Development Model of Takakura Composting Method (TCM)

as an Appropriate Environmental Technology (AET) for urban waste management

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Scientific Conference on Policy, Engineering, Art, Culture, and Education (SCOPEACE)

Hiroshima, 21 July 2018

IGES

Institute for Global Environmental Strategies

Content

- Introduction
- Previous studies
- Research formulation
- Case study
- Discussions
- Conclusions

What is AT? Is this technology appropriate?

- **Appropriate Technology (AT)** was developed into a global discourse on the appropriateness and impacts of implementation of technology advancement on human civilization as seen from various perspectives.
- **AT? Or ET?** No single definition, multi-perspective, local, human value.
- Covering both the **hard element** and physical appearance of a technology and also the **soft element** and non physical factors.
- This study focuses on **implementation**, or development process.

Is environmental technology (appropriate)?

- **Environmental technology** covers the **techniques, concepts, products, and knowledge-based services** for environmental protection, conservation, and improvement on environmental issues such as climate change, air pollution, biodiversity, waste management, and others.

- **Composting** is one of the environmental technologies (techniques) that could contribute to the improvement of urban waste management by introducing **organic waste reduction** within the concept of re-use.

- **Takakura Composting Method (TCM)**, developed by Koji Takakura, was introduced in the city of Kitakyushu, Japan, and then to many other cities.

3 Key Technical Points for Successful Takakura Composting Method

① **Fermentative Microorganisms (prepare fermentation bed in advance)**

Example of failure (Too much moisture)

Example of failure (Too little moisture)

Example of success!

Maintain the moisture level at 40-60%

② **Aerobic fermentation (by stirring)**

③ **Proper moisture control**

Tempeh (fermented soybeans)

Tape (fermented cassava)

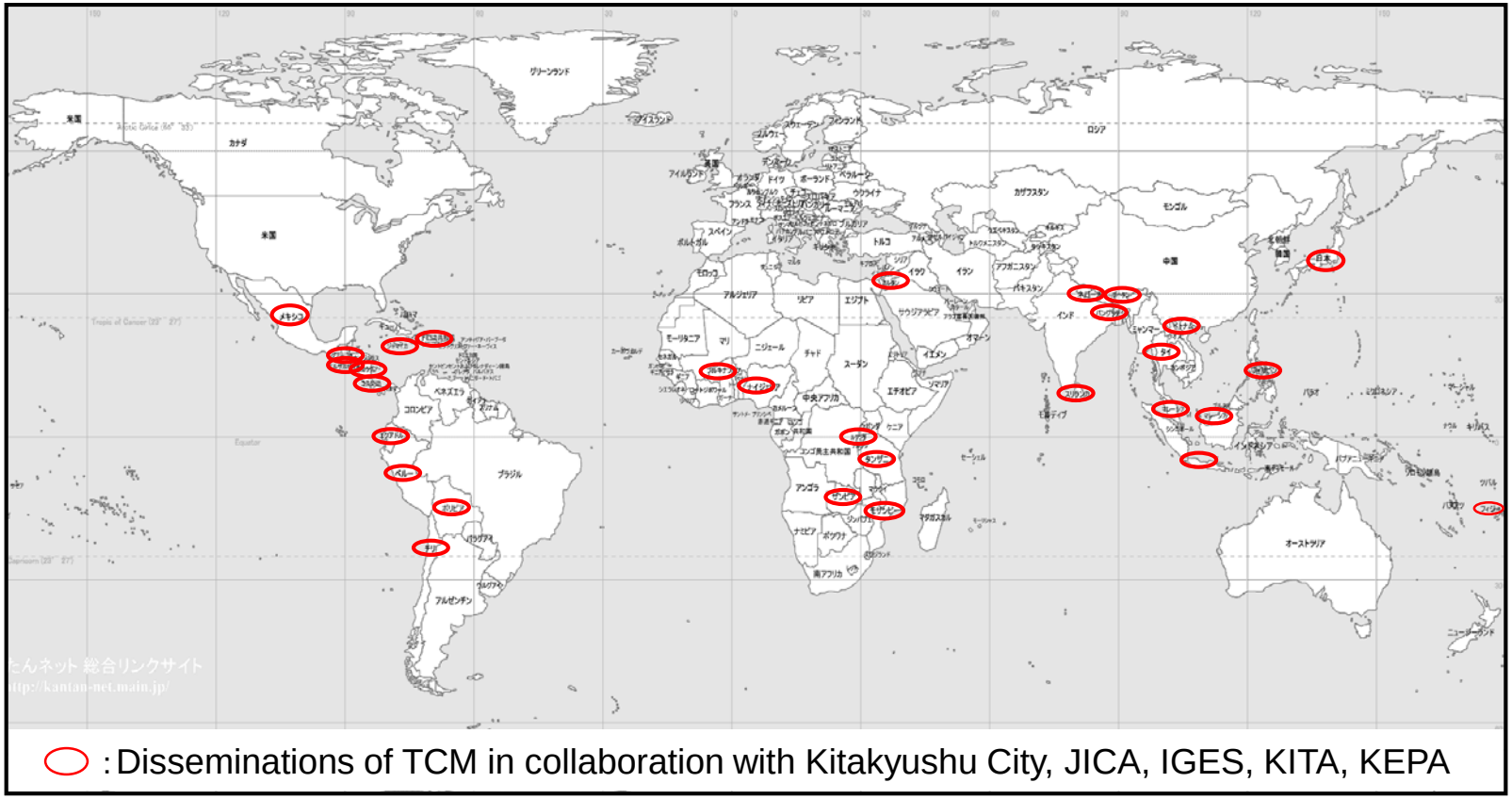
Gather a wide variety of fermented foods from the local region.

