Alternative Business Models for FSM – System's Perspective

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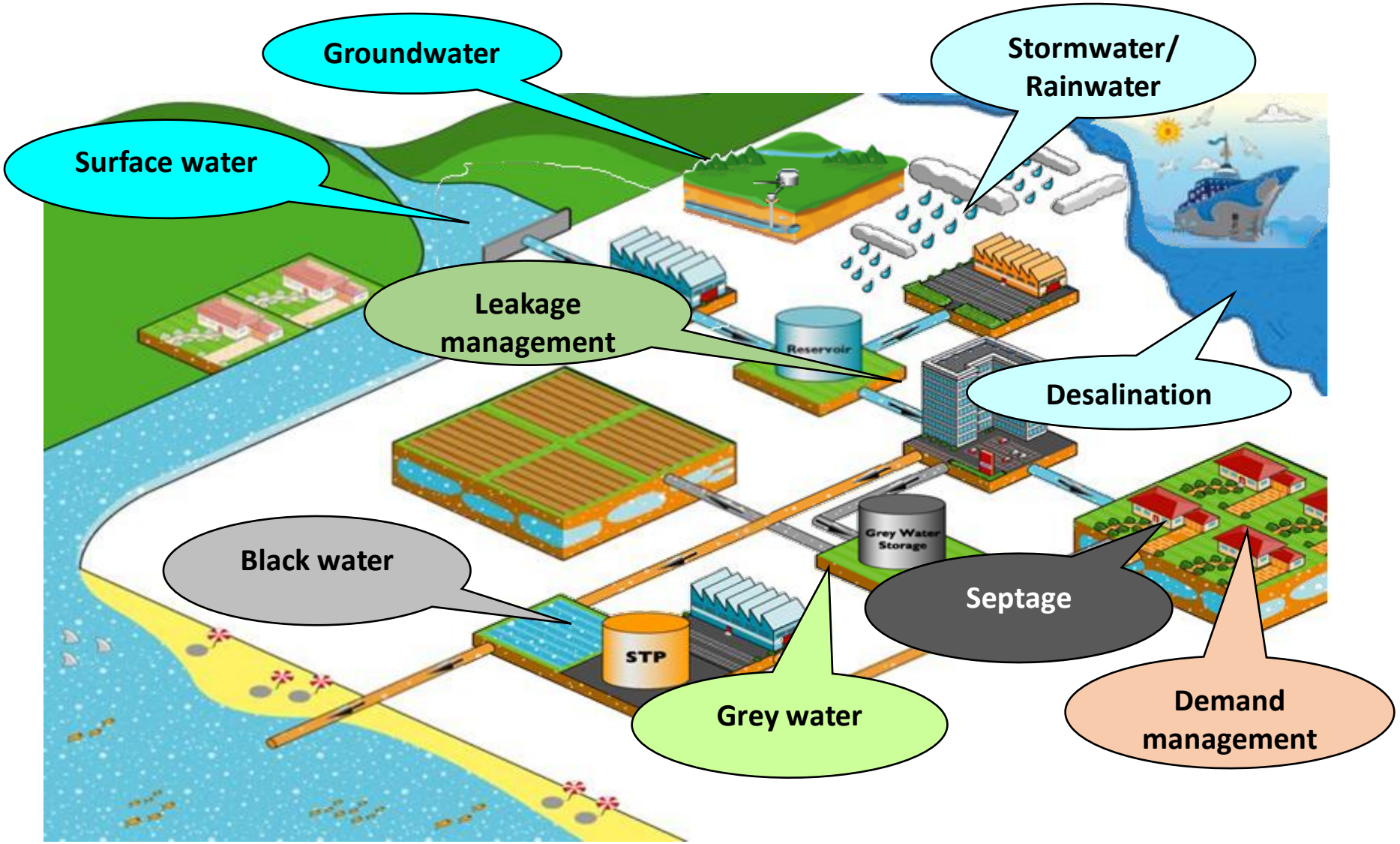
International Water Management Institute

Mainstreaming Citywide Sanitation: Opportunities and Challenges for Excreta Management
4 -5 April 2016, New Delhi, India

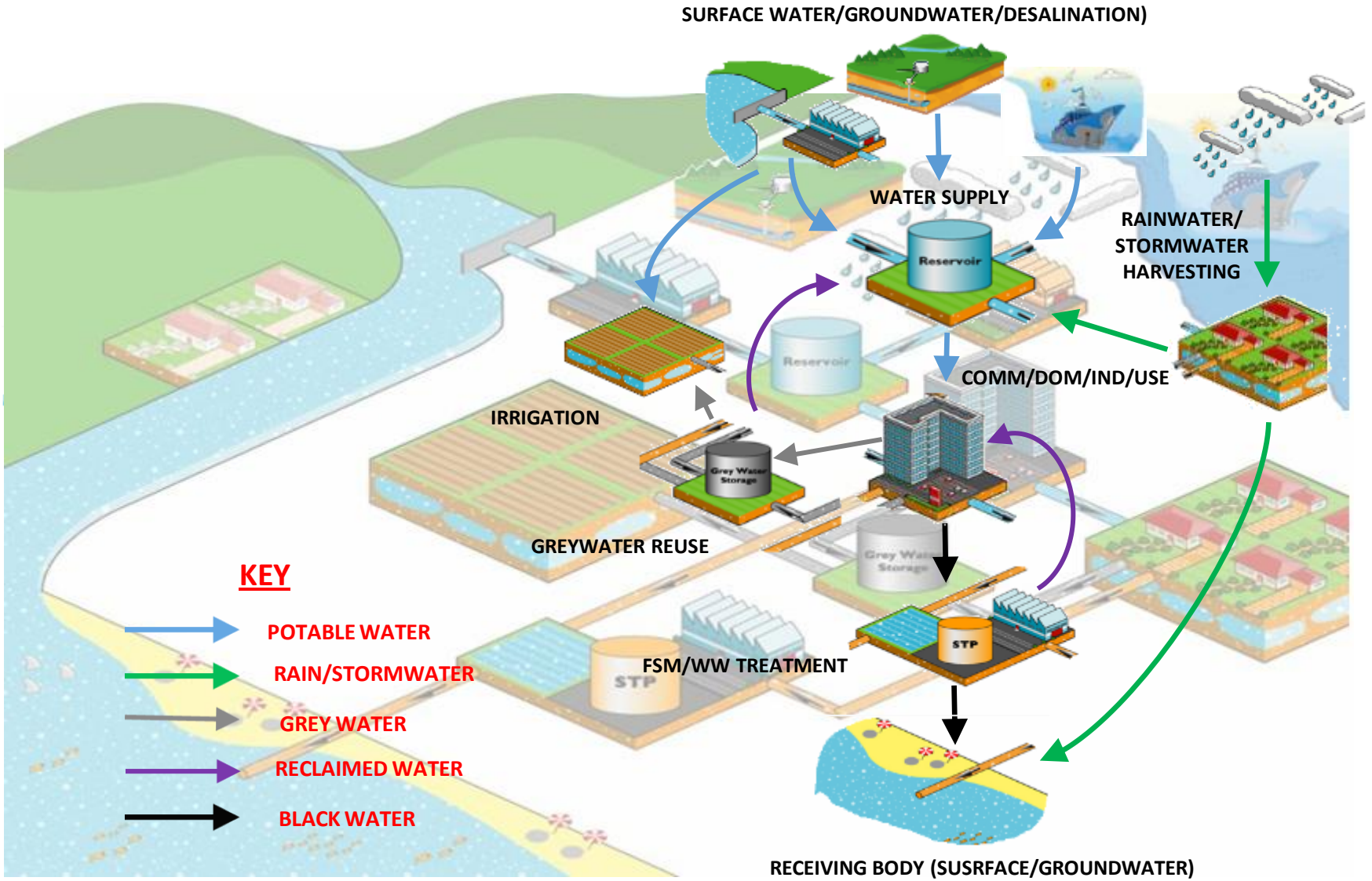
major change in perspective

productive use of water

We need to have a systems perspective of the water cycle

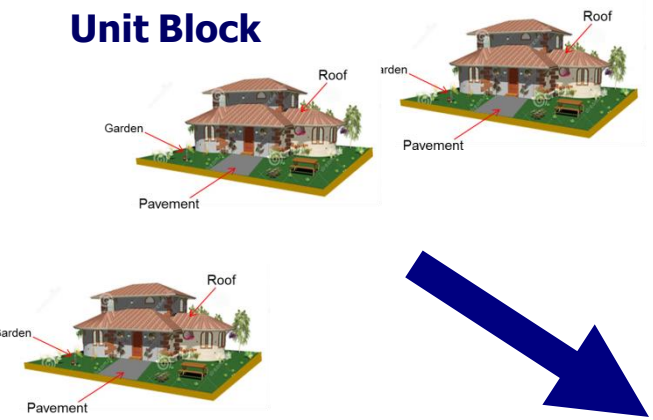


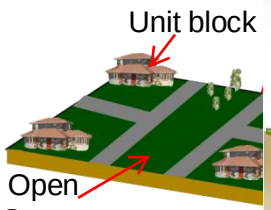
Modelling allows us to connect all flows with productive uses

