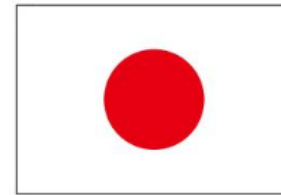
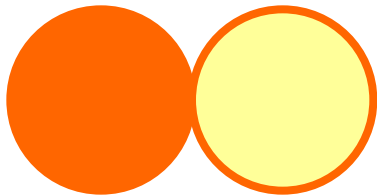




Partnership project of solid waste management in Palau





Mengkur W. Rechelulk¹⁾, Takeshi Fujiwara²⁾, Hideaki Nagare²⁾

1) Ministry of Resource and Development, Republic of Palau

2) Graduate School of Environ. and Life Sci., Okayama University



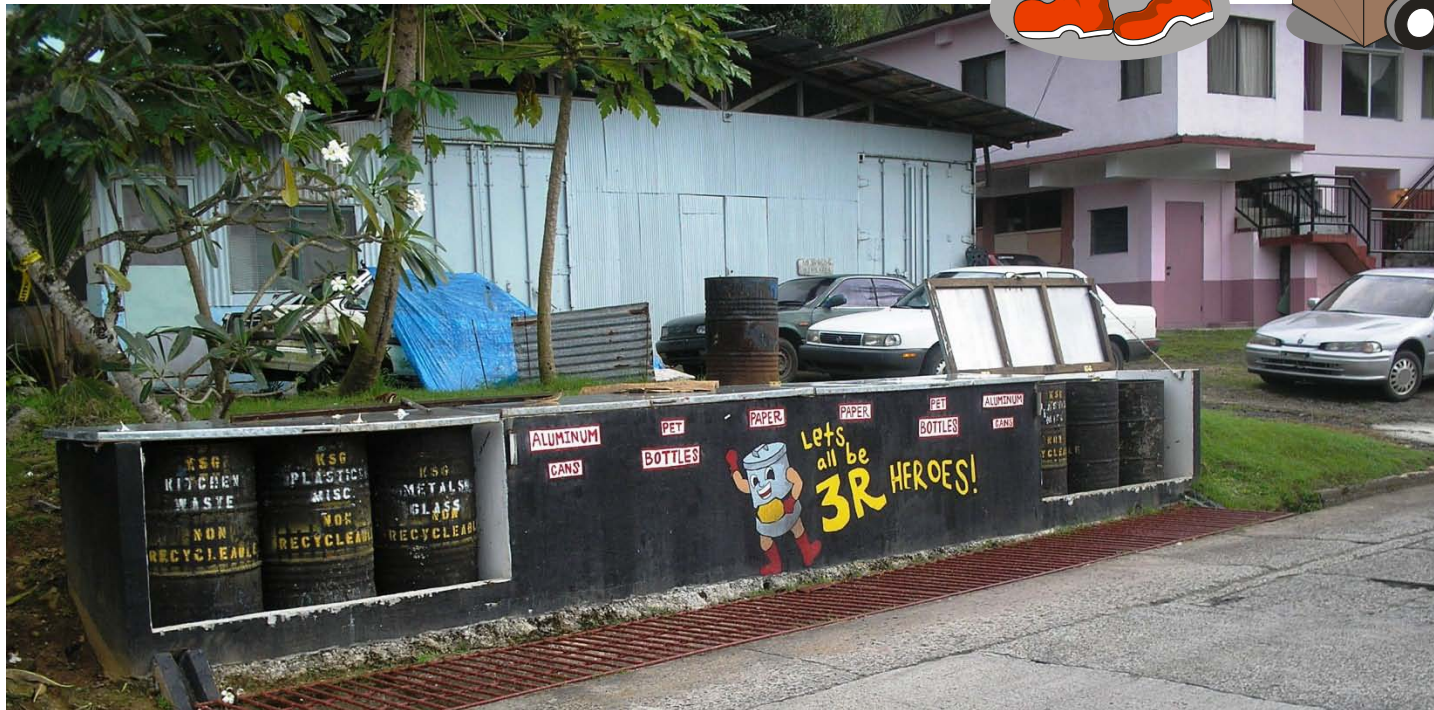
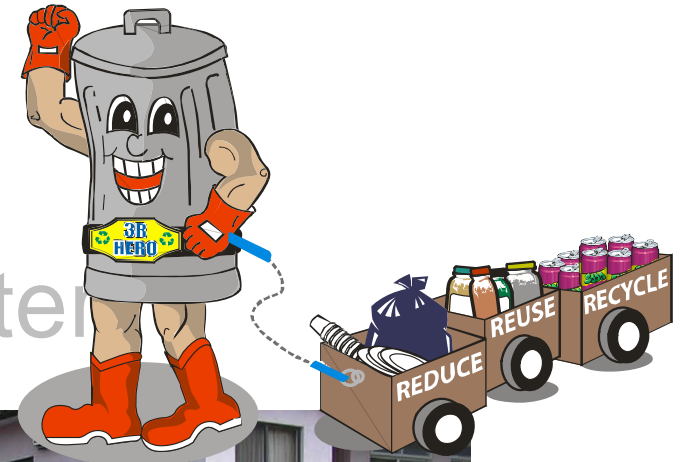
Contents

- Japan-Palau Seminar
- Study on Solid Waste
- Study on Leachate Water



Contents

- Japan-Palau Seminar
- Study on Solid Waste
- Study on Leachate Water



“Importance of Solid Waste Management in Palau”

- Date: August 28, 2012
- Venue: Palau Community College (PCC)
- Number of audience: 84
 - Students of PCC
 - Staffs of Japanese embassy and JICA
 - Others
- Objectives:
To show the achievements of our researches and activities to public, and encourage 3R.

Japan-Palau Joint Seminar 2012

- Programs:
 - Opening address
 - Two presentations from Japanese side
 - One presentation from PCC students
 - Two presentations from Palau side
 - Closing remark

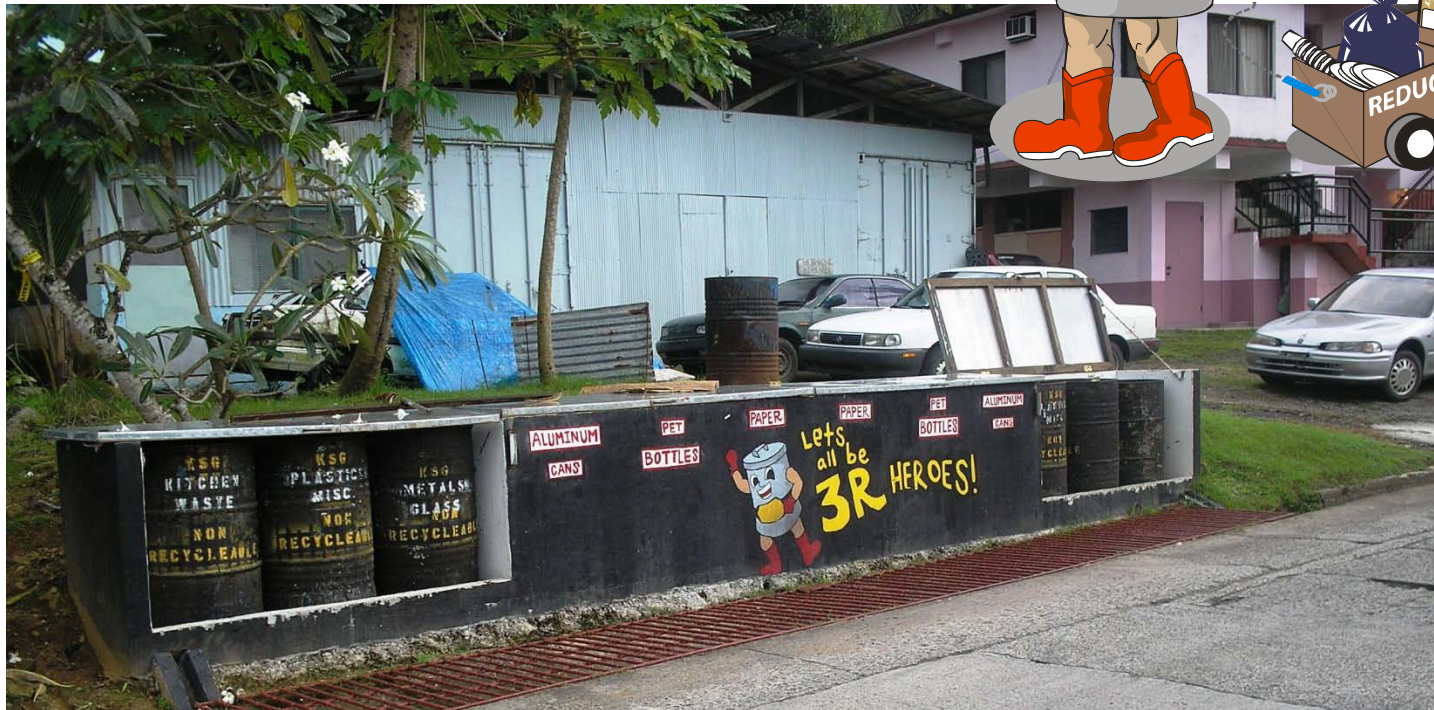
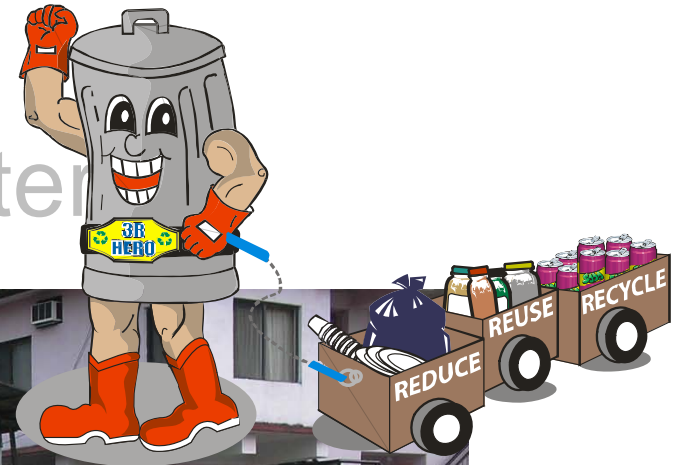