Indonesia

Philippines

Japan

Nepal



: Disseminations of TCM in collaboration with Kitakyushu City, JICA, IGES, KITA, KEPA

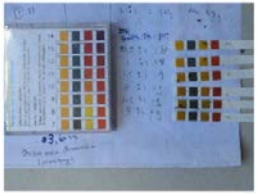
Pilot model project in Surabaya

Waste composition survey

Shredding of waste

Mixing with seed compost

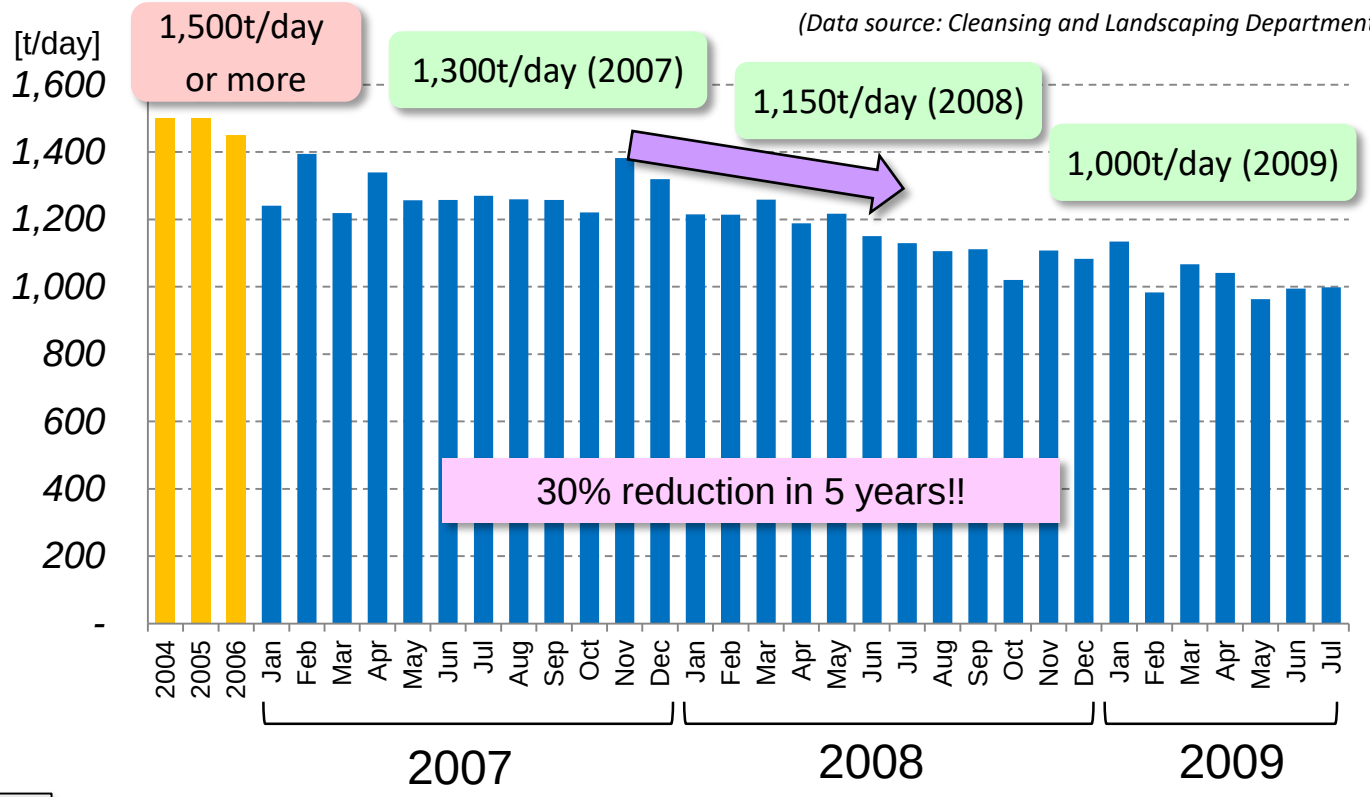
Temperature measurement



Fermentation and pH tests

Explaining to communities

Average daily amount of waste disposed at Benowo Landfill in Surabaya, 2004-2009



Literatures and references

- Database of **ScienceDirect** (sciencedirect.com)
- **Recent** publications are prioritized (last 5 years)
- **Keywords:**
  Appropriate Technology, environment technology, waste management, development, assessment, developing countries
- 30 papers were studied, **7** of them were selected as main references

Technology sustainability depends on its ADAPTABILITY, which is determined by:

- **TECHNICAL SUSTAINABILITY** (the accessibility of component parts, the availability of the needed infrastructure, the availability of technical know-how to accomplish such service, and the elapsed time between repairs);
- **ECONOMIC SUSTAINABILITY** (affordability, reusability, and local availability of required servicing resources);
- **ENVIRONMENTAL SUSTAINABILITY** (resource consumption, environmental releases, resource conservation, and environmental compliance);
- and **SOCIO-POLITICAL SUSTAINABILITY** (the level of awareness, acceptability, governmental policy and continuity, and the socio-cultural influence).

Israel Dunmade. Indicators of sustainability: assessing the suitability of a foreign technology for a developing economy. Technology in Society 24 (2002) 461–471

The biggest challenges to THE ACCEPTANCE OF TECHNOLOGY are:

- identifying the **PROPER DRIVERS** (institutional, socio-cultural, technological, and/or financial);
- alternative **FINANCIAL MECHANISMS** (such as involvement of micro finance organizations);
- the involvement of **COMMUNITY** based organizations;
