

# Closed-loop supply chain network optimization for Thailand motorcycle industry



Jirapat PHORNPRAPHA  
Graduate school of Science and Technology  
Nihon University



# Background of study

- ▶ Recently, logistics have been increasing rapidly. However logistics network is still not advanced and transportation is still ineffective.
- ▶ In addition, number of the scraped equipment also increased which can be considered as environmental problem.
- ▶ To deal with these problems, Closed-loop supply chain investigation which both forward and reverse logistics are needed.



# Objectives of study

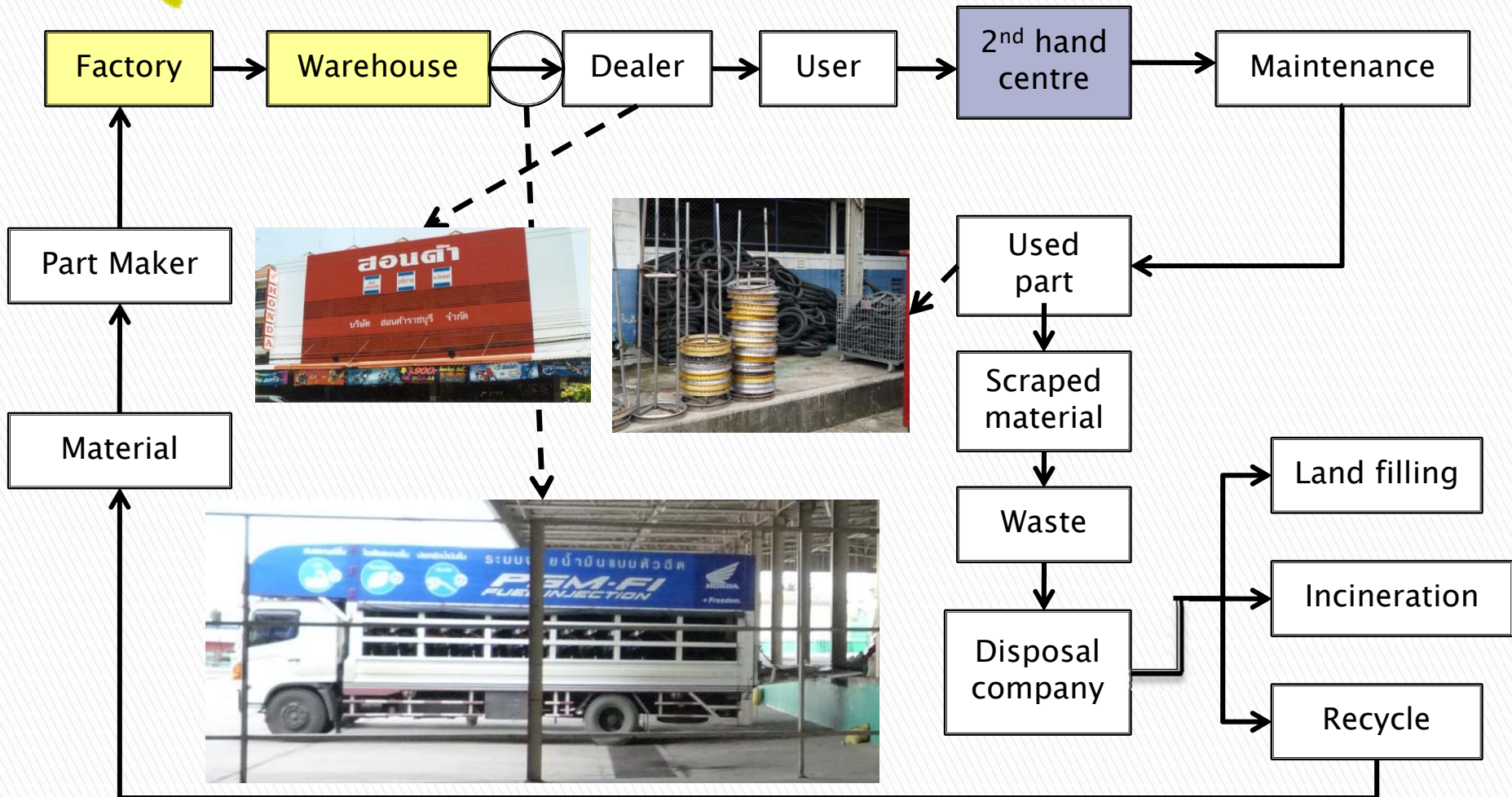
- ▶ In Thailand, there is no much data about logistics which make it difficult to figure out the real current situation.
- ▶ The objective of this study is to propose, the reverse logistics by allocating the facility in the network.



