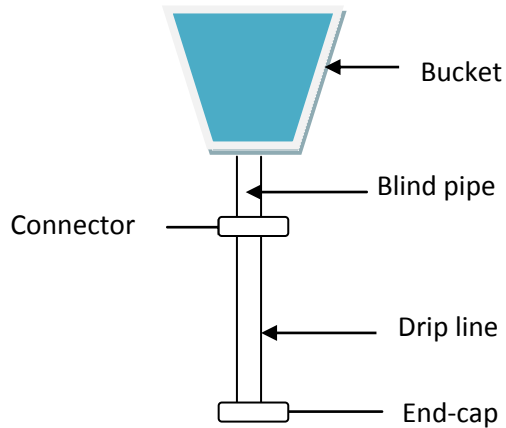


## IRRIGATION OPTIONS FOR SMALL-HOLDER FARMERS

### Introduction

Bucket-kit drip irrigation is a low cost method that delivers adequate amounts of water to crops in an efficient way both in terms of labour and quantity of water used. The system is locally assembled using an ordinary plastic bucket and drip lines readily available in shops selling farm equipment. The buckets serve as the reservoir and are raised to a height of 1m to allow water to flow to the plants by gravity.

### Bucket-kit irrigation system



1. The system comprises a drip line connected to bucket through a blind pipe.
2. Between the bucket and blind pipe is a connector and a ring to hold them firm.
3. At the end of the drip line is an end cap which is a device for maintaining pressure within the system.
4. The system is raised on a stand with two posts and crossbars made from timber poles.
5. The system can be used for growing high value vegetables.
6. The water requirements may vary according to location, crop and soil type. The practice is to fill the bucket early in the morning and in the evening.

**Components of a five bucket kit drip irrigation system for 150m<sup>2</sup> area**

S/N	Item	Number	Rate	Total (UGX)
1	Bucket	5	14,000	70,000
2	Blind pipe	20m	1,600	32,000
3	Connector	10	1,300	13,000
4	Drip line	150	1,800	270,000
5	End cap	10	1,800	18,000
6	Nets	9m	10800	97,200
	<b>Total</b>			<b>500,200 /-</b>

NB: On average, each drip line will have 25 cabbages

### Planting

When planting, do not plant crops directly below the drip hole because it promotes leaching of nutrients needed by the plant. Instead, plant close to the drip hole and use a string to ensure proper alignment which will facilitate accurate delivery of water to the root zone. Keep the drip lines firmly on the ground and in line by using sticks or hooks to hold the lines in place. When the growing season is complete, coil the drip lines together and hook them onto the poles. This prevents blockage of the drip-holes.

## Fertigation

Fertigation is the application of fertilizers to plants using an irrigation system. The fertilizers are mixed with water and applied simultaneously. These combined interventions greatly improve crop yields since the crops receive both nutrients and water. However, adaptation of these low cost technologies in Uganda is still poor because of lack of information on their applicability. Irrigation has remained a preserve for more affluent farmers.

## ATC action research on Bucket kit Irrigation

ATC carried out two experiments; growing cabbage and sukuma wiki using both fertigation and bucket kit drip irrigation. Fertigation was done using human urine. Urine is a no-cost fertilizer with high potential to boost crop yields since it is rich with three key nutrients needed for healthy crop growth; i.e. Nitrogen, Potassium and Phosphorous. ATC investigations focused both on the feasibility of the technology and food safety.

## Cabbage experiment



The irrigation and fertigation plots produced better yields compared to the other plots as illustrated in the table below. Failure rate in the irrigation fertigation plot was only 6.3%. Missing results in the table below are attributed to the fact that the cabbages were not harvested most especially because they never matured. The biggest cabbage in the fertigation plot weighed 3.4 kg and the smallest 1.5kg compared to the control plot (no intervention) where the biggest cabbage weighed 1.1 kg and the smallest 0.4kg.