Japan-Palau Joint Seminar 2012



Contents

- Japan-Palau Seminar
- Study on Solid Waste
- Study on Leachate Water



- Mr. Fukui: Optimal positioning of waste separation stations and evaluation of recycling effects on landfill waste reduction. (2008-2009)
- *Ms. Ito: Questionnaire survey on solid waste generation and future projection of the amount of waste by considering growth population and tourism (2010-2011)*

News Paper Articles in Japan



研究者や学生、行政の担当者が出発

岡山大学

アジア諸国と共同プロジェクト

中国の学術協定を以て、日本と岡山大学、11学部と7研究科を擁する総合大学の特徴を

生かし、異分野連携による先進的な研究を推進しています。その一つが岡山大学廃棄物マネ

廃棄物処理で国際貢献

プロジェクト研究センター(岡山山)がアジア・太平洋地域の大学、行政と共同で行っている国際研究プロジェクトです。異分野を統合して、日本の技術を利用して現地の環境問題解決を推進しています。

アジア諸国で廃棄物処理が急務となっており、岡山大学は、その解決に向けて、アジア諸国と共同で行っている国際研究プロジェクトです。異分野を統合して、日本の技術を利用して現地の環境問題解決を推進しています。



アジア諸国の廃棄物処理の現状

〒730-8530 岡山県北区内岡山大学 1 番 (086) 252-1111

来月2日から岡山・一宮高2年生4人

4人が、太平洋の島国パラオが進めているごみ問題調査に参る。美しい自然を観光資源と一が進む同国を、8月2日から5ね、廃棄物処理に悩む現状と取り組みを学ぶ。(黒崎平雄)

パラオのごみ調査



話す一宮高2年生

岡山大に環境学習へ意欲

国際的な科学者育成に、一宮高が連携を保持する。仲村君と山本君は自然環境の変化について、パラオの環境を学ぶ。山本美穂さん(16)、伊藤州で家庭ごみの調査。レアルルク指導員が「海のごみがサンゴ礁にダメージを与えている。」「地球温暖化で水位が上がっている」と答えた。塩見さん(16)は「リサイクル意識を高めることが重要だ」と話した。

アジア・太平洋地域の大学、行政と連携

廃棄物問題の研究開始

岡山大によると、パラオやグアムは観光開発が進み、ごみが急増。処分場は可燃物と不燃物が交差するごみ処理技術が不足した状態。埋立方式で汚水の流出防止など適切な処理システムの確立が急務とされている。

本年度は岡山大教員らが、パラオ・アイライ州とグアムで分別収集実施に向け、家庭ごみの種類と量を調査し、グアム大にはバイオマス(生物資源)技術を紹介。パンドン工科大(インドネシア)で8月20日午前9時半

3日 王京

プロジェクトをスタートさせた。本年度はパラオ政府、グアム、インドネシアの大学と連携し、日本の技術を生かして現地での循環型社会実現の道を探る。(黒崎平雄)

マネジメントセンター



で「市民の環境プロジェクト」に講演やパ

Objectives

- Questionnaire survey is conducted to understand the amount and composition of the household and commercial household waste.
- Projection of future waste generation is performed through economic analysis to clear effect of population and tourism.
- Collection simulation of recyclable waste is performed

Study Area

Palau



Koror



Airai



Population

20,000

14, 000

2,700

Area

480km²

20km²

44km²

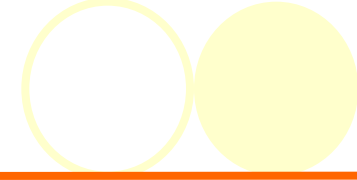
Households

4,710

3,300

530

Questionnaire survey



	Household Survey	Commercial Survey
Target	Residents in Airai State	Commercials in Koror (shops, restaurants, offices, banks schools, hospitals, churches, hotels, airport)
Period	2010/8/2~2010/8/13	2010/8/2~2010/8/13
Area	Airai State	Koror
Response Rate	54% (distributions: 187 responses: 101)	70% (distributions: 143 responses: 100)
Methods	<ul style="list-style-type: none">▪ selected the houses randomly▪ handed the questionnaire to each house and collected later	<ul style="list-style-type: none">▪ selected the famous commercials▪ handed the questionnaire to each commercial and collected later

Questionnaire Survey (household)

- Students with a teacher of Okayama Ichinomiya high school city joined our questionnaire survey as research practice.
- Visit and hearing about solid waste characteristics and amount of discards



Questionnaire survey (household)

● Practical Knowledge

Frequency of the collection in Ailai



Do you know where the collected waste is being taken?

YES

74%

NO

26%

Do you know how much waste do you generate in daily?

55%

45%

Questionnaire survey (household)

● 3Rs Knowledge

Have you ever heard of the “3Rs”?

YES

NO

77%

23%

Do you know what the “3Rs” represents?

89%

5.5%

Somewhat
5.5%

● Experience

Have you ever taken part in any campaign related to waste management or environmental protection?

YES

NO

46%

54%

Have you ever sold or taken your garbage to any waste recycling centre?

57%

43%

Questionnaire survey (household)

● Willing to participate

Do you make any attempt to minimize waste generated in your house?

YES

NO

80%

20%

Would you use second-hand items in your household in order to help reduce discards?

88%

12%

Are you willing to separate your waste at your house?

YES

NO

Not sure

94%

3%

3%

Are you willing to keep your waste until the collection they are collected?

90%

3%

7%

Are you willing to obey the rules?

