The Musi River: a case for resource recovery?

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Anil Agarwal Dialogues
Excreta Does Matter
India Habitat Centre, Delhi


Photo: Tom van Cakenberghe/IWMI

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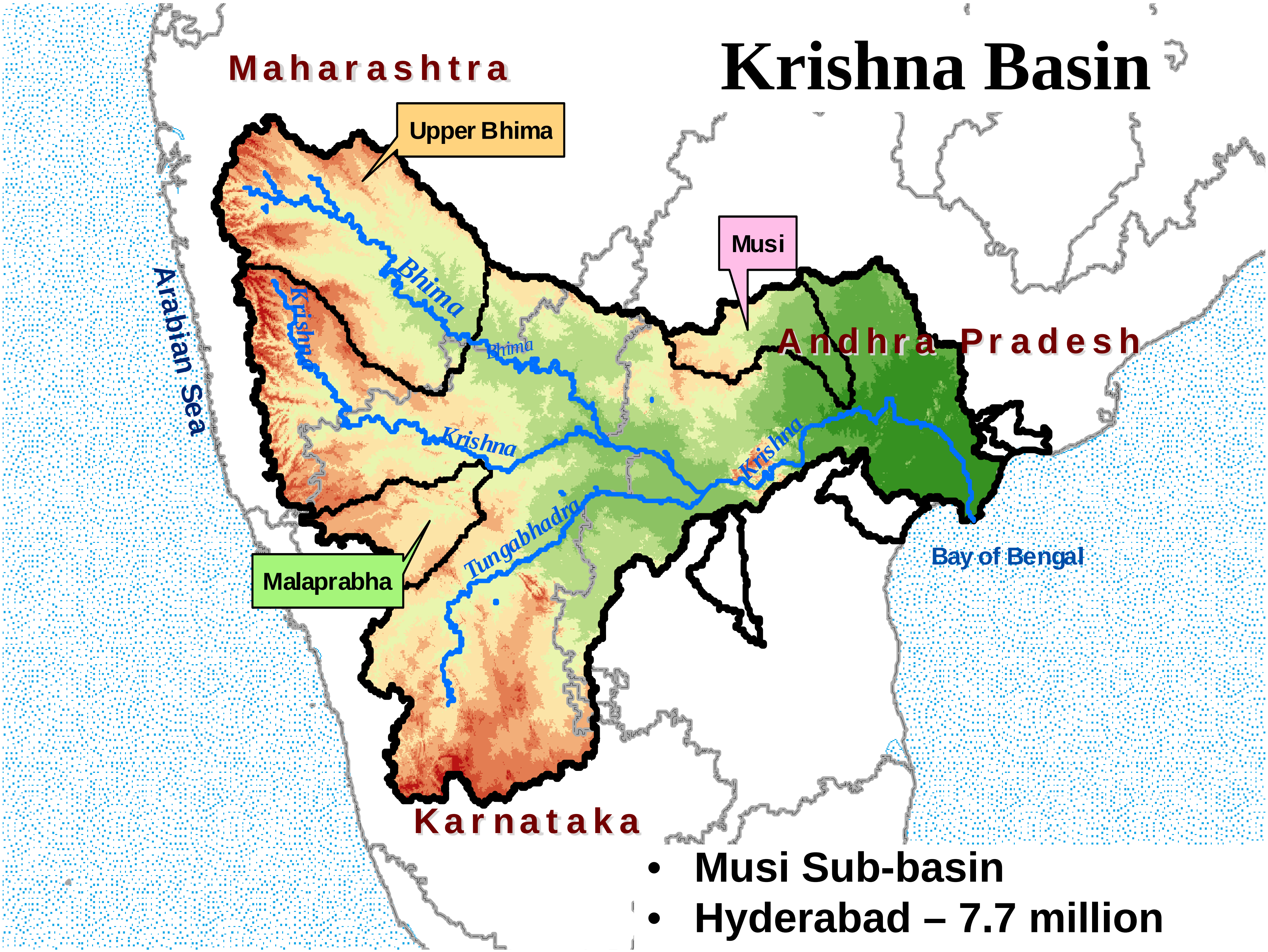
Content

