

THE RAPID PLANNING IN KIGALI/RWANDA: DECENTRAL GREYWATER TREATMENT STUDY AND MASS FLOW ANALYSIS – RAPID PLANNING MICRO-APPLICATION

The study innovated, scientifically tested and proved successful the performance of an up-scalable Decentral Greywater Treatment system to recycle domestic greywater, as hybrid technology option for the upgrading of Agatare, an informal settlement in Rwanda's capital Kigali. For that we developed a transferable method to rapidly assess yet unknown planning-relevant data on domestic greywater. The results contribute to the Informal Settlement Upgrading Program of the City of Kigali and the World Bank (MININFRA 2016) by enabling sustainable infrastructure planning knowing the local mass flows, environmental impacts and the potential nexus with urban food production.

Local Context

Greywater is discharged informally untreated into drainages and pits to an unknown extent and causes pollution and hygiene risk to the groundwater and wetlands including the food production area of Agatare. A citywide sewer connection to a central sewage treatment plant is not economical due to low wastewater volume, willingness to pay and hilly topography of the area (OPM 2017).

With the predominant use of direct drop pit latrines (no water flush) in Agatare (OPM 2017), the largest share of the generated wastewater is greywater. In contrast to blackwater (sewage from toilets) and kitchen wastewater (high fat and food waste), greywater is low contaminated, fecal free wastewater from body hygiene, laundry and cleaning (EN 12056-1).



Problems of Greywater in Agatare

Micro-application of Rapid Planning Methodology

Two Decentral Greywater Treatment pilot systems were developed, built on-site in cooperation with local stakeholders and operated by trained residents (usage, maintenance, digital monitoring). Chemical and microbiological analyses proved successful reduction of the pollution indicators (Chemical Oxygen Demand (COD) -96%, Fecal Coliforms (FC) -99.88%, Nitrogen (N) -85% and Phosphorus (P) -67%.) and compliance with Rwandan and international discharge tolerance limits (RSB 2009; BGI 2016) and the WHO (2000) limit for reuse for irrigation.

Combined with GIS mapping, physicochemical analysis of informal greywater disposals in drainages, a survey of 293

households and interviews with local stakeholders, the data for a greywater mass flow analysis and environmental impact assessment was collected:

With 1292 households, Agatare discharges annually approx. 20,000 m³ greywater (40% of total generated greywater) containing ca. 8.7 t COD, 22,600*10⁹ Cfu FC, 2.2 t TSS, 0.3 t N and 0.1 t P via drainages into the agriculturally used wetlands.

Projected onto Kigali, annually approx. 6.3 Mio m³ of domestic greywater accounting for 57% of the total domestic wastewater and for 40% of the total domestic freshwater consumption are generated.

Recommendation for the Informal Settlement Upgrading Program in Agatare

Decentralised settlement-based greywater treatment systems with constructed wetland technology at 3 strategic spots combined with decentralised blackwater collection (PIVOT) is recommended as an affordable, ecological and socially sound sanitation upgrading option to City of Kigali and World Bank.

Ecological advantage

- stops pollution and hygiene risk of the agriculturally used wetlands and groundwater basin
- increases availability of non-potable water (e.g. irrigation) and alleviates freshwater demand
- preserves wetlands as natural habitat and buffer zone for flooding and groundwater recharge

Social advantage

- integrates local need of farmers for safe, hygienic irrigation water and management habits
- 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)

Technical & Economic advantage

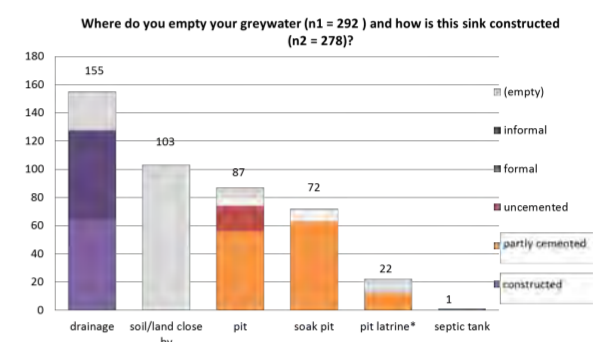
- uses greywater, the major wastewater mass which is accessible as mostly separately disposed
- use of existing gravity fed stormwater drainages to channel greywater to treatment (in pipe)
- upscales the local successfully proven technique of the greywater treatment pilot systems
- more affordable than citywide sewer coverage and central treatment plant



