

Gardening with Low-Cost Drip Irrigation in Kenya: For Health and Profit¹

By
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Background

Like other sub-Saharan countries, land and water resources are becoming even scarcer and arable land in Kenya has decreased from about 5 ha per person in 1960 to 0.2 ha per person in 1998. The high population growth has contributed to this decline but it is evident that agricultural production has also kept pace perhaps because it was based on intensification policies, which are no longer feasible. Coupled with lack of appropriate technologies, this decline in per capita arable land is the main cause of declining food security and increasing poverty, which the country has been experiencing over the last decade.

According to information I obtained from various sources (Ministry of Agriculture, Kenya Agricultural Research Institute, and the University of Nairobi) the estimated irrigation potential of Kenya is somewhere between 250,000 and 540,000 ha depending on who made the estimate, and somewhere between 65,000 and 78,000 ha have been put under irrigation to date. Of this about 40% is privately managed by large firms, 20% is managed by the government, and 40% is managed by smallholders. However, because of inadequate maintenance it is estimated that less than 55,000 ha are now being utilized. The main constraints to irrigation development are water availability and poor water management. While there are several efficient water use irrigation systems, those used in Kenya are mainly traditional furrow and overhead sprinkler systems, which tend to use too much of the limited water.

According to the Permanent Secretary, Ministry of Agriculture and Rural Development in his remarks at *Low-head Drip Irrigation Review Workshop in February 2000*³, the root cause of the poor economic performance, poverty and food insecurity in Kenya is because of unsound development policies. He stated that

¹ This report was prepared by Jack Keller and presents the Kenyan results of a recent Fact Finding Study conducted in Kenya (1-5/3), India (6-11/3), and Nepal (12-17/3) in March 2001. The purpose of the Study was to evaluate the potential and technical aspects of improving irrigation performance and reducing poverty simultaneously through applying a market creation approach to development. The core of this market creation approach is to promote the sale of low-cost micro-irrigation to poor farmers tending small plots. The Study was funded by the Swiss Agency for Development and Cooperation under a program championed by Dr. Urs Heierli.

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³ The proceedings of this workshop provide a very good source of background material on the state of the low-cost drip irrigation situation in Kenya. The workshop was held at the National Agricultural Research Laboratories, Nairobi, 17 – 18 February 2000. I was organized by Winrock International and the International Water Management Institute (IWMI).

everybody who has been attending seminars on public policy questions agree that there is presently a lack of new ideas and policy options. It seems that currently, everybody believes in the market logic, in privatisation and in the primacy of the private sector. But the policy debates should shift from discussing privatisation, retrenchment and incentives to the private sector, to finding why to assist small-scale rural agriculture. Poverty has entrenched itself in Kenya because the government had ignored the small-scale rural farmer and supported the large-scale farmers. He believes that Kenya achieved economic growth in the Sixties and the Seventies because the government implemented land redistribution policies. In other words, policies that gave the majority of the population improved access to economic assets and social services. He expressed his conviction that such simple and adapted technologies as the small-scale drip irrigation give the rural population improved access to economic asset (technologies).

He continued by pointing out that increased production in the 60s and 70s was achieved mainly due to expansion of agriculture (extensification) into new areas in addition to new technologies. However, over the last 20 years, because of the rapid increases in population the option of extensification has dwindled. The Kenyan government is now convinced: a) that intensification of agriculture including use of irrigation is the only solution to the problems of increasing agricultural productivity and hopefully food sufficiency and the reduction of poverty; and b) that appropriate technologies, in both improved crop varieties and soil and water management technologies, are the key to intensification.

Findings

In the early 1970's widespread droughts and famines in Africa were reported in the news media. At the request of the Catholic Relief Services, Mr. Richard D. Chapin went to Senegal in 1974 to provide a small-scale drip system that could operate without a pump. This system operated from a bucket or small drum supported about a meter above the ground. It worked well and produced excellent vegetables where there was little or no rain. Since then Mr. Chapin has developed and promoted a simple, low-cost, and efficient drip irrigation system, called a "drip-kit".

To make it possible for low-income families to afford these drip-kits for their subsistence needs in areas that faced long dry seasons, Chapin Watermatics now produces and sells the kits on a non-profit basis and promotes their use through the Chapin Living Water Foundation⁴. The Foundation has in place a training program on drip-kit use as well as training in dry season vegetable production. In 1996 it assisted the Kenya Agricultural Research Institute (KARI) in introducing the Chapin drip-kits in Kenya with the objective of improving the economic conditions, nutrition level and enhanced food self-sufficiency of small-scale resource poor farmers.

