RAPID PLANNING

SUSTAINABLE INFRASTRUCTURE, ENVIRONMENTAL AND RESOURCE MANAGEMENT FOR HIGHLY DYNAMIC METROPOLISES

SPONSORED BY THE
Federal Ministry of Education and Research

Future Megacities
Megastädte von morgen

UN HABITAT
FOR A BETTER URBAN FUTURE

ifeu
INSTITUTE FOR ENERGY AND ENVIRONMENTAL RESEARCH HEIDELBERG

RAPID PLANNING
www.rapid-planning.net

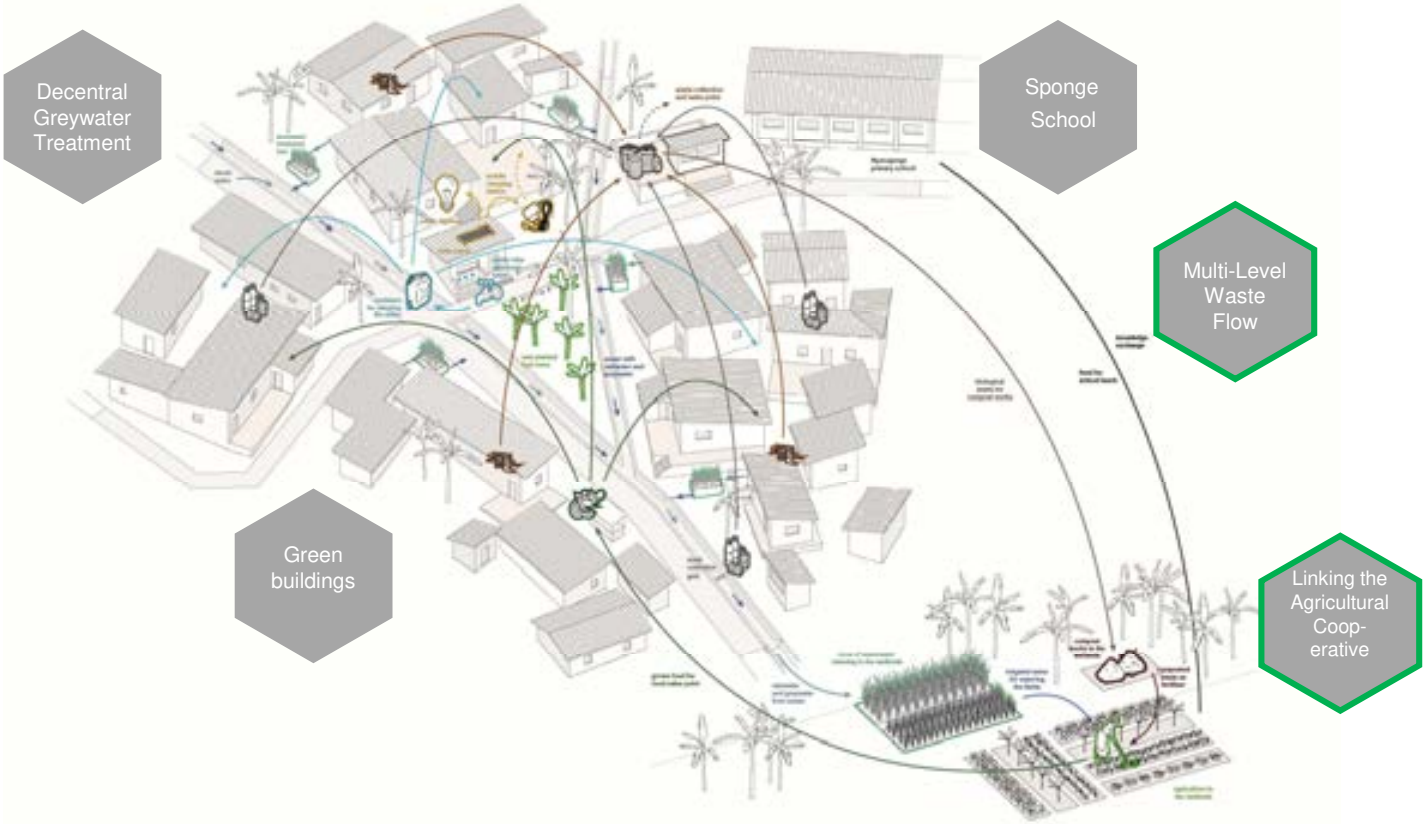
STAKEHOLDER CONFERENCE KIGALI 24TH OCTOBER 2018

SESSION 4 ENTRY PROJECT

CHRISTIN ZEITZ

ENTRY PROJECT

The RP Entry Project serves as a visible showcase for utilizable synergies identified by the trans-sectoral planning methodology developed within RP to upgrade informal settlements or develop new settlements. It connects spatially and substantially to the *Informal Settlement Upgrading Program* of CoK and World Bank located in Agatare/ Nyarugenge. It consists of 5 components, which spatially links the resource flows and actors through local, decentral organization:



RAPID PLANNING
www.rapid-planning.net

Input to the *Informal Settlement Upgrading Program Strategy o*f CoK

DECENTRAL GREYWATER TREATMENT STUDY

LOCAL CONTEXT

Greywater, low contaminated, faecal free wastewater from body hygiene, laundry and cleaning (EN 12056-1),

is neither treated nor recycled before discharge into the environment in the EP area.

LOCAL CONTEXT

The lack of greywater management and storm water retention in the catchment area causes pollution, hygienic risk and flooding of the wetlands including the fields of the agricultural cooperative.

A citywide sewer connection to a central sewage treatment plant is not economic due to **low wastewater volume, willingness to pay and hilly topographic** (OPM 2017).

GOAL

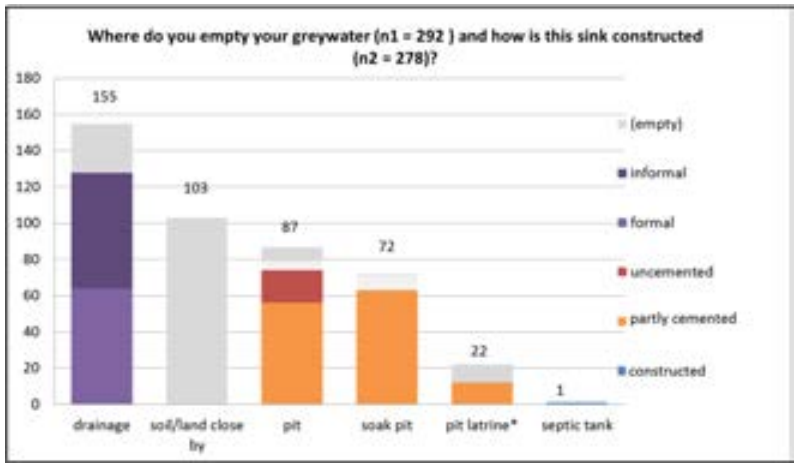
The *Decentral Greywater Treatment* study gathered yet unknown planning relevant data on domestic greywater (amount, properties, pathways and sinks) tested scientifically the potential of a decentralized technique to treat and recycle household greywater as an interim or hybrid technology.

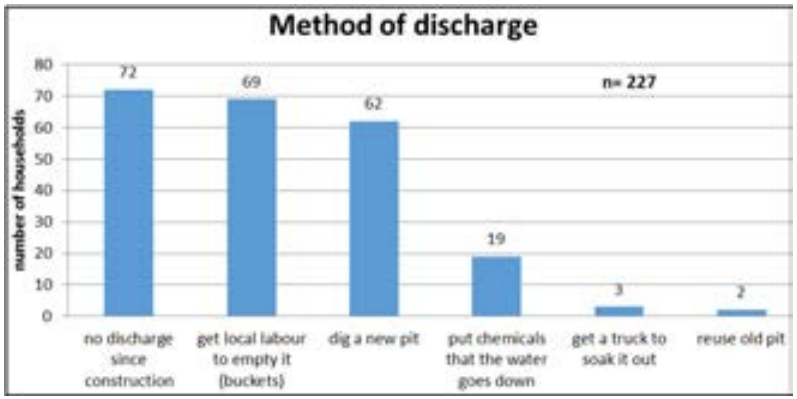
In line with the *SDG 11: Sustainable Cities and Communities and SDG 6: Clean Water and Sanitation,* the recycling of greywater is a core component in sustainable water management to upgrade slums and improve the access to basic services for all (UN 2016).

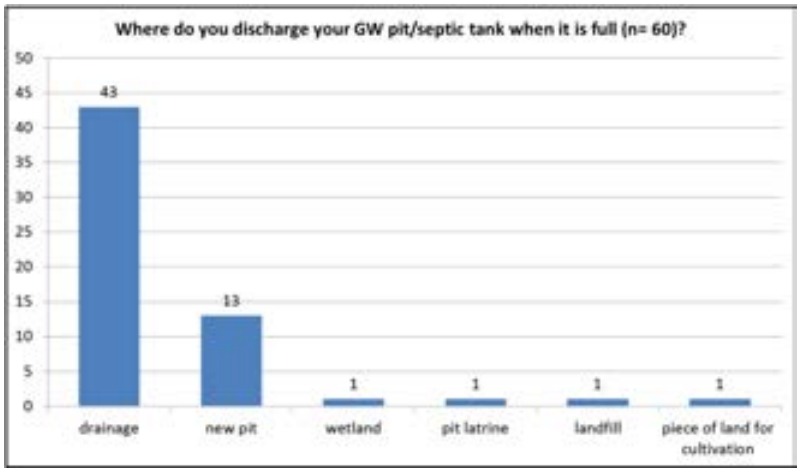
https://sustainabledevelopment.un.org/sdgs

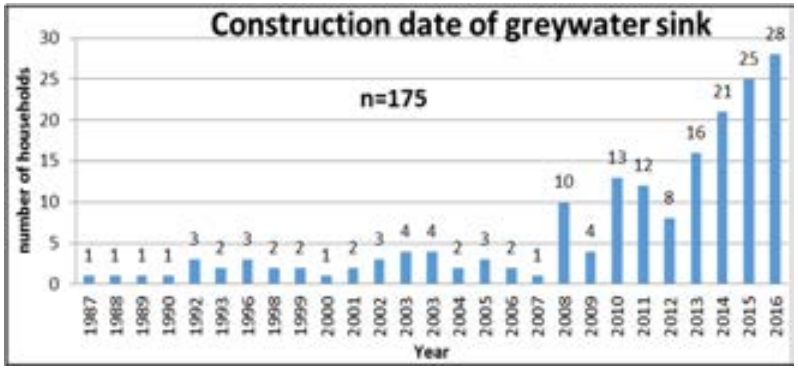
HOUSEHOLDS SURVEY

The 293 household surveys on current greywater management practices in Agatare…









Which negative impacts caused by GW have you observed?

