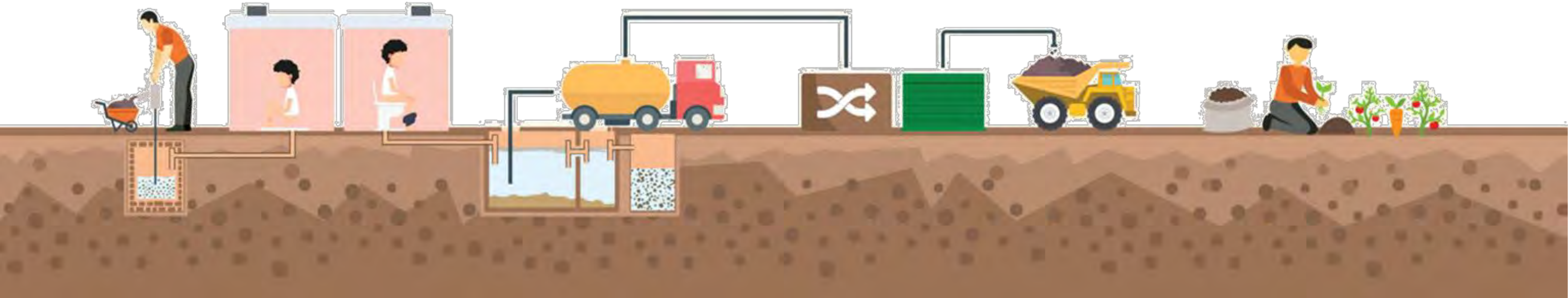
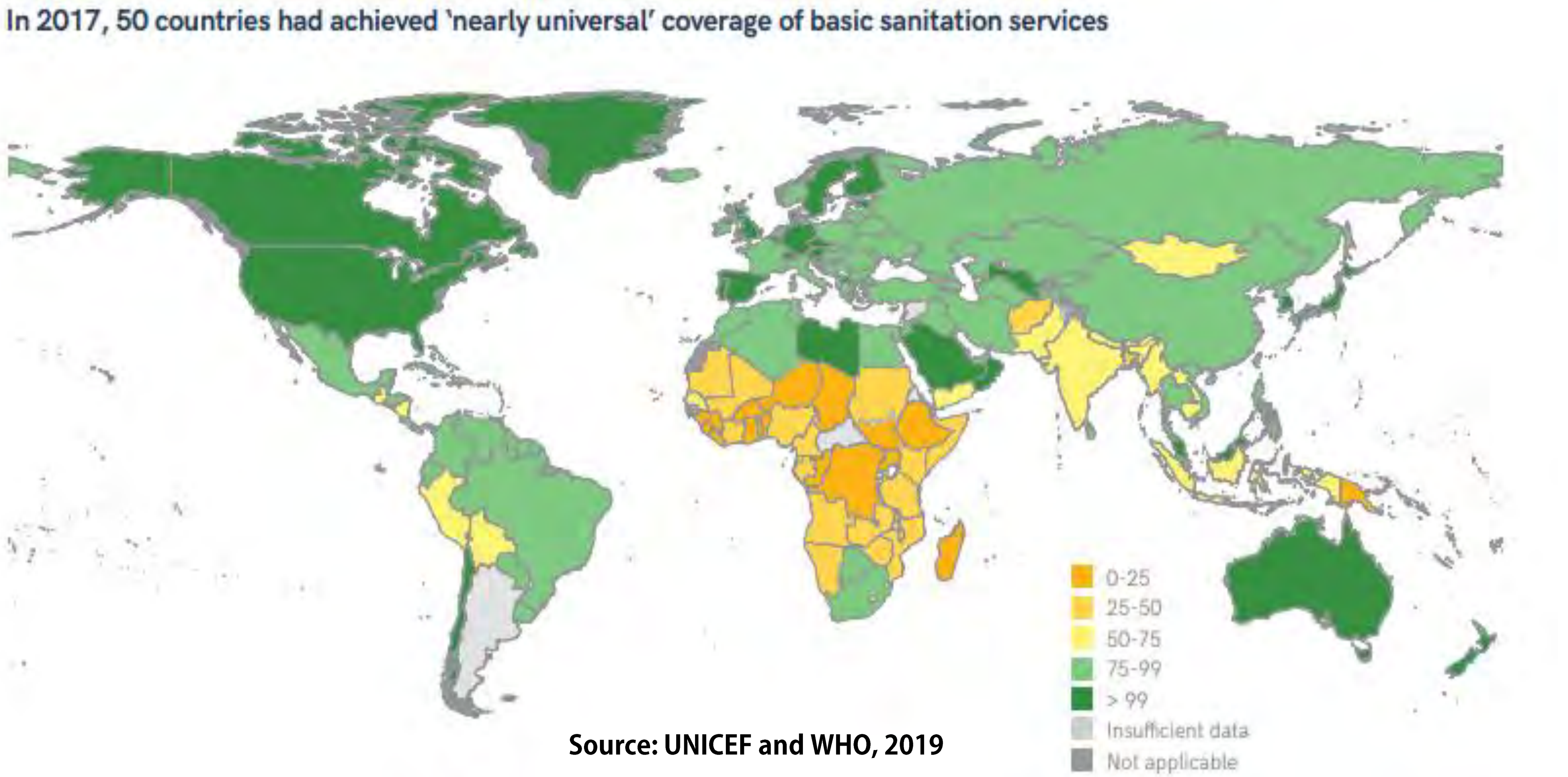
DECENTRALISED WASTEWATER MANAGEMENT APPROACH TO ENHANCE THE REGIONAL ENVIRONMENTAL SUSTAINABILITY IN THE POST COVID-19

Prof. Thammarat Koottatep



SANITATION STATUS
World-wide

- In 2017, *74%* of world's population used at least basic sanitation system
- Contrasting disparity between *urban (85%)* and *rural sanitation coverage (59%)*
- Need to double current annual rate of coverage for achieving universal coverage by 2030

