Towards a circular economy transition through safe collection, treatment & resource recovery of wastewater and fecal sludge

T2D3

www.worldwaterforum.org
Dr. Pierre Flamand

Japan Sanitation Consortium (JSC)

Pierre is the Manager of International Affairs at JSC, the Asia-Pacific Water Forum’s Knowledge Hub for sanitation.

He has 20 years of experience in sanitation, with particular focus on fecal sludge management. Since joining JSC in 2009, he has been involved in sanitation projects in Viet Nam, Malaysia and Bhutan. He is the co-author of ‘Sanitation and Sustainable Development in Japan’ (ADB 2016) and ‘Accountability Mechanisms for Inclusive City-Level Public Services in Asia’ (ADBI 2023).

Since 2015, he has been involved in Working Groups of ISO/TC 224 as an expert representing Japan for the development of several international standards.

Pierre holds a doctoral degree in regional development studies. He is a visiting researcher and lecturer at Toyo University in Japan.
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<td>Dr. (Mr.) Yoshitaka Ebie; Manager of International Coordination Office, Planning Division, National Institute for Environmental Studies (NIES); Advisor for Water Environment Partnership in Asia (WEPA)</td>
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<td>Presentation 1: Wastewater and faecal sludge recycling, energy and nutrient recovery - towards a circular economy</td>
<td>Mr. Hezekiah Pireh; Water and Sanitation Team Leader; Urban Basic Services Section; Urban Practices Branch; Global Solutions Division; United Nations Human Settlements Programme, UN-Habitat</td>
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<td>Mr. Safwatul Haque Niloy; Team Leader - Public Health Engineering; OXFAM Bangladesh</td>
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<td>Presentation 3: Fecal Sludge Compost Production from a 24-Hour Composting Machine</td>
<td>Mr. Supriyanto; Head of Wastewater Operator; Public Works and Spatial Office, Tasikmalaya City, Indonesia</td>
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<td>Panel Discussion</td>
<td>Moderator: Ms. Saniya Niska; WASH SDG Programme Manager; Interim Water Sector Leader; SNV Panelists: Ms. Rouguiyatou Ba; Association des Jeunes Professionnels de l'Eau et de l'Assainissement du Sénégal (AJPEAS) Prof. (Mr.) V. Srinivas Chary; Director of the Centre for Environment, Urban Governance, and Infrastructure Development; Administrative Staff College of India (ASCI) Ms. Mélodie Boissel; Head of Mediterranean basin and knowledge production, pS-Eau Mr. Shu Nishi; Director for Sewerage International Affairs and Engineering Office; Ministry of Land, Infrastructure, Transport and Tourism (MLIT) of Japan</td>
</tr>
<tr>
<td>Questions from the audience</td>
<td></td>
</tr>
<tr>
<td>Closing Remarks</td>
<td>Dr. (Mr.) Papa Samba Diop; Governor, World Water Council; Technical Advisor, National Sanitation Office of Senegal (ONAS) - OK</td>
</tr>
</tbody>
</table>
Dr. Yoshitaka Ebie
National Institute for Environmental Studies (NIES)
Water Environment Partnership in Asia (WEPA)

Dr. Yoshitaka Ebie is a Chief Senior Researcher in Material Cycles Division at National Institute for Environmental Studies (NIES), Japan. His research fields are wastewater treatment, greenhouse gas emissions and disaster waste management.

He is one of the authors of IPCC Guidelines for National Greenhouse Gas Inventories. He is also involved in ISO TC224/WG8 for on-site domestic wastewater services.

Dr. Ebie holds a doctoral degree in Agriculture from the University of Tsukuba, having focused for his research on: ‘Nitrifying bacterial ecology in biological nitrogen removal processes’.
Standardization of wastewater treatment systems

Dr. Yoshitaka Ebie
National Institute for Environmental Studies, Japan
A Key Message towards a circular economy transition through safe collection, treatment and resource recovery of wastewater and fecal sludge.