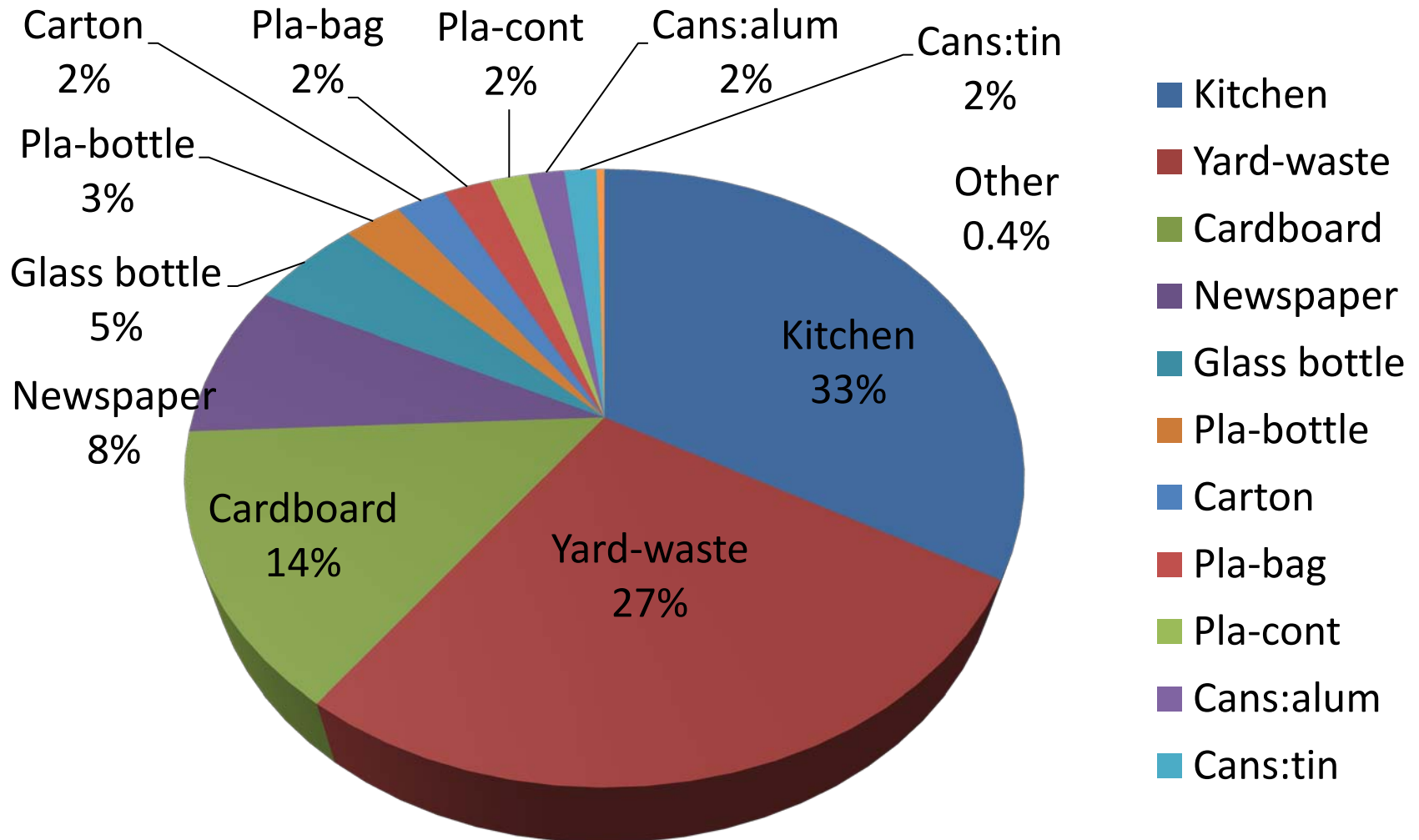
89%

3%

8%

Questionnaire survey (household)

● Waste composition of household



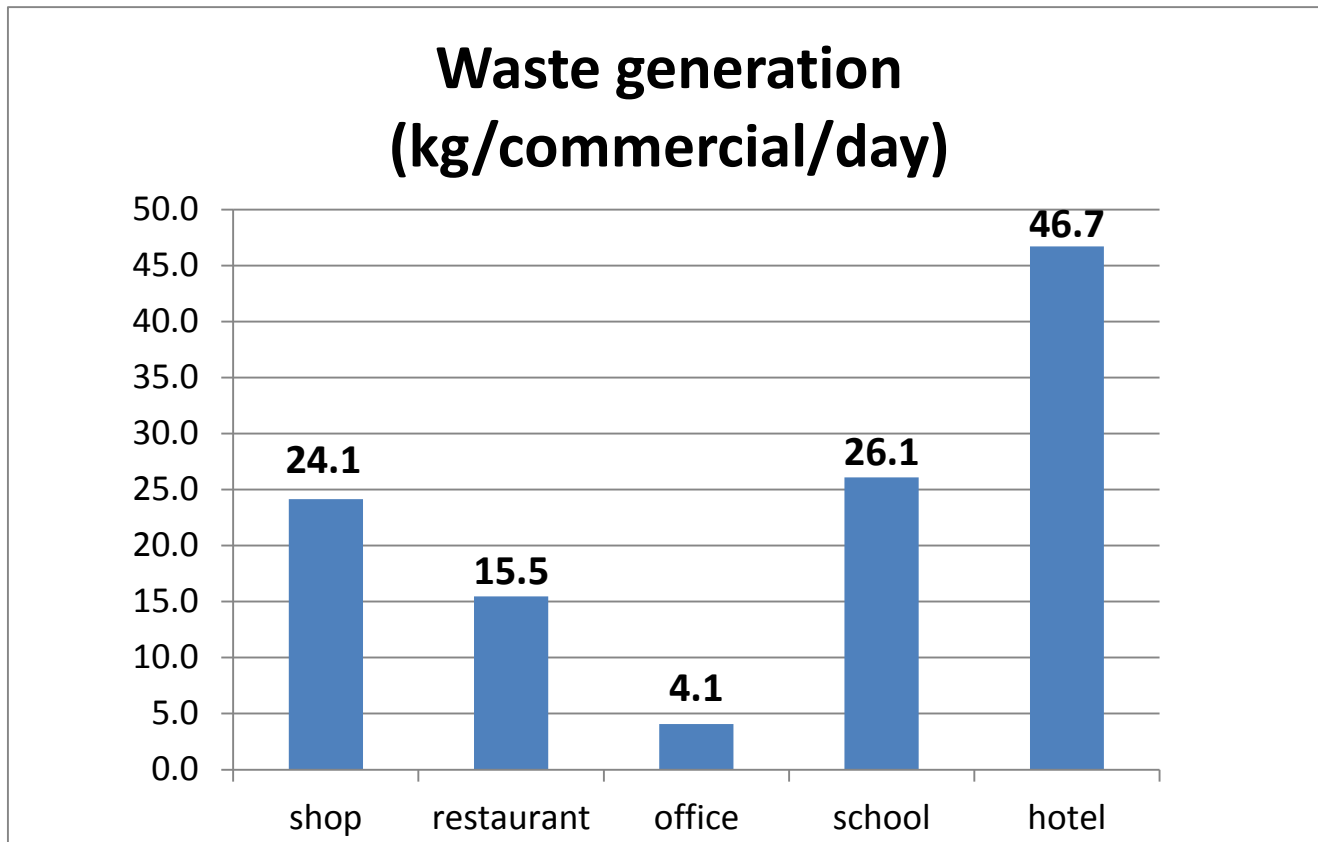
Questionnaire survey (household)

	Household waste ¹⁾ Koror(g/cap/day)	Recyclable waste ²⁾ Ailai(g/cap/day)
Kitchen	63.3	67.0
Yard	4.9	113.7
Paper	36.5	80.9
Textile	4.9	–
Plastic	82.8	30.3
Leather/Rubber	2.4	–
Metals	24.3	19.5
Glass/Ceramic	9.7	16.0
Miscellaneous	17.0	–