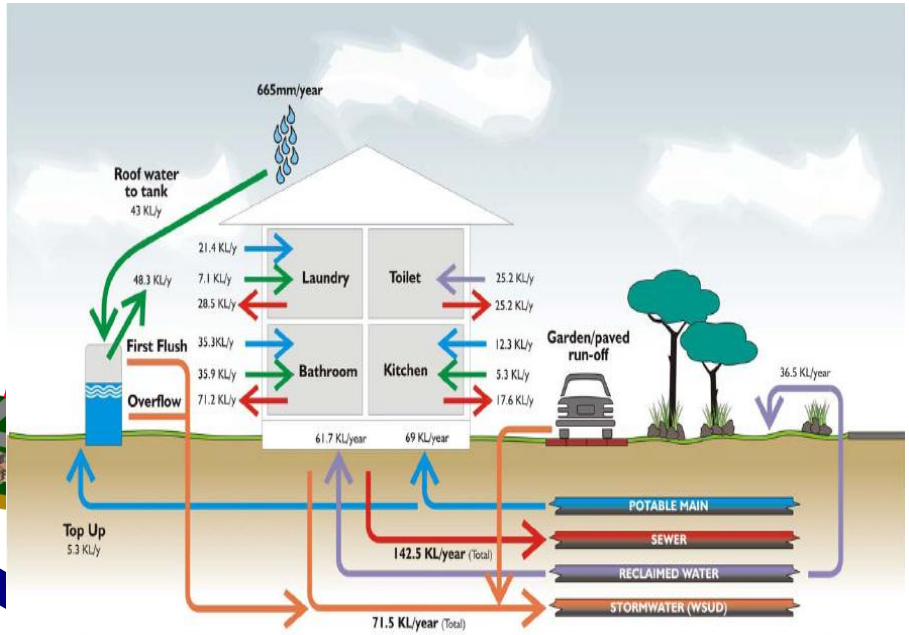


Analysis is performed using a nested systems approach

Unit Block







Community

Cluster

Exploring alternative urban water solutions to rapid population growth

Water demand will at least double until 2035

ICLEI Local Governments for Sustainability

Patel College of Global Sustainability

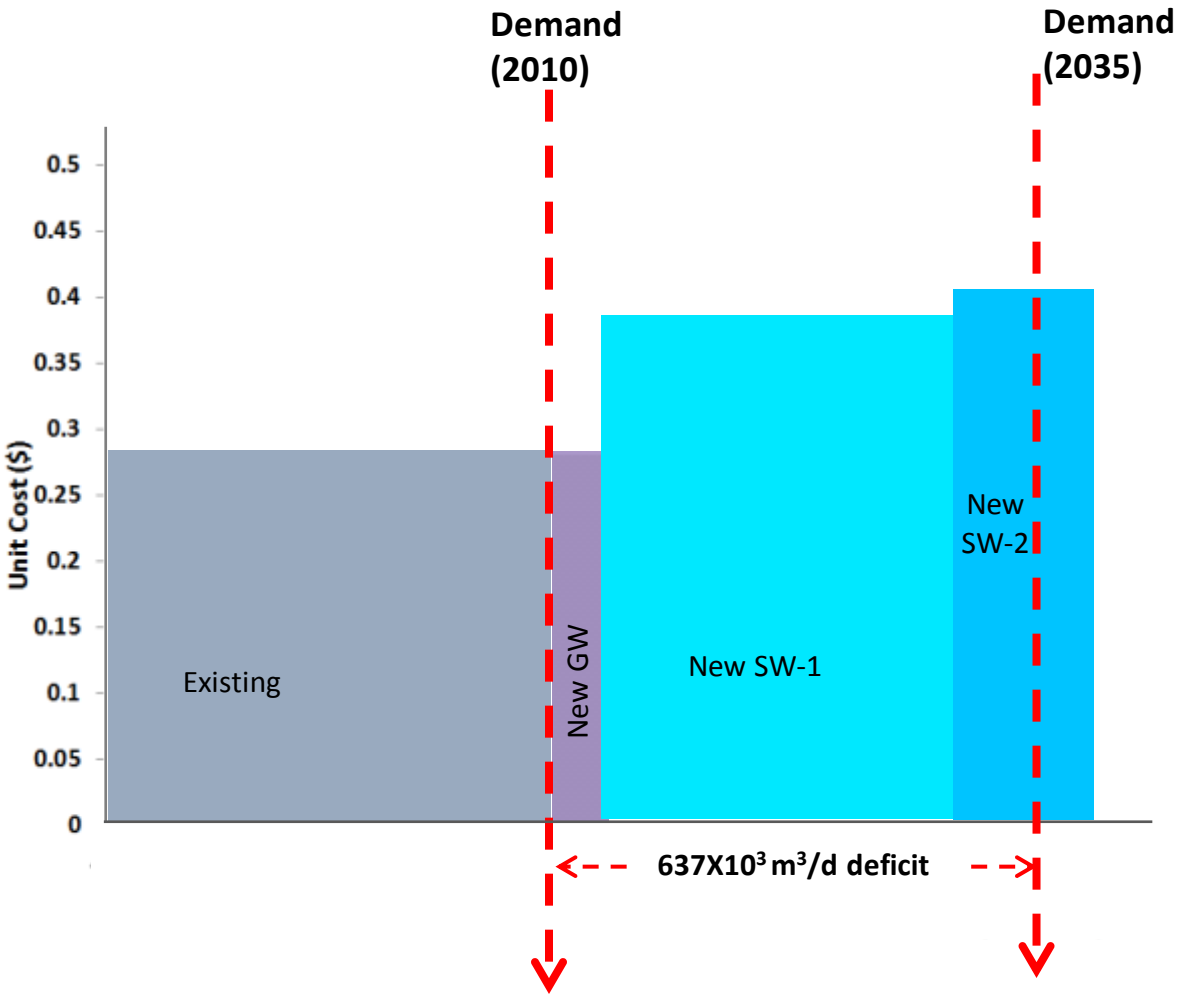
WATER IS LIFE
NATIONAL WATER AND SEWERAGE CORPORATION

MAKERERE UNIVERSITY

Panafcon

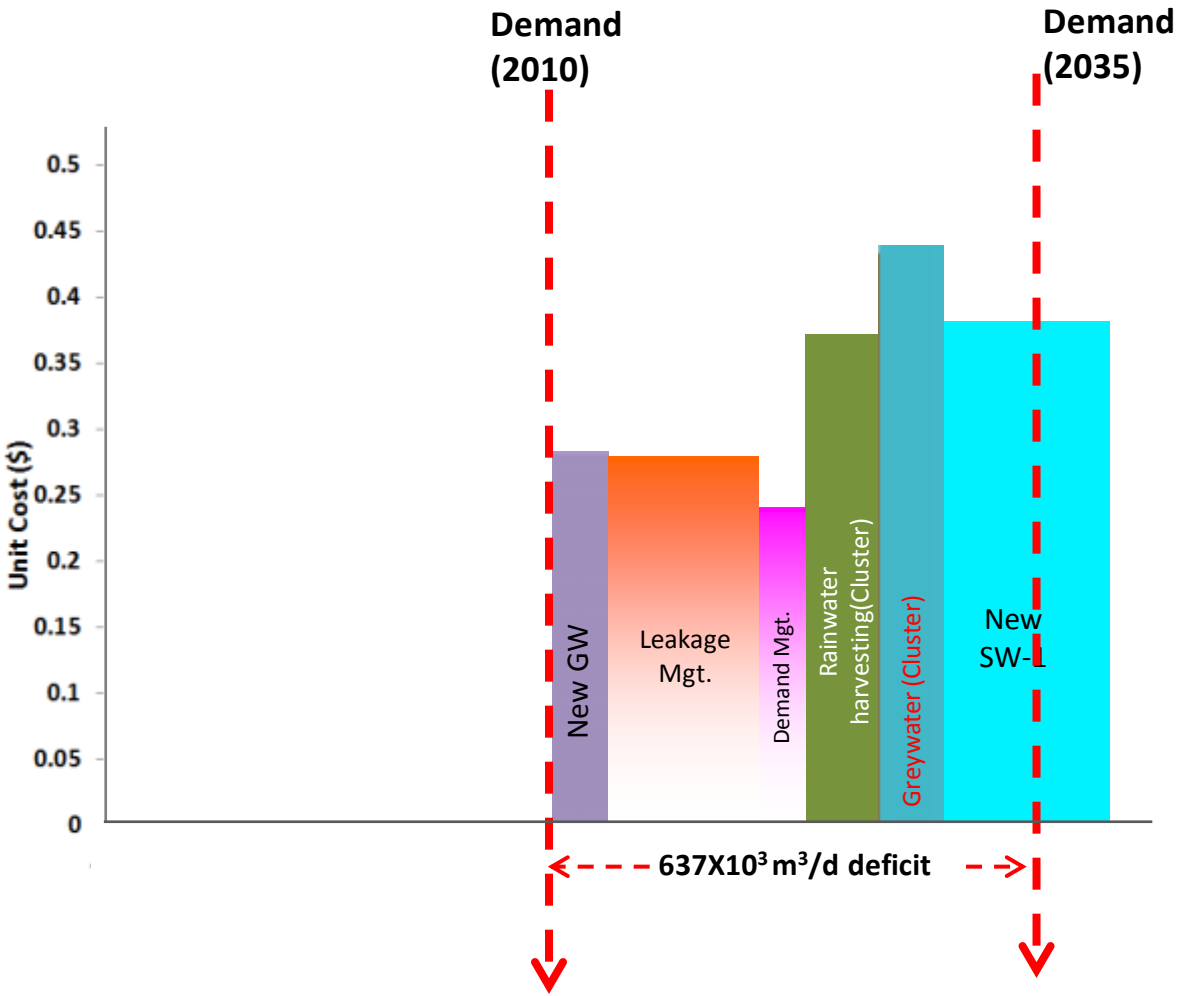
Typical solutions - import more water to meet growing needs

- Unit costs of **US$ 0.36/m3**



Need to consider non-conventional resources – a portfolio of options

- Unit costs of **US$ 0.31/m3** (cf. to 0.36)



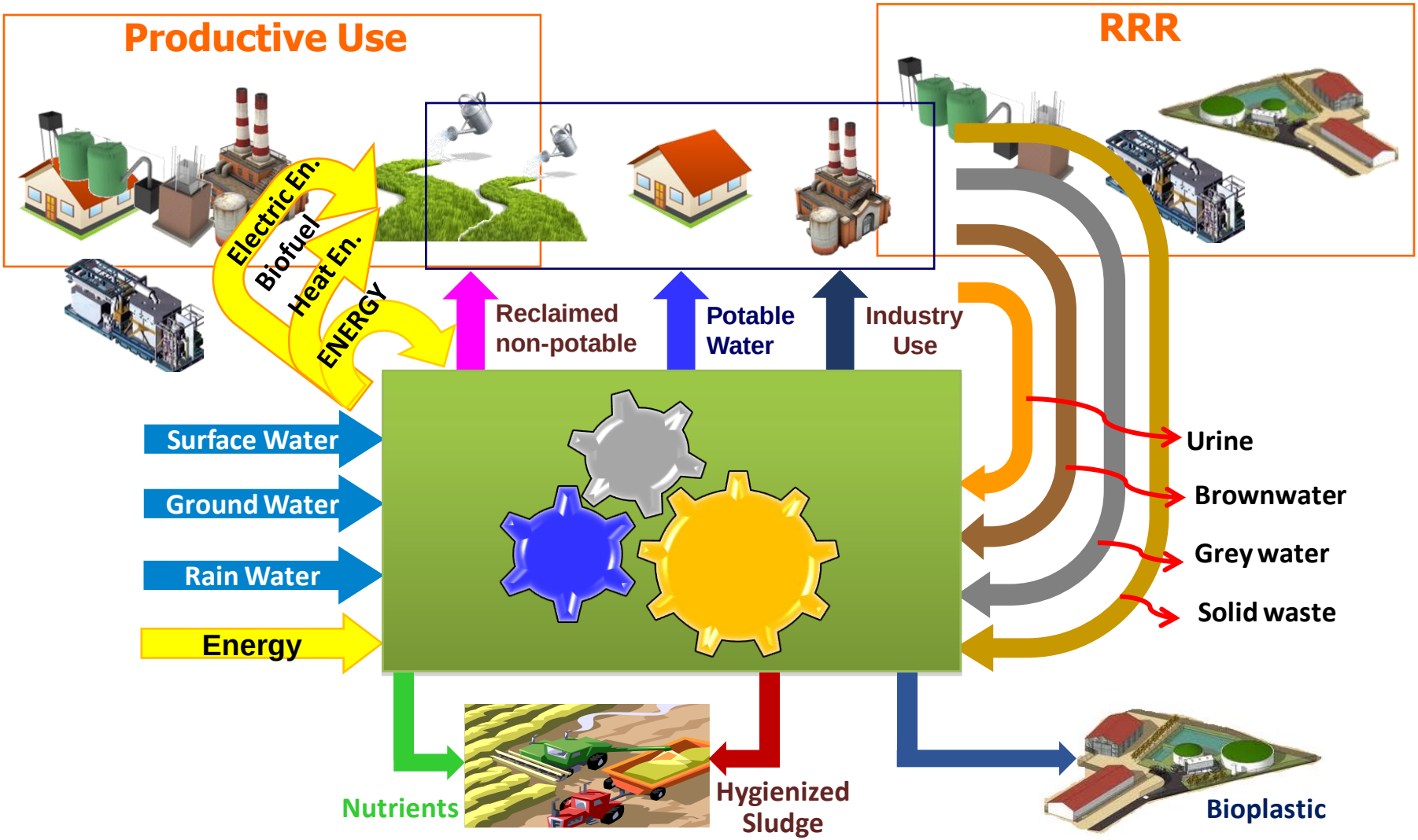
Need to consider non-conventional resources – a portfolio of options

- Unit costs of **US$ 0.4**

major change in perspective

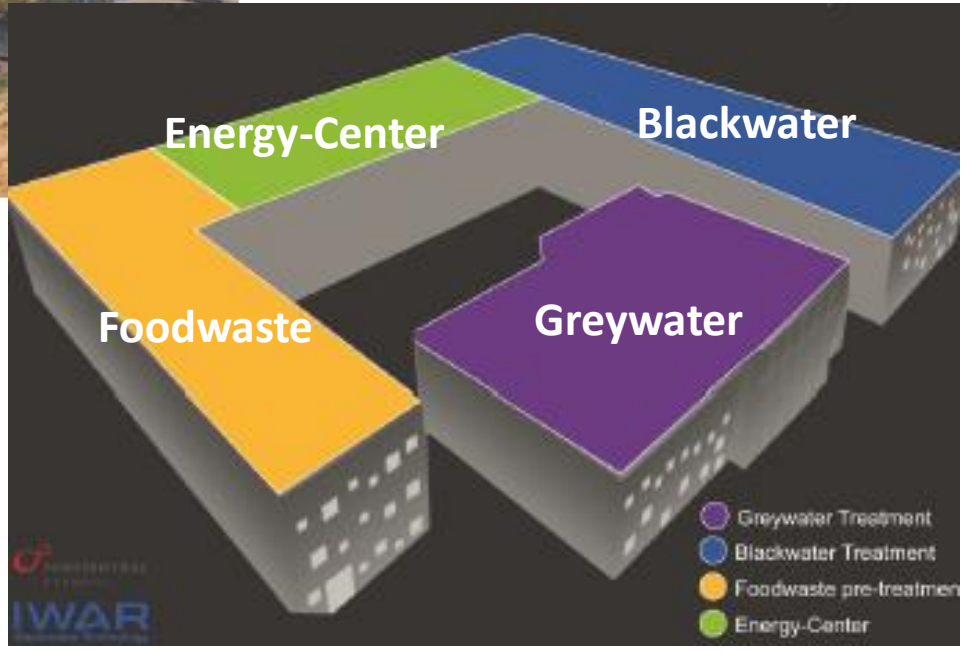
waste as a resource

Changing our perspective creates opportunity to do things differently



April 2014: Semizentralized Resource Recovery Center Qingdao Shiyuan

TECHNISCHE UNIVERSITÄT DARMSTADT



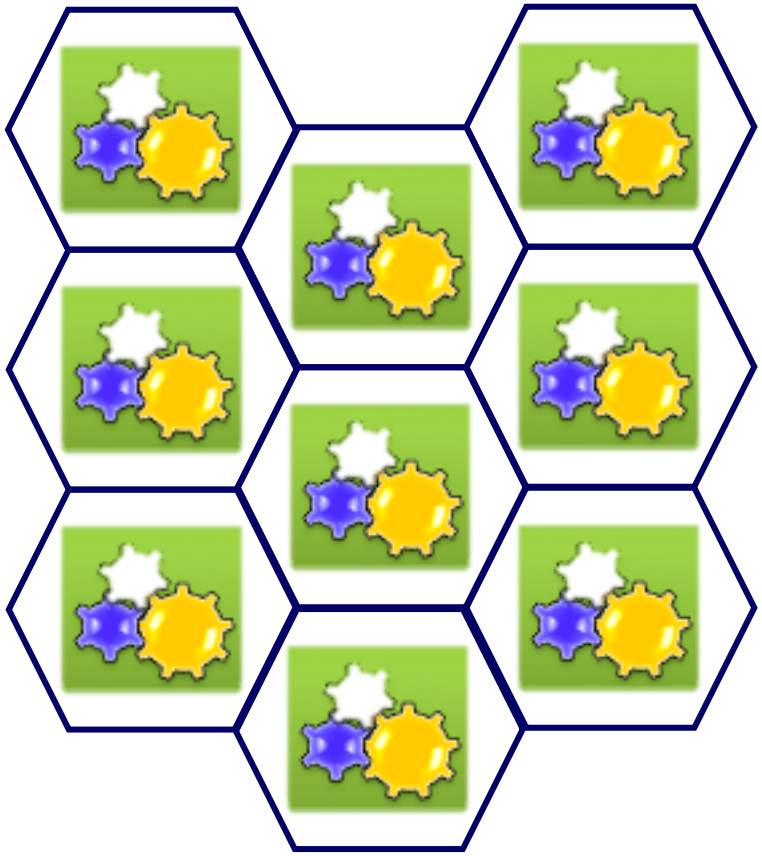
| Dr.-Ing. Susanne Bieker | Institute IWAR | TU Darmstadt, Germany |

IWAR

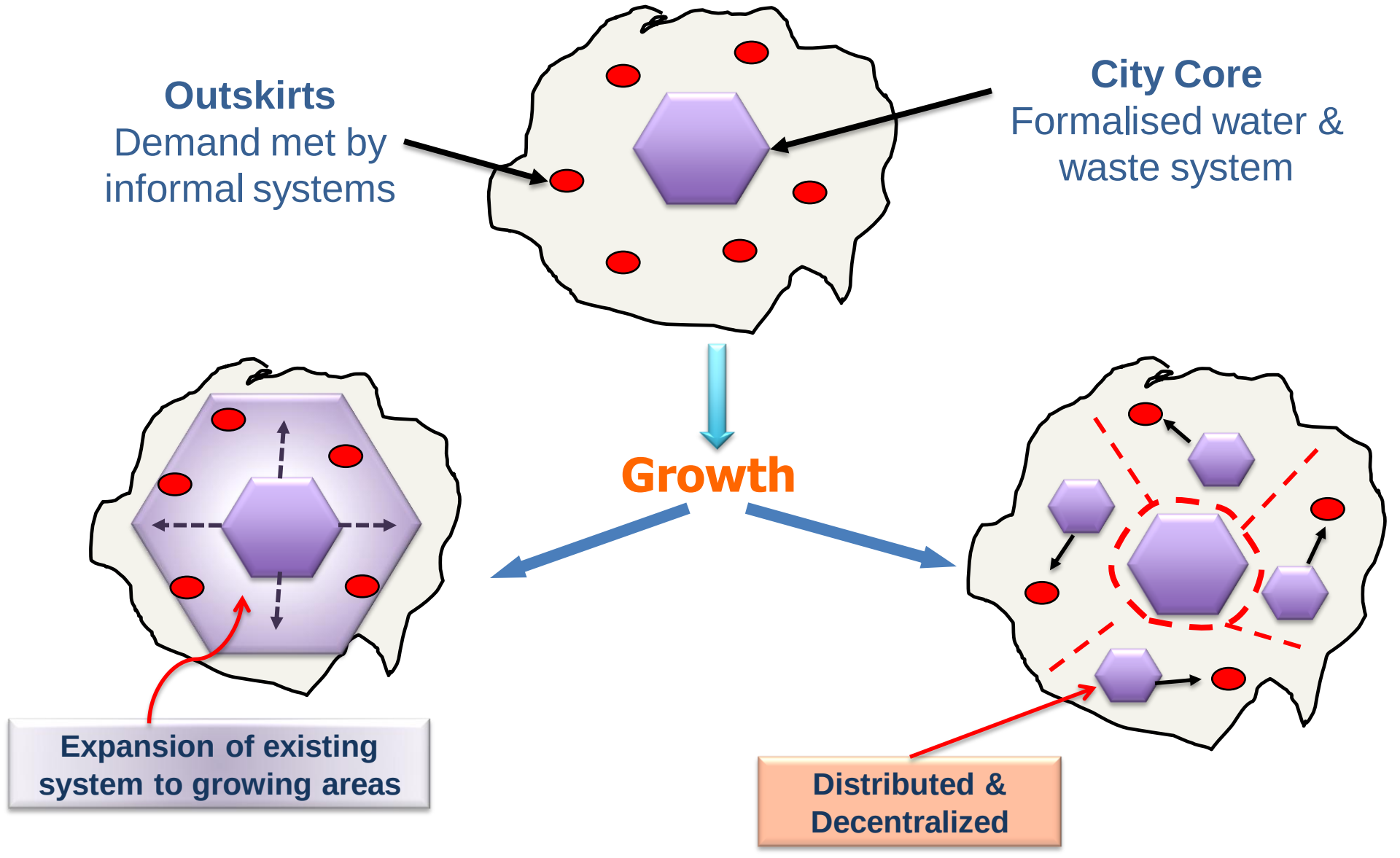
Clusters allow maximum efficiency while giving adaptive capacity

A machine for each district

- Semi central supply and treatment unit as part of clustered city structure
- Use scalability of treatment technology (membranes)
- Customized supply and treatment for each cluster
- Utilizing synergy effects and re-use potentials



Look for opportunities to create new paradigms (not extend old ones)



