Visualization of Questionnaire-based Person Trip and its Analysis

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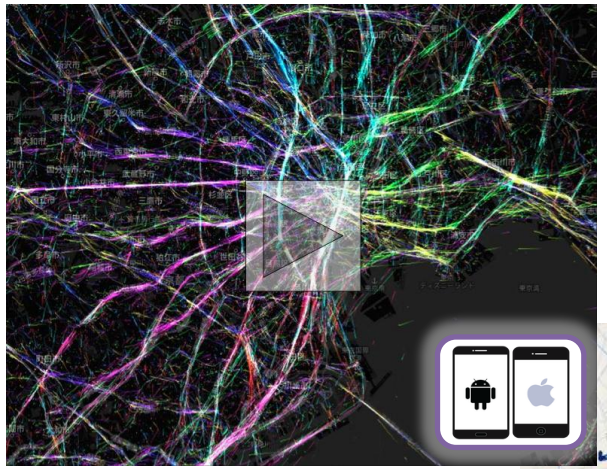
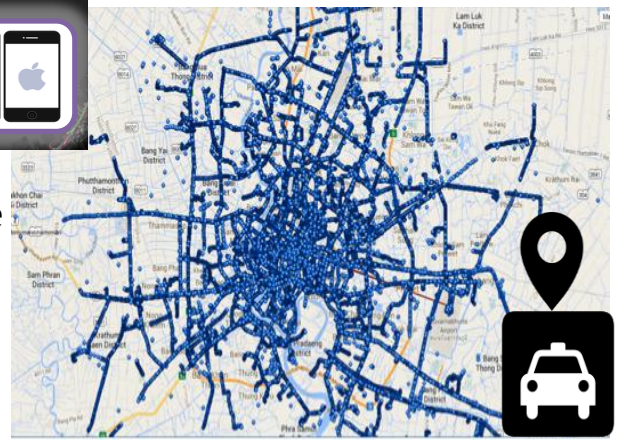
Introduction

Due to the development of ITC, dynamic personal movements have been studied by tracking taxi and mobile phone data.

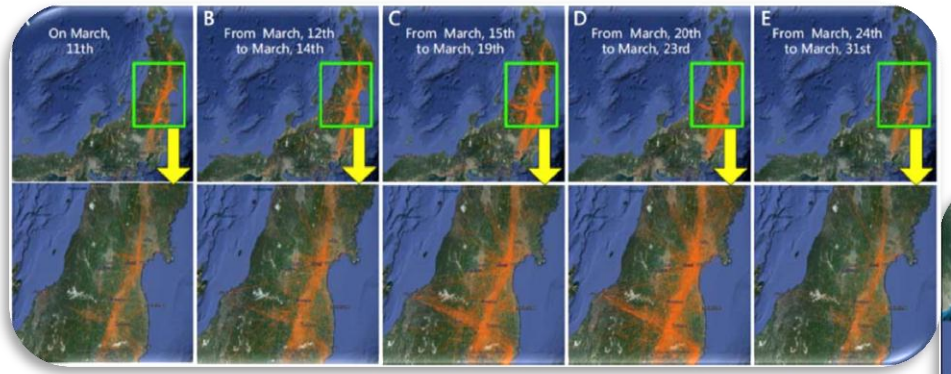


Big data of people flow in Tokyo during the East Japan Earthquake
Source: The Univ. of Tokyo



Big GPS data visualization by taxi probe in Bangkok *Source: Rangit (2014)*

The level of use and number of mobile phones users are increasing, analyzing the individual trip behavior using mobile phone can be a powerful tool to capture a human behavior and provide useful information.



The discovered evacuations in Fukushima, Miyagi and Iwate Prefectures, *Source: The Univ. of Tokyo*

Evacuation destinations by CDR data during Thai Mega Flood, *Source: The Univ. of Tokyo*

Introduction (cont.)

- The Greater Mekong Sub-region Economic Corporation Program (GMS-ECP) facilitated the market-liberal policies which provide excellent opportunities to develop various sectors in South East Asia.

- These developments restructure life style and behavior of local people.

- Information of person trip would be very useful to assess socio-economic and environment impacts from such developments even in South East Asia.

Problem statement

1. Distribution of mobile phones in rural areas in the developing courtiers is very few.

1. Even though person trips are supposed to be changed along with various environmental changes such as rapid increase of foreign investments, infrastructure and land cover change, changes of trip patterns in the least developing countries such as Myanmar can not be traced due to non existence of established methods, lack of existence of secondary data and its distrusted reliability .

1. Traditional transportation analysis tool is unable to assess diverse person trip at large scale.

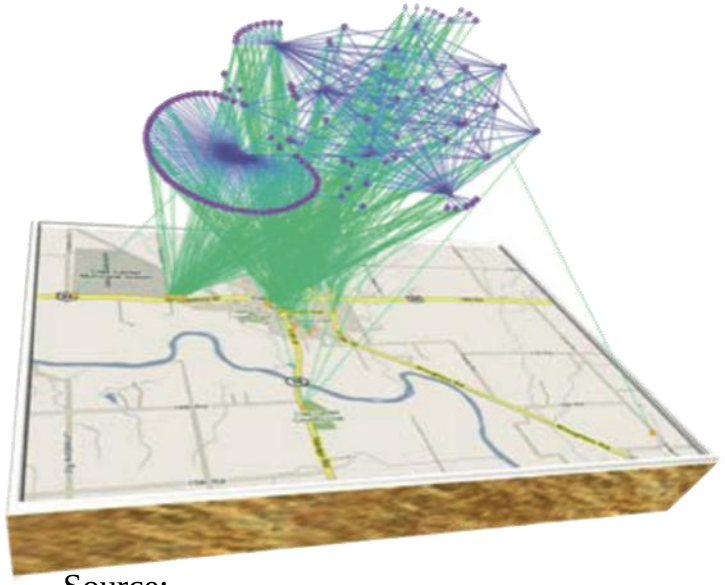
Research objectives

General Objective

To study the person trip pattern and its monitoring and analysis method

Specific Objectives;