1) provided by Mr. Fuji of Koror state, 2) this questionnaire survey

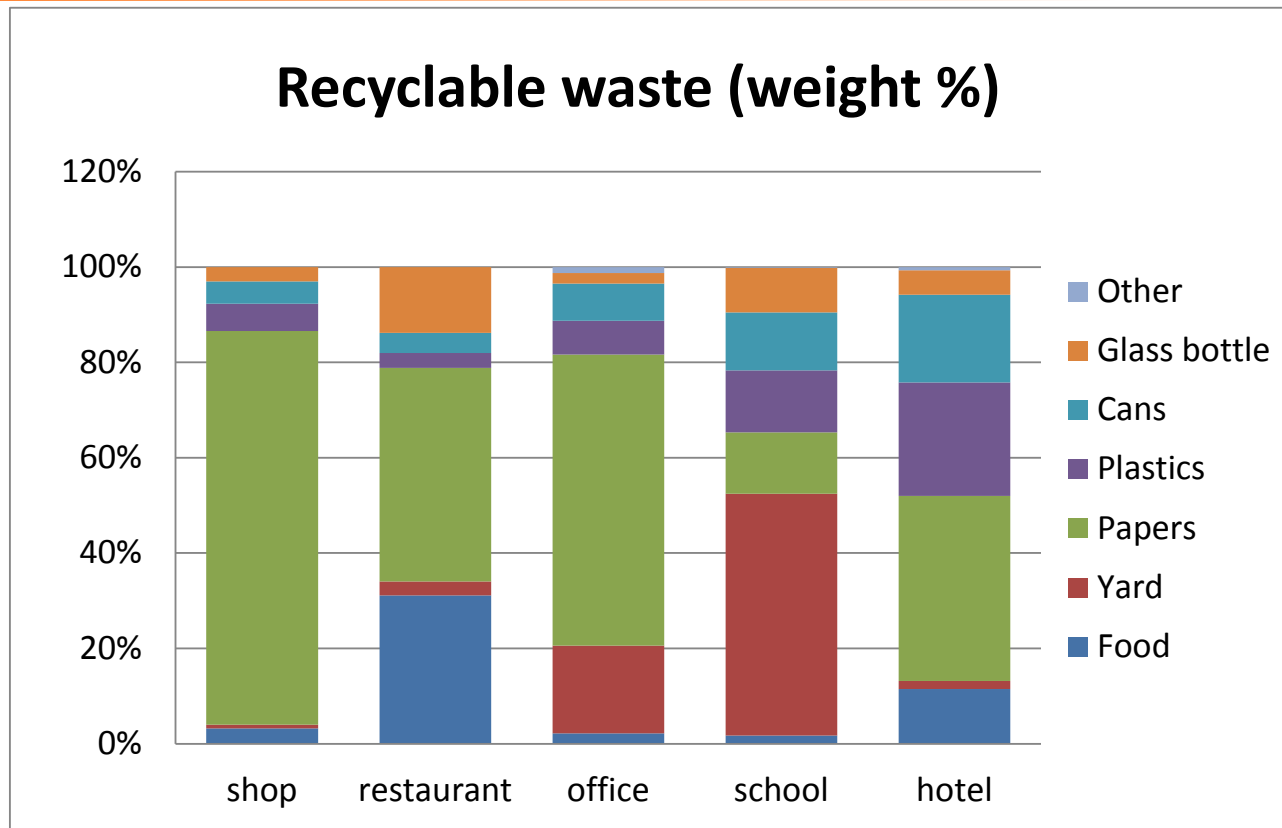
- Total waste discards per capita per day
327g(Ailai) > 246g(Koror)
- Yard and paper waste is high in Ailai state, and plastic waste is high in Koror
- Kitchen waste is almost same.

Questionnaire survey (Business)



	shop	restaurant	office	school	hotel
Number of samples	7	20	18	12	3

Questionnaire survey (Business)



- Paper waste occupies large part in shop, office, restaurant and hotel. Plastic waste and cans are high in hotel waste.
- Half of school waste is yard waste.
- Restaurant and hotel generate food waste.

Questionnaire survey (Business)

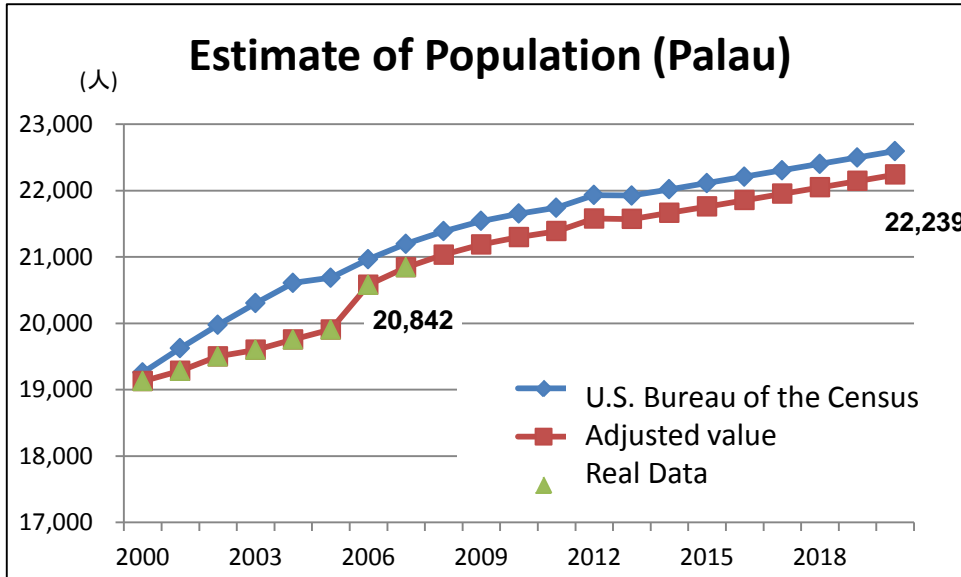


- Waste is transported by company-self or collection company

Prediction of Solid Waste Generation

- Habitant population increase is predicted
- Number and expenditure of tourist is assumed (increase, stable, decrease)
- Future solid waste generation of household and business is predicted by considering economic effect.

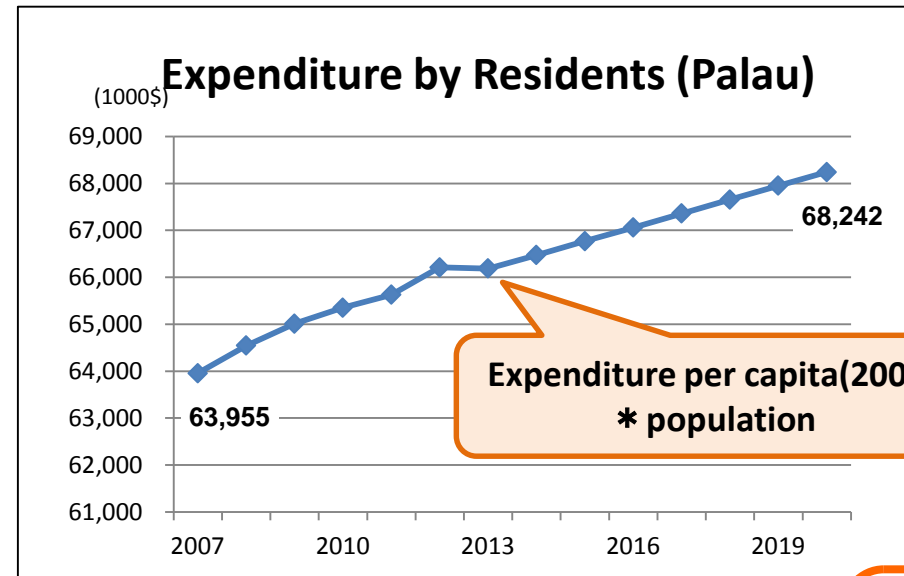
Population Scenario



Population of Palau predicted by U.S. Bureau of the Census has difference from real population.