- Musi River
  - Characteristics
  - Pollution

- Health and Agronomic risks

- Looking for solutions: Resource recovery and reuse

Krishna Basin

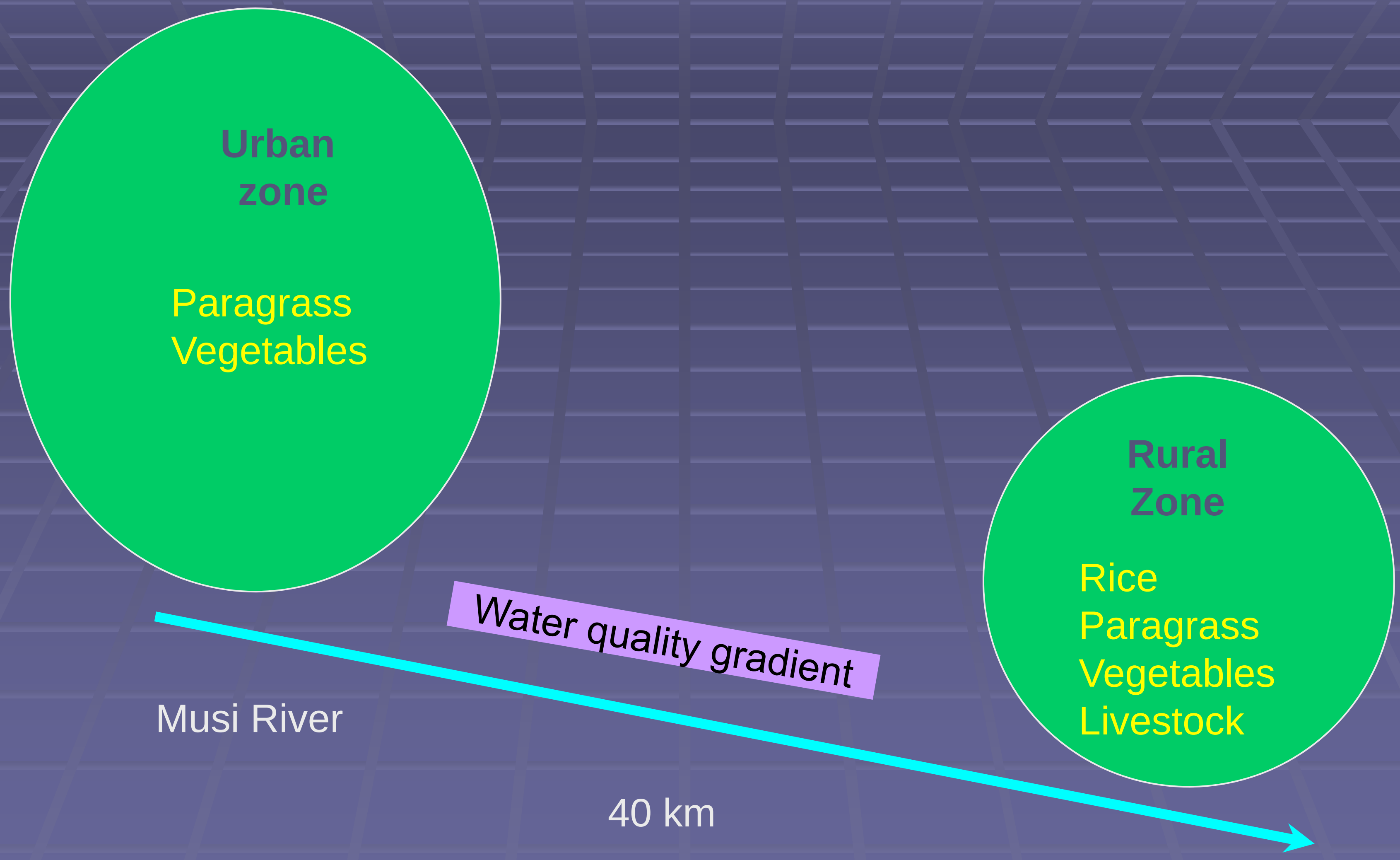


- Musi Sub-basin
- Hyderabad – 7.7 million

Hyderabad - Water Supply
Population – 7.7 million

Source	MLD
Osmansagar	86
Himayathsagar	63
Manjira Barrage	167
Singur Dam	279
Krishna Project	670
Total	**1265**
Ground water	**??**

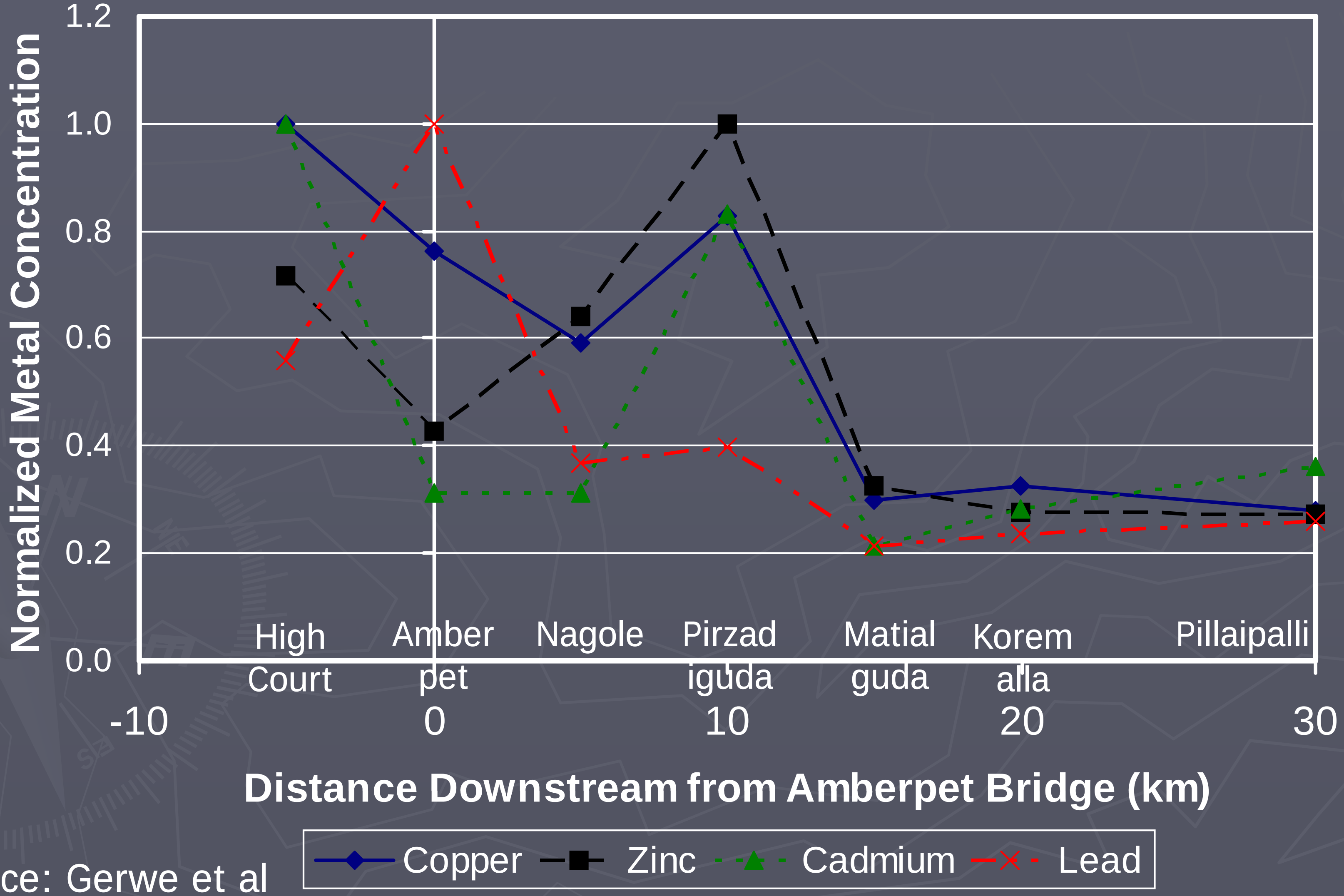
STP	Capacity (mld)	Location	Year of Commission
Amberpet	339	Amberpet	Dec-08
Nagole	172	Nagole	Dec-08
Nallacheru	30	Nallacheru	Jun-09
Attapur	51	Attapur	-
Patel Cheruvu	2.5	Nacharam	Aug-10
Pedda Cheruvu	10	Nacharam	Feb-07
Durgam Cheruvu	5	Madhapur	Nov-07
Mir Alam Cheruvu	10	Near Zoo Park	Feb-07
Saroor Nagar Lake	2.5	Saroornagar	2003
Safil guda Lake	0.6	Malkajgiri	2003
Langer Houz Lake	1.2	Near Golkonda Fort	2003
Noor Mohammad Kunta	4	Rajendra nagar	Mar-09
Ranghadhamini Lake	5	Kukatpally	Jul-12
[illegible]			[illegible]


Urban zone
Paragrass
Vegetables
Rural Zone
Rice
Paragrass
Vegetables
Livestock
Water quality gradient
Musi River
40 km

