「ルワンダでのゴミ問題への関わりを中心とした、アフリカでの持続可能な開発への考察」

北九州産業学術推進機構（FAIS）・GX推進部長
／北九州市立大学・特任教授

三戸（みと）俊和

E: mitotoshi@gmail.com
E: t-mito@ksrp.or.jp

2026.02.02 @世銀1818 Society Japan Chapter

1. 自己紹介

1996-

環境省

(https://mdai.jp/photo/2013tokyo_sakura/hibiya024_640.jpg)

2001-2003

カナダ・
ウォータールー
大学

カナダへ

環境省

外来生物法

内閣官房

安倍内閣官房長官

ルワンダへ

2007-2009

国連開発計画
（UNDP）
Rwanda

ルワンダで

2009 - 2016

UNコンサルタント /
招聘講師/
フリーター/
ルワンダ政府職員

日本へ

2016

主夫

- 人工知能 (AI)
- 洋上風力人材育成　など

2017-

北九州産業学術
推進機構
(FAIS)

＋

2018 -

アフリカ
のゴミ捨
て場改善

- UN-HABITAT
- 日本政府
- 世界銀行

途上国で働きたい！

環境問題で行こう

どうもアフリカがすごいらしい@カナダ

環境問題＋現場へのこだわり

他分野にも拡大

WORLD BANK GROUP

English

OPEN KNOWLEDGE REPOSITORY

Search

BROWSE

Collections
Authors
Dates
Topics
Titles

BROWSE THIS COLLECTION

Authors
Dates
Topics
Titles

AUTHOR PROFILES

View

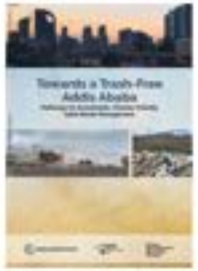
SITE STATISTICS

Authors
Countries
Titles

Home » 07. Economic and Sector Work (ESW) Studies » Sector/Thematic Studies » Other Environmental Study

REPORT

Towards a Trash-Free Addis Ababa : Pathways for Sustainable, Climate-Friendly Solid Waste Management



ABSTRACT VIEWS
985

FILE DOWNLOADS
730

Download

TWEET LIKE SHARE

Addis Ababa, Ethiopia, has experienced significant population growth and an increase in living standards for years, resulting in increased solid waste generation and solid waste management (SWM) challenges. Inadequate SWM in the city causes land, water, and air pollution as well as negative impacts on natural ecosystems, local economies, public health, social equality, and the global environment. Despite efforts made by the Addis Ababa government and some stakeholders, the city's SWM systems urgently need to be upgraded and modernized. This report prioritizes and proposes a set of SWM interventions that Addis Ababa may include in its investment program over the next decade. The interventions are grouped in institutional strengthening, research and technical assistance, and physical investments. Additionally, the report designs three scenarios to implement the interventions for SWM in Addis Ababa: Business-as-usual, conservative, and aggressive. The changes in waste generation, treatment, and greenhouse gas emissions in 2020-2030 across the three scenarios were projected.

Citation

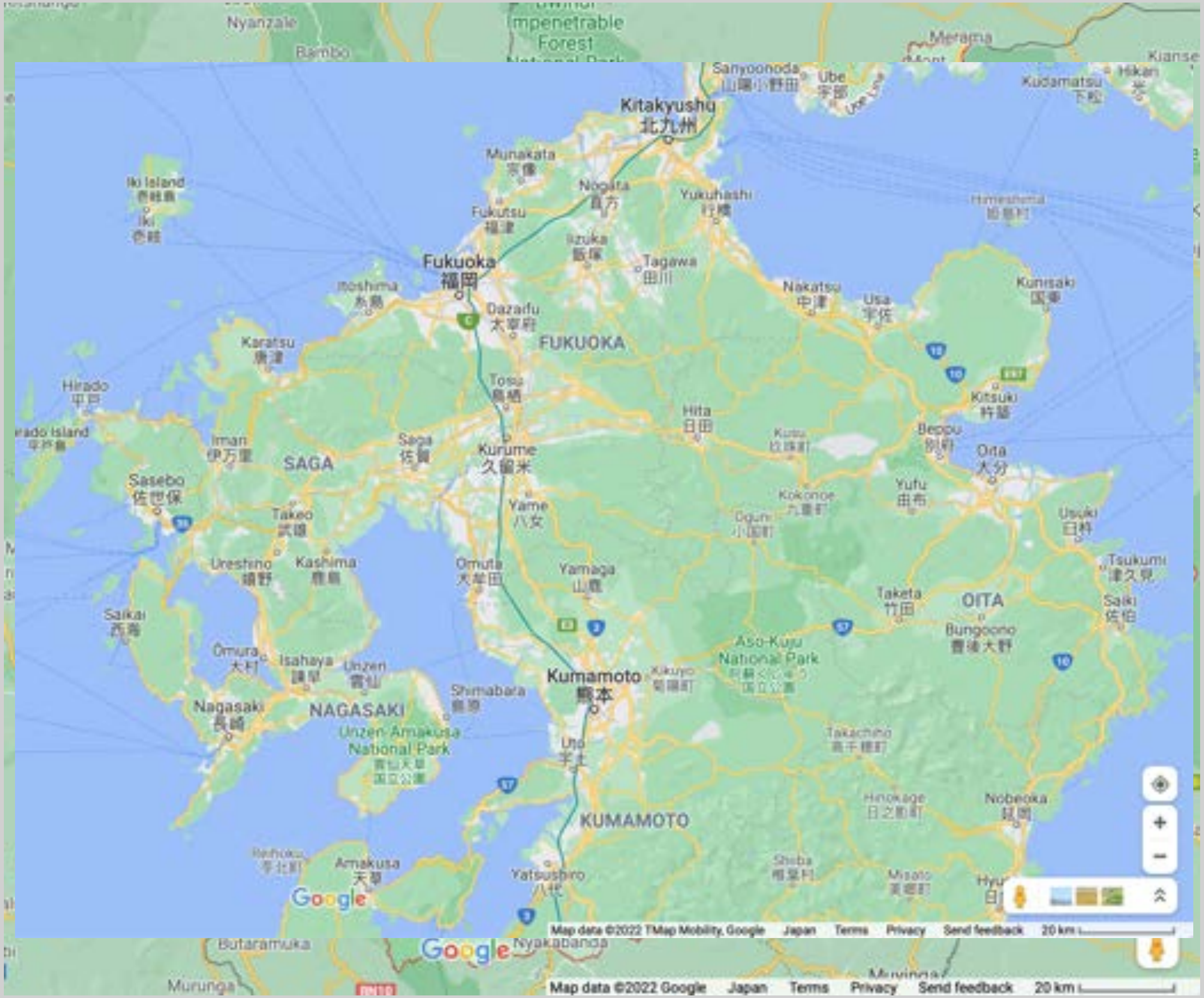
"Xie, Jian; Mito, Toshikazu. 2021. Towards a Trash-Free Addis Ababa : Pathways for Sustainable, Climate-Friendly Solid Waste Management. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/36746 License: CC BY 3.0 IGO."

URI

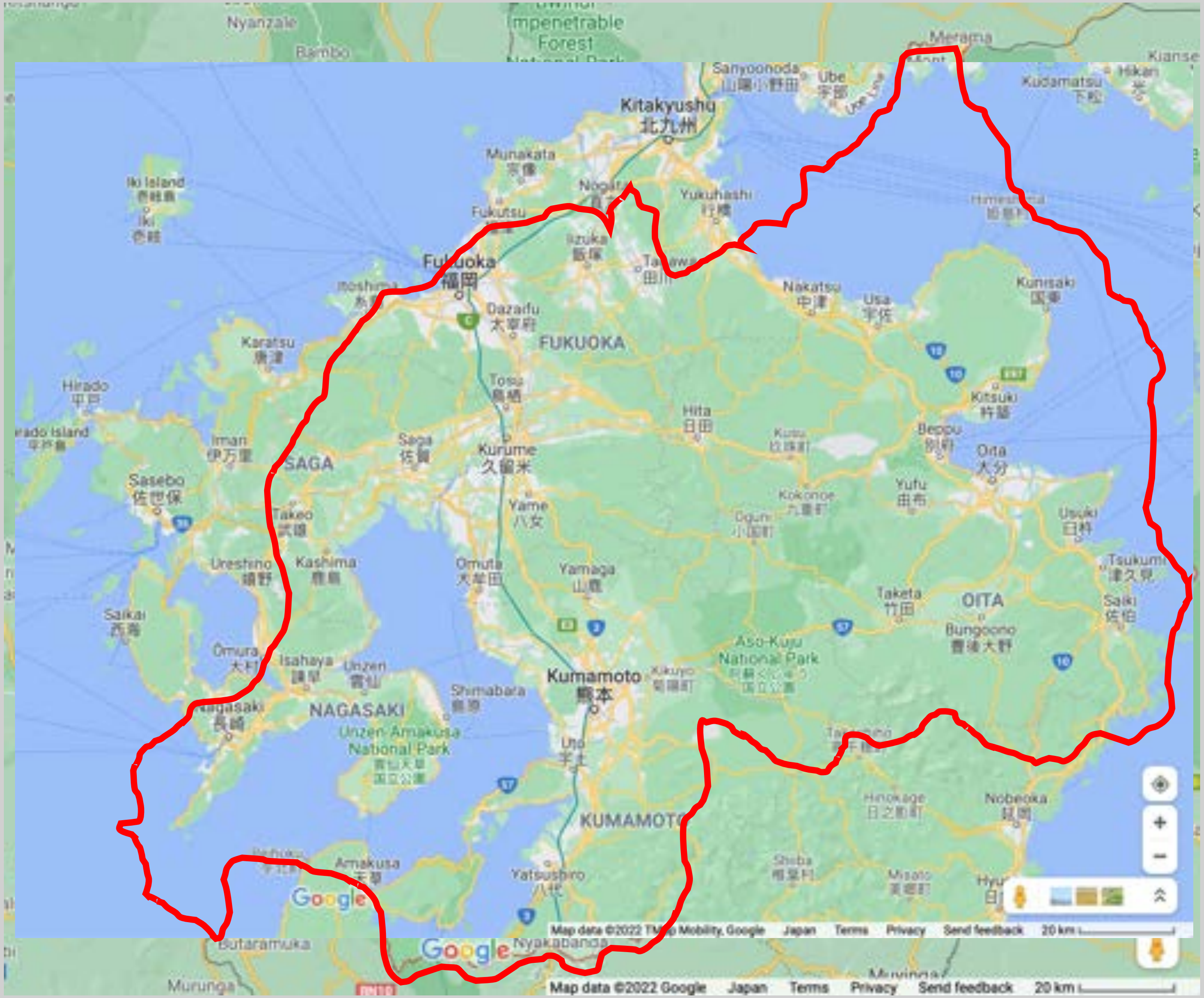
http://hdl.handle.net/10986/36746

2. ルワンダの紹介
（環境問題を含めて）

(Source: google map)



(Source: google map)



(Source: google map)

問1

- ルワンダの現地語(欧米言語除く)の数は？

答1：　1

答2：　約40

答3：　約200

問2

- ルワンダ人の性格は？

答1：　シャイでまじめ

答2：　雄弁だがずる賢い

答3：　平気でうそを言うがすぐばれる
　　＋　気さく

ルワンダ基礎データ0

ISUKU TUYIGIRE UMUCO
TURENGERE IBIDUKIKIJE
TURWANYE IBIYOBYABWENGE
DUFATE NEZA IBIKORWA REMEZO

ルワンダ基礎データ0

1. 文化大切
2. 環境保全
3. 酒・薬はだめ
4. インフラ保全

ルワンダ：基礎データ1

(Source: http://www.worldatlas.com/webimage/countrys/africa/rw.htm)

(Source: http://statistics.gov.rw/)

(Source: http://hdr.undp.org/)

(Source: The World Factbook (CIA))

人口:
約13.6百万人
(2024 est.)