KARI's Role in Drip Irrigation

Since 1996 KARI has made use of grants from USAID and the World Bank and has imported, assembled, and sold/distributed over 3500 Chapin bucket-kits and roughly 400 1/8-acre (500 m²) drip systems. In addition KARI has established demonstration

⁴ Mr. Chapin formed the Chapin Living Waters Foundation to promote micro irrigation for small plots in developing countries and he now serves as the Foundation's Executive Director.

drip-kit and low-cost drip irrigation demonstration sites at the National Agricultural Research Laboratories (NARL) in Nairobi, the National Dryland Farming Research Center in Makueni, and the Regional Research Centers in Mtwapa and Perkerra. The Agricultural Engineering Department of the University of Nairobi has also conducted research on the effectiveness of the bucket-kit drip irrigation systems. Initially, for demonstration and promotional purposes, KARI freely distributed bucket-kits to various women's groups and NGOs working with small-scale poor farmers

A bucket-kit has a 20-liter bucket that is supported 1-meter above the ground and supplies two 15-meter (or four 7.5-meter) long drip lines. The drip lines are lay-flat 16 mm tubing (0.25 mm wall thickness) with internal long-tortuous-path emitters spaced at 0.3-meter intervals. A bucket-kit supplies irrigation to a small vegetable plot of 15 to 25 m², depending on row spacing, and costs about \$15. This is usually sufficient for a family's self-sufficiency in vegetables and many families even have some extra vegetable, which they market. Women own most of the bucket-kits and they also do the vegetable gardening. KARI researchers informed me that farmers report gross incomes of \$40 to \$60 per crop and grow two crops per year where there is sufficient water.

KARI has recently scaled up the Chapin bucket-kit to what they call a "drum-kit". It is comprised of 10 of the 15-meter long drip lines connected to a 200-liter drum to serve a plot of from 75 to 125 m² (depending on row spacing) at a cost of about \$100. They also provide a double drum-kit with 20 of the 15-meter long drip lines connected to a single 200-liter drum at a cost of about \$135.

KARI's 1/8-acre (500 m²) drip systems have a 50 mm diameter 15-meter long header that serves 20 drip lines that are each 30 meters long. The drip lines come in a 600-meter roll and are cut in the field. This system actually irrigates a 450 m² plot and it costs about \$200, which does not include the water supply⁵ or a head tank.

Currently KARI sells drip-kits to farmers and Projects. Farmers and donor-funded project personnel visit the demonstration sites and purchase the kits there. Some bucket-kits are still being donated to farmers through various charitable organizations but farmers are now directly purchasing roughly half of the kits that KARI sells. While survey results have indicated that many of the bucket-kits that have been given to farmers are not being fully utilized, most farmers who have purchased their kits use them for two crops per year except where the water supply has failed.

Other Promoters of Low-cost Drip Systems

Besides KARI there are a number of other institutions and groups that have begun marketing drip-kits. Following are some brief comments about some of these other actors.

⁵ If a Super MoneyMaker treadle pump supplied through Appropriate Technologies for Enterprise Creation's (ApproTEC) marketing system were used for the water supply this would add about \$75 for the pump plus about \$25 for the necessary hoses and head tanks. They have also developed a one cylinder pressurized treadle pump that they intend to sell for about \$45.

FREAK. The Fresh Produce Exporters Association of Kenya (FPEAK), which was established through a grant from USAID, has purchased a few container loads of bucket-kits and 1/8-acre drip-kits plus some roles of drip tape. They sell the systems as an aid to their growers and as an income generating activity to help fund the activities of the association.

ApproTEC. The Appropriate Technologies for Enterprise Creation (ApproTEC) is in the process of developing a 1/16-acre and a 1/8-acre drip-kit to be used in conjunction with their Super MoneyMaker pressurized treadle pump. They intend to sell the 1/16-acre kit for approximately \$130. Unlike KARI they plan to promote the drip-kits through a mass media advertising campaign and sell them through the through the network of roughly 100 dealers they have established to market their treadle pumps.