1. To visualize questionnaire-based person trip patterns
1. To validate the questionnaire-based person trip data by applying GPS loggers
1. To assess the change of person trip in 2005, 2010 and 2015



Source: http://www.nature.com/srep/2012/120905/srep00632/fig_tab/srep00632_F8.html

Overview of research methodology

Objective 1

Questionnaire survey data Visualization

Questionnaire survey data

2005

2010

2015

Objective 2

GPS data

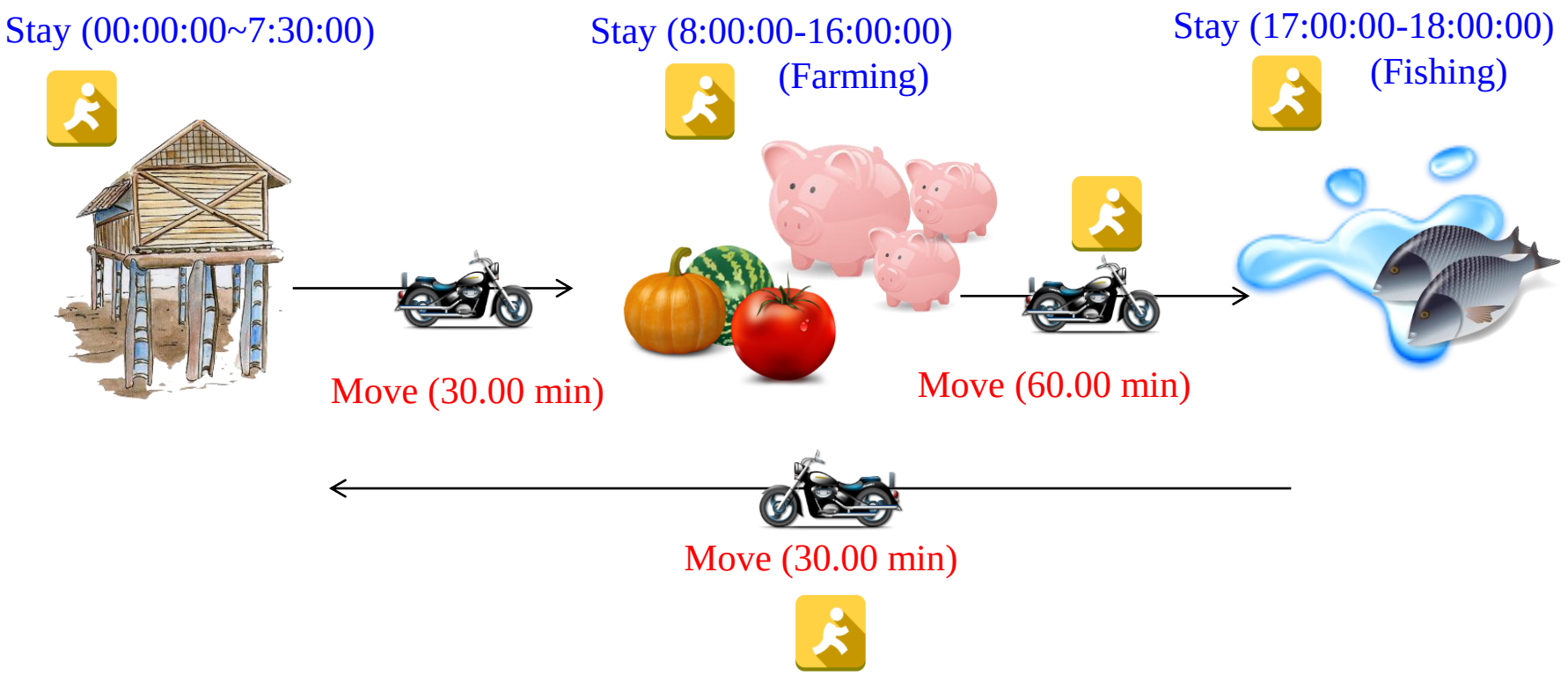
Accuracy assessment

Objective 3

Analyze person trip behavior in time-series

What is person trip?

- Identifying origin, destination, purpose, trip mode and time.
- Person trip survey in the developing country, where mobile phones are not well distributed, will help tracking local villagers' trip patterns.



Survey design

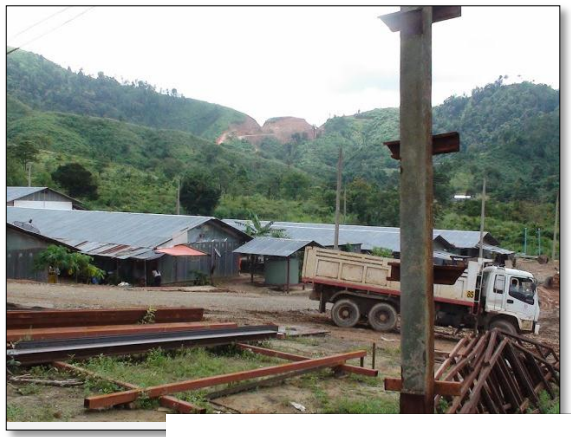
- Study area: Dawei, Myanmar
- Survey duration: 7 Mar- 3 April 2015
- Methods: Questionnaire survey with a GPS and 38 GPS loggers
- Sample size: 345 of which 331 were available for further analysis

