The

Billion Dollar Business Alliance

FOR RAINWATER HARVESTING

Kenya Chapter

HOUSEHOLD POND PROTOCOL APPLICATION

HoPPA

Prepared by

Alex Oduor, Charles Songok & Maimbo Malesu

World Agroforestry Centre / World Food Programme

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Preamble

On the Household Pond as a PREMIER RWH Technology

Current problems / challenges
on Household Ponds

Biophysical

•Torrential runoff: ilt/mud Turbid water

•High evaporation rates

•Porous soil: water lost through seepage

93% of soils in Africa are porous: Only 7&

are none porous

Design of Ponds

•Hardly any systems approach to pond design

•Existing designs concentrate on pond layout

•Pre-conveyance mechanisms rarely de

Current problems / challenges
on Household Ponds

Reservoir

•Different formula for pond volume

•Challenges on how to deal with seepage, evaporation & turbidity

•No matching of supply and demand for production.

Water abstraction & irrigation

•Wide variety but inadequate information on selection of pumps/pumping options.

•No clear options on irrigation method

•Irrigation scheduling is haphazard

Objectives of

HoPPA

- Develop a protocol on pond systems design
- Develop a platform for use by all practitioners (policy & decision makers, field supervisors, extension agents & farmers)
- Develop digital protocol for:
  - Geo-referencing & viewing ponds in google earth
  - Viewing individual farmer profile
  - Digital farm/pond data entries & repositories
  - Live/historical viewing of pond dynamics
    - Runoff inflows into pond
    - Seepage/evaporation monitoring
    - Turbidity monitoring
    - Soil moisture
    - Temperature/humidity
- Provide rights for selected individuals to view live & historical dynamics of pond and farm operations
- Improve the efficiency of runoff pond system and thus, boost yields and gross margins.

HOUSEHOLD POND PROTOCOL APPLICATION

MANUAL ADMINISTRATION

THE BILLION DOLLAR BUSINESS ALLIANCE - BDBA KENYA CHAPTER

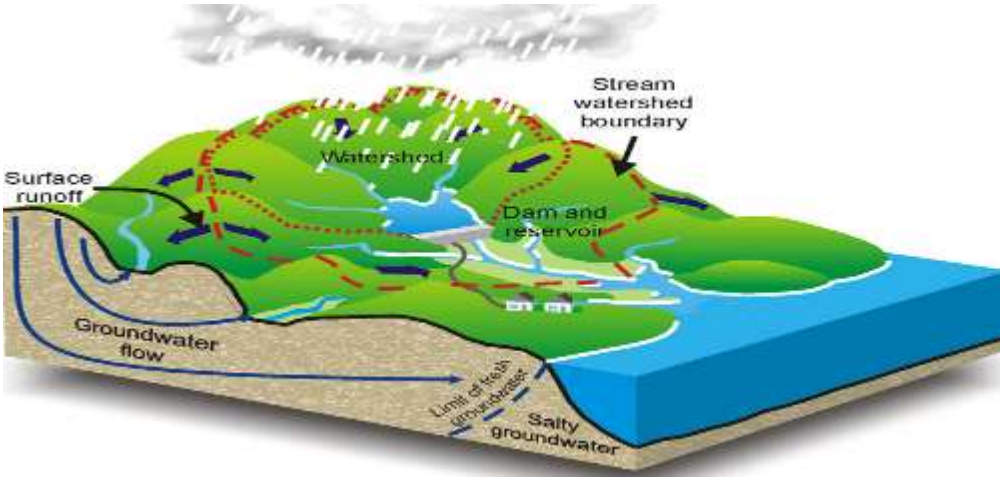
POND INFRASTRUCTURE PROTOCOL

Basic Details	Full Names of Farmer			Are you a member of a registered group? (Yes) (N If yes, what is group name:_____
	Pond Location	Sub-County:	Ward:	Village:
	Coordinates	Eastings	Northings	Elevation (m)
Catchment	Landuse types & catchment mapping	Landuse types	What are the landuse types: Forests, Buildings/settlements, Grasslands, Wetlands & Croplands,	
		Catchment mapping & demarcation	Is the catchment already mapped? If yes what percengtage does each of these landuse types cover?	
	Catchment assessments	Watershed plans	Has the WRUAs already developed Sub-catchment Plans? If not who is responsible and when can it be done?	
		Watershed potential	What is the RWH potential for the catchment & each of the sub-catchments	
			Are erosion hotspots identified, if yes, what are the soil losses from erosion. What measures are in place to conserve such areas?	
Pre-Conveyance Component	Waterway	Is there a waterway.	Yes (Y), or No (N)	
		Type of waterway.	e.g. Stone piching (S), Grassed (G), Tractor Treads (T) or combination [C].	
		Shape of water way	e.g. Rectangular trench or Concave parabolic	
		Approx dimesnions of waterway in meters.	Defined in length (L), Width (W) and Depth (D)	
	Silt traps	Lock & Spill silt traps	Number	
			Dimensions of LxWxH (cm)	
		Automated silt trap	Dimensions of LxWxH (cm)	
	Mitre drain	Length of mitre from automated silt trap to the pond	Answer in meters	

Reservoir	Shape of pond	Hemi-spherical, Hemi-spheroid, cuboid	Choose one	
	Dimensions of the pond	Give dimensions in centimetres. For Hemi-spherical & Hemi-spheroid give radius (R) and depth (D); for cuboid, give LxWxD (cm)	Top dimensions (Width & Length in m)	
			Bottom dimensions (Width & Length in m)	
			Vertical Depth (Vd) or Average side depth (Sd)	
	Pond lining	Nature of pond	State if it is lined or unlined	
		If lined, state the following	Type: HDPE or LDPE	
			Thickness of lining in (mm)	
	Masonry Course work over the Pond lining (To secure lining as well as keep away external silt from sliding into the pond	Is the brick coursework available?	Yes (Y), or No (N)	
		Perimeter of coursework	If yes, Choose if it is made of Bricks or stones	
			Perimeter of coursework (m)	
		Number of coursework (m)	Should be between 1 and 5	
	Checking on evaporation	Is the pond covered	Yes (Y), or No (N)	
		If yes, state the type	Shadenet on trusses, Shadenet on wire grid, Passion fruits on trusses or Iron sheets on trusses	
Abstration & application mechanism	Type of pump	Rope & Bucket, Rope & Washer, Treadle, or Hip	Choose one	
	Abstraction parameters	What is the suction head	Answer in (m)	
		What is the lift head	Answer in (m)	
		What is the flow rate	Answer in (m/s)	
	Overhead tank	What is the size of overhead tank	Answer in (litres)	
		What is the head difference between tank and command area	Answer in (m)	
		Are filtration gadgets for treatming irrigation water installed? If yes which type?	Yes (Y), or No (N)	
	Agricultural enterprise	Which irrigation techniques is to be used?		
		What measures are in place to enhance irrigation efficiency?		
		Is water supply from the ponds matched to water demand by the crop?		
		Can other agricultural enterprises e.g. poultry, apiary and tree nurseries benefit from the pond		
		If so, what measures are in place to ensure these animal based enterprises are added to enhance pond water productivity and farm income?		