No	Answers	Number of respondent HH
1	Bad smell	256
2	Neighbouring disputes	212
3	Pollution	186
4	Diseases	65

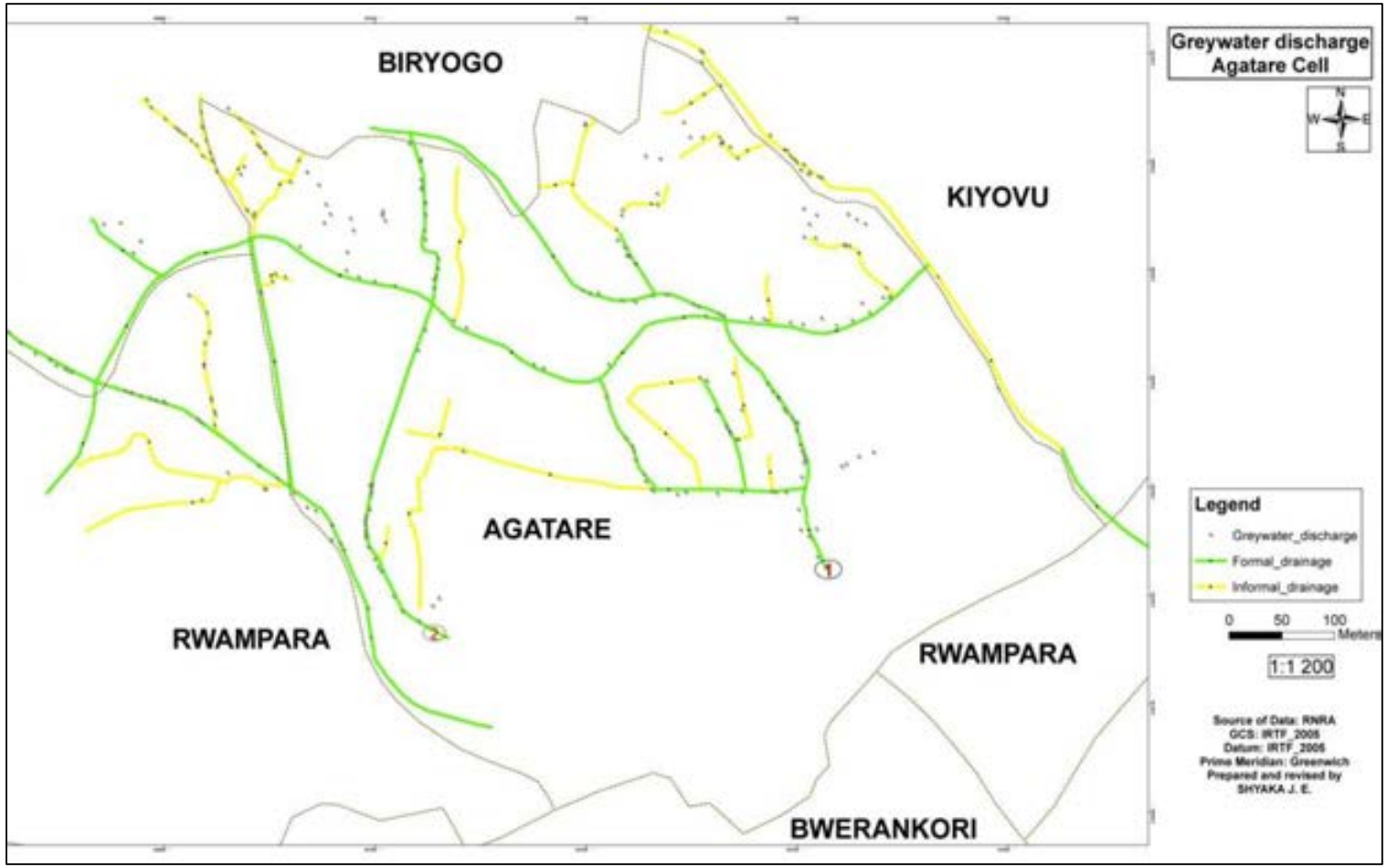
GIS

… mapping of 303 greywater discharge points found, that greywater is mostly informally discharged direct or indirect into stormwater drainages.

Mapping of informal greywater discharge points in 06/16

GIS

… mapping of 303 greywater discharge points found, that greywater is mostly informally discharged direct or indirect into stormwater drainages.



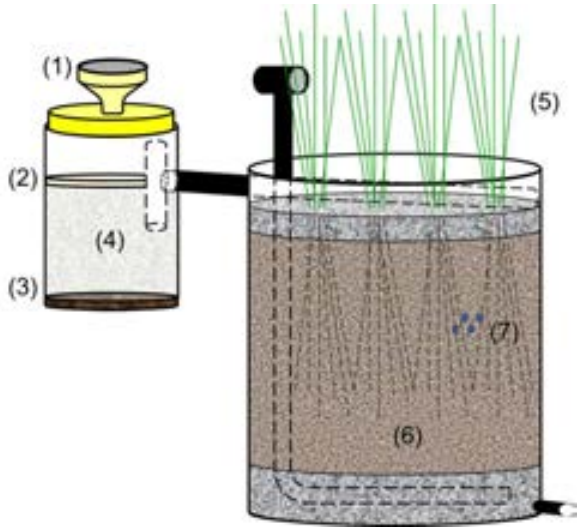
RAPID PLANNING
www.rapid-planning.net

2 DECENTRAL HH GREYWATER TREATMENT PILOT SYSTEMS

1st Decentral Greywater Treatment Pilot System with kitchen garden installed in 09/16 and used ever since, kitchen gardens irrigated with the treated water in 12/17

2 DECENTRAL HH GREYWATER TREATMENT PILOT SYSTEMS

Chemical and microbiological analyses of 2 greywater treatment pilot systems done over 6 month showed a successful reduction of all pollution indicators, **Fecal Coliforms (FC) -99.88%, Total Suspended Solids (TSS) -98%, Nitrogen (N) -85%, Phosphorous (P) -67% and Chemical Oxygen Demand (COD) -96%.** Thereby the output water quality complies with Rwandan and international discharge tolerance limits (RSB 2009; BGBl 2016) and the WHO (2000) limit of FC for reuse for irrigation.



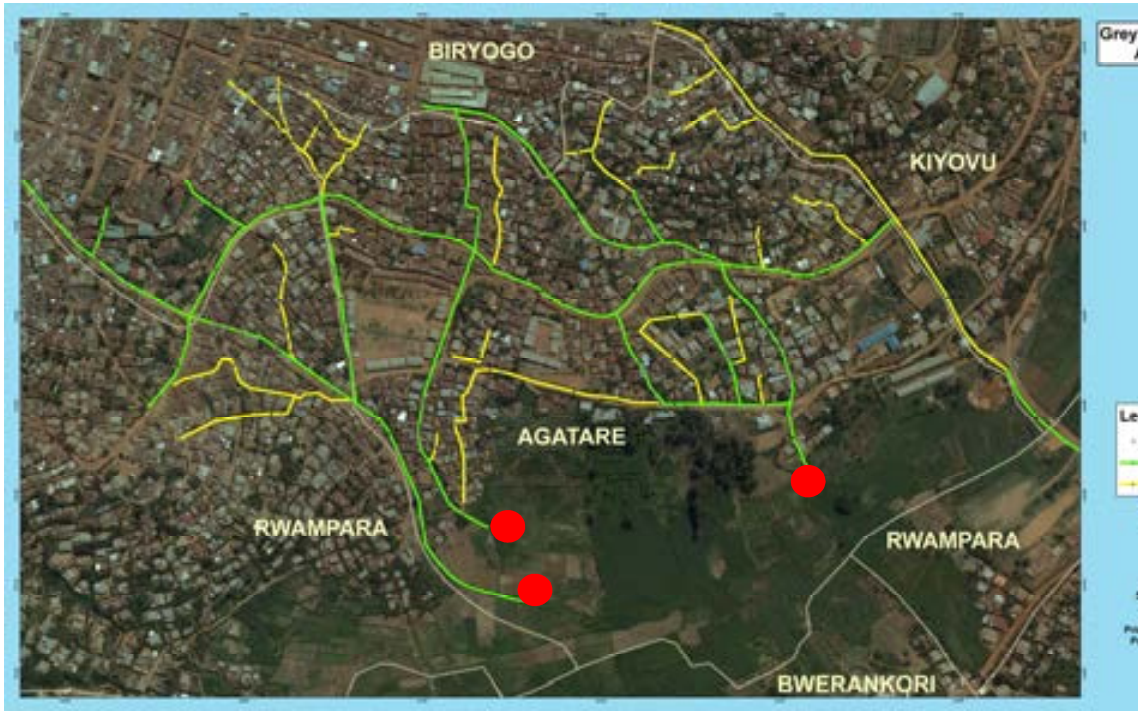
Parameter	Limits for discharge of domestic wastewater			Gakwaya Household Analysis (range: original - corrected by error factor)									Mutanqana Household Analysis (range: original - corrected by error factor)								
	REMA (WHO) 2015*	RSB 2009**	Date	In			Out			% change			In			Out			% change		
TSS mg/l	≤50	<50	07.10.16	393			3			99			507			4			99		
			11.11.16	118			4			97			748			7			99		
			13.12.16	2750			55			98			2875			108			96		
			25.01.17	279			2			99			383			4			99		
			03.03.17	307			2			99			319			22			93		
			21.04.17	370			5			99			675			2			100		
			Ø	**703**	-		**12**	-		**99**	-		**918**	-		**25**	-		**98**	-	
Total Nitrogen mg/l	≤30	<30	07.10.16	18.3	-	42.7	2.3	-	5.4	87	-	87	23.1	-	54.0	2.7	-	6.4	88	-	88
			11.11.16	13.8	-	32.2	2.9	-	6.7	79	-	79	21.8	-	50.9	1.5	-	3.4	93	-	93
			13.12.16	9.8	-	22.9	1.2	-	2.8	88	-	88	10.5	-	24.5	2.3	-	5.4	78	-	78
			25.01.17	18.7	-	43.7	4.0	-	9.2	79	-	79	19.3	-	45.1	3.0	-	6.9	85	-	85
			03.03.17	11.5	-	26.8	2.04	-	4.8	82	-	82	12.3	-	28.7	1.93	-	4.5	84	-	84
			21.04.17	14.2	-	33.2	1.12	-	2.6	92	-	92	15.45	-	36.1	0.74	-	1.7	95	-	95
			Ø	**14.4**	-	**33.6**	**2.3**	-	**5.3**	**85**	-	**85**	**17.1**	-	**39.9**	**2.0**	-	**4.7**	**87**	-	**87**
Total phosphorus mg/l	≤5	<5	07.10.16	1.9	-	1.4	0.9	-	0.7	53	-	53	2.1	-	1.5	0.9	-	0.7	57	-	57
			11.11.16	2.5	-	1.8	1.1	-	0.8	54	-	54	3.0	-	2.2	1.1	-	0.8	63	-	63
			13.12.16	1.7	-	1.2	0.5	-	0.4	68	-	68	6.5	-	4.8	2.6	-	1.9	61	-	61
			25.01.17	3.6	-	2.7	0.5	-	0.4	87	-	87	9.9	-	7.4	1.0	-	0.7	90	-	90
			03.03.17	3.8	-	2.8	0.5	-	0.4	86	-	86	4.6	-	3.4	4.0	-	2.9	14	-	14
			21.04.17	5.3	-	3.9	0.6	-	0.5	88	-	88	5.6	-	4.2	1.0	-	0.7	83	-	83
			Ø	**3.1**	-	**2.3**	**0.7**	-	**0.5**	**73**	-	**73**	**5.3**	-	**3.9**	**1.7**	-	**1.3**	**61**	-	**61**
COD mg/l	≤400	<250	07.10.16	1560	-	3469	48	-	33	97	-	99	1845	-	4102	131	-	291	93	-	93
			11.11.16	673	-	1496	60	-	41	91	-	97	1530	-	3402	87	-	59	94	-	98
			13.12.16	456	-	1014	17	-	11	96	-	99	621	-	1381	46	-	31	93	-	98
			25.01.17	727	-	1616	30	-	20	96	-	99	1088	-	2418	87	-	59	92	-	98
			03.03.17	1156	-	2570	19	-	13	98	-	100	2445	-	5436	97	-	65	96	-	99
			21.04.17	1945	-	4325	39	-	27	98	-	99	1820	-	4047	68	-	46	96	-	99
			Ø	**1086**	-	**2415**	**36**	-	**24**	**96**	-	**99**	**1558**	-	**3464**	**86**	-	**92**	**94**	-	**97**
Fecal Coliforms Cfu/100ml	≤400	<400	07.10.16	2100	-		4	-		99.810	-		76000	-		91	-		99.880	-	
			11.11.16	1800	-		6	-		99.667	-		52000	-		68	-		99.869	-	
			13.12.16	4000000	-		600	-		99.985	-		8000000	-		200	-		99.998	-	
			25.01.17	2000000	-		600	-		99.970	-		500000	-		600	-		99.880	-	
			03.03.17	300000	-		70	-		99.977	-		2000000	-		300	-		99.985	-	
			21.04.17	2000000	-		50	-		99.998	-		4000000	-		400	-		99.990	-	
			Ø	**1383983**	-		**222**	-		**99.901**	-		**2438000**	-		**277**	-		**99.934**	-	