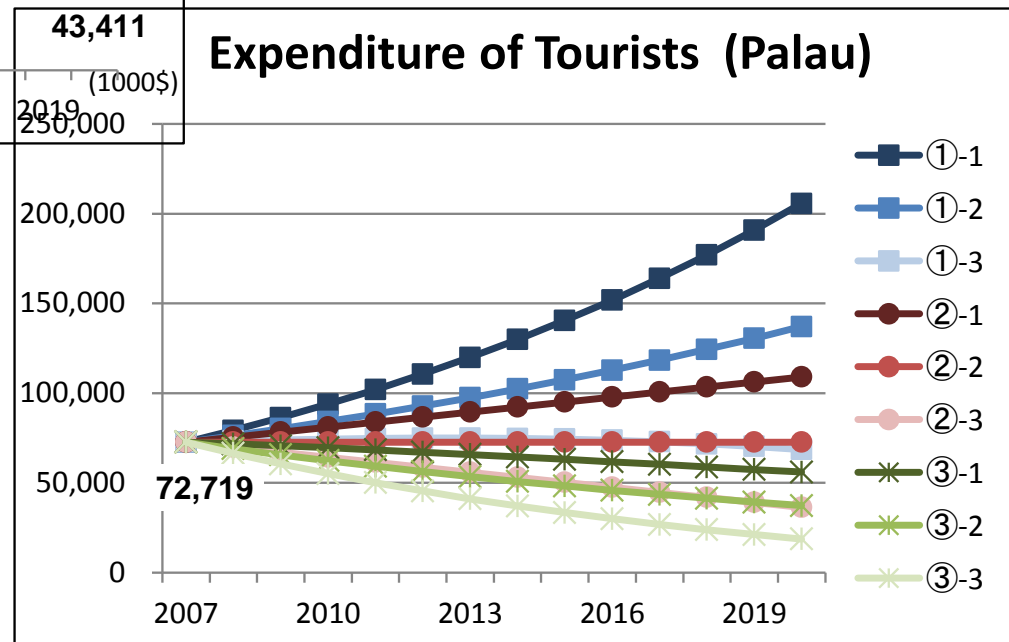
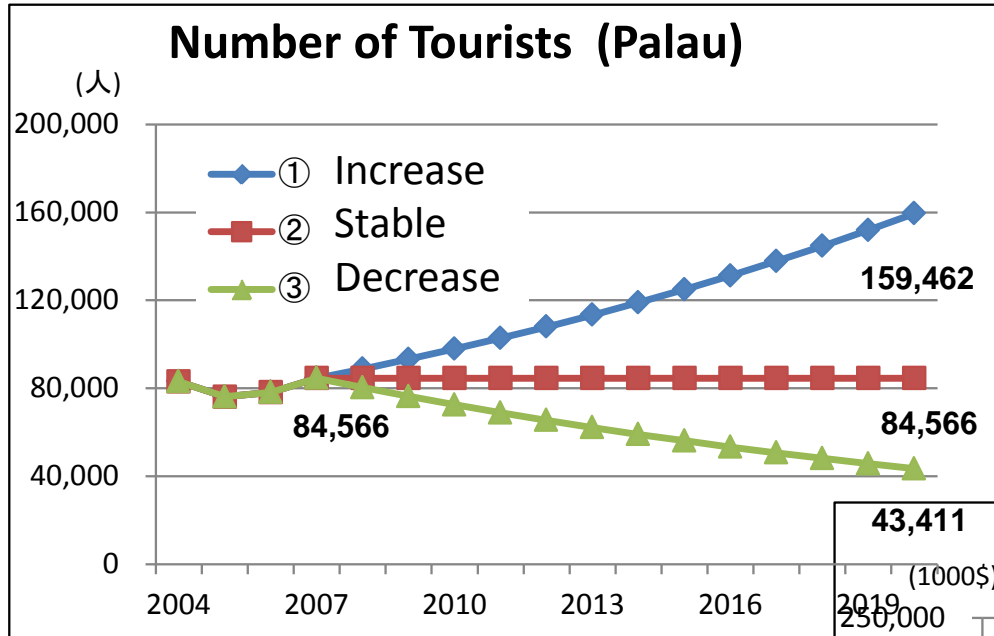
Therefore, population curve is adjusted to the real.

Expenditure by residents (household consumption) is estimated by using the adjusted population curve and expenditure per capita of 2007.



Tourist Scenario

Simulation of the number and total expenditure of tourists



Government Scenario

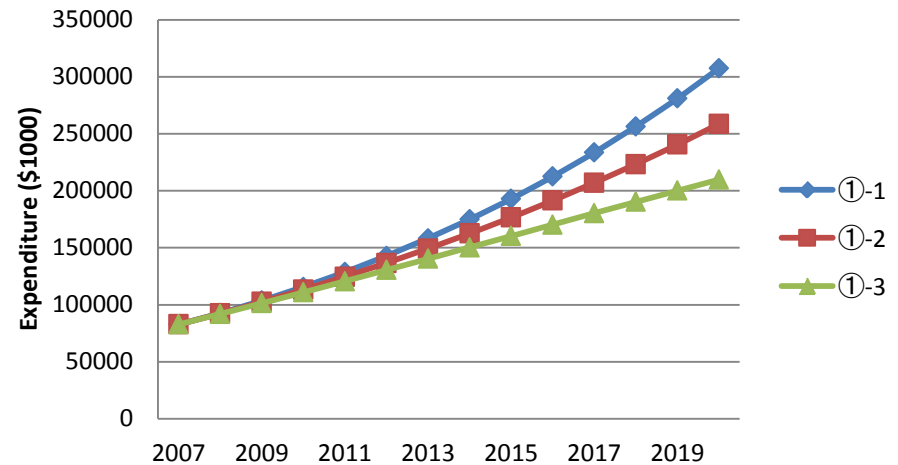
• Tax Payment Rate : **12%**

Global Insight(2005)

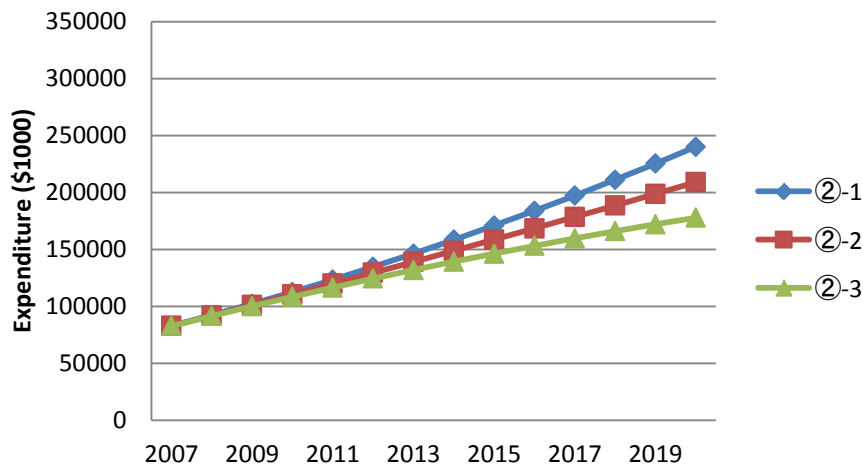
• Tax Payment per capita:
984\$/capita

$$\text{(Tax payment per capita)} = \frac{\text{(Total Tax)} - \text{(Tax by Tourist)}}{\text{Population}}$$