This Check List was developed courtesy of the BDBA Consortium

RUNOFF POND COMPONENTS



① Farm details
② The catchment area
③ Pre-storage conveyance mechanisms
④ Storage dynamics
⑤ Water abstraction
⑥ Post-storage conveyance mechanisms
⑦ Water application

①

Farm Details

Basic Details	Full Names of Farmer			Is the farmer a member of a registered group? (Yes) (No)
				If yes, what is the group name:_____
	Pond Location	Sub-County:	Ward:	Village:
	Coordinates	Eastings	Northings	Elevation (m)

Telephone number of the Farmer…..:

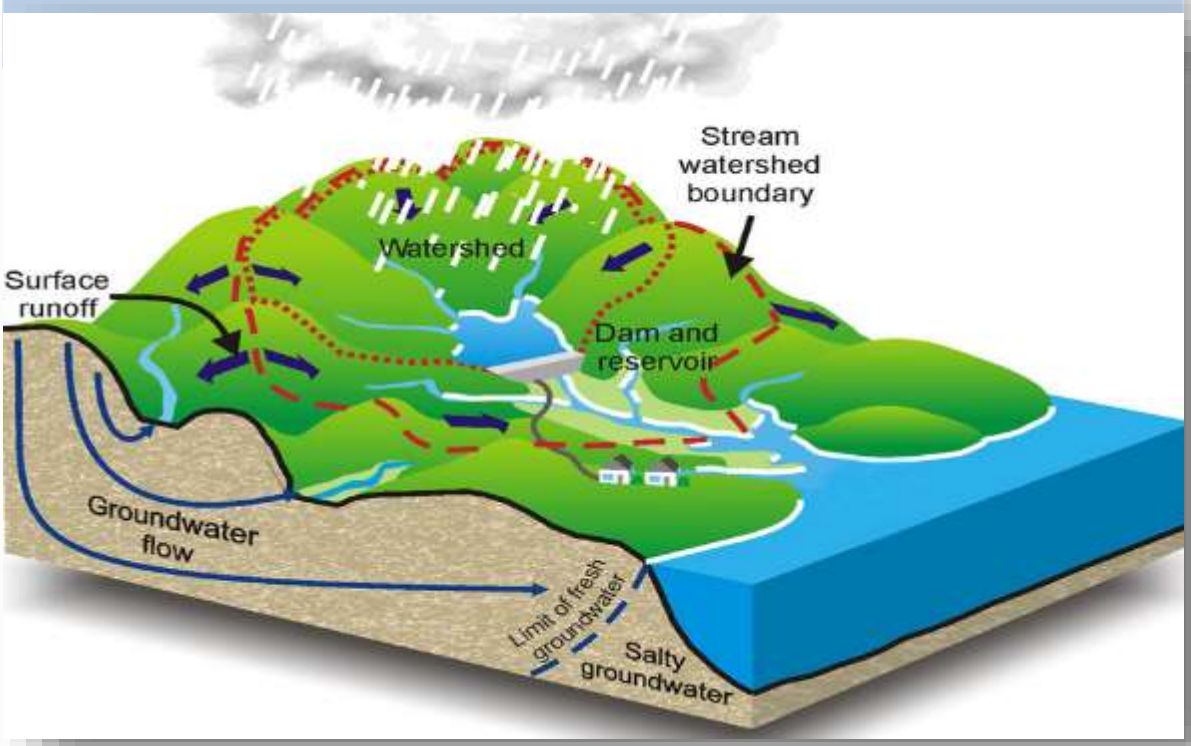
Farm Details

1a) Rationale for collecting farm details:

- Geo-referencing for Google-Earth viewing to enable:
  - Detailed assessments of the household pond system.
  - Viewing of all individual ponds simultaneously to determine their spatial distribution.
- Assess the potential of up-scaling based on sub-catchments studies.
- Use pond geo-reference to gather farm details

(2)

The catchment area



The Catchment Area

2a) Significance of the catchment area

- Determination of hydrologic unit/ boundary at sub-catchment level

- The farmer has no direct control of landuse beyond farm borders.

2b) Siting of runoff ponds

1. Local knowledge.

- The farmer has right of choice for the pond spot.
- The farmer knows runoff flow patterns

2. Topographic surveys.

- Using low cost equipment e.g. Line levels/A-Frames.
- Dumpy levels, Theodolites or Total Stations
- GPS sets to generate grid points

Catchment Area

2d) Determination of runoff depth using SCS-CN

Depth determination helps us to compute the volume of water flowing towards the pond. The formula is given below as follows:

$$Q = \frac{(P - 0.3S)^2}{(P - 0.7S)} \qquad S = \frac{25400}{CN - 254}$$

Where

Q = runoff (mm)

P = rainfall (mm)