Color code: below limit; below limit - but over halfe of the limit; over limit; compared to RSB 2009

*REMA (WHO) - 2015 - Integrated study of wastewater treatment systems in Rwanda

**RSB RS 110:2009 Water Quality – Tolerance limits of discharged domestic wastewater

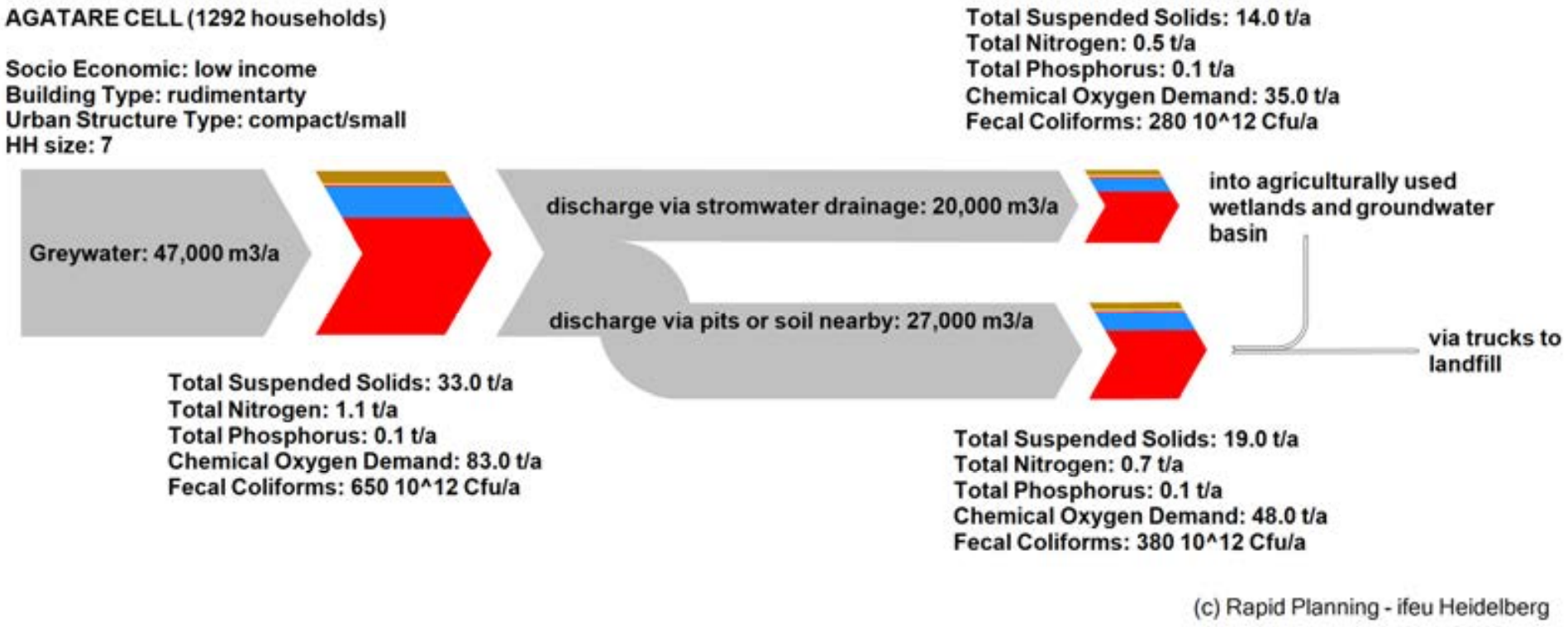
ANALYSIS OF GREYWATER DISPOSALS IN DRAINAGES



Physicochemical analysis of informal greywater disposals in drainages in 11/16

Upscaling → **mass**, economic, ecologic and spatial **perspective**

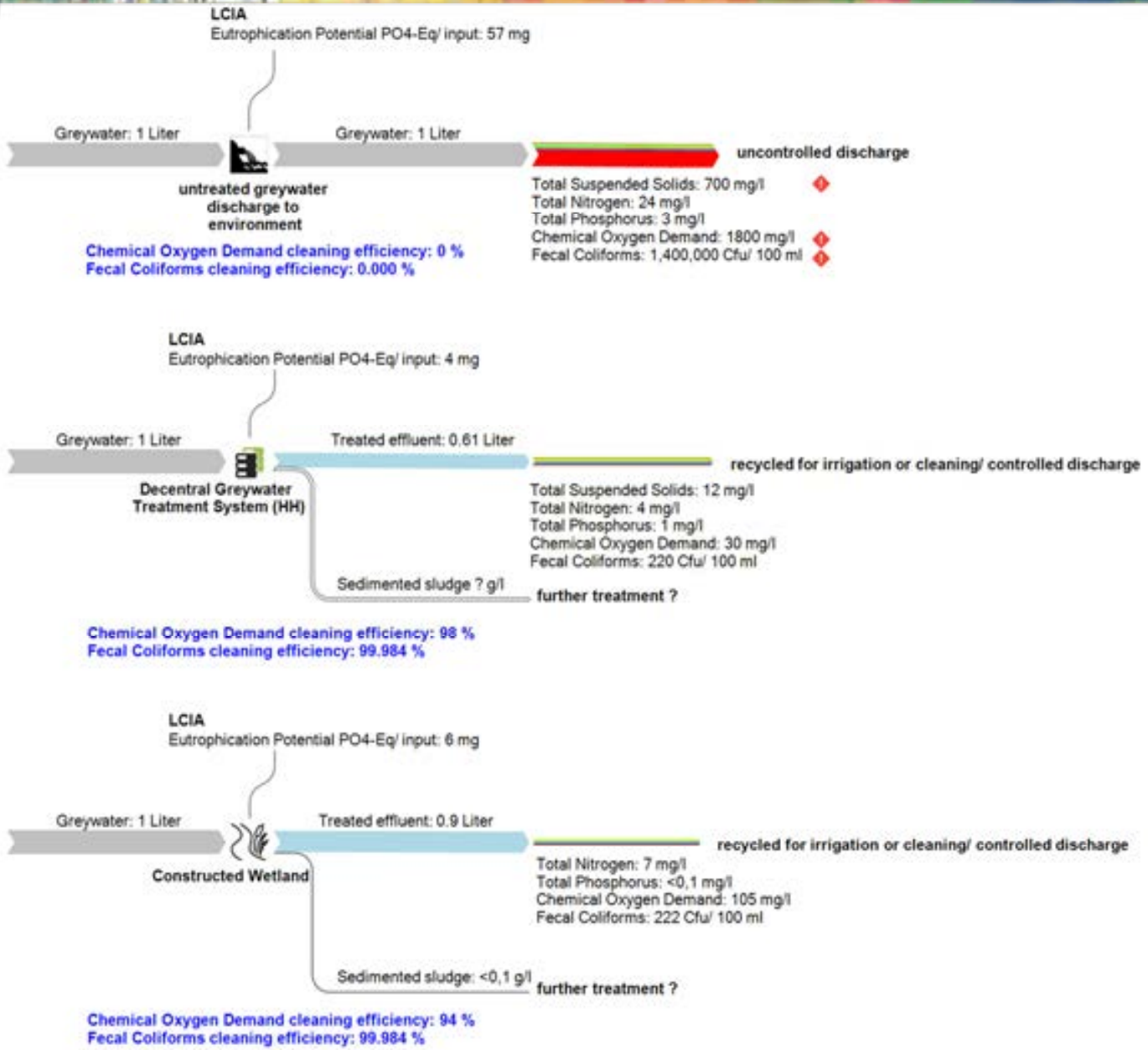
The data from the pilot systems plus the discharge flow measurements and samplings enabled the **mass flow analysis and environmental impact assessment for Agatare**: **annually approx. 20,000 m^3 greywater (40% of total generated greywater) containing ca. 35 t COD, 280*10^12 Cfu FC, 14 t TSS, 0.5 t N and 0.1 t P are discharged via drainages into the agriculturally used wetlands.**



Upscaling → mass, economic, **ecologic** and spatial **perspective**

RAPID PLANNING

www.rapid-planning.net



Parameter	Limits for discharge of domestic wastewater	
	REMA (WHO) 2015*	RSB 2009**
TSS mg/l	≤50	<50
Total Nitrogen mg/l	≤30	<30
Total phosphorus mg/l	≤5	<5
COD mg/l	≤400	<250
Fecal Coliforms Cfu/100ml	≤400	<400
Color code		below limit

*REMA (WHO) - 2015 - Integrated study of waste
**RSB RS 110:2009 Water Quality – Tolerance l