Water Quality – Selected Parameters

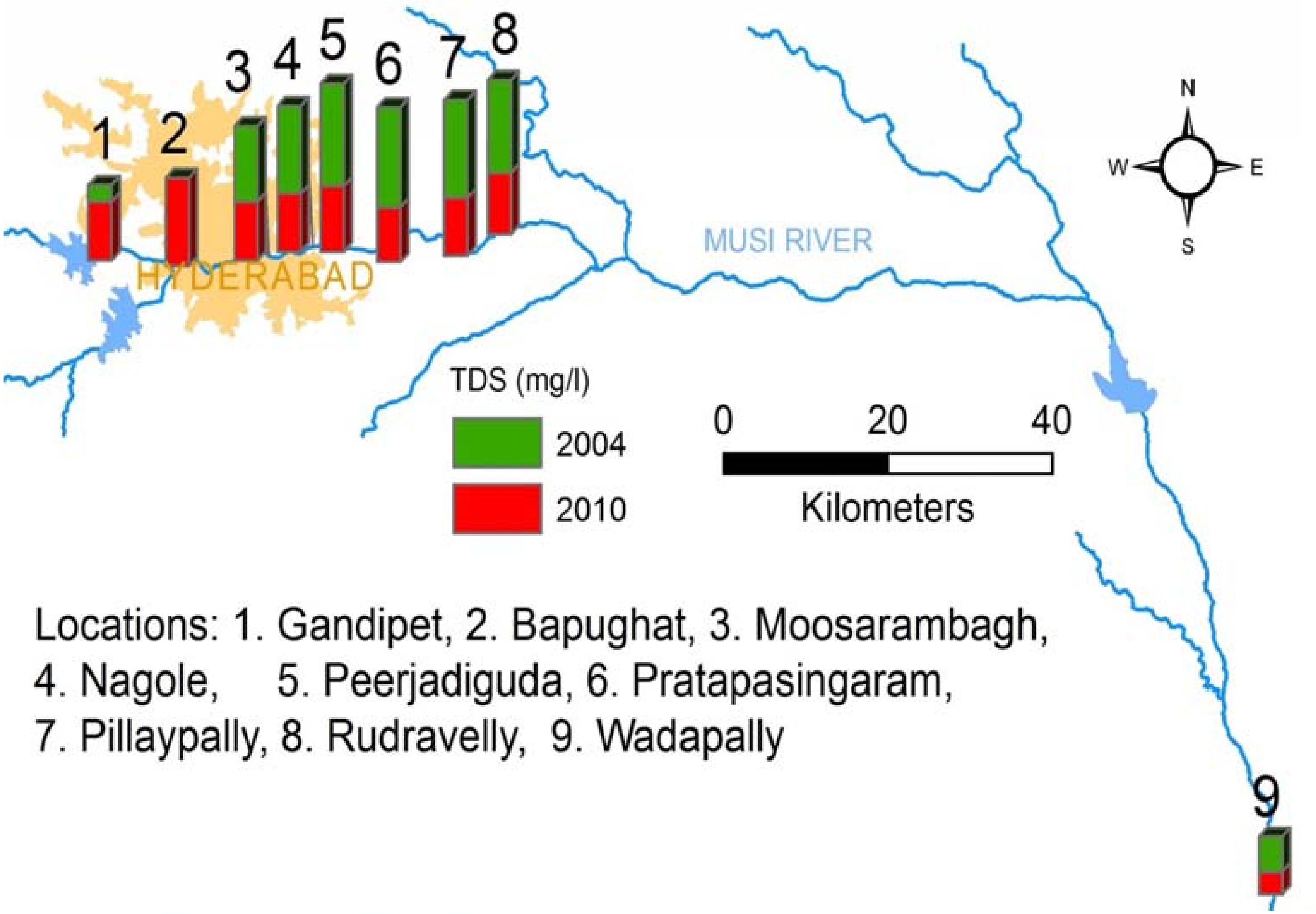
	Amberpet	Gowrelli	Pillaipalli
BOD in mg/L	205.8 (37.1)	77.8 (47.3)	36.2 (10.7)
Nitrate in mg/L	3.3 (1.9)	3.5 (2.6)	3.1 (2.2)
Ammonical Nitrogen in mg/L	32.1 (6.0)	27.5 (6.8)	26.4 (5.7)
EC in µs/cm	1244.8 (242.1)	1545.6 (162.7)	1601.4 (157.5)
Nematode eggs/L	16.9 (18.3)	1.2 (2.8)	0.1 (0.3)
E. coli (cfu/ml)	3×10^6 to 2×10^8	-	1×10^2 to 3×10^3

Heavy Metal Profile in River Sediments:
Mobility restricted to 15 km



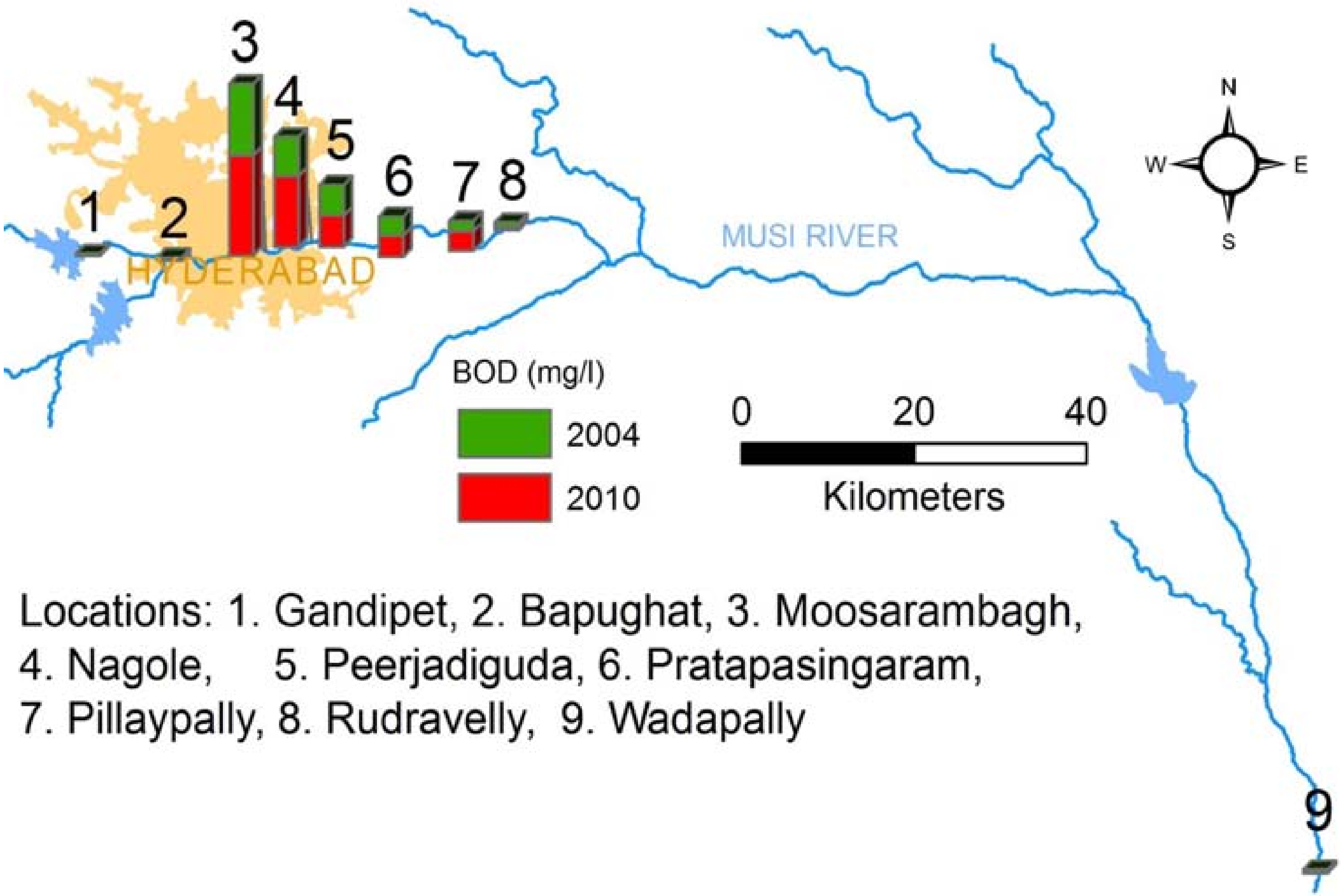
Source: Gerwe et al

Total Dissolved Solids (mg/L)