面積:
約26,000km²

GDP／人:
US$644 (2014)
US$3,300
(2024 est.)

国連人間開発指標
(HDI):
151th (2014)
159th (2025)

標高:
950-4,519m

ルワンダ：基礎データ2

<ルワンダの気候>

Climate data for Kigali, Rwanda [hide]													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high °C (°F)	26.9 (80.4)	27.4 (81.3)	26.9 (80.4)	26.2 (79.2)	25.9 (78.6)	26.4 (79.5)	27.1 (80.8)	28.0 (82.4)	28.2 (82.8)	27.2 (81)	26.1 (79)	26.4 (79.5)	26.89 (80.41)
Average low °C (°F)	15.6 (60.1)	15.8 (60.4)	15.7 (60.3)	16.1 (61)	16.2 (61.2)	15.3 (59.5)	15.0 (59)	16.0 (60.8)	16.0 (60.8)	15.9 (60.6)	15.5 (59.9)	15.6 (60.1)	15.73 (60.31)
Precipitation mm (inches)	76.9 (3.028)	91.0 (3.583)	114.2 (4.496)	154.2 (6.071)	88.1 (3.469)	18.6 (0.732)	11.4 (0.449)	31.1 (1.224)	69.6 (2.74)	105.7 (4.161)	112.7 (4.437)	77.4 (3.047)	950.9 (37.437)
Avg. precipitation days (≥0.1 mm)	11	11	15	18	13	2	1	4	10	17	17	14	133
Source: World Meteorological Organization [19]													

(参考：日本は約1,700mm/年)

(Source: http://worldweather.wmo.int/en/city.html?cityId=254)
(Source: http://www.mlit.go.jp/river/pamphlet_jirei/bousai/saigai/kiroku/suigai/suigai_3-1-1.html)

ルワンダ：基礎データ３

(Source: Gapminder)

ルワンダ：基礎データ 3

(Source: Gapminder, 2013)

ルワンダ：基礎データ　4

通りの清掃

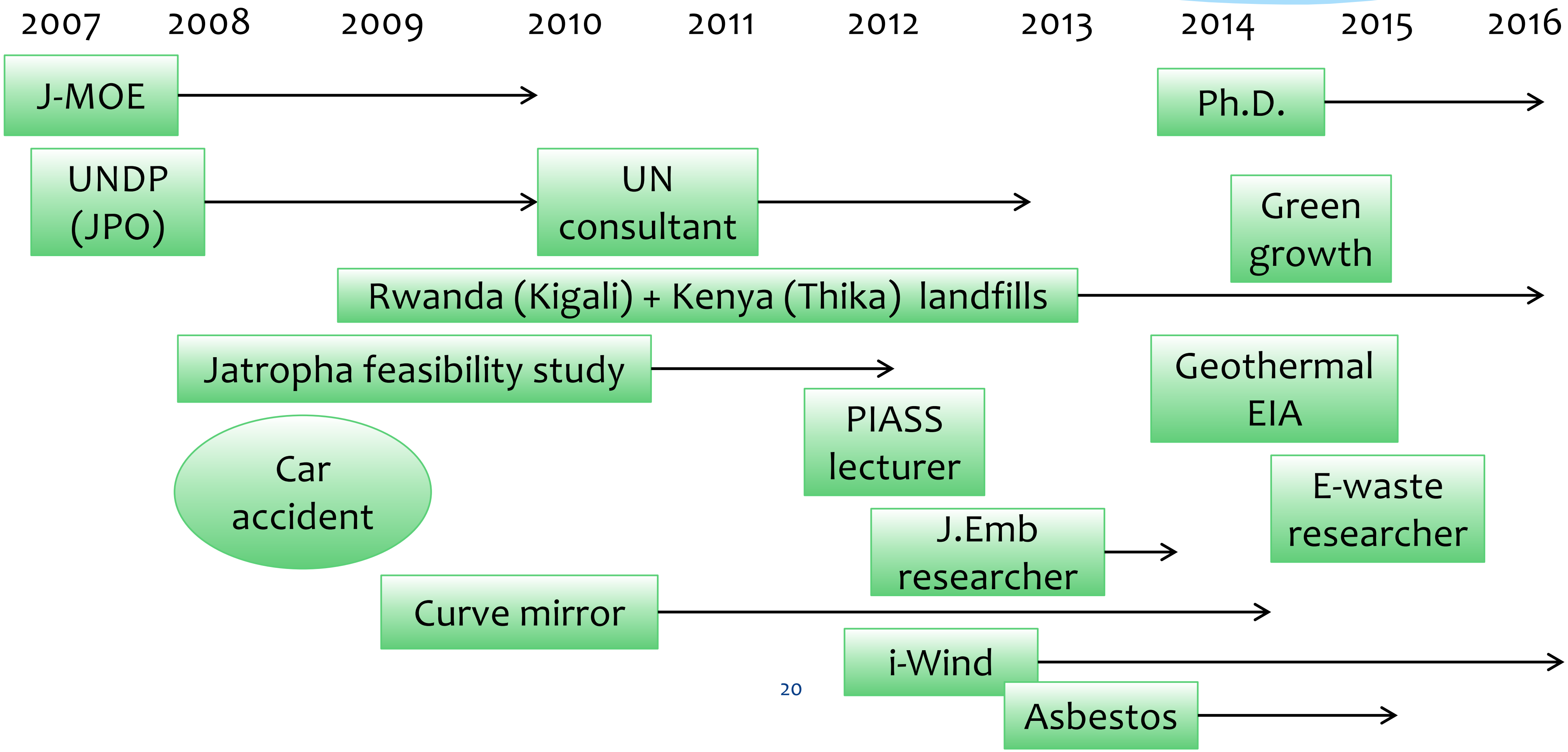
→　主に女性団体が地方自治体から受託（法人には清掃税）

ウムガンダ

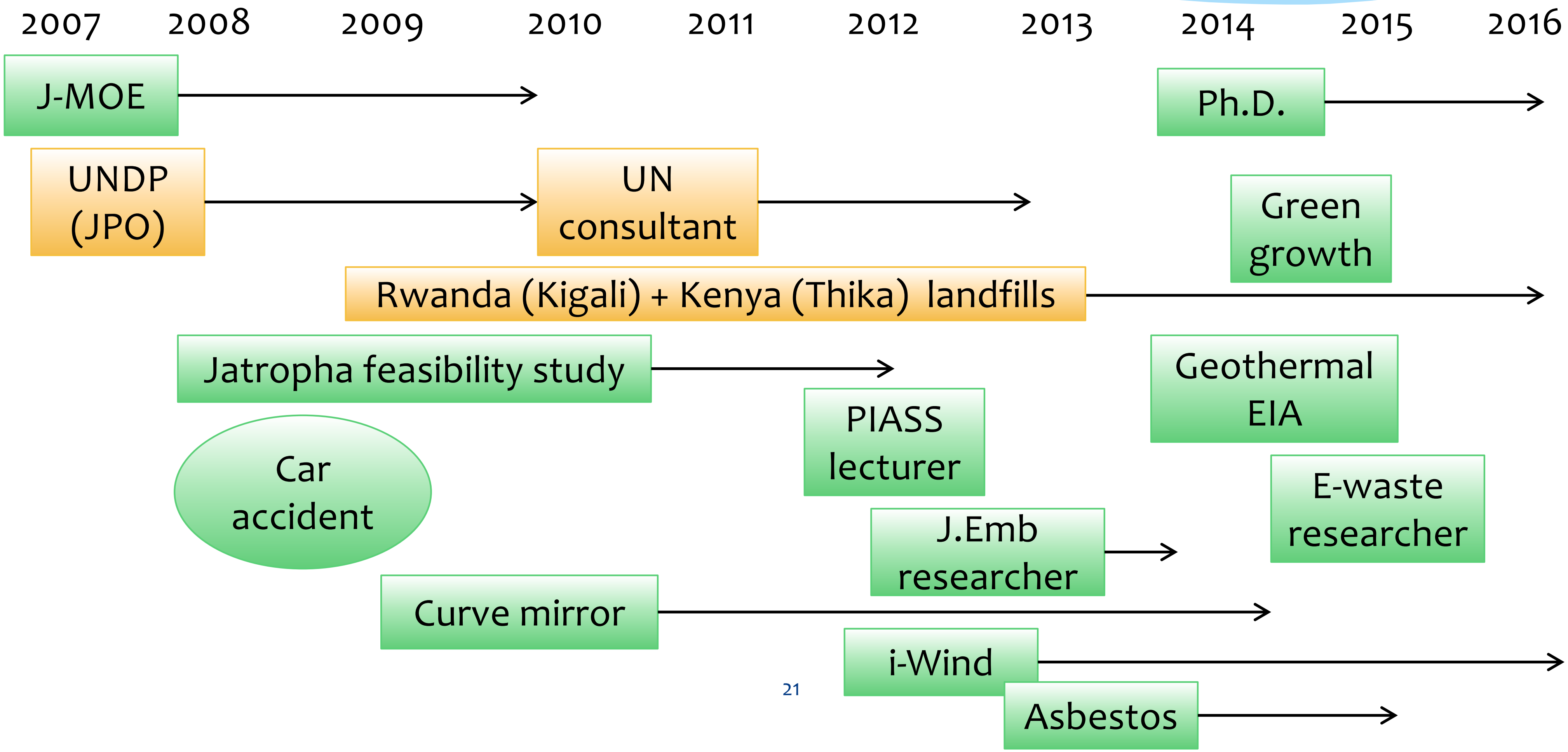
→　毎月最終土曜日の午前中、国土基盤整備、和解、罰金5千Rwf

3. ルワンダでの活動

Toshikazu Mito in Rwanda



Toshikazu Mito in Rwanda



UNDP (JPO)

UNDP (JPO)

FINAL UNDAF 06 June 2007

UNDAF 2008-2012
RWANDA

Government of Rwanda

United Nations Development Programme

Country: Rwanda
Project Document

Project Title	Consolidated Waste Management Project in Rwanda
UNDAF Outcome(s):	Outcome 2: Capacity at national, district and community levels to restore and protect ecosystems of national and global importance against potential degradation strengthened
UNDAF Output(s):	Output 2.3: Technical and operational capacity of districts for the management of wastes and contaminants developed
Expected Output(s):	1) Condition of Kigali Landfill site improved 2) Method of high briquettes production realized 3) Action plans and institutional framework for national/local waste management in Rwanda established
Executing Entity:	Kigali City and MININFRA
Implementing Agencies:	UNDP

Brief Description

Considering the fact that Rwanda does not yet have a comprehensive Waste Management Framework and not always conducting proper waste management practices, this project aims to develop the framework and relating infrastructure to make the waste management socially and environmentally more sustainable.