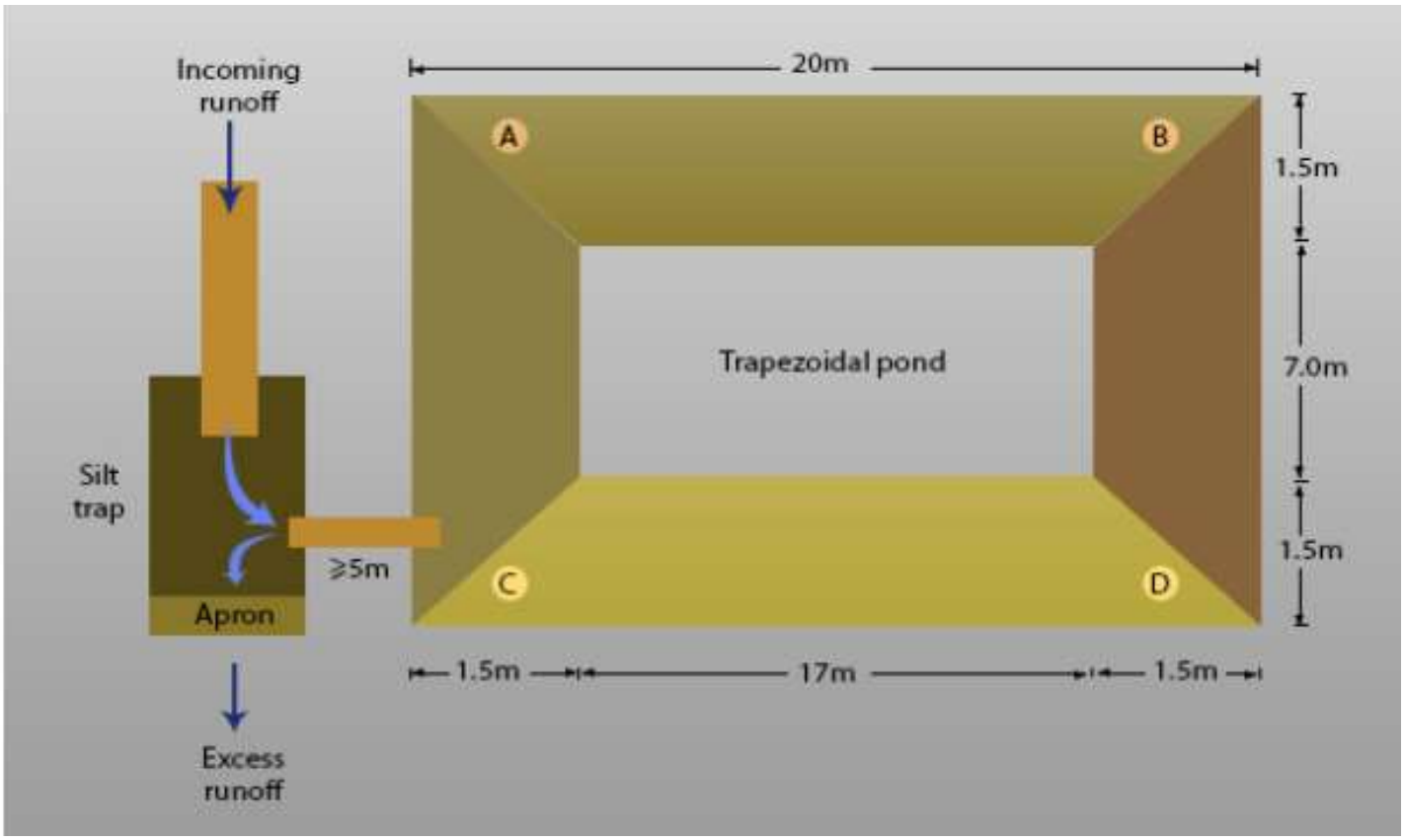
S = maximum recharge capacity

- (Water storage parameter of rainfall after 5 days antecedent moisture retention).
- To get the value of 'S', 1st determine the runoff curve number based on landuse and soil hydrologic condition.
- See Runoff curve number table in Page 11.

Pre-Conveyance Mechanisms

3. Conveyance Mechanisms

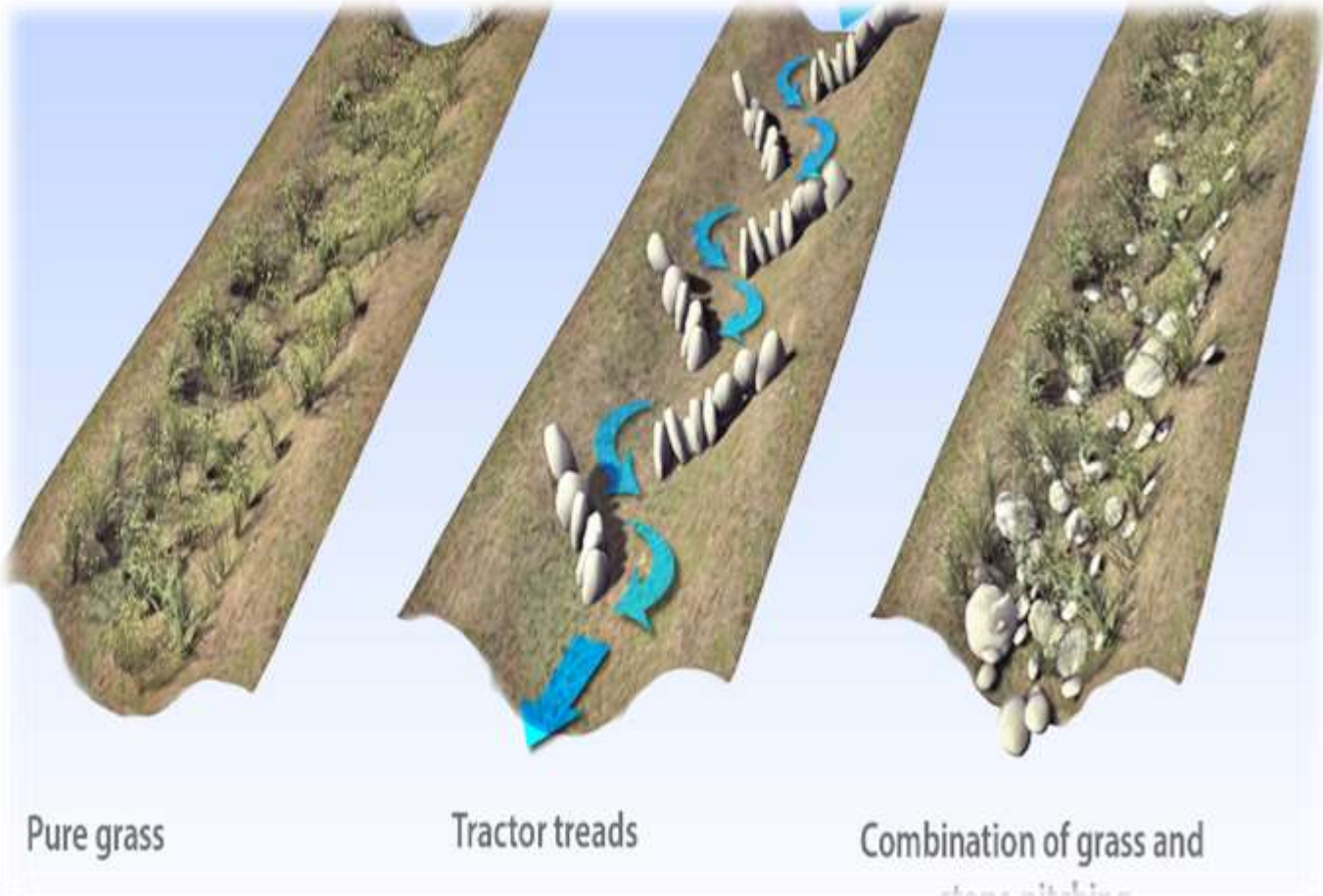
Waterway	Is there a waterway.	Yes (Y), or No (N)
	Type of waterway.	e.g. Stone piching (S), Grassed (G Tractor Treads (T) or combination |
	Shape of water way	e.g. Rectangular trench or Concav parabolic
	Approx dimesnions of waterway in meters.	Defined in length (L), Width (W) an Depth (D)
Silt traps	Lock & Spill silt traps	Number
		Dimensions of LxWxH (cm)
	Automated silt trap	Dimensions of LxWxH (cm)



