




**SBE2006
SUSTAINABLE RAINWATER
HARVESTING DESIGNS FOR
COMMUNITY BASED ORGANIC
FARMING PROJECTS**



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SYNOPSIS

It has been said that the next war will not be over oil, but rather about securing water resources. The rapid rate of urbanization and growing populations worldwide is placing a huge strain on the provision of water for domestic consumption and agriculture. It therefore follows that water should be treated as a scarce commodity and its usage be carefully planned in a sustainable manner.



CONTENTS

- INTRODUCTION
- SOURCES OF INSPIRATION
- DESIGN PROJECTS
- ANALYSIS
- CONCLUSIONS



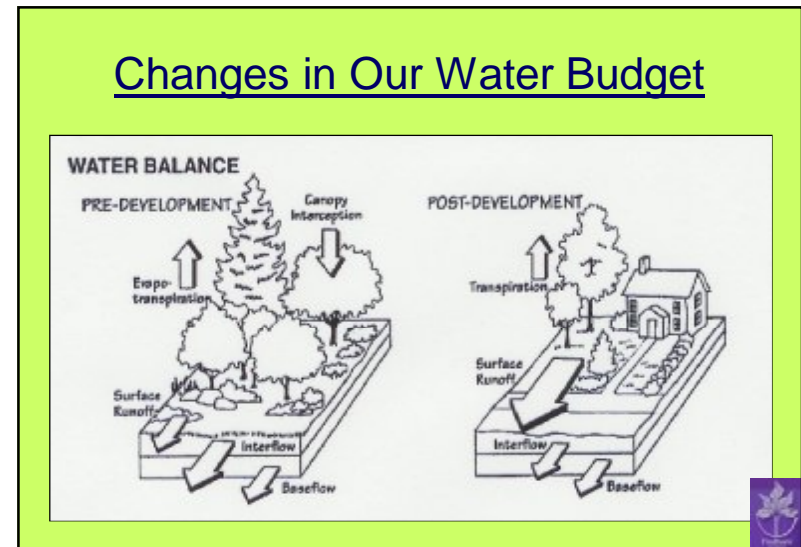
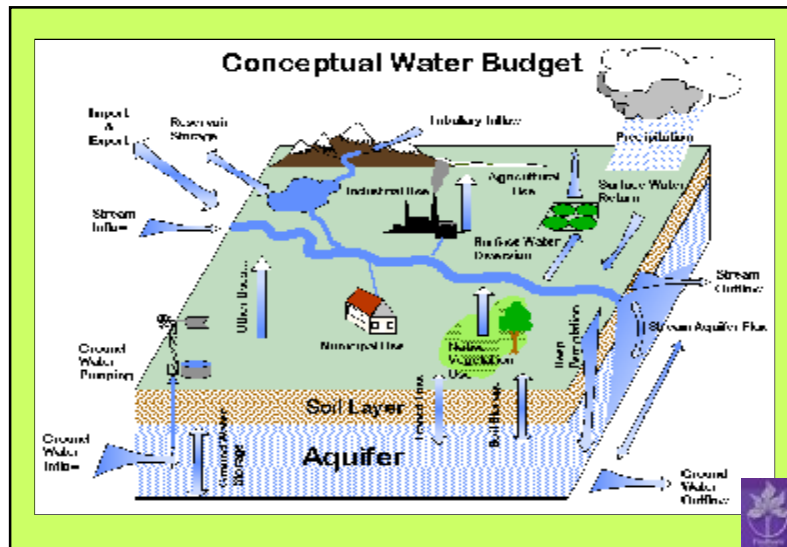
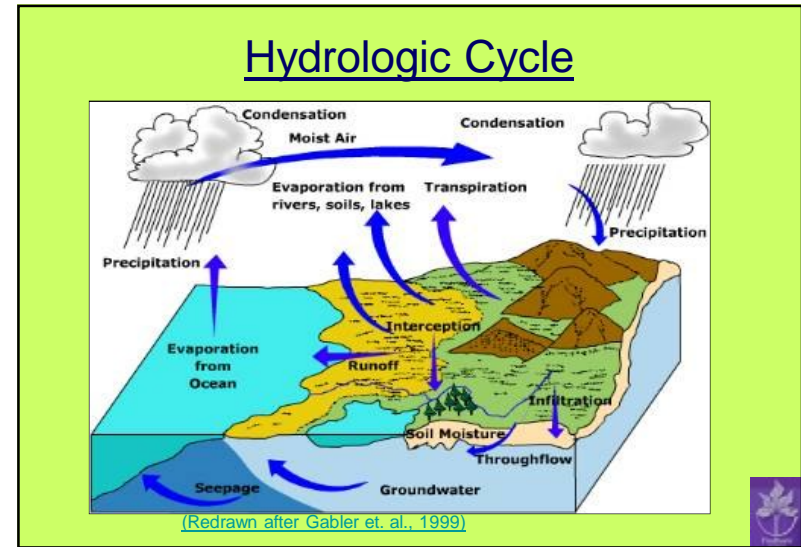
INTRODUCTION

- MANY COMMUNITY BASED AGRICULTURAL AND LAND REFORM PROJECTS ARE FAILING
- DIRE NEED FOR SUSTAINABLE SOLUTIONS FOR COMMUNITY BASED AGRICULTURAL PROJECTS
- IRRIGATION IS A KEY RESOURCE WHICH REQUIRES CAREFUL PLANNING & DESIGN
- A HOLISTIC APPROACH IS REQUIRED FOR PRODUCT AND PROCESS
- INFORMATION IS REQUIRED FOR AN EMERGING POLICY ON THE DEVELOPMENT OF SMALL GROWER GROUPS (SGGs)



SOURCES OF INSPIRATION FOR RAINWATER HARVESTING

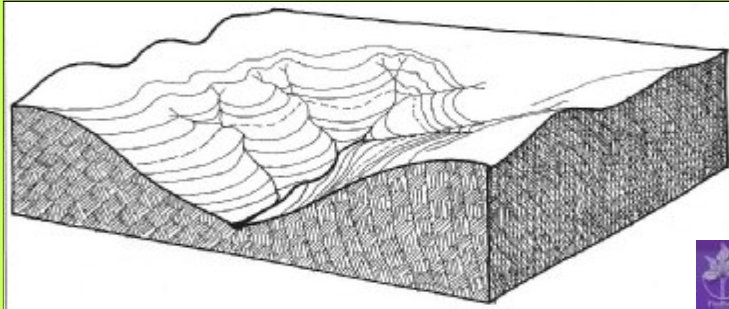
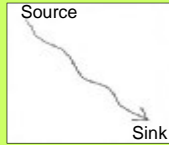
- WATER & SANITATION PRESENTATION SLIDES FROM FINDHORN ECOVILLAGE EXPERIENCE WEEK
- YEOMAN KEYLINE
- BILL MOLLISON KEYLINE (PERMACULTURE)
- SWALES & VETIVER GRASS
- RAINWATER HARVESTING FOR HOMESTEAD DESIGN
- LIMITED TILL FARMING SYSTEMS