More specifically, the project will implement the following four components:

1) Conduct a feasibility study on *Fukuoka Method for the current Kigali Landfill Facility*.
2) Support IRST to produce high quality combustible briquettes for contribution to both reduction of organic waste discharge to landfill sites and avoidance of in-house air pollution.
3) Establish waste management national and local action plans in addition to creating institutional framework to make it possible for all the stakeholders to get and work together.
4) Construct improved Kigali Landfill Facility.

Programme Period:	2009-2012
Key Result Area (Strategic Plan)	Env &Sus Dev
Atlas Award ID:	
Start date	Q1-2009
End Date	Q1-2012
PAC Meeting Date	
Management Arrangements	NEX

Total resources required	US$3,150,000
Total allocated resources:	US$3,100,000
• Regular	US$2,500,000
• Other:	
○ One Fund	US$ 600,000
○ Donor	
○ Donor	
○	
Unfunded budget:	
In-kind Contributions	US$50,000 (GoR)

Agreed by (Executing Entity): Eng. Albert B[illegible]
Minister of State [illegible] Water in MININFRA

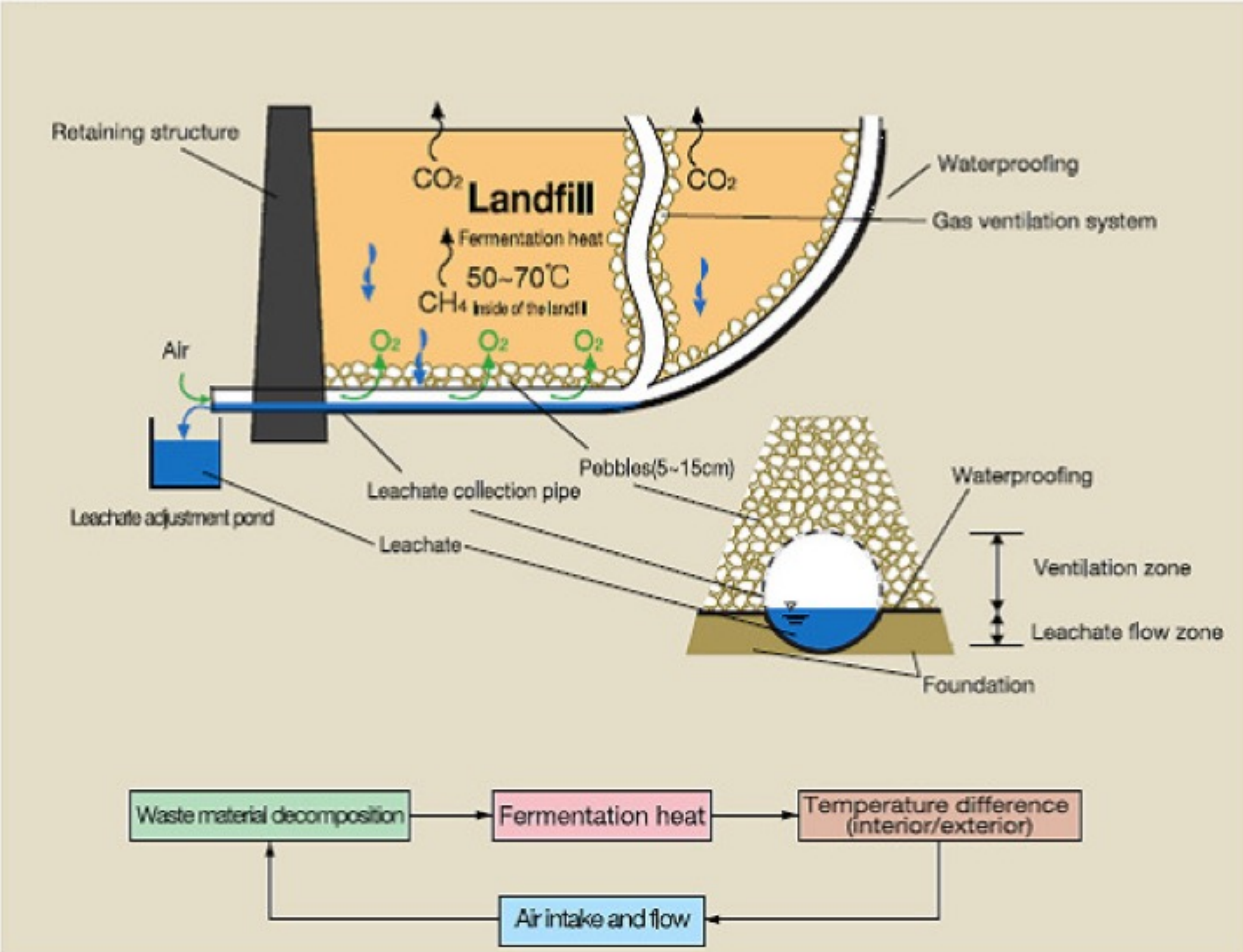
Agreed by (Government): Mr. James Musoni
Minister of Finance and Economic Planning (MINECOFIN)

Agreed by (UNDP): Mr. Anthony Ohemeng-Boamah
Country Director

Nyanza until 2009

Fukuoka Method

Fig-2 Semi-aerobic Landfill Mechanism

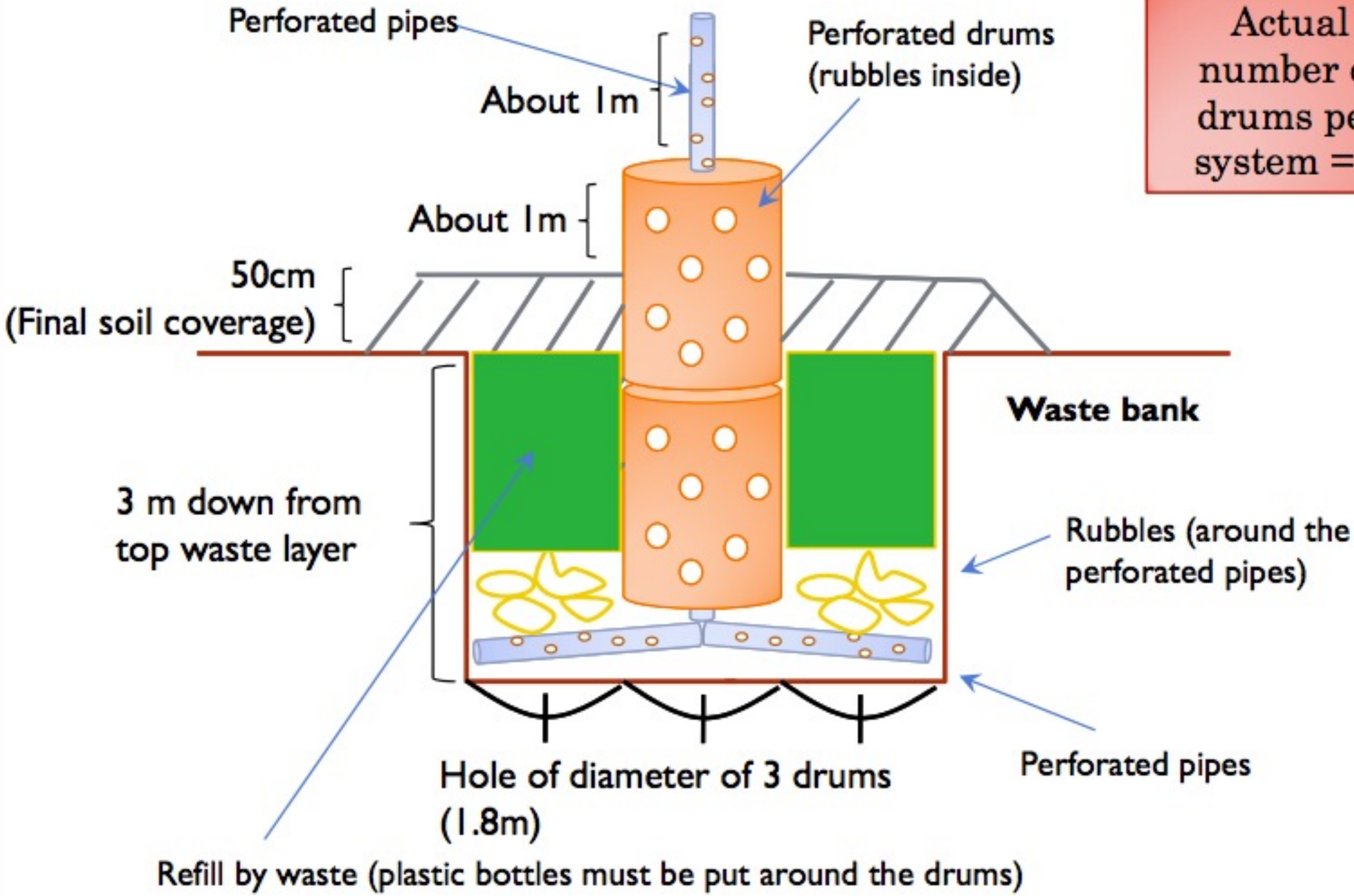


Decrease of fire

From 2010

November, 2009

Design of the gas ventilation system 1



Actual number of drums per system = 5

Ventilation system

- In order to enhance decomposition of organic waste (CH_4 (methane) → CO_2)

Soil coverage (2010)

Safe closure of Nyanza Landfill by *Fukuoka Method*

Spoiling city beauty

Bad odor

Water pollution

Soil contamination

Smokes – air pollution

Fires & gas explosion

Closed Nyanza Landfill in September 2013

Cost of safe closure = 154M Rwf (about US$228,000)

