Fecal Sludge Management
A Case Study of Malaysia

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Kuala Lumpur, Malaysia
Status of Sanitation & Environmental Health in Malaysia

- 96% Population with access to improved sanitation
- 70% Population Connected to Wastewater Treatment Systems
- 90% Increase in ratio of Clean Rivers in 2015 vs 1993
- 26% Population Connected to Septic Tanks
- 95.5% Population served with Piped Water Services
- Water Borne Disease Related to Sewage Pollution => Negligible
The Needs of Sewerage Services

Initial Priority for Public Health

Gradual Shift of Priority to Protecting Water Resources and Environment

Focus of priority on all 3 aspects

Priority Levels

Time
Sewerage Management in Malaysia progressively strengthened & enhanced

**SERVICES PROVIDER**
- Sanitary Board
- Municipalities & MOH
- IWK via Concession
- MOF Inc. bought over IWK (CAPEX by Govt.)
- IWK via Authorised Person (CA)

**REGULATIONS**
- Sewerage Services Act was passed
- SSD was formed
- WSIA and SPAN Act were passed
- SPAN was established

Non-optimal service levels

**SSA 1994**
1. JPP – regulator;
2. Concession Agreement;
3. Septic tank – scheduled desludging once every 2 yrs & 6 monthly bill by IWK

WSIA 2006
1. SPAN – regulator;
2. Individual (FL & SL) / class licence – public / private sewerage systems;
3. Various offences – criminal in nature & power of prosecution with SPAN;
IWK’s Key Obligations

a) Manage, operate, maintain the existing and new public sewerage systems;
b) Upgrade and refurbish the existing public sewerage systems;
c) Plan, design, construct and commission new public sewerage systems;
d) Receive, collect, treat and dispose of sewage and sewage sludge;
e) Empty, transport, treat and dispose of sewage sludge from septic tanks;
f) To collect and retain sewerage charges from customers

Note:
Item (b) and (c) are not carried out since Water Services Industry Act (WSIA) 2006 was enforced.
The role is being undertaken by the Government.

Spirit of the WSIA 2006:
• OPERATOR TO BE ASSET LIGHT
• OPERATOR FOCUS ON DELIVERY OF SERVICE TO CUSTOMERS
Governance Structure of Sewerage Services in Malaysia

Ministry of Finance

Owns Indah Water through the Minister of Finance Incorporated

Ministry of Natural Resources & Environment

Regulates Effluent Discharge

Department of Environment

Ensures a well balanced and sustainable management of natural resources and environment

Indah Water

1. Provision of Sewerage Services in 87 Local Authority Areas
2. Sewerage Services Billing & Collection

SPAN

Suruhanjaya Perkhidmatan Air Negara

National Water Services Commission

Policy & Control of National Sewerage Agenda by Government

Ministry of Energy, Green Technology and Water

Undertakes Refurbishment or Upgrading Projects Funded by Government
IWK Operates in Peninsular Malaysia

excludes Kelantan, Part of Johor, Sabah & Sarawak

<table>
<thead>
<tr>
<th>Business Dimension</th>
<th>2000</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Unit Offices</td>
<td>17</td>
<td>21</td>
</tr>
<tr>
<td>No. of Local Authorities</td>
<td>86</td>
<td>87</td>
</tr>
<tr>
<td>No. of STP</td>
<td>3,003</td>
<td>6,460</td>
</tr>
<tr>
<td>No. of CST</td>
<td>3,454</td>
<td>3,637</td>
</tr>
<tr>
<td>No. of IST</td>
<td>890,870</td>
<td>1,278,904</td>
</tr>
<tr>
<td>No. of NPS</td>
<td>277</td>
<td>1,063</td>
</tr>
<tr>
<td>Sewer length (km)</td>
<td>9,236</td>
<td>18,153</td>
</tr>
<tr>
<td>Total PE</td>
<td>9.0Mil</td>
<td>23.1Mil</td>
</tr>
<tr>
<td>No. of billed customers</td>
<td>1.4 Mil</td>
<td>3.7 Mil</td>
</tr>
</tbody>
</table>

Data as of 2016

- IWK Operational Area
- Non IWK Operational Area
- Outside Local Authority Areas
**Profile of Public Sewage Treatment Plants**

