goal is to ensure that contamination of vegetables is reduced, farmers' and extension workers' awareness of water quality issues is increased and their technical skills in water and crop management are improved.

Capacity building and awareness of safe vegetable handling

In addition, farmers' and market traders' perceptions and practices in relation to water sources, water use and contamination have been analysed to demonstrate and discuss improved strategies and procedures for vegetable handling at the farm and market levels, and thereby guarantee greater safety for the consumers. IWMI has generated substantial knowledge in the past few years on simple irrigation methods (Keraita 2008) and post-harvest handling of vegetables (Amoah 2008) for safe vegetable production in urban farming (see articles in UA-Magazine 8 and 19). These are cost-effective methods for reducing pollution at the farm site and beyond (see the article on page 29). The RUAF working group AGWUPA collaborates with IWMI in awareness raising and this knowledge base, amongst others, is further used at the catchment and demonstration site through the field school. By increasing the farmers' and market traders' awareness and use of safe vegetable handing, water pollution and crop contamination levels and associated health risks will be reduced.

Inclusion and access

Although the emphasis of the work is on water and safe handling of produce, attention is also paid to strengthening urban producer groups. Support is also provided to improve the farmers' capacity to manage the water treatment interventions. Information gathered during the baseline study shows that the Roman Ridge farmers are not in any organised group while the Dzorwulu farmers benefit from their existing farmers' association. Information is thus also being gathered about the accessibility of urban producers' groups, these groups' access and entitlement to land and water and their degree of security/vulnerability (see the next article). The relationships of the producers' groups with city authorities are also being investigated, including tenure arrangements and processes of representation and communication. Farmer representatives are already participating in the working group. This work will also be linked to the RUAF From Seed to Table programme, which will start in January 2009.

Sustainable sanitation

This will involve mainly the collection, treatment and use of urine for farming at the demo site. Preliminary investigation shows this to be a readily available resource for use in urban agriculture. However, the cost of transportation is usually too high, hence farmers are encouraged to store urine on farm site (Tettey-Lowor, 2008) in mini disposal units, which will be tested.

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