Non-sustainable Water Use

Current Water Culture:

- Channel water off landscape as quickly as possible
- Move polluted water away from area
- People downstream not considered



Non-sustainable Water Use

Local Resources Left to Deteriorate



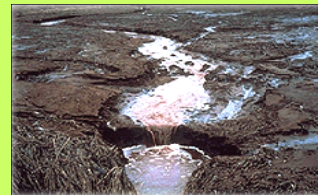
Photo WHO/P. Virot



Groundwater Depletion



Surface and Groundwater Contamination



Alteration of Ecosystems and Communities from Large Dams

Half of the world's large dams (estimated to be about 42,000 of them) were built exclusively or primarily for irrigation

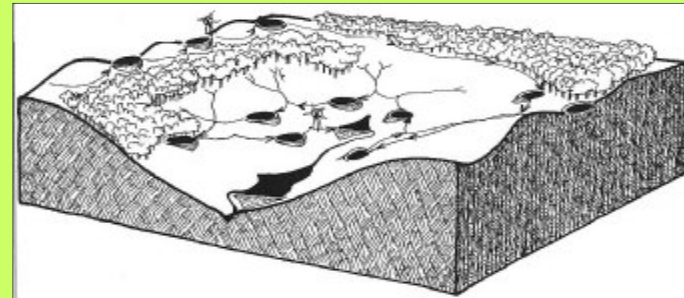
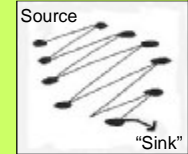
'Dams and Development: A New Framework for Decision-Making' Report of the World Commission on Dams, November 2000



Sustainable Water Use

A New Water Culture:

- Landscape to collect and store precipitation
- Minimize water pollution
- Maximize Efficiency
- Eliminate Waste
- Maintain social and ecological integrity of the community



Community Water Collection Techniques

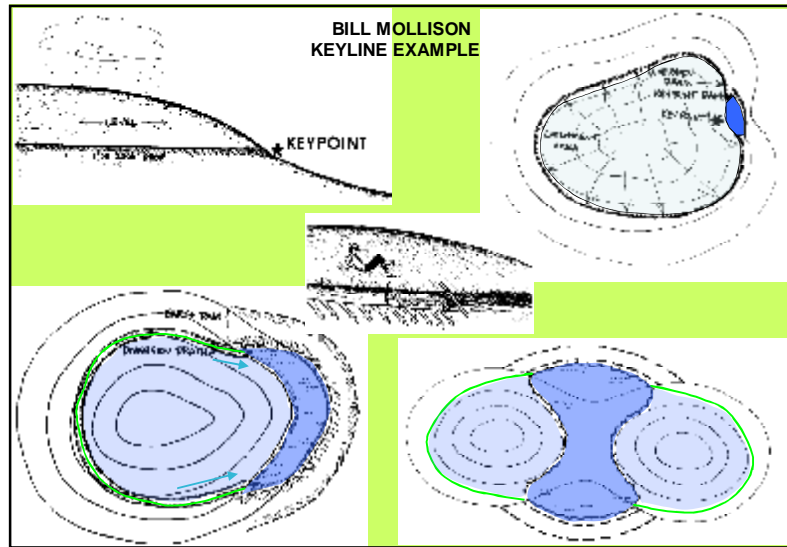
Slow Surface Water Runoff



BETTER DESIGN

- Increases Time of Retention
- Recharges Groundwater
- Reduces Flooding Downstream
- Removes Pollutants





SWALES & VETIVER GRASS

vetiver grass, fruit trees, Swales slightly off centre to lengthen channels

Progressive benefits from Swales	No Swales	Swales	Swales & Mulching
Rainwater harvesting	None	Good	Very good
Soil erosion	Bad	Very little	Contained
Water table	Low	Good	Very good
Moisture retention	Low	Good	Very good
Crop yields	Low	Good	Very good

Below ground!!!

Five month old plants with 3.3m deep root system

Vetiver roots have a tensile strength equivalent to 1/5 the strength of mild steel reinforcement!

HOW IT WORKS

Left - Longitudinal section through vetiver hedgerow root system

Right - Cross section through a vetiver hedgerow

Above Ground

A one year old Vetiver stand showing stiff and erect leaves that form a thick hedge

广州普根
Guangzhou Science and

THE VETIVER NETWORK

The Vetiver System
A simple grass hedge
Deep and tough roots

A unique technology for soil and water conservation, land rehabilitation, infrastructure stabilisation, pollution control and other uses.

English French

RAINWATER HARVESTING FOR HOMESTEAD DESIGN

Berm: A low wall (berm) is built around the house to catch rainwater that runs down the roof and spill over the side.

French drain: A trench with a grate is installed along the side of the house to collect runoff.

Channel: A narrow channel is dug in the ground to guide rainwater from the roof to a collection point.

Complex: A combination of a French drain and a channel leading to a storage tank.

RAINWATER HARVESTING FOR HOMESTEAD DESIGN

Cans: Large water storage containers (cans) are placed near the house to catch runoff.

Measure: A flat roof is designed to direct water into a central collection point.

Vines: A wall is covered in climbing vines to filter and slow down rainwater before it reaches the ground.

Sidewalk: A sidewalk is designed to channel rainwater from the roof down to a collection area.

RAINWATER HARVESTING FOR HOMESTEAD DESIGN

Driveway: A paved driveway is designed to collect rainwater and direct it to a collection system.

Parking: A paved parking area is designed to collect rainwater and direct it to a collection system.

Paving: A paved area around a tree is designed to collect rainwater from the tree's canopy.

Cutout: A cutout in a concrete surface is designed to collect rainwater from a specific area.

RAINWATER HARVESTING FOR HOMESTEAD DESIGN

Dripline: A circular basin is placed around a tree to catch water from its drip line. Labels include: MATURE TREE, EDGE OF BASIN, and DRIP LINE.

Basin: A series of basins are placed in a row to catch runoff from a slope.

Crescent: A crescent-shaped basin is placed around a tree to catch runoff from its canopy.

Gabion: A structure made of wire mesh filled with stones is used to catch and filter rainwater.

NO-TILL OR LIMITED TILL FARMING

Pot hole capacity 20 litres
Plant stations
Root zone
Ground level
1.0 m
1.5 m
Compaction zone
Water penetration from pot hole
Wheel track furrow 20 to 25 cm deep
Raised beds

DESIGN PROJECTS

- NEWLANDS MASHU PERMACULTURE LEARNING CENTRE, eThekweni Municipality, November 2005.
- AMAOTI ORGANIC FARMING PROJECT, eThekweni Municipality, Development Concept Plan, September 2005.
- BHAMBAYI ORGANIC FARMING PROJECT, eThekweni Municipality, Development Concept Plan, September 2005.
- DEVELOPMENT PLAN FOR ORGANIC SMALL GROWER GROUPS, Ugu District Municipality, July 2006.