- Standardization of wastewater treatment systems in National, Regional or International level
  - Necessity
  - Difficulty

- Structure
- Performance evaluation
- O&M
- Building permission
- Pollution load per capita
On-site and off-site

On-site/decentralized
- Individual (ex. 1 HH; 5 PE)
- Communal (ex. 2-10 HH; 10-50 PE)

Off-site
- Settlement scale: ex. 50~20,000 PE
- City scale: ex. >20,000 PE
5 things we need to consider for dissemination of appropriate wastewater treatment technologies

1. Effluent standards
2. Structure standards and/or standardized performance evaluation
3. Standardized O&M and monitoring
4. Standardized Sludge collection, treatment and disposal
5. Standardized license for technicians and/or service providers
Regulation has been updated

- Ministry of Environment and Forestry has issued new effluent standard for domestic wastewater (2016).
- This new and stringent regulation for domestic wastewater is a major step forward to improve water environment.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Unit</th>
<th>Old Regulation</th>
<th>New Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>-</td>
<td>6-9</td>
<td>6-9</td>
</tr>
<tr>
<td>BOD</td>
<td>mg/L</td>
<td>100</td>
<td>30</td>
</tr>
<tr>
<td>COD</td>
<td>mg/L</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>TSS</td>
<td>mg/L</td>
<td>100</td>
<td>30</td>
</tr>
<tr>
<td>Oil and Grease</td>
<td>mg/L</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Ammonia</td>
<td>mg/L</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>Total Coliform</td>
<td>N/100 mL</td>
<td>-</td>
<td>3,000</td>
</tr>
<tr>
<td>Discharge</td>
<td>L/person/day</td>
<td>-</td>
<td>100</td>
</tr>
</tbody>
</table>
On-site/decentralized domestic wastewater treatment facilities

Septic tank
Biofil
IPAL

Are they all reliable?

septic tank?
5 things we need to consider for dissemination of appropriate wastewater treatment technologies

1. Effluent standards
2. Structure standards and/or standardized performance evaluation
3. Standardized O&M and monitoring
4. Standardized Sludge collection, treatment and disposal
5. Standardized license for technicians and/or service providers
Compliance to the regulation may not be ensured

National structure standard.

You don’t need to worry about new effluent standard with our new product.

Nobody knows!

We need a standardized performance testing method and reliable certification system.
Major standards in the world

European Standard (EN)
EN12566-3: Small wastewater treatment systems for up to 50 PE

The United States
NSF/ANSI Standard 40: Residential Wastewater Treatment Systems

Australia
AS/NZS 1546 Part 3: Aerated wastewater treatment systems

Japan
Performance testing method for Johkasou
Advantages

• If you have no standard, it would be chaos.
• If you have different local standards in different area of your country, manufacturers need to have different kind of products for each area.
  • This must exert upward pressure on price.
• If we standardize these local standards, we can make a big market within the area sharing the same standard.
5 things we need to consider for dissemination of appropriate wastewater treatment technologies

1. Effluent standards
2. Structure standards and/or standardized performance evaluation
3. Standardized O&M and monitoring
4. Standardized Sludge collection, treatment and disposal
5. Standardized license for technicians and/or service providers
• If you have standardized structure or performance evaluation, O&M procedures and frequency could also be standardized.

Otherwise, you must learn many O&M procedures for every single site and prepare many kinds of tools.
5 things we need to consider for dissemination of appropriate wastewater treatment technologies

1. Effluent standards
2. Structure standards and/or standardized performance evaluation
3. Standardized O&M and monitoring
4. Standardized sludge collection, treatment and disposal
5. Standardized license for technicians and/or service providers
• Regular desludging is closely related with the standardization of treatment facilities.
  - Japanese law requires annual desludging, then manufacturers design the capacity of the sludge storage tank with this condition.

• Desludging procedures also rely on the standard of the treatment facility.
  - Manhole size, desludging port size, depth, etc.
5 things we need to consider for dissemination of appropriate wastewater treatment technologies

1. Effluent standards
2. Structure standards and/or standardized performance evaluation
3. Standardized O&M and monitoring
4. Standardized Sludge collection, treatment and disposal
5. Standardized license for technicians and/or service providers
• Civil engineering, microbiology, mechanical engineering, etc.

