

## Potential Applicability of the IDE Drip Irrigation System in Vegetable-Agroforestry Systems

by  
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## Drip Irrigation

- irrigation method involving delivery of water through a pipe distribution network consisting of a main pipe, submain, manifold and lateral pipes under low pressure and emission through small outlets of drippers or emitters into the soil surrounding the crop to be irrigated
- a.k.a trickle irrigation or microirrigation

## Advantages of Drip Irrigation

- Adaptable to any crop, soil and topography
- Can be used under limited water supply conditions
- High water use efficiency
- Low operating costs
- Easier field operations
- Minimizes incidence of leaf diseases caused by direct water contact
- Facilitates liquid fertilizer application thru fertigation

## Major Disadvantages of Drip Irrigation

- High cost (esp the conventional systems)
- Susceptibility to clogging

## Types of Drip Irrigation

(~ on emitter types)

- Orifice type
- Pressure compensating
- Long path
- Tortuous path
- Vortex
- Flushing

## The IDE Easy Drip Kit

- Developed by the International Development Enterprises (IDE)
- Makes use of microtubes for emitters
- Relatively inexpensive (<\$500/ha or PhP 22,500/ha compared to \$1,200 to \$3,000/ha or PhP 54,000 to 135,000/ha for conventional drip systems, Smith (2008))
- Operates at relatively low pressure
- Adaptable to small areas (comes in packages for 20 sq.m., 100 sq.m., 200 sq. m. and 500 sq.m.areas)

## The IDE Easy Drip Kit



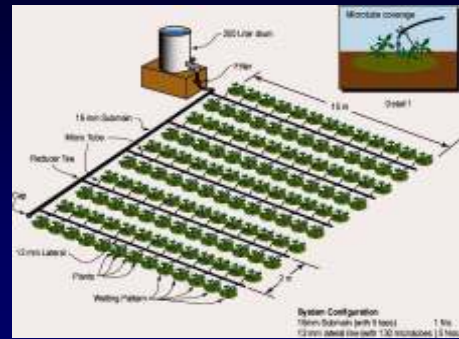
## The IDE Easy Drip Kit



## The IDE Easy Drip Kit



## The IDE Easy Drip Kit



## Applicability of Easy Drip Kit in VAF Systems

## Typical view of cultivated upland watershed (Lantapan, Bukidnon)



Source: M.R. Reyes et al., 2008 SANREM-CRSP

## Issues on Drip Applicability in Upland Watersheds

- Maximization of crop yield depends on irrigation water distribution uniformity
- Uniformity of water distribution is affected by operating head and slope
- The choice of operating pressure head is compounded by topographic condition

## Basic Question:

What operating head to employ to maximize water distribution uniformity under sloping conditions?

## Laboratory Drip Experiments

## OBJECTIVE

To determine the effect of hydraulic head and slope on the water distribution uniformity of the IDE 'Easy Drip Kit' and consequently develop mathematical relationships to characterize the effect of slope and head on water distribution uniformity

## METHODOLOGY

- 100 sq. m IDE Easy drip kit (10 m x 10 m)
- Submain Slopes: 0%, 10%, 20%, 30%, 40% and 50% ( $S_1 = 0\%$ )
- Operating Head: 1.0 m, 2.0 m and 3.0 m
- Sampled from 11 emitters per lateral for a total of 110 samples
- Direct volumetric measurement for emitter discharge
- 3 trials per setting
- At least 54 laboratory experiments

## Experimental Set-up for Testing the IDE Drip Irrigation System



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Source: Ella et al. (2008)

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### Sampling and Data Collection



### Evaluation of Water Distribution Uniformity

Christiansen's Coefficient of Uniformity

$$CU = 100 \left( 1.0 - \frac{\sum_{i=1}^n |q - M|_i}{\sum_{i=1}^n q_i} \right)$$

where:

UC = coefficient of uniformity (%)  
 q = emitter discharge  
 M = average of discharge values

### Evaluation of Water Distribution Uniformity

Merriam and Keller's Emission Uniformity

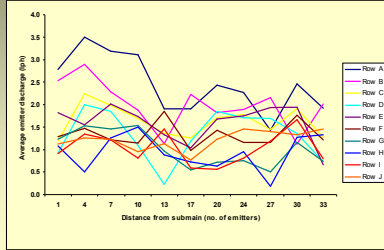
$$EU = (q_{LQ}/q_{mean})100$$

where:

EU = emission uniformity (%)  
 q<sub>LQ</sub> = average of the lowest quarter of the observed discharge values  
 q<sub>mean</sub> = average of observed discharge values

## RESULTS

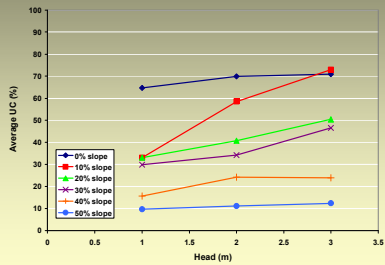
### Typical emitter discharge variation along the lateral of the IDE drip kit at 0% slope