Dream Drip-Kit. Dream Drip Kit was established by Water Resources Management (WAREM) Consultants who wanted to use locally manufactured products as much as possible. The Dream Drip Kits utilize a high quality locally extruded⁶ light-weight 16 mm outside diameter hose with inline emitters. The available systems are similar to the Chapin drip-kits, and cost about the same although the drip lines are made of thicker (0.5 mm vs. 0.25 mm wall thickness) plastic.

NRM³ Project. The Natural Resources Monitoring, Modeling, and Management (NRM³) Project is located in the rain shadow of Mt. Kenya in the vicinity of Nayuki, which is a very drought prone and impoverished area. This is a research project activity related to comprehensive rural development that is being carried out by the University of Nairobi with Swiss Development Corporation funding. Bucket-kits are a part of the water management program. The project personnel have assembled bucket-kits that are similar to the KARI Chapin kits but they have three 15-meter long drip lines instead of two and cost about \$16, which is only \$1 more. They innovated their own system using basically locally manufactured components, in fact they even have a local plumber craft elbows and other fittings from straight PVC tubing.

They have sold or donated about 100 bucket-kits to local farmers and women's groups, and have set up a nursery to provide fruit vine and tree plants that are adapted to the area and a demonstration plot to promote them. They have also worked with water storage tanks that capture rainfall runoff for use in the drip systems during the dry season. Another innovation they have tried is the use of donkey-carts to deliver water for the bucket-kits.

Typical incomes from the kits are in the neighborhood of \$25 per vegetable crop plus enough small vegetables for the family's consumption. One women's group we visited had their first bucket-kit donated to them, had purchased a second kit, and were intending to purchase a third kit for the next crop season.

⁶ Extruded by a local company called Shade Net, that uses a modern Italian manufactured extruder and high quality LLDPE plastic. They also make the inline emitters locally and currently extrude over 7 million meters of drip line for sale to the commercial irrigation sector in Kenya. The drip line is sold under the brand name Victoria Driplines.

ALIN. The Arid Lands Information Network (ALIN) has been an active promoter of bucket-kits. They have either purchased kits directly from Chapin or from KARI. They have promoted and distributed over 400 bucket-kits, about half of which have been sold. They periodically place articles in their tri-annual magazine *Baobab* to promote bucket-kits throughout Africa.

Miscellaneous. There are several other groups promoting bucket-kits in addition to the above. These include Catholic relief Services, the Mennonite Church, the Christian Children Fund, German Agro-Action, and many others.

Issues

This section covers what I see as the technical and socio-economic problems related to the current low-cost drip system available in Kenya⁷.

Technical Problems

The main technical problems that were reported and observed were:

- The filters used are too small so they clog very quickly and they also break
- The drip lines are fragile and emitter clogging is a problem so the lines only seem to last for a couple of years
- The drip lines are vulnerable to attack by rodents in the field and in storage
- There is a general lack of skills in installation, operation, maintenance and repair of the bucket-kits
- Both the kits and the spares are in short supply nationally as well as at the user level

Socio-Economic Issues

At the workshop a number of socio-economic issues emerged. The bucket-kit is very popular with users because the benefits are easily recognizable. They have potential for growing high value crops and provide an opportunity to create employment and better nutrition in rural areas. However, about 80% of the users are women, and they receive little support from men at present.

Although the \$15 bucket-kits are fairly inexpensive, the prevailing high poverty levels in rural areas make them unaffordable to many potential beneficiaries. It would appear that there are two ways to alleviate this problem. First more attention should be given to reducing the cost of the bucket-kits. For example, in India and Nepal bucket-kits of the sizes sold by KARI and others cost less than \$10. Secondly, access to credit should be investigated, including mobilization of local resources through self-help groups, revolving funds and merry-go-rounds.

⁷ The comments in this section are based a mixture of the my personal observations and the conclusions reached at the *Low-head Drip Irrigation Review Workshop*, held at the National Agricultural Research Laboratories, Nairobi, 17 – 18 February 2000.

Conclusions and Recommendations

Both drip irrigation systems serving large commercial farms and low-cost drip-kits designed for resource poor farmers with small plots are well established in Kenya. I would estimate that commercial drip systems are serving somewhere between 4,000 and 7,000 ha of land. In total there are probably somewhere between 5,000 and 6,000 bucket-kits, 300 to 500 drum-kits and perhaps as many as 200 to 300 1/16- to 1/8-acre drip-kits serving poor farmers who have limited financial and land resources.