Questionnaire survey

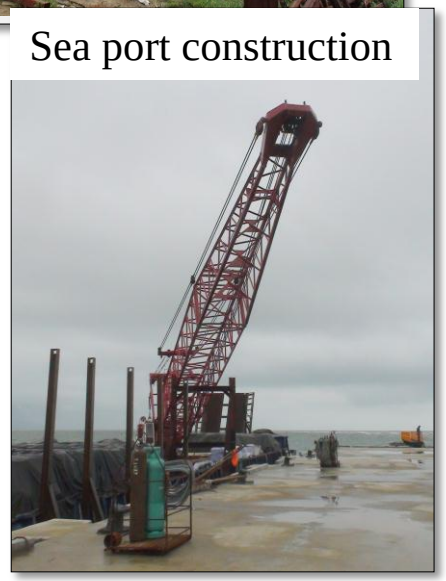
- Individual profile: age, sex, ethnic, marriage status, head of HH, occupation, HH income etc.
- Acquired Person trip information with spatial information (e.g. trip origin, destination, direction, distance, trip tool, activities, and time) in 2005, 2010 and 2015

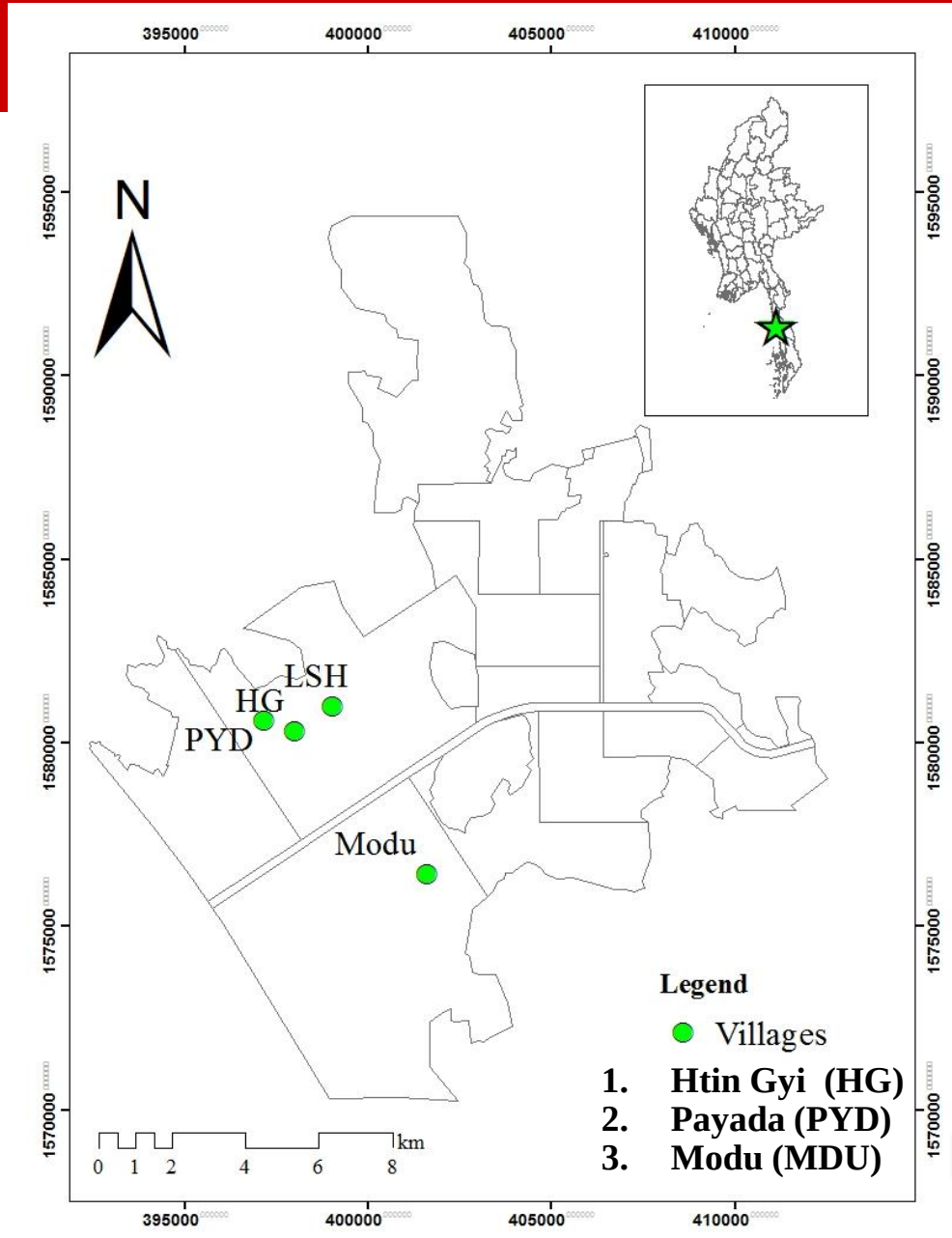
Study area

Road infrastructure construction



Sea port construction



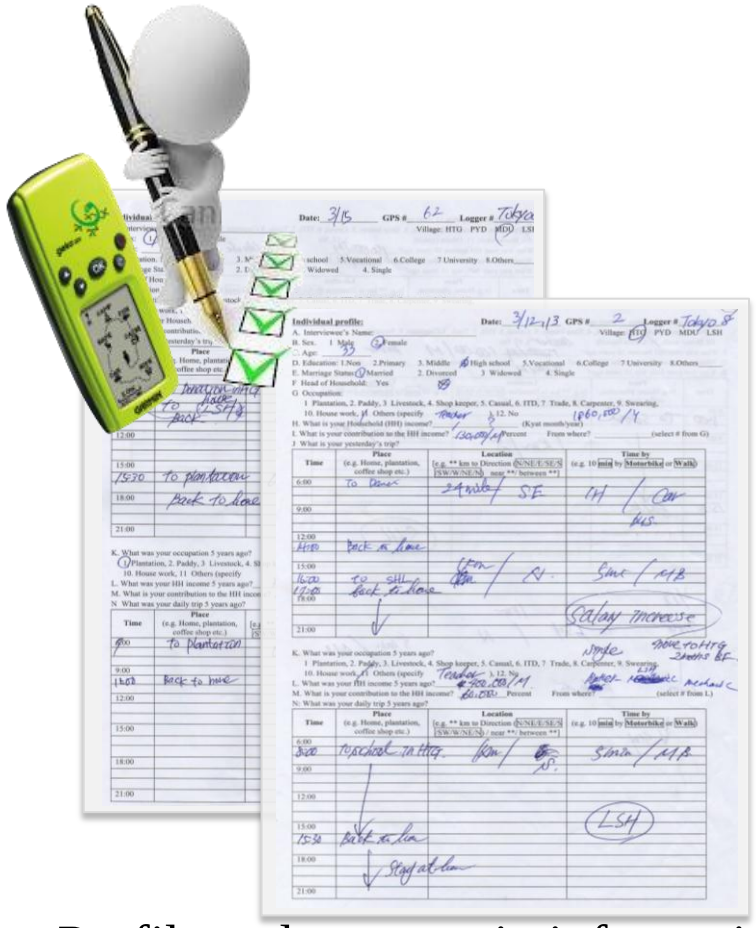


1 HTG