Exploring opportunities to do thinks differently in emerging cities

Quick growing emerging towns

ICLEI Local Governments for Sustainability

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MAKERERE UNIVERSITY

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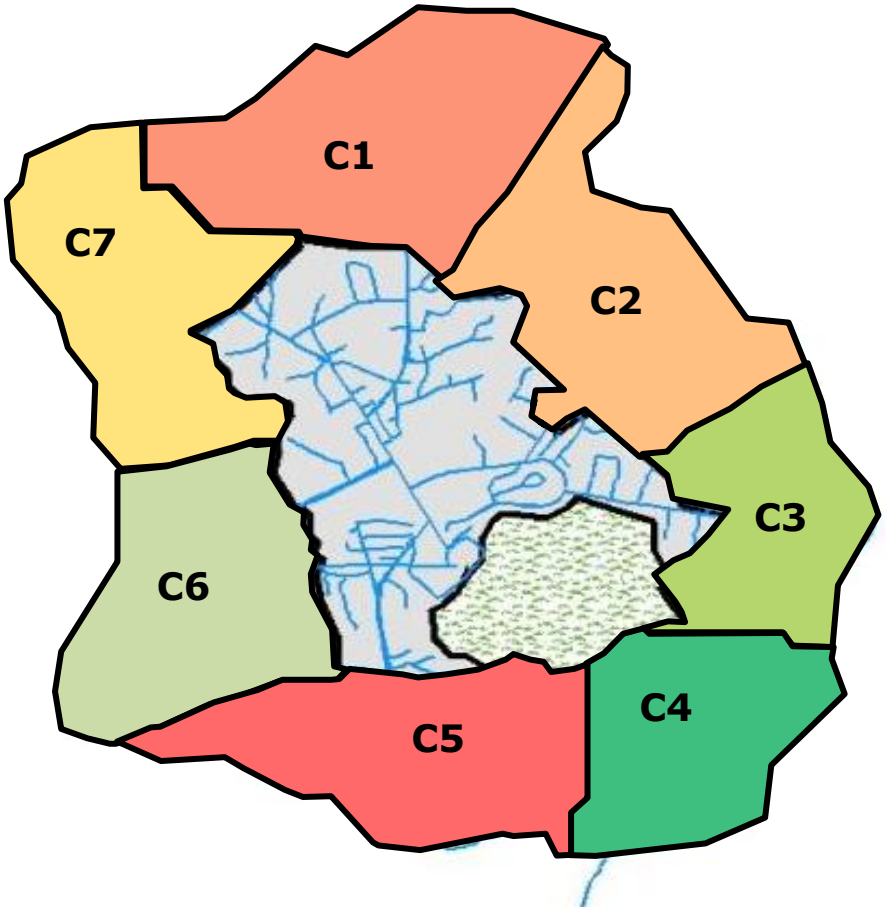
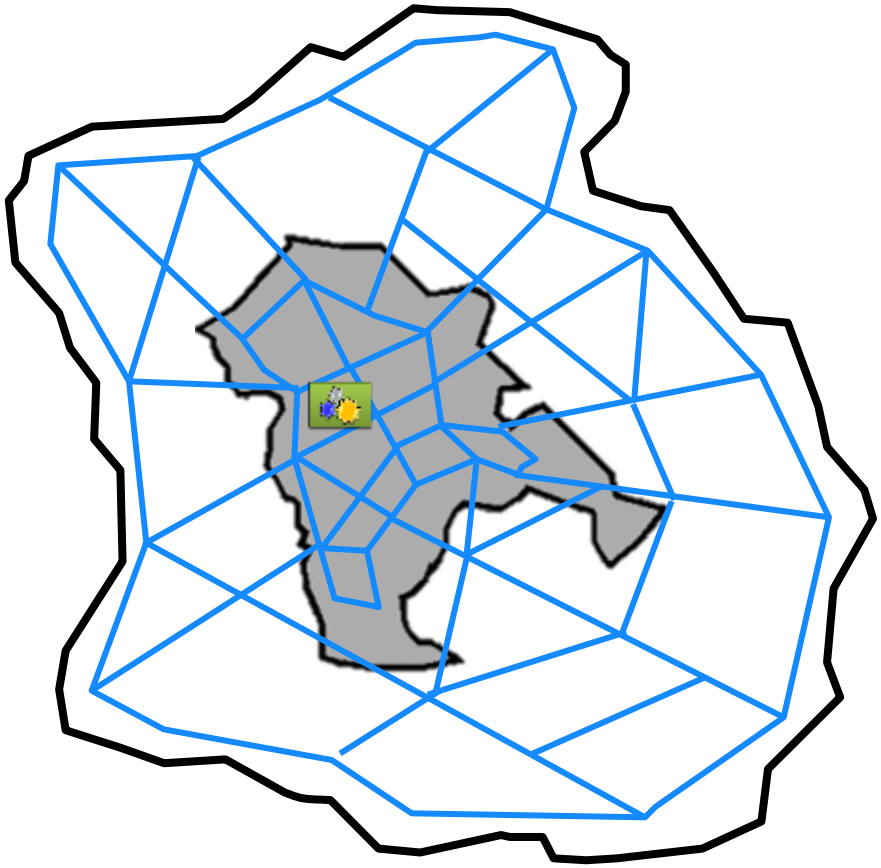


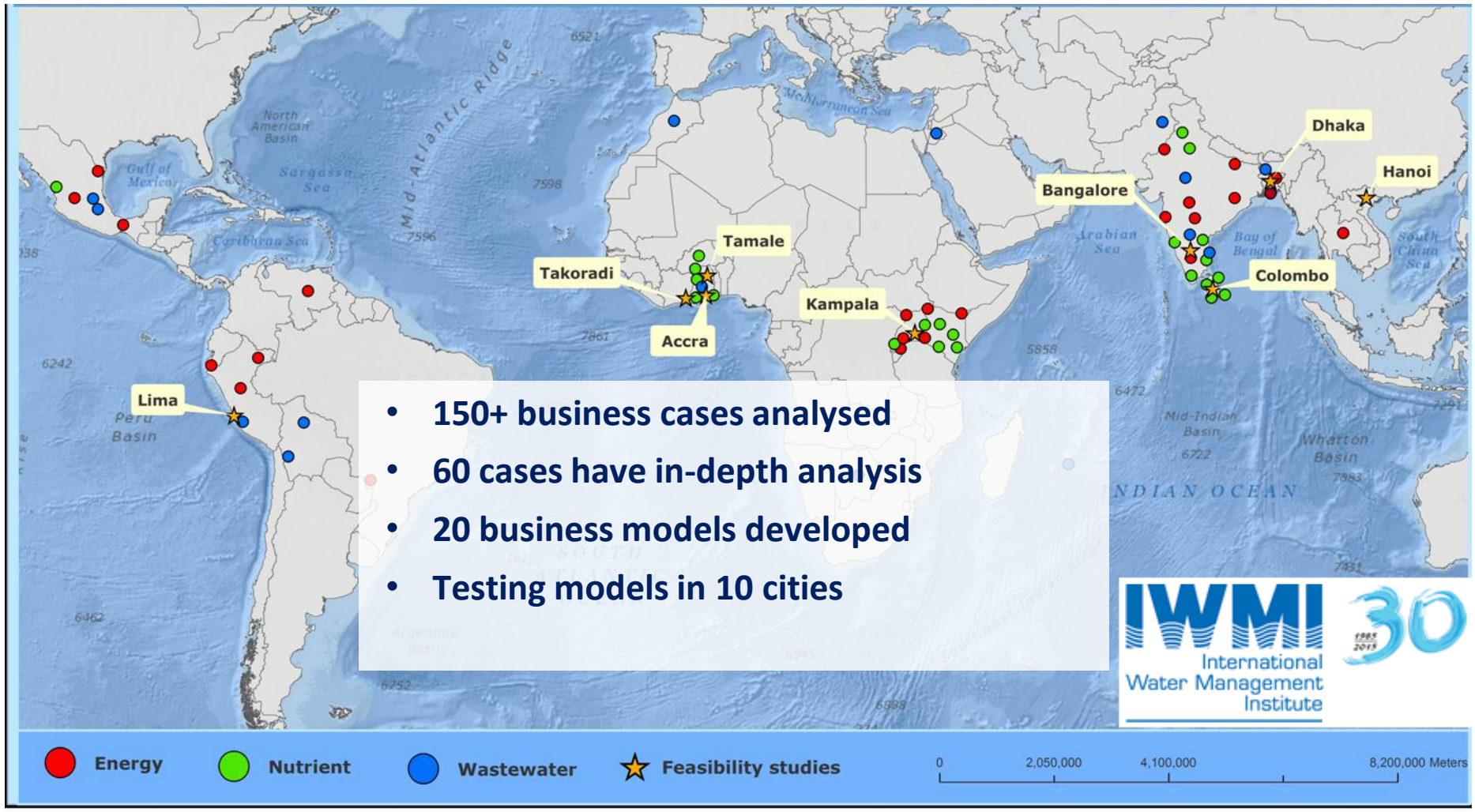
Semi-centralized is cheaper?



Average Annual Costs
5,148,000 US$

Average Annual Costs
3,787,000 US$

IWMI developing comprehensive catalogue of RRR business cases



The Business Model Canvas

Key Partners

Key Activities

Value Proposition

Customer Relationships

Customer Segments

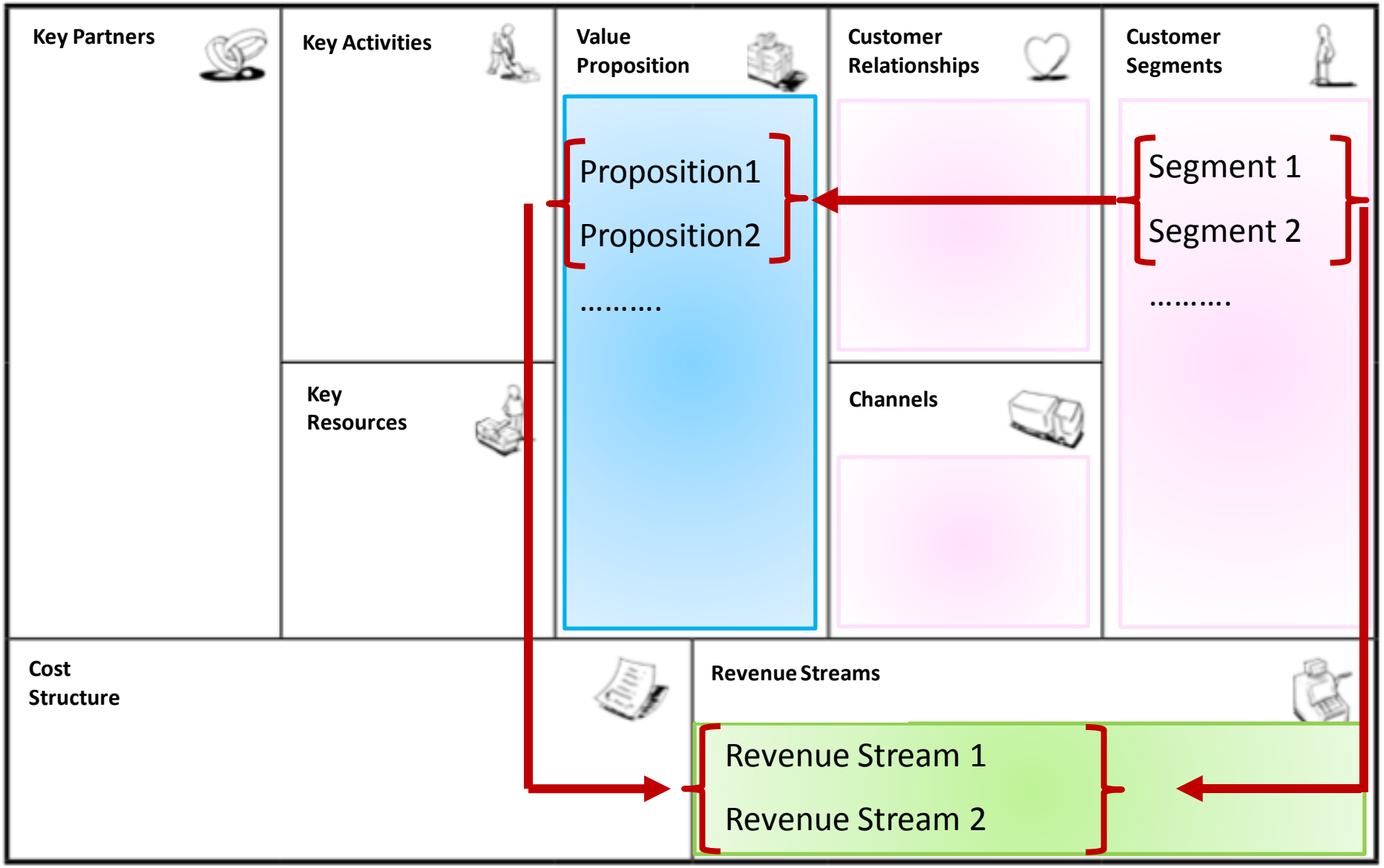
Key Resources

Channels

Cost Structure

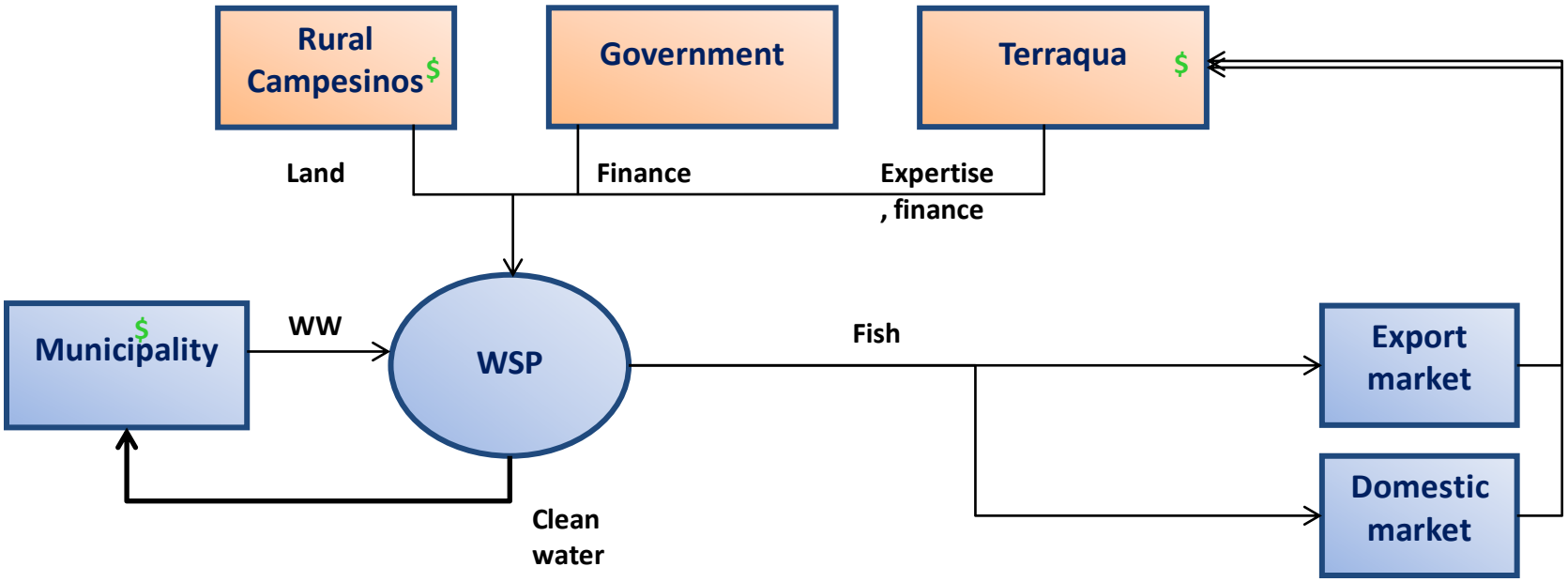
Revenue Streams

The Business Model Canvas



Phyto-remediative wastewater treatment & fish production

- PPP's
- Domestic/industrial wastewater (pref. dom.)
- Alternative source of fish, advanced tertiary state treated wastewater
- Averts pollution of water bodies
- Scale: Small to medium/large
- Location: South Asia, Latin America, Africa