# Current motorcycle transportation in Thailand

- ▶ Recently, the environmental issue has become more concerned, in developed country there is a law that manufacturer must take responsibility to collect the product at the end of life.
- ▶ Japan: Automobile (2002~)、Motorcycles (2004~)
- ▶ EU: (2002~)
- ▶ Korea: 3Rs
- ▶ Thailand: no regulation currently but the tendency is high.

# Current motorcycle transportation in Thailand

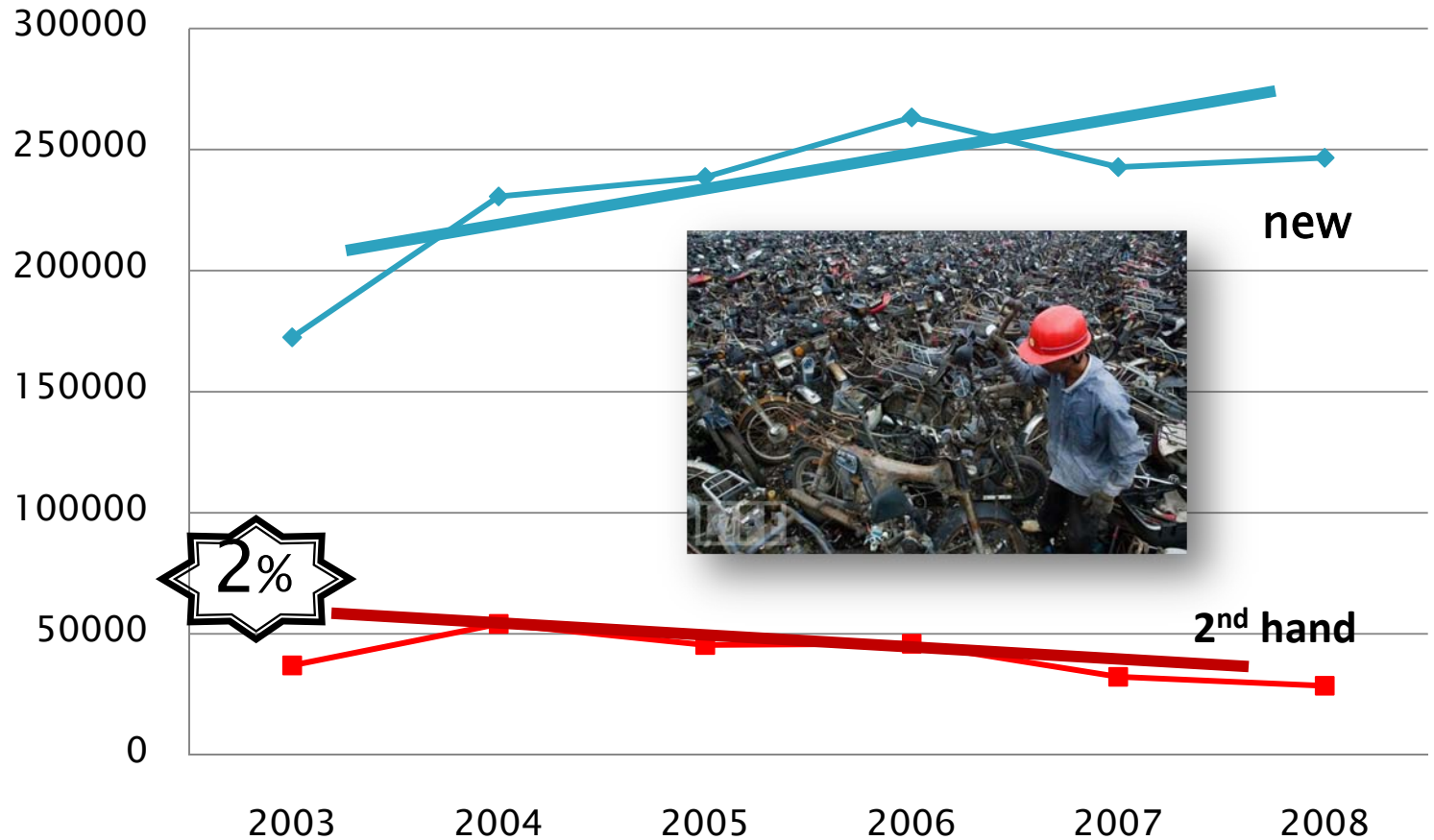






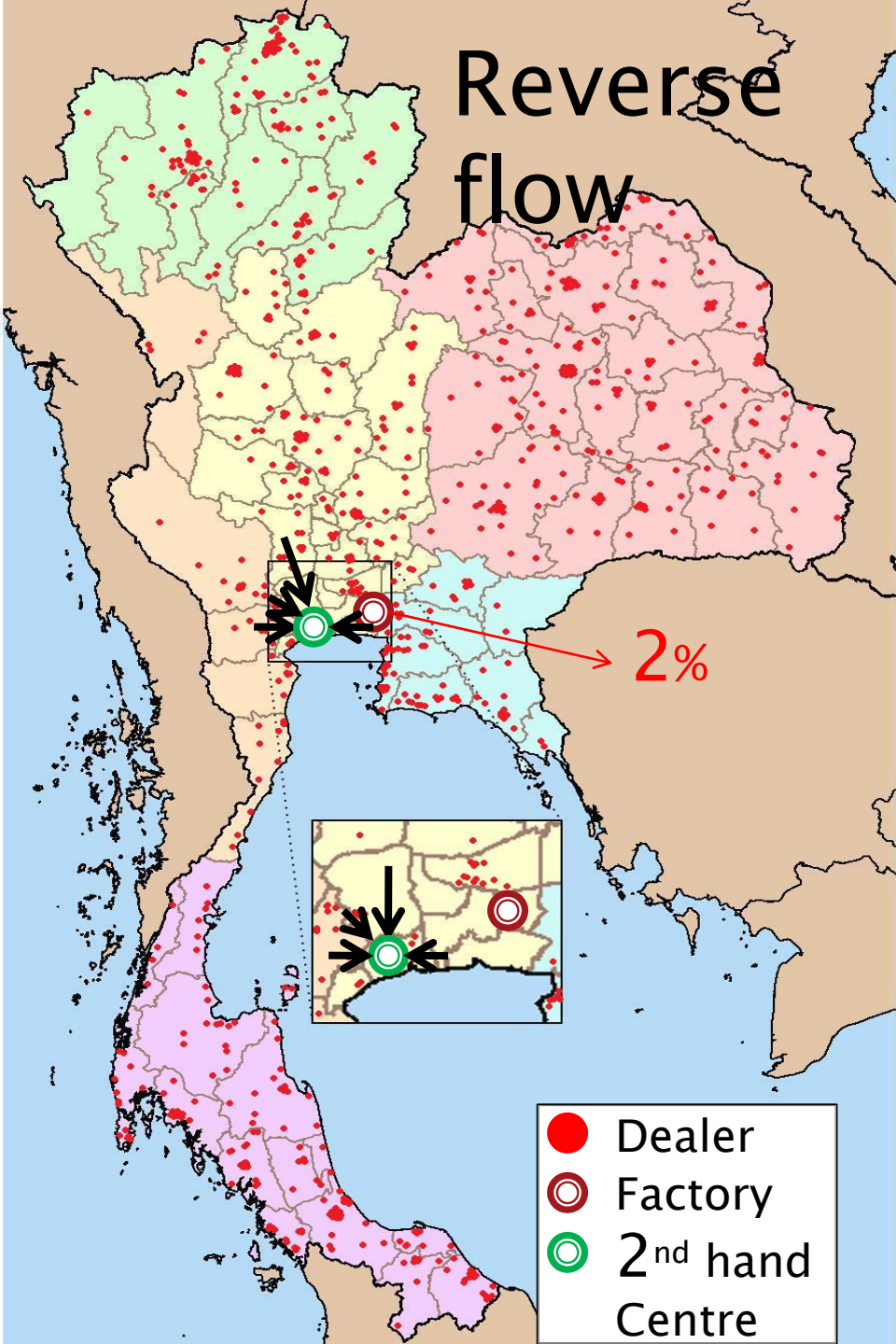