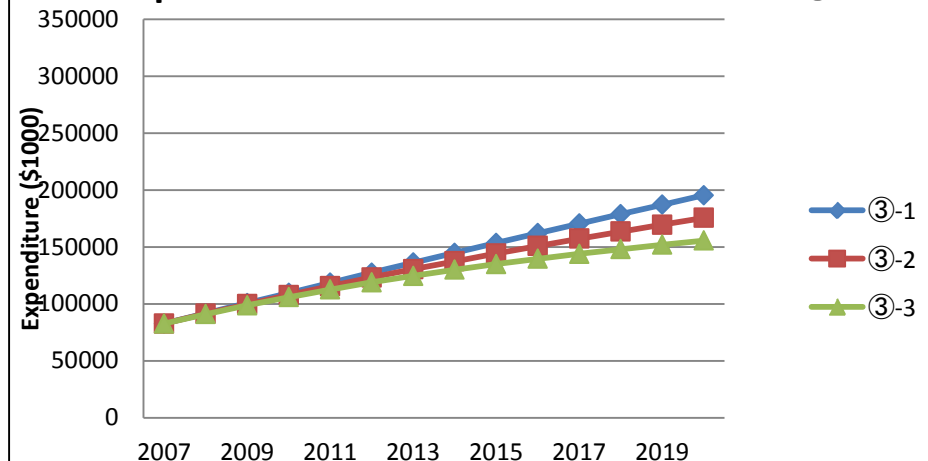
Expenditure of Government: scenario ①



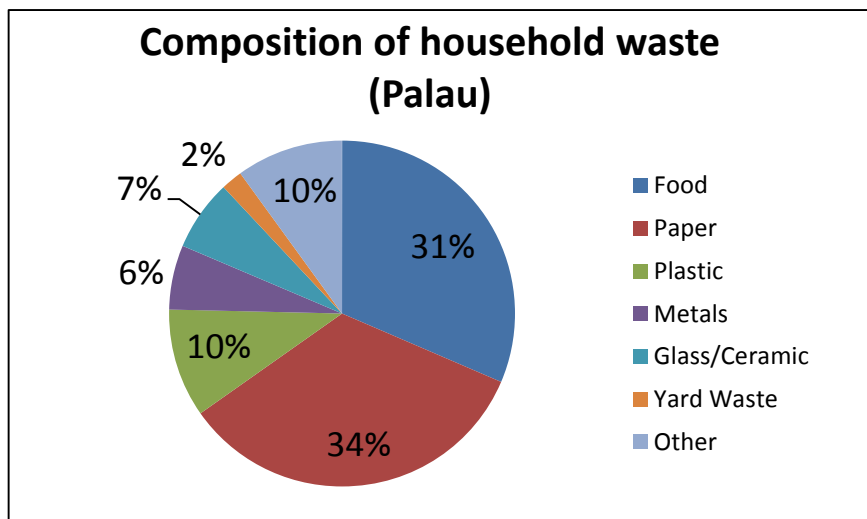
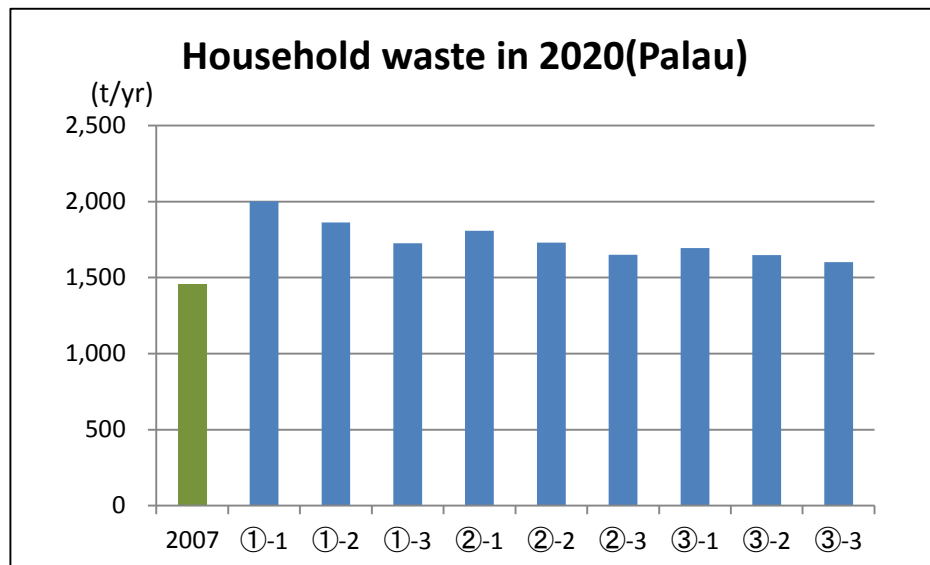
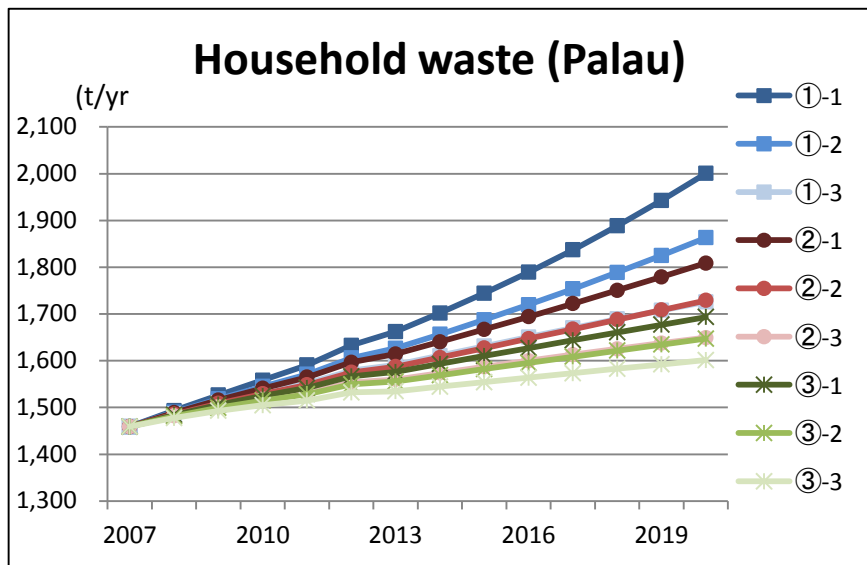
Expenditure of Government: scenario ②



Expenditure of Government : scenario ③



Result of Future Household Waste



◆ Waste generation

2007	1,459t
① Increase	2,000t
② Stable	1,729t
③ Decrease	1,601t

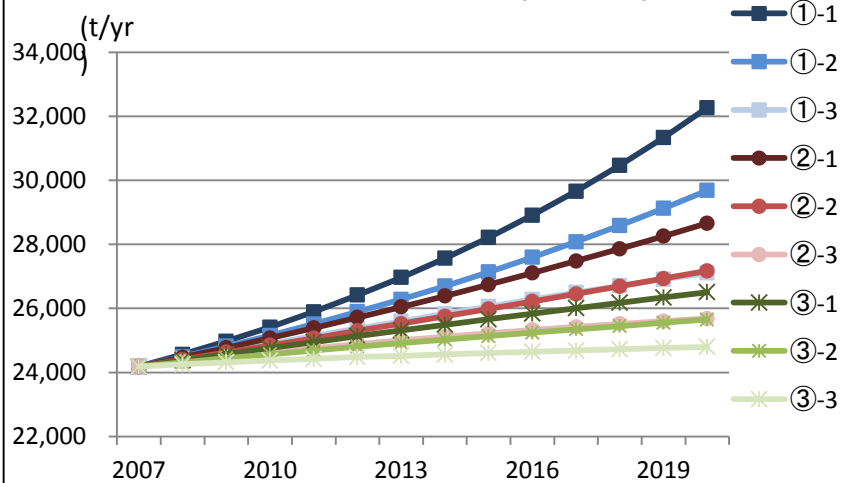
← 1.37 times
← 1.19 times
← 1.10 times

◆ Composition

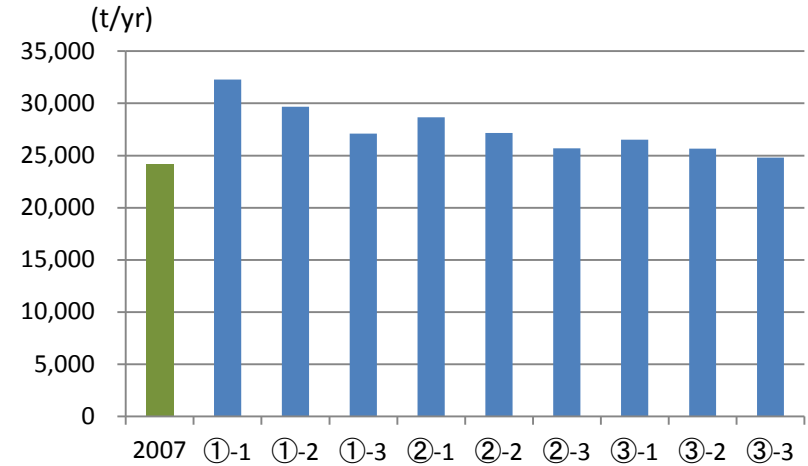
Paper and Food occupy high percentages

Result of Future Business waste

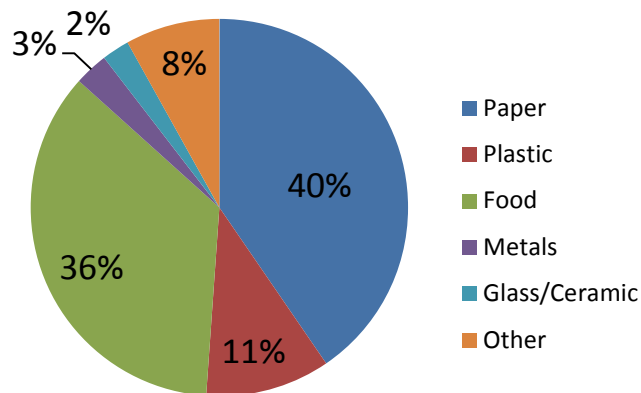
Business waste(Palau)