	2004	2010
1	188	671
2	NA	1000
3	859	672
4	1000	660
5	1169	745
6	1140	624
7	1117	658
8	1058	699
9	402	256

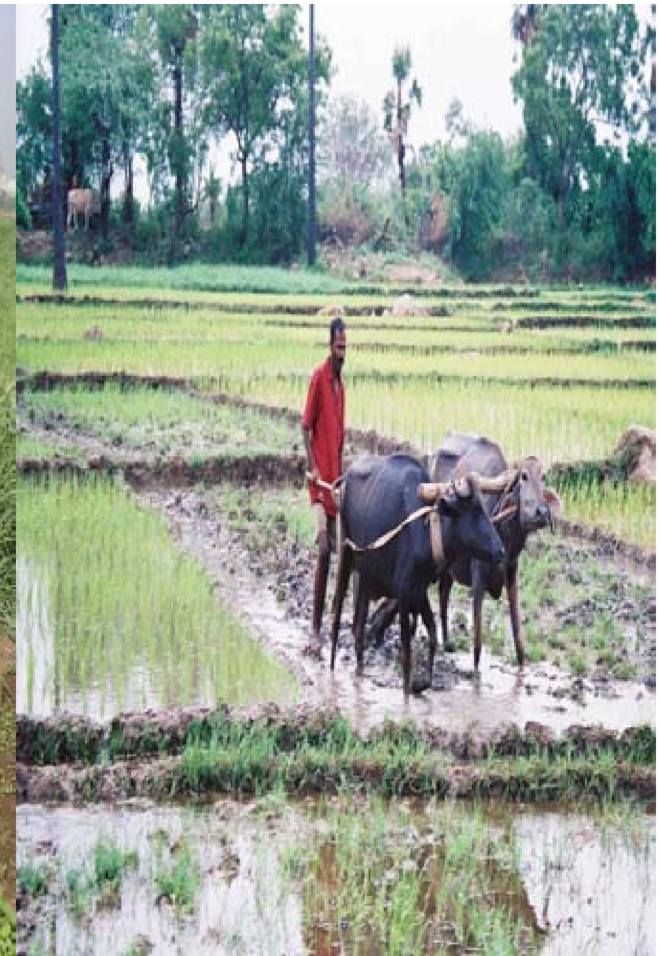
Biological Oxygen Demand mg/L



Locations: 1. Gandipet, 2. Bapughat, 3. Moosarambagh, 4. Nagole, 5. Peerjadiguda, 6. Pratapasingaram, 7. Pillaypally, 8. Rudravelly, 9. Wadapally

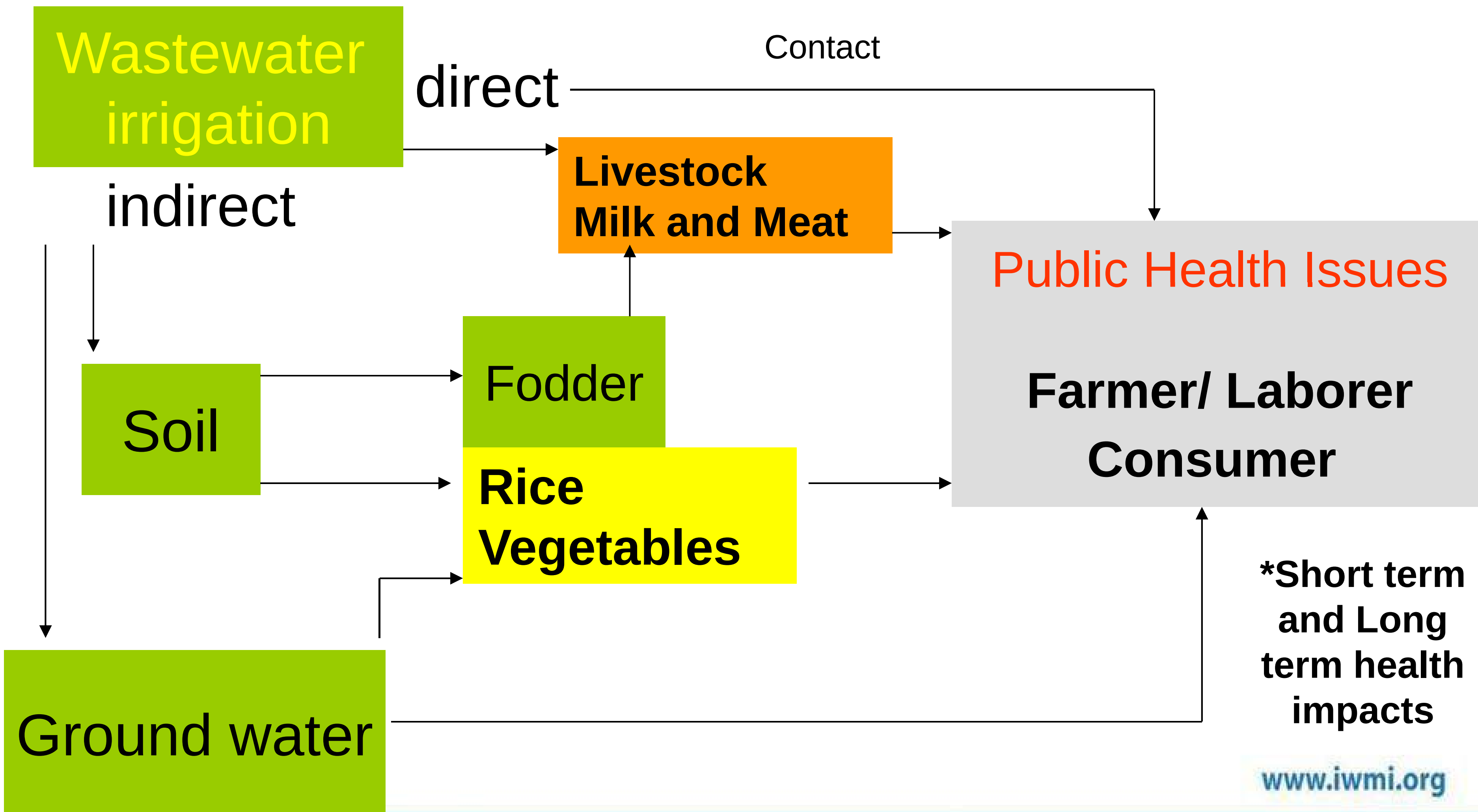
	2004	2010
1	1.8	1
2	NA	4.3
3	93	130
4	51	92
5	40	41
6	25	28
7	14	25
8	6	4
9	3.2	2