Conveyance mechanisms

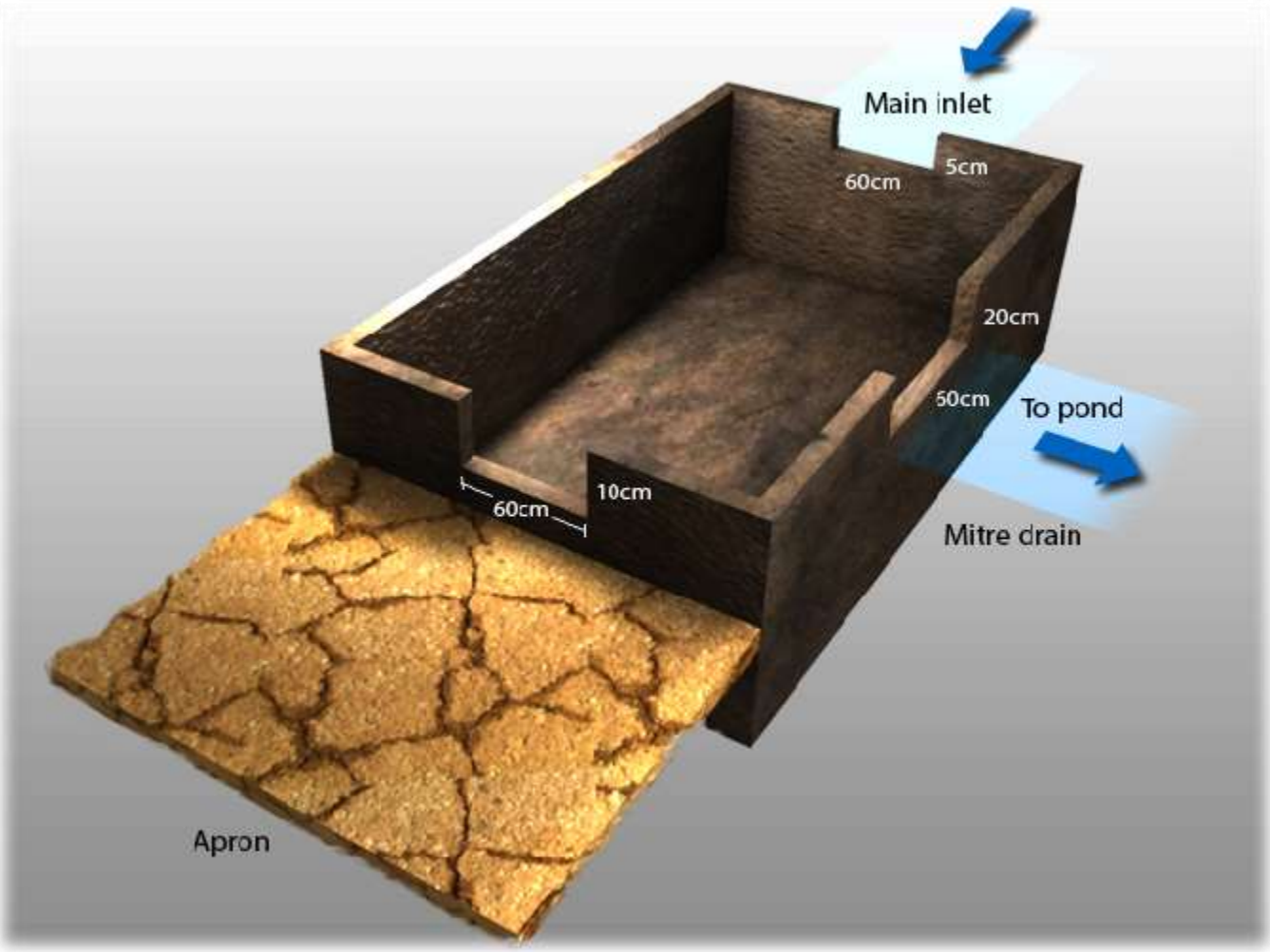
Channels & Waterways

Below are the different ways of treating channels and waterways



Conveyance mechanisms

Automated Silt Trap

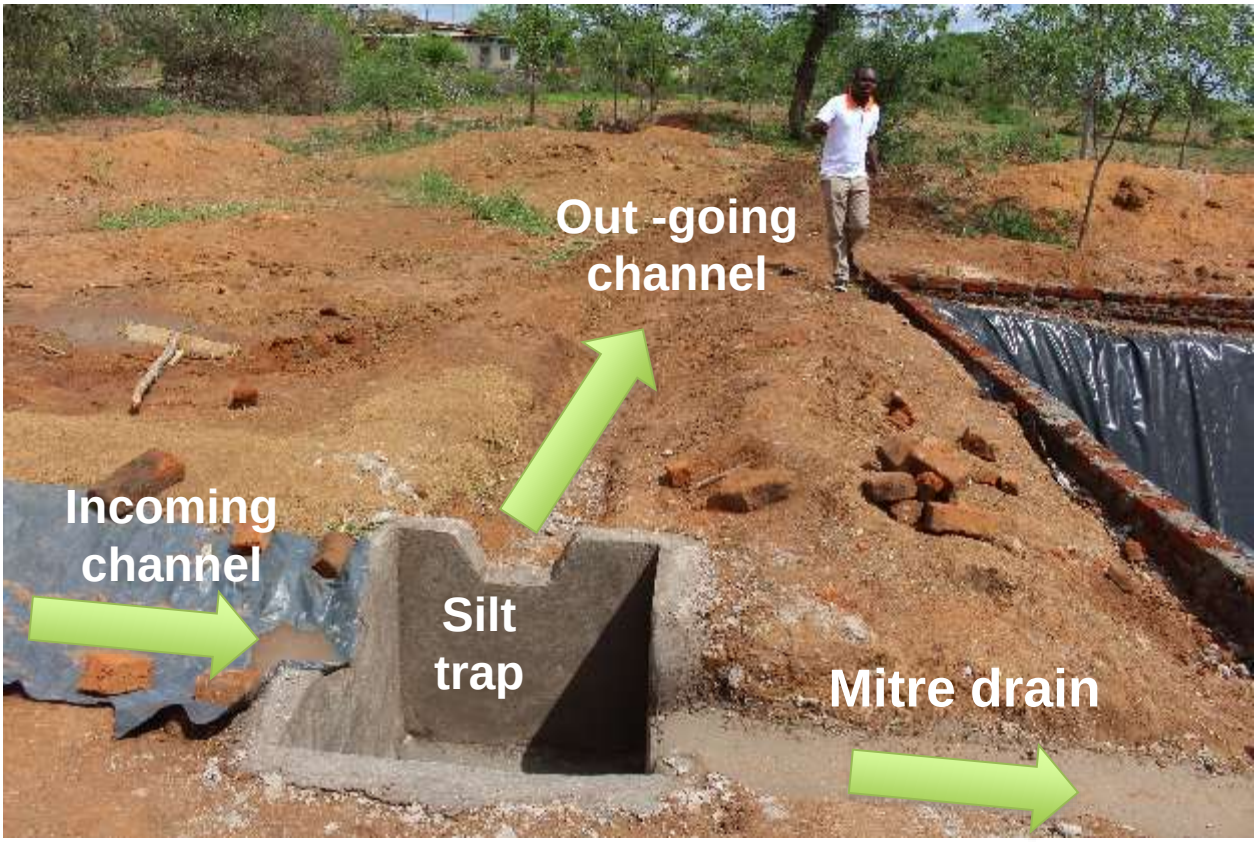


The inner dimensions (LxWxD) of the automated Silt Trap should be
(1.2m x 0.9m x 0.9m)
or approx.
(4ft x 3 ft x 3ft)