Upscaling → mass, **economic**, ecologic and spatial **perspective**

RAPID PLANNING
www.rapid-planning.net

CONSTRUCTED WETLAND

For Agatare Cell 1292 HH
47.000 m³ greywater/a with average COD of 1.800 mg/

Area* ca. 12.000 m²
Costs* ca. 1,800,000 €

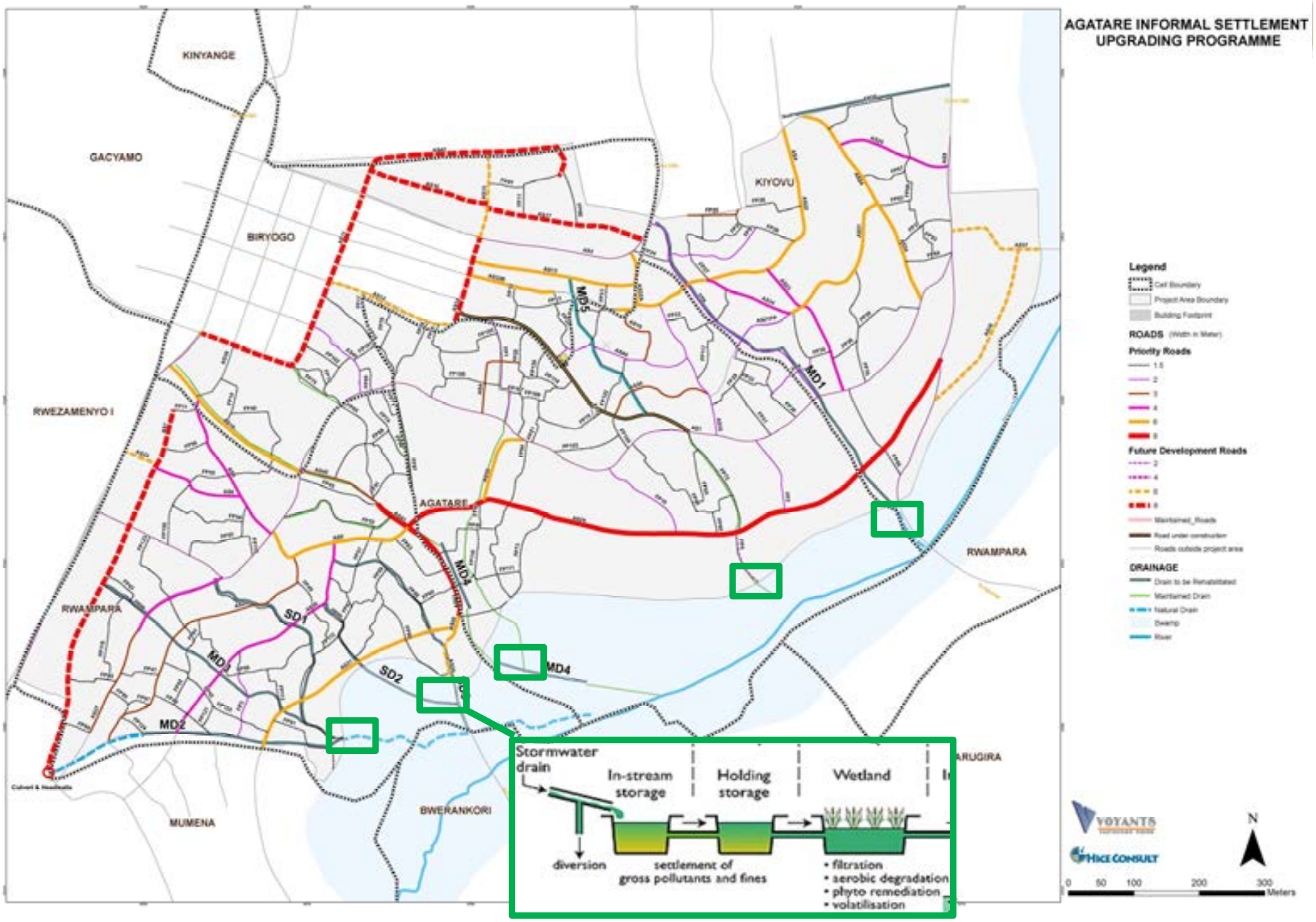
*without purification pond

Technology for Municipal WW	O & M 10.000 PE*	O & M 20.000 PE*	
Activated Sludge Plant (ASP) with simultanous sludge stabilazation	20,70	22,95	€ /(c x d)
Trickling Filter or RBC	19,24	21,54	€ /(c x d)
Anaerobic Pond	13,00	14,50	€ /(c x d)
Aerated Pond	19,20	20,70	€ /(c x d)
Constructed Wetland with Purification Pond	8,60	9,35	€ /(c x d)
UASB with subsequent ASP	17,25	19,50	€ /(c x d)

These estimated netto costs* refer to German climate and Geman standards as well as German labour costs.

Upscaling → mass, economic, ecologic and **spatial perspective**

CONSTRUCTED WETLANDS AT DECENTRAL CATCHMENT AREA LEVEL



RAPID PLANNING
www.rapid-planning.net

UPSCALING

Decentral catchment-based greywater treatment systems with Constructed Wetland Technique or Rotating Biological Contactor Technique are recommended as **economic, ecological and social sound sanitation upgrading** option to the City of Kigali and World Bank for the Informal Settlement Upgrading Program in Agatare.

Ecological advantage

- stop pollution and hygiene risk of the agriculturally used wetlands and the groundwater basin
- increase availability of non-potable water (for irrigation, cleaning, toilet flush) and alleviate the freshwater demand
- preserves the wetlands as natural habitat, buffer zone for flooding and groundwater recharge area

Social advantage

- integrates the local need of farmers for safe, hygienic irrigation water especially for dry season (Synergy Waste Water ←→ Food)
- integrates local greywater management practices/habits

Technical & Economic advantage

- takes advantage of greywater as biggest mass flow and of the separate waste water flows of black- and greywater
- use of existing gravity fed stormwater drainages to channel greywater to treatment
- represents an upscaling of the local successfully proven technique of the greywater treatment pilot systems
- more affordable than citywide sewer coverage and central treatment plant
- considers small wastewater volume, hilly topography and willingness to pay
- the decentral treatment plants shall be centrally/public operated by respective entity to ensure hygienic safety

RAPID PLANNING
www.rapid-planning.net

Input to the *Informal Settlement Upgrading Program Strategy o*f CoK

SPONGE SCHOOL

LOCAL CONTEXT

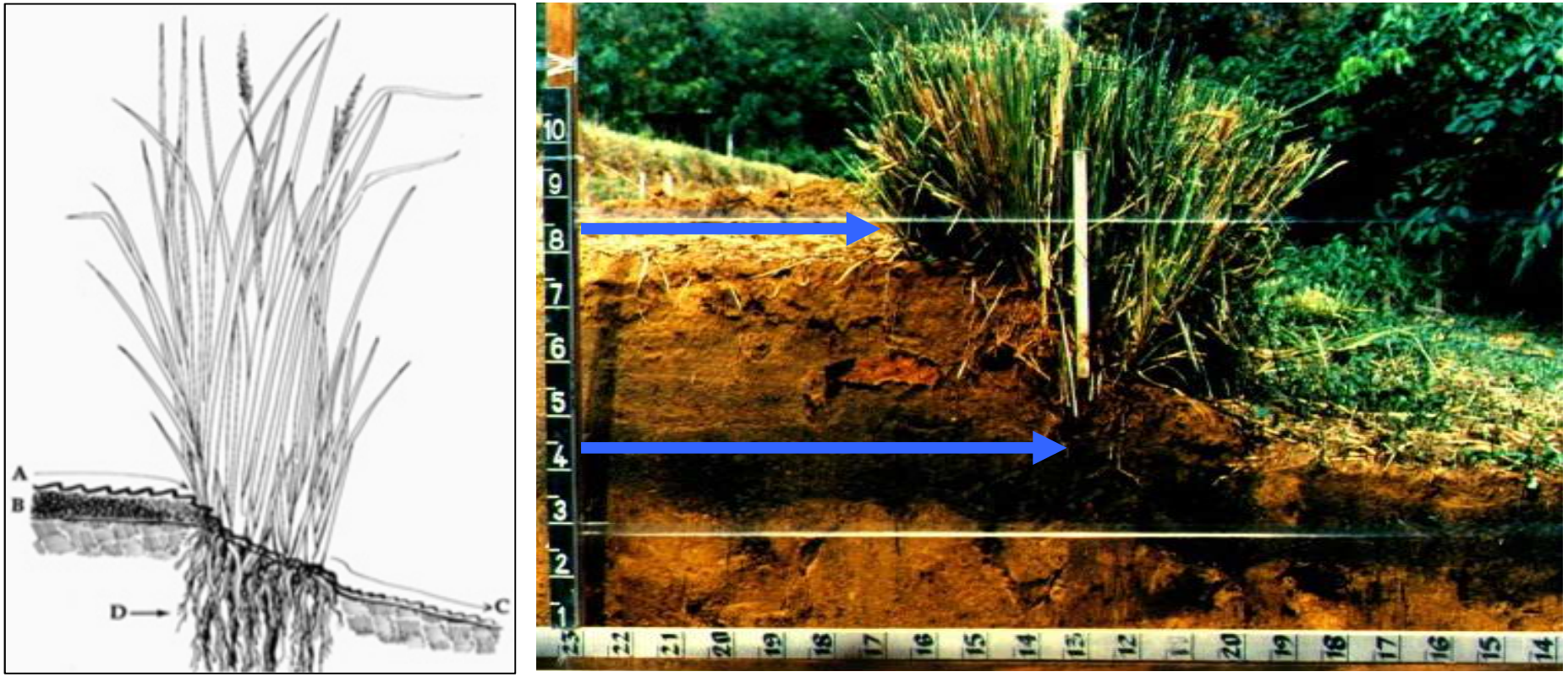
Inadequate storm water management and bare soils at Biryogo Primary School (BPS) cause **erosion and flooding**, leaving little organic carbon in the lateritic soils and triggering **dust** generation.

GOAL

The **Sponge School** component is to demonstrate its potential to tackle erosion and increase resilience to extreme weather with the affordable vegetative bio-engineering techniques and upcycling.
… to demonstrate the *Sponge City* approach as alternative to the predominant management of erosion and storm water by impermeable sealing and rapid drain via cement-based structures (World Future Council 2016).

Worldwide **25 to 40 billion t topsoil** get lost due to erosion annually (FAO 2015).

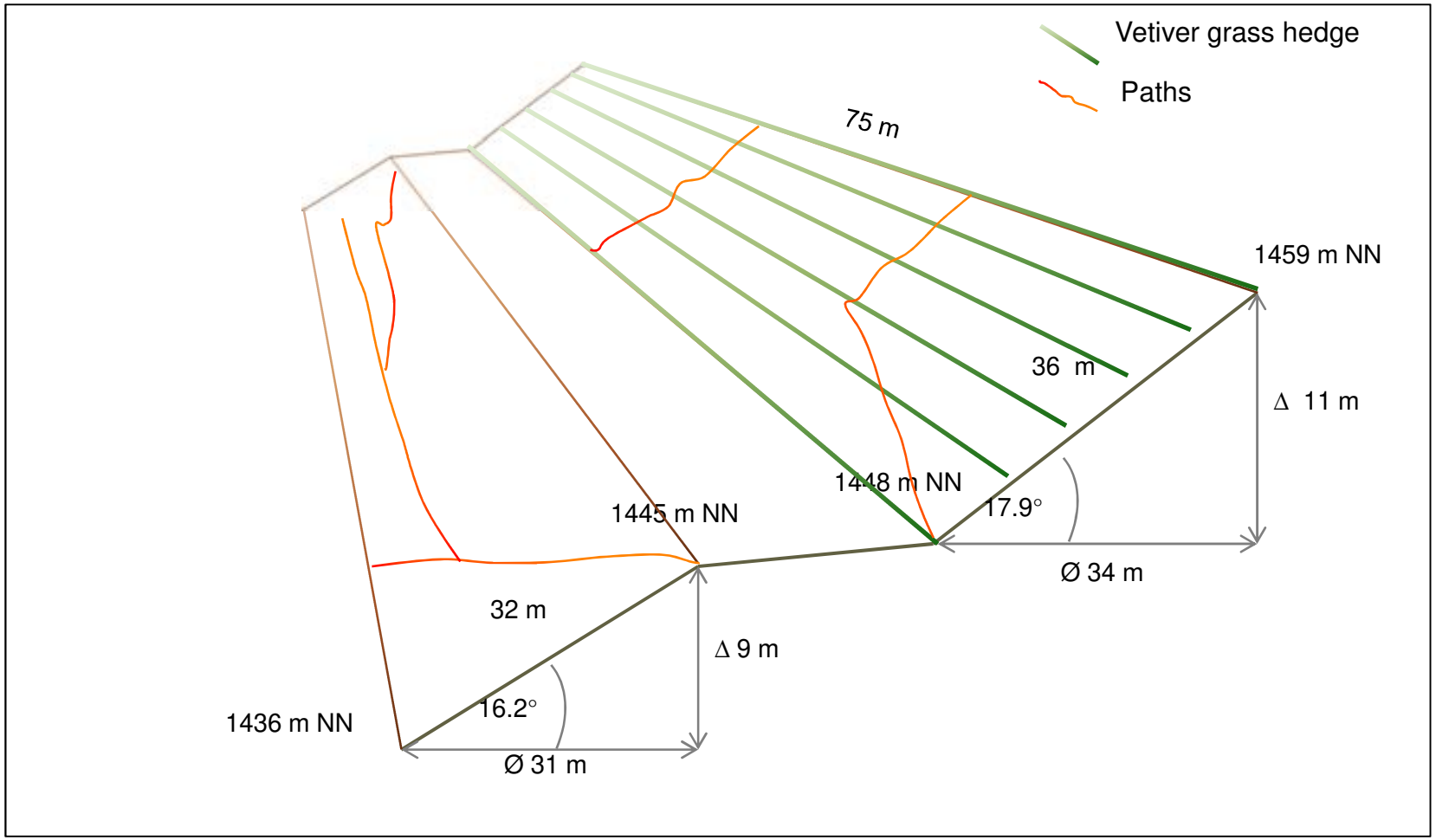
VETIVER GRASS (*CHRYSOPOGON ZIZANIOIDES*)