2 PYD

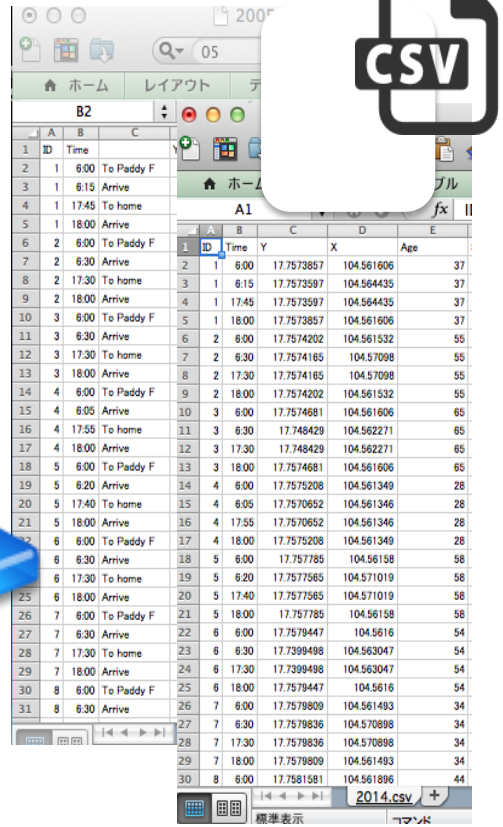
3 MDU

Conversion of person trip information to the spatial information



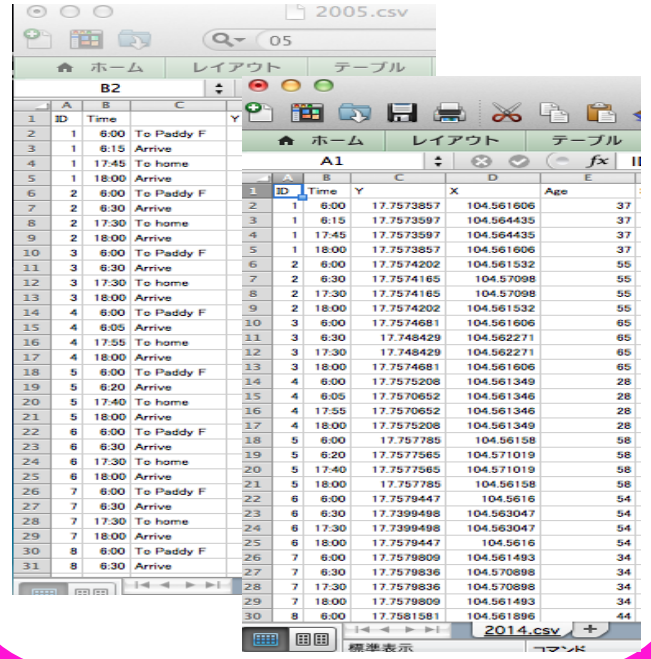
Profile and person trip information in 2015, 2010, 2005

ID	Time	Y	X
4	7:00	14.29038889	98.05444305
4	7:15	14.29038403	98.08433817
4	10:45	14.29038403	98.08433817
4	11:30	14.29038889	98.05444305
4	13:30	14.29038889	98.05444305
4	13:45	14.29038403	98.08433817
4	16:45	14.29038403	98.08433817
4	17:00	14.29038889	98.05444305