Construction of automated Silt Trap Construction

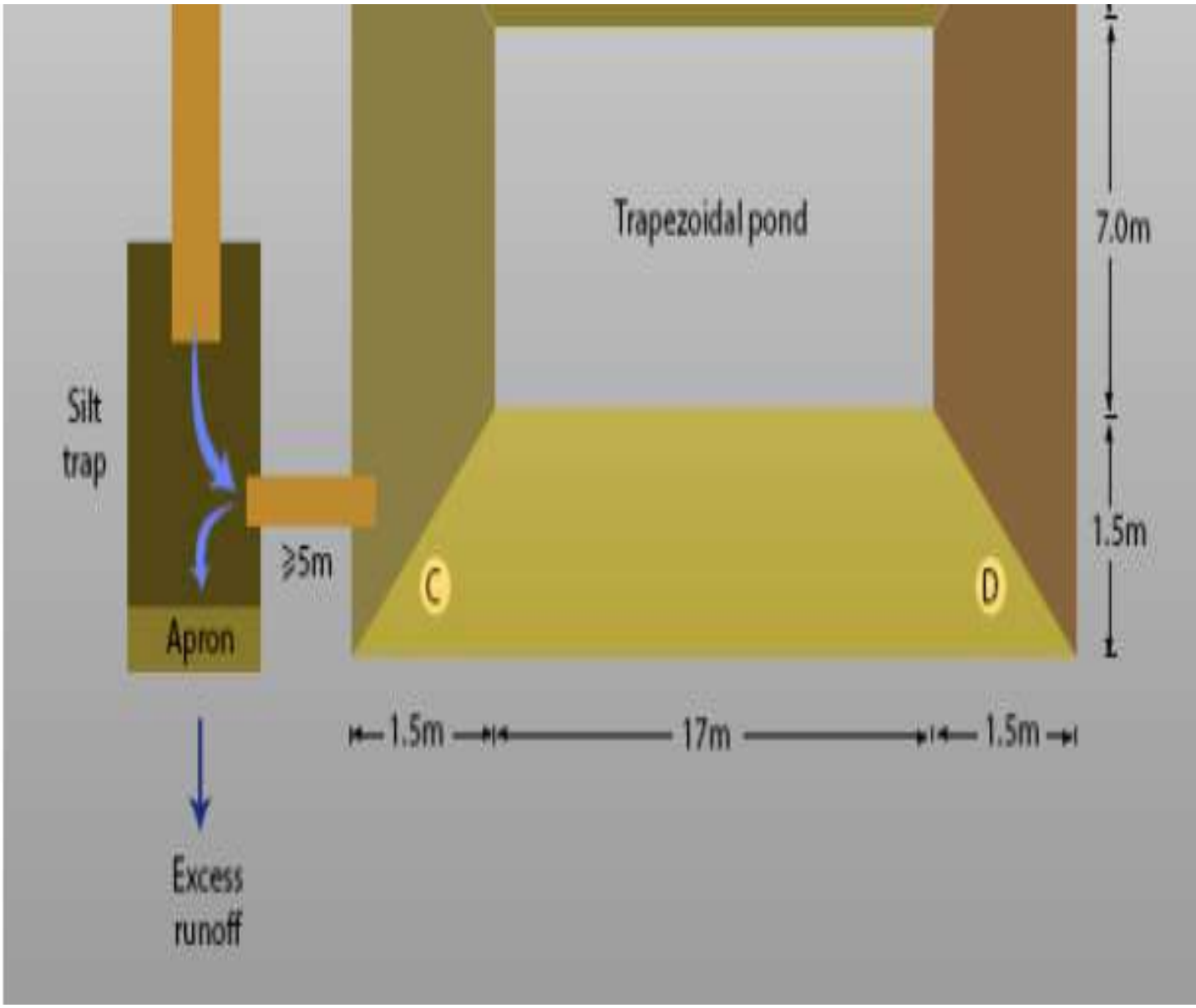
Automation of runoff flow

Runoff comes via the incoming channel.
It enters the automated silt trap.
When full in the silt trap, the runoff goes into the pond via the mitre drain.
When the pond is filled up, the water comes back into the silt trap and continues downstream via the out-going channel.



Storage Mechanisms

Layout of the runoff pond



Layout of the runoff ponds

1. Start with the upper rectangle of the truncated pyramidal pond (viewed in 3D) or trapezoidal pond (as viewed in 2D).

a)Layout its length.

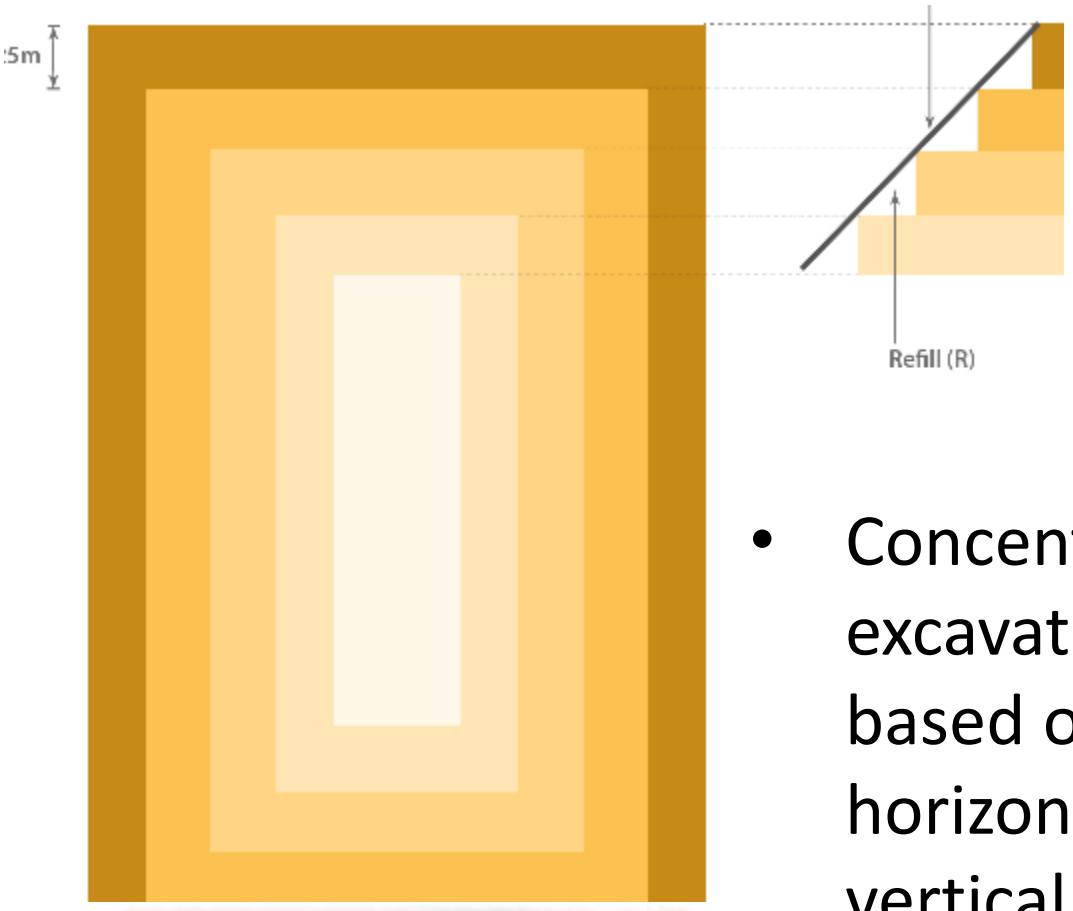
b)Go to one of the ends of this length and use Pythagoras theorem (of 5-12-13 etc) to determine the 90-degree angle from which the width shall be extended

c)Repeat this process at the other end of the length to get the other width, then join the two ends of these widths to establish the other length.

d)Insert pegs in the four corners of this rectangle. Tie and join these pegs with a twine or cotton rope for visibility.

Pond excavation

Construction of the ponds using human labour



- Concentric excavation based on horizontal to vertical ratios
- This is followed by manual sloping of the sides.