- and the active participation of **LOCAL GOVERNMENTS.**

Sayed Mohammad Nazim Uddin, Victor S. Muhandiki, Akira Sakai, Abdullah Al Mamun, Sanjida Marium Hridi. Socio-cultural acceptance of appropriate technology: Identifying and prioritizing barriers for widespread use of the urine diversion toilets in rural Muslim communities of Bangladesh. Technology in Society 38 (2014) 32–39

CRITERIA FOR APPROPRIATE technology in developing countries are:

- Systems **INDEPENDENCE**
- Image of **MODERNITY**
- **INDIVIDUAL** or **COLLECTIVE** technology
- **COST** of technology
- **RISK** factor
- **EVOLUTIONARY CAPACITY** of technology
- **SINGLE-PURPOSE** and **MULTI-PURPOSE** technology

Robert C. Wicklein. Designing for appropriate technology in developing countries. Technology In Society 20 (1998) 371–375

APPROPRIATE TECHNOLOGY ASSESSMENT TOOL (ATAT) employs multi-criteria decision analysis (MCDA) to generate Appropriateness Index:

- 49 independent indicators

- The most PREVALENT INDICATORS: **community input, affordability, autonomy, transferability, community control, scalability, local availability of raw materials, and adaptability**.

A. Michael Bauer, Aaron Brown. Quantitative assessment of appropriate technology. Procedia Engineering 78 (2014) 345 – 358

CONSIDERATIONS in AT development and implementation:

- Meets the **BASIC NEEDS** of users
- **SOUND** technology
- **FLEXIBLE** technology
- Meet **LOCAL CAPABILITIES** by utilizing local materials and resources
- **AFFORDABILITY**
- SUSTAINABILITY
- Encourages local **PARTICIPATION**
- **CULTURALLY/SOCIALLY** appropriate
- **GENDER** considerations
- Appropriate **TECHNOLOGY TRANSFER** mechanisms

Heather M. Murphy, Edward A. McBean, Khosrow Farahbakhsh. Appropriate technology – A comprehensive approach for water and sanitation in the developing world. Technology in Society 31 (2009) 158–167

APPROPRIATE TECHNOLOGY is:

- **ADAPTABLE**
- **SELF HELP**
- **ENERGY EFFICIENT**
- **LOCALLY CONTROLLED** and
- also leading to a **STRONG COMMUNITY INVOLVEMENT**.