Musi river water and livelihoods

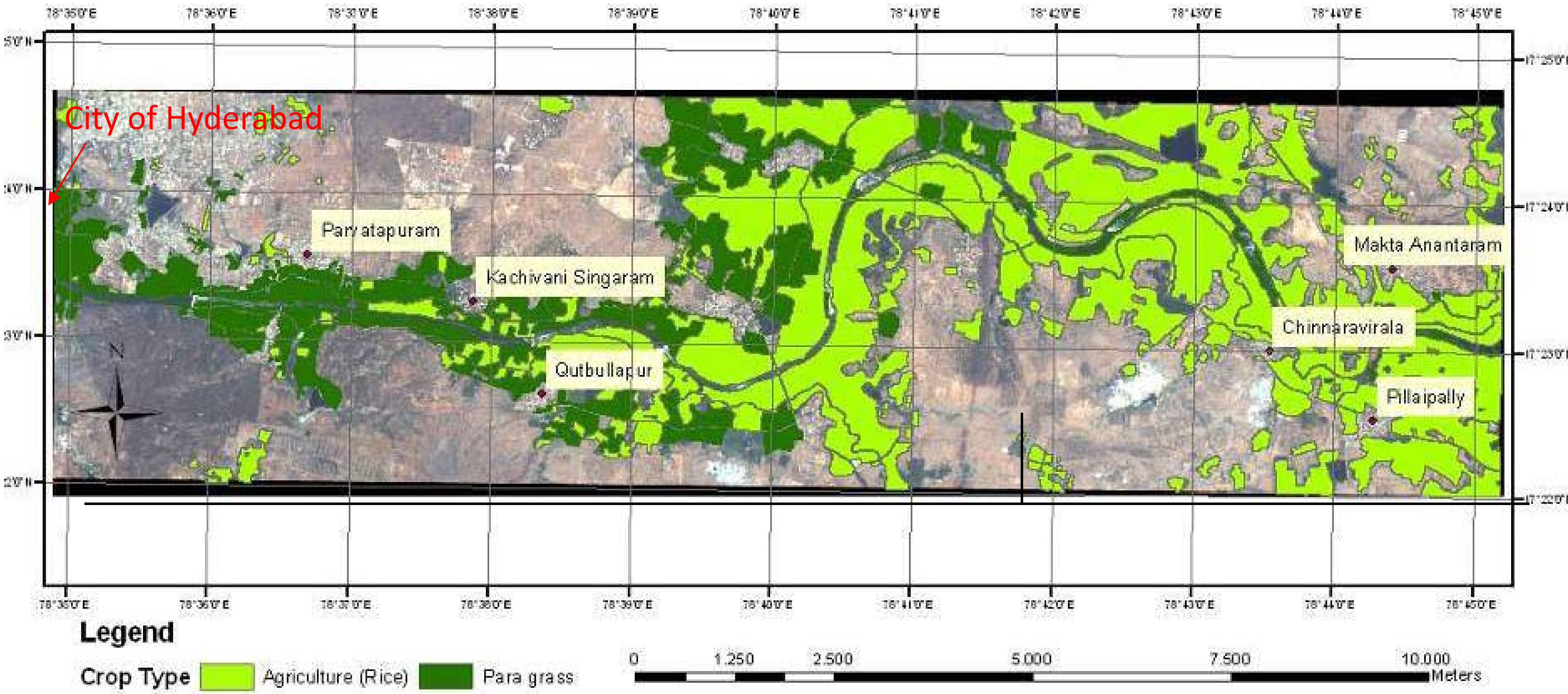


Canal /lift and ground water irrigation

Evaluation of health and agronomic risks from field to consumer



Irrigated agriculture along the Musi river



Spatial Reference System:
WGS 1984 UTM Zone 44N
Data Source:
Quickbird Image (8/4/2006)
Crop Mapping done by EPTRI (2006)

Map done by: Leonhard Suchenwirth, IWMI, November 2007

27 km stretch of Musi River

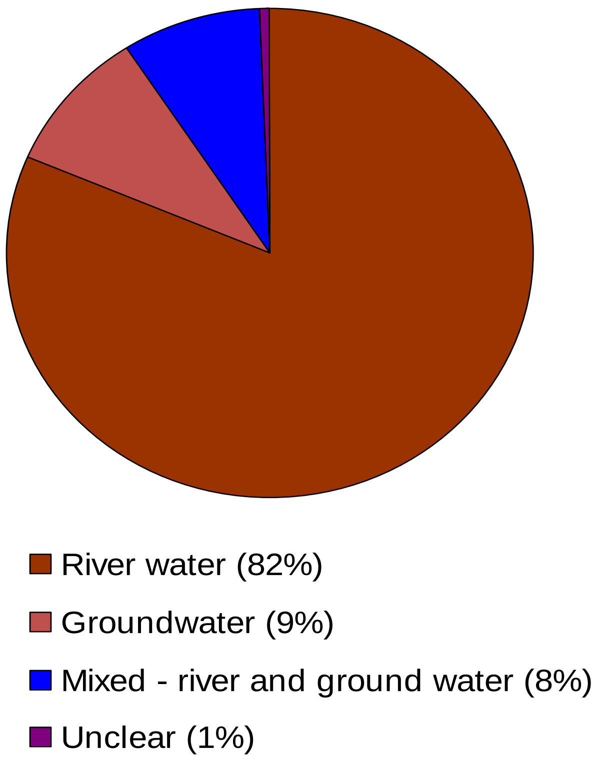
Amberpet to Pillaipally

Periurban zone
1562 HH (6808)

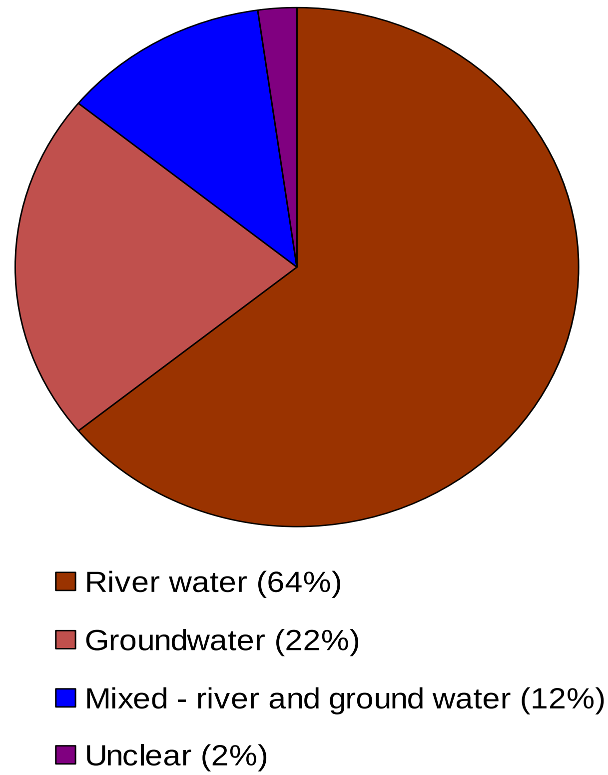
Rural zone
1109 HH
(5081)

Types of irrigation (% area)

Periurban Zone (492 ha)