Construction of the ponds using human labour

Dam scoopers drawn by animals

Small tractors for excavating ponds

Excavation, lining & brick coursework

- Use Animal or tractor drawn power for initial excavation
- Compliment this with human power for refinement
- Use HDPE/HDPP for lining of 0.8 of 1m thickness
- Construct 2 to 3-courseworks of bricks around the pond

Pond roofing using shade-net

Setting for shade-net roofing to cover the pond

- The roofing is best done using the Gable design
- Roofing is done after the brick coursework is complete.
- The Gables could either be widthwise or lengthwise of the pond
- Use 1.5”x1.5” angle bars.
- The middle bars and end bars are used for setting.
- The length of the middle bars should be equal to depth of hole (about 45cm), height of brick coursework and 1m above the coursework).
- The end bars should be equal to depth of hole (about 45cm), height of brick coursework and 10cm above the coursework).

Setting up of pond covering to reduce evaporation

Pond Covering

- Done to reduce or eliminate evaporation
- Reduce or eliminate algal growth

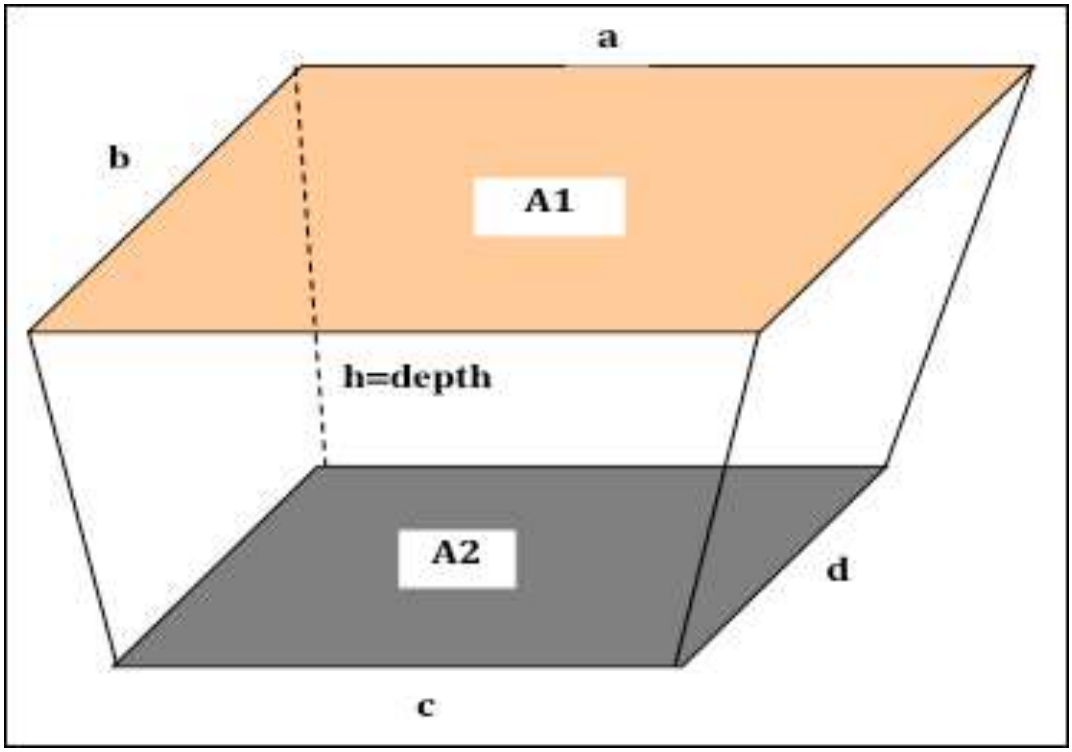
- Use nets of at least 70% shading. The denser, the more effective but the higher the cost.

TopUp Ball System

Balls for reducing Evaporation
in Israel

Can we also use used bottles or Jerrycan to cover our ponds?

Determination of ponds dimensions



Option 1: $V = \frac{1}{3}((A1+A2) + (A1*A2)^{\frac{1}{2}}))h$

Option 2: $V = \frac{1}{6}(2ab + ad + bc + 2cd)h$

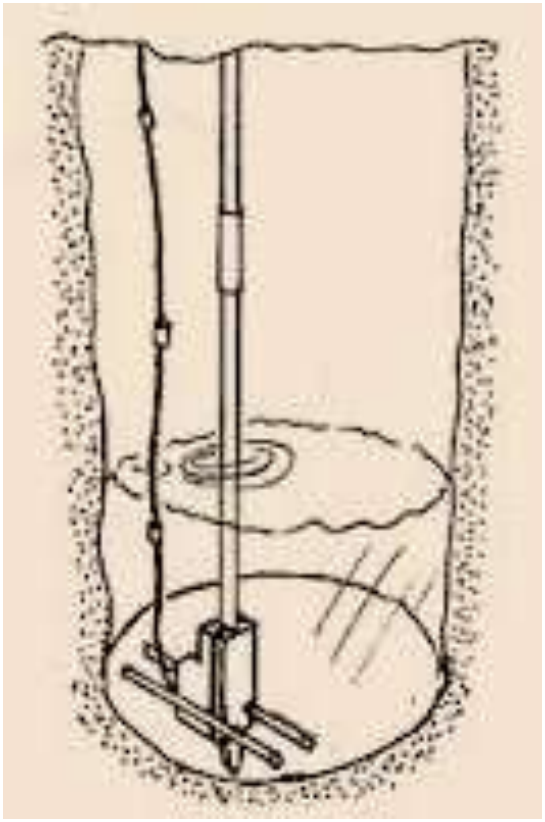
1. Determination of the pond volume using DOMCA (Double Mass Curve Analysis) approach.

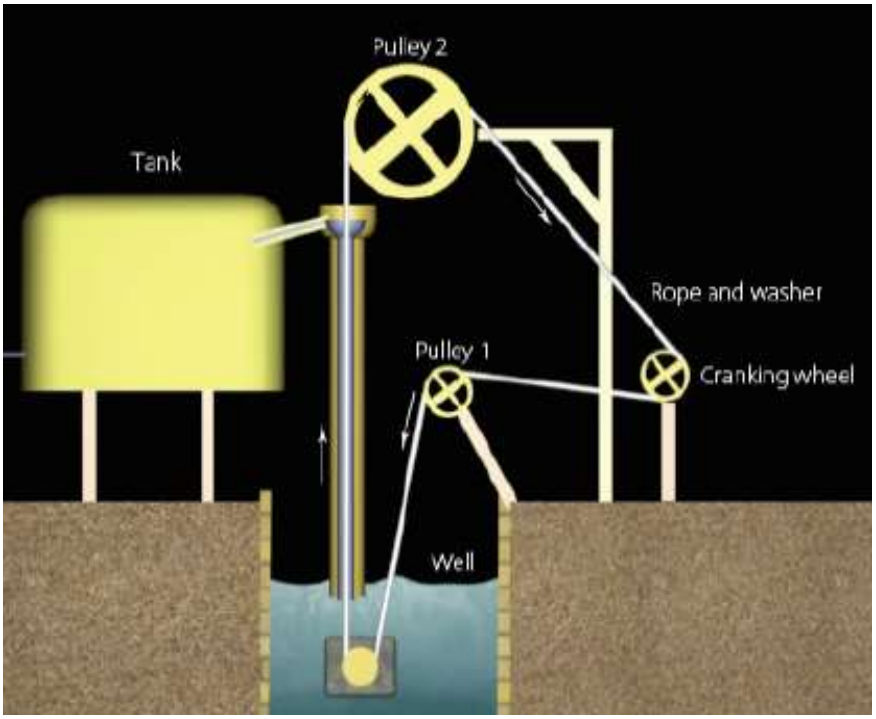
a)Determine the average monthly rainfall over at least a 10-year period.
b)Estimate the catchment area wherefrom runoff is generated
c)Compute the monthly runoff supply volume using a simple continuity equation by getting the products of area, monthly rainfall, runoff coefficient and probability of rainfall occurrence.
d)Starting from the wettest month, get cumulative monthly supply volume for the next 12 months.
e)Determine the monthly evaporation losses and from the same month as in d) above, get cumulative evaporative losses.
f)Get the monthly differences between monthly cumulative water supply and monthly cumulative evaporative losses.
g)Compute the monthly and cumulative water demand starting from the wettest month
h)The reservoir size will be the month with the greatest difference.