Visualization of person trip

Spatial Information



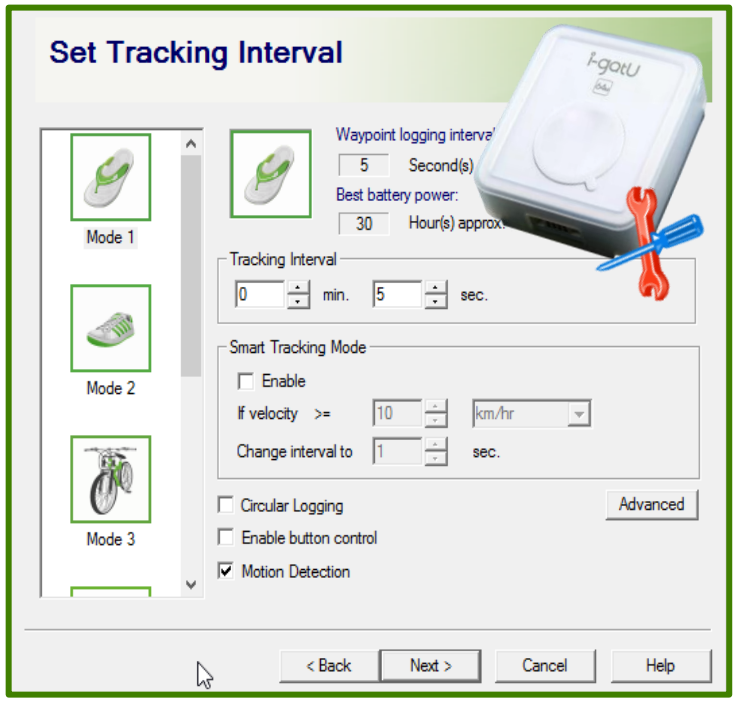
Non-spatial Information

Visualization tool

Source: The Univ. of Tokyo

Validation of Questionnaire-based person trip

Application of GPS loggers



GPS Logger : IgatU GT 600
Quantity : 38
Recording interval: 5 seconds

Sample size: 345

Data processing of the obtained data from GPS loggers

- **Stay Point Detection:**

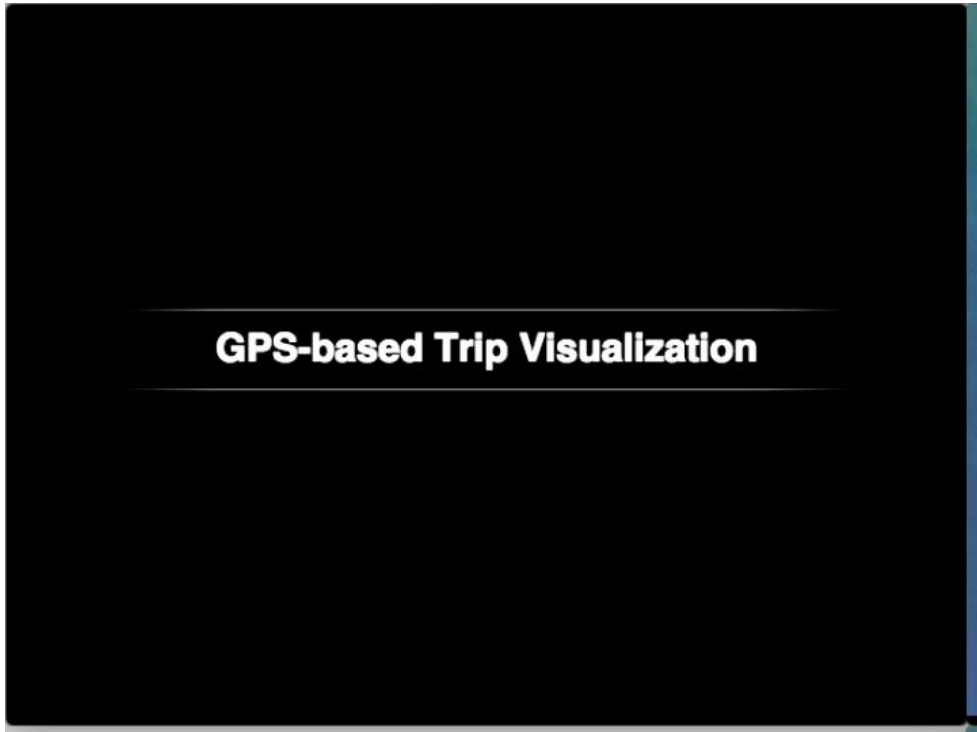
Distance (p_{start}, p_{end}) < D_{threh} and TimeDiff (p_{start}, p_{end}) > T_{threh}
Where T_{threh} > 20 minutes and D_{threh} <= 300 meters