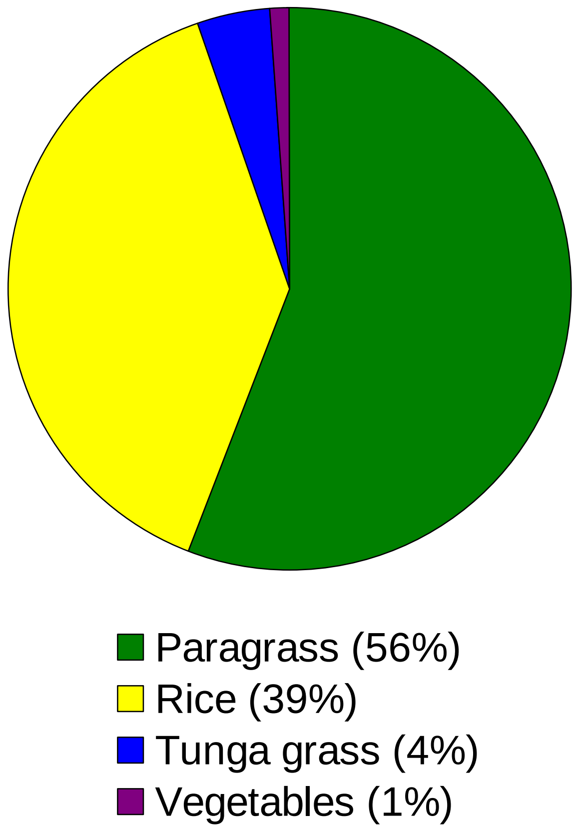


Rural Zone (518 ha)

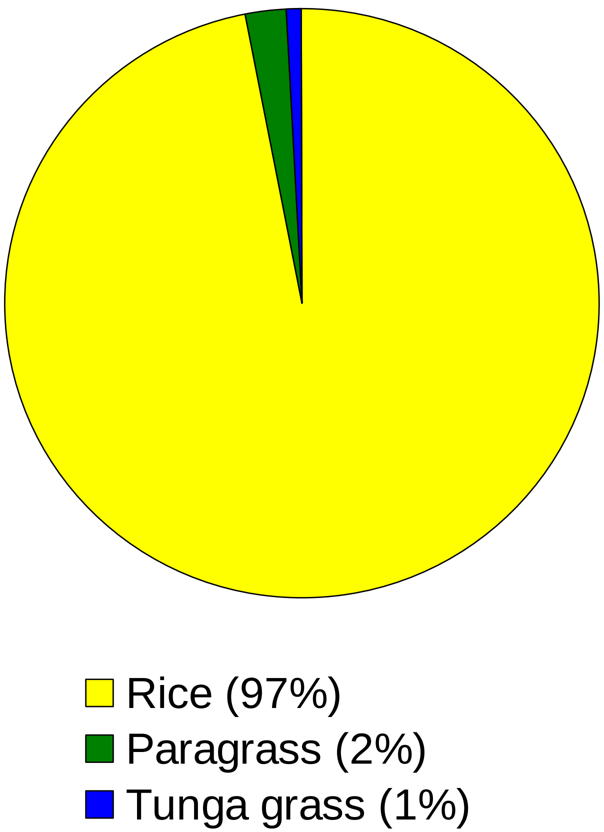


Types of crops (% area)

Periurban Zone (492 ha)



Rural Zone (518 ha)



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Heavy Metals in Soil
Vegetables and Paragrass – Periurban areas

Soil pH (1:5w)	ECe (dS m^{-1})	Org-C (%)	Total-Cd (mg kg^{-1})	Total-Pb (mg kg^{-1})	Total-Zn (mg kg^{-1})
7. 54 (6.2 – 8.1)	1.73 (1.0 – 3.2)	1.45 (0.7 – 3 6)	1.34 (0.5 – 5.05)	35.03 (7.1 – 190)	192 (33. 9 – 1391)
Directive 86/278/EC N=28	-	-	<3. 0	<300	<300

Source: Simmons et al.

Heavy Metals - Vegetables (Periurban areas)

	Mean estimated element concentration (mg kg-1) Fresh Weight (FW)	
Vegetable	Cd	Pb
Coriander (n=5)	0.019 (±0.004)	0.048 (±0.015)
Mint (n=7)	0.002 (±0.0005)	0.107 (±0.047)
Spinach (n=11)	0.012 (±0.002)	0.052 (±0.021)
Amaranth (n=5)	0.015 (±0.003)	0.079 (±0.021)
CCFAC Maximum Levels of Cd and Pb in leafy vegetables Fresh Weight (FW)	<0.2	<0.3

Assuming a Fresh Weight (FW) moisture content of 95%: Source USDA (2002).

Source: Simmons et al.

Heavy Metals
Rice Straw – Rural Zone

Irrigation	Straw-Cd (FW) (mg kg-1)	Straw-Pb (FW) (mg kg-1)
Direct	**0.015**a (±0.001)	**0.249**a (±0.009)
Lift	**0.024**a (±0.002)	**0.236**a (±0.008)
Control	**0.029**b* (±0.004)	**0.354**b** (±0.021)
Directive 2002/32/EC	<1. 0	<10. 0

a and b significantly different (p = <0. 05* p = <0. 001**).

Source: Simmons et al.

Heavy Metals in Soil
Rice – rural zone

Irrigation Method	Total-Cd (mg kg-1)	Total-Pb (mg kg-1)	Total-Zn (mg kg-1)
Direct	4.44a**	14.60a**	54.0a**
Lift	2.25b**	11.98b**	35.1b**
Control	1.41c**	9.79c**	20.4c*
Directive 86/278/EC	<3.0	<300	<300

N=64; a, b, and c = Significantly different; (p = <0. 05* p = <0. 001**)

Source: Simmons et al.

Testing methods to reduce heavy metal contamination (on farm methods)

Photo credit::Francisco Javier Luque Ruiz

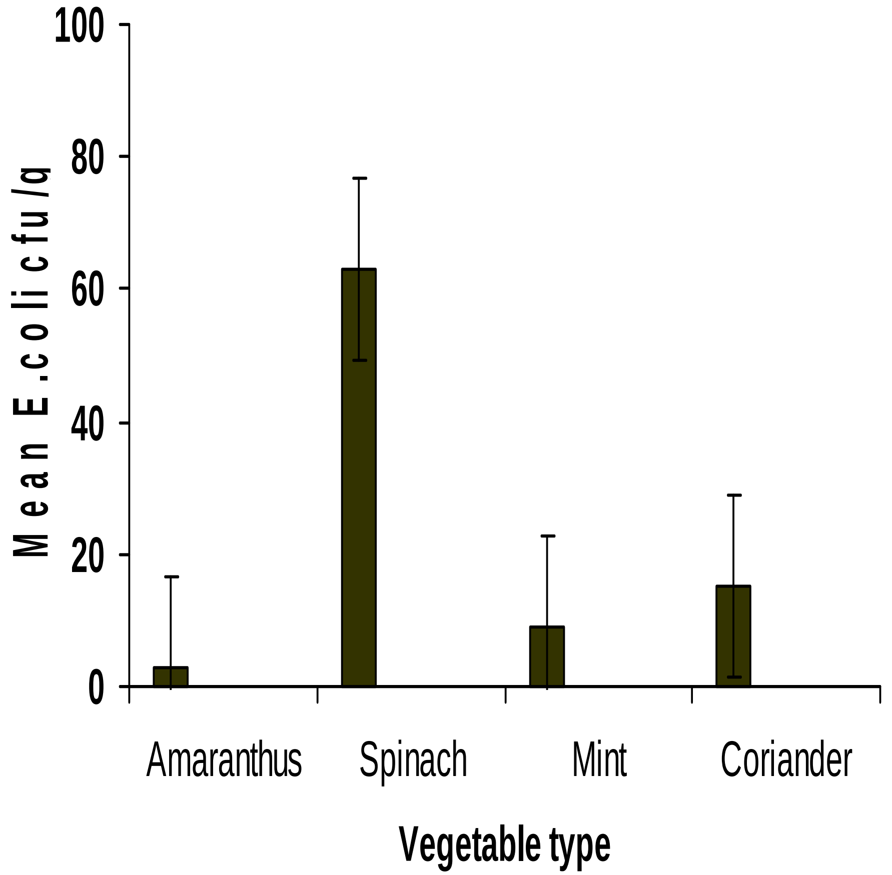
The pump device is usually buried in the sludge/sediment weighted down by a heavy device.