Abstraction Mechanisms

Abstraction mechanisms

Rope & Washer Pumps





Abstraction mechanisms

Rope & Washer Pumps

Brazilian Improvisation

Abstraction rates & timing for the Rope & Washer Pumps

For the runoff ponds, the abstraction rate is 39 litres/min for a child and 70 litres/min for an adult.

Application of pond water

ENTERPRISES

1. High Value crops
2. Trees nurseries & for agroforestry
3. Poultry production
4. Bee keeping

ENTERPRISES

1. High Value crops
2. Trees nurseries & for agroforestry
3. Poultry production
4. Bee keeping

1. Food for humans
2. Animal feed – esp. Kales
3. Income generation

ENTERPRISES

1. High Value crops
2. Trees nurseries & for agroforestry
3. Poultry production
4. Bee keeping

1. Income generation from timber/firewood
2. Fruits & vegetables
3. Ecosystem sustenance

ENTERPRISES

1. High Value crops
2. Trees nurseries & for agroforestry
3. Poultry production
4. Bee keeping

1. Income generation
2. Food security & health
3. Liquid manure for crops

ENTERPRISES

1. High Value crops
2. Trees nurseries & for agroforestry
3. Poultry production
4. Bee keeping

1. Income generation
2. Food security & health
3. Yield enhancement through pollination

Application mechanisms

Measured Irrigation Using Evaporators

Still Under construction

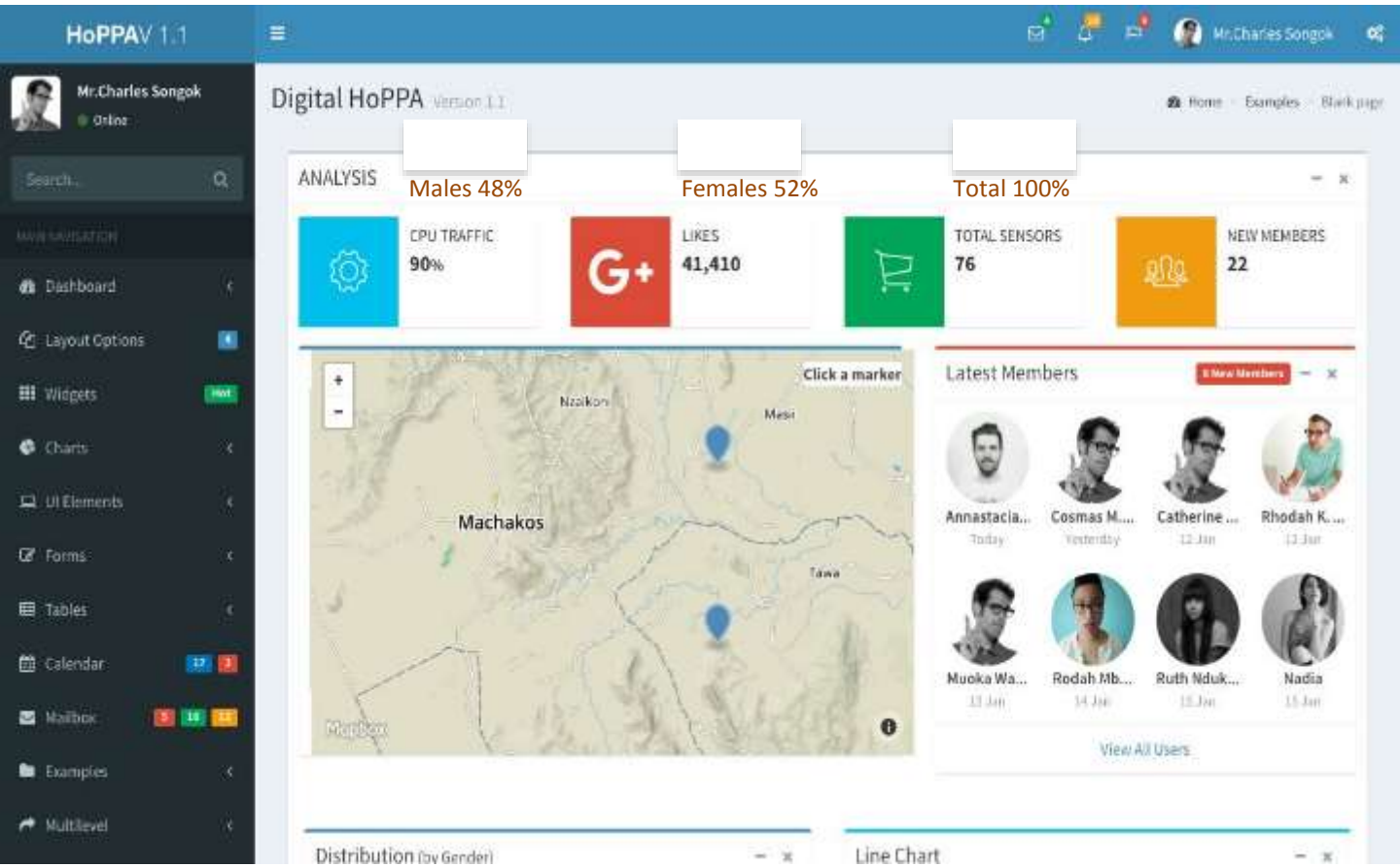
Integrated pond enterprises

- Tree – Nursery
- Irrigation of High Value Crops
- Poultry production
- Bee keeping