• Quality control of services
Platform for the standardization

Stakeholders Meeting

Industry-academia-government collaboration

SNI 9161:2023
Standardized testing method of domestic wastewater treatment plant in Indonesia
**WEPA** is an initiative **proposed by the Ministry of the Environment, Japan (MOEJ) in 2003** at the Third World Water Forum

- The first phase started in 2004, following a **five-year cycle**;
- The objective is to **improve water environmental governance** in Asia with full support of MOEJ;
- WEPA currently consists of the following **13 countries in Asia**.

1. Cambodia  
2. China  
3. Indonesia  
4. Japan  
5. Lao PDR  
6. Malaysia  
7. Myanmar  
8. Nepal  
9. Philippines  
10. Republic of Korea  
11. Sri Lanka  
12. Thailand  
13. Viet Nam
Sharing knowledge and experiences

WEPA database  www.wepa-db.net

Publication
WEPA Outlook on Water Environmental Management in Asia

Annual meeting

Action program
Terima kasih
Mr. Hezekiah Pireh leads the water and sanitation team at UN-Habitat. He has over 25 years of experience in water and sanitation governance, policy and institutional capacity development support and citizen engagement.

He is managing several of UN-Habitat’s water and sanitation projects in Africa and Asia and has extensive experience in formulating and implementing strategies for effective involvement of city-level stakeholders, including the urban poor and vulnerable groups, in the management of water and sanitation services.

Over the years, he has helped to strengthen operational structures of local governments and other service providers by creating a governance framework favourable for stakeholder engagement and partnership building in pro-poor basic service provision.
Towards a circular economy transition through safe collection, treatment and resource recovery of wastewater and fecal sludge
Wastewater and faecal sludge recycling, energy and nutrient recovery – Interesting times for wastewater management!

- Alleviate the global water crisis through wastewater reuse.
- A shift in focus from pollutant removal to resource recovery and reuse.
- Circular economy for wastewater and faecal sludge.
- Policy and institutional arrangements to support the reuse of wastewater and feacal sludge.

*Global Report on Sanitation and Wastewater Management in Cities and Human Settlements | UN-Habitat (unhabitat.org)*
Wastewater and faecal sludge by-products resource recovery

Wastewater and faecal sludge treatment by-products

- Treated water
  - Cooling plants
  - Recreational use
  - Drinking water
- Sludge
  - Industrial processes
  - Irrigation
  - Replenishing aquifers
  - Nutrient-rich biosolids
- Nutrient-rich
  - Biogas for energy
  - Carbon credits

Source: Global Report on Sanitation and Wastewater Management in Cities and Human Settlements | UN-Habitat (unhabitat.org)
Hamburg Wasser recovers phosphorus from sludge ash produced by its wastewater treatment plants
Policy and institutional arrangements to support the reuse of wastewater in Hanoi, Vietnam

Policies and legislation

• Decision No 1930/QD-TTg dated November 20, 2009, on urban drainage and wastewater.

• Article 72 of the Law on Environmental Protection 2020.

• The Law on Water Resources (LOWR, 2012).

Institutional arrangements

• Hanoi Sewerage and Drainage Company (HSDC).

• Department of Rural and Agricultural Development (DARD) of Hanoi City.
Advances in using wastewater as a source of potable water