- Scale: 70.000 m3/day
- Cost of investment: $22 M
- Organizational type: PPP
- Business model: value-driven & cost-driven end-sales
- Form of financing: I-A Dev. Bank through Government, equity
- Driving factors: Water scarcity, abundant ww polluting water bodies, land availability and conducive ownership structures

Key Partners
- Wastewater producers
- Expertise / R&D provider
- Central government
- Farmers
- External financier(s)

Key Activities
- Treat wastewater
- Grow duckweed, co-crops & fish
- Quality control
- Fish processing & packaging
- Marketing & sales of fish and co-crops

Key Resources
- Tanks and ponds
- Expertise duckweed
- Capital
- Partnerships with lagoon - & wastewater provider
- Marketing & sales force
- Packaging & storage
- Quality control mechanism

Value Propositions
- Provide quality processed & packaged fish for domestic & export markets.
- Provide cost effective wastewater treatment
- Provide highest standard treated water

Customer Relationship

Channels
- Marketing channels, local and export

Customer Segments
- Municipality (wastewater producer)
- Municipality (water consumer)
- Domestic whole sellers & retail for processed & packaged fish
- Export processed & packaged fish markets

Cost Structure
- Capital investment
- O&M, including fingerlings
- Debt repay & equity value
- Marketing & sales with retailers and whole sellers
- Packaging & storage

Revenue Streams
- Sale of processed & packaged fish to domestic whole sellers and retail
- Whole sale of processed & packaged fish to export markets
- Potable water sales (potential)
- *Wastewater handling fee*

Value Propositions

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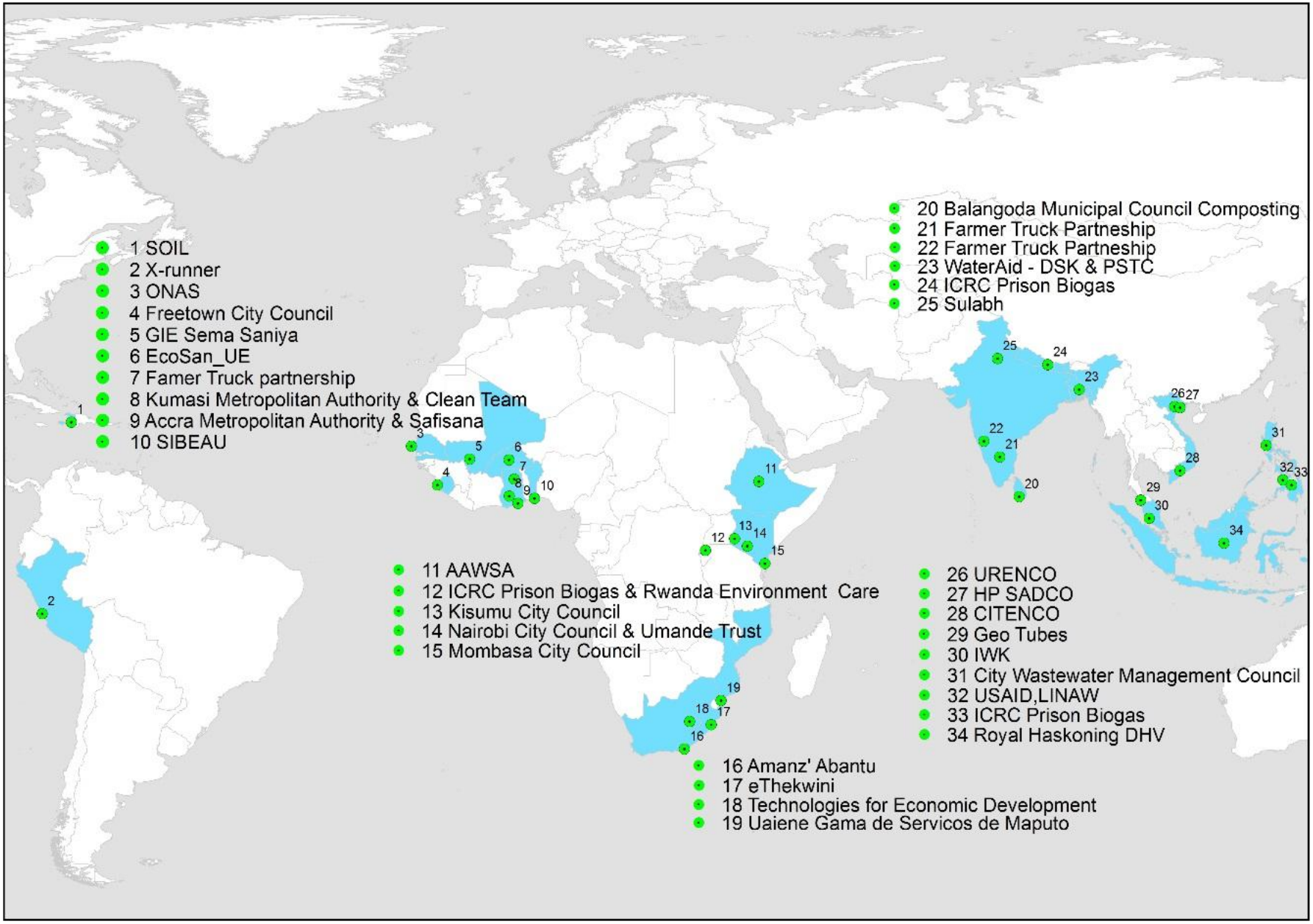
Available Dec 2016

Fecal Sludge Management

Business Models


1 SOIL
2 X-runner
3 ONAS
4 Freetown City Council
5 GIE Sema Saniya
6 EcoSan_UE
7 Famer Truck partnership
8 Kumasi Metropolitan Authority & Clean Team
9 Accra Metropolitan Authority & Safisana
10 SIBEAU
11 AAWSA
12 ICRC Prison Biogas & Rwanda Environment Care
13 Kisumu City Council
14 Nairobi City Council & Umande Trust
15 Mombasa City Council
16 Amanz' Abantu
17 eThekwini
18 Technologies for Economic Development
19 Uaiene Gama de Servicos de Maputo
20 Balangoda Municipal Council Composting
21 Farmer Truck Partneship
22 Farmer Truck Partneship
23 WaterAid - DSK & PSTC
24 ICRC Prison Biogas
25 Sulabh
26 URENCO
27 HP SADCO
28 CITENCO
29 Geo Tubes
30 IWK
31 City Wastewater Management Council
32 USAID,LINAW
33 ICRC Prison Biogas
34 Royal Haskoning DHV

Economic Viability

HOUSEHOLD PUBLIC TOILET BUSINESS

INDISCRIMINATE DISPOSAL IN OPEN DRAINS/LAND OR SEWER LINES

FECAL SLUDGE TREATMENT PLANT (PUBLIC OR PPP)