Nyanza landfill

2010

(Source: Google Earth)

Nyanza landfill

2012

(Source: Google Earth)

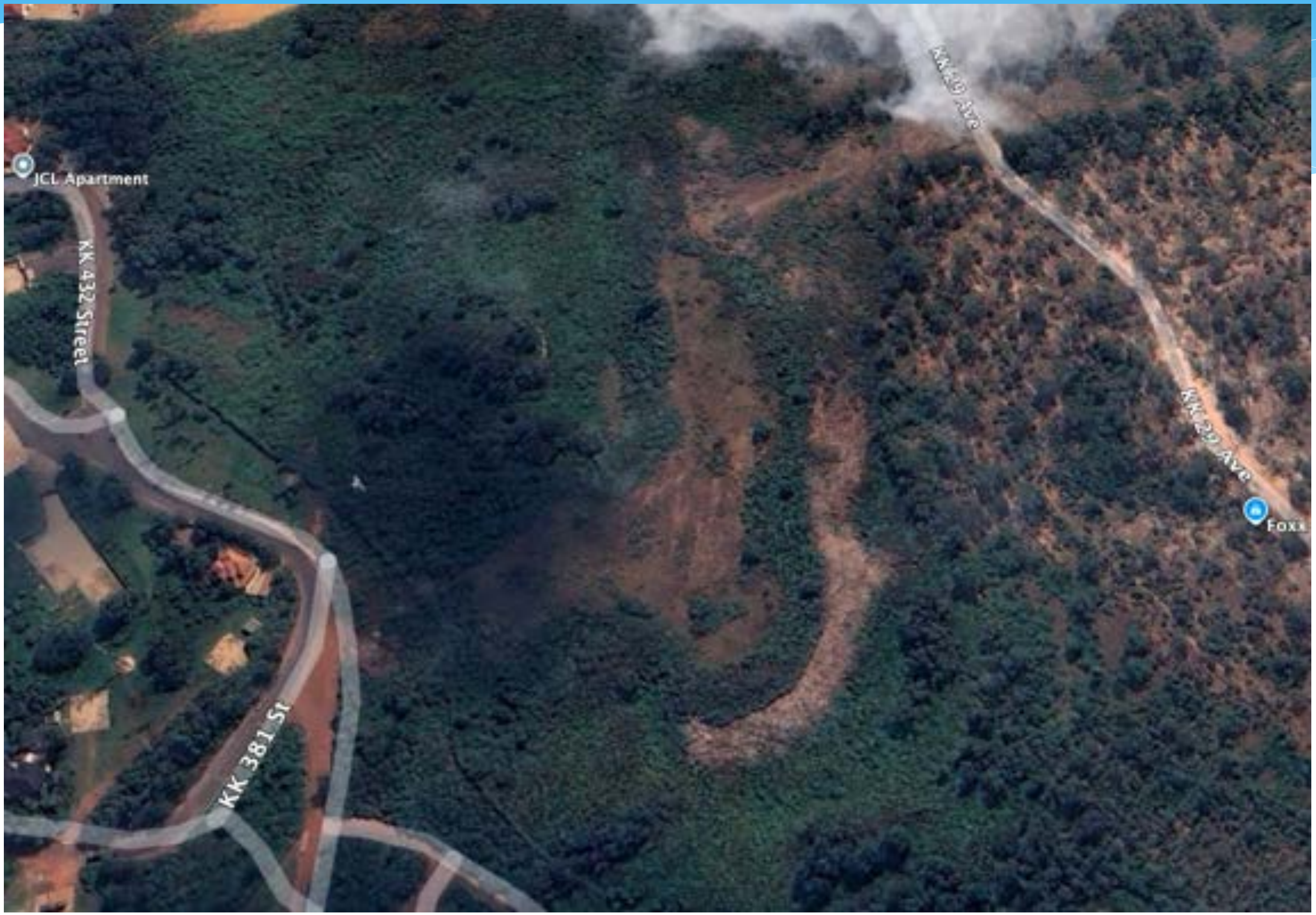
Nyanza landfill

2014

(Source: Google Earth)

Nyanza landfill

2025



(Source: Google Earth)

アフリカ・ルワンダ「ゴミ問題」

2009年7月

2010年5月

アフリカ・ルワンダ「ゴミ問題」

2009年7月

2013年5月

2014 on-air

Nduba landfill in Kigali

January 2016

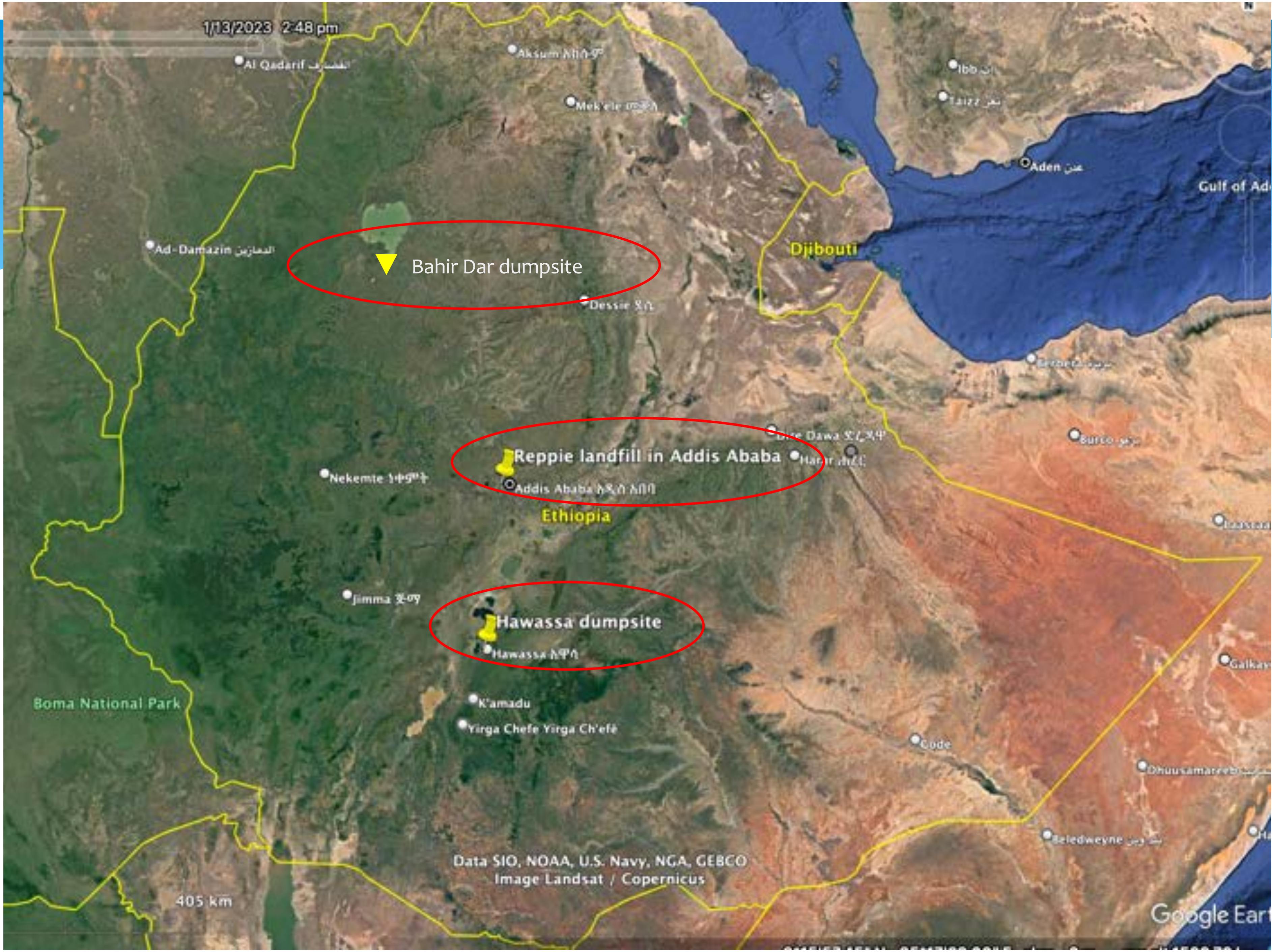
3.5. アフリカ他国への展開（例：ケニア・エチオピア）

New pilot landfill (1ha) (2015)