Business waste in 2020(Palau)



Composition of Business waste(Palau)



◆ Waste generation

2007	24,182t	
① Increase	32,269t	1.33 times
② Stable	27,172t	1.12 times
③ Decrease	24,797t	1.03 times

◆ Composition

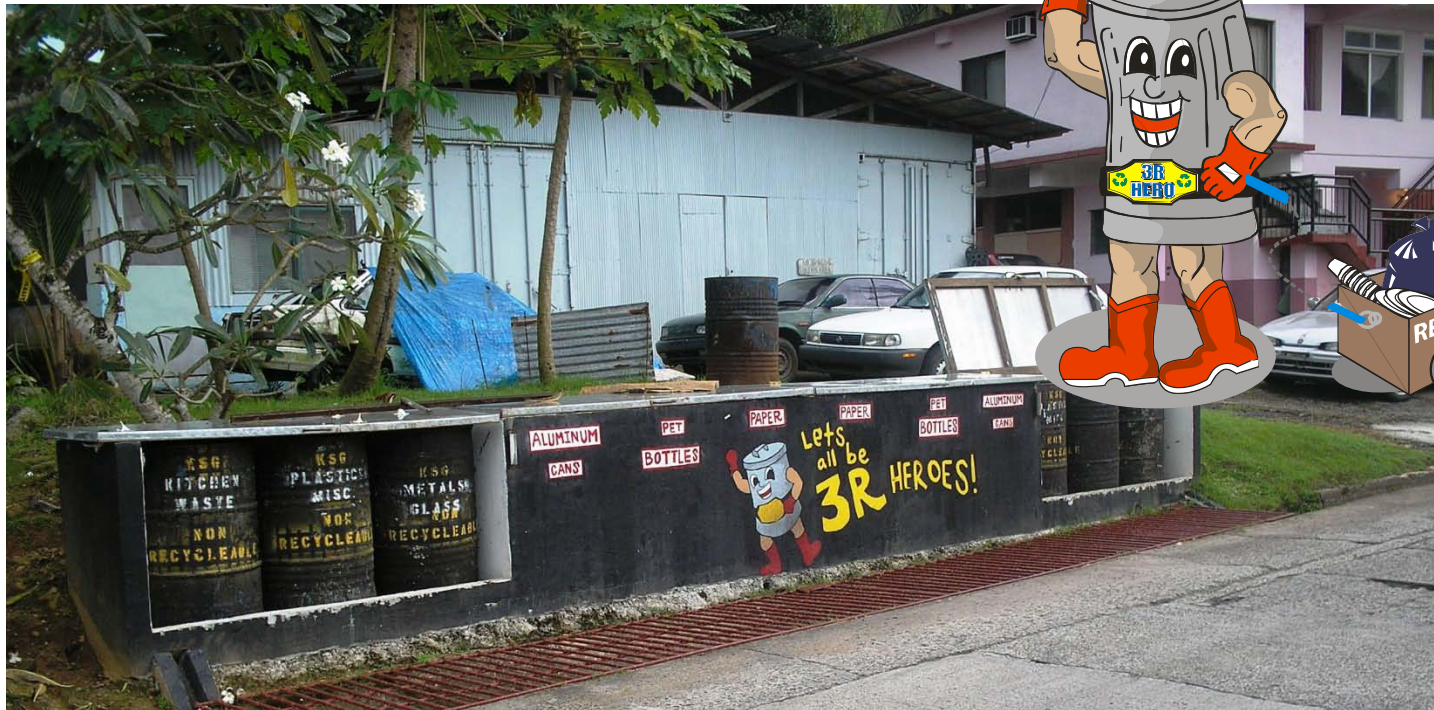
Paper and Food occupy high percentages

Conclusion

- Questionnaire survey to household and business: the composition of these waste were cleared.
- Future waste generation effected by tourists were calculated

Contents

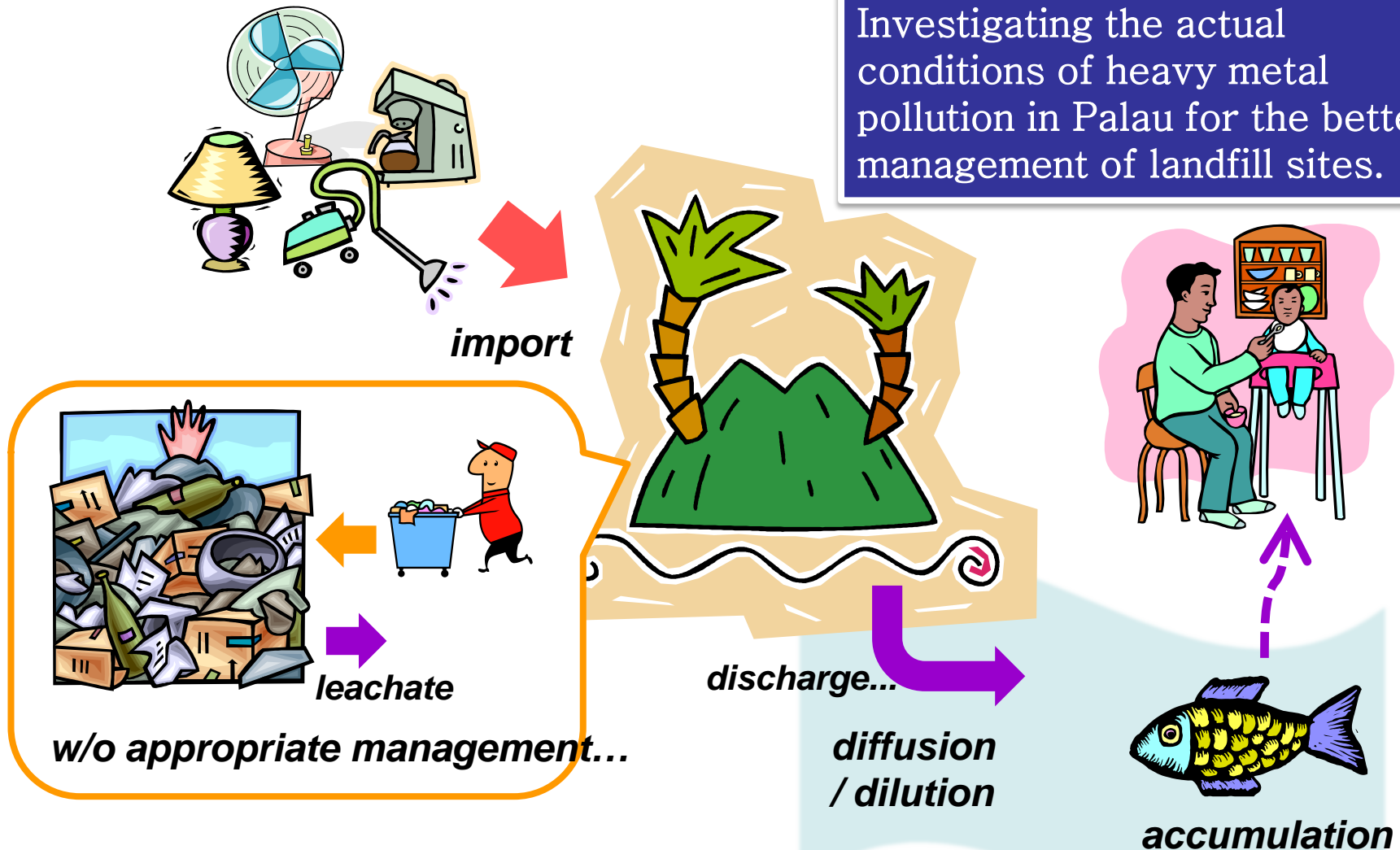
- Japan-Palau Seminar
- Study on Solid Waste
- Study on Leachate Water



Study on Leachate Water

【 Objective 】

Investigating the actual conditions of heavy metal pollution in Palau for the better management of landfill sites.