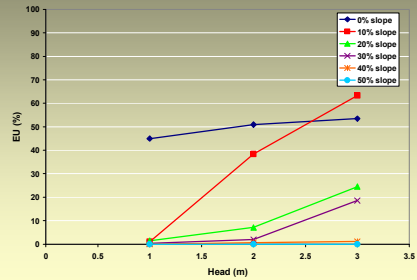
### UC and EU at various Heads at 0% slope

Head (m)	Coefficient of Uniformity, UC (%)				Emission Uniformity, EU (%)			
	1	2	3	Mean	1	2	3	Mean
1.0	66.99	62.51	64.82	64.77	52.10	38.89	43.98	44.99
1.5	70.66	68.68	70.10	69.81	50.79	50.33	50.01	50.38
2.0	72.62	66.81	70.15	69.86	56.13	46.89	49.81	50.95
2.5	65.24	62.87	65.67	64.60	46.81	38.06	46.47	43.78
3.0	72.48	70.47	70.06	71.00	55.11	53.61	51.80	53.51
3.5	72.20	67.56	71.37	70.38	53.24	45.52	51.35	50.04

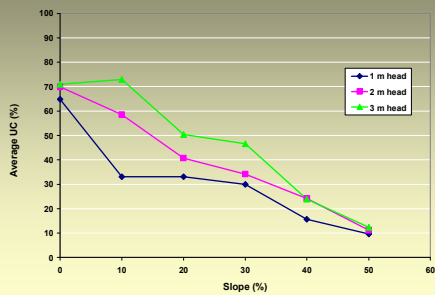
### Effect of Head on UC at Various Slopes



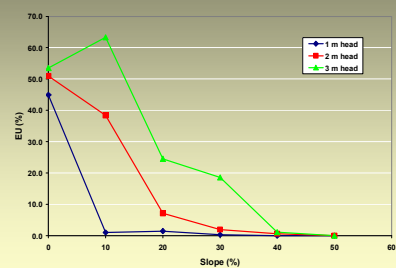
### Effect of Head on EU at Various Slopes



### Effect of Slope on UC at Various Heads



### Effect of Slope on EU at Various Heads



## Linear Regression Models for UC as a Function of Head at Various Slopes

Slope (%)	Linear Regression Model*	R <sup>2</sup>
0	$Y=1.50X + 65.02$	0.233
10	$Y=19.90X + 15.06$	0.975
20	$Y= 8.67X + 24.09$	0.995
30	$Y = 8.32X + 20.25$	0.927
40	$Y=4.14X + 12.98$	0.722
50	$Y = 1.35X + 8.37$	0.997

\* Y = coefficient of uniformity, UC (%)  
X = head (m)

## Linear Regression Models for UC as a Function of Slope at Various Heads

Head (m)	Linear Regression Model*	R <sup>2</sup>
1.0	$Y= -0.95X + 54.69$	0.850
2.0	$Y= -1.15X + 68.57$	0.987
3.0	$Y= -1.27X + 77.91$	0.943

\* Y = coefficient of uniformity, UC (%)  
X = submain slope (%)

## Summary of Findings from Lab Experiments

- Water distribution uniformity of the 100 sq m IDE Easy drip kit proved to be influenced by operating head and submain slope
- UC and EU increase with increasing head for all slopes
- A head of 3.0 m may be considered as recommendable from both hydraulic and practical considerations for all slopes
- UC and EU decrease with increasing slope for all heads
- UC and EU decrease tremendously for slopes > 30%

## Findings (cont'd.)

- For 0% slope, a head differential of 0.5 m does not cause significant change in UC or EU
- UC is linearly related to either head or slope
- Linear regression models proved to be adequate to characterize the relationship between UC and head and between UC and slope

## Field Experiments





## Initial Findings from Field Experiments

Crop	With Drip	Without drip
Cabbage	4.5 kg/sq m	2.4 kg/sq m
Chinese cabbage	6.0 kg/sq m	3.3 kg/sq m

## Initial Findings from Field Experiments

- Higher crop yield under drip irrigated crops than rainfed crops (with all other production inputs the same for both treatments)
- Relatively larger size of produce under drip irrigated over rainfed
- Higher plant height under drip than under rainfed

## Social Considerations (Farmers trainability issues)

SANREM Training on Drip Irrigation,  
Lantapan, Bukidnon, May 2007



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**SANREM Training on Drip Irrigation,  
Lantapan, Bukidnon, May 2007**



**SANREM Training on Drip Irrigation,  
Lantapan, Bukidnon, May 2007**



**SANREM Farmers Field Day, Lantapan,  
Bukidnon, September 2007**



## **CONCLUSION**

- ❖ The IDE low-cost drip kit is highly adaptable to VAF systems in Philippine upland watersheds
- ❖ The IDE low-cost drip kit has a great potential for adoption in Philippine upland watersheds for sustainable vegetable production based on technical and social considerations
- ❖ The low-cost drip irrigation system can potentially maximize crop yield and farmer's income and alleviate poverty

## **RECOMMENDATION**

- ☞ IDE may consider including affordable pressure regulators for use of the drip kit in steep slopes to minimize non-uniformity of water distribution
- ☞ Emitter clogging should be addressed to prevent occurrence of minimal or zero emitter discharge
- ☞ Government should consider pouring resources on drip irrigation technology adoption in the Philippines as part of poverty alleviation program for upland farmers

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**Thank You!**

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