Cross section of a vetiver hedge (left), 2.5 year old hedge trapped 40cm top soil (right) (World Bank 2000; Mathowald 2015)

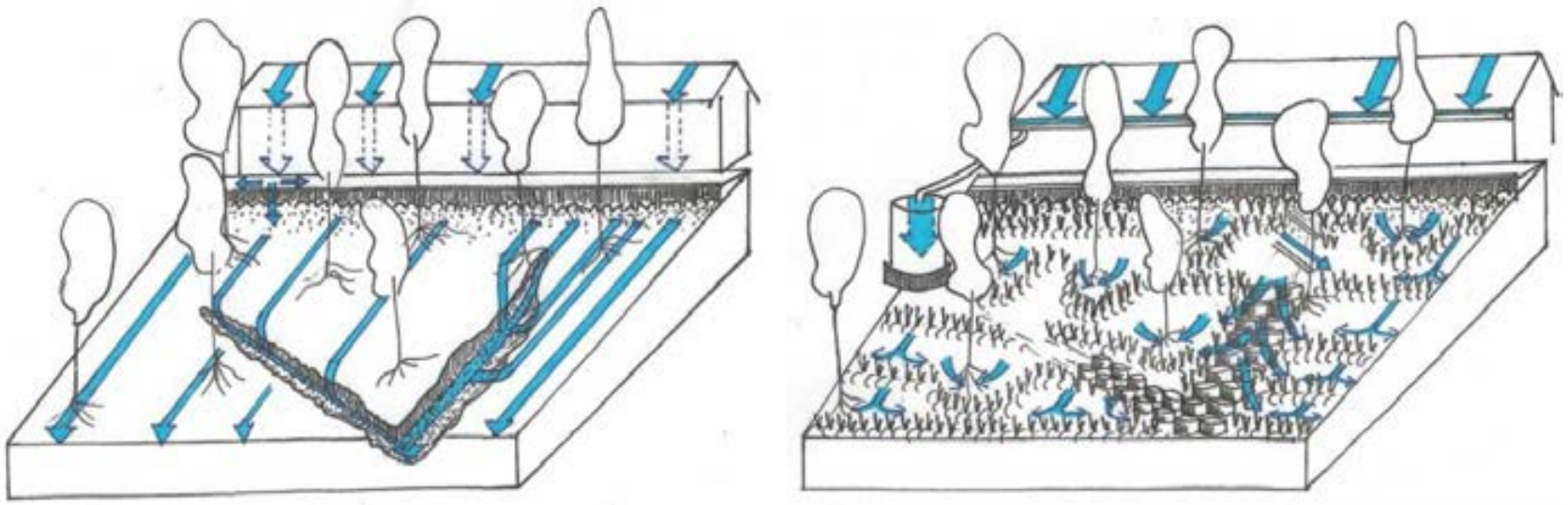
The concept combines **Vetiver grass system** for erosion control slows, spreads, infiltrates and stores rainwater.

6 Vetiver grass hedgerows on contour



Vanishing point perspectives of schoolyard with Vetiver grass hedgerows

6 Vetiver grass hedgerows on contour



IMPLEMENTATION

Control – Erosion control and pathway improvement *SLOW SPREAD INFILTRATE*

IMPLEMENTATION

Control – Erosion control and pathway improvement *SLOW SPREAD INFILTRATE*

11/3/17 1a after implementation

IMPLEMENTATION

Control – Erosion control and pathway improvement *SLOW SPREAD INFILTRATE*

05/18 Soil Sedimentation Ruler installation, trapped ca. 20cm soil at 1st line

12/17 Fruit tree planting

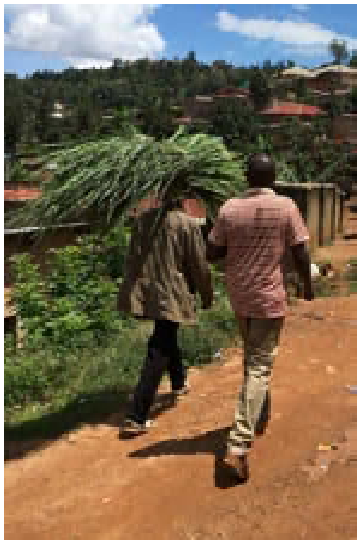
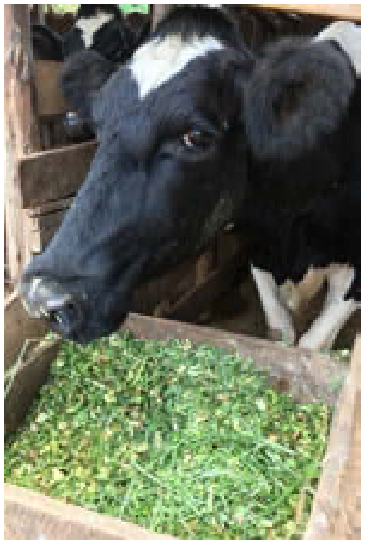
Collect – Rain water harvesting *STORE*

RAPID PLANNING
www.rapid-planning.net

SPONGE SCHOOL

VETIVER – FROM EROSION CONTROL TO PRODUCT

Harvest – Vetiver Grass Value Chain *VALORIZE*

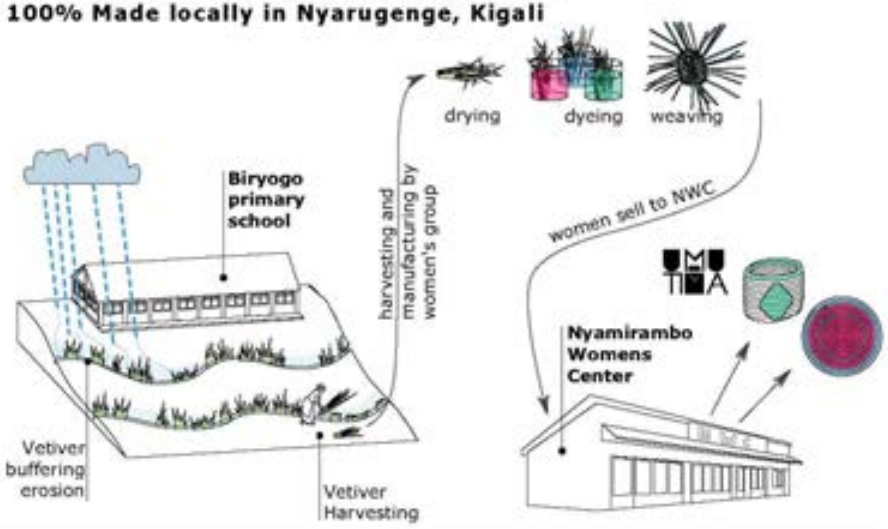
In cooperation with **CoK Agaseke Promotion Project**, the RP concept ***Vetiver – From Erosion Control to Product*** valorizes Vetiver leafs by creating a local handicraft value chain and thereby adds economic interest to environmental conservation.

RAPID PLANNING
www.rapid-planning.net

Product Label

Front

VETIVER - from Erosion Control to Product
100% Made locally in Nyarugenge, Kigali



Rapid Planning Project 2017, concept: ifeu; visualisation: TU Berlin

Back

Umatima is a women's cooperative
Our products are made with love in Rwanda

Biryogo Primary School in Agatare cell faced heavy soil erosion and responded together with the **Rapid Planning Project** with planting the 3 meter deep rooting VETIVER grass. The Vetiver Grass System is a vegetative bio-engineering technique, planted along the contour of the hill the grass forms a hedge that slows, spreads and sinks the water runoff and thereby controls erosion and reduces flooding.
Through Vetiver leaves the School and **Nyamirambo Women's Center** came together to create a sustainable local value chain - 100% made in this neighborhood.

"Rapid Planning - Sustainable Infrastructure, environmental and resource management for highly dynamic Metropolises" identifies and showcases the synergies of linking urban resource flows (water, waste, energy, urban agriculture) and actors. The project is funded by the German Federal Ministry for Education and Research (BMBF).

Visit us in Kigali!
Our store & studio, where the artisans work onsite, is located in Nyamirambo. We also offer community walking tours of our historic neighborhood.

www.nmc-umutima.org
Address: House 22, KN 7 Av
Telephone: +250 782111860

Join us on:
Facebook (Nyamirambo Women's Center / rapidplanning)
Instagram (umutima_Rwanda)