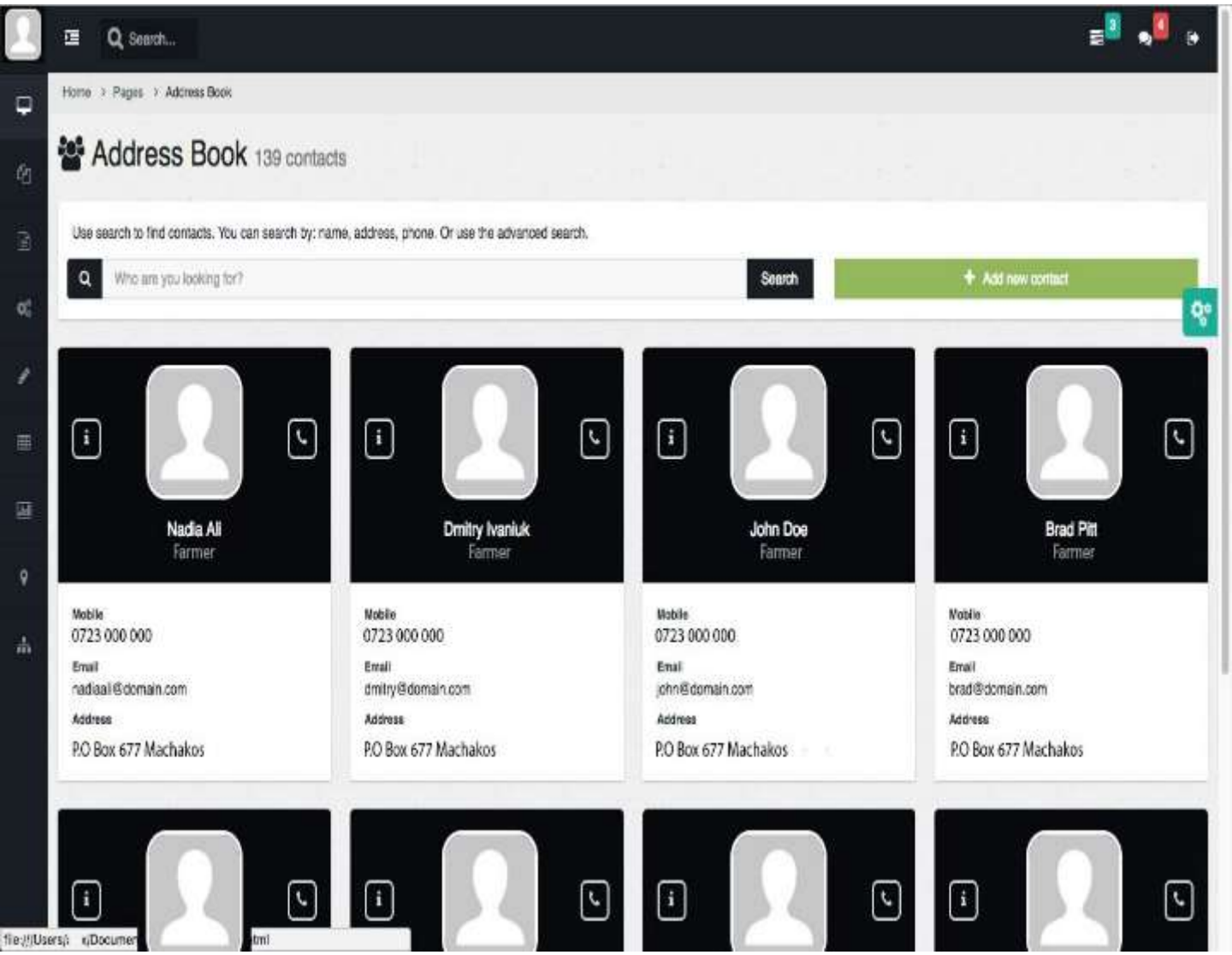
HOUSEHOLD POND PROTOCOL APPLICATION

DIGITAL ADMINISTRATION

Viewing all farmers & their contacts



Viewing profiles or biodata of all farmers



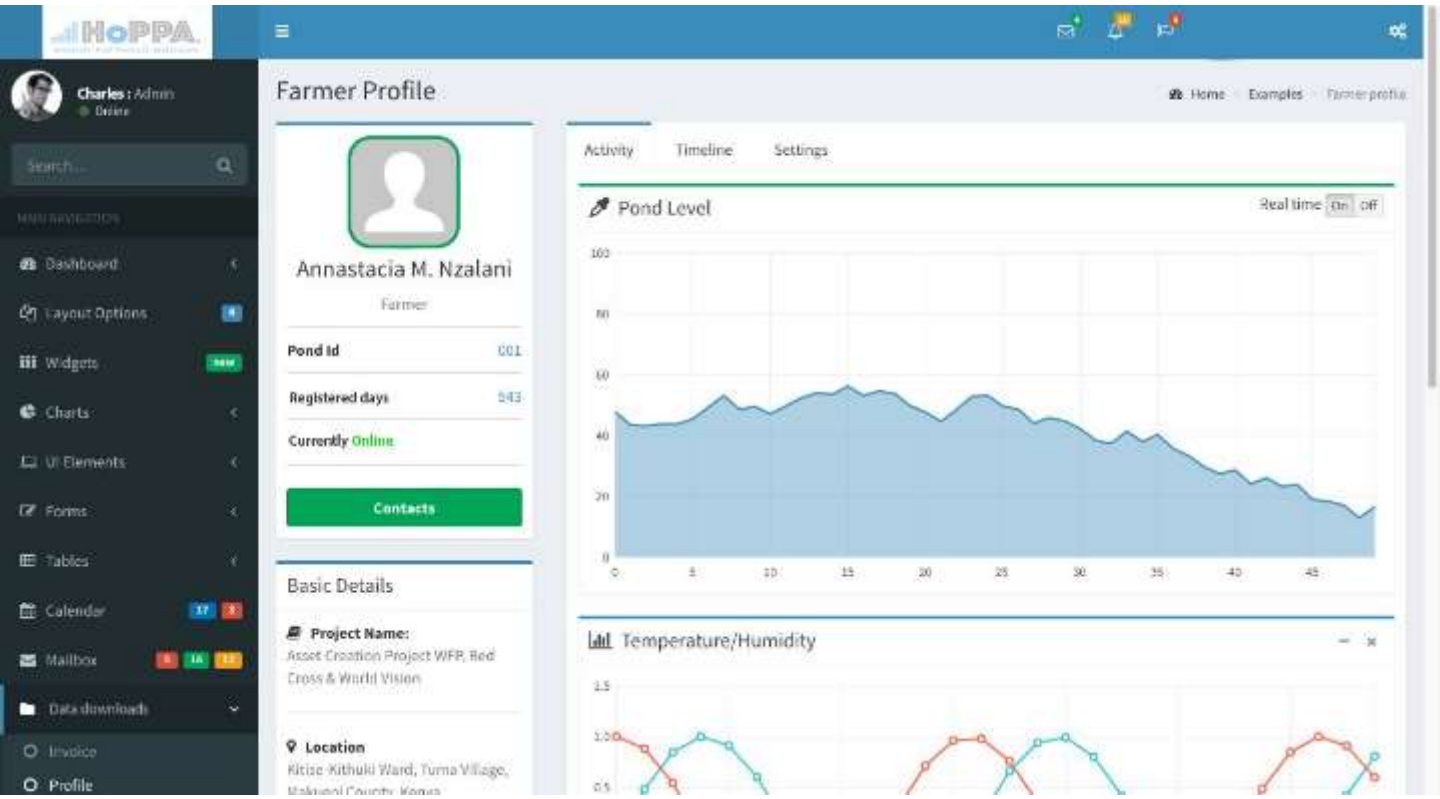
Demonstration on the Digital HoPPA

Demonstration of the use of D-HoPPA to determine pond water level, humidity, temperature and soil moisture

INSTALLATION OF THE **D-HoPPA**

INASTALLATION OF THE **D-HoPPA**

Monitoring of pond level using D-HoPPA



Monitoring of Community Dynamics using D-HoPPA

Farm pond Financial & Economic Analysis Protocol

Frank van Schoubroeck