Pradwi Sukma Ayu Putri, Made Widiadnyana Wardiha. Identification problems in the implementation plan of appropriate technology for water and sanitation using FGD approach (case study: Kampong Sodana, Sumba Island, East Nusa Tenggara Province). Procedia Environmental Sciences 17 (2013) 984 – 991

4 of 16 separate factors of the PURCHASING MANAGERS' STRATEGIC FRAMEWORK (NHS Supply Chain, 2015) were applicable to select appropriate waste treatment technologies:

- **Legal and Compliance**
- Sector specific **guidelines**
- Mandatory **reporting** requirements (Environment, Sustainability & Carbon Reporting)
- **Cost** of purchased solution (Economics)

Steve Lee, Mentore Vaccari, Terry Tudor. Considerations for choosing appropriate healthcare waste management treatment technologies: A case study from an East Midlands NHS Trust, in England. Journal of Cleaner Production 135 (2016) 139-147

How to develop the appropriate technology?

Key-factors

TECHNICAL SUSTAINABILITY
the accessibility of component parts,
the availability of the needed infrastructure,
the availability of technical know-how to accomplish such service, and
the elapsed time between repairs

ECONOMIC SUSTAINABILITY
affordability,
reusability, and
local availability of required servicing resources

ENVIRONMENTAL SUSTAINABILITY
resource consumption,
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SOCIO-POLITICAL SUSTAINABILITY
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EVOLUTIONARY CAPACITY of technology
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Sector specific guidelines (Guidelines)
Mandatory reporting requirements (Environment, Sustainability & Carbon Reporting)
Cost of purchased solution (Economics)

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1. Financial mechanism and cost affordability

and continues…

Common Key-factors

1. Financial mechanism and cost affordability
2. Technological adaptability and independence
3. Social and cultural acceptability
4. Local needs, demands, and resources
5. Community participation and involvement
6. Commitment from local government
7. Environment consciousness
8. Continuity and long-term impact

1. Financial mechanism and cost affordability

affordability;

cost of technology;

cost of purchased solution (economics);

financial driver;

financial mechanisms

2. Technological adaptability and independence

the accessibility of component parts;

the availability of the needed infrastructure;

the availability of technical know-how to accomplish such service;

the elapsed time between repairs;

systems independence;

individual or collective technology,

evolutionary capacity of technology,

single-purpose and multi-purpose technology;

autonomy;

adaptability;

sound technology;

flexible technology;

technological driver

3. Social and cultural acceptability

the level of awareness;

acceptability;

the socio-cultural influence;

image of modernity;

culturally/socially appropriate;

gender considerations

4. Local needs, demands, and resources

local availability of required servicing resources;
local availability of raw materials;
meets basic needs of users;
meet local capabilities by utilizing local materials and resources;
local availability of raw materials;
self help;
locally controlled

5. Community participation and involvement

community input;

community control;

encourages local participation culturally/socially;

leading to a strong community involvement;

the involvement of community based organizations

6. Commitment from local government

governmental policy and continuity;

legal and compliance;

sector specific guidelines;

institutional driver;

active participation of local governments

7. Environment consciousness

resource consumption;

environmental releases;

resource conservation;

environmental compliance;

mandatory reporting requirements (environment, sustainability & carbon reporting);

energy efficient

7. Continuity and long-term impact

reusability;

risk factor;

transferability;

scalability;

sustainability;

appropriate technology transfer mechanisms

Discuss the case study utilising the common factors & development stages

- Comprehensive development process of AET includes the initial stage, the implementation stage, and the advancement stage.
- Therefore each key-factors will be discussed using the information and the condition from the case study area for each development stage.
- Based on the discussion, levels of priority for each key-factor will be suggested for each development stage. Descriptive analysis will be used to synthesize the development model(s).

Hai Phong, Vietnam (Green Port City 2020)

- Hai Phong is the 3rd largest city in Vietnam (1,980,000).
- Sister City of Kitakyushu.
- Green Growth Promotion Plan (GGPP) in May 2015

Seven sectors set in the GGPP	
Main sectors	Waste
	Energy
	Transportation
	Cat Ba Island
Other sectors	Water, sewage and rainwater drainage
	Environmental conservation
	Green production

Current status

- Waste is landfilled with no separation and recycling, the landfill site will be over capacity soon.
- There is already composting facility at the Trang Cat Landfill site, it could not produce high-quality compost.
- The composting facility is operated by the Hai Phong Urban Environment Company (URENCO).
- In Hai Phong, 1,600t of waste per day is created by households and business, and only 200t of that is treated in the compost facility.
- To improve the existing composting facility by introducing more appropriate system and method.