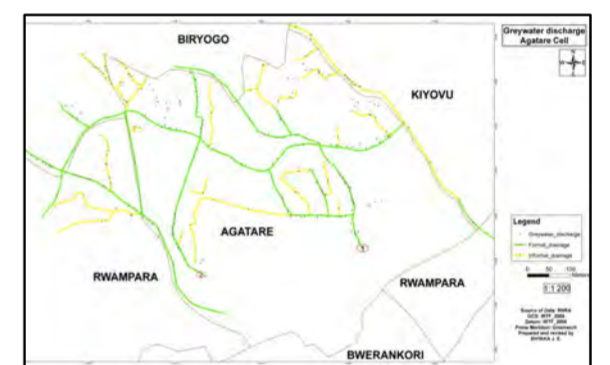
Decentral greywater treatment system



293 household surveys on greywater management



Mapping and testing greywater

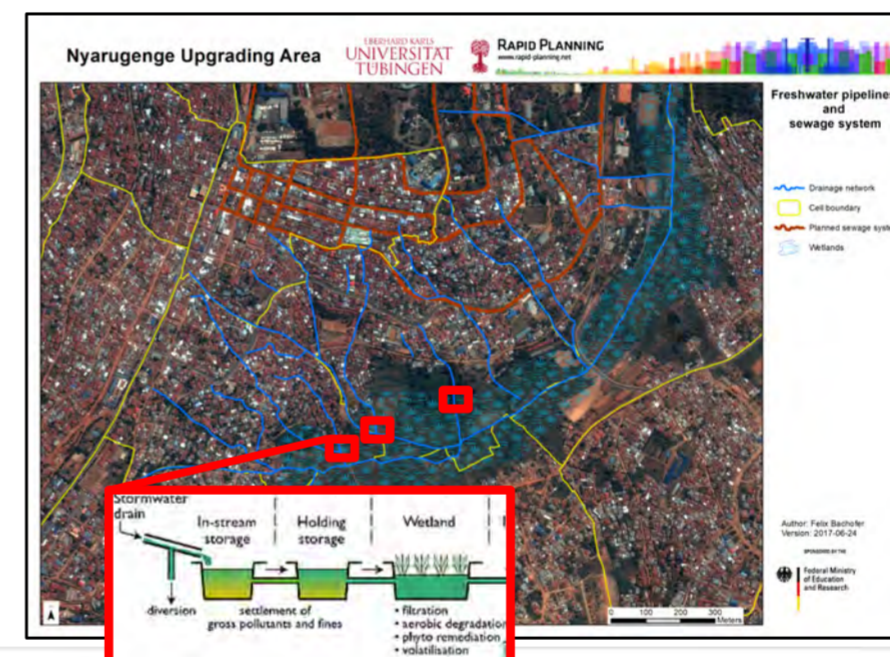
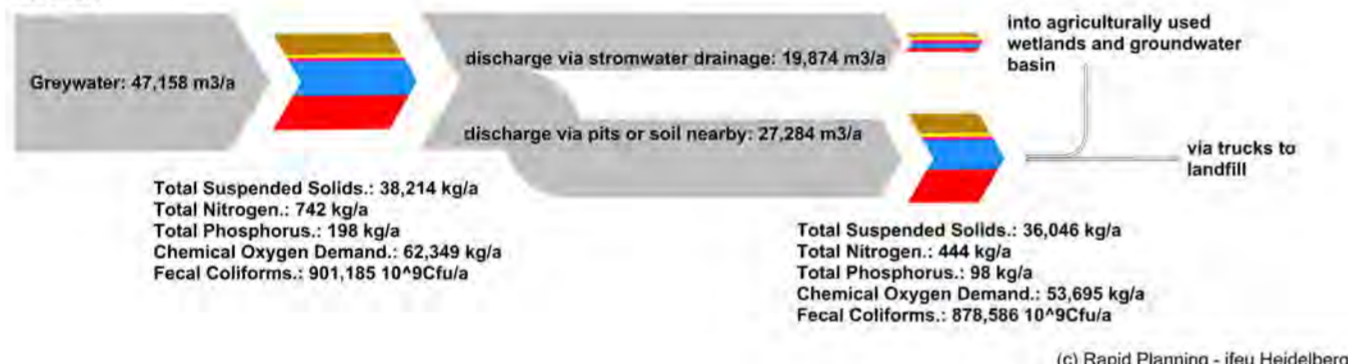