In Thika town, Kiambu county, Kenya

February

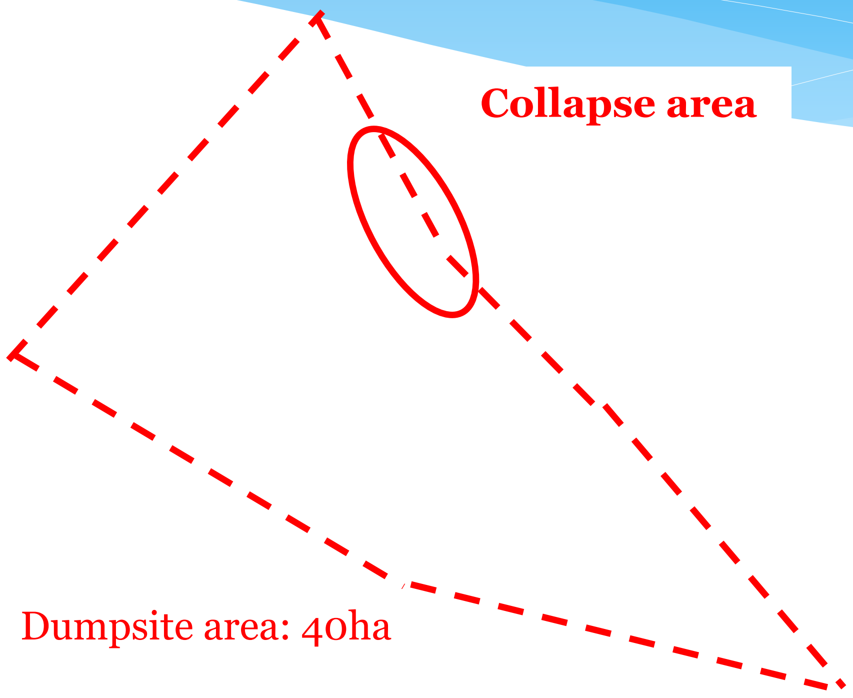
November



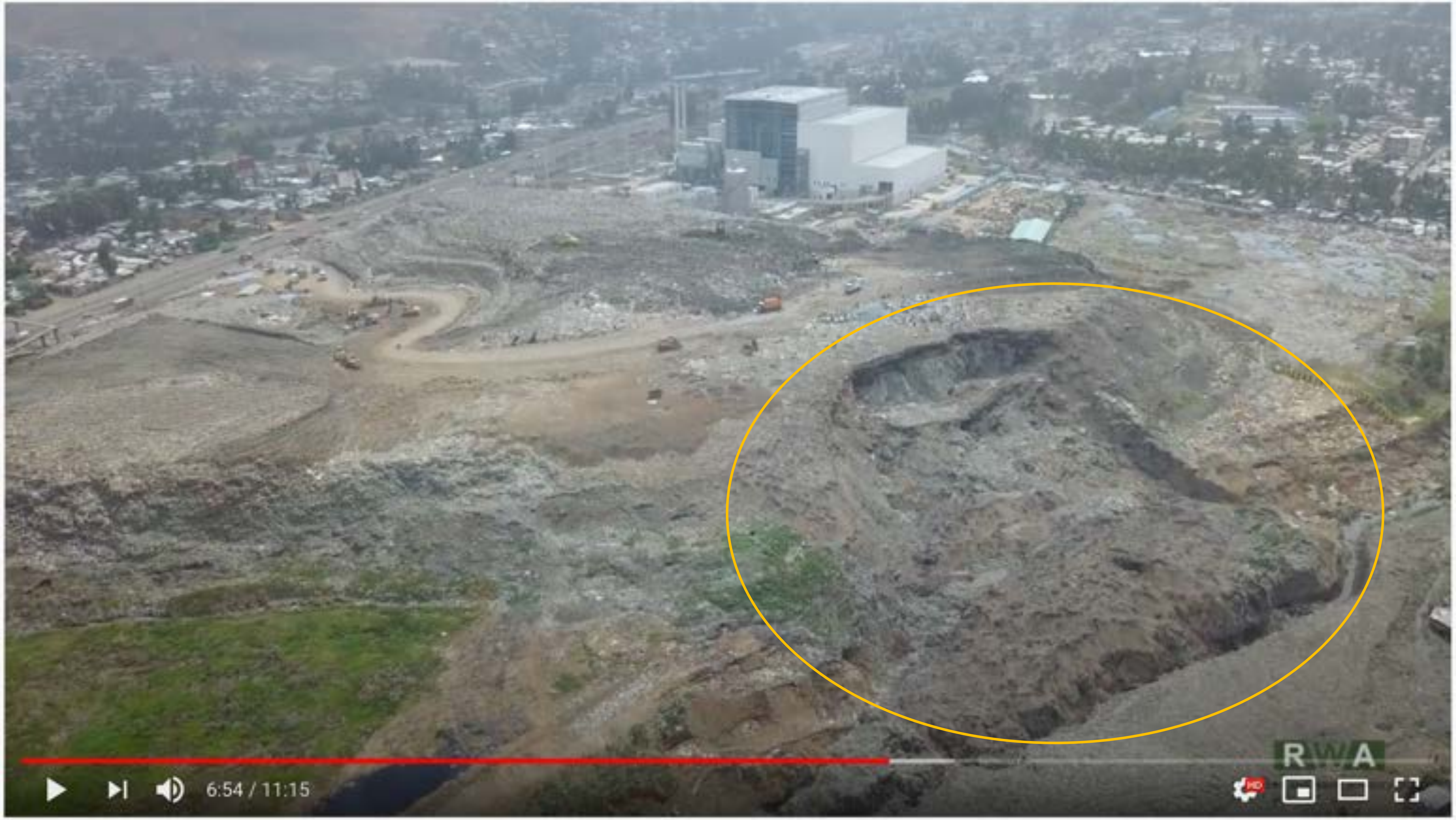
(Source: Google Earth)

Addis Ababa (Reppie / Koshe)

Koshe/Reppie dumpsite and its landslide in March, 2017



June 2017

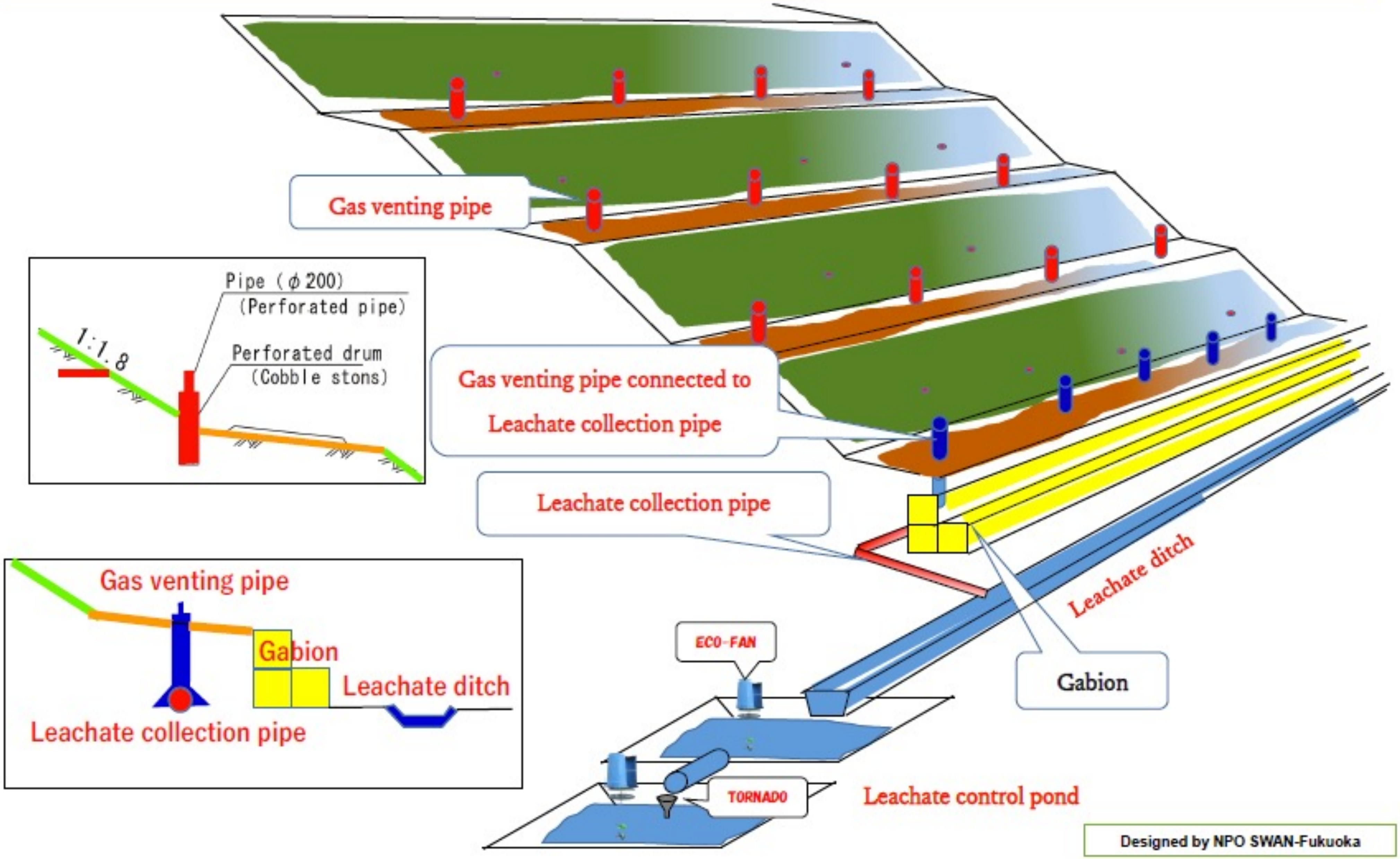


(Source: https://www.youtube.com/watch?v=zg8y6mh10Fc)


MOV_0069

Completion Drawing of Improvement and stabilization of landslide area of Koshe Dump Site

Construction Period : JUL 2018 – FEB 2019




DJI_0001

Oct. 2018

Nov. 2018

Mar. 2019

Aug. 2019

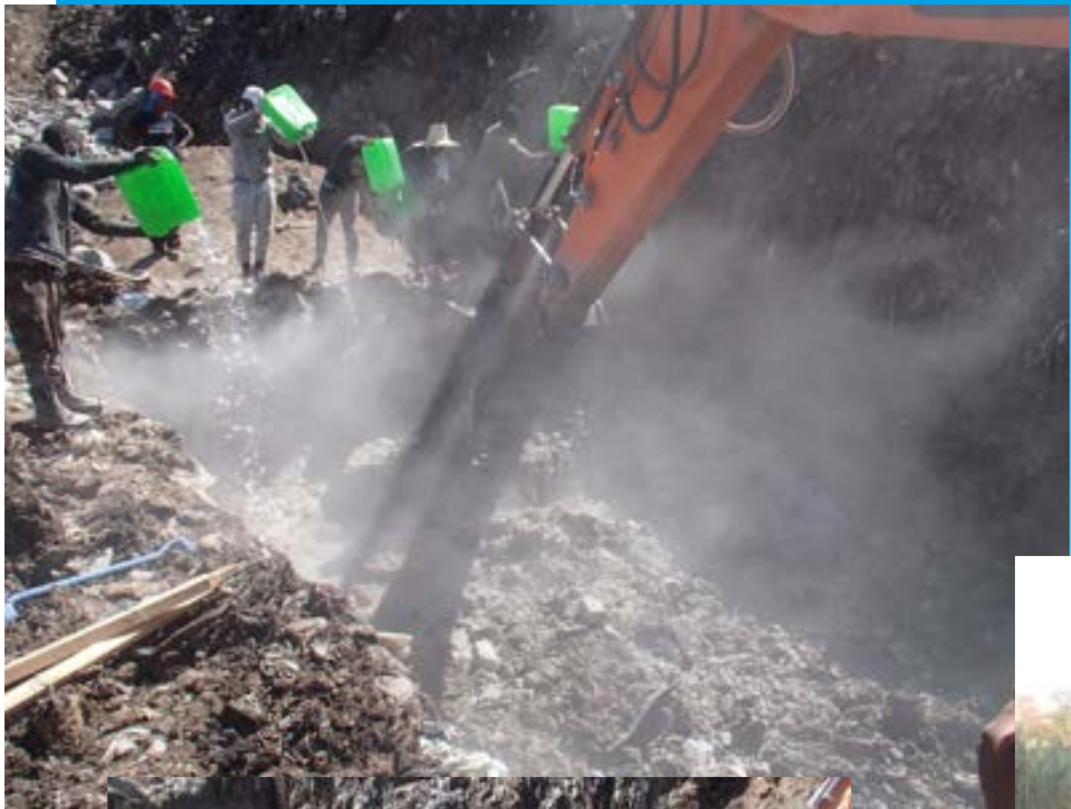
Mar. 2020

Gas venting system



Gabion

Leachate treatment pond



ECO-FAN

ECO-FAN: aeration system by natural air

ECO-FAN

Apr. 2020

Greening

Greening

Greening

Composting

Hand washing (COVID-19 prevention)