Testing method:
Positioning the pump device so that the sludge/sediment is not transported to the fields.

Prevent complete flooding of vegetables

E. coli and Parasites – field samples

Based on a permissible level of <20 *E. coli* for market produce (UK standards), the *E. coli* contamination in the vegetables tested could be regarded as varied. Spinach had a higher level of contamination than others

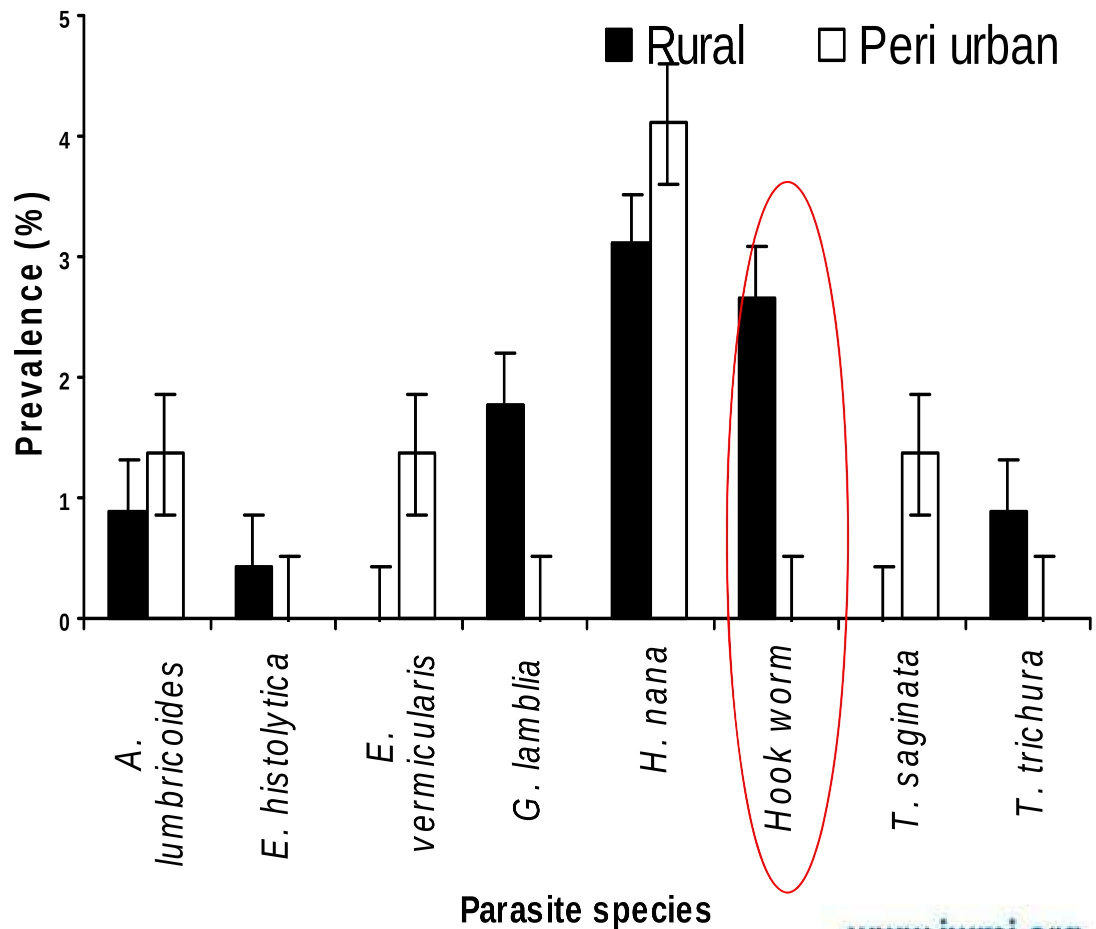


(ANOVA statistic at 95% CI, p=0.000)

Helminth ova were found at less than ≤1 ova g-1 posing negligible risk

Parasite prevalence – farming community

	Periurban %	Rural %
Stool Participants	146	225
Stool Positives	11	21
% Positive	8	9



Community Responses

	Periurban zone		Rural zone	
	Farming (n=295) %	Non-farming (n=143) %	Farming (n=298) %	Non-farming (n=102) %
Diarrhea (last 2-3 weeks)	35	39	57.1	48.1
Water borne	35	76	33	81
Food borne	1.8	4.1	7.1	4.1
Causative agent not known	47	12.2	55	12