Initial stage



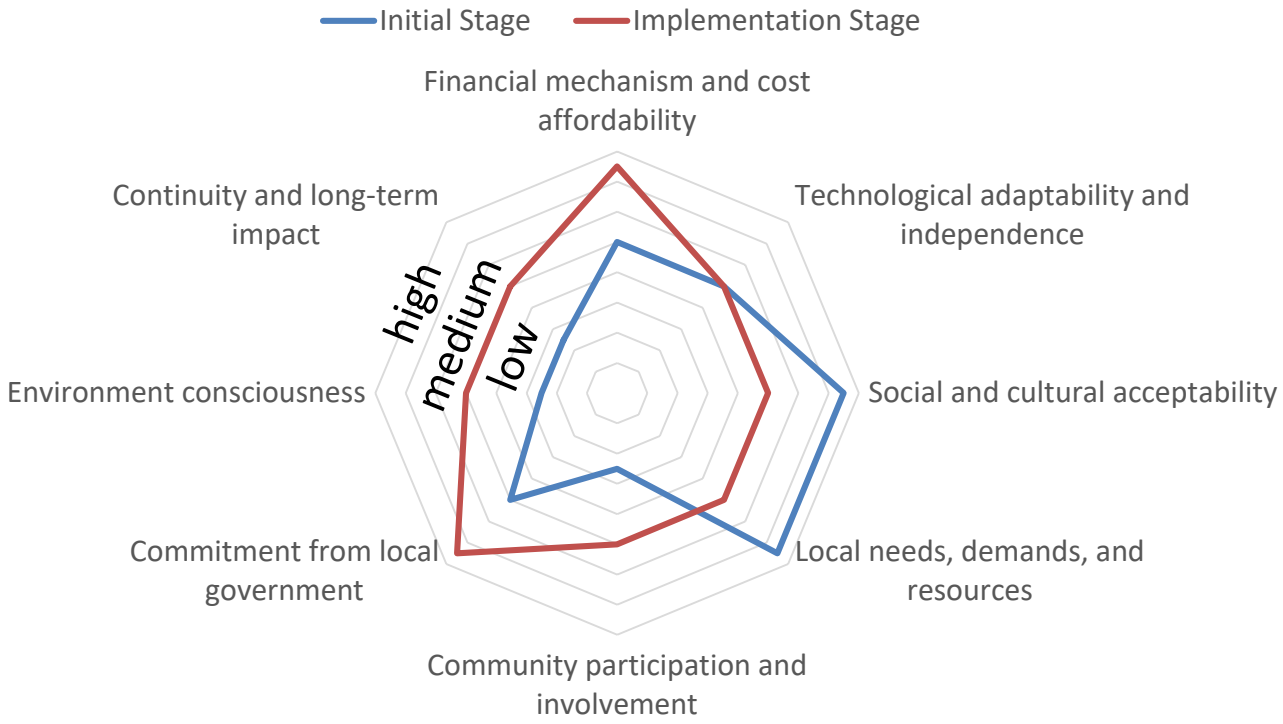



- In Vietnam, composting is basically existed in the local culture and the existing communities.
- The microorganism as the main element of TCM will be gathered from the local environment.
- Hai Phong needs an appropriate method to to reduce the waste that goes to the landfill.
- Training of staffs and pilot composting were conducted in cooperation with URENCO (produced 20t of compost per day).
- Implementation is using mostly the existing technology and system.

Implementation stage

- The budget for the scaling-up of the TCM pilot composting to the capacity of 40t per day will also be provided by the Department of Construction of Hai Phong City.
- Department of Construction is responsible for reduction the amount of final disposal by intermediate treatment of waste and recycling.
- For the implementation stage, the waste will be collected from the local shops, hotels, and restaurants. The owners were voluntary committed to cooperate with URENCO and the local government.

AET Development Model



- This study discusses the key-factors for a framework on Appropriate Technology such as: financial mechanism and cost affordability; technological adaptability and independence; social and cultural acceptability; local needs, demands, and resources; community participation and involvement; commitment from local government; environment consciousness; and continuity and long-term impact.

- Then the case study of Hai Phong was discussed in relation to each key-factors within the on-going development stages (initial and implementation stages) in order to develop the development model of Appropriate Environmental Technology (AET).

- The development model would be useful to identify priority key-factors for each stages especially on the case study. The model would also be very useful to determine priorities and action plans for each development stage.

Thank you!

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