www.rapid-planning.net

RAPID PLANNING
www.rapid-planning.net

First Vetiver Products – Material tests

Vetiver Grass is good for

- ✓ Dyeing
- ✓ Weaving
- ✓ Designs
- ✓ Material mix with Sisal

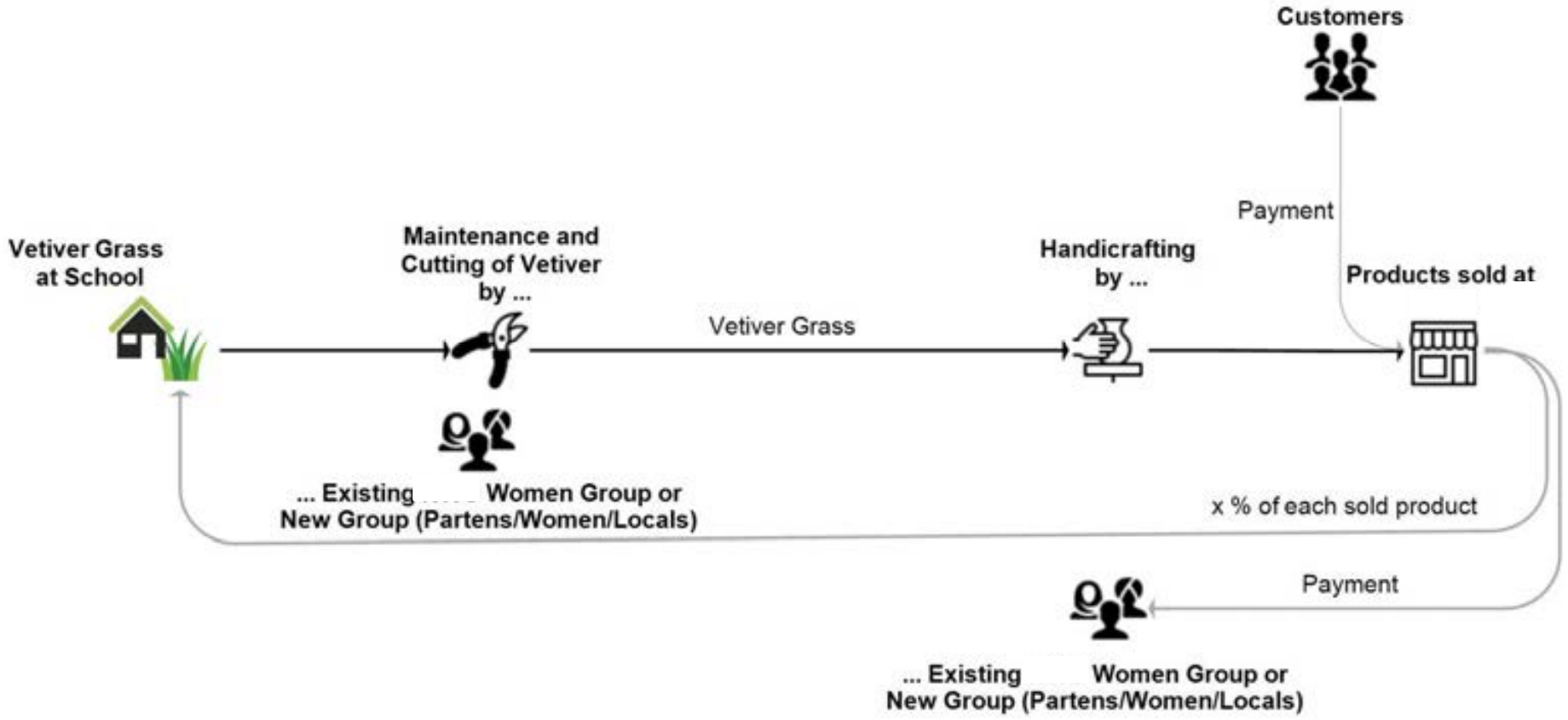
Upscaling → **mass**, **economic**, ecologic and spatial **perspective**

Parameter	Unit	Value	Source
Growing area	ha	0.02	@ 0.45 m width per contour line with vetiver double lines 15cm apart and 6 lines à 76 m length
Vetiver biomass dry	kg DM' a^{-1}	3600	@ 176,800 kg DM' ha^{-1} a^{-1} (a)
Vetiver value add	RWF a^{-1}	25,000,000	@ 70,000 RWF/ product out f 10 kg vetiver leaves

Table 1-5 Vetiver biomass in greywater treatment system for the Agatare/Nyarugenge upgrading area
' dry matter (DM)
•*used Vetiver growth rates at application rates of 10 t N ha^{-1} a^{-1} and 0,5 – 1 t P ha^{-1} a^{-1}* (Wagner et al. 2003)*, calculated loads for Agatare: ca. 14.5 t N ha^{-1} a^{-1} and 6 t P ha^{-1} a^{-1}*
•*average of 31.09 - 38.92 % dry matter content of Vetiver* (Falola et al. 2013)

Practical Concept Option

Training of a new Biryogo Women Group by 2 experienced trainer



UPSCALE

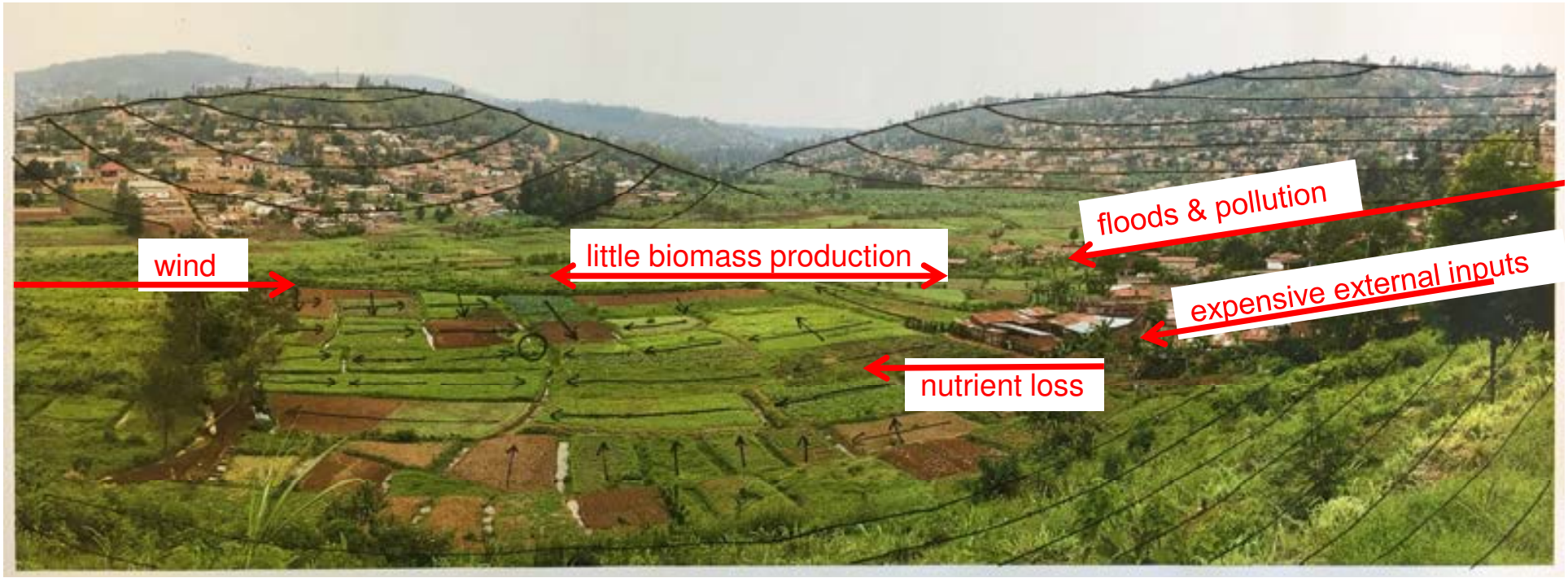
The Vetiver Grass bio-engineering technique is recommended as **affordable, ecological, social sound and economic attractive option** to upscale the sponge concept for erosion control and create jobs to the City of Kigali.

RAPID PLANNING
www.rapid-planning.net

Input to the *Informal Settlement Upgrading Program Strategy o*f CoK

RESILIENT URBAN WETLAND FARMING

LOCAL CONTEXT



The lack of greywater management and storm water retention as well as waste dumping in the catchment area cause pollution and flooding of the wetlands including the fields of the agricultural cooperative in Rwampara wetlands. In addition, the lack of fertilizer, little biomass production and inefficient irrigation limits productivity.

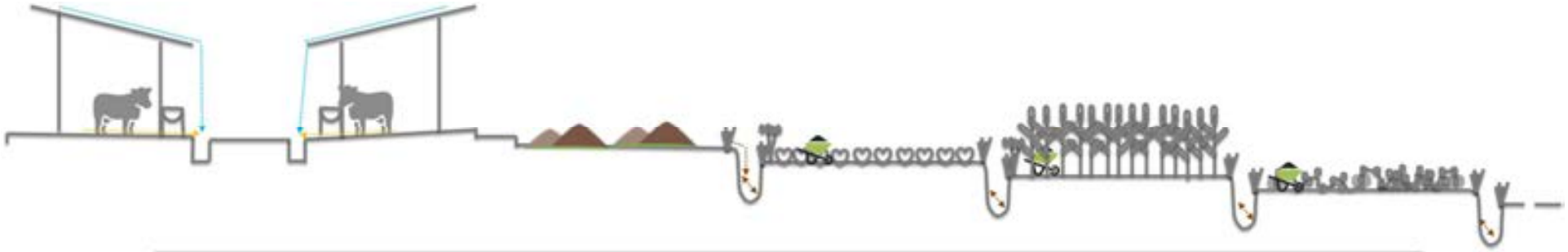
GOAL

Create a shining example for resilient urban wetland agriculture with nutrient recycling, permaculture design, zero pollution & waste and minimal external inputs producing fresh food for Kigali.

https://sustainabledevelopment.un.org/sdgs

improvable cow comfort, loss of nutrients and lack of fertilizer→ **saw dust bedding & composting with saw dust**

Nutrient capture – Cowshed/Compost – fields



Problems	Ecosystem Service/Purpose
Compost ○ Lack of fertilizer ○ Low soil organic matter ○ Costs for bought mineral fertilizer and compost ○ Lack biomass for composting and cow fodder	Compost ○ Organic Fertilizer ○ Increase of soil organic matter and thereby higher nutrient und moisture capacity ○ Reduction of waste volume ○ Spread of nutrients by gravity into the fields ○ Biomass production for cow fodder and mulch ○ Food production ○ Adjacent to new road/accessibility
Cowshed ○ Punctual eutrophication by cow urine ○ Costs for bought mineral fertilizer and compost ○ No prober flooring of cowshed	Cowshed ○ Excess nutrient absorption and transformation in biomass ○ Reduction of aquatic and terrestrial Eutrophication

improvable cow comfort, loss of nutrients and lack of fertilizer→ **saw dust bedding & composting with saw dust**

Nutrient capture – Cowshed/Compost – fields

2017 Composting Training
Phase 1 with COPED

2018 Composting Training
Phase 2
(cow dung + saw dust)

improvable cow comfort, loss of nutrients and lack of fertilizer→ **saw dust bedding & composting with saw dust**

Nutrient capture – Cowshed/Compost – fields

QUALITY CRITERIA	PARAMETER	ANALYSIS RESULTS	TOLERANCE LIMITS* and REFERENCE VALUES*°	UNIT	ANALYSIS COSTS (€)
HYGIENE	Salmonella spp.*	negative in 50g sample	negative in 50g fresh compost		26
	Fecal Coliforms (E.Coli)	< 10	-	MPN°°/g	32
	Gastro-enteric worm eggs	negative	-		9
	Maw worm eggs (*Ascaris lumbricoides*)	negative	-		
	Tape worm eggs (*Eucestoda*)	negative	-		
	Capillaria Worm eggs (*Haemonchus contortus*)	negative	-		
POLLUTANT CONTENT*	As	15.4	40	mg/kg DM	29
	Pb	37	150	mg/kg DM	13
	Cd	0.12	1.5 or 50mg/kg P_2O_2	mg/kg DM	13
	Cr, $Cr^{(VI)}$	72	-, 2	mg/kg DM	13
	Ni	13	80	mg/kg DM	13
	Hg	0.07	1*°°	mg/kg DM	23
	Tl	0.2	1	mg/kg DM	29
COMPOST QUALITY	Total N	8.7	9	kg/t DM	135
	N as (NH4-N + NO3-N)	1.18		kg/t DM	
	P2O5	7	4.5	kg/t DM	
	K2O	13.9	7.7	kg/t DM	
	MgO	4.6	0.498% in DM equal 4.89 kg/t DM	kg/t DM	
	Na	2.6	0.2% in DM equal 2 kg/t DM	kg/t DM	
	S	1.3	0.3% in DM equal 3 kg/t DM	kg/t DM	
	Alkaline Substances as CaO	41.5	27	kg/t DM	
	Cu	31	100-70+°°	mg/kg DM	
	Zn	177	400-300+°°	mg/kg DM	
	Organic Matter	22.9	min. 15% (weight) in DM	% in DM	
	Dry Mass	72.5	max. 45% (weight) water content	% DM from WM	
	C/N Ratio	15	less or equal 25 ++	in DM	
	Volume weight	0.676	0.54+++	kg/l DM	8
IMPURITIES*	>2mm	0.07	max. 0.5% (weight)	% in DM	5
thereof	Glass	0		% in DM	5
	Hardplastic	0		% in DM	10
	Plastic foil	0.07		% in DM	
	others	0		% in DM	5
Stones	>10mm	0.34	max.0.5 % (weight)	% in DM	5
TOTAL incl. 19% VAT					**443.87**

improvable cow comfort, loss of nutrients and lack of fertilizer→ **saw dust bedding & composting with saw dust**