NEWLANDS MASHU PERMACULTURE LEARNING CENTRE

NEWLANDS MASHU
Permaculture Learning Centre




AMAOTI ORGANIC FARMING PROJECT

eThekweni Municipality

Development Concept Plan

Version 1 – 1st September 2005


Prepared for



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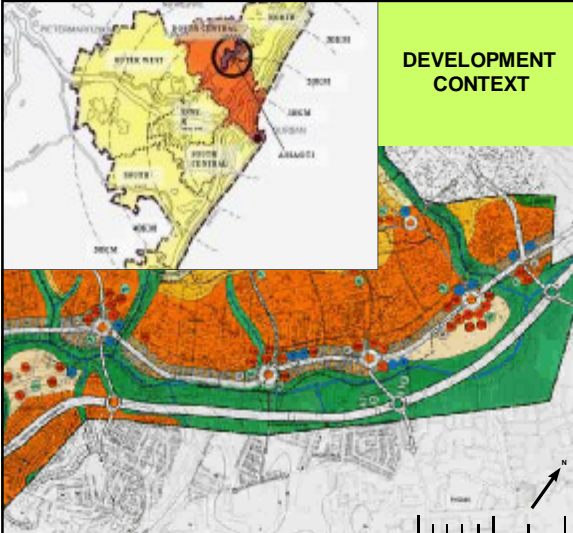
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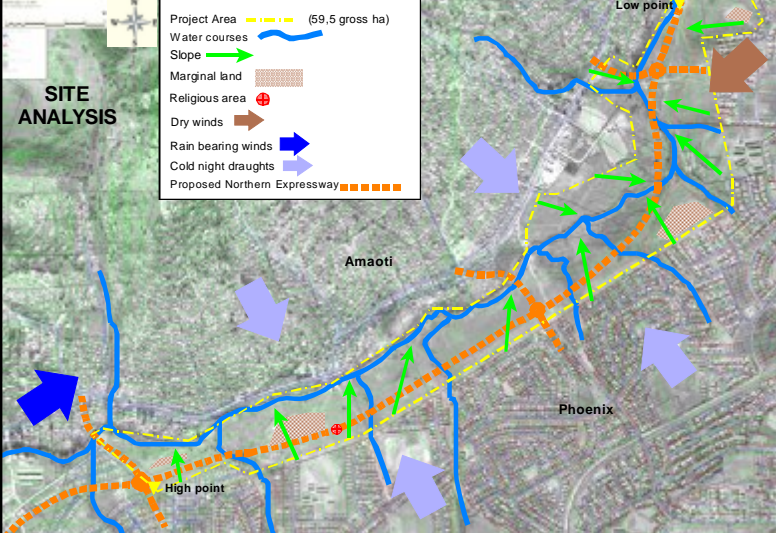
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DEVELOPMENT CONTEXT



- Urban agricultural land
- Historical buffer strip
- Inanda Ntuzuma KwaMashu Urban Renewal Programme (INK)
- 53,000 people or 11,000 households
- Community bridge building
- Pilot urban agricultural project

SITE ANALYSIS



Project Area (59.5 gross ha)

Water courses

Slope

Marginal land

Religious area

Dry winds

Rain bearing winds

Cold night draughts

Proposed Northern Expressway

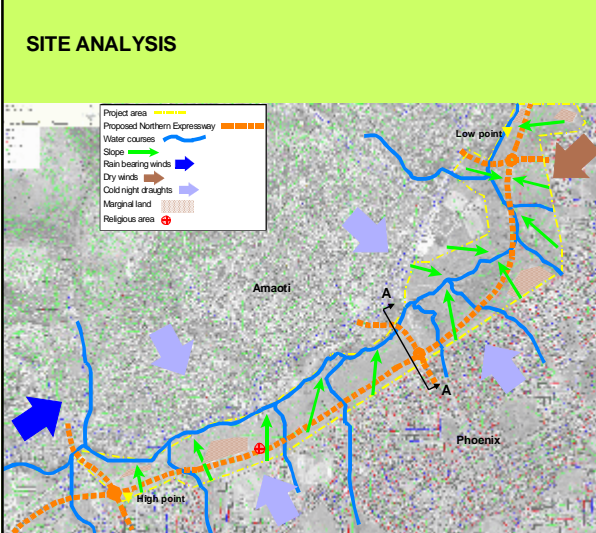
High point

Low point

Amaoti

Phoenix

SITE ANALYSIS



- Establish wind breaks
- Trap stormwater via detention ponds
- Incorporate the proposed Northern Expressway as a design feature
- Enhance groundwater seepage

SITE DESIGN CONCEPT – RAINWATER HARVESTING

X-Section AA

- Percolation dams along the proposed alignment of the Northern Expressway
- Sub-surface dams alongside the Ohlanga River to enhance the water table
- Water wheel pumps to abstract water table to holding tank
- Check weirs in Ohlanga River to spread stormwater discharges
- Swales with vetiver grass
- Gravity fed irrigation from holding tanks

SITE DESIGN CONCEPT – ALLOTMENTS

Plan Section AA

- 20m by 20m grid for a 400m² allotment
- Vetiver grass and fruit trees provide tree canopy, wind breaks and biomass
- 8 Adjacent allotments can be grouped for a polyculture of integrated rotation system of crops and chickens
- Pecan nut orchard alongside the Ohlanga River
- Polyculture with tilapia fish in percolation dams
- LEISA principles minimise operating costs and create better income margins
- Income yields about 2,5 to 3 times better than yields of conventional large scale agriculture
- Each allotment to earn at least R3,600 per annum

SITE DESIGN CONCEPT – ALLOTMENTS

SITE DESIGN CONCEPT – HOMESTEAD GARDENS

- Trainees to become the new community based farm stewards to help establish some 1,000 homestead gardens
- Homestead gardens :- rainwater tank; plant material; fruit and nut trees; and, small tools
- Homestead gardens to be established via small loans up to R2,500 each, R2,000 value of goods and R500 paid to the farm steward upon completion
- Loan funding to be based on the Grameen Banking system
- Bona fide loan applicants will need to provide loan collateral via 4 other households
- Loan guarantee fund worth 10% of the loan stock to be secured in order to entice a micro-finance service provider
- The scheme stops once the loan guarantee fund is exhausted

SITE DESIGN CONCEPT – FARMERS CO-OPERATIVE SUPPORT CENTRE

The scale of this project makes for a viable Farmers Co-operative Support Centre as an independent business unit in order to consolidate and deliver a wide range of functions, such as:-

- management and administration of allotments
- inspections for organic compliance
- administration of micro loans
- training and mentoring of farmers
- advisory services for farmers
- propagation of seeds and trees
- storage and exchange of seeds
- collection point for recycling of glass, paper and steel
- use of local garden refuse for large scale composting
- hiring of plant and equipment
- provide a trading platform on market days
- produce delivered for onward transport to other markets
- add value to niche produce such as packaging and marketing
- provide assistance to emerging SMEs




Phase	1	2	3	4	5	6	7	8	9	10
Phase 1: 1/2	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Phase 2: 1/2	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Phase 3: 1/2	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Phase 4: 1/2	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Phase 5: 1/2	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Phase 6: 1/2	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Phase 7: 1/2	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Phase 8: 1/2	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Phase 9: 1/2	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Phase 10: 1/2	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green