LANDFILL

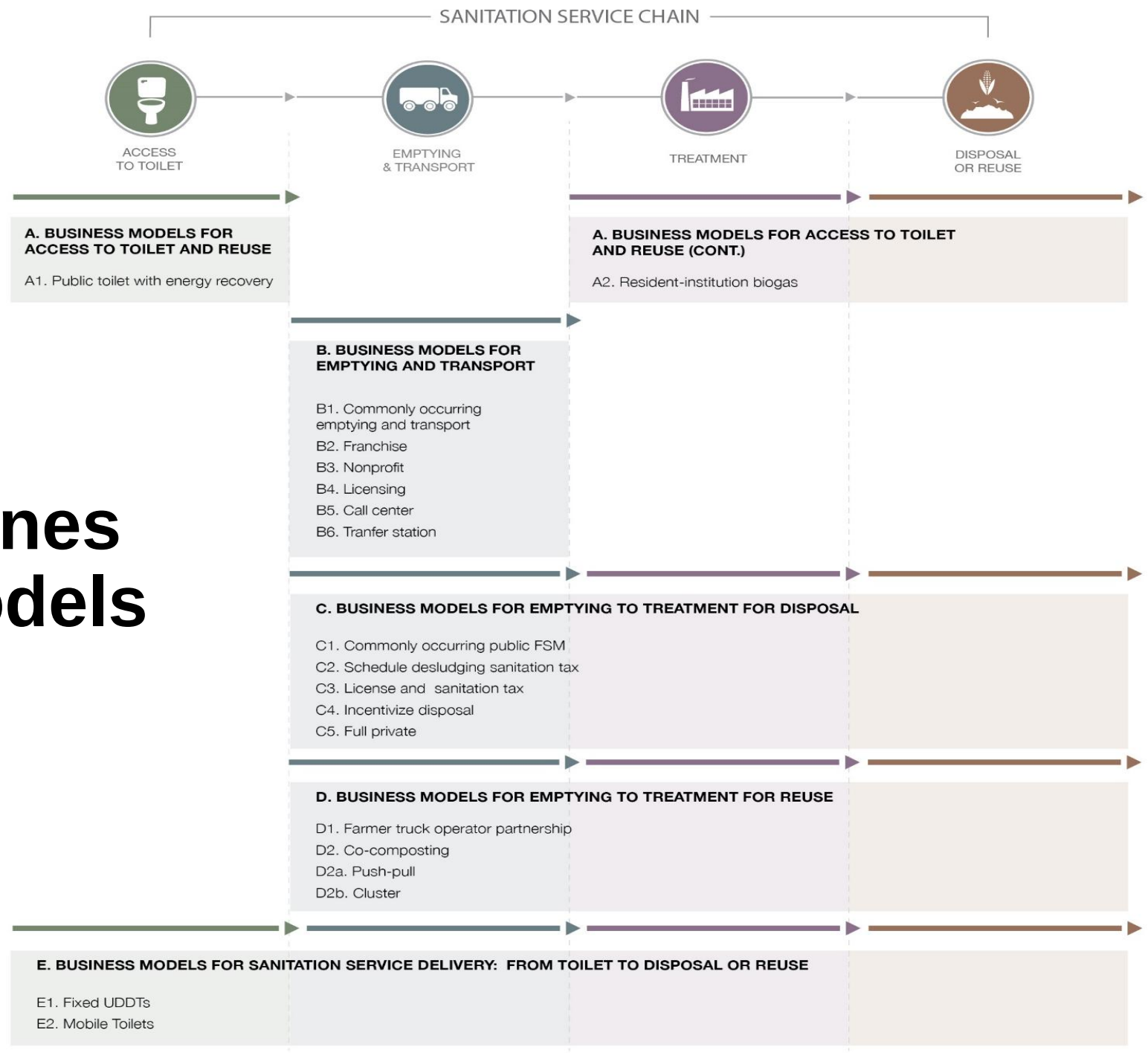
Regular desludging
Sanitation tax

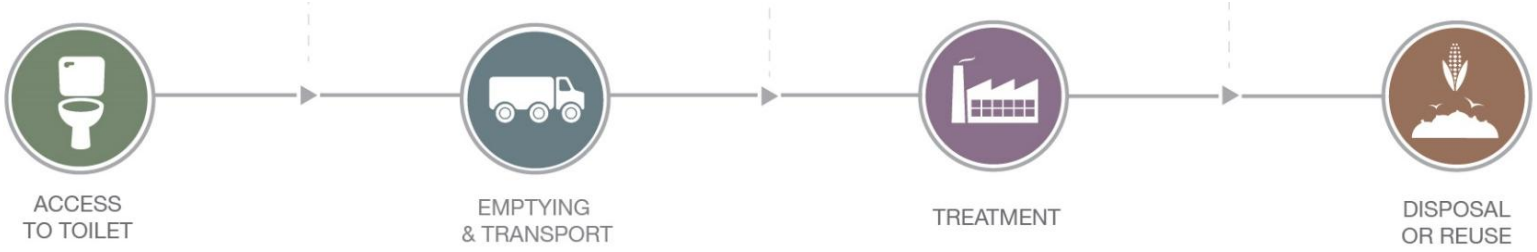
MUNICIPALITY

DEVELOP MARKET FOR SALE OF COMPOST

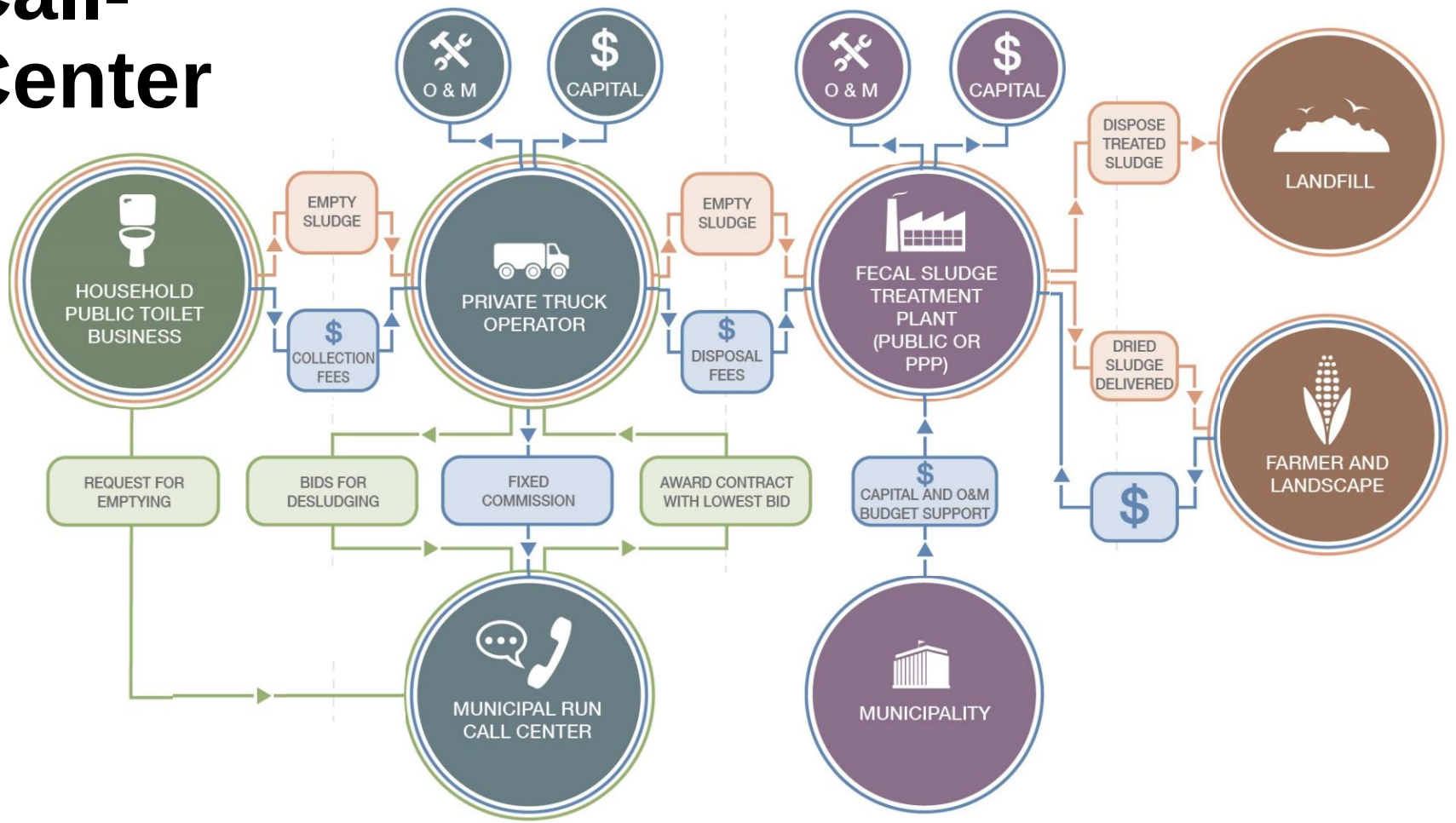
COMPOST

FSM Business Models



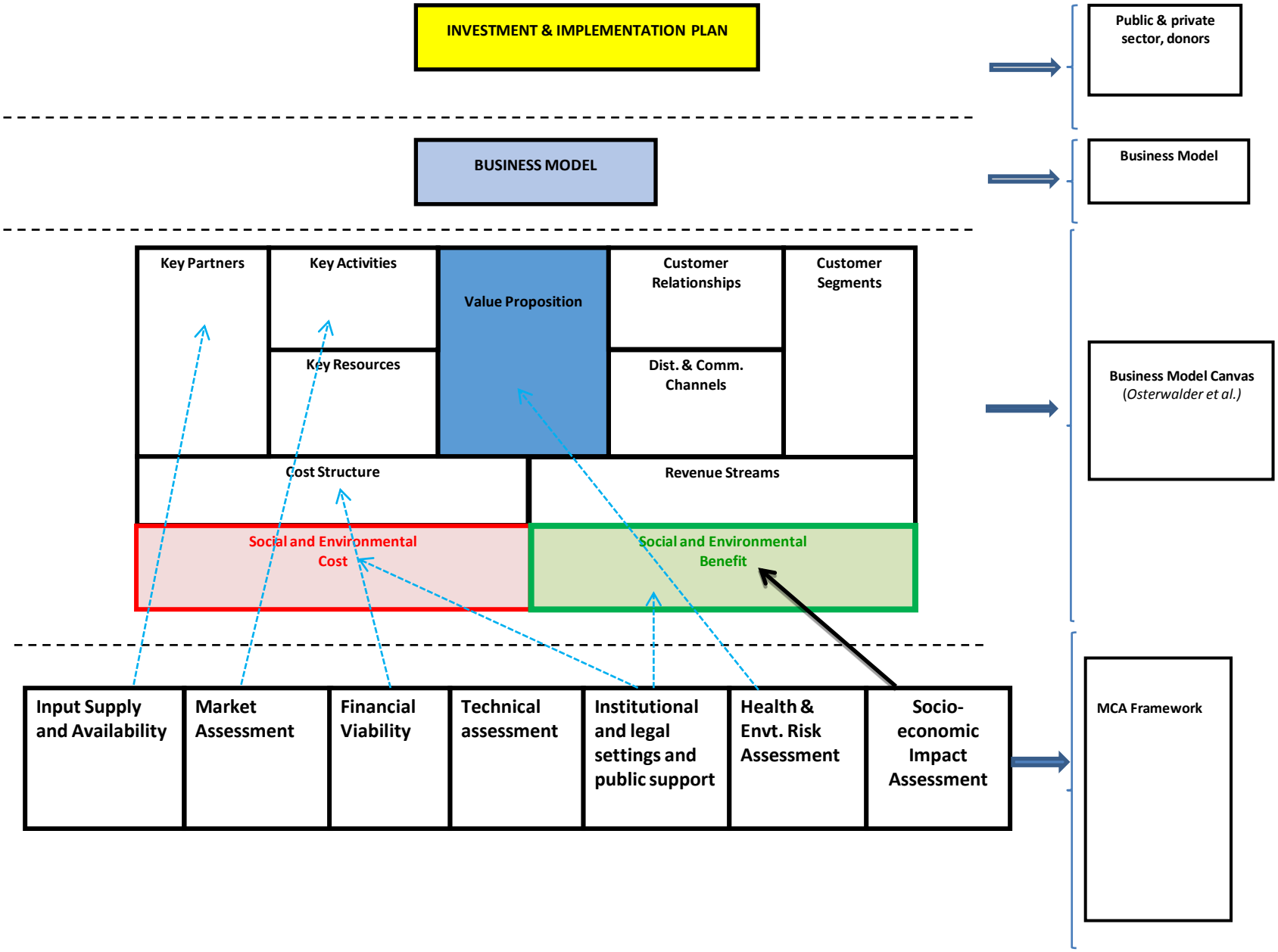

ACCESS TO TOILET
EMPTYING & TRANSPORT
TREATMENT
DISPOSAL OR REUSE

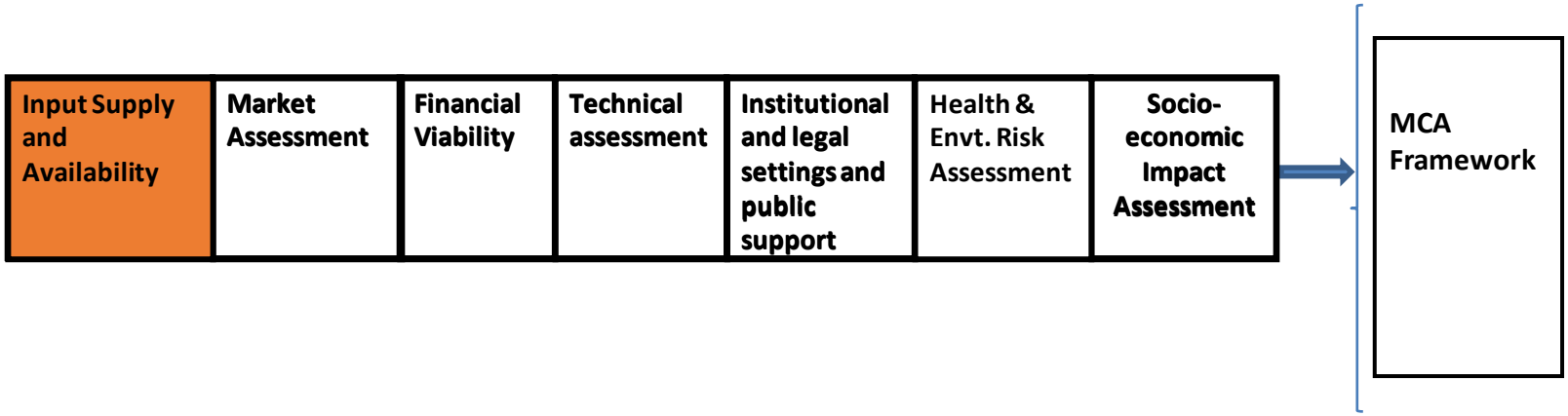
Call-Center


O & M
CAPITAL
O & M
CAPITAL
DISPOSE TREATED SLUDGE
LANDFILL
HOUSEHOLD PUBLIC TOILET BUSINESS
EMPTY SLUDGE
COLLECTION FEES
PRIVATE TRUCK OPERATOR
EMPTY SLUDGE
DISPOSAL FEES
FECAL SLUDGE TREATMENT PLANT (PUBLIC OR PPP)
DRIED SLUDGE DELIVERED
FARMER AND LANDSCAPE
REQUEST FOR EMPTYING
BIDS FOR DESLUDGING
FIXED COMMISSION
AWARD CONTRACT WITH LOWEST BID
CAPITAL AND O&M BUDGET SUPPORT
MUNICIPAL RUN CALL CENTER
MUNICIPALITY
SERVICE FLOWS
FINANCIAL FLOWS
INSTITUTIONAL RELATIONSHIPS

Fecal Sludge Management

Feasibility study results from India, Ghana, and Sri Lanka


INVESTMENT & IMPLEMENTATION PLAN
Public & private sector, donors
BUSINESS MODEL
Business Model
Key Partners
Key Activities
Key Resources
Value Proposition
Customer Relationships
Dist. & Comm. Channels
Customer Segments
Cost Structure
Revenue Streams
Social and Environmental Cost
Social and Environmental Benefit
Business Model Canvas (Osterwalder et al.)
Input Supply and Availability
Market Assessment
Financial Viability
Technical assessment
Institutional and legal settings and public support
Health & Envt. Risk Assessment
Socio-economic Impact Assessment
MCA Framework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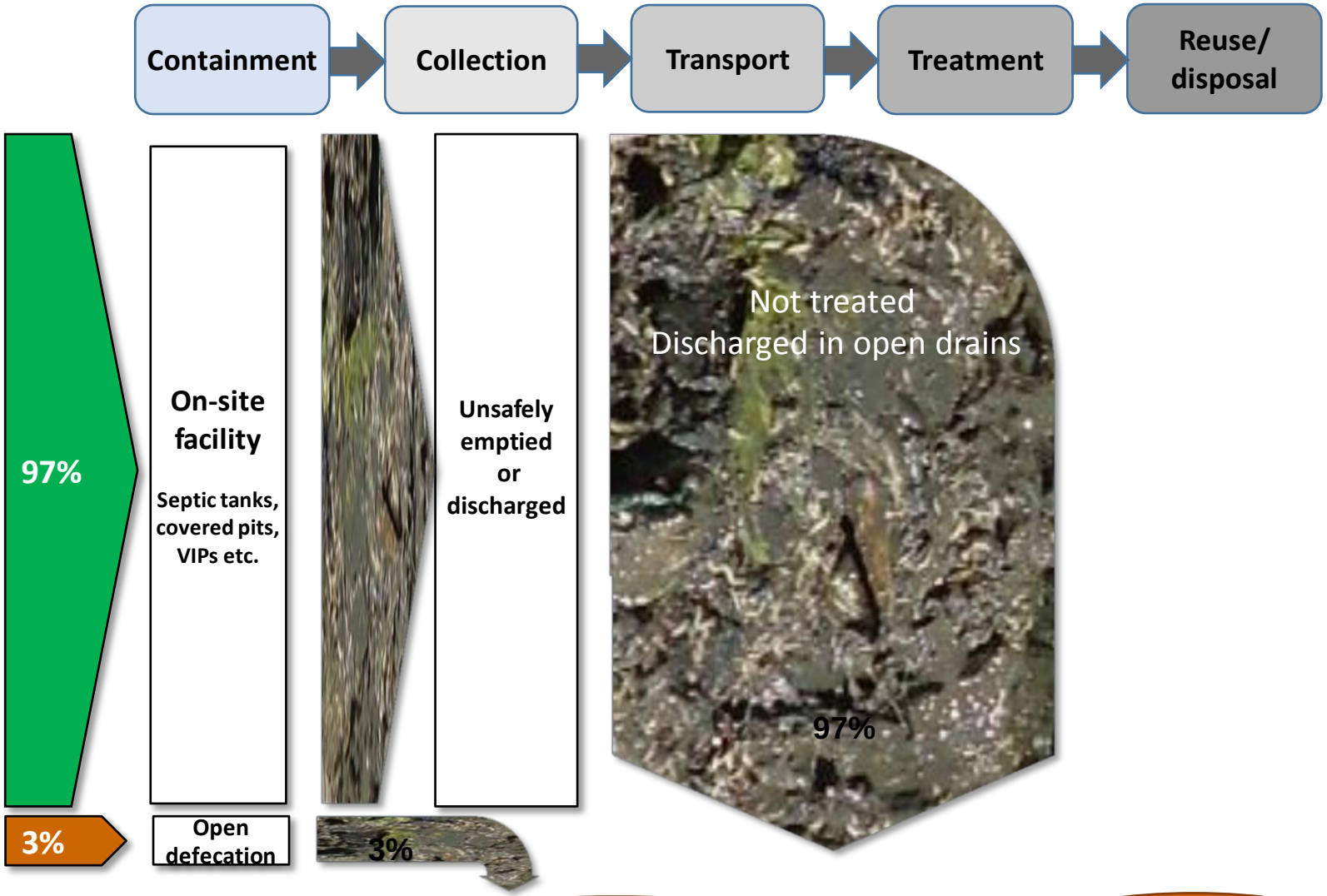
Gangaghat (based on Survey)



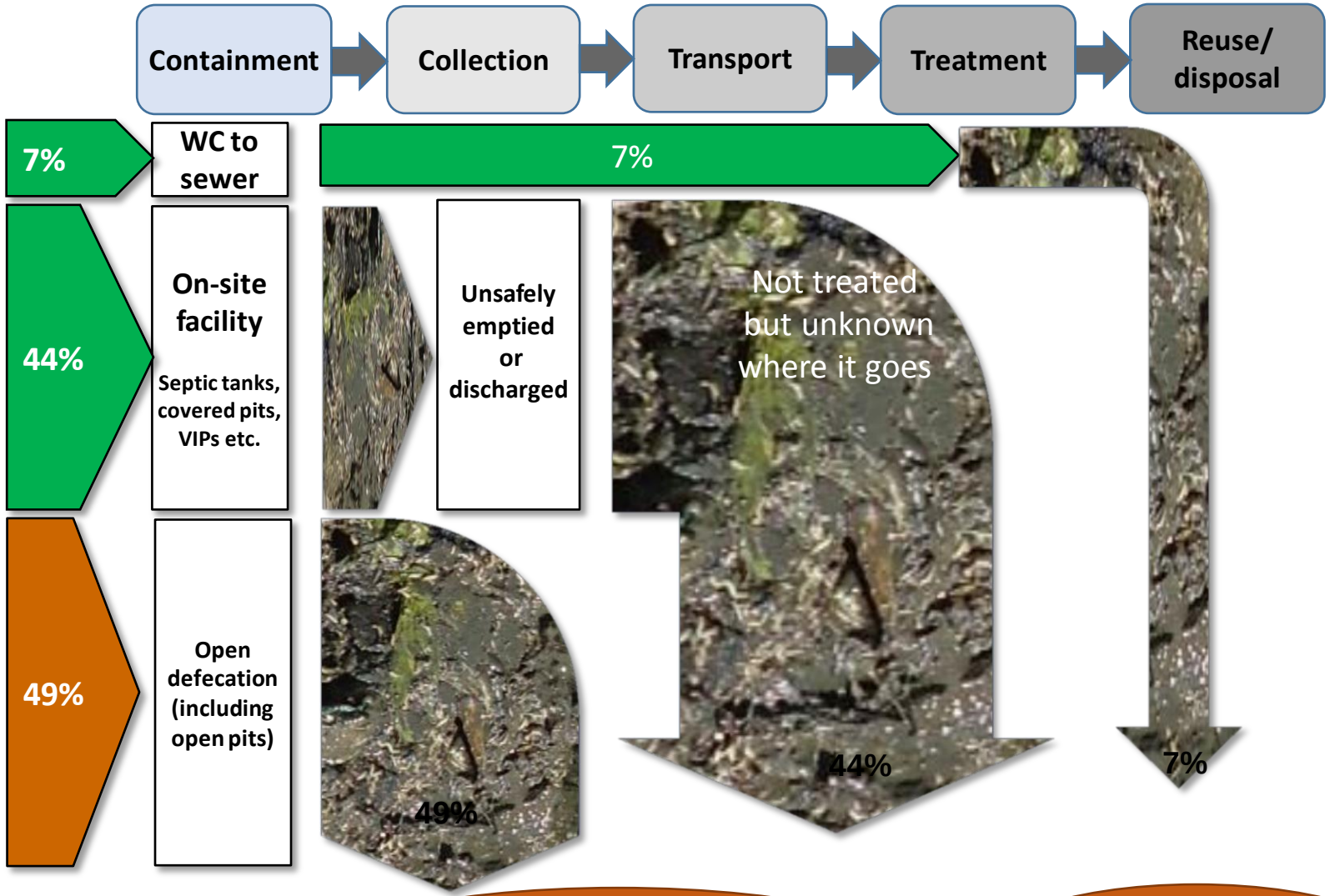
Source: Sample HH Survey

100%

Land, and indirectly to ground and surface waters via percolation or run-off

Directly to surface waters, via drains and/or sewers

Mughalsarai (Survey data)