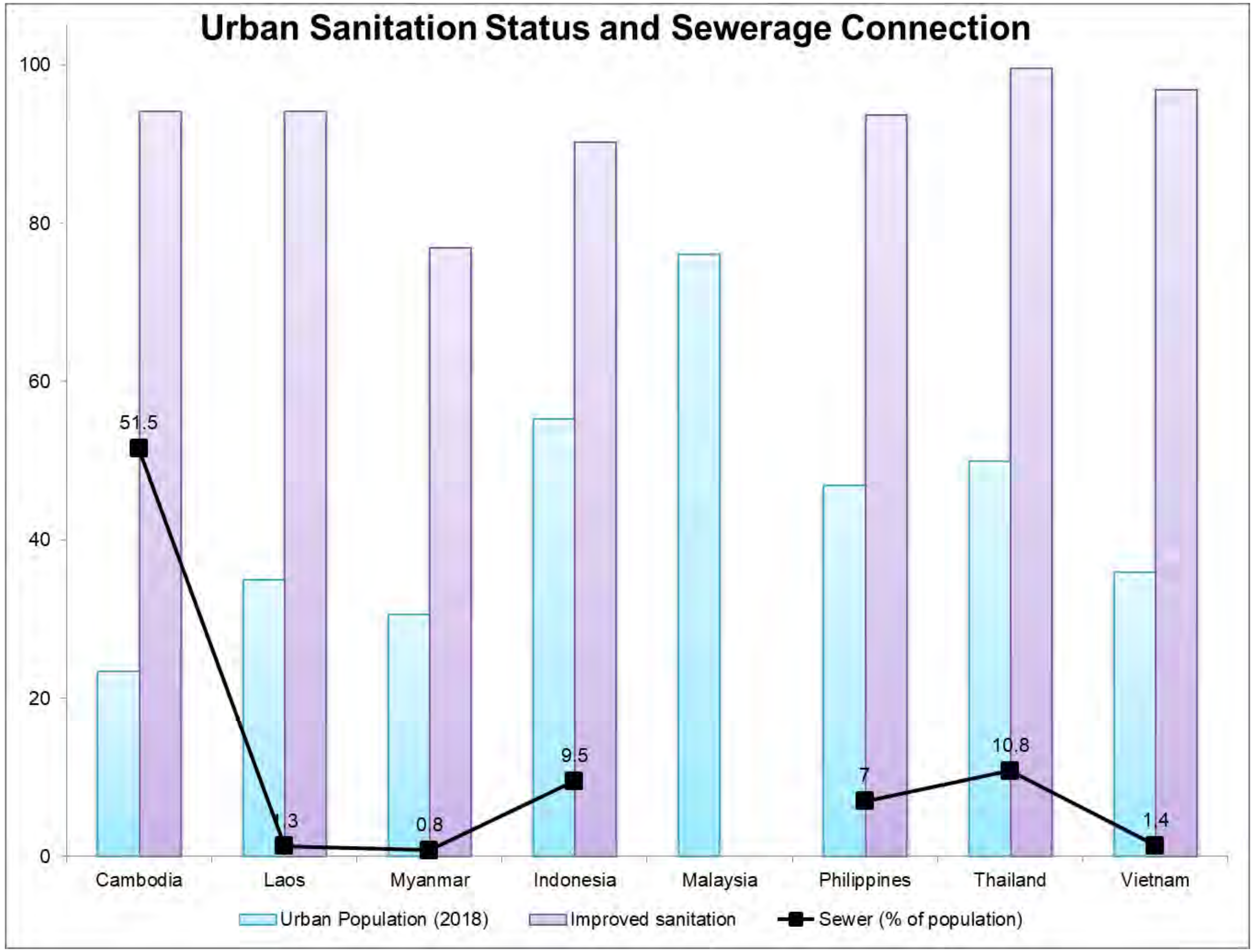


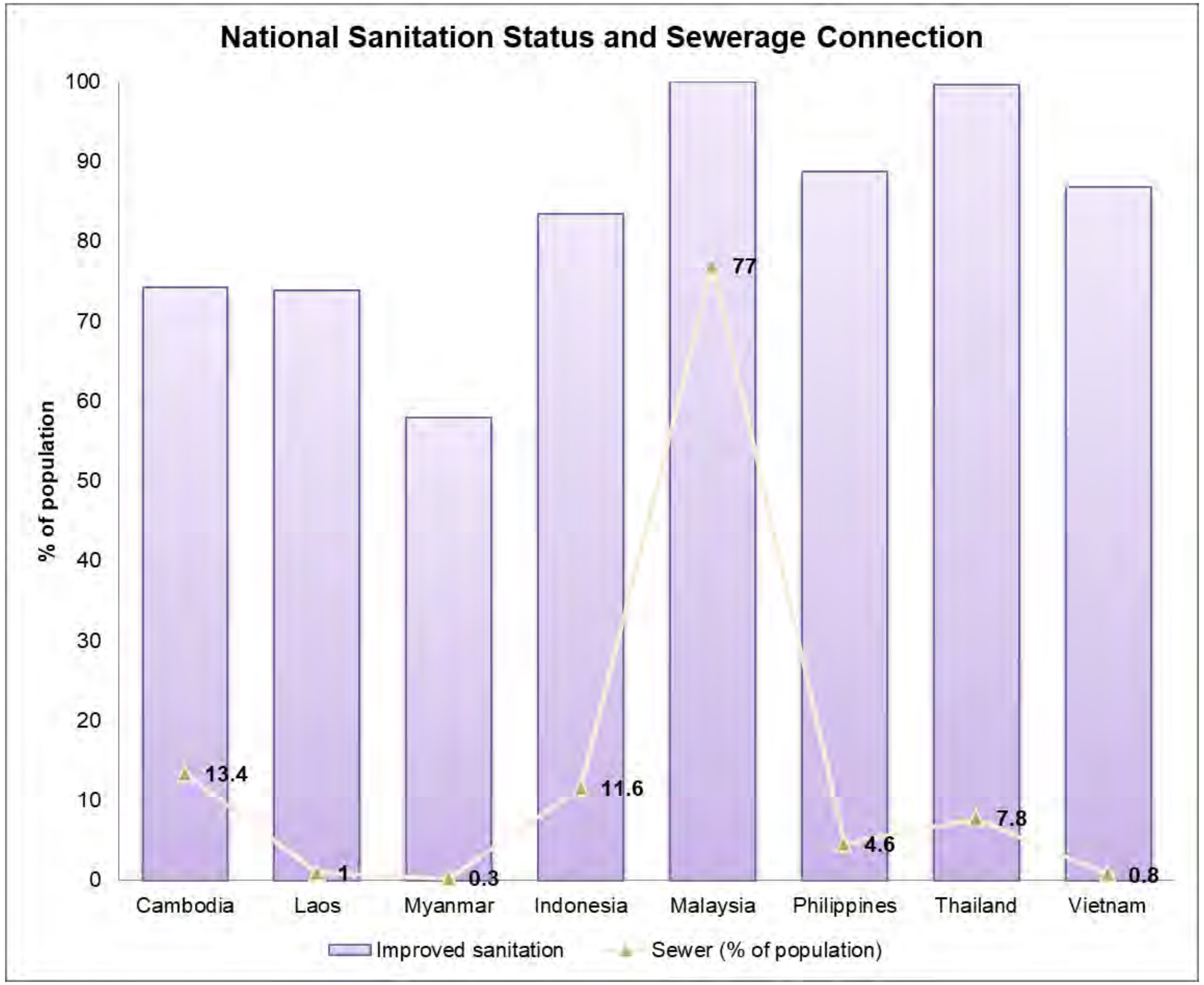
Source: UNICEF and WHO, 2019

REGIONAL SANITATION STATUS

Nation wise

- Improvement in sanitation facility does not mean improvement of aquatic environment *(example: though improved sanitation facilities coverage has reached 87% in Indonesia but rivers are heavily polluted (ADB, 2019)*