PROJECT PHASING

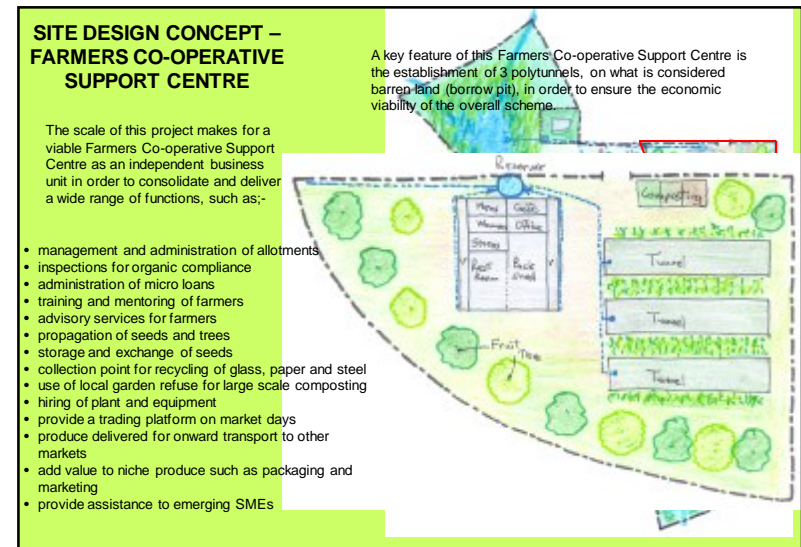
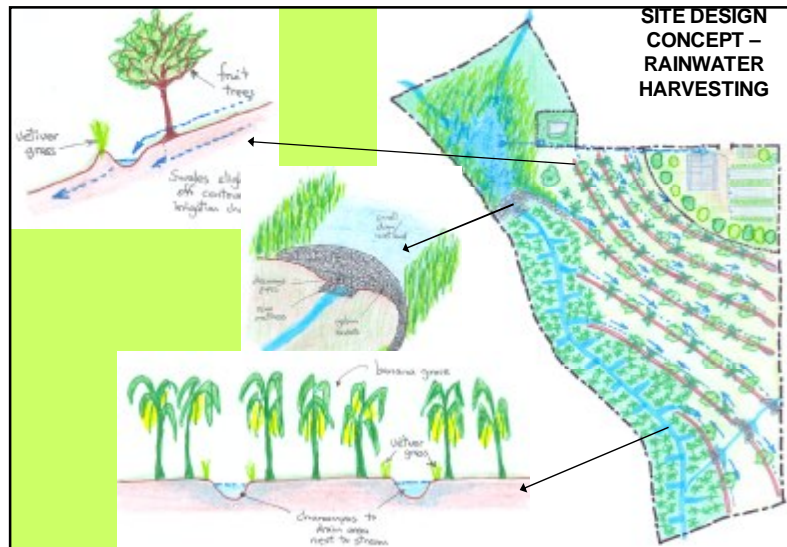
DESIGN CONCEPT FOR PART OF PHASE 1 ALLOTMENTS



BHAMBAYI ORGANIC FARMING PROJECT
 eThekweni Municipality
Development Concept Plan
 Version 1 – 15 September 2005

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SITE DESIGN CONCEPT – HOMESTEAD GARDENS

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DEVELOPMENT PLAN FOR ORGANIC SMALL GROWER GROUPS IN UGU DISTRICT MUNICIPALITY

DEPARTMENT OF ECONOMIC DEVELOPMENT

Funded by

EUROPEAN UNION

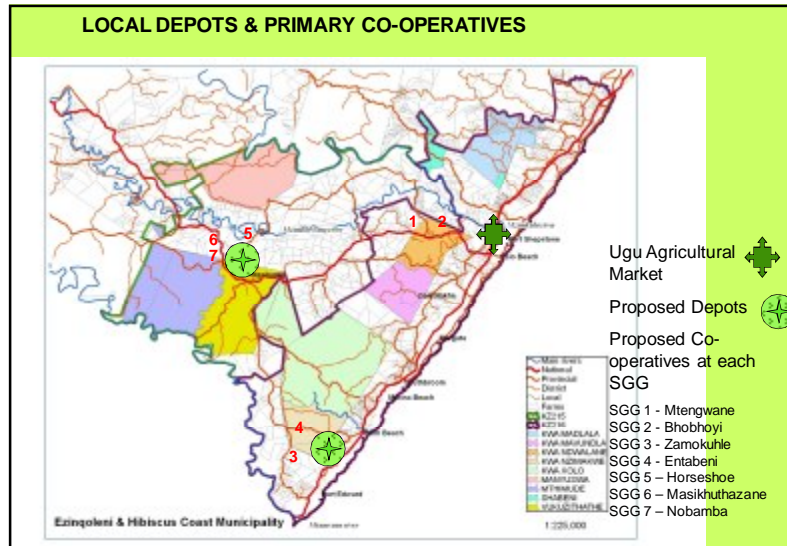
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CROP CYCLE & WATER REQUIREMENTS

Typical crop cycle				
Plant Seedlings & Initial Growth				
Vegetative Growth				
Vegetative & Flowering				
Fruiting				
Fruiting and Harvesting				
Harvesting and Land Prep for next Crop				