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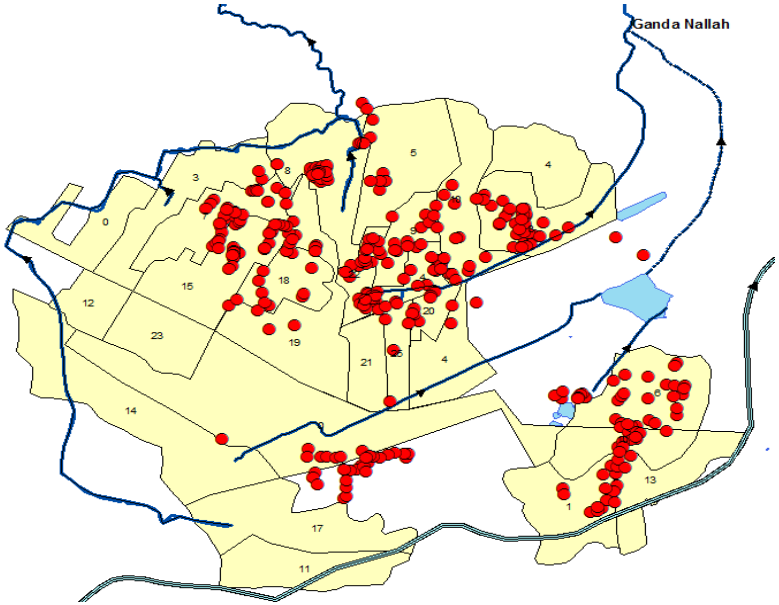
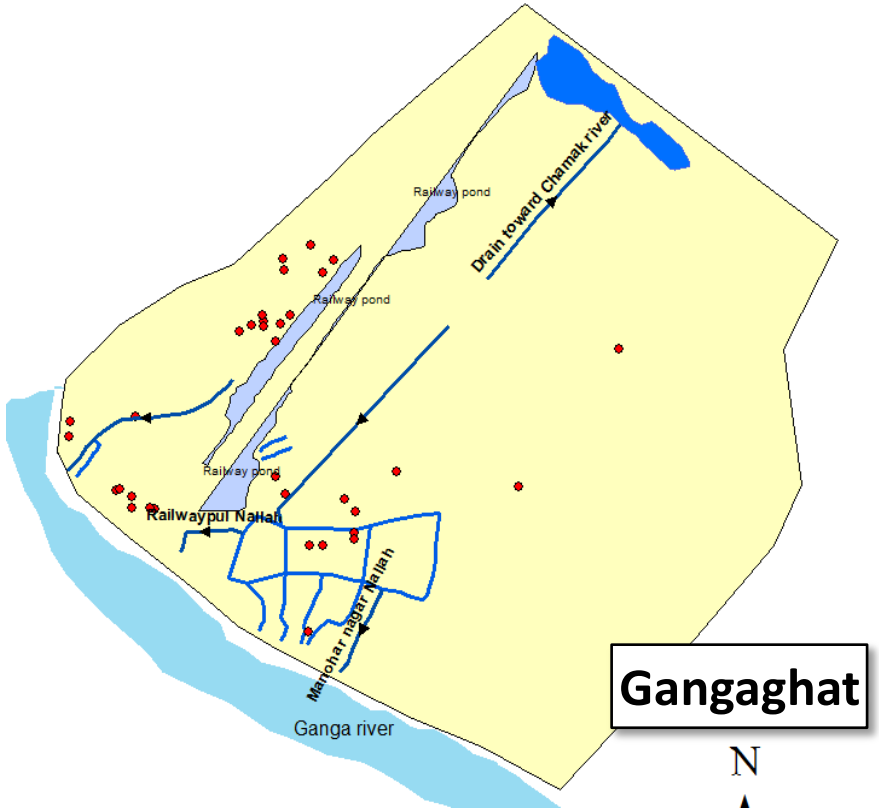
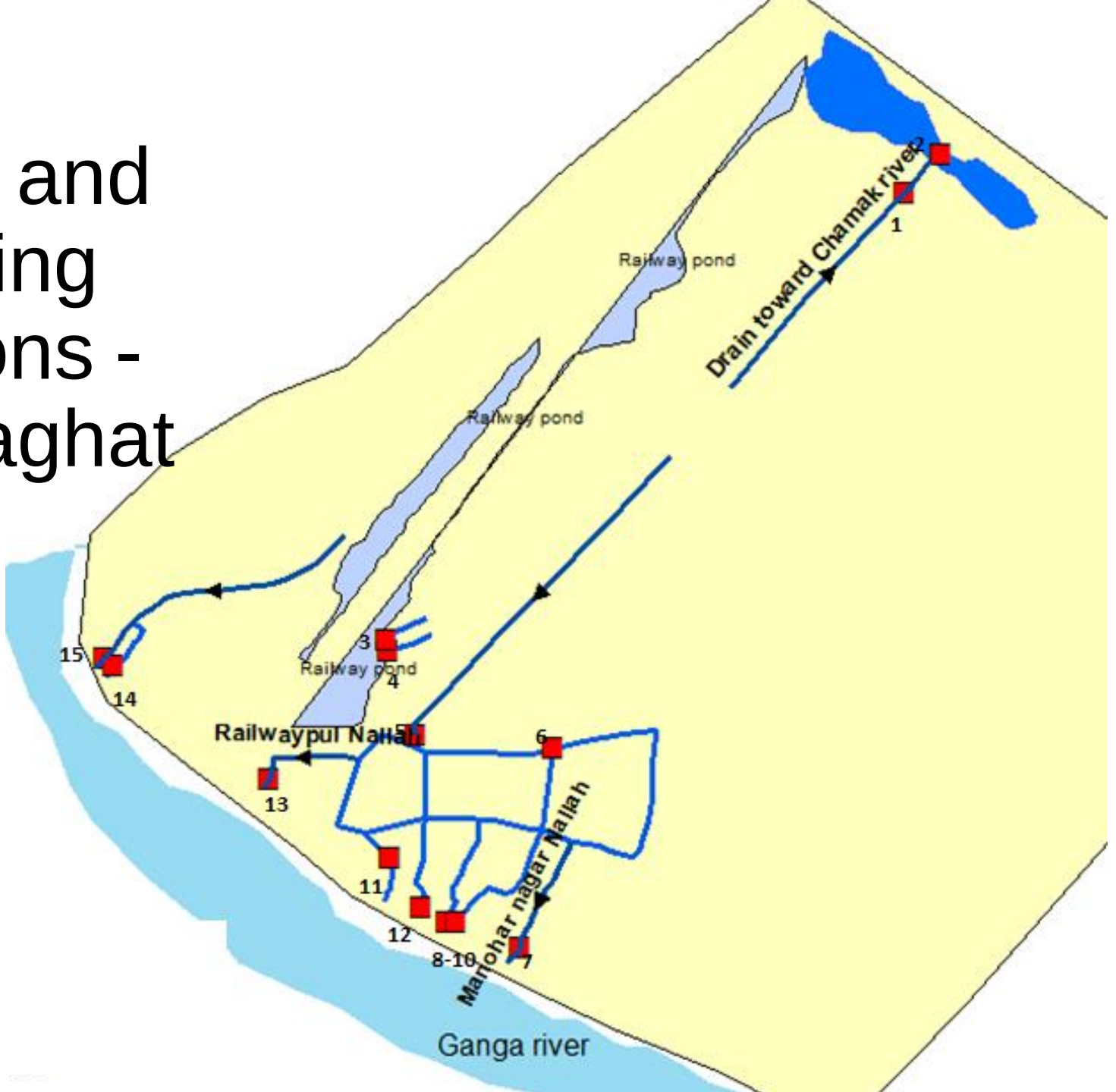
Households Practicing Open Defecation

Mughalsarai





Open drains and sampling locations - Gangaghat



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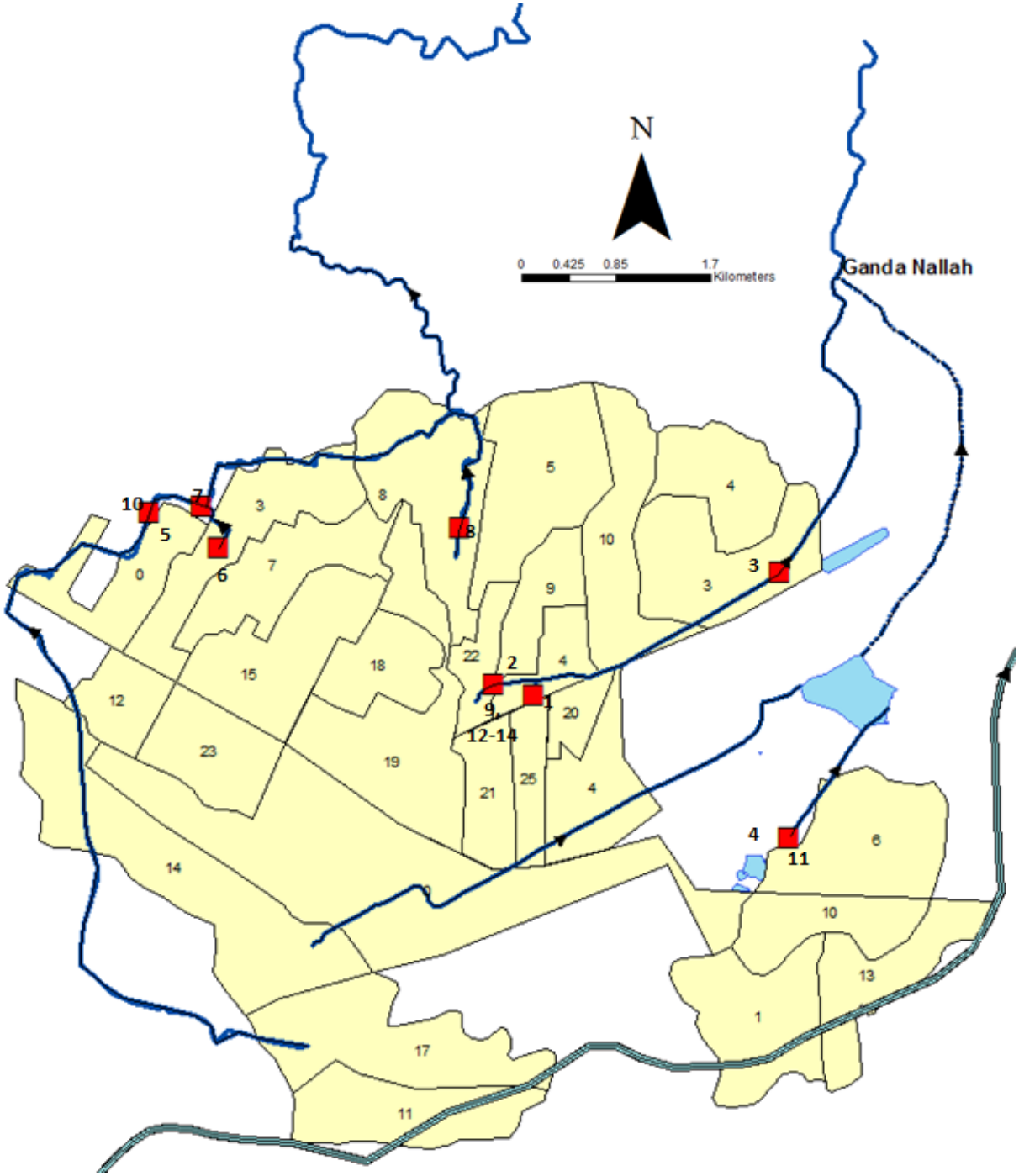
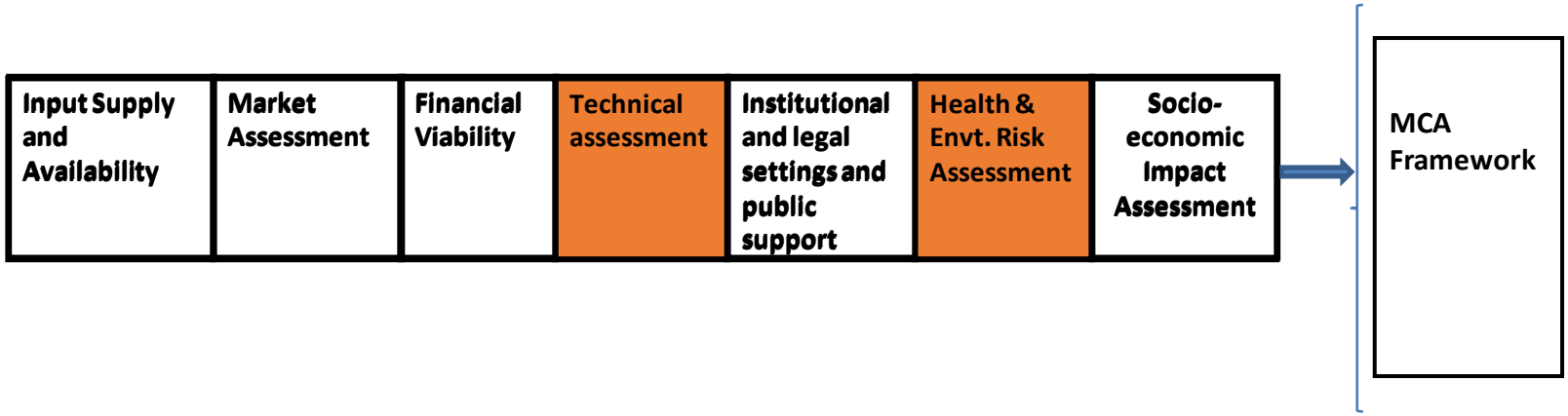


Pollution loads from open drains (kg/d)