**Types of Sewage Treatment Plant (STP) as of April 2016**

- Mechanical Plants: 5,254 Nos. (81%)
- Imhoff Tank: 652 Nos. (10%)
- Oxidation Ponds: 392 Nos. (6%)
- Aerated Lagoon: 162 Nos. (3%)

Total STPs = 6,460

**Population Equivalent (PE) catered by STP as of April 2016**

- Mechanical Plants: 18,348,359 PE, (79%)
- Imhoff Tank: 491,568 PE, (2%)
- Oxidation Ponds: 1,666,940 PE, (7%)
- Aerated Lagoon: 2,636,362 PE, (12%)

Total PE STPs = 23,143,229

**Type of Service and Population Served**

<table>
<thead>
<tr>
<th>Type of Service</th>
<th>IWK Service Areas</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Public (IWK)</td>
<td>Private / Individual (Non-IWK)</td>
<td>Total PE</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>PE</td>
<td>No</td>
<td>PE</td>
</tr>
<tr>
<td>Connected</td>
<td>6,460</td>
<td>23,143,229</td>
<td>4,682</td>
<td>2,958,572</td>
</tr>
<tr>
<td>CST</td>
<td>-</td>
<td>-</td>
<td>3,637</td>
<td>412,673</td>
</tr>
<tr>
<td>Septic Tank</td>
<td>-</td>
<td>-</td>
<td>1,278,904</td>
<td>6,394,520</td>
</tr>
<tr>
<td>Pour Flush</td>
<td>-</td>
<td>-</td>
<td>826,388</td>
<td>4,131,940</td>
</tr>
<tr>
<td>Total</td>
<td>6,460</td>
<td>23,143,229</td>
<td>2,113,611</td>
<td>13,897,705</td>
</tr>
</tbody>
</table>

**Aspects**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban</td>
<td>Rural</td>
<td></td>
</tr>
<tr>
<td>Concession Target</td>
<td>84.3%</td>
<td>15.7%</td>
<td>29.5%</td>
</tr>
<tr>
<td>Current Status</td>
<td>73.2%</td>
<td>17.8%</td>
<td>38.7%</td>
</tr>
</tbody>
</table>

**PE</5,000 | 5,000</PE</20,000 | PE</20,000 | TOTAL | **STP No | 5,646 | 654 | 160 | 6,460 | **Total PE | 6,503,012 | 6,109,100 | 10,531,117 | 23,143,229 | 13% STP</5,000PE; serving 72% of PE
Various Sewerage System Types Co-exist in a City in varying proportion, based on the need of the City

**Penang**
STP = 1.3 Mil PE  
(3 Regional STP, 144 Local STP)  
Septic Tanks = 0.04 Mil PE  
Pour flush = 0.03 Mil PE

**Kuala Lumpur**
STP = 3.5 Mil PE  
(10 Regional STP, 181 Local STP)  
Septic Tanks = 0.27 Mil PE  
Pour flush = 0.025 Mil PE

**Subang Jaya**
STP = 1.7 Mil PE  
(6 Regional STP, 119 Local STP)  
Septic Tanks = 0.04Mil PE  
Pour flush = 0.01 Mil PE

**Putrajaya**
STP = 0.3 Mil PE  
(2 Regional STP)  
Septic Tanks = Nil  
Pour flush = Nil

**Kuala Terengganu**
STP = 0.08 Mil PE  
(0 Regional STP, 118 Local STP)  
Septic Tanks = 0.15 Mil PE  
Pour flush = 0.17 Mil PE

**Kemaman**
STP = 0.04 Mil PE  
(0 Regional STP, 25 Local STP)  
Septic Tanks = 0.1Mil PE  
Pour flush = 0.2 Mil PE

**JB Tengah**
STP = 1.3 Mil PE  
(12 Regional STP, 120 Local STP)  
Septic Tanks = 0.2 Mil PE  
Pour flush = 0.002 Mil PE
### Investment In Sewage Infrastructure

![Graph showing investment in sewerage infrastructure](image)