<table>
<thead>
<tr>
<th>Location</th>
<th>Year implemented</th>
<th>Treatment Processes</th>
<th>Effluent end use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windhoek, Namibia</td>
<td>1969</td>
<td>PAC → Pre-ozoneation → Coagulation/Flocculation → DAF → Rapid Sand Filtration → Ozonation → BAC Filtration → GAC Filtration → UF → Chlorination</td>
<td>Blended with raw water prior to drinking water treatment</td>
</tr>
<tr>
<td>Beaufort West, South Africa</td>
<td>2011</td>
<td>Sand Filtration → UF → RO → UV/ AOP → Chlorination</td>
<td>Blended with raw water prior to drinking water treatment</td>
</tr>
<tr>
<td>Big Spring, Texas, USA</td>
<td>2013</td>
<td>MF → RO → UV/AOP → Conventional Treatment</td>
<td>Blended with raw water prior to drinking water treatment</td>
</tr>
<tr>
<td>Village of Cloudcroft, New Mexico, USA</td>
<td>2016</td>
<td>MBR → RO → UV/AOP → Storage → UF → UV → GAC → Chlorination</td>
<td>Blended with raw water prior to drinking water treatment</td>
</tr>
</tbody>
</table>

Fully leveraging the potential of treated wastewater requires safeguards and the development and enforcement of standards.
Faecal sludge: towards a circular sanitation economy

<table>
<thead>
<tr>
<th>CBS provider</th>
<th>Containment</th>
<th>Treatment process</th>
<th>Reuse products</th>
<th>Service costs to user per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOIL</td>
<td>Portable seated</td>
<td>Aerobic composting: static pile then window turning, with sugarcane bagasse co-waste at start of process</td>
<td>Compost branded as Konpos Lakay, sold at USD 280/t.</td>
<td>USD 36</td>
</tr>
<tr>
<td>Sanergy</td>
<td>Fixed squat</td>
<td>Aerobic composting with a variety of agricultural/organic co-waste materials.</td>
<td>Evergrow compost sold at USD 400/BSFL digestion of faeces.</td>
<td>USD 63+</td>
</tr>
<tr>
<td>Clean Team</td>
<td>Portable seated</td>
<td>Municipal treatment plant</td>
<td>None</td>
<td>USD 106</td>
</tr>
<tr>
<td>Sanivation</td>
<td>Portable or fixed seated</td>
<td>Pasteurisation</td>
<td>Solid fuel briquettes</td>
<td>NA</td>
</tr>
<tr>
<td>Loowatt</td>
<td>Portable seated</td>
<td>Anaerobic digestion</td>
<td>Electricity, fertilizer</td>
<td>NA</td>
</tr>
</tbody>
</table>

Note: BSFL = black soldier fly larvac
* Estimated based on a family of two adults and three children, each making one paid visit per day
* Source: adapted from World Bank, 2019; Mackinnon, 2019

According to the CBSA, during 2021-2022, their members served over 190,588 people, sold 4,431 CBS toilets, serviced over 10,874 CBS toilets, removed over 18,207 tons of sludge, and provided over 531 jobs, operating over nine countries and 26 municipalities.
Recommendations and enabling factors for safe wastewater and feacal sludge reuse

- **Opting for relevant technologies**, which allow valorization, and providing capital support to developing these technologies;
- **Legal and regulatory instruments** that set standards for valorization and licensing for the production and sale of byproducts such as compost and biogas;
- **Institutional arrangements** to ensure the fair allocation of resources, especially for farming purposes;
- **Incentives** that contribute to market building for by-products; for example, the provision of subsidies for faecal based (organic) compost; or support with community/end-user engagements to promote by-products.
- **Strong environmental monitoring and controls** to mitigate risk.

Enablers:
- Invest in further **research and innovation** on wastewater and faecal sludge management.
- Support **peer-to-peer learning** and **south-south collaboration**.
Mr. Safwatul Haque Niloy is serving as the WASH Coordinator at OXFAM in Bangladesh.

He is a Civil Engineer with 7 years of experience in addressing rapid onset and post-emergency crises to enhance WASH response in refugee settings.