Apr. 2020

Onsite safety training (Mar.11, 2019)

Common practice

Onsite safety training (Mar.11, 2019)

Safer practice (test)

Onsite safety training (Mar.11, 2019)

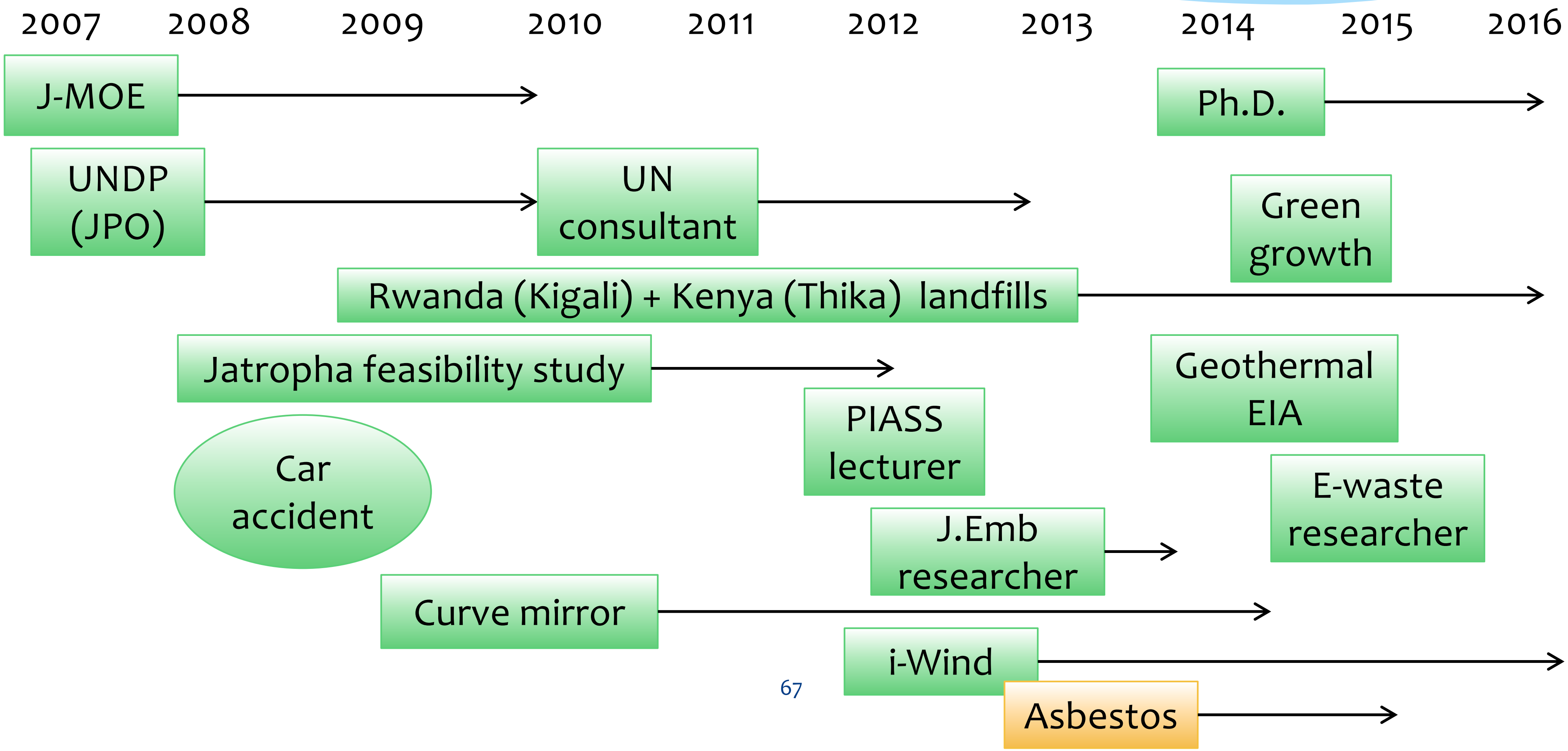
Common practice → **4.5 minutes** for plastic collection

Safer practice (test) → **1 minute** for plastic collection

Site marking for embankment construction work

@Bahir Dar, Ethiopia

Toshikazu Mito in Rwanda



Asbestos

Republic of Rwanda
Ministry of Infrastructures

National action plan for eradication of asbestos from buildings in Rwanda

«Background»

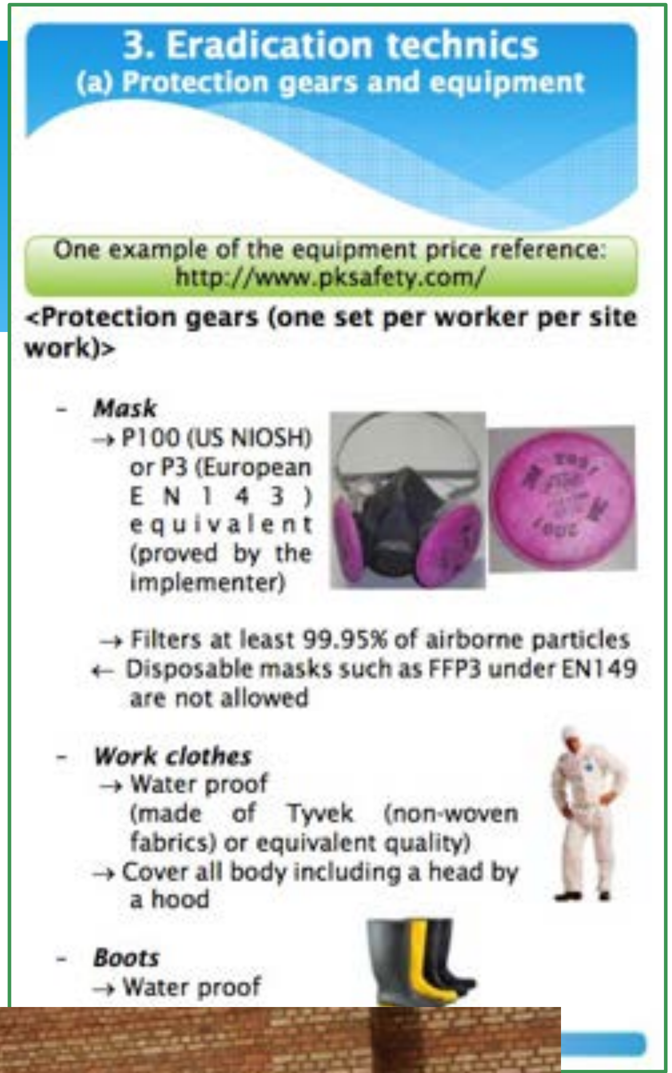
The baseline technical, environmental, and operational analyses and recommendations for the national action plan for eradication of asbestos from buildings in Rwanda have been conducted by the Experco International Ltd. from Canada guided by MININFRA. The recruitment of this consulting firm specialized in asbestos eradication and drafting of the report are originated from the National Dialogue on asbestos issues dated on December 10-11, 2009 and the Cabinet decision about the asbestos eradication in Rwanda as of October 14th, 2009.

The consulting firm has conducted field visits and data collection from all districts to estimate an existing amount of asbestos construction materials, and drafted eradication plan in the context of Rwanda together with the most advanced and safest eradication technologies currently available. The plan also contains the total eradication cost estimate.

This plan has been fully discussed at the national government taskforce on asbestos with all stakeholders such as the Rwanda Environment Management Authority (REMA), the Ministry of Health, and the Rwanda Bureau of Standards (RBS), and the proposal is endorsed by the taskforce (10/03/2011) and at the high-level consultative meeting chaired by the Right Honorable Prime Minister (18/04/2011).

Asbestos diseases	Death rates	Incubation periods
Asbestosis	50%	15 – 20 years
Lung cancer	100% (no effective medical treatment is available)	15 – 40 years
Mesothelioma	100% (no effective medical treatment is available)	20 – 50 years

Asbestos



3. Eradication technics
(a) Protection gears and equipment

One example of the equipment price reference: http://www.pksafety.com/

<Protection gears (one set per worker per site work)>

- ***Mask***
  → P100 (US NIOSH) or P3 (European EN 143) equivalent (proved by the implementer)
  → Filters at least 99.95% of airborne particles
  ← Disposable masks such as FFP3 under EN149 are not allowed
- ***Work clothes***
  → Water proof (made of Tyvek (non-woven fabrics) or equivalent quality)
  → Cover all body including a head by a hood
- ***Boots***
  → Water proof