- **Total Allocation**: 5.3, 13.1, 41.1, 78.5, 40.0, 58.5, 103.6, 170.0, 200.0, 215.0, 2.6
- **Water Supply**: 0.2, 0.3, 0.9, 2.8, 3.2, 3.5, 3.1, 3.1, 6.5, 6.5, *NA*
- **Sewerage**: 0.0, 0.0, 0.2, 0.3, 0.1, 0.5, 0.6, 1.3, 2.5, 2.3, 2.6

- **Cumulative Private Sector Investment**
- **Cumulative Government Investment**

- Government investment in sewerage infrastructure to-date (up to RMK11) is estimated at RM9 billion.
- Private sector is estimated to have invested nearly RM22.2 billion to-date in sewerage infrastructure.
- The sewerage development, which is predominantly driven by developers, has resulted in many problems.

### Impact Due To Shortfall In CAPEX Investment:

- The imbalance in investment by the Government and private sector has resulted in the sewerage industry being not on par with other utilities.
- Ad-hoc development by private sector has caused IWK to increase its operational costs in addition to higher risks to the environment.
Sewerage Services Tariff in Malaysia
since 1994
Regulated under the Sewerage Services (Charges) Regulations 1994

**DOMESTIC & GOVERNMENT QUARTERS**

<table>
<thead>
<tr>
<th>Category / Description</th>
<th>Connected (RM)</th>
<th>Septic Tank (RM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic premises &amp; Government Quarters class A, B, C, D and E</td>
<td>8.00</td>
<td>6.00</td>
</tr>
<tr>
<td>New Village</td>
<td>3.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Low Cost premises &amp; Government Quarters class F, G, H and I</td>
<td>2.00</td>
<td>2.00</td>
</tr>
</tbody>
</table>

**GOVERNMENT PREMISE**

<table>
<thead>
<tr>
<th>Connected (RM)</th>
<th>Septic Tank (RM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.00</td>
<td>25.00</td>
</tr>
</tbody>
</table>

Excess Charge of RM0.45 per m³ (>100m³)
Excess Charge of RM0.95 per m³ (>200m³)

**INDUSTRIAL PREMISE**

<table>
<thead>
<tr>
<th>Connected (RM)</th>
<th>Septic Tank (RM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM2.50 per person</td>
<td>RM2.00 per person</td>
</tr>
</tbody>
</table>

Min charge of RM25.00 per month

**COMMERCIAL PREMISES**

<table>
<thead>
<tr>
<th>Band</th>
<th>Min Annual Value (RM)</th>
<th>Max Annual Value (RM)</th>
<th>Connected (RM)</th>
<th>Septic Tanks (RM)</th>
<th>Avg Water Consumption per month (m³)</th>
<th>Excess Charge per m³ (RM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>2,000</td>
<td>8.00</td>
<td>7.00</td>
<td>100 or less</td>
<td>Exempted</td>
</tr>
<tr>
<td>2</td>
<td>2,001</td>
<td>5,000</td>
<td>14.00</td>
<td>8.00</td>
<td>Above 100 to 200</td>
<td>0.30</td>
</tr>
<tr>
<td>3</td>
<td>5,001</td>
<td>10,000</td>
<td>20.00</td>
<td>14.00</td>
<td>Above 200</td>
<td>0.45</td>
</tr>
<tr>
<td>4</td>
<td>10,001</td>
<td>20,000</td>
<td>26.00</td>
<td>19.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>20,001</td>
<td>30,000</td>
<td>29.00</td>
<td>21.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>5,000,001</td>
<td>7,000,000</td>
<td>9,200.00</td>
<td>6,000.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>7,000,001</td>
<td>above</td>
<td>9,600.00</td>
<td>6,600.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 USD = RM 4.45
RM 1 = INR 15.04
Improvement in Sewerage Services

**Capacity Development**
- Training & Certification
- R&D & Innovation

**Public Awareness**
- Communications
- Public Campaigns
- Education

**Collection Trends**
- Billing & Collection Mechanism

**Operational**
- Operations & Maintenance
- Risk Management
- Desludging Services
- Compliances
- Enhanced Security
- Monitoring System