GIS mapping of 303 greywater discharge points

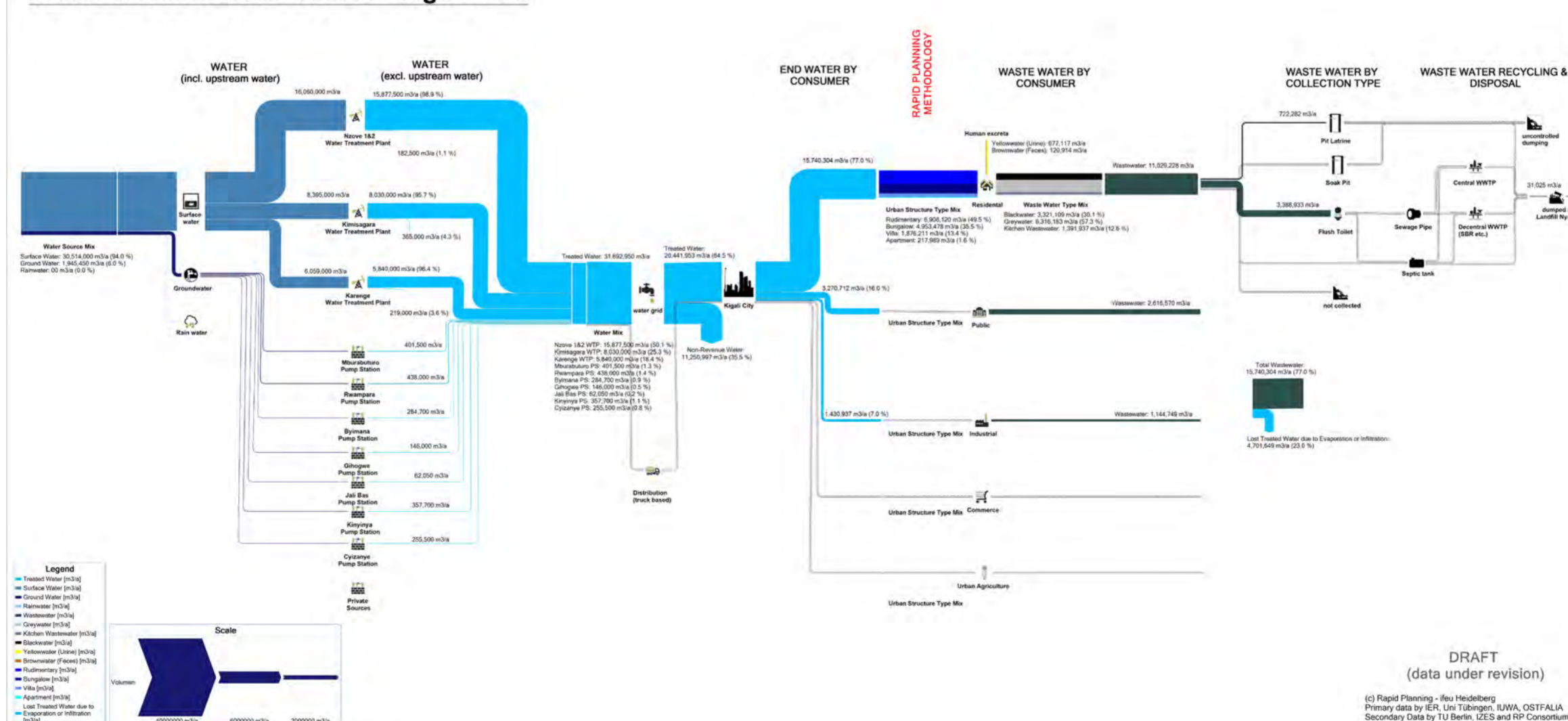
AGATARE CELL (1292 households)

Socio Economic: low income
Building Type: rudimentary
Urban Structure Type: compact/small
HH size: 7

Total Suspended Solids.: 2,168 kg/a
Total Nitrogen.: 298 kg/a
Total Phosphorus.: 99 kg/a
Chemical Oxygen Demand.: 8,654 kg/a
Fecal Coliforms.: 22,600 10⁹Cfu/a



Water & Waste Water Sector - Kigali 2016



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