Rwanda Housing Authority

HOME ABOUT RHA MANDATE SERVICES UPDATES PUBLICATIONS

UPDATES

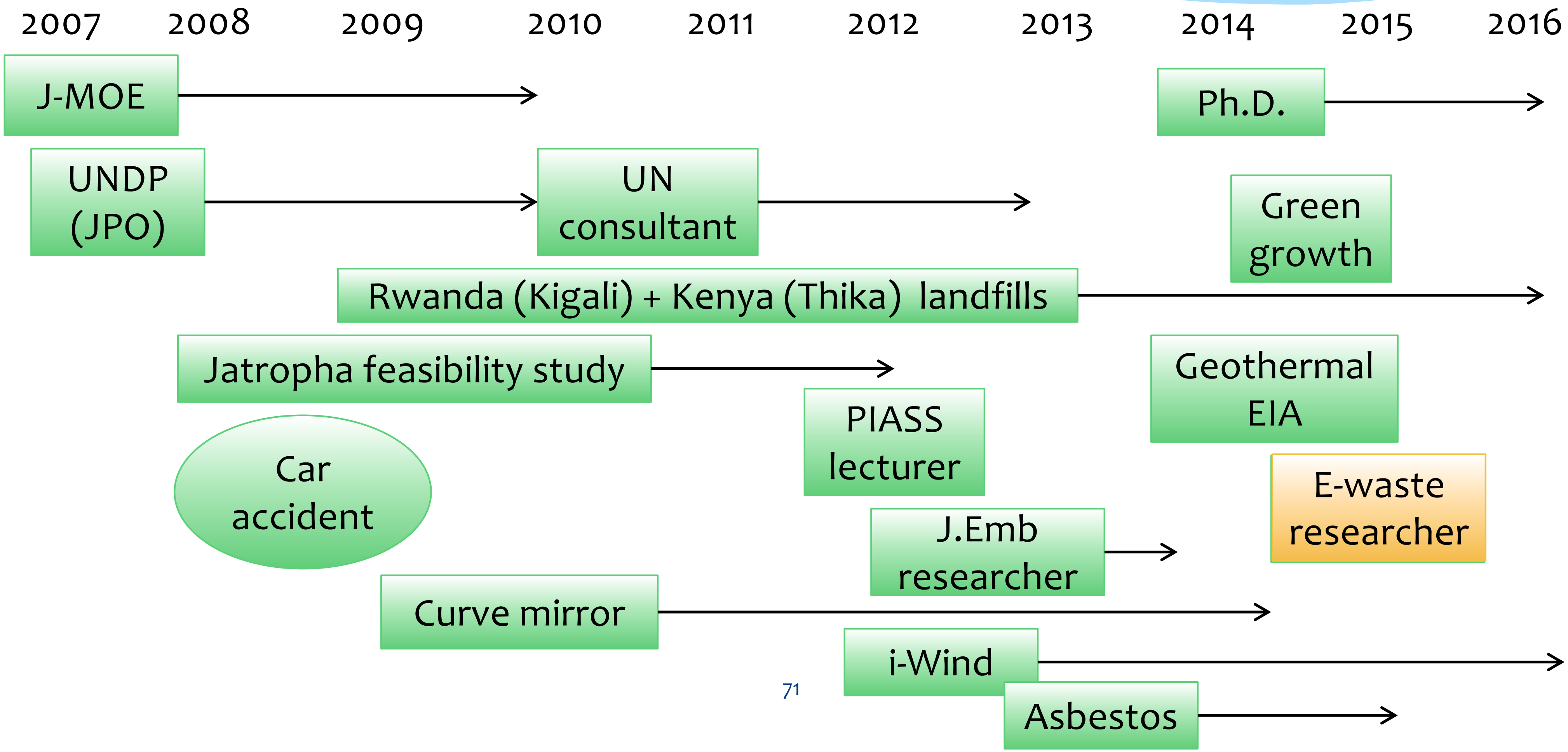
HAZARDOUS ASBESTOS ROOFING REMOVED FROM OVER 80% RWANDAN BUILDINGS

| Created by Jean Claude NIYONSABA / Public Relations and Communication Officer

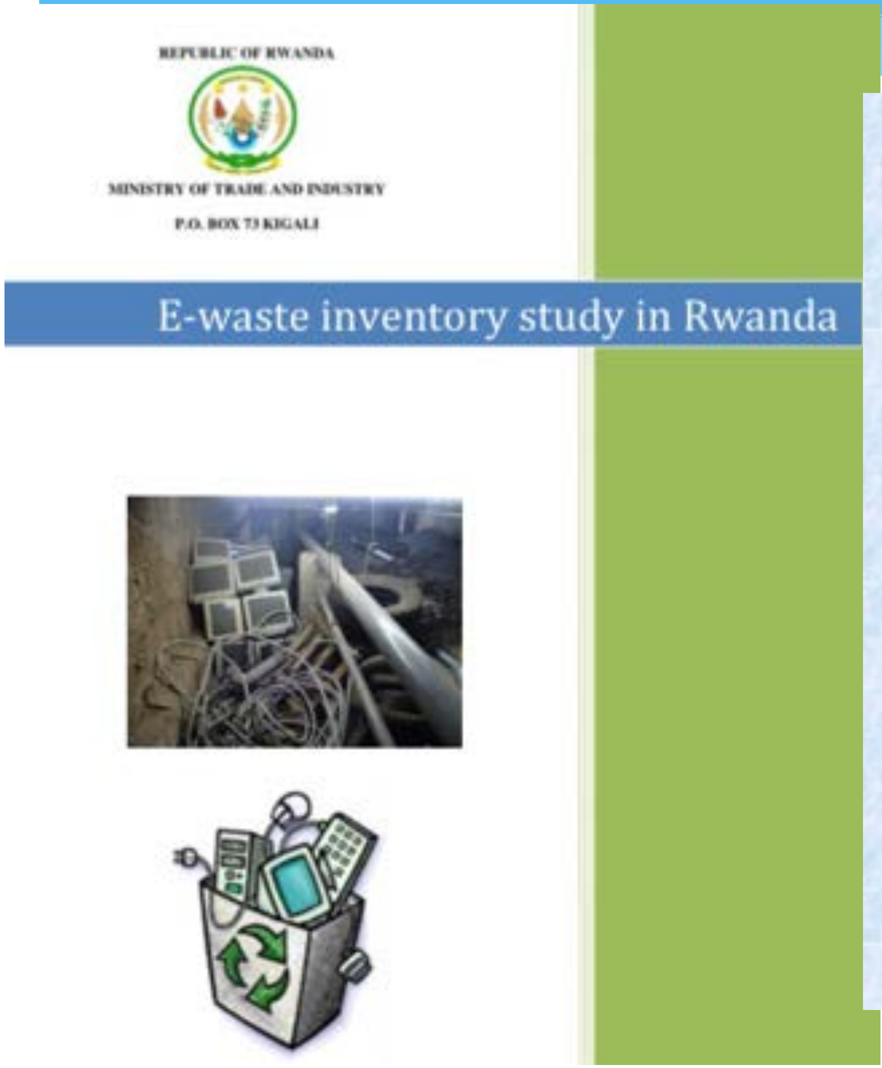
As of October 31, Government aided the removal of about 1.4 million (82.4 per cent) square metres of asbestos roofing from

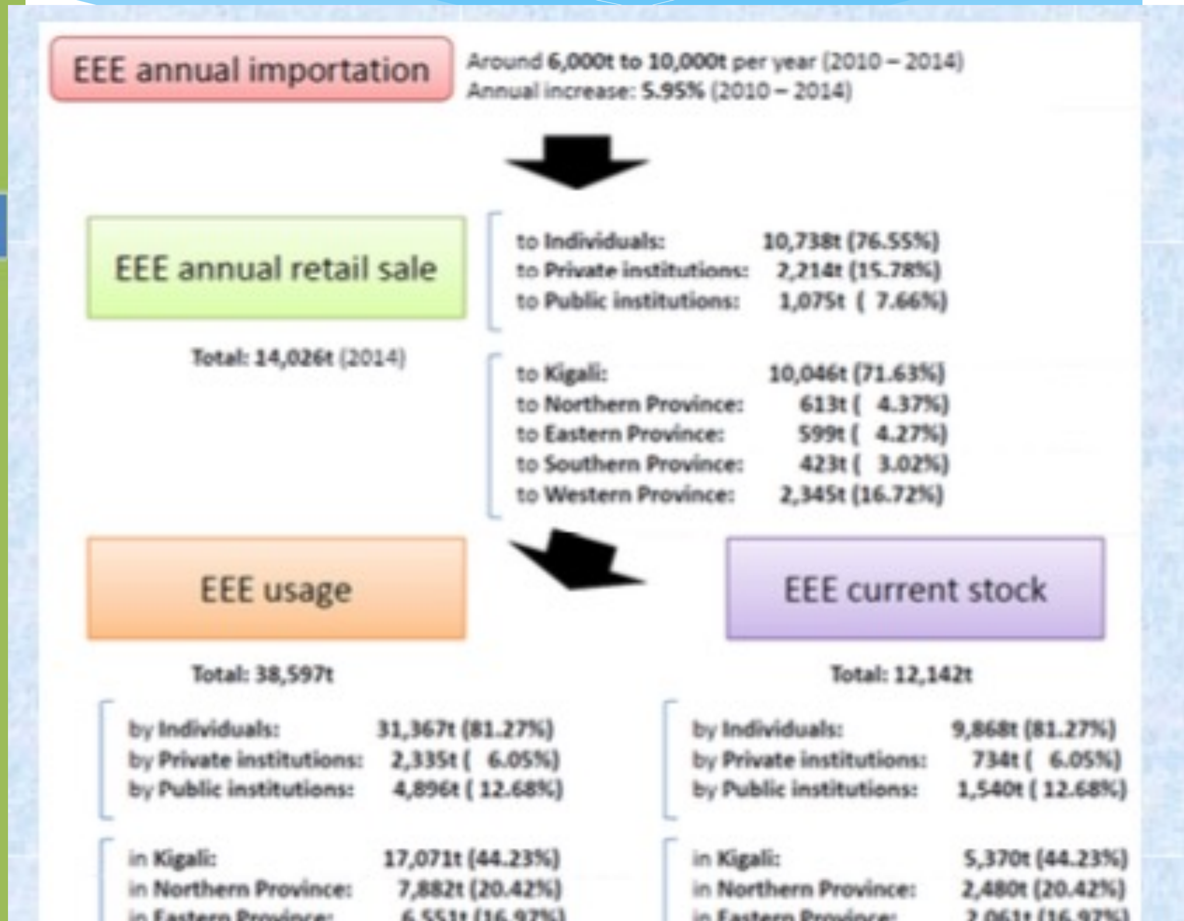
(Source: Rwanda Housing Authority website)