He specializes in water facilities, fecal sludge management, solid waste management, waste to energy projects and climate-resilient WASH facilities in both emergency and development contexts.
Towards a circular economy transition through safe collection, treatment and resource recovery of wastewater and fecal sludge

Fecal Sludge Management in Emergency Settings

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PRESENTATION BRIEF

• Session number: T2D3
• Name of presenter: Safwatul Haque Niloy
• Institution: OXFAM in Bangladesh

Key phrases:
• Water security and fecal sludge management are intricately connected.
• Contextualized and Innovative solution is required to deal with Emergencies
• Resource recovery remains a challenge, highlighting the absence of enabling policies, social acceptance and positive ecosystems.
50,000 latrines

1000 m³/day of sludge produced Everyday, 26% increased in Rainy season

160+ operational FSTP
Initial phase, water source contamination from poor sanitation

Emergency Phase

Gradual Upgradation

Shallow Tubewell

Tap Stand

Deep Tube well

Pit latrines, Septic tanks

Worm Based Toilets
DUE TO HIGH USER NUMBER, LATRINE PIT GETS FILLED QUICKLY.

If not emptied, sludge will overflow to drains, shelters posing serious public health risks.
Manual Transportation
Discouraged & not acceptable, as unsanitary and undignified conditions pose significant health risks to sanitation workers."

Transportation with Vacutug
Disadvantages
• Accessibility
• Capacity
• Suction lift

Intermediate Fecal Sludge Transfer Network, IFSTN
Three centralized Fecal Sludge Treatment Plant serving more than 350,000 refugees

FSTP 1, Capacity 180m³/day

FSTP 2, Capacity 180m³/day

FSTP 3, Capacity 120m³/day
Resource Recovery, Yet to scaled and successful

Biogas to Electricity Generation

Biosolid/ Co Compost as organic conditioner
THANK YOU

For any further queries please contact
Email : Sniloy@oxfam.org.uk
Mr. Supriyanto
Tasikmalaya City, Indonesia

Supriyanto is the Head of Wastewater Operator in Tasikmalaya City, West Java, Indonesia. He holds a bachelor’s degree in civil engineering and has been pursuing his career with the Tasikmalaya City Government.

He leads the utility in managing on-site and off-site sanitation services in the city and has been part of the city’s effort towards Open Defecation Free status and safely managed sanitation.
FECAL SLUDGE COMPOST PRODUCTION FROM A 24-HOUR COMPOSTING MACHINE

STUDY CASE IN TREATMENT PLANT IN TASIKMALAYA CITY, WEST JAVA, INDONESIA

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PRESENTATION BRIEF

• Session number: T2D3
• Name of presenter: Supriyanto
• Institution: Wastewater Operator from Tasikmalaya City, Indonesia
• Key phrases:
  • Reuse initiatives
  • Fecal sludge compost
  • compost qualified for ornamental flower and food crops
BACKGROUND

• Tasikmalaya City in West Java has a population of 716,160 inhabitants with density of 3,930 inhabitants per sq km. The annual growth rate is 0.81%.

• Rapid growth and high population causes significant increase of wastewater generation. While in 2023, Tasikmalaya City has 15% safe sanitation access and 71% basic sanitation access.

• Singkup Fecal Sludge Treatment Plant (FSTP) established in 2014 has designed capacity of 38 m³/day which only covers 12% of total city’s population, with idle capacity of 68%.

• Each month, the FSTP generates 950 kg which allow sludge accumulation to the point it will not fit into available space at FSTP. While expanding the area require high capital expenditure.

• Reuse practice as an alternative ways to reduce faecal sludge volume and it has a potential economic benefits.
Ecological Sanitation approach by empirical research, a collaboration between Tasikmalaya City Government and SNV
METHODOLOGY

Preparing the treated sludge from Sludge Drying Bed (SDB)

Mechanised composting process in 24-hr composting machine

Compost production

Generates several compost type using different mixture for comparison (with soil, cow dung, food waste, dry leaves) – research process

Test on ornamental flower and food crop (soybean, palm oil)

Plant measurement against research indicator (height, number of leaves, number of flower)
METHODOLOGY
Mixture composition for visual and laboratory test