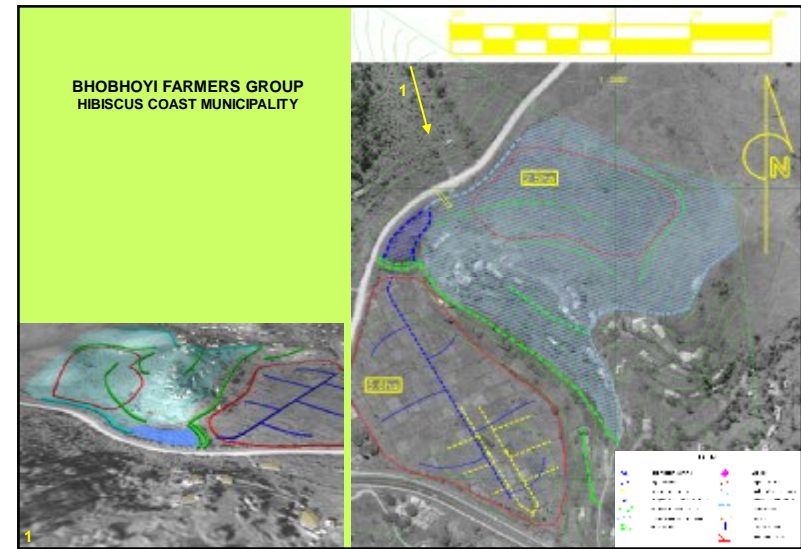
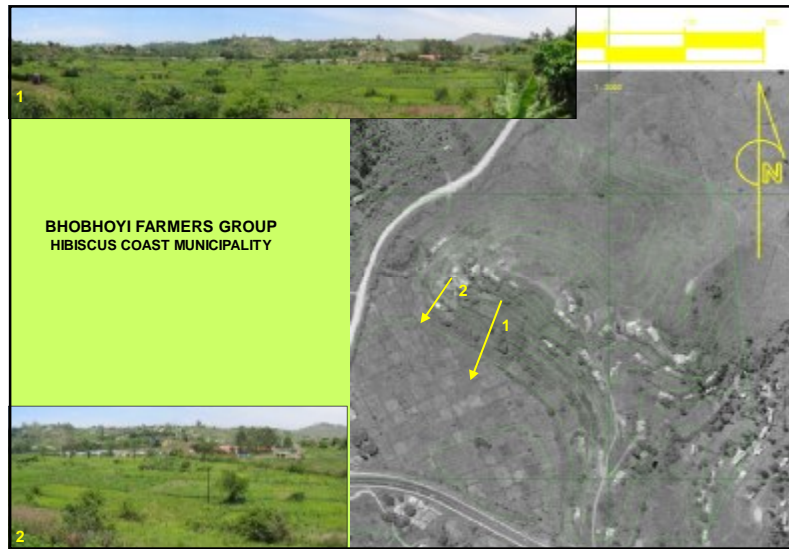
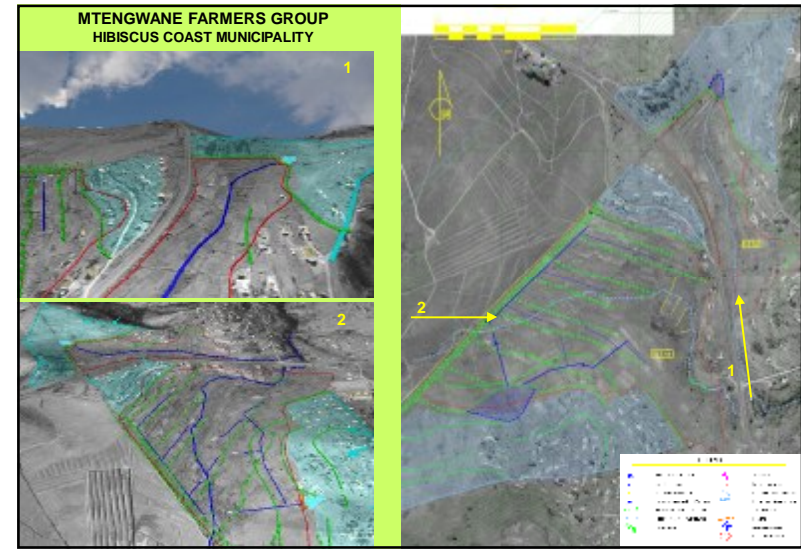
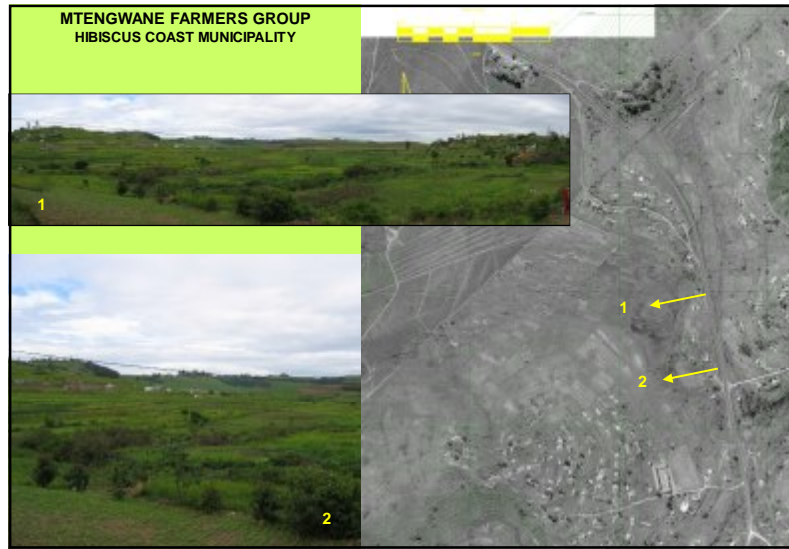
Water Requirements Et/Eo	0.4	0.8	1	0.7
Hot months - Water Usage (mm/ha)	80	160	200	140
Cold months - Water Usage (mm/ha)	60	120	150	105