A rough estimate of the potential market for low-cost micro-irrigation systems for small plots in Kenya is in the order of 1 million bucket-kits, 100,000 drum-kits, and 100,000 1/8- to 1/2- acre drip and mini-sprinkler kits. These systems would irrigate roughly 20,000 ha and serve roughly 1/3 of Kenya's 4 million rural households.

It appears that the demand for low-cost drip irrigation for small plots is becoming well established in Kenya. However, there has not yet been a concerted effort to develop a comprehensive marketing approach for low-cost micro-irrigation for small plots.

Promotion and Marketing

Limited promotion, availability, and accessibility of drip-kits to farmers at the local rural levels are a major constraint to the rapid expansion of low-cost micro-irrigation systems for small plots. At this point a true marketing approach directed at selling drip-kits to the poor rural farmers with small holding has not been used. This can be improved by developing a marketing approach like International Development Enterprises (IDE) uses to discrimination of the technology.

The marketing approach to development used by IDE and others is beautifully presented and explained in the Swiss Agency for Development and Cooperation's Report by Urs Heierli (2000), *Poverty Alleviation as a Business: The Market Creation Approach to Development*. This report includes program descriptions with examples of successes along with the performance indicators used. It covers treadle pumps in Bangladesh, the agro-forestry and sanitary water-trap latrines in Bangladesh, maize storage-silos in Central America, and concrete-roofing tiles Globally. The Report contains Annexes covering: *The Setup of the Marketing Approaches for Each of the Above Mentioned Projects*; *The Practical Steps of How IDE Installed 1.3 Million Treadle Pumps in Bangladesh by Activating the Private Sector*; and *The Design Process for the IDE Low-Cost Drip Irrigation Systems*.

There has not yet been a concerted effort to develop more robust drip-kits and produce them locally at a reduced cost. Furthermore, I saw no evidence of any efforts at developing an appropriate mini-sprinkler kit to accompany ApproTEC's very excellent pressurized treadle pumps.

In view of these findings I recommend that efforts be made to further refine and reduce the cost of the various drip-kits and to develop a mini-sprinkler kit, and market test them in accordance with the strategies presented below.

Micro-irrigation Development

Developing suitable low-cost micro-irrigation systems and establishing the market demand for them through private sector micro-enterprises is the role that organizations like IDE or ApproTEC must perform. Donors are needed to provide what are in effect indirect subsidies to farmers by covering the costs of developing the affordable technologies that improve productivity and establishing the market demand for them. Funding the development of low-cost systems and establishing the demand driven markets for them has proven to be a very cost-effective role for donors.

The strategy that has been successfully used by IDE to develop suitable low-cost micro-irrigation systems prior to establishing the production capacity and implementing the marketing program for them includes the following:

- The initial challenge is to identify promising technologies that have the potential to improve productivity if they can be packaged in a manner that is suitable for small plots of land and affordable to the potential farmers. While the final products may appear simple, developing affordable and user-friendly products requires inventive and talented engineering.
- Promising designs must be market-tested and those that are not rejected must usually undergo considerable change to trim cost, increase functionality, and better address field requirements to gain farmer acceptability.
- The most cost-effective way to provide systems for the initial market testing and after that to provide larger but still limited numbers of systems for the early stages of marketing may be to purchase imported or locally available components that are relatively costly. Then discount the selling price of the systems to more affordable levels based on the anticipated ongoing cost (including reasonable profit margins) after the market has matured.
- The design stage essentially never ends because of remaining possibilities for reducing cost and increasing functionality. However, at some point further design changes should be restricted to those that are necessary to address significant problems uncovered by users or take advantage of new insights that have the potential to significantly reduce costs and or increase functionality.

The roles described above for organizations like IDE and the donors are necessary since low-cost systems should be designed around more or less generic (without patent protection) components. Thus micro-enterprise manufacturers and vendors cannot afford to invest in the necessary product and market development activities since these costs would not be recoverable after the market demand is established. If they attempt to maintain sufficient profits to cover these development costs, competitors will arrive on the scene and undercut their prices. However, this competition is actually a positive aspect of the donor supported market creation approach. It continuously stimulates inventiveness to gain market share by increasing cost-effectiveness and functionality.