**Infrastructures**
- Asset Management System
- Nationwide Catchment Strategy
- Guidelines Standardisation
- Product Standardisation
- STP Standardisation
- Green Technology
- Management IT Support System

**Customer Services**
- Operational Complaints
- Level of Services
INDIVIDUAL SEPTIC TANKS

1.3 Million

CAST IN-SITU

PREFABRICATED

COMMUNAL SEPTIC TANK (3600 Nos)

Non Standard System – Pourflush (800,000 Nos)
Septic Tanks Need to be Desludged or Emptied
2 to 3 years cycle depending on household occupancy
Septic Tank Desludging Status in Malaysia

Two Types of Services – Scheduled and Demand

- **Achieve 30% success rate**
- **Unsuccessful reasons:**
  - Refused access
  - Nobody home
  - Obstruction
  - Inaccessible
  - Lack of enforcement
- **Liberalization of desludging services**
- **Onus on the house owners/occupier to ensure septic tank is desludged** – scheduling stopped
Investing in sewerage infrastructure is important but actions are also needed to address other polluters, if river pollution is to be effectively addressed.

### Typical Sources of River Pollution

**Sewage (Non-IWK)**
- Private STPs, ISTs & CSTs
- BOD Load = 36%
- AMN Load = 54%
- SS Load = 26%

**Sewage (IWK)**
- BOD Load = 15%
- AMN Load = 30%
- SS Load = 15%

### Sources of River Pollution in Malaysia

- **Animal farm** (Pig farming)
  - BOD LOAD (%): 41
  - SS LOAD (%): 49
  - AMN LOAD (%): 11.3
- **Sewage**
  - BOD LOAD (%): 51
  - SS LOAD (%): 41
  - AMN LOAD (%): 83.7
- **Manufacturing Industries**
  - BOD LOAD (%): 5
  - SS LOAD (%): 6
  - AMN LOAD (%): 1.5
- **Agro-based Industries**
  - BOD LOAD (%): 2
  - SS LOAD (%): 3
  - AMN LOAD (%): 3.4
- **Wet Market**
  - BOD LOAD (%): 1
  - SS LOAD (%): 1
  - AMN LOAD (%): 0.1

**TOTAL**
- BOD LOAD (%): 100
- SS LOAD (%): 100
- AMN LOAD (%): 100

*Sources: DOE, Environmental Quality Report, 2015 & IWK Asset Database Dec 2015*
# Sources of River Pollution in Malaysia

## Septic Tanks are the Major Source

### Estimation of Loadings (BOD, SS & AMN) from Various Sewage Sources (as at December 2015)

<table>
<thead>
<tr>
<th>Types</th>
<th>Sources</th>
<th>PE</th>
<th>Regulatory Standard</th>
<th>Total Loading (kg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BOD</td>
</tr>
<tr>
<td>Public Plants (IWK) 1,2,3</td>
<td>6,397</td>
<td>22.65 mil</td>
<td>EQ(S)R, 2009</td>
<td>80,833</td>
</tr>
<tr>
<td>Private Plants 4</td>
<td>4,626</td>
<td>3.03 mil</td>
<td>EQ(S)R, 2009</td>
<td>34,081</td>
</tr>
<tr>
<td>CST 4</td>
<td>3,637</td>
<td>0.41 mil</td>
<td>EQ(S)R, 2009</td>
<td>7,428</td>
</tr>
<tr>
<td>IST (Desludged) 5,7</td>
<td>215,463</td>
<td>1.08 mil</td>
<td>No regulatory standard</td>
<td>19,392</td>
</tr>
<tr>
<td>ISTs (Non Desludged) 6</td>
<td>1,058,515</td>
<td>5.29 mil</td>
<td>No regulatory standard</td>
<td>119,083</td>
</tr>
<tr>
<td>Pour Flush / Primitive System 6</td>
<td>826,388</td>
<td>4.13 mil</td>
<td>No regulatory standard</td>
<td>92,969</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>36.58 mil</td>
<td></td>
<td>353,786</td>
</tr>
</tbody>
</table>