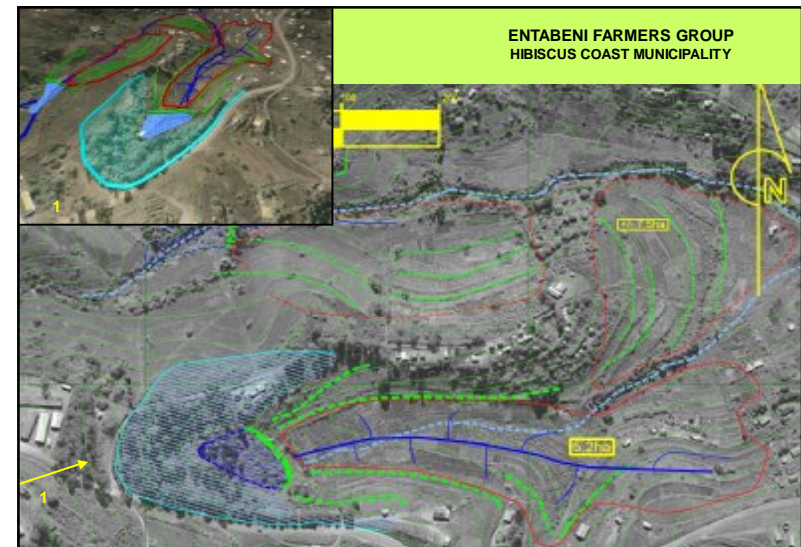
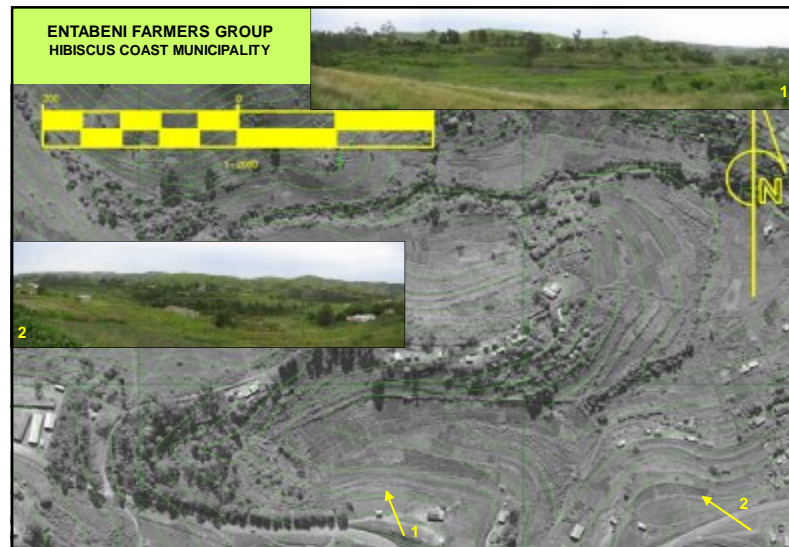
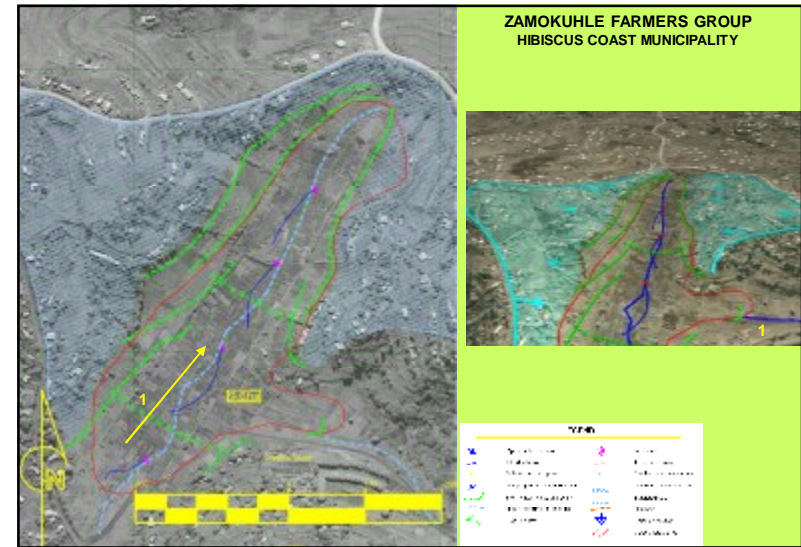
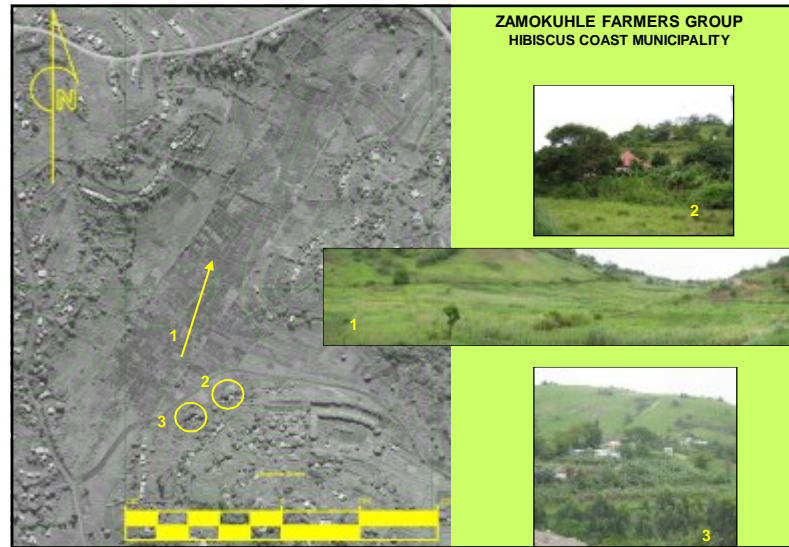
CROP SCENARIOS & WATER REQUIREMENTS

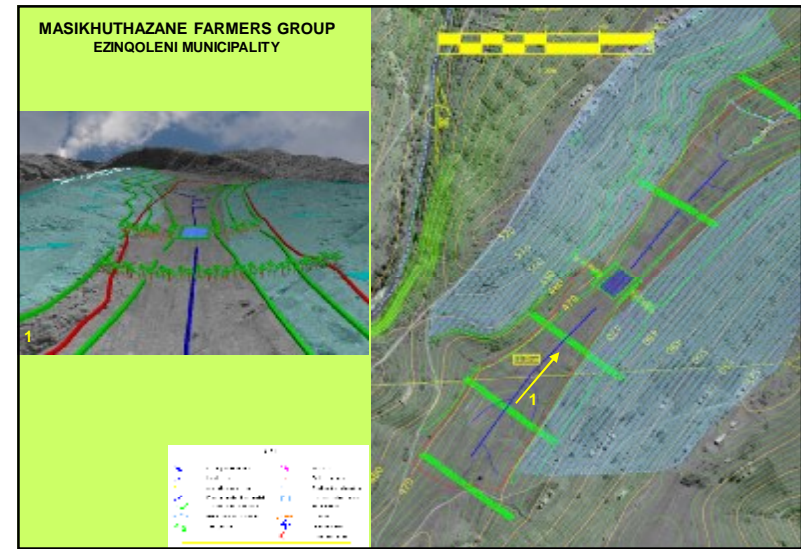
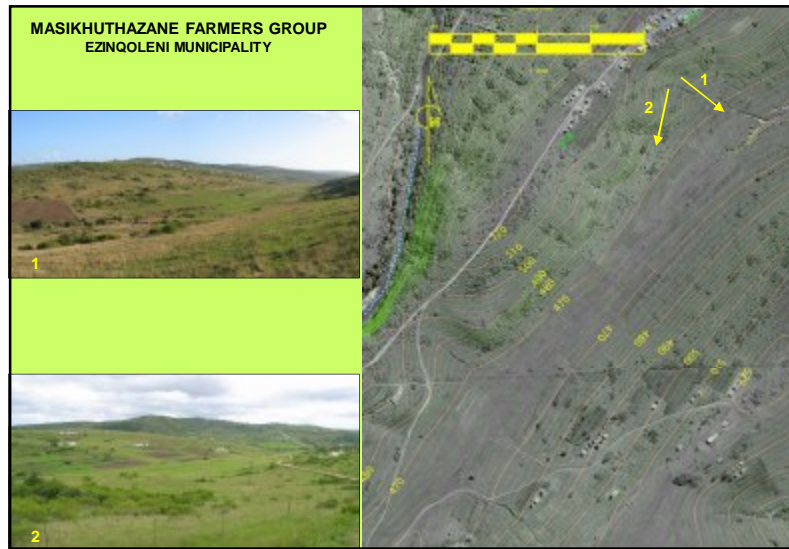
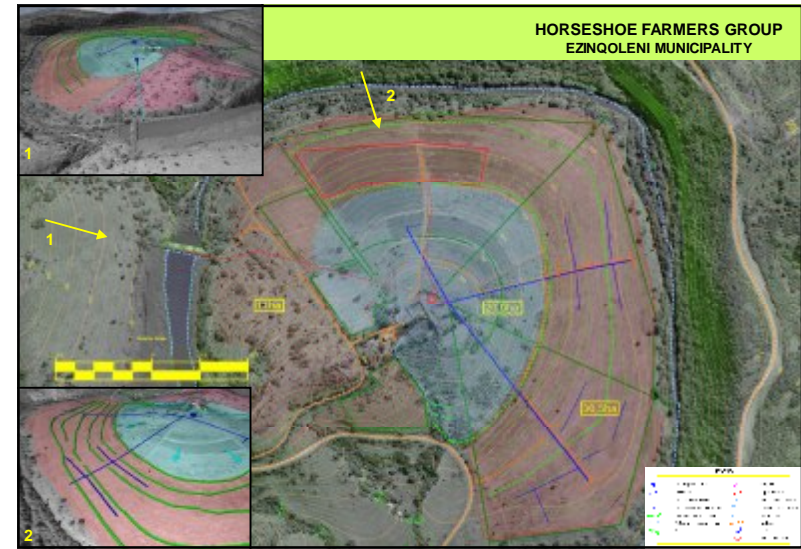
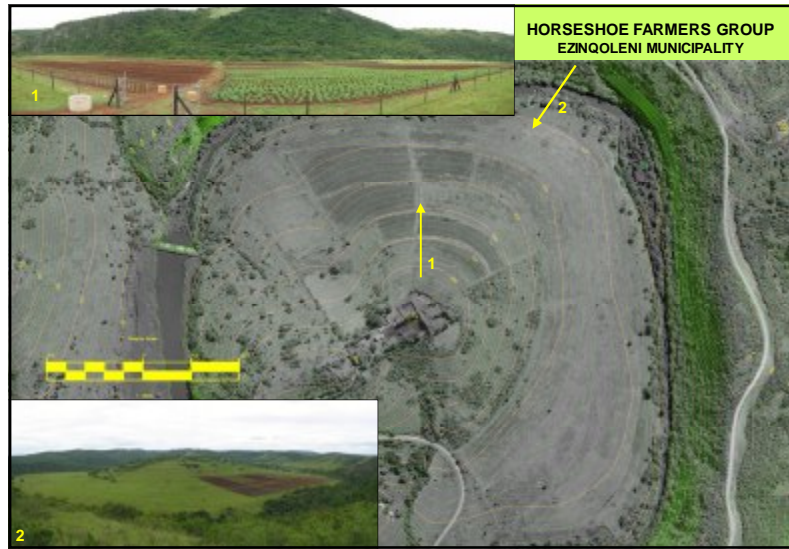
Phase	Phase 1				Phase 2				Phase 3			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1 Crop per season	Plant Seedlings & Initial Growth											
	Vegetative Growth											
	Vegetative & Flowering											
	Fruiting											
	Harvesting and Land Prep for next Crop											
2 Crops per season	Plant Seedlings & Initial Growth											
	Vegetative Growth											
	Vegetative & Flowering											
	Fruiting											
	Harvesting and Land Prep for next Crop											
3 Crops per season	Plant Seedlings & Initial Growth											
	Vegetative Growth											
	Vegetative & Flowering											
	Fruiting											
	Harvesting and Land Prep for next Crop											