City	Dry weather							
	WW (MLD)	BOD Load	COD	TN	TP	NO_3	TS	VS
Unnao	**39**	2,639	8,796	7,919	210	519	43,678	6,657
Gangag hat	**35**	4,498	14,996	7,114	368	691	53,438	9,642
Mughals arai	**122**	4,699	15,728	10,541	127	2,282	170,620	39,059
City	**Wet weather**							
	WW (MLD)	BOD Load	COD	TN	TP	NO_3	TS	VS
Unnao	**58**	3,383	11,340	2,679	399	406	54,869	10,240
Gangag hat	**42**	3,833	12,783	5,462	468	451	64,192	12,052
Mughals arai	**374**	18,254	60,852	37,058	1,771	7,897	496,395	137,539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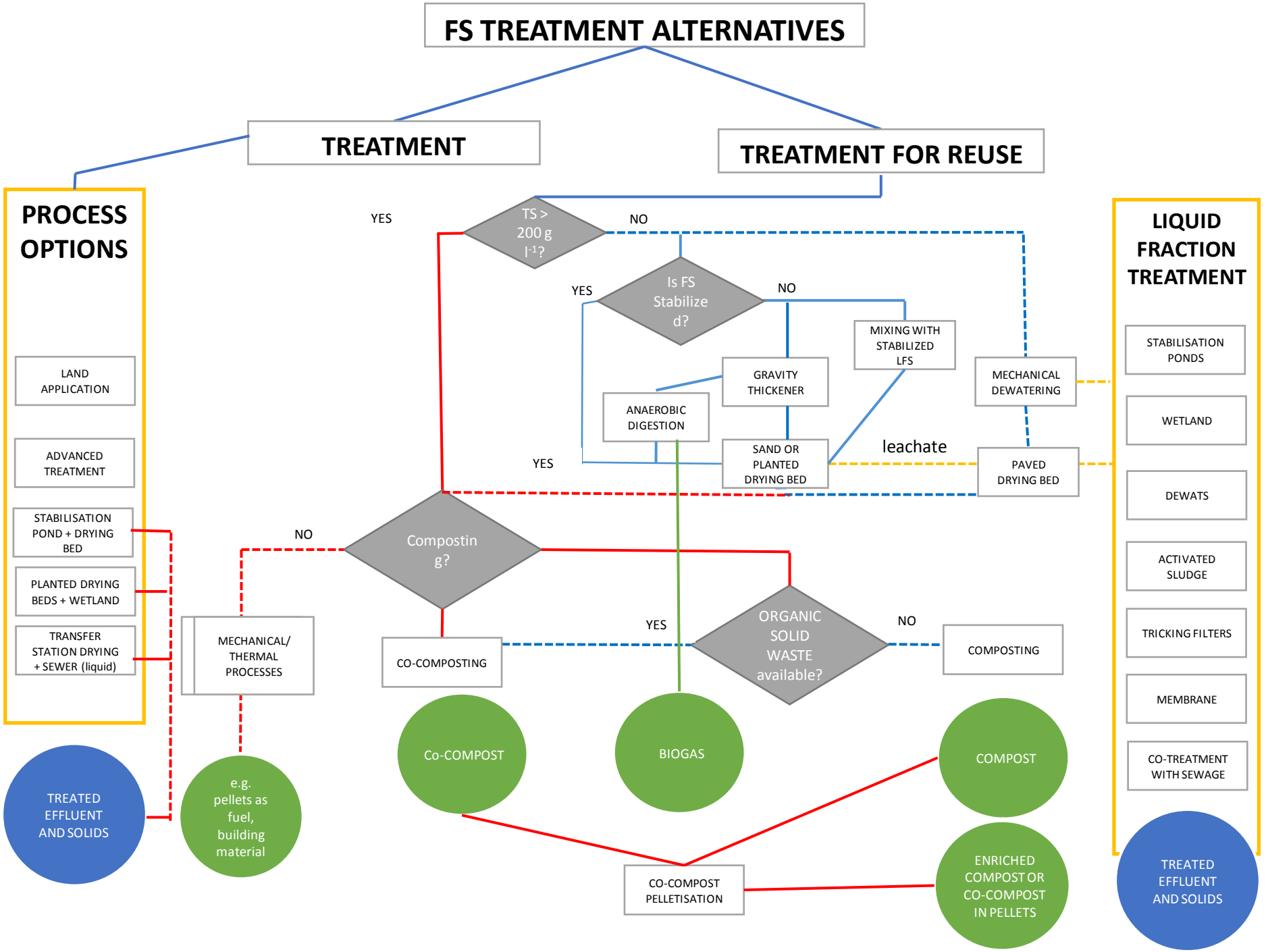
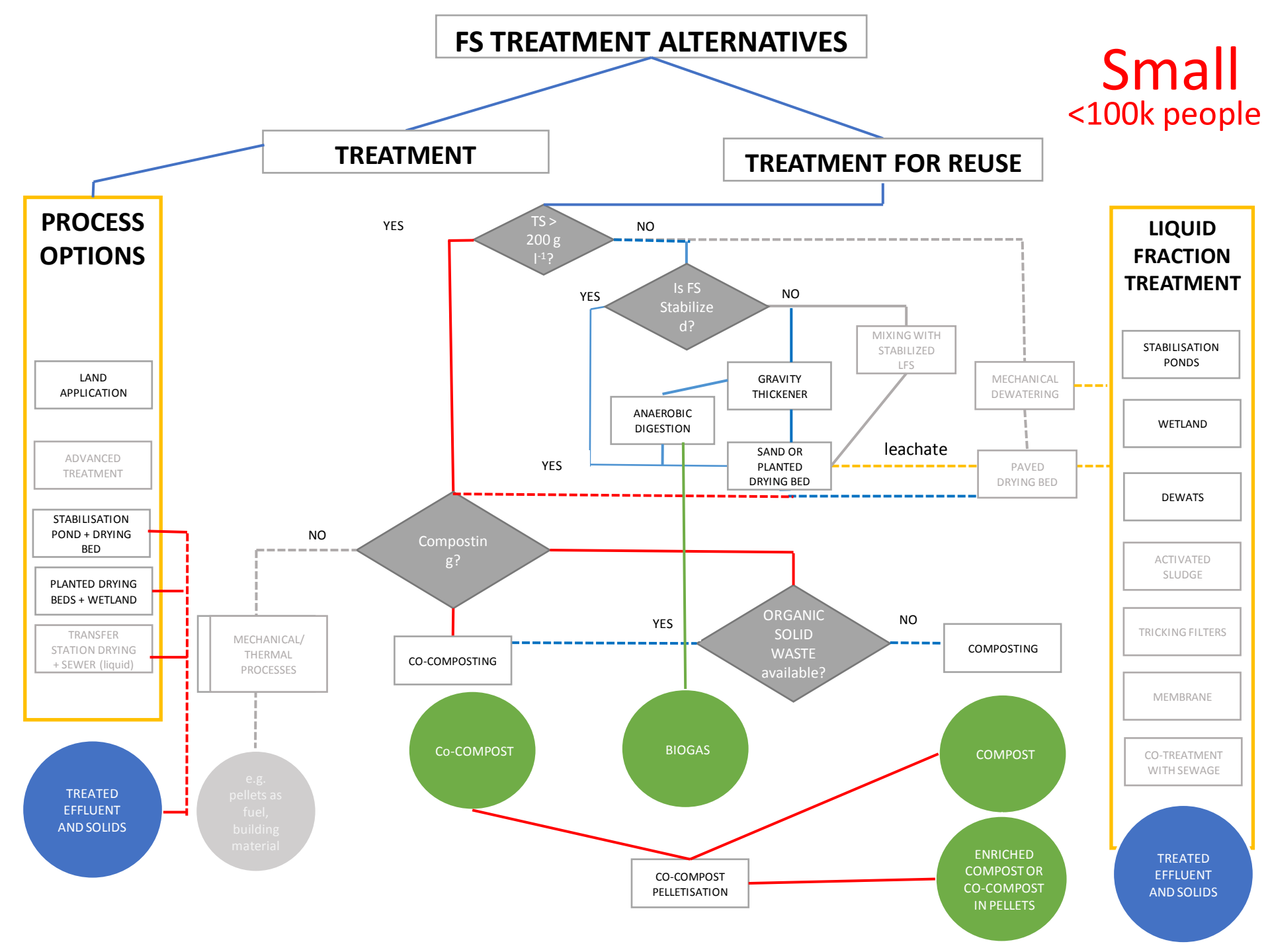

FS TREATMENT ALTERNATIVES
TREATMENT
TREATMENT FOR REUSE
PROCESS OPTIONS
LAND APPLICATION
ADVANCED TREATMENT
STABILISATION POND + DRYING BED
PLANTED DRYING BEDS + WETLAND
TRANSFER STATION DRYING + SEWER (liquid)
TREATED EFFLUENT AND SOLIDS
MECHANICAL/ THERMAL PROCESSES
e.g. pellets as fuel, building material
TS > 200 g l-1?
YES
NO
Is FS Stabilized?
YES
NO
MIXING WITH STABILIZED LFS
GRAVITY THICKENER
ANAEROBIC DIGESTION
SAND OR PLANTED DRYING BED
MECHANICAL DEWATERING
leachate
PAVED DRYING BED
YES
Composting?
NO
CO-COMPOSTING
Co-COMPOST
ORGANIC SOLID WASTE available?
YES
NO
BIOGAS
COMPOSTING
COMPOST
CO-COMPOST PELLETISATION
ENRICHED COMPOST OR CO-COMPOST IN PELLETS
LIQUID FRACTION TREATMENT
STABILISATION PONDS
WETLAND
DEWATS
ACTIVATED SLUDGE
TRICKING FILTERS
MEMBRANE
CO-TREATMENT WITH SEWAGE
TREATED EFFLUENT AND SOLIDS


FS TREATMENT ALTERNATIVES
Small
<100k people
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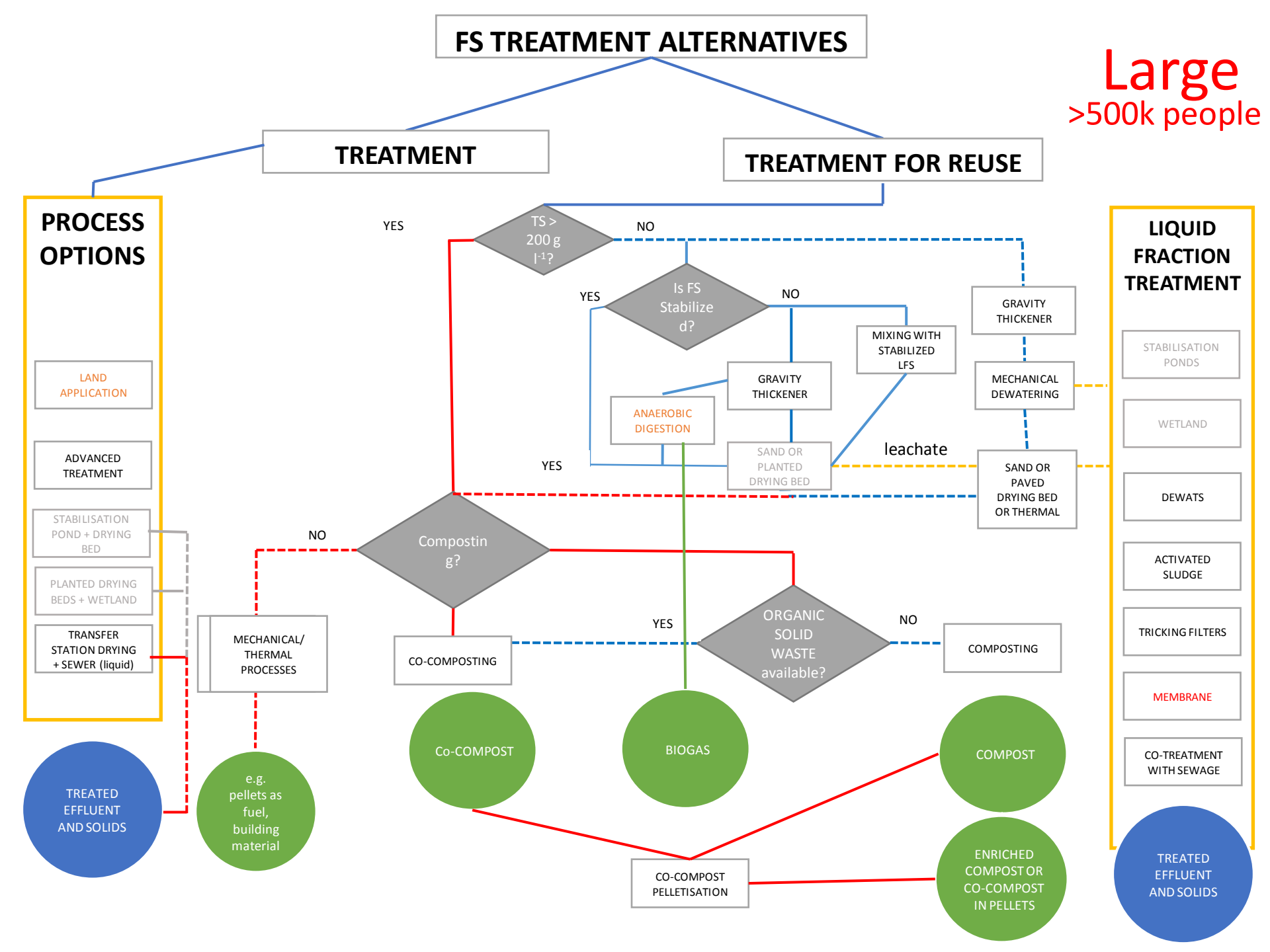
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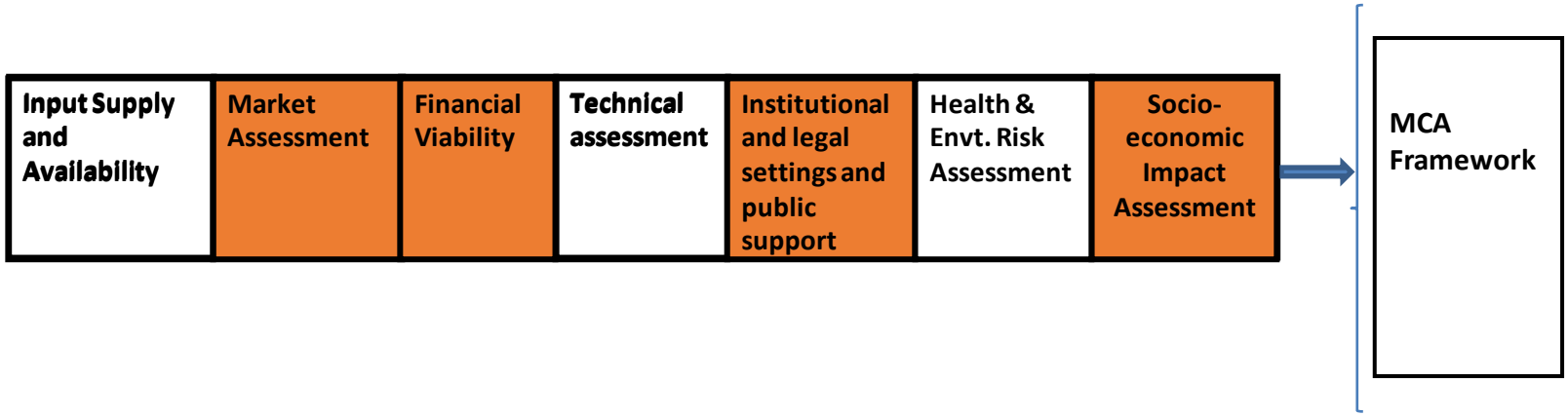
Tool - Septage Treatment Technology Comparison

Technology	Capital (USD)	O&M (USD/yr)	Area (m2)	Energy (kWh/d)	Application Area (ha/yr)
RRR1 -Gravity Thickner + (a)Sand or (b)Planted Drying Beds + (a)Ponds or (b)Wetland + Composting + Enrichment + Pellitisation					
TOTAL aa (Sand+Pond)	$ 459,264.25	$ 89,076.02	9347	42	214
TOTAL ba (Planted +Pond)	$ 606,499.96	$ 96,437.80	12997	42	214
TOTAL bb (Planted + Wetland)	$ 580,376.62	$ 95,131.64	11729	42	214
RRR2 - Gravity Thickner + (a)Sand or (b)Planted Drying Beds + (a)Ponds or (b)Wetlands + Co-composting + Enrichment + Pellitisation					
TOTAL aa (Sand+Pond)	$ 1,397,779.76	$ 453,749.25	28448	42	891
TOTAL ba (Planted +Pond)	$ 1,545,015.48	$ 461,111.04	32098	42	891
TOTAL bb (Planted + Wetland)	$ 1,518,892.14	$ 459,804.87	30830	42	891
T1 - Stabilisation Pond + Drying Bed					
TOTAL	$ 194,596.06	$ 13,621.72	8538	0	Low
T2					
TOTAL	$ 321,710.88	$ 22,519.76	7725	0	Low
RRR3 - Land Application					
TOTAL	0	0		0	45.0

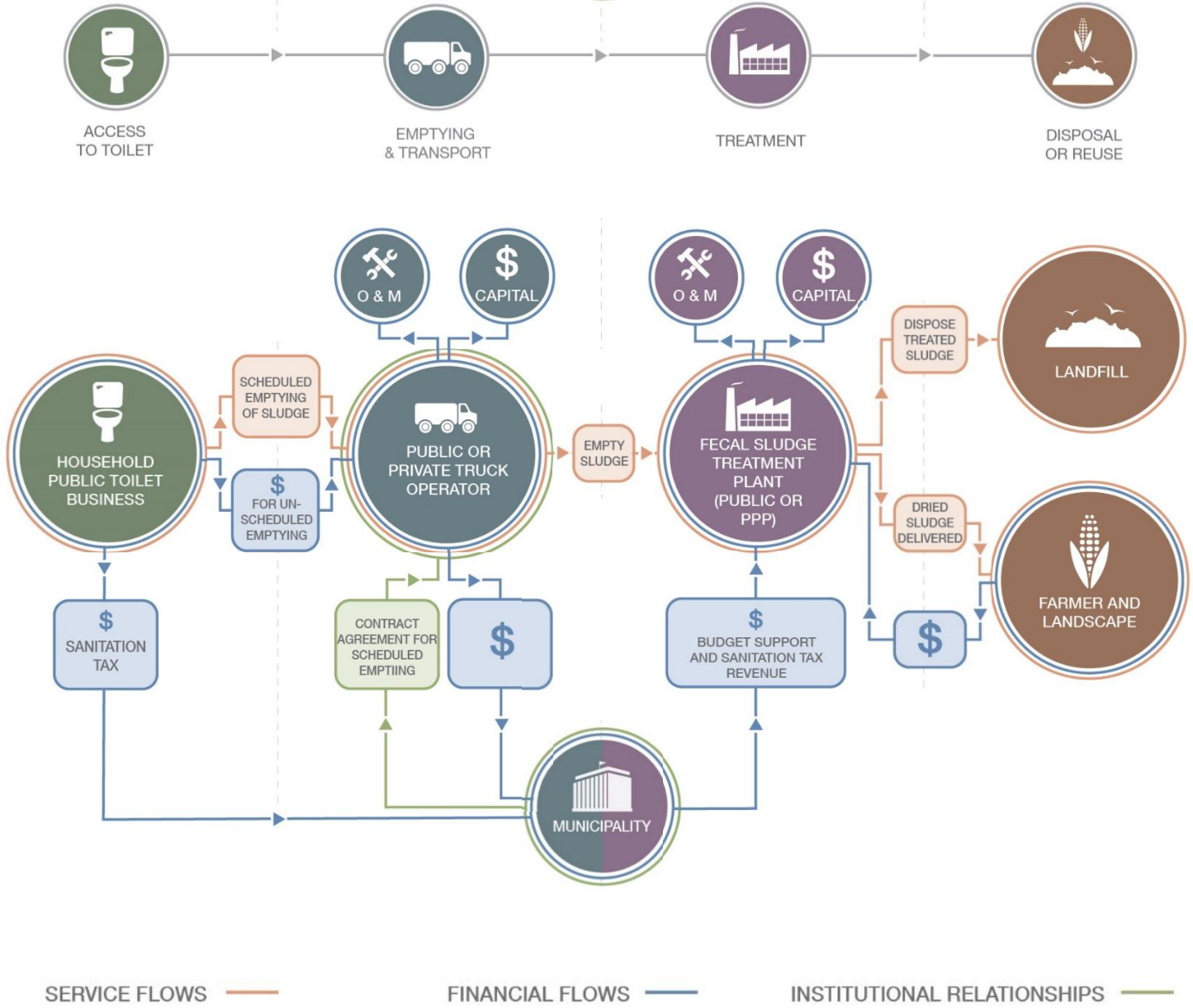
Sand Drying Bed + Wetland for Composting