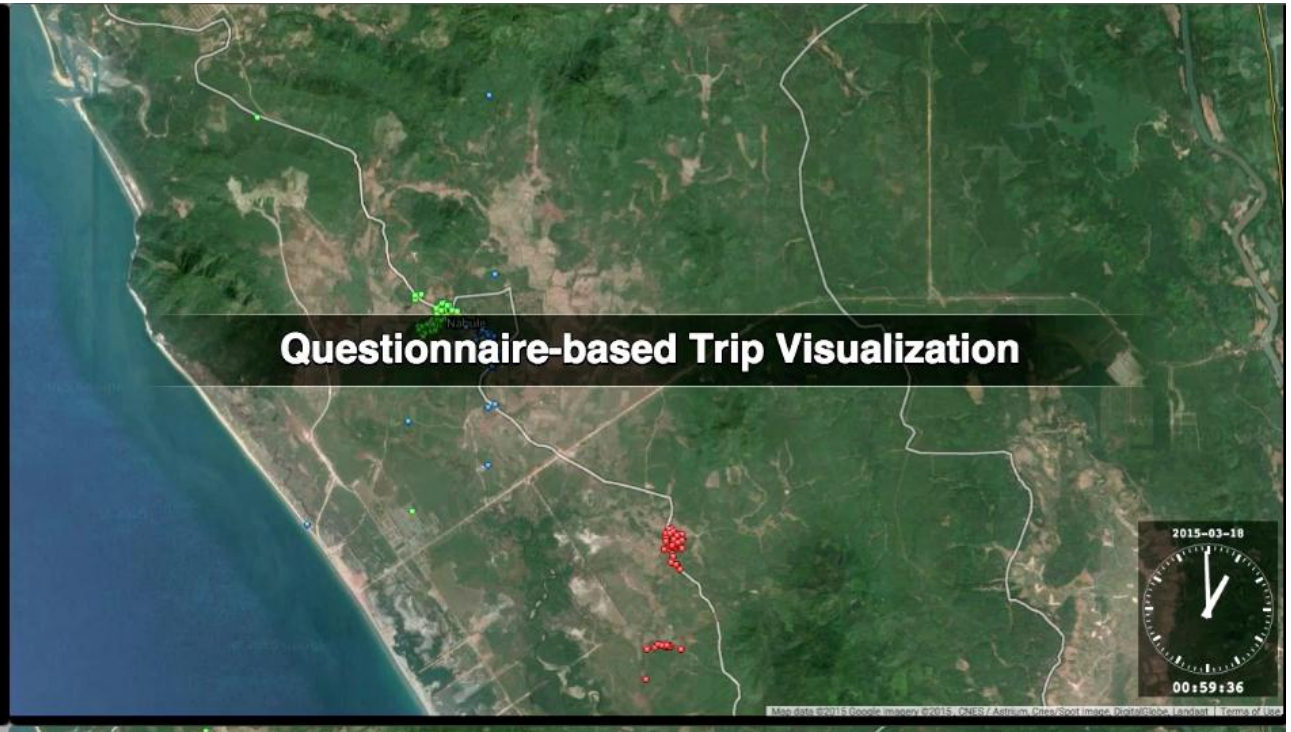
- **Difference Calculation:**

Relative Change (x, y) = Absolute difference/ Max (x, y)*100
= $|\Delta|$/ Max (x, y)*100
Where x is the data from questionnaire and y is the data from the GPS logger.

* Considerable respondents from a total of 331 is
- 331 samples in 2015
- 241 samples in 2010
- 250 samples in 2005

Result 1: Visualization of GPS logger-based person trip





Whole area

Zoom in to the study villages

Date: 2015/03/18
Time: 00:00-24:00
# of sample: 335

HG
PYD
MDU

Result 2: Validation of data from questionnaire

Avg. difference of two data

	Avg. differences (%)
(A) No. of Person Trip	25.3
(B) Trip Distance (km)	34.86
(C) Trip Time (min)	38.03

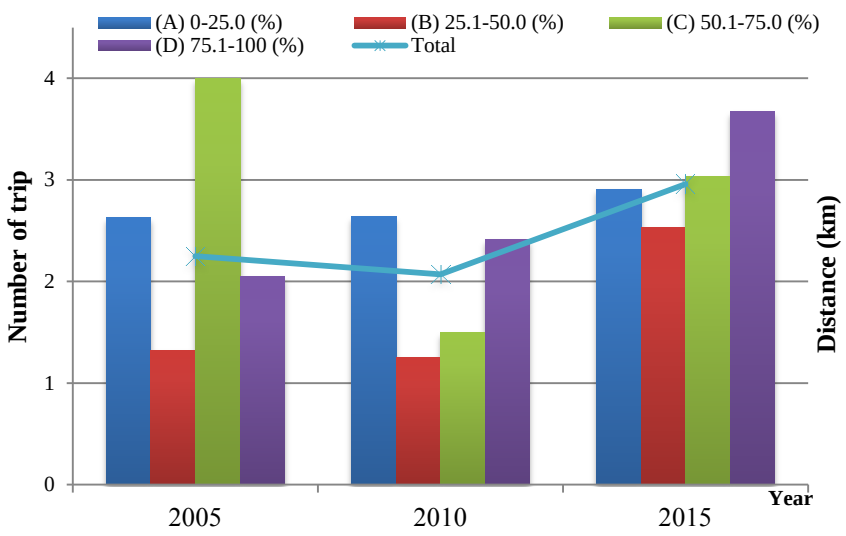
Average number of person trip, trip distance and trip time by year

	2005	2010	2015
(A) No. of Person Trip	2.25	2.07	2.96
(B) Trip Distance (km)	2.26	4.38	9.18
(C) Trip Time (min)	40.62	58.37	46.00