Toshikazu Mito in Rwanda

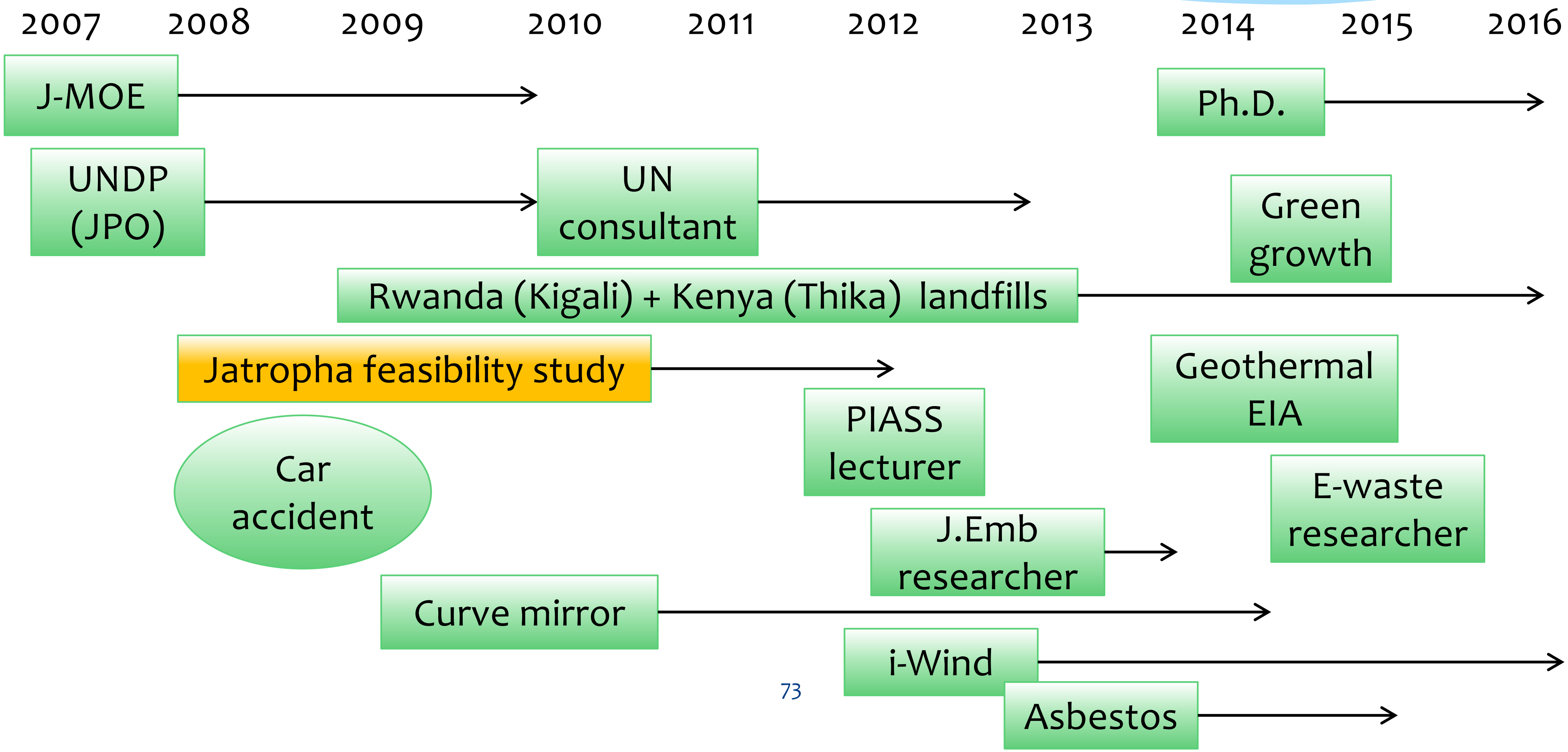


E-waste researcher





Toshikazu Mito in Rwanda



Jatropha feasibility study (reforestation and biofuel)

Steep Rutsiro site with soil erosion
ルツィロの急傾斜地と土壌侵食

In Rubavu district. The tree is high (2m) but no seeds yet
ルバヴ地区で。樹高は高いが（2m）結実はまだしていない

74

Jatropha feasibility study (reforestation and biofuel)

Jatropha seeds in Rusizi. The opposite side of the river is DRC
ルシジのジャトロファのタネ。川の対岸はコンゴ（DRC）

Kids enjoying watermelon for the first time in their lives
生まれて初めてスイカを食べて喜ぶ子供たち

Jatropha roots
ジャトロファの根

Jatropha feasibility study (reforestation and biofuel)

Jatropha Feasibility Study Results (2008-2010)

Site	Size in m²	Plant number	Planting date	1st Flowering date	# of date btw planting & flowering	Average Plant height in cm	Yield in kg/plant/year	pH	Altitude above the sea level	Topography
Rusizi	780	300	21.06.08	10.12.08	7 months	123.3cm	0.1kg =100g	6.3	950m	Flat
Ruhango	884	256	29.05.08	15.01.09	8 months	79cm	0.013kg =13g	5.6	1,580m	Slight slope
Rubavu	800	320	27.06.08	10.03.09	10 months	97cm	0.014kg =14g	6.5	1,500m	Slight slope
Karongi	600	130	12.07.08	04.09.10	27 months	79cm	0.0054kg =5.4g	6.1	1,640m	Slight slope
Nyabihu1	680	200	27.06.08	01.11.10	29 months	97.6cm	0.0005kg =0.5g	6.4	1,480m	Flat
Ngororero	4,513	2,131	15.11.08	N/A	N/A	N/A	N/A	5.3	1,620m	Slight slope

Table 1: Site comparison data (2008-2010) indicating all data from each site during our Jatropha feasibility study

（調査結果－http://solarcookerjapan.sunnyday.jp/?page_id=174）

自給農産品育成支援のためのパイロット有機農業事業
（リンゴ栽培）

アフリカでの持続可能な開発への考察

依存体質からの脱却の重要性

本当にお金がないときにどうするか？
（例：DRC Bukavu）

人口圧（世界人口の半分はいずれアフリカ人？）

Population pressure in Rwanda

Rwanda 2008 national agricultural household survey → Average land holding size per household → **0.72ha**

Fourth Population and Housing Census, Rwanda, 2012 → 2012 population: **10,378,021**
2012 household size: **4.3**
(in urban: 4.02, rural: 4.3)

Land capacity in Rwanda:

26,338km² (land size) / 0.0072km² x 4.3 = 15,729,639 > 10,378,021

(0.72ha) (no protected area considered nor…)

Considering protected area (10%): **the land capacity will reach the limit in 2024**

(Source: World Bank Policy Research Working Paper:6770 (2014): p.2)
(Source: Fourth Population and Housing Census, Rwanda, 2012 (2014): p.8)
(Source: http://en.wikipedia.org/wiki/Geography_of_Rwanda)

アフリカでの持続可能な開発への考察

依存体質からの脱却の重要性

本当にお金がないときにどうするか？
（例：DRC Bukavu）

人口圧（世界人口の半分はいずれアフリカ人？）

持続可能な開発について (SDGs)

SDGsに対する個人的感想

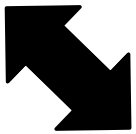
優先順位の付け方の難しさ

（投入できる資源は限られている）

SDGs：優先順位の付け方の難しさ

◎「国の発展」の考え方

Figure 1 / 図1



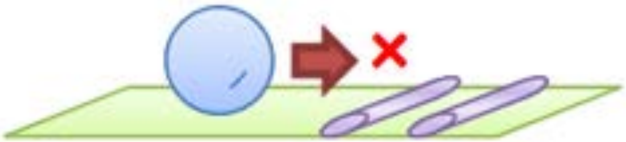


Figure 2 / 図2

Figure 3 / 図3

よくある発展途上国の状況　←　開発援助はここを改善したい！

SDGs：優先順位の付け方の難しさ

◎「国の発展」の考え方

よかれと思った支援の集合体……
（参照：支援のライバル意識）

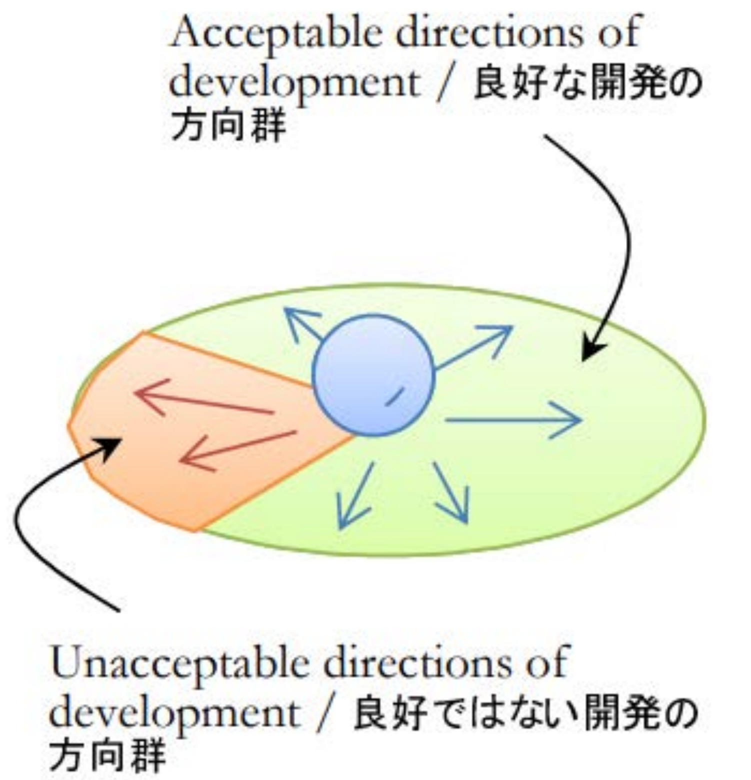


Figure 4 / 図4

SDGs：優先順位の付け方の難しさ

◎「国の発展」の考え方

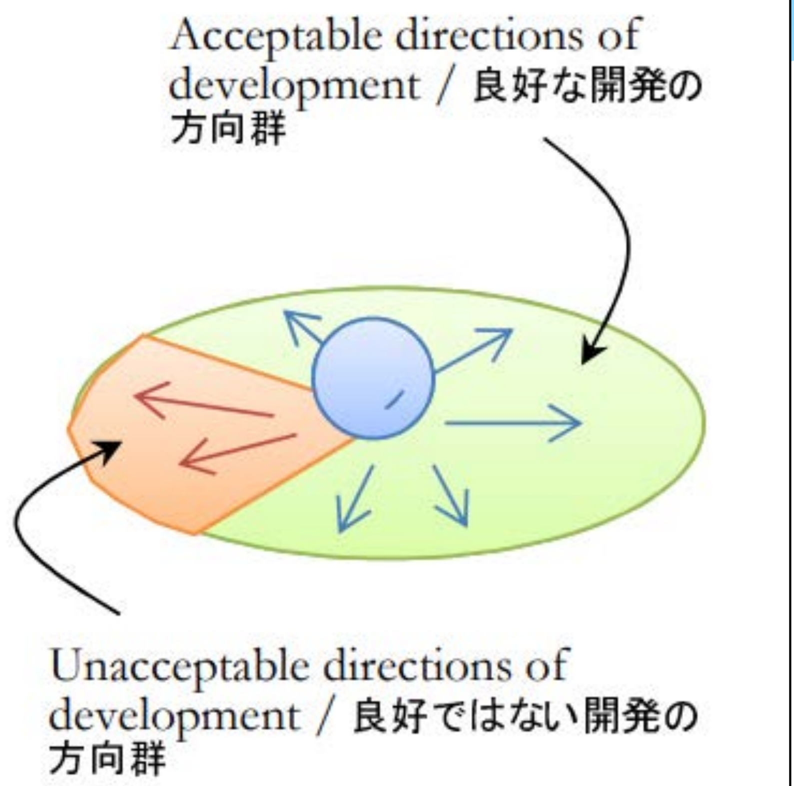


Figure 4 / 図4

よかれと思った支援の集合体……
（参照：支援のライバル意識）

← 発展の方向は国民が決めるべき！

アフリカでの持続可能な開発への考察

依存体質からの脱却の重要性

本当にお金がないときにどうするか？
（例：DRC Bukavu）

人口圧（世界人口の半分はいずれアフリカ人？）

持続可能な開発について (SDGs)

アフリカはかわいそうか？

エチオピアの waste pickers

2019.01.16

エチオピアの waste pickers

2019.01.16

かわいそうな人？

エチオピアの
waste pickers

2019.01.16

かわいそうな人？

マリファナ（大麻）・収監……

Q & A?

以上です

ありがとうございました！

三戸俊和（みととしかず）

Contact: mitotoshi@gmail.com