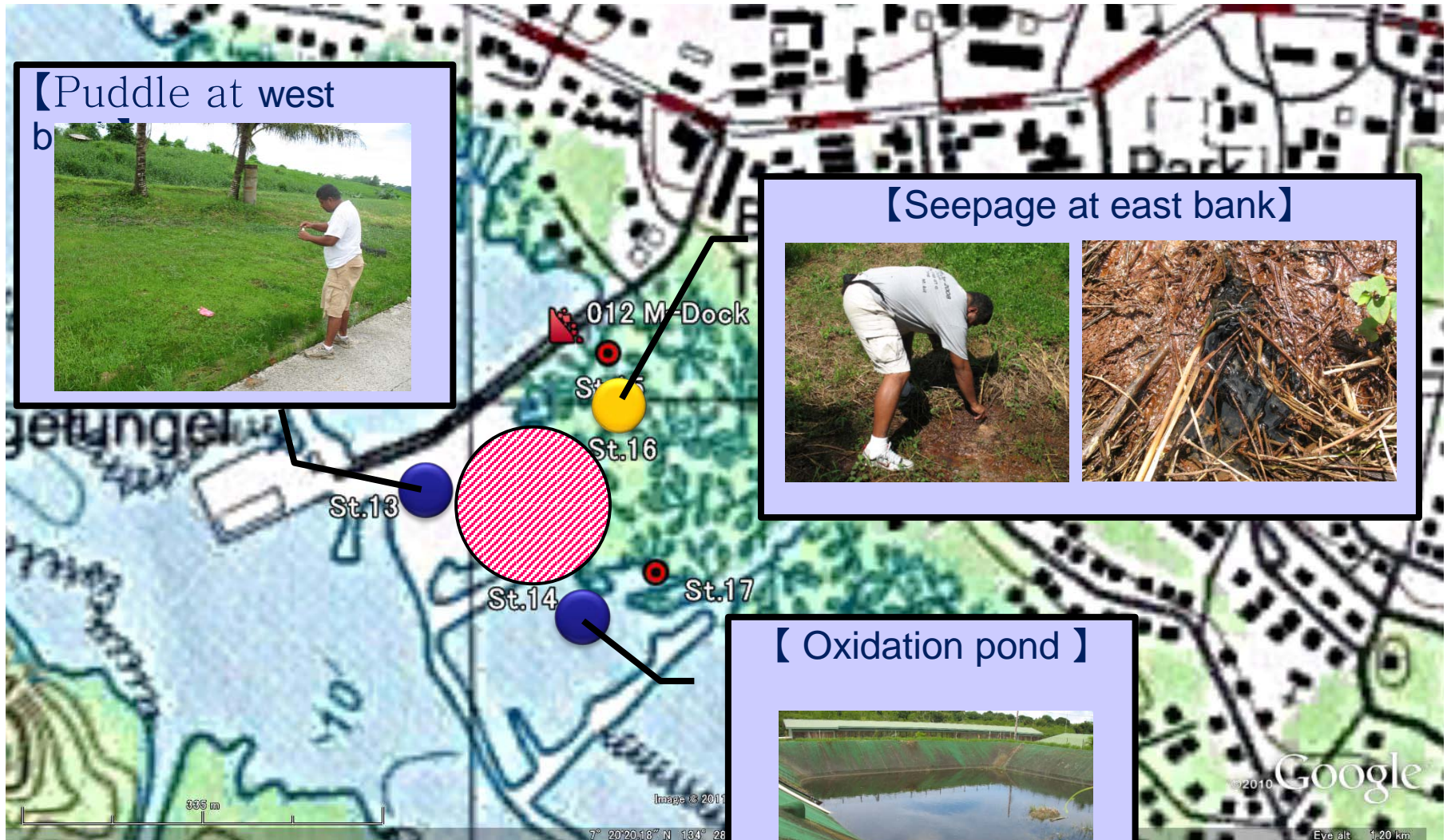


Water quality survey in Palau

- Date
 - August 10-12, January 8
- Site
 - Dumping site in Airai state and its downstream area
 - Dumping site in Koror state (M-Dock) and its periphery
- Water quality items
 - pH, EC, ORP, TOC, P, and 22 metals



Sampling points



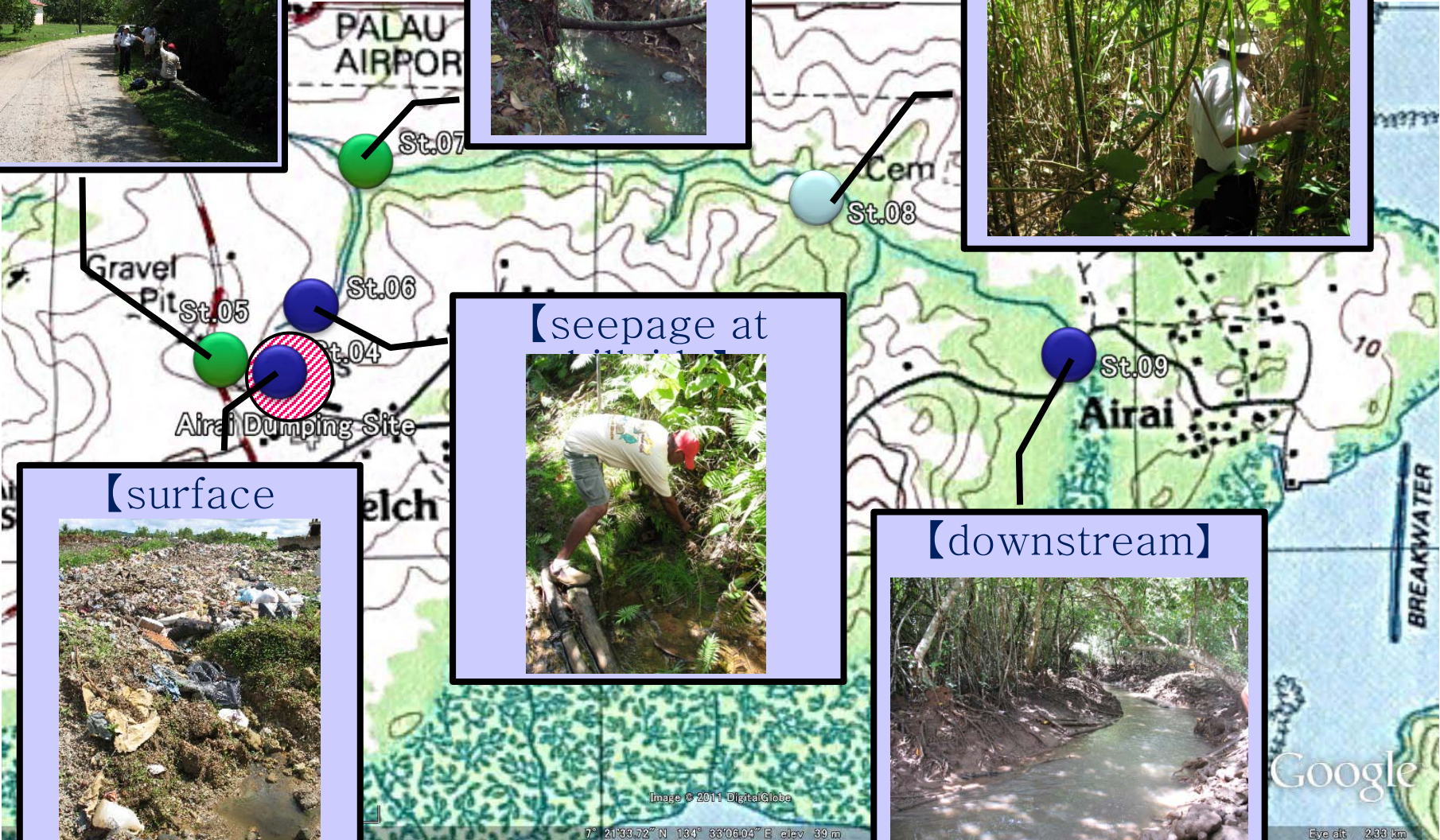
【upstream】



【downstream】



【downstream】



【seepage at】



【surface】



【downstream】



- As for the water quality indices measured in this research, pollution issued from dumping solid wastes seems not critical at this moment in Palau.

← Possible reasons:

- Household waste (esp. plastics) is the dominant.
 - Lifetime of home appliances are rather long.
 - There are no heavy or chemical industries.
- Note: At some points, leachate came out of the landfill sites. Attention should be paid for the leachate.



Conclusions of the project





Thank you for your kind attention !