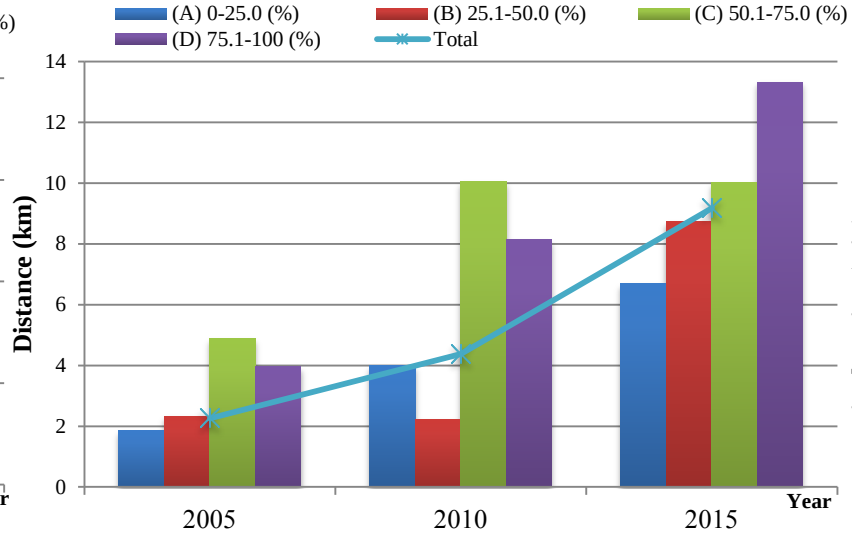
Identified causing factors

- **Human error:**
  Short trips and exact trip routes tend to be under reported among the respondents.
  Staying more than 20 minutes on the way to a destination were not counted as a trip by respondents due to unimportance.
- **Data processing error:**
  Short trips ranging less than 300 meter more than 20 minutes and short stays on the way to the next destination during trips were not counted.

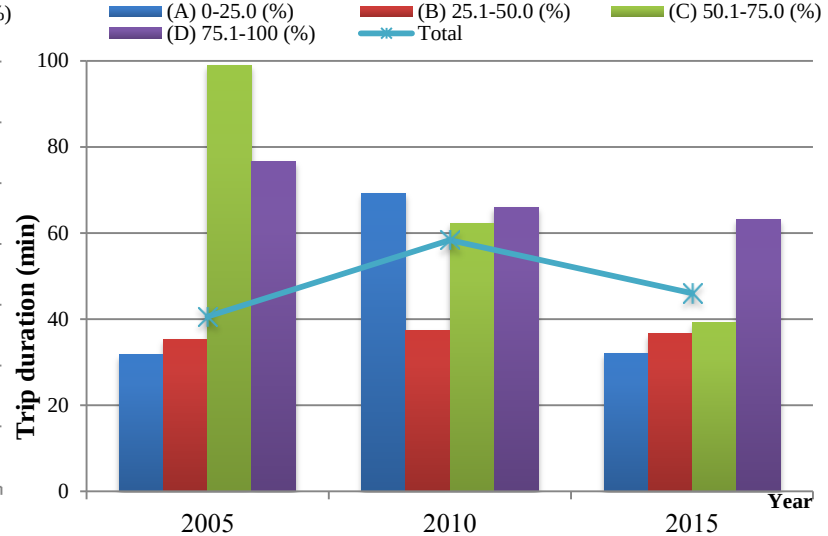
Result 3: Trends of Trip Behavior by Household Income Contribution



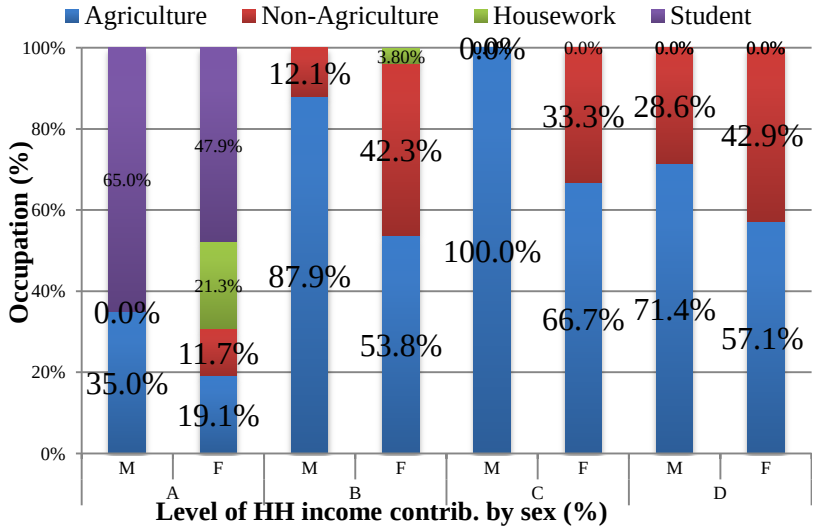
Avg. number of trip and HH income contrib. by year



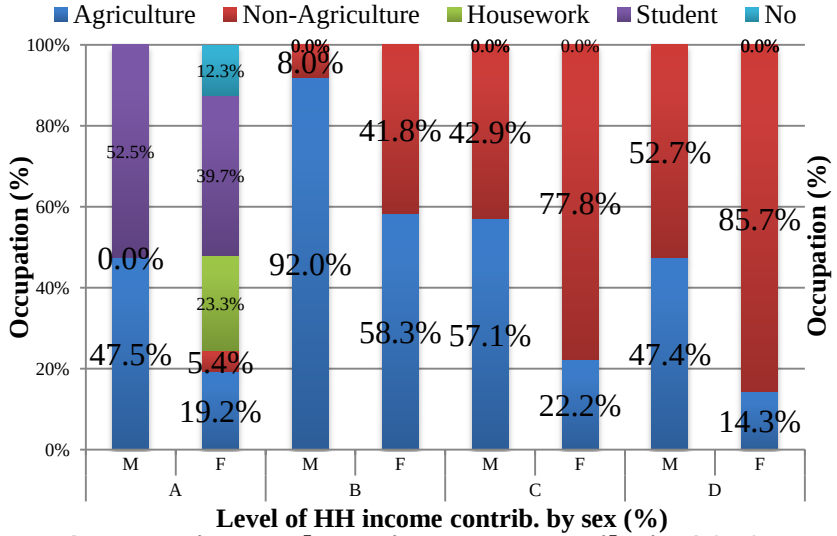
Avg. trip distance and HH income contrib. by year