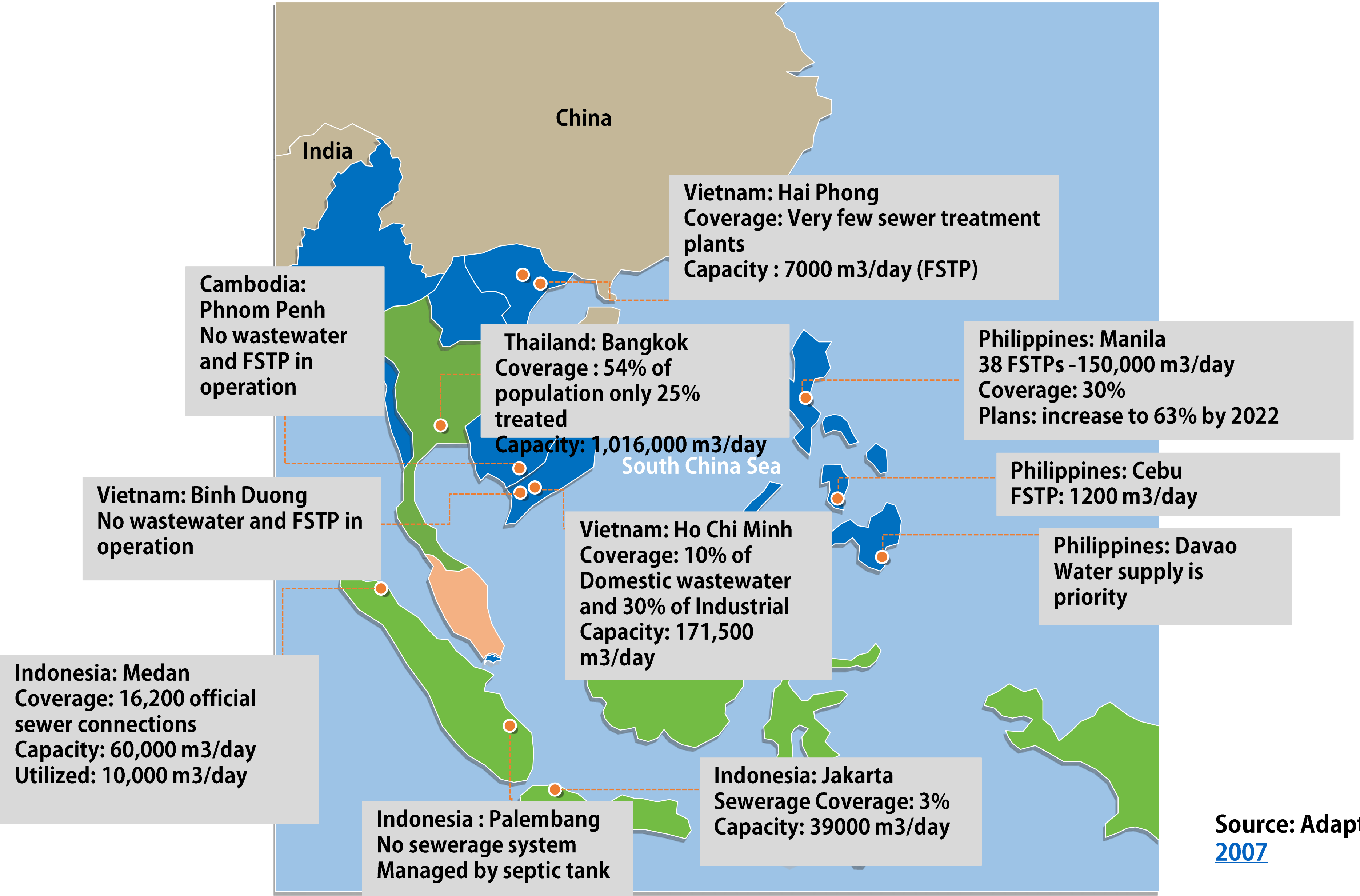




Source: Lorenzo, T. E. and Kinzig, A. P., 2019

REGIONAL SANITATION STATUS

Disparity among cities in terms of wastewater management



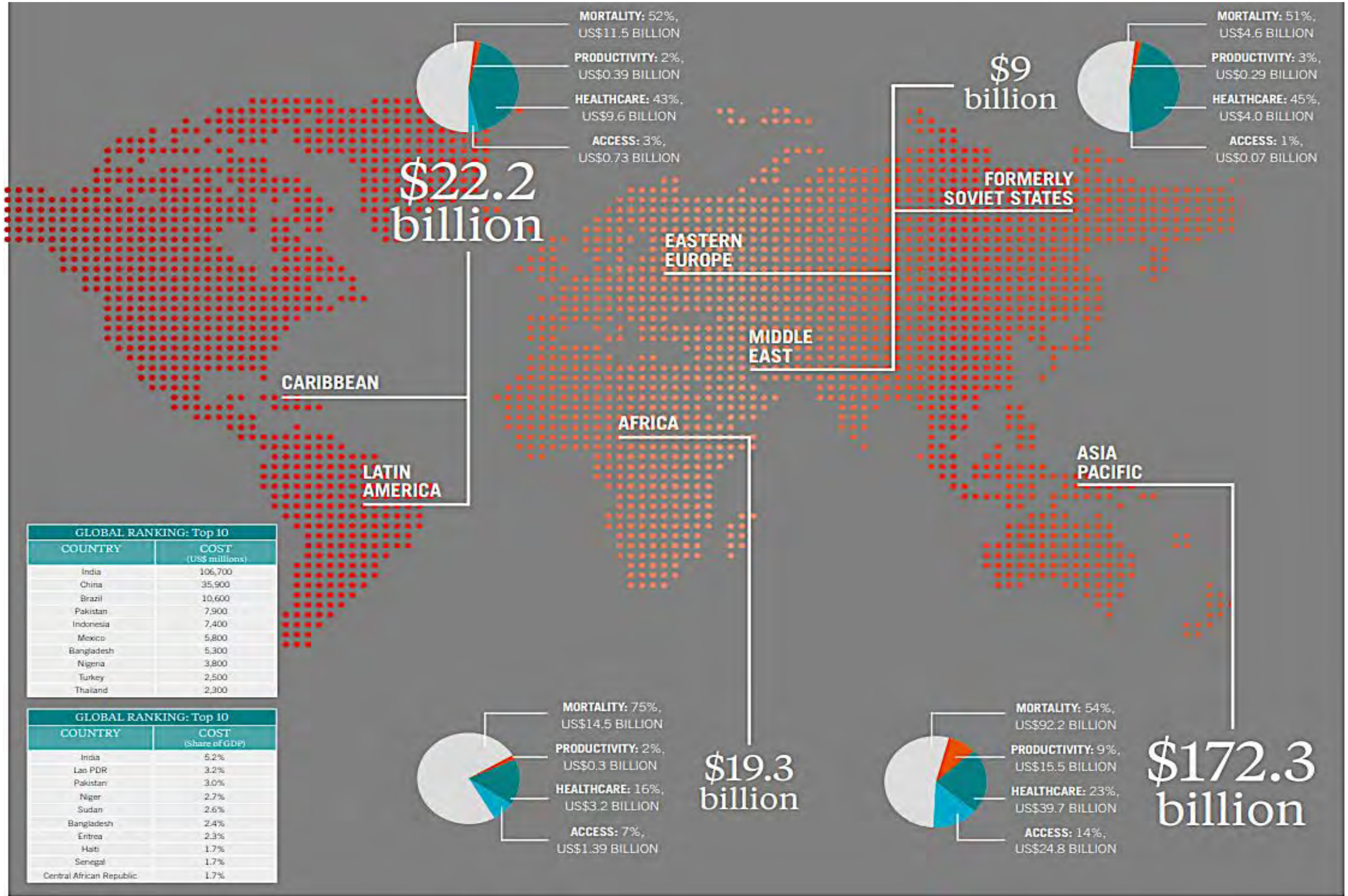
Source: Adapted from WSP, 2007

BURDEN OF POOR SANITATION

World-wide

- **Asia Pacific alone is accountable for US $172.3 billion, ¾ of the total burden.**

- **US $1 invested in sanitation yield a global economic return of US $ 5.3**



GLOBAL RANKING: Top 10	
COUNTRY	COST (US$ millions)
India	106,700
China	35,900
Brazil	10,600
Pakistan	7,900
Indonesia	7,400
Mexico	5,800
Bangladesh	5,300
Nigeria	3,800
Turkey	2,500
Thailand	2,300

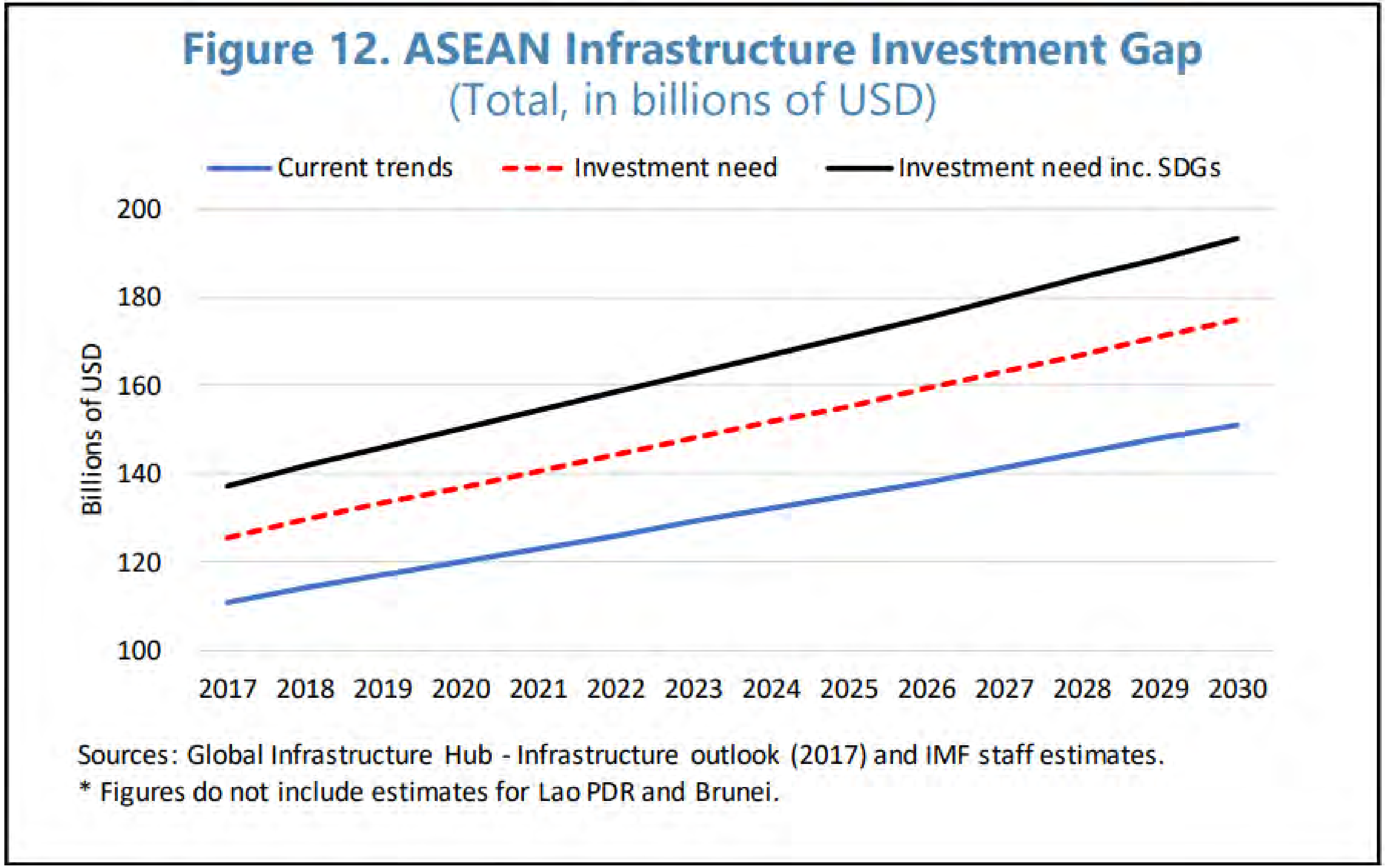
GLOBAL RANKING: Top 10	
COUNTRY	COST (Share of GDP)
India	5.2%
Lao PDR	3.2%
Pakistan	3.0%
Niger	2.7%
Sudan	2.6%
Bangladesh	2.4%
Eritrea	2.3%
Haiti	1.7%
Senegal	1.7%
Central African Republic	1.7%