Nutrient capture – Cowshed/Compost – fields

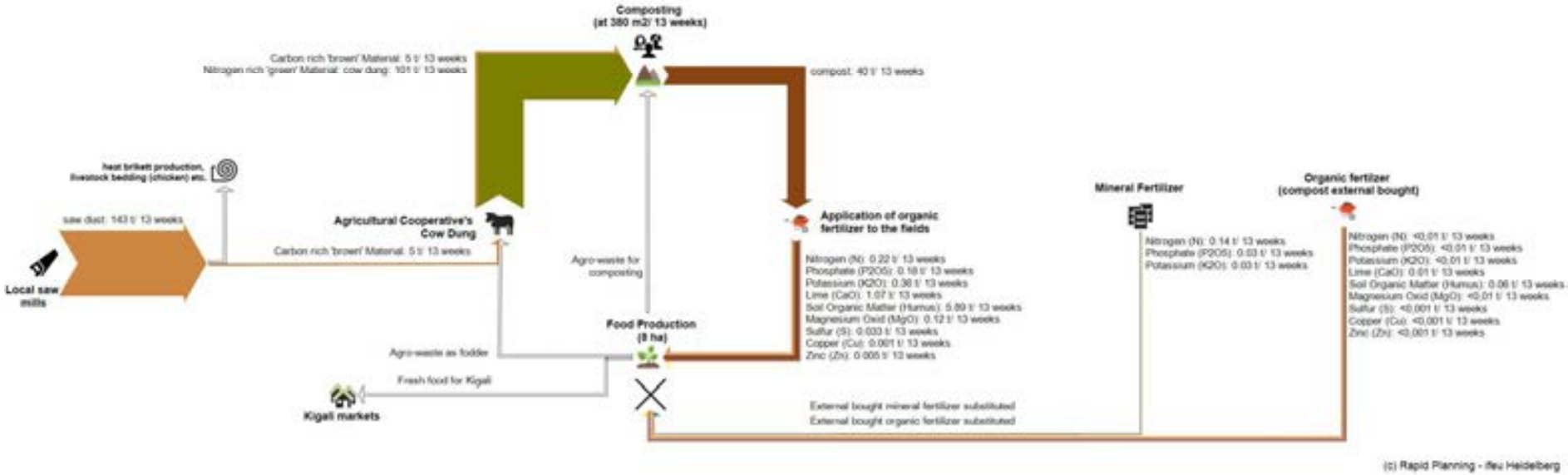
1t compost (WM) as organic fertilizer → **Food Production**

Nitrogen (N): 5.6 kg/ t
Phosphate (P2O5): 4.5 kg/ t
Potassium (K2O): 9.0 kg/ t
Soil Organic Matter (Humus): 147.9 kg/ t
Lime (CaO): 26.8 kg/ t
Magnesium Oxid (MgO): 3.0 kg/ t
Sulfur (S): 0.8 kg/ t
Zinc (Zn): 0.1 kg/ t
Copper (Cu): <0.1 kg/ t

Rapid Planning Entry Projekt Kigali
Decentral Composting - Mass Flow Analysis (MFA)

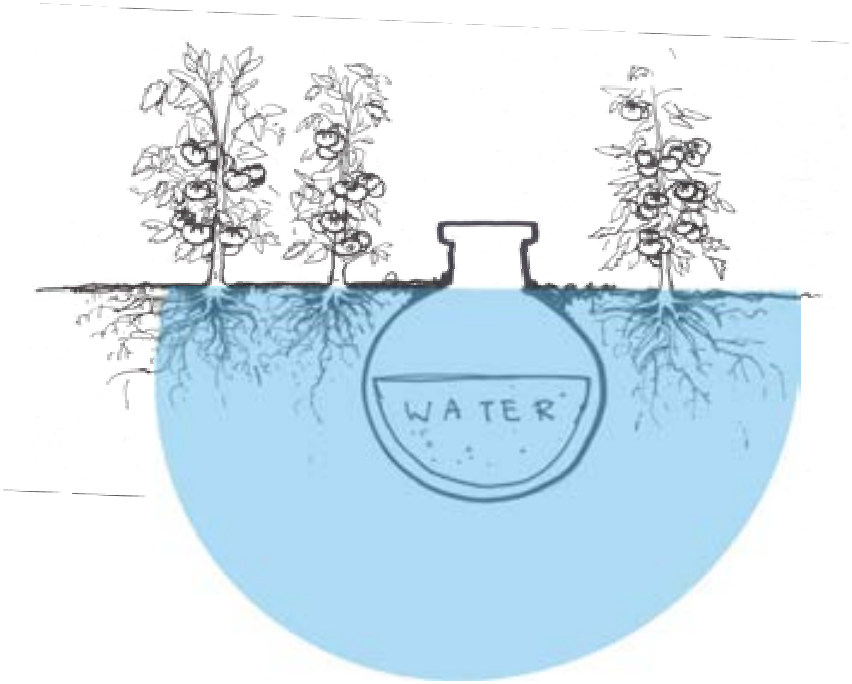
Calculation based on reference year 2016
Data refers to tons wet mass compost in 13 weeks

Scenario A Small Scale Composting by AGRICULTURAL COOPERATIVE Abishyize Hamwe Rwampara - NUTRIENT CYCLE



lack of efficient irrigation → **solar pump & sub soil irrigation**

Solar Pump + Subsoil irrigation technique

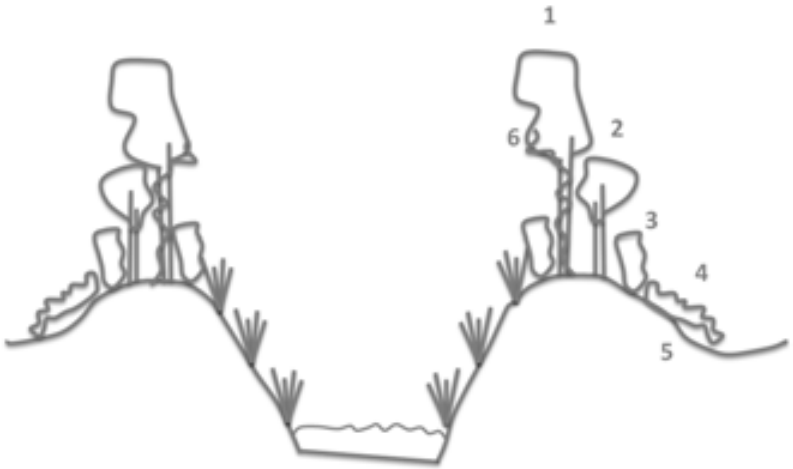


lack of efficient irrigation → **solar pump & sub soil irrigation**

Solar Pump + Subsoil irrigation technique for up to 70% less water use

lack of flood buffer zone and wind break → **permaculture designs**
lack of biomass for composting (carbon rich) and cow fodder → **permaculture designs**

Permaculture Design with Riverbank stabilisation with food forest /agroforest



Food Forest Elements

1 Big tree (avocado etc.)

2 Small tree (guava, citron, papaya)

3 Shrub (locen, napier, vetiver)

4 Ground cover (squash, pumpkin)

5 Tubers/roots (sweet potato, peanut etc.)

6 Herbaceous /Vegetables (beans etc.)

7 Climbers (passion fruit, climbing beans etc.)

Problems	Ecosystem Service/Purpose
○ Riverbank Erosion ○ Flooding ○ River access ○ Lack biomass for composting and cow fodder	○ Riverbank stabilisation ○ Biomass production for cow fodder and mulch ○ Tree shade reduces evaporation ○ Food production ○ Increased surface (vertical gardening) ○ Wind break ○ Water filter/ Phytoremediation

lack of flood buffer zone and wind break → **permaculture designs**
lack of biomass for composting (carbon rich) and cow fodder → **permaculture designs**

Permaculture Design with Riverbank stabilisation with food forest /agroforest

Lack of cooling, storage and improved marketing → cold room storage and marketing place

Zero Energy Cold Room Storage

The New Times — RWANDA'S LEADING DAILY

NEWS (/CATEGORY/2910/NEWS)

With zero-energy storage facilities, post-harvest losses are set to drop

By Emmanuel Ntirenganya (/profile/emmanuel-ntirenganya) Published : September 06, 2018

LEGAL CONTEXT

Masterplan

- defines wetland buffer zones of 20m around the wetlands towards the residential area. Within these 20m only very light structures are allowed. Agriculture only allowed in the inner 10m (facing the wetland center) of the wetland buffer zone