Sand Drying Bed + Wetland for Co-Composting

Stabilisation Pond + Drying Bed for Treatment only


Input Supply and Availability
Market Assessment
Financial Viability
Technical assessment
Institutional and legal settings and public support
Health & Envt. Risk Assessment
Socio-economic Impact Assessment
MCA Framework

Scheduled Desludging with Sanitation Tax



Cases: Philippines, Vietnam and Indonesia

Dumaguete

- Population: 0.12 million - about 75% septic tank coverage)
- Service by Municipality
- Tariff: 2 pesos (USD 5 cents) per m^3 of water consumed
- Covers O&M and capital costs in 8 years

San Fernando

- Population: 115,000
- Service by Private sector
- Fees through property tax

Hai Phong

- Population: 1.8 million
- Service by state run utility company
- Wastewater fee – 15% surcharge added to the water bill
- Water tariff of USD 0.29/m^3 and daily consumption of 0.54m^3
- Recover O&M costs

Co-Composting

- Implementing PPP FSTP in Accra
- Guiding municipalities on FSTP in Sri Lanka and Nepal
- Agronomic Trials
  - Compost quality
  - Enrichment
  - Pelletization
- High applicability in smaller towns to treat both solid and liquid waste

Co-Composting Cases

Balangoda, Sri Lanka

Owner/Operator: Public

Waste: 12 ton MSW/day and 10 m^3 FS/day

Capital: INR 2.1 crores
O&M: INR 85K/month

Revenue:
- FS collection: INR 1,800 to 2,000 per trip
- Compost: INR 4 per kg (2 tons/day)
- Recyclable & MSW fees

Accra,Ghana

Owner/Operator: PPP

Waste: 50-60 m^3 FS/day and 3 tons/day organic waste

Capital: INR 3.3 crores
O&M: INR 6.5 to 8 lakhs

Revenue:
- Tipping fees: INR 130 per truck
- Compost: INR 18 to 20 per kg (2 to 4 tons/day)

Operational cost breakeven in 3 to 5 years

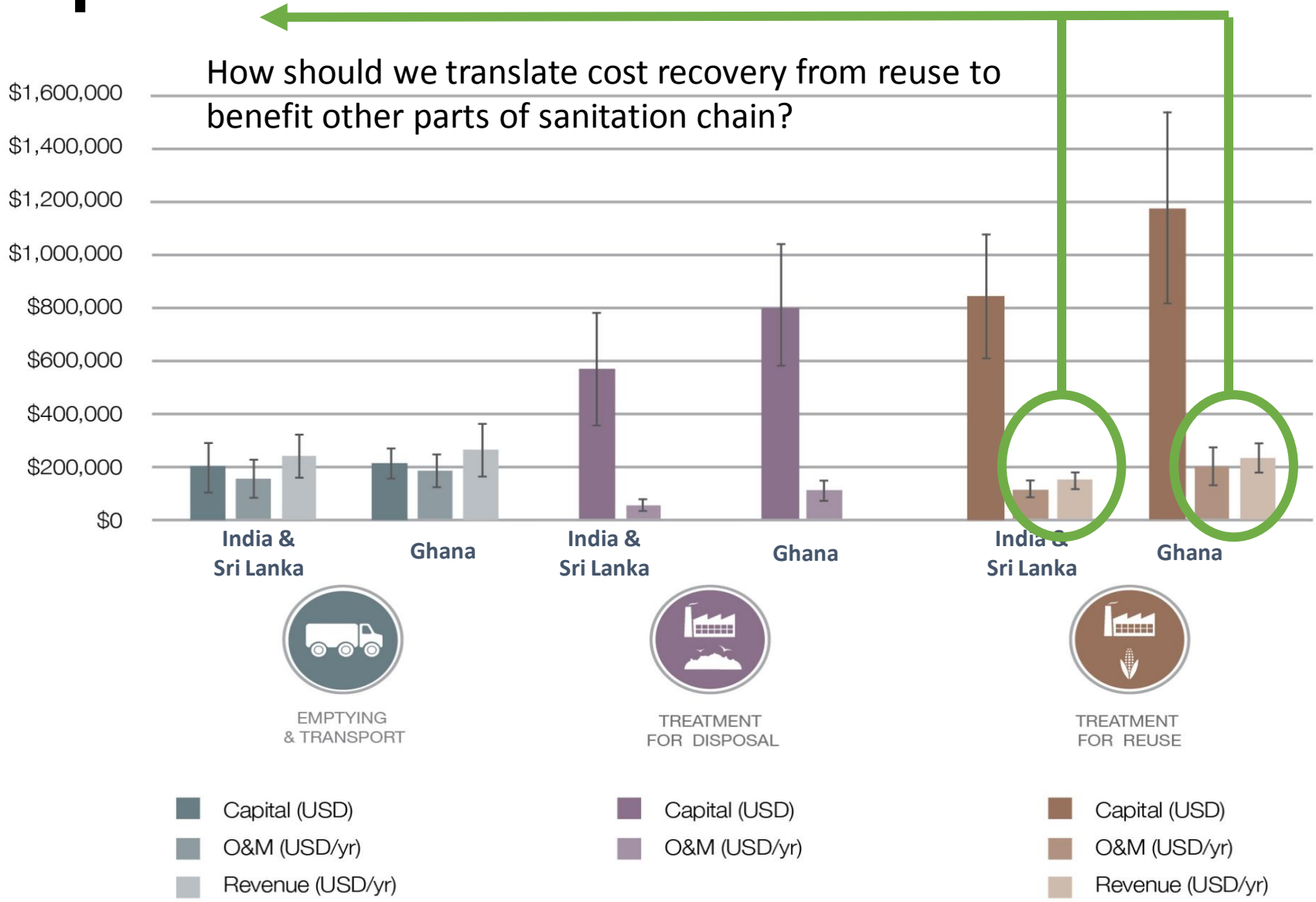
Madhya Pradesh, India

Waste: 40m^3 FS/day and 12.8 tons MSW/day

Capital: INR 4.4 crores
O&M: INR 4 lakhs/month

Revenue:
- FS collection: INR 1,000 to 1,900 per trip
- Compost: INR 1.4 to 4 per kg – 4.4 tons/day

CAPEX and OPEX for 100,000 population

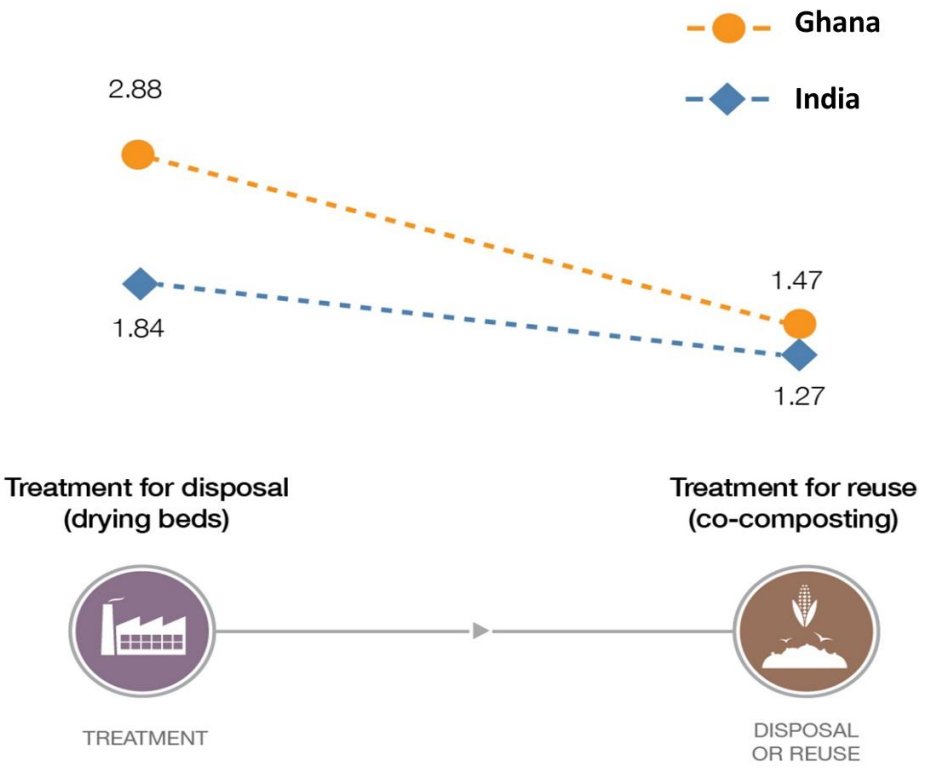


Cost Recovery from Reuse – User Charges

Case Example

Three neighboring towns in Madhya Pradesh (population of 7,784 households)

- Fecal Sludge: about 40 m^3
- MSW: 12.8 tons of MSW per day
- Compost: 4.4 tons per day
- Sale price of compost in India: INR 1,400 to INR 4,000 per ton



Cost Recovery

- User charges: INR 84 to 122 per household per month
- Reduction in user charges from sale of compost: INR 20 to INR 57 per month (depending on the sale price)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Greywater and Fecal Sludge with
Reference to West Africa
RESOURCE RECOVERY & REUSE SERIES 3
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Recycling of Nutrients and Organic M
from Waste through Co-composting
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RESOURCE RECOVERY & REUSE SERIES 6
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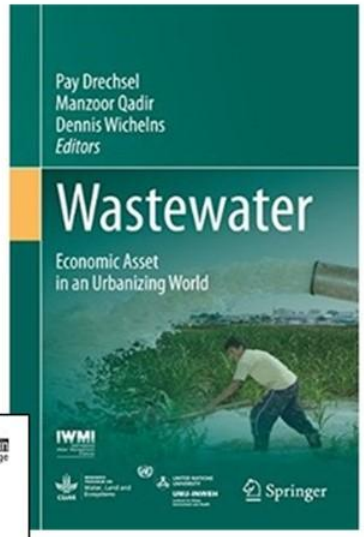

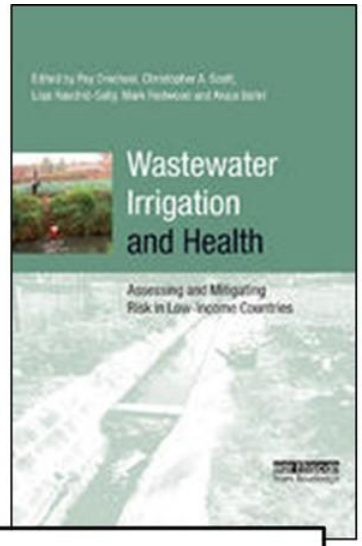

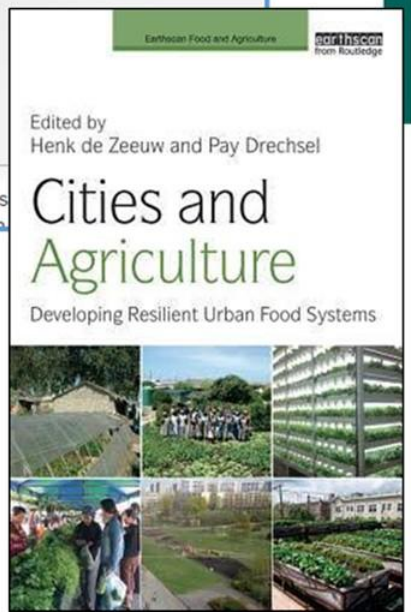

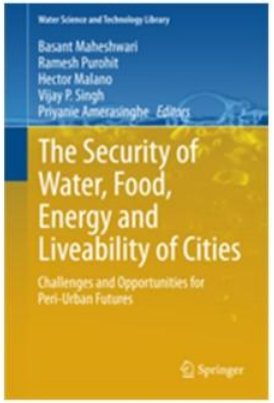

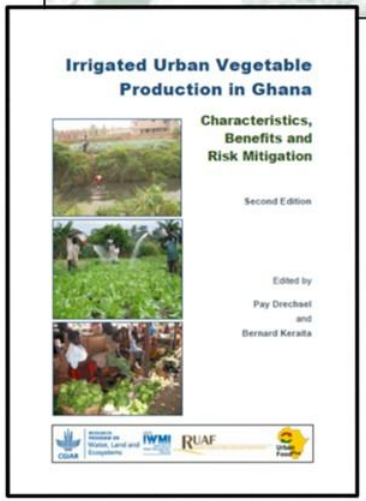

RRR books

with UN or uptake partners

Thank You


To you it's Shit. To us it's
BREAD & BUTTER
Shit Business is Serious Business

Pollution from Septic Tanks

Insufficient treatment provided to overflow from the septic tank

City	Not connected to Soak-pit (Percent)	Connected to soakpit (Percent)
Mughalsarai	42	58
Shuklaganj	96	4
Unnao	96	4
Total	90	10

Improper management of septic tank sludge

City	HH	HHs with ST (%)	Avg vol of STs (m^3)	STs emptied (%)	Septage Generation (m^3/day)
Mughalsarai	16,796	28	14	6	3
Unnao	33,273	68	13	35	68
Gangaghat	17,210	95	20	55	120

Pollution loads from open drains (kg/d)

City	Dry weather							
	WW (MLD)	BOD Load	COD	TN	TP	NO_3	TS	VS
Unnao	**39**	2,639	8,796	7,919	210	519	43,678	6,657
Gangag hat	**35**	4,498	14,996	7,114	368	691	53,438	9,642
Mughals arai	**122**	4,699	15,728	10,541	127	2,282	170,620	39,059
City	**Wet weather**							
	WW (MLD)	BOD Load	COD	TN	TP	NO_3	TS	VS
Unnao	**58**	3,383	11,340	2,679	399	406	54,869	10,240
Gangag hat	**42**	3,833	12,783	5,462	468	451	64,192	12,052
Mughals arai	**374**	18,254	60,852	37,058	1,771	7,897	496,395	137,539

Key Findings

Gangaghat:

The city of Gangaghat contributes a significant quantity of flow and pollution load despite being the smallest city. This is likely due to the direct physical connection between the city and the River. The flows generated within the city are directly routed into the river.

Mughalsarai:

The open drains flowing through the city of Mughalsarai contribute a large quantum of flow, far in excess of the expected flow from a similar sized city, and significantly greater than the flows generated from the other cities. This is likely a result of agricultural runoffs and flows from surrounding village panchayats flowing through the “Hiloni Pulia” drain, which flows on the boundary of the city. While this drain receives some flow from the city’s households, a major share of the flow may be arising from activities outside the city’s municipal limits.