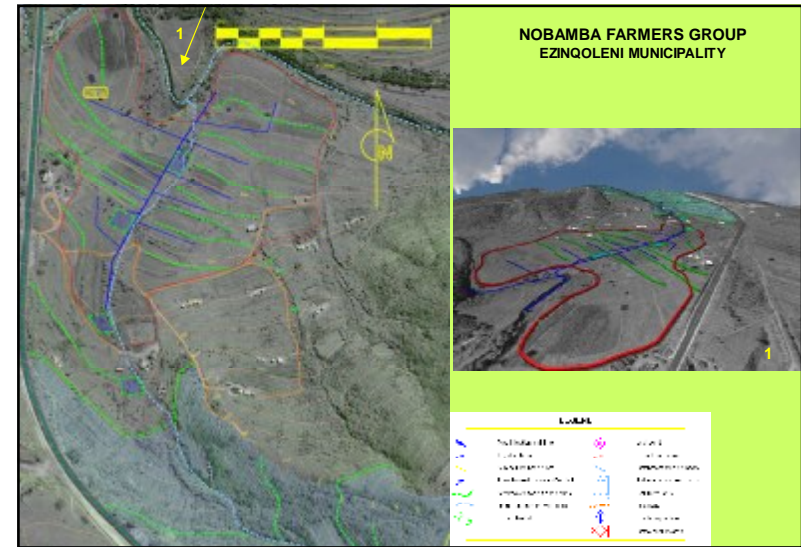
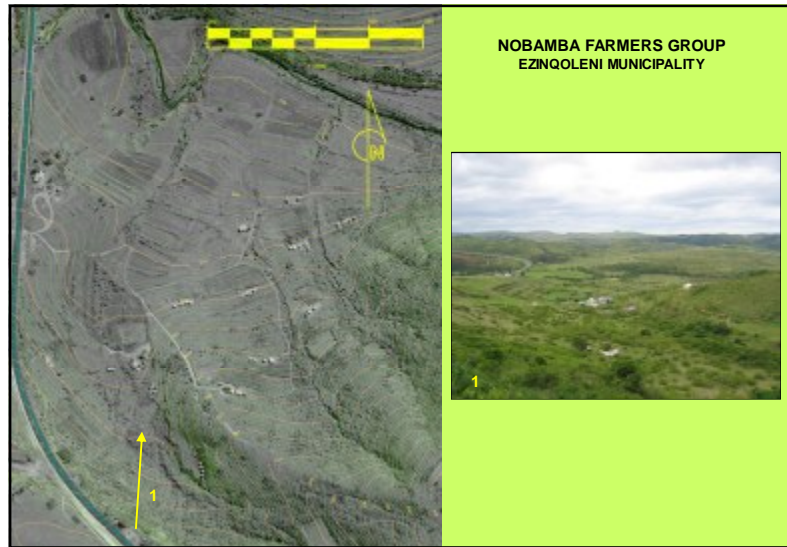
IRRIGATION CALCULATIONS FOR 3 CROPS PER ANNUM

Rainfall	Area	Irrigation	Catchment	Losses	Catchment Volume
mm pa	ha	Klitres pa	ha	%	Klitres
1,273	1	3,636	0.6	50.0%	3,636
1,000	1	3,636	0.7	50.0%	3,636
900	1	3,636	0.8	50.0%	3,636
800	1	3,636	0.9	50.0%	3,636
700	1	3,636	1.0	50.0%	3,636
600	1	3,636	1.2	50.0%	3,636
500	1	3,636	1.5	50.0%	3,636
400	1	3,636	1.8	50.0%	3,636
300	1	3,636	2.4	50.0%	3,636
200	1	3,636	3.6	50.0%	3,636
100	1	3,636	7.3	50.0%	3,636









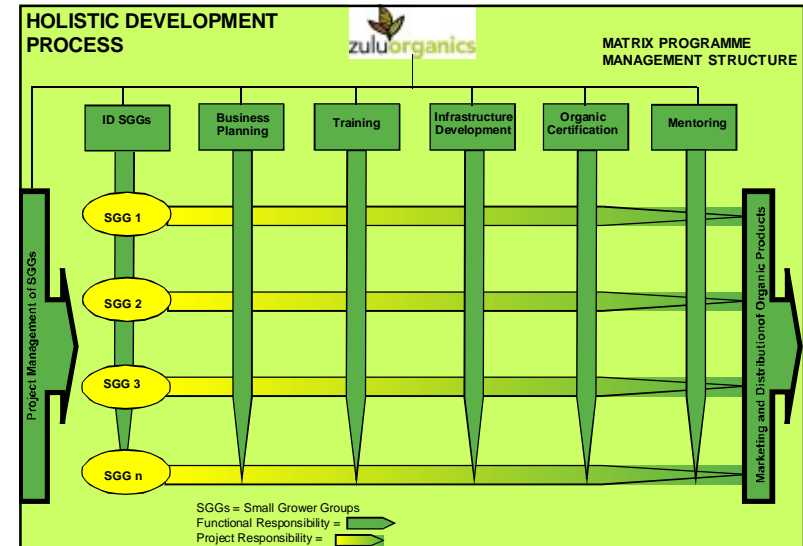
- ANALYSIS**
- EFFICIENT LOW COST AND MINIMAL MAINTENANCE SOLUTIONS FOR RAINWATER HARVESTING AND STORAGE
 - COST COMPARISONS FOR URBAN, PERI-URBAN AND RURAL RAINWATER HARVESTING SOLUTIONS
 - CHART A HOLISTIC DEVELOPMENT PROCESS TO ACHIEVE A SUSTAINABLE PRODUCT