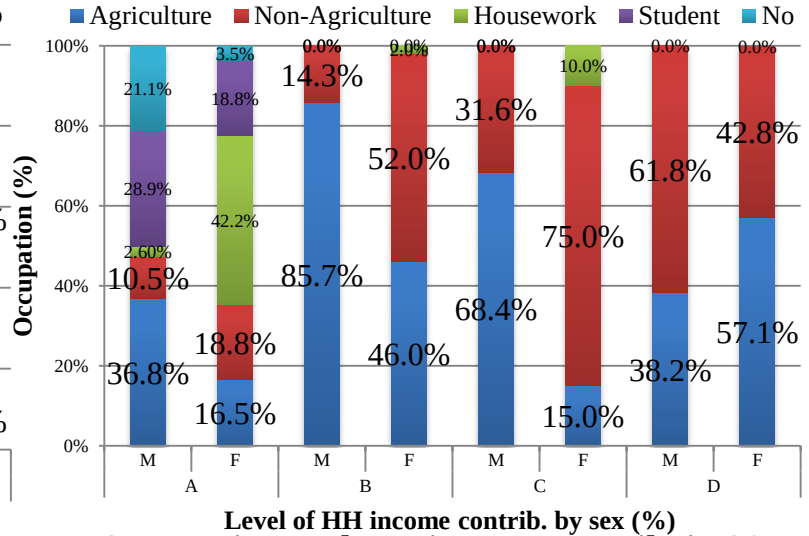
Avg. trip duration and HH income contrib. by year



Occupation and HH income contrib. in 2005



Occupation and HH income contrib. in 2010



Occupation and HH income contrib. in 2015

Result 3: Trip mode by HH income contribution level by year

Trip mode by HH income contribution in

2005

Income contrib. (%)	Stay	Walk	BC	MB
(A) 0-25.0	25.4 (23.1)	63.4 (44.8)	3.7 (0.8)	7.5 (0.8)
(B) 25.1-50.0	47.5 (27.1)	44.1 (15.3)	1.7 (1.7)	6.8 (0)
(C) 50.1-75.0	0.0 (0)	87.5 (37.5)	12.5 (0)	0.0 (0)
(D) 75.1-100	23.8 (4.8)	57.1 (28.6)	0.0 (0)	19.0 (0)
Total	30.2 (22.1)	58.6 (35.1)	3.2 (0.9)	8.1 (0.5)

2010

Income contrib. (%)	Stay	Walk	BC	MB	Others
(A) 0-25.0	23.0 (22.1)	49.6 (27.4)	15.9 (9.7)	8.0 (2.7)	3.6 (2.6)
(B) 25.1-50.0	50.8 (36.1)	31.1 (16.4)	0.0 (0)	18.0 (6.6)	0.0 (0)
(C) 50.1-75.0	43.8 (43.8)	31.3 (12.5)	0.0 (0)	25.0 (0)	0.0 (0)
(D) 75.1-100	14.8 (3.7)	48.1 (22.2)	0.0 (0)	37.0 (3.7)	0.0 (0)
Total	31.3 (25.4)	42.9 (22.6)	8.3 (5.1)	15.7 (3.7)	1.9 (1.4)

2015

Income contrib. (%)	Stay	Walk	BC	MB	Car	Others
(A) 0-25.0	25.0 (21.8)	33.3 (25.8)	0.8 (0)	38.6 (18.9)	1.5 (0.8)	0.8 (0)
(B) 25.1-50.0	17.8 (16.7)	27.8 (16.7)	1.1 (0)	52.2 (22.2)	1.1 (1.1)	0.0 (0)
(C) 50.1-75.0	23.1 (23.1)	17.9 (10.3)	5.1 (2.6)	53.8 (15.4)	0.0 (0)	0.0 (0)
(D) 75.1-100	8.2 (3.2)	29.5 (21.0)	0.0 (0)	59.0 (14.5)	3.3 (0)	0.0 (0)
Total	19.6 (18.2)	29.2 (21.9)	1.2 (0.3)	48.2 (19.8)	1.6 (0.7)	0.3 (0)

- Change of major trip mode: especially the major shift of trip mode from walk to vehicle among females from 2010 to 2015 shows the increase of (A) 7.17, (B) 3.39, (C) N/A, and (D) 3.92 times.
- In this study, changing trip can be explained by increase of vehicle ownership, increased of female driver and employee work engagement and is consistent with the case reported by [16] in Tamil Nadu, India where increase in vehicle ownership (both two-wheelers and car), the number of employee and increase of female driver has resulted into increasing driving travel demand.

Conclusion

- Questionnaire-based trip data were visualized and the trip data were validated by employing GPS loggers.
- Average differences between the two data in average number of person trip, trip distance and trip time were found as 25.3, 34.86, 38.03 respectively.
- The trends from 2005 to 2015 were examined and large increase of trip distance was found due to change of mode from walk to motorbike especially among female increasing the amount of household contribution.
- Quantitative measurement associated with survey questionnaire is an alternative tool to validate data reliability and help tracing dynamic changes of person trip by socio-economic status in areas where data availability is extremely limited.
- With along to urbanization resulted from rapid economic growth in Asia, exploring trends of these trip changes associated to the rate of urbanization by focusing socio-economic diversity in the society, enables researchers and decision makers to conduct future assessment that would be crucial in making informed decision on appropriate transportation design and management for sustainable development.

Khob Khun Kha

Thank you