Source: Lixil, Oxford Economics and Water AID, 2016

INVESTMENT GAP FOR SDG

Asia-Pacific

- **Asia-Pacific developing countries requires an estimated amount of US $1.5 trillion per year or 5% of their combined GDP (UN ESCAP, 2019)**



Source: [IMF, 2018]

WATER SECURITY INDEX

Regional

- Fresh water demand to increase by 1/3rd by 2025 and double by the latter half of 21st century (source: The ASEAN Secretariat, 2017)
- Uncontrolled sewage discharge and leakage – increased eutrophication of water bodies

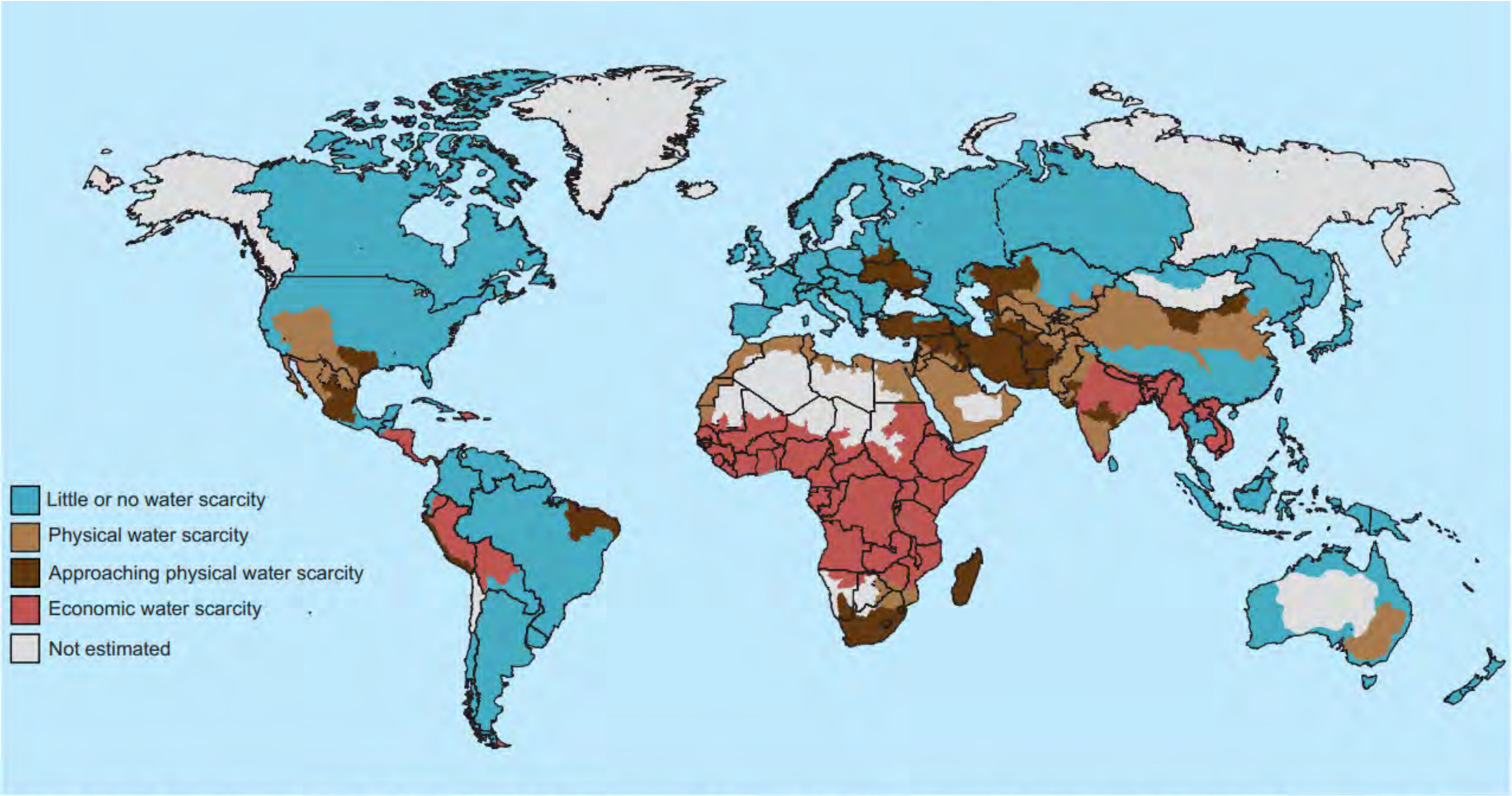


Figure: Based on International Assessment of Agricultural Science and Technology for Development data (www.grida.no/graphicslib/detail/areas-of-physical-and-economic-water-scarcity_1570).

Eutrophication of canals in Bangkok. Source: Water Encyclopedia

CONSTRAINTS WITH CURRENT SYSTEM

Regional

- *Sanitation still a least priority*
- *Overarching national plans* and commitments – *contrasting performance at local level*
- *Centralized approach – not efficient*
- *Treatment plants capacity underutilized and too costly* to provide satisfactory solution
- Requires consistent *maintenance, trained operators, chemical and electricity* and releases biogases to atmosphere

Ho Chi Minh, Vietnam(swing-w.com)

Bang Sue, Thailand (Aquathai)

Baatan, The Philippines (Claudio, L., E., 2015)

CONSTRAINTS WITH CURRENT SYSTEM

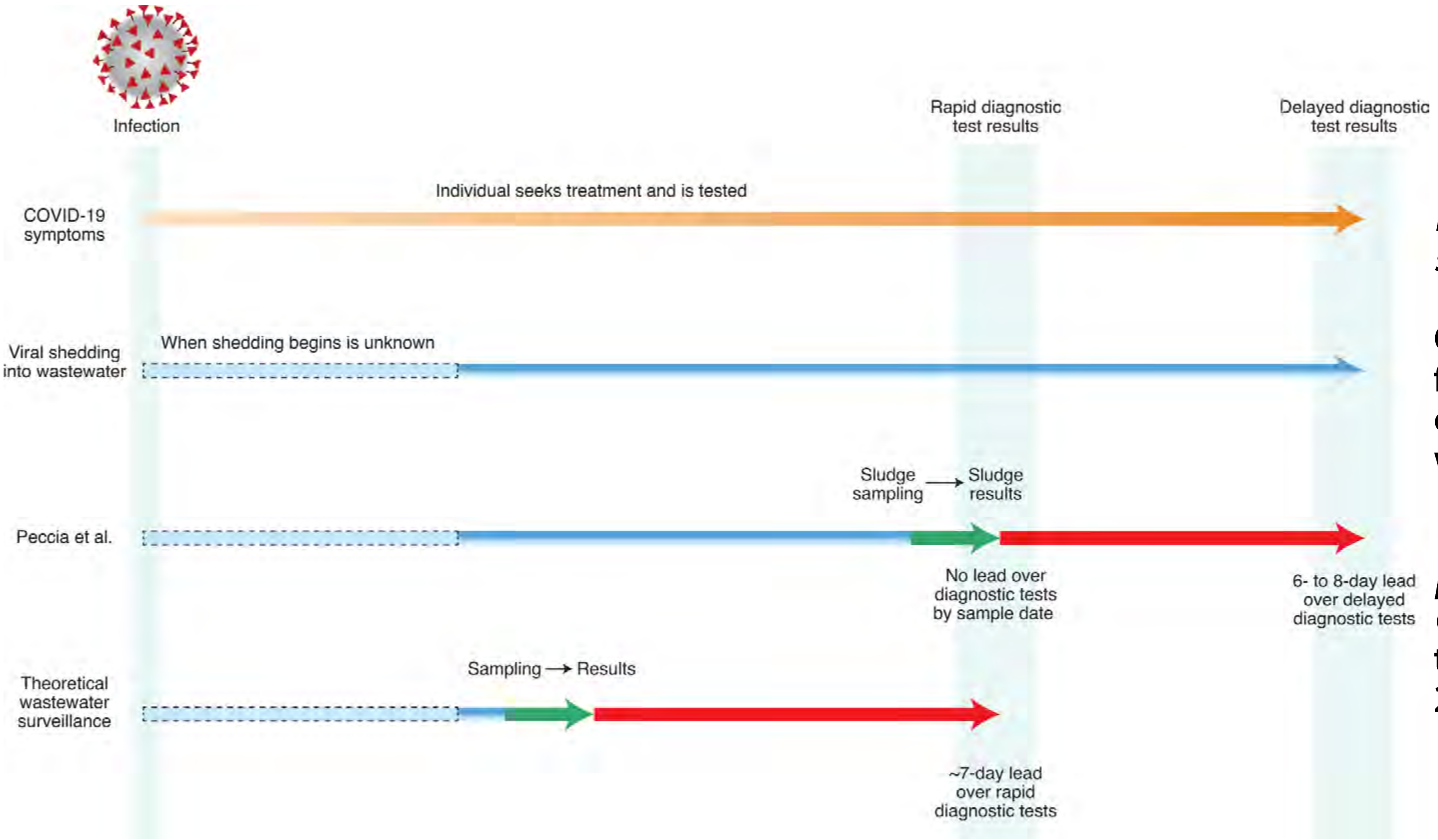
Regional

- ***Heavily relies on OSS but fails to recognize fecal sludge management in policy***
- ***Unregulated private operators and lack of disposal facilities*** **causes FS to land in open environment**
- ***Low wastewater treatment levels for a growing population***
- **Added level of** ***uncertainty on water availability*** **due to** ***changing climate***

FS being dumped at open drain, India
Source: DownToEarth

COVID-19 SITUATION

Wastewater monitoring for early detection of pandemic



Diagnostic capacity – may not be sufficient. **Lag in hospitalization**

Concentration of viral RNA varies from person to person - still signal can be traced in feces for several weeks

Wastewater monitoring – could be powerful tool in tracking spread of COVID -19 **(considering presence of traces of COV-2 RNA) (Bogler et al., 2020)**

Source: Larsen and Wigginton, (2020); www.nature.com

IMPACT OF COVID-19 ON WATER AND SANITATION SECTOR

Regional

- *Slow down investments* in water and sanitation sector
- Sanitation workers are frontline and expected to be affected significantly
- Lack of *PPE and health insurance* for workers
- Added burden of COVID-19 on the top of existing urban water and sanitation services deficit
- *Cramped living* and inadequate public services - *hotspots for pandemic*
- Revenue loss impacting the capacity for investments
- *Lockdown delayed the project and payments* and crippled the labor shortage
- Short terms *budgetary diversion to healthcare and emergency response*

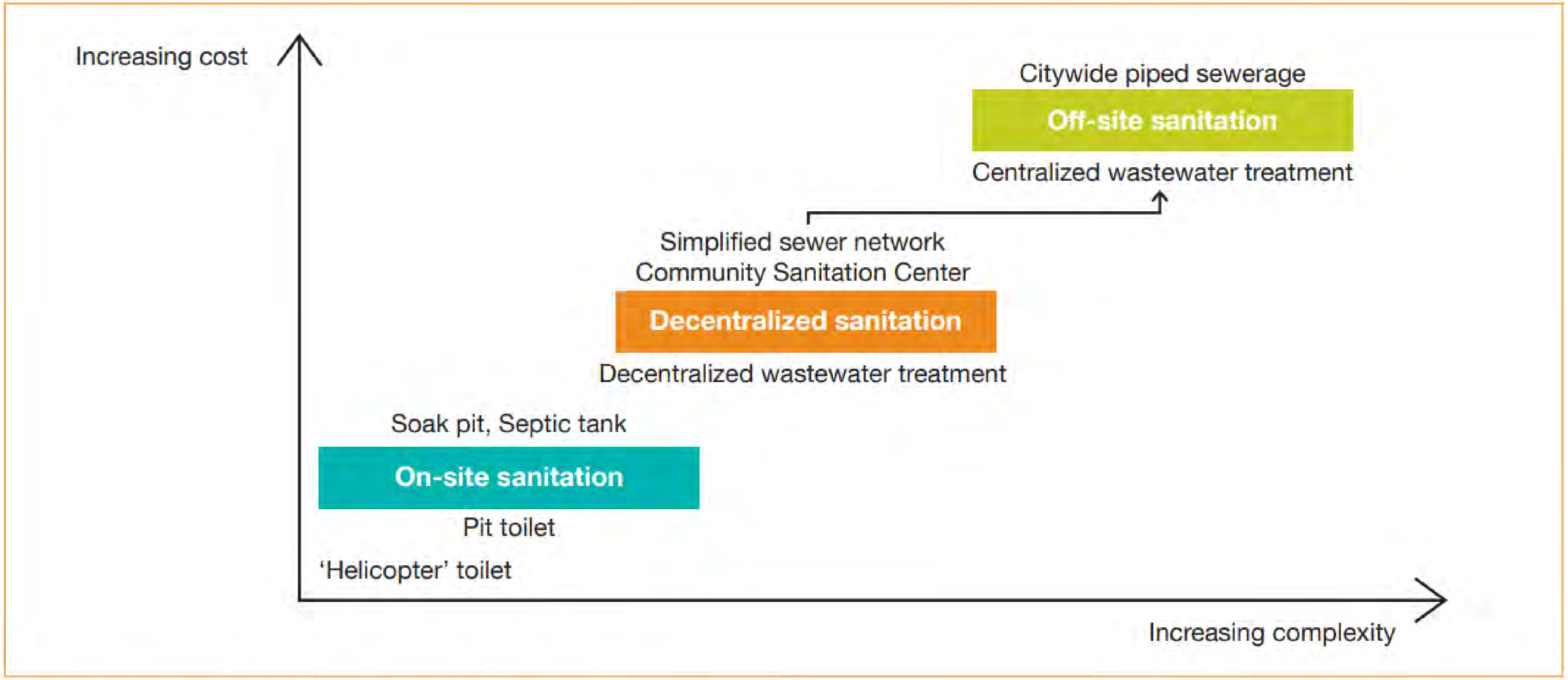
A new alternative approach DEWATS is gaining greater attention!

A NEW ALTERNATIVE APPROACH

DEWATS

Target 6.2: *. . . achieve access to adequate and equitable sanitation and hygiene for all, and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.*

Target 6.3: *. . . improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater, and substantially increasing recycling and safe reuse globally.*

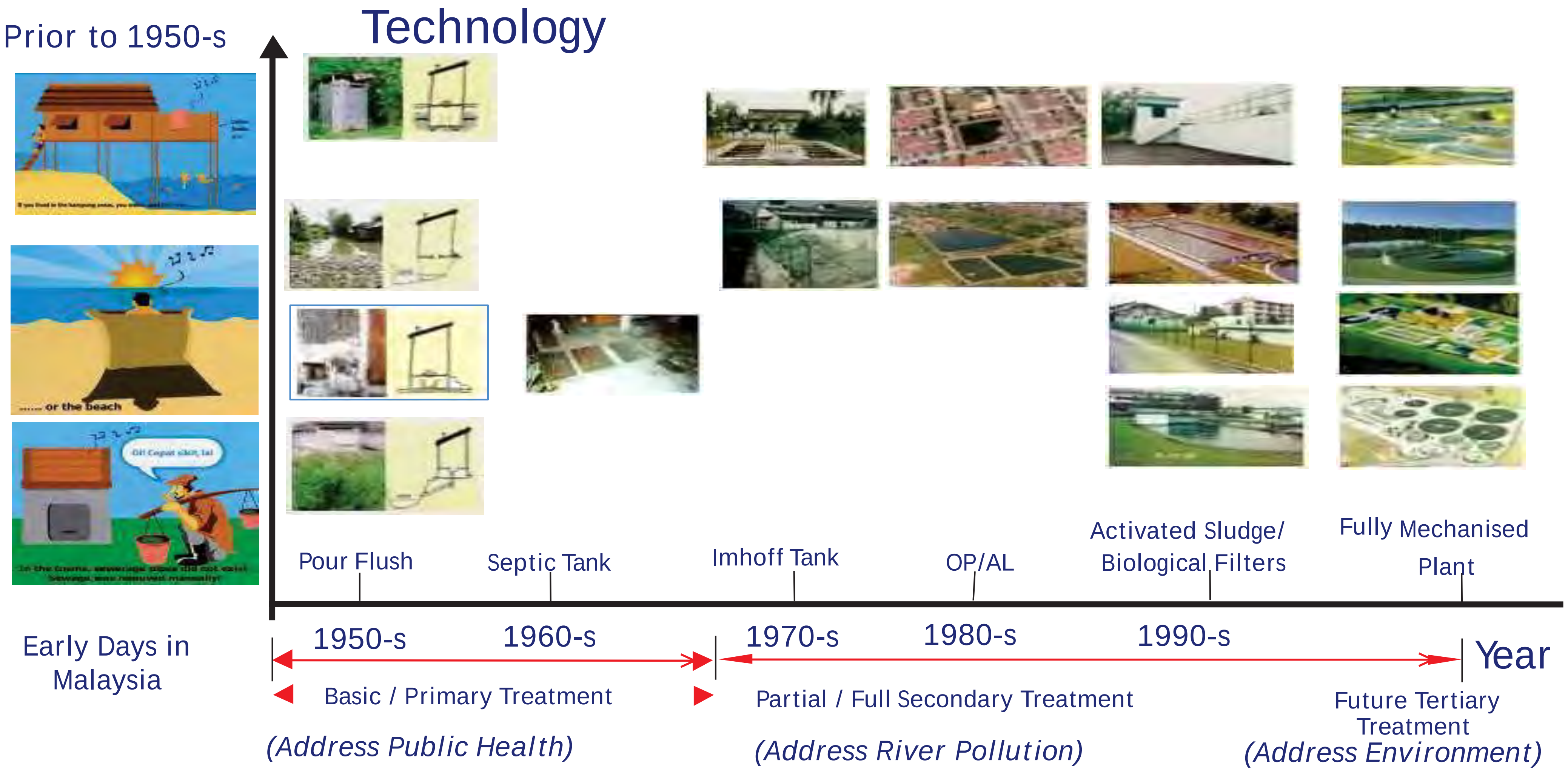


Source: Adapted from BORDA (2005), Blackett & Perez (2006) and Utomo (2012)

- **A new alternative approach DEWATS is gaining greater attention to bridge the gap between sanitation coverage and its post management for lower and middle income countries.**

DEWATS: A PROGRESSIVE SANITATION APPROACH

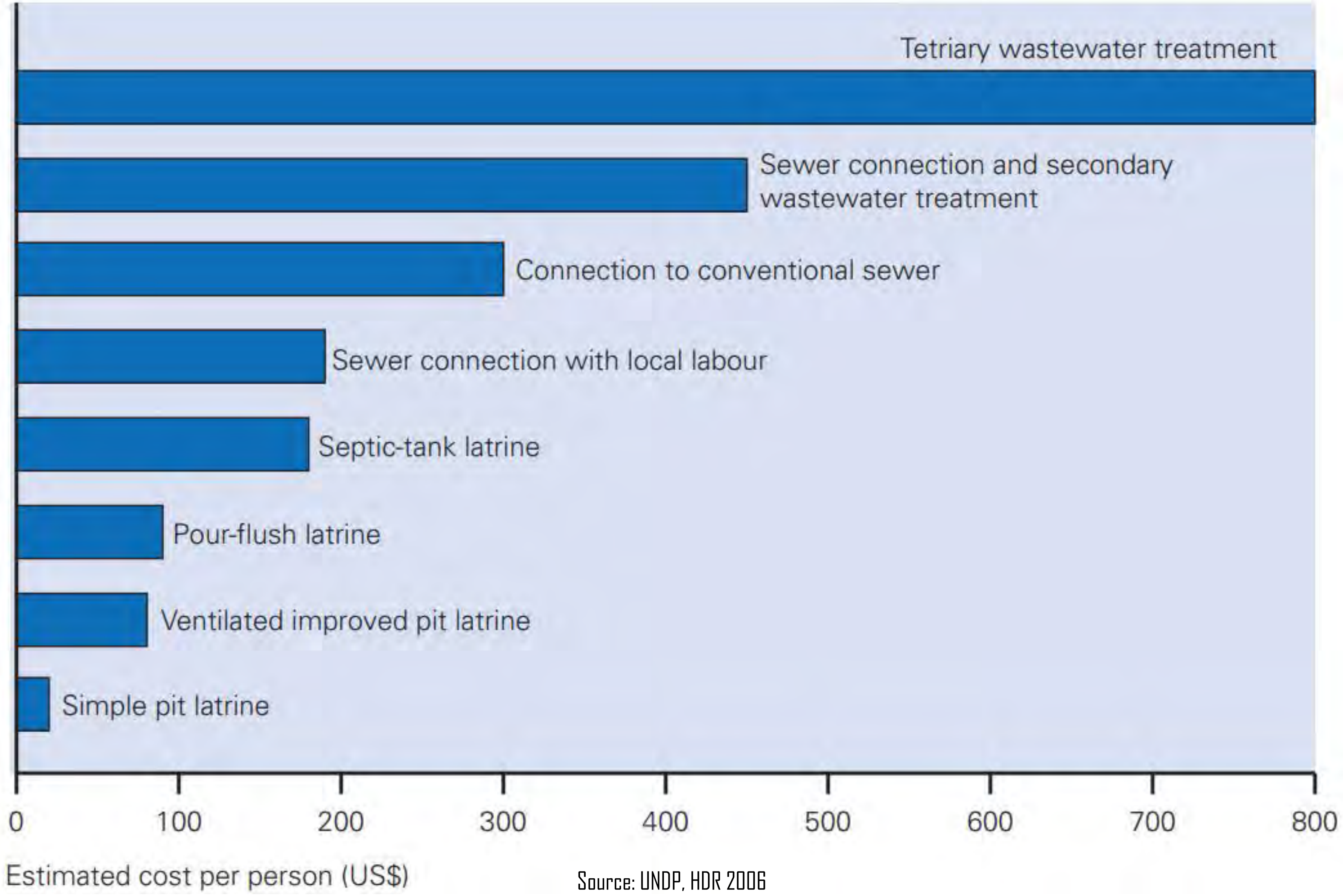
Malaysia: Example for other regional nations



Source: Dr. Christoph Lüthi, Ewag, Sandec

PER CAPITA INVESTMENT

For different systems



Source: UNDP, HDR 2006

DEWATS: A PROGRESSIVE SANITATION APPROACH

DEWATS and Centralized system comparison – Thailand: (Suriyachan, C., Nitivattananon, V and Amin, A.T.M.N., 2012)

	Decentralized	Centralized
1. Treatment Efficiency		
1.1 Capacity	40-4500 m^3/day (<5000 m3/day)	200-138000 m^3/day
1.2 Effluent BOD concentration	7- 30 mg/l	<20 mg/l
1.3 Nutrients removal	Not effective	Not effective
1.4 Reclaimed water	5-100%	5%
2. Cost		
2.1 Capital cost	23- 166 USD/capita	200 USD/capita
2.2 O&M cost	0.10-0.12 USD/capita	0.07 USD/capita
2.3 Staffing requirement (people/m3)	0.003-0.025 (3 for every 100 cubic meters)	0.0003 (3 for every 10000 cubic meters)
3. Social Values		
3.1 Service coverage	5-6.38 peoples /m^3	3 peoples /cubic meters
3.2 Green Open space	Provides 0.24 -0.65 m^2/capita	-
3.3 Job opportunities	Higher considering the staffing requirement	Lower compared to decentralized
Private company engagement	National Housing Association for construction and Operation	Operation as contracted by government

POST COVID-19 SITUATION

How DEWATS fit into post Covid-19 situation?

- Adoption of a wastewater based epidemiology – ***effective system for rapid on-site detection*** of SARS-CoV-2 or Covid-19 ***and take early precautionary measures.***
- Proper ***DEWATS provides onsite containment*** of virus
- Preventing pollution of water at the source

Low-income regions often lack wastewater sanitation, with partial to no sewer systems.

Unsafe sanitation is often combined with inadequate drinking water infrastructure.

REGIONAL ENVIRONMENTAL SUSTAINAIBILITY

How DEWATS helps maintain regional environmental sustainability?

In order to be sustainable - DEWATs must be cost effective

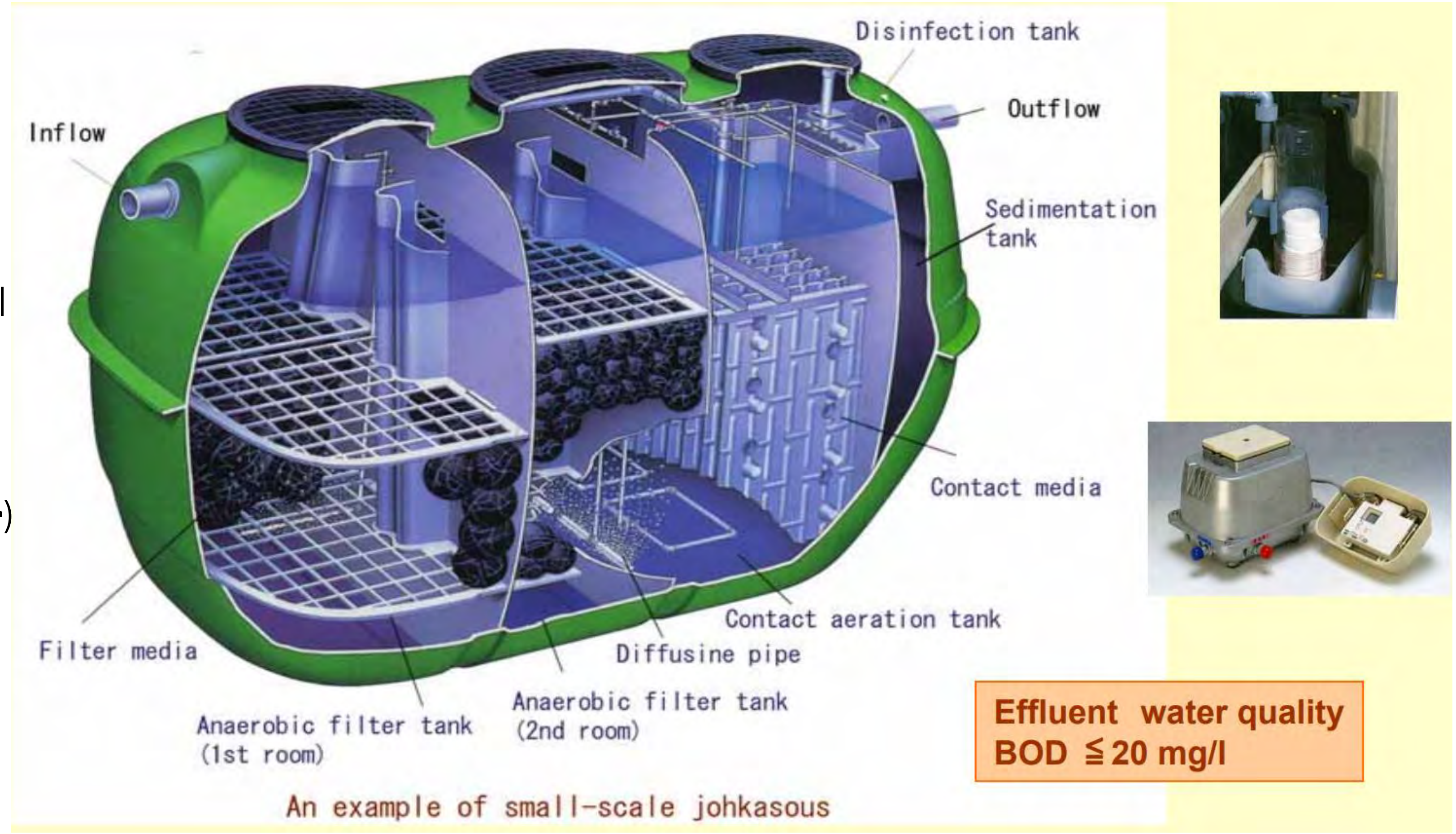
- ***Promising treatment capacity*** for sanitation facilities, housing, public entities such as hospitals, businesses etc.
- ***Reduce pollutants load***
- ***Renewable energy source*** - example biogas
- ***Reliability, longevity and tolerance towards inflow fluctuation***, cost efficiency and low control and maintenance requirements
- ***Functions without technical energy inputs*** *(for example: Independence from outside energy sources and sophisticated equipment provides more reliable operation and, thereby, fewer fluctuations in effluent quality.)*

REGIONAL ENVIRONMENTAL SUSTAINAIBILITY

Case of Japan

- In 1970s - 80s ***water bodies eutrophication*** - a big issue of Japan attributed by the ***poor performance and maintenance of the Johkasou*** (then black water type only) especially in rural Japan while sewer systems developed in cities

- In 1983 Johkasou Act was promulgated - requiring the regular desludging and maintenance (handled both black and grey water)

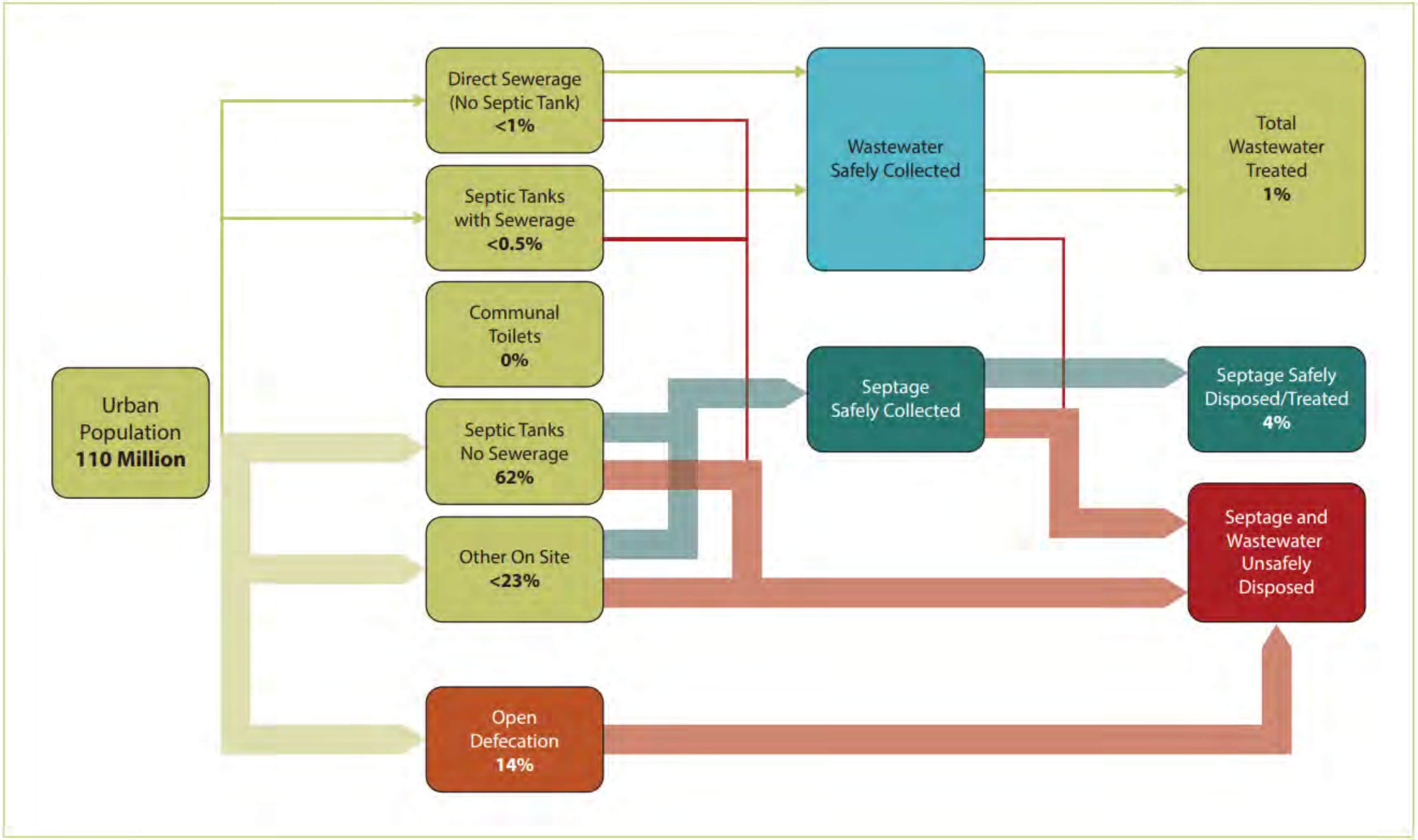


An example of small-scale johkasous

Source: Hiroshi Ogawa

REGIONAL ENVIRONMENTAL SUSTAINAIBILITY

Case of Indonesia



Source: World Bank and Australian Aid, 2012

- Community-managed DEWATS - a ***bridge to eradicate open defecation, a viable option to reach urban poor.***
- Mostly funded by government with emphasis on community engagement and empowerment
- Households connected to simplified sewer systems with treatment facilities often built under road (each system serving between 20 - 100 households)
- DEWATS typically comprises of Communal Septic tank, Bio digester plus anaerobic baffled reactor and anaerobic filter, Settler annexed to anaerobic baffled reactor in series with anaerobic filter.

REGIONAL ENVIRONMENTAL SUSTAINAIBILITY

Case of Indonesia: Strengths and Challenges (World Bank, 2013)

Strengths

- Provide substantial benefits and improves environmental health in urban areas
- Effective for serving poor communities in dense urban settlements
- Cost effectiveness of system is dependent on the number of users
- DEWATS operated by local users more likely reach urban poor in short and medium terms in a context of bigger picture.

Challenges

- Vulnerable to the changes in community leadership
- Only few user communities regard desludging as necessary and responsibility
- Absence of local government support and NGO implementation approaches were not readily replicable by government
- Low level of tariff collection

REGIONAL ENVIRONMENTAL SUSTAINAIBILITY

Case of Dumaguete, Philippines (ADB, 2019)

- Early 2000, Dumaguete City in the Philippines faced ***tremendous contamination of waterbodies from uncontrolled untreated FS and wastewater.***
- ***Establishment of FS treatment plant in 2006 with investment of US $500,000***.
- Following its operation, ***city witnessed improvement in health, economy and environment***
- Investment ***recovery in 8 years – each households paid US $1 per month*** to local government for the emptying service every 5 years.
- ***Overall economic growth observed*** – with increasing industries, tourism, productivity and property values.

REGIONAL ENVIRONMENTAL SUSTAINAIBILITY

Case of India (A. A. Forbis-Stokes *et al*., 2020)

Issues (similar to Southeast Asian Nations)

- In 2011, 38.2% of urban households had septic
- India's ***domestic wastewater management reliant on septic tank*** which is ***emptied once full*** by private operators on receiving ***demand call*** from households
- Fecal sludge treatment systems are ***either absent or non-functional or receives no sludge***
- Lately greater focus on DEWATS - to address aforementioned issues a mobile septage treatment unit (MTU) was developed in Chennai India.

REGIONAL ENVIRONMENTAL SUSTAINAIBILITY

Case of India (A. A. Forbis-Stokes *et al.*, 2020)

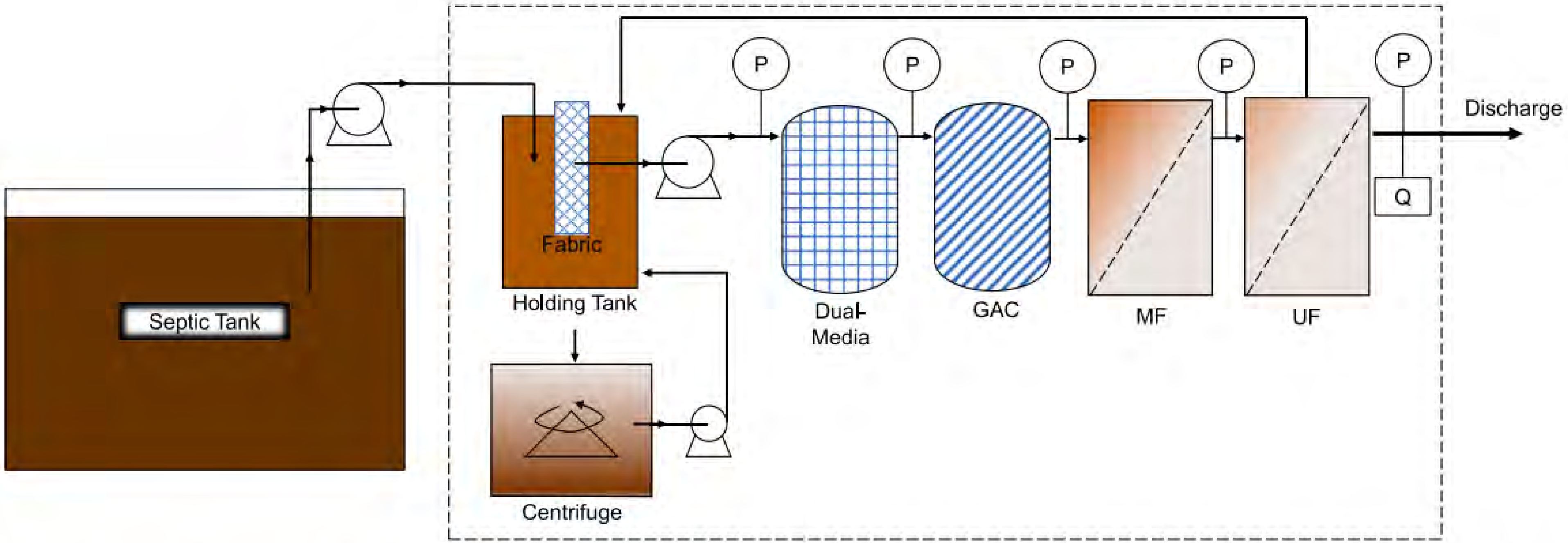


Fig. 1. Mobile treatment unit (MTU) process flow diagram with a dashed line designating which materials are located on the MTU truck. Symbols "P" and "Q" designate locations of pressure and flow gauges, respectively. Septage is pumped from a household septic tank into a holding tank through a fabric-covered feed tube. Liquid is pumped from the holding tank through the series of filters: Dual-Media (D–M), GAC, MF, and UF. UF effluent is discharged into environment, while only the concentrated solids are transported to a centralized treatment system. The UF reject value is partially opened to allow some reject to return to the holding tank, shown by arrow returning from UF to holding tank. Solids settled in the holding tank flow to centrifuge while centrate is returned to the settling tank. Figure is not to scale.

REGIONAL ENVIRONMENTAL SUSTAINAIBILITY

Case of India (A. A. Forbis-Stokes *et al.*, 2020)

Total cost : about US $ 15,700 less than typical emptying truck (US $20,000- 30,000 in India)

The MTU met the Indian discharge standards (effective in treating organics and pathogen) and was able to treat 330,000L of septage in 10-day period

Component	Cost (US $)
Total Filtration related components	3600
Truck used and structural modifications	9317
Pump hardware	2600
Monitoring devices	100

Summary of average concentrations and standard of deviation from inlet ("Septage") and outlet for each MTU in Phase II (Number of observations: MTU-2a = 24, MTU-2b = 18, and MTU-2c = 11). See Table 1 for threshold levels according to Indian discharge standards.

	Septage		MTU-2a		Septage		MTU-2b		Septage		MTU-2c	
Parameter	Avg.	St.Dev.	Avg.	St.Dev.	Avg.	St.Dev.	Avg.	St.Dev.	Avg.	St.Dev.	Avg.	St.Dev.
pH	7.7	0.5	7.8	0.5	7.8	0.4	7.9	0.5	7.8	0.3	7.8	0.3
BOD (mg/L)	193	178	23	8	148	85	35	27	711	773	27	11
COD (mg/L)	1000	1530	157	98	253	176	100	23	2510	3330	177	97
TSS (mg/L)	2010	2029	381	450	809	529	264	194	4400	4760	308	177
Turbidity (NTU)	604	2070	27	43	173	211	21	27	744	940	20	42
NH_3 (mg/L)	152	99	141	80	256	185	173	181	142	95	104	57
PO_4 (mg/L)	14	13	14	18	8	7	5	1	35	38	15	13
TC (CFU/100 mL)	59,800	95,500	437	778	8300	8900	127	45	456,000	598,000	1450	1870

CONCLUSION

Summary

DEWATS can help achieve regional environmental sustainability (like Japan, Malaysia), however following should be considered :

- No one size fits all solution
- City has both affluent managed neighborhood and adjacent informal settlements - ***different needs***
- Sanitation should be city-wide and inclusive – different demand and affordability
- Meet interim and intermediate needs