## Harvest from the experiment using Cabbage

Intervention		Weight (grams)															Total harvest (grams)	Average Weight (grams)	
Fertigation	Band A	3381	1662	3249	3414	2566	1837	1542	2443	3214	2447	2860	3215	2443	2113	3215	3058	42659	2666.19
	Band B	2375	2222	2571	2827	2891	2373	3185	2579	2623	1849	3171	2942	2112			4238	37958	2593.85
Irrigation manual fertilizer	Band A	3272	3228	2497	2615	2437	2553	2708	2895	2412							2873	27490	2735.22
	Band B	2793	2531	2079	2024	2131	1243	2431									2488	17720	2176.00
Irrigation no Fertilizer	Band A	1967	1748	2139	2165	1838	1977										2786	14620	1972.33
	Band B	2118	1985	2017	2311	365											1932	10728	1759.20
Fertilizer no irrigation	Band A	1853	1367	1947	1814	2282	1031	664	458								1180	12596	1427.00
	Band B	1856	1628	1145	1375	1406											1925	9335	1482.00
No intervention	Band A	843	720	331	895	906	577	506	714	405							1131	7028	655.22
	Band B	910	631	552	506	467	1083	572	1135								1257	7113	732.00

## Sukuma wiki experiment



Three experimental plots were set up. Each of the experimental plots had 220 plants but there was variation in growth i.e., The Irrigation and fertigation plot (experiment 1) registered 73.6% growth rate compared to the irrigation only (experiment 2) which registered 52% and control (experiment 3) registered 22.3%. Similarly, experiment 1 had outstanding leaf weights as illustrated in the table below:

Weights of leaves (in grams) from the different crop lines subjected to specific treatment

Lines	1	2	3	4	5	6	7	8	9	10
Fertigation	18384	17736	17371	19943	10859	17666	13626	18361	14270	10014
Irrigation	12385	11157	15891	12001	11182	13051	9865	8616	11090	14698
Control	6540	7703	8091	3887	2438	7872	2110	3850	3019	0

## Microbial safety analysis

The microbial safety analysis carried out in all experiments indicated presence of salmonella in some yields both in the fertigation and control plots. It was however hard to establish the possible cause of salmonella since earlier analysis of urine samples were negative for salmonella analysis. This may point to its introduction from the environment and not from the urine.

## Recommendations

- Bucket kit irrigation and fertigation should be promoted amongst vegetable farmers to improve their yields
- Farmers who are already using manure should be encouraged to also apply bucket kit irrigation for better yields
- Access to credit should be opened up to allow farmers to access the drip lines
- Universities should pay more attention to the irrigation needs of small farms which are the majority
- Boil the leafy vegetables before eating or use vinegar to eliminate any pathogens that may be present.
- Before application, urine should be kept in a closed container for at least 30 days to kill pathogens that can be present and on application; dilution rate of 1:6 (Urine to water) should be used.
- After use, drip lines should be coiled around the support post to maintain them for next harvest
- There is need to rigorously control diseases which would attack the plant at any time during growth period using approved pesticides

**Cost analysis**

Analysis of the results indicated that when drip irrigation and fertigation using urine are applied the yields are better (43%) but also the weights of the cabbages are at least 3times heavier than those where no intervention was done. Further analysis revealed that including the cost of drip irrigation systems, an investment in drip irrigation together with fertigation using urine will provide a profit of 62% within one calendar year. In contrast, an investment on labour and seeds for one garden without fertigation or irrigation will lead to a loss of 39%.

**Conclusion**

The experiments confirmed clear benefits to applying irrigation and fertilizers to enhancing crop yield. Irrigation reduces the dependence of farmers on rain- fed irrigation providing them the opportunity to produce vegetables out of season and therefore get better profit margins. This model should be piloted on small farms and NARO and NAADS should promote the bucket kit irrigation system as an appropriate irrigation technology for small farmers where the terrain allows it.

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