<table>
<thead>
<tr>
<th></th>
<th>Soil only (as blanko)</th>
<th>Fresh fecal sludge compost only</th>
<th>Fresh fecal sludge compost + cocopeat</th>
<th>Fresh fecal sludge compost + cabbage waste</th>
<th>Fresh fecal sludge compost + cow dung</th>
<th>Fresh fecal sludge compost + dry leaves</th>
<th>Fresh fecal sludge compost + kitchen waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>Soil only (as blanko)</td>
<td>Fresh fecal sludge compost only</td>
<td>Fresh fecal sludge compost + cocopeat</td>
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<td>Fresh fecal sludge compost + cow dung</td>
<td>Fresh fecal sludge compost + dry leaves</td>
<td>Fresh fecal sludge compost + kitchen waste</td>
</tr>
</tbody>
</table>
Visual observations from plant testing found that plants grown in compost from sludge produced in the 24-hr composting machine had taller stems, more leaves, and more flowers.

The laboratory result from faecal sludge compost has met the criteria from Indonesian Agriculture Law for organic compost (Kepmentan 261/KPTS/SR-310/M/4/2019).

E. coli bacteria were not found in the produced compost.
## COST ESTIMATION

Cost estimation for 1 cycle compost production: 25 kg compost

<table>
<thead>
<tr>
<th>No</th>
<th>Item</th>
<th>Unit Cost (IDR)</th>
<th>Quantity</th>
<th>Total Cost (IDR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Manhour</td>
<td>80.000</td>
<td>2 person</td>
<td>160.000</td>
</tr>
<tr>
<td>2.</td>
<td>Electricity</td>
<td>115.000</td>
<td>1 cycle</td>
<td>115.000</td>
</tr>
<tr>
<td>3.</td>
<td>Packaging</td>
<td>2.000</td>
<td>25 Pcs</td>
<td>50.000</td>
</tr>
<tr>
<td>4.</td>
<td>Labelling</td>
<td>500</td>
<td>25 Pcs</td>
<td>12.500</td>
</tr>
<tr>
<td>5.</td>
<td>Transportation cost</td>
<td>20.000</td>
<td>1 cycle</td>
<td>20.000</td>
</tr>
</tbody>
</table>

TOTAL (Rp) 357.500

Equivalent to EUR 20.58 per cycle
LESSON LEARNED

• Producing organic compost from treated fecal sludge is feasible, provided attention is paid to laboratory test that ensure the standard nutrient content is met and that no harmful pathogens are present, aligned with existing regulation

• A legal wastewater institutional framework that permits business generation need to be in place

• Suitable areas inside FSTPs need to be included during construction planning to give space for reuse practice

• Further market research need to be conducted to assess the level of demand for using organic compost derived from faecal sludge for domestic use
THANK YOU
Ms. Saniya Niska
SNV

Saniya is SNV Indonesia’s Water Sector Lead and Programme Manager.

She holds master’s degree in environmental engineering and has strong interest in GEDSI mainstreaming in Water Sector.

She is SNV Indonesia’s reference person for Gender, Menstrual Hygiene Management, Universal Design of WASH facilities, Inclusion of Children with Disabilities and WASH in Schools. Represents SNV in national and international multi-stakeholders’ platforms and research groups.
Panelists

Ms. Rouguiyatou Ba
Association des Jeunes Professionnels de l’Eau et de l’Assainissement du Sénégal (AJPEAS)

Mr. Shi Nishi
Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Japan

Ms. Mélodie Boissel
pS-Eau, France

Prof. V. Srinivas Chary
Administrative Staff College of India (ASCI)
Questions from the audience
Closing Remarks

Dr. Papa Samba Diop
National Sanitation Office of Senegal (ONAS)

Dr. Papa Samba Diop is a Governor at the World Water Council since 2022 and technical advisor at ONAS, building on 33 years of professional experience accumulated in taxes and domains and in the water sector.

Doctor in economics and management and MBA from Paris Dauphine/Panthéon Sorbonne University and engineer in civil engineering (expert in water and sanitation), he has more than 30 years in urban hydraulics and sanitation, areas where he has developed various skills.

Furthermore, his functions as President of the Scientific and Technical Council (CST) of the African Water and Sanitation Association (AAEA) have allowed him to have a broad view of the situation of water and sanitation in Africa.
THANK YOU