% may not tally due to multiple responses or, no comment

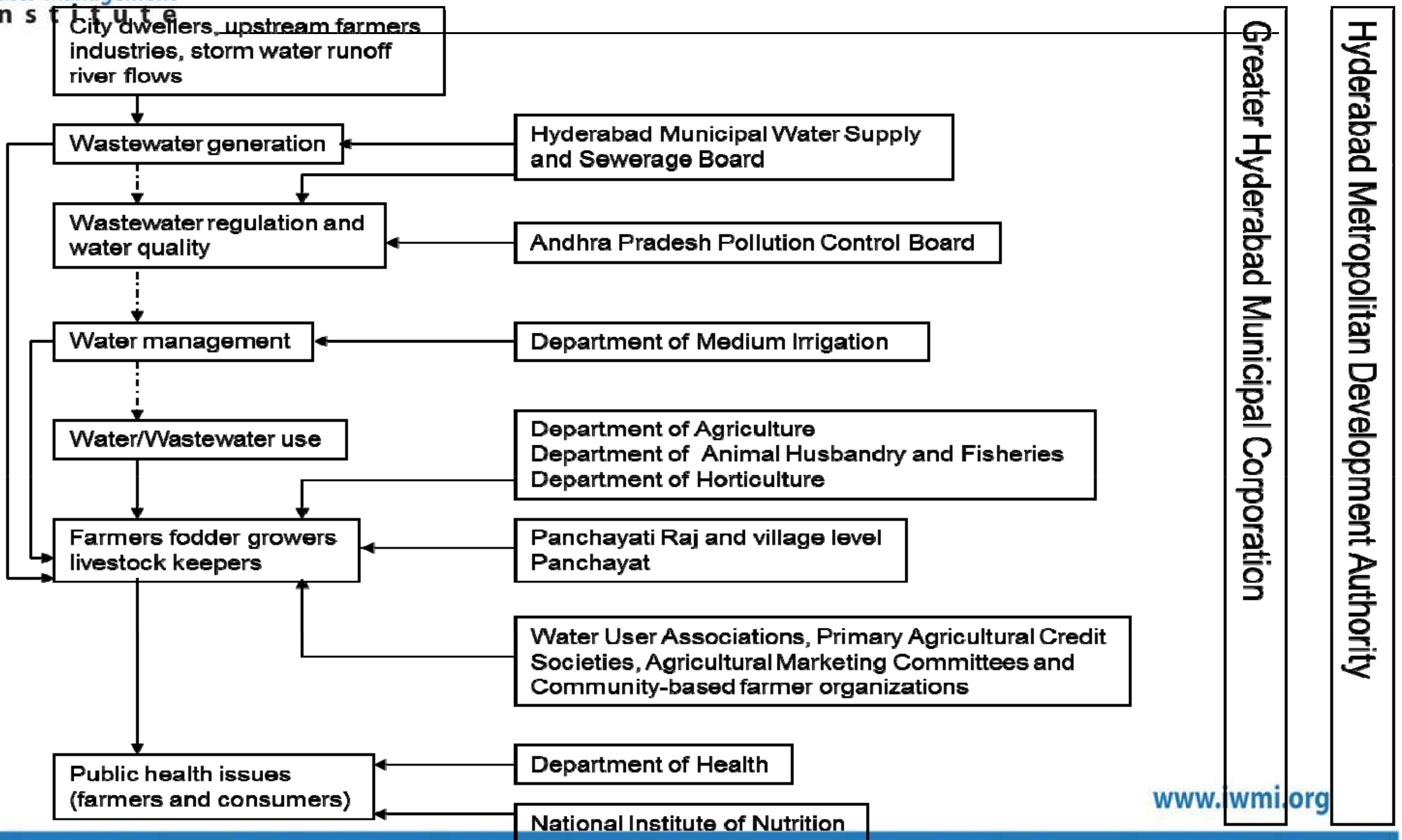
Sanitation and Drinking Water

	Latrine Facilities %				Drinking Water Sources %		
	Separate Latrine	Shared Latrine	No Latrine	No Response	Ground Water	Purchase/ supplied (Krishna/ Manjira)	Both
Peri Urban (164 HH)	44	38	5	13	79	18	3
Rural (187 HH)	36	24	28	12	72	27	1

Bore well (some) water was not suitable for drinking, could be impacted by wastewater

Poor sanitation and practice of open defecation in rural zone

Institutional analysis



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Improving water and land resources management for food, livelihoods and nature

Resource Recovery & Reuse:
A business opportunity

Source: Pay Drechsel

Learning from success stories

- Of 150 identified promising RRR cases, 50 success stories are currently being analyzed in detail for their institutional settings, business plan, technical approach etc.
- About 15 of those 50 cases are from India which reflects a high entrepreneurial spirit.
- The business models of those 50 cases will now be tested for their feasibility at largest possible scale in 4-8 cities around the globe. *Bangalore* is one of them, and if funding allows, more cities could be added.

Source: Pay Drechsel

Action Research

These studies are accompanied by field trials on

- faecal sludge co-composting standards
- pelletizing and blending (urine, NPK, rock-P)
- testing safe application rates in farming.

Source: Pay Drechsel

Beneficiaries

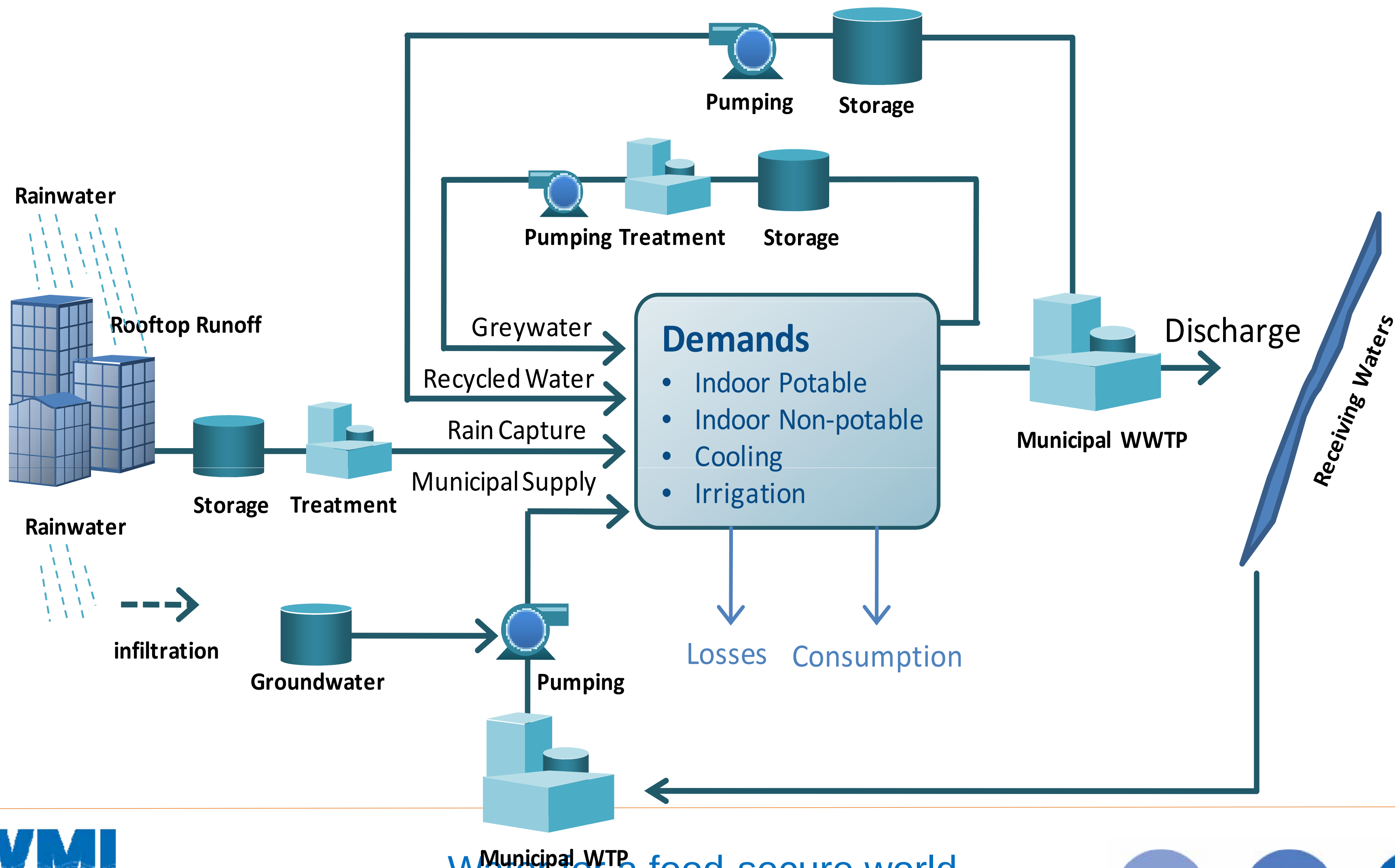
- Private sector, public sector, donors
- Farmers, households and authorities in charge of waste management.

Wastestreams considered:

- Organic domestic waste, septage, agro-industrial waste

Contact: Dr Miriam Otoo at <m.otoo@cgiar.org> ; www.iwmi.org/Topics/RRR

Total water management



Source: Da Silva, CDM Smith

Thank you