DEVELOPMENT COSTS BREAKDOWN	Urban		Shambyi		Peri-Urban		Rural	
	Amount	% Cost	Amount	% Cost	Amount	% Cost	Amount	% Cost
1 Business Planning	R 66,800	0.6%	R 48,800	2.5%	R 228,571	3.8%	R 171,429	2.5%
2 Training	R 2,688,000	24.2%	R 458,000	20.8%	R 1,352,000	21.5%	R 898,000	13.4%
3 Site Planning & Survey	R 656,200	5.9%	R 31,300	1.6%	R 402,271	6.4%	R 471,214	6.8%
4 Site Infrastructure	R 3,959,550	35.6%	R 339,810	17.2%	R 2,841,847	47.7%	R 3,145,828	46.1%
5 Initial crop production	R 368,240	3.3%	R 37,100	1.9%	R 84,500	1.3%	R 108,000	1.6%
6 Organic Certification	R 0	0.0%	R 0	0.0%	R 48,000	0.8%	R 36,000	0.5%
7 Site supervision	R 450,000	4.0%	R 115,000	5.8%	R 51,200	0.8%	R 172,800	2.5%
8 Initial Mentoring	R 270,000	2.4%	R 90,000	4.6%	R 151,200	2.4%	R 172,800	2.5%
9 Plan & Design Primary Co-op	R 85,200	0.8%	R 32,208	1.6%	R 100,000	1.6%	R 200,000	2.9%
10 Establish Primary Co-op	R 806,000	7.2%	R 329,400	16.7%	R 400,000	6.4%	R 800,000	11.5%
11 Homestead Gardens	R 460,000	4.2%	R 239,000	12.1%	R 0	0.0%	R 0	0.0%
12 Homestead & Livestock	R 0	0.0%	R 0	0.0%	R 37,800	0.6%	R 43,200	0.6%
13 Project Management	R 780,000	7.0%	R 210,000	10.7%	R 344,301	5.6%	R 393,487	5.6%
14 Project Administration	R 537,030	4.8%	R 83,078	4.8%	R 288,196	4.6%	R 324,000	4.6%
15 Extension Services	R 0	0.0%	R 0	0.0%	R 0	0.0%	R 0	0.0%
	R 11,127,746	100.0%	R 1,971,394	100.0%	R 6,279,853	100.0%	R 6,975,419	100.0%
	R 1,557,884		R 275,955		R 879,179		R 976,559	
	R 12,685,630		R 2,247,349		R 7,159,032		R 7,951,978	

DEVELOPMENT COSTS COSTS PER HECTARE COSTS PER PERSON	Urban		Shambyi		Peri-Urban		Rural	
	Cost/ha	Cost/person	Cost/ha	Cost/person	Cost/ha	Cost/person	Cost/ha	Cost/person
1 Business Planning	R 1,044	R 67	R 9,760	R 98	R 3,638	R 1,302	R 2,381	R 1,465
2 Training	R 42,000	R 2,688	R 81,200	R 812	R 21,460	R 8,000	R 13,000	R 8,000
3 Site Planning & Survey	R 10,280	R 62	R 6,340	R 62	R 6,346	R 2,380	R 5,554	R 4,053
4 Site Infrastructure	R 61,865	R 3,960	R 67,982	R 680	R 42,569	R 15,889	R 43,692	R 26,887
5 Initial crop production	R 5,720	R 368	R 7,400	R 74	R 1,500	R 559	R 1,500	R 503
6 Organic Certification	R 0	R 0	R 0	R 0	R 762	R 284	R 500	R 308
7 Site supervision	R 7,051	R 463	R 23,000	R 230	R 2,460	R 895	R 2,460	R 1,477
8 Initial Mentoring	R 4,215	R 270	R 18,000	R 180	R 2,460	R 895	R 2,460	R 1,477
9 Plan & Design Primary Co-op	R 1,343	R 85	R 6,442	R 64	R 1,587	R 592	R 3,778	R 1,703
10 Establish Primary Co-op	R 12,594	R 806	R 65,980	R 657	R 6,340	R 2,307	R 11,111	R 6,838
11 Homestead Gardens	R 7,224	R 463	R 47,800	R 478	R 0	R 0	R 0	R 0
12 Homestead & Livestock	R 0	R 0	R 0	R 0	R 600	R 204	R 600	R 380
13 Project Management	R 12,188	R 780	R 42,000	R 420	R 5,460	R 2,037	R 5,460	R 3,361
14 Project Administration	R 8,391	R 537	R 18,725	R 188	R 4,574	R 1,705	R 4,500	R 2,769
15 Extension Services	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0
	R 173,871	R 11,128	R 394,279	R 3,943	R 99,680	R 37,159	R 96,881	R 59,619
	R 24,342	R 1,558	R 55,199	R 552	R 13,502	R 5,202	R 13,563	R 8,347
	R 198,213	R 12,686	R 449,478	R 4,495	R 113,182	R 42,361	R 110,444	R 67,966

Development Programme for a SGG of 50 farmers

#	Task	Year 1				Year 2				Year 3			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	ID SGGs	█											
2	Business Planning	█											
3	Training		█	█									
4	Site Planning & Survey		█	█									
5	Site infrastructure			█	█								
6	Initial crop production				█	█							
7	Organic Certification				█	█	█						
8	Site supervision				█	█	█	█					
9	Initial Mentoring					█	█	█	█				
10	Plan & Design Primary Co-op				█	█							
11	Establish Primary Co-op					█	█						
12	Marketing & Distribution						█	█	█				
13	Project Management	█	█	█	█	█	█	█	█				
14	Project Administration	█	█	█	█	█	█	█	█				
15	Extension Services									█	█	█	█



CONCLUSIONS

- PRODUCT AND PROCESS - A HOLISTIC APPROACH IS REQUIRED
- EMBRACE "COMMON SENSE" / "FUSION" FARMING SYSTEMS / PERMACULTURE DESIGN PRINCIPLES
- AN EMERGING POLICY FOR DEVELOPMENT OF SMALL GROWER GROUPS (SGGs)
- CO-OPERATIVE GOVERNANCE AMONGST GOVERNMENT ENTITIES NEEDS TO WORK OTHERWISE PROJECTS WILL FAIL