*Note: Data provided is within IWK services area only*

1. BOD Actual Load from Public Plants (IWK) is **23%** of total sewage load
2. SS Actual Load for Public Plants (IWK) is **29%** of total sewage load
3. AMN Actual Load for Public Plants (IWK) is **34%** of total sewage load
4. Allowable total load if all plants were to comply to EQ(S)R, 2009 Standards
5. Total loading from ISTs (desludged) based on effluent discharged of BOD=200 mg/l, SS=180 mg/l, AMN = 100mg/l
6. Total loading were taken based on raw sewage discharged (BOD=250 mg/l, SS=300 mg/l, AMN = 100mg/l)
7. Total number of ISTs desludged in year 2013, 2014 and 2015 (3 years cycle)
Fecal Sludge Treatment
Type of Methods, Systems and Technologies

- Trenching
- Drying Bed
- Geobags
- Sludge Lagoon
- Mechanized Sludge Dewatering Facility
- Centralized Sludge Treatment Facility

- There is no one type that fits all purpose
- Built with environmental mindedness
Disposal / Reuse of Sludge
Treated Sludge is not Fecal Matter

- In Malaysia, dewatered sludge is disposed – landfill
- R&D on reuse extensively done
  - Potential for resource recovery
  - Nutrient, energy value
- Reuse – very marginal but gaining interest.
  - Use for landscaping plants by Municipalities.
- Land application, composting – for non food crop
- Leverage on National Green Technology Policy
- Guidelines being developed by the Regulator
Challenges in Fecal Sludge Management

The Malaysian Scenario

- Unavailability of suitable sites
- Public resistance
- Land for Infrastructure/Facility
- Environmental concerns
- High capital cost
- Lack of Enforcement Will
- Low Tariff
Management of Fecal Sludge
Summary & Takeaways

• Engage with stakeholders – from regulators to customers/public

• Enforcement
  – Empower the main providers of sewerage and desludging services

• Communications Programme – Public Awareness and Education for ALL stakeholders
  – Use various media forms, from newspapers to Facebook
  – Involve Schools
  – Include Policy and Decision Makers

• Be transparent
  – Institute Customer Charter, Level of Services and Targets
  – Measure, monitor and improve

• Know your customers
  – Collect and capture customer data,
  – Septic tank details – e.g. size, location
Management of Fecal Sludge
Summary & Takeaways

• Exploit on IT system
  – Customer care system
  – Mapping of septic tank areas and customers

• Adapt and adopt Technology to facilitate FSM efficiently and effectively
  – Vehicle Monitoring System (VMS)
  – Instant dewatering of sludge – mobile units

• Operations management – desludging works/logistics, outsourcing/term contractors, sludge treatment and disposal facilities at strategic locations, record keeping

• Develop local vendors, service providers and enterprises
  – Partnership programme

• Capacity Building & Training

• Incentive scheme helps
Management of Fecal Sludge
Summary & Takeaways

• Selection of Technology for sludge treatment
  – Proven, modular basis, innovative low-medium technology, less demand on operator skill, low energy and O&M cost, efficient land use
  – affordable to the community.

• Be responsible for the fecal sludge
  – Know its quality, quantity and fate (cradle to grave)

• Rebrand “Fecal Sludge” to encourage Recycling and Resource Recovery

• Short Term and Long Term Sludge Management Strategies

• Sustainable tariff and strategies for full cost recovery
Quotes on Sanitation

“Sanitation in India is not only cleanliness; it is also an end of the humiliation and miseries of scavengers who carry human excreta on the head.”

Indira Gandhi

“I may not be born again, but if it happens I will like to be born in a family of scavengers, so that I may relieve them of the inhumane, unhealthy and hateful practice of carrying nightsoil.”

Mahatma Gandhi

“The day everyone of us gets a toilet to use, I shall know that our country has reached the pinnacle of progress.”

Jawaharlal Nehru

THANK YOU

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Lessons Learned from Malaysian Sewerage Management

Water & sewerage to be managed as a full water cycle
- Integration of water & sewerage services

Reduce proliferation of small plants
- Rationalization of plants

Mixed Sewerage Systems in a Catchment/Local Areas
- Institute effective management

Many plant types & sizes affecting efficiency & effectiveness
- Standardization of plants

Escalating cost of operations vs Tariff is not sustainable
- Optimize cost
- Risk management
- Engagement with stakeholders