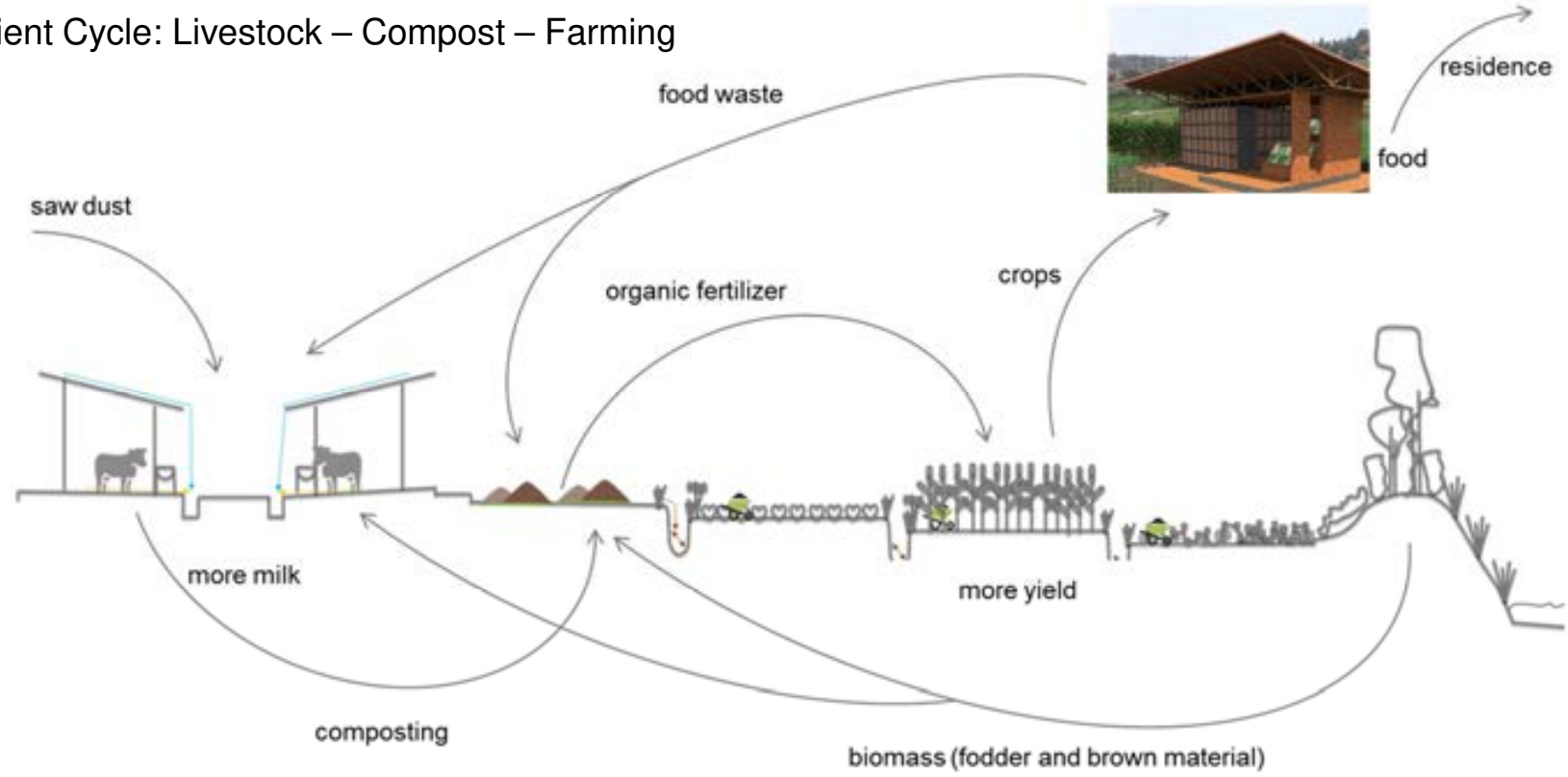
- allows agriculture production, low key business, education, recreation and ecotourism in wetland <u>but no buildings like the cow shed or composting</u>

Prolongation letter send in May 2018 to CoK with Rapid Planning Support Letter
→ approved until May 2019 by CoK

UPSCALE

The *Resilient Urban Wetland Agriculture* concept, incorporating livestock and farming, is recommended to the City of Kigali to recycle nutrients and create a resilient, divers and productive urban wetland agriculture serving fresh healthy food to the city.

Nutrient Cycle: Livestock – Compost – Farming



UPSCALING

- spatial concepts for integrating multi-functional and trans-sectoral linkages
- linking the urban food system, open green space planning and promotion of local economies in the wetlands of Kigali and beyond

OPEN GREEN SPACES PLANNING – KIGALI MASTERPLAN

Local open spaces

existing urban structure

planned neighbourhood

community parks within 10-15 min.
walk from majority of residential areas
for recreation

Use of native plants

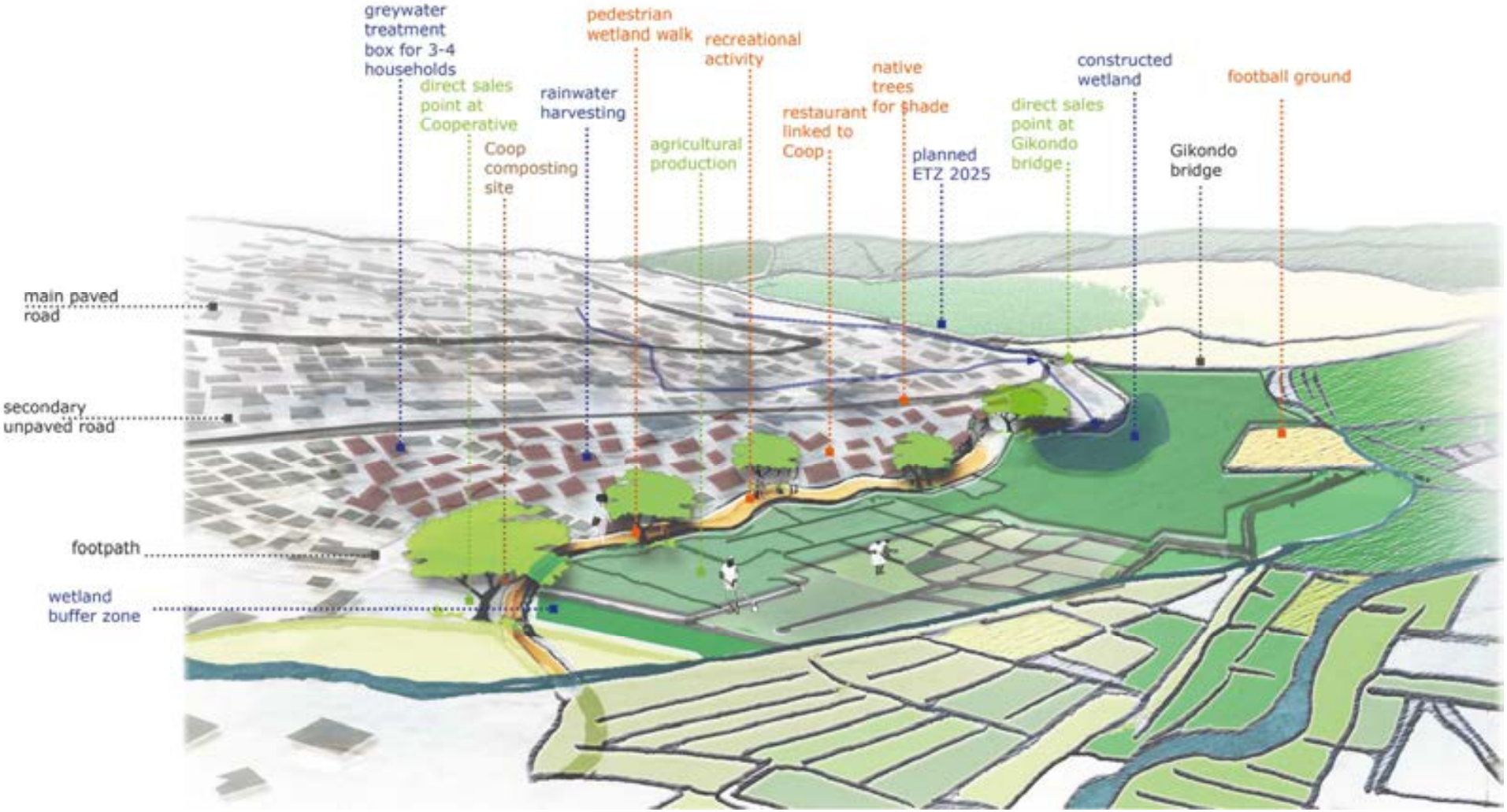
for drought tolerance,
shade and soil
erosion management
in public landscaping

"WETLAND WALK"

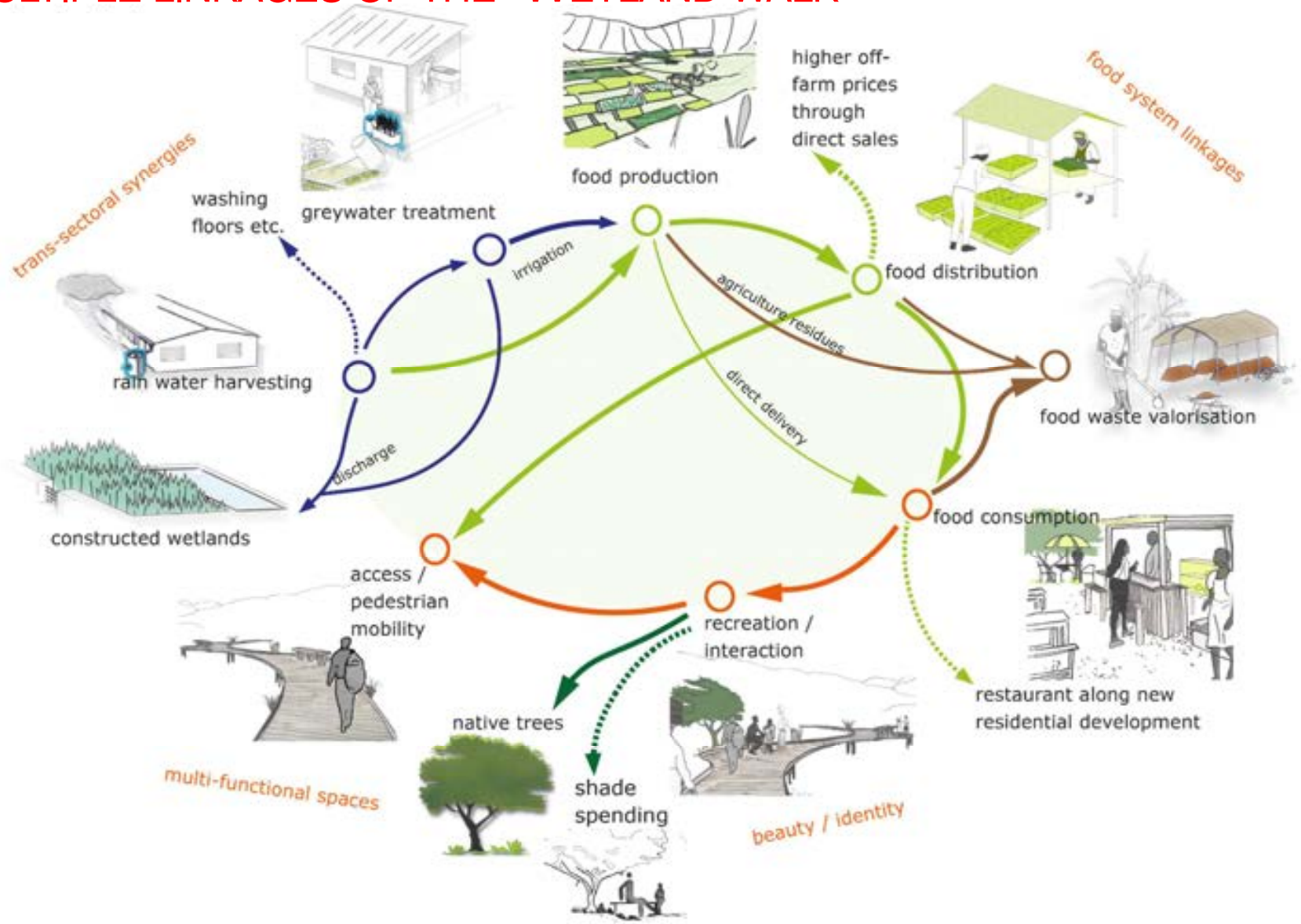
Example: Agatare

RAPID PLANNING
www.rapid-planning.net

INTEGRATED WETLAND LANSCAPES



MULTIPLE LINKAGES OF THE "WETLAND WALK"



RAPID PLANNING
www.rapid-planning.net

CONTACT

Christin Zeitz and Bernd Franke
Email: christin.zeitz@ifeu.de and bernd.franke@ifeu.de
Phone: ++49 (6221) 4767-0
Rwandan Phone: +250 780 293 426 (not permanent active)
ifeu – Institute for Energy and Environmental Research Heidelberg GmbH
Wilckensstr. 3
69120 Heidelberg
Germany

ifeu INSTITUTE FOR ENERGY AND ENVIRONMENTAL RESEARCH HEIDELBERG