INSTITUT TEKNOLOGI BANDUNG
INDONESIA

Review of Applied Wastewater Treatment Technology for Floating and Flooded Communities

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Outline

- Get to know floating and flooded communities
- Problem Statement
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  - Wastewater System to be Reviewed
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- Conclusions

FLOATING AND FLOODED COMMUNITIES

Problem Statement

- > 2 million Indonesian people live **along and above river**
- 1.5 – 2 million Indonesian people live in the **coastal and estuaries**
- 1.5-2 million Indonesian people live in **swamp area** around the sea, river, and lake

Other South East Asia Countries :

- Cambodia 1.4 –2.2 million
- Lao 1 –1.5 million
- Philippines < 5 million

(Djonoputro, 2010; Blacket, 2011)

RIVER

COASTAL

SWAMP

Figure source : Blacket, 2011 –WSP presentation

Problem Statement

COMMUNITIES

Part of urban slum area, exist and grow mainly because of economical reason

Mostly are illegal settlement, not priority area to be developed

Lack of sanitation facilities, including wastewater system facilities

PROVIDING WASTEWATER SYSTEM

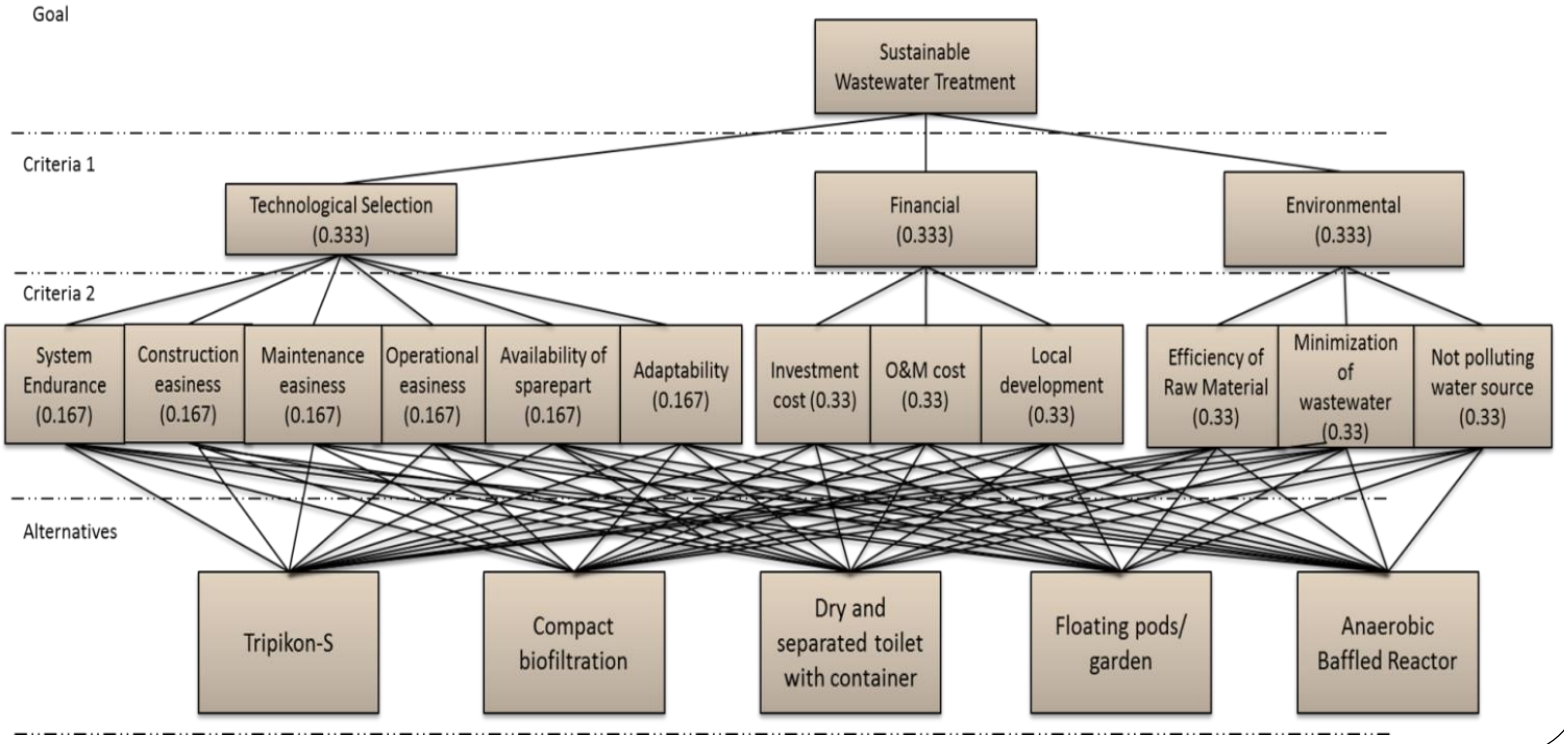
Some technical and non-technical problems in applying wastewater system for those communities

Need evaluation for applied wastewater system in floating and flooded communities

Methodology

Review Methods

- Analytical Hierarchy Process (AHP) to evaluate wastewater treatment technology that has been applied in many floating and flooded communities
- Goal : Sustainable wastewater system
- Data are collected from literature, interview, and field survey
- Sustainability criteria based on sustainability criteria for general urban wastewater treatment combine with some consideration factors related to specific environmental condition



Methodology

Analysis Criteria

Technological selection	Explanation	Weight (0.333)
1. System endurance	Durability (responding tidal wave and seasonal effect)	0.167
2. Operational easiness	Easy to operate	0.167
3. Maintenance easiness	Easy to maintain (by communities)	0.167
4. Construction easiness	Easy to construct (not more difficult than on land)	0.167
5. Availability of sparepart	Easy to fine sparepart	0.167
6. Adaptability	Can be adapat easily in other place	0.167

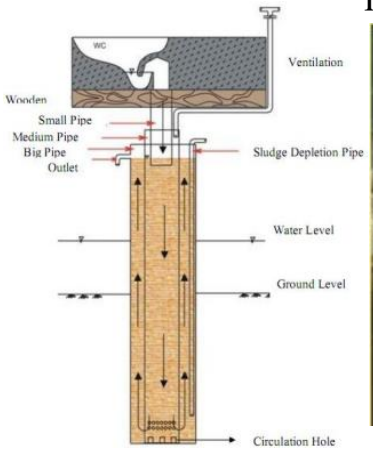
Environmental	Explanation	Weight (0.333)
1. Not polluting water area	High removal efficiency, low leakage potency	0.333
2. Efficiency of raw materials	Raw material are efficiently used	0.333
3. Minimization of wastewater	Reducing water used, water-solid separation	0.333

Financial	Explanation	Weight (0.333)
1. Investment cost	Considerably low	0.333
2. O&M cost	Considerably low	0.333
3. Local development	Communitites possible to pay cost	0.333

Methodology

Wastewater system to be reviewed

Three-consentric pipe septic (Tripikon-S



Compact biofiltration system

Anaerobic baffled

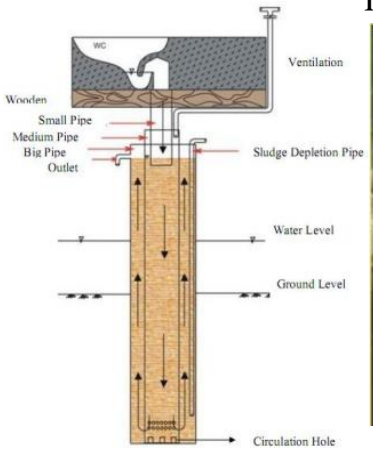
- Modified septic tank - **vertical flow** and pipe as construction materials – **effluent pipe higher** than surrounding water level
- Consider as **low cost, easy to build, easy finance, easy to replicate**
- Applied as on-site system in Pontianak, Demak, and Palembang (Indonesia) – some **breakage due to some forces from water and breakage of toilet floor**
- Access for **desludging** consider **quite difficult**

(Saraswati et al, 2009; Djonoputro et al, 2010; Wijaya et al, 2011; Nurmandi, 2012)

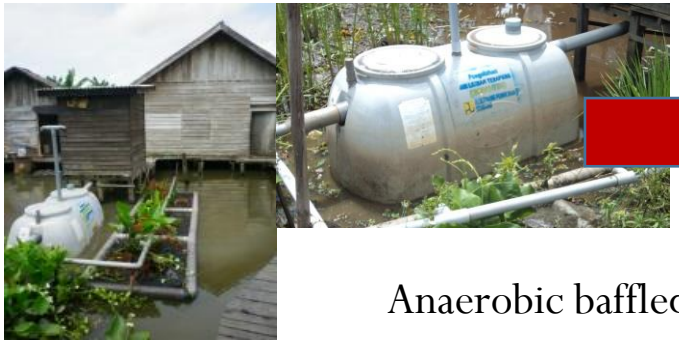
Methodology

Wastewater system to be reviewed

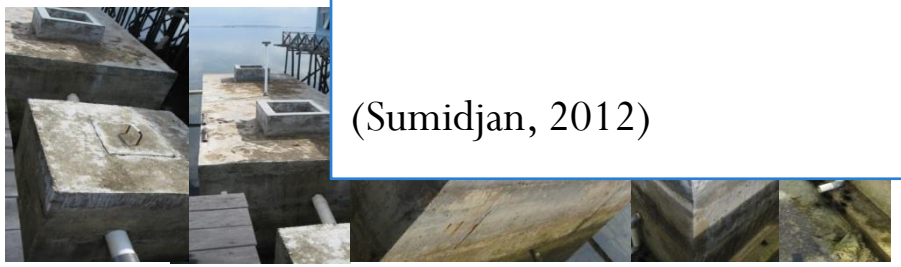
Three-consentric pipe septic (Tripikon-S



Compact biofiltration system



Anaerobic baffled



- **Fabricated, fiberglass** construction
- Claimed **do not required further treatment** or infiltration/filter, **unaccumulated sludge** for several years
- Applied as on site sanitation in Tanjung Pagar, Banjarmasin, Indonesia – found **breakage because of force to the river bottom** affected by **tidal wave**

(Sumidjan, 2012)

Methodology

Wastewater system to be reviewed

- Applied in Phat Sanday Floating Community inTonle Sap, Cambodia – as community chosen system
- Use **local materials**, consider as **low cost and easy build system**
- **Separation** of urine, wash water, and faeces
- Need **communities effort to operate and maintain** the system well – include wastewater bucket transfer to further stabilized and procedure for proper use of the toilet

Floating toilet project – Tonle Sap
Live & Learn Environmental Education Cambodia - Engineers Without Borders Australia

Dry and separated toilet with container (Urine diversion dehydrating toilet – UDDT)

Floating pods/ garden

Methodology

Wastewater system to be reviewed

Three-consentric pipe septic (Tripikon-S)

- Applied in floating communities in Tonle Sap, Cambodia (main treatment) and Banjarmasin, Indonesia (complimentary treatment)
- Use local material, low cost, easy to build, easy to operate, easy to maintain, can be long term treatment
- Limited efficiency, high potency of leakage problem

(Chakraborty et al, 2012; Sumidjan, 2012)

Dry and separated toilet with container (Urine diversion dehydrating toilet – UDDT)

Floating pods/ garden

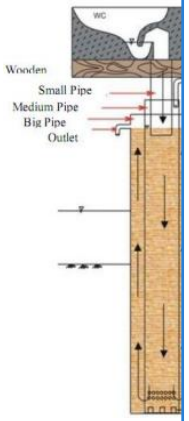
Methodology

Wastewater system to be reviewed

- Applied in coastal communities in Bontang, Indonesia
- **Higher efficiency than septic tank**, not required further treatment
- **Concrete construction in the bottom of the water area** - construction difficulties – adaptation foundation construction (use wood hock as lock and supporting foundation)

(Bontang survey, Djonoputro et al, 2011)

Three-



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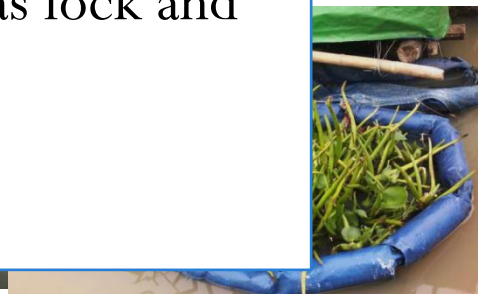

Anaerobic baffled reactor

Result and Discussion

Tripikon-S

Endurance	No	Investment cost	Yes
Operational easiness	Yes	O&M cost	Yes
Maintenance easiness	No	Local development	Yes
Construction easiness	Yes	Efficiency of raw material	Yes
Sparepart availability	Yes	WW minimization	No
Adaptability	Yes	Not polluting	No

Biofiltration

Endurance	No	Investment cost	No
Operational easiness	Yes	O&M cost	Yes
Maintenance easiness	No	Local development	No
Construction easiness	Yes	Efficiency of raw material	No
Sparepart availability	No	WW minimization	No
Adaptability	Yes	Not polluting	Yes

Result and Discussion

UDDT

Endurance	Yes	Investment cost	Yes
Operational easiness	No	O&M cost	Yes
Maintenance easiness	No	Local development	Yes
Construction easiness	Yes	Efficiency of raw material	Yes
Sparepart availability	Yes	WW minimization	Yes
Adaptability	No	Not polluting	Yes

Floating pods/garden

Endurance	Yes	Investment cost	Yes
Operational easiness	Yes	O&M cost	Yes
Maintenance easiness	Yes	Local development	Yes
Construction easiness	Yes	Efficiency of raw material	Yes
Sparepart availability	Yes	WW minimization	No
Adaptability	Yes	Not polluting	No

Result and Discussion

ABR

Endurance	Yes	Investment cost	No
Operational easiness	Yes	O&M cost	Yes
Maintenance easiness	No	Local development	No
Construction easiness	No	Efficiency of raw material	No
Sparepart availability	Yes	WW minimization	No
Adaptability	Yes	Not polluting	Yes

Result and Discussion

Alternative system	Technological selection score	Financial score	Environmental Score	Total Score
Tripikon S	0.668	1.000	0.333	0.666
Biofiltration	0.501	0.333	0.333	0.389
UDDT	0.501	1.000	1.000	0.832
Floating Pods/Garden	1.000	1.000	0.333	0.777
ABR	0.668	0.333	0.333	0.444

UDDT, Floating Pods/Garden and Tripikon-S :

- Consider as low cost wastewater system
- Developed with consideration of floating and flooded area condition (including communities consideration for UDDT)

Biofiltration and ABR :

- Directly adapt from system applied in land area, only different in installation method
- Not consider for low cost criteria and not involve possibility of local development

Conclusions

- Based on sustainability analysis for wastewater treatment applied in floating and flooded communities, some **key factors** give big contribution to **achieve high sustainability** index, those are **low cost system consideration**, **specific environmental condition consideration** in develop the system, and could be become **more sustain by community involvement** in applying system

- **Direct used of land-design wastewater system** consider **less sustain** to be applied in floating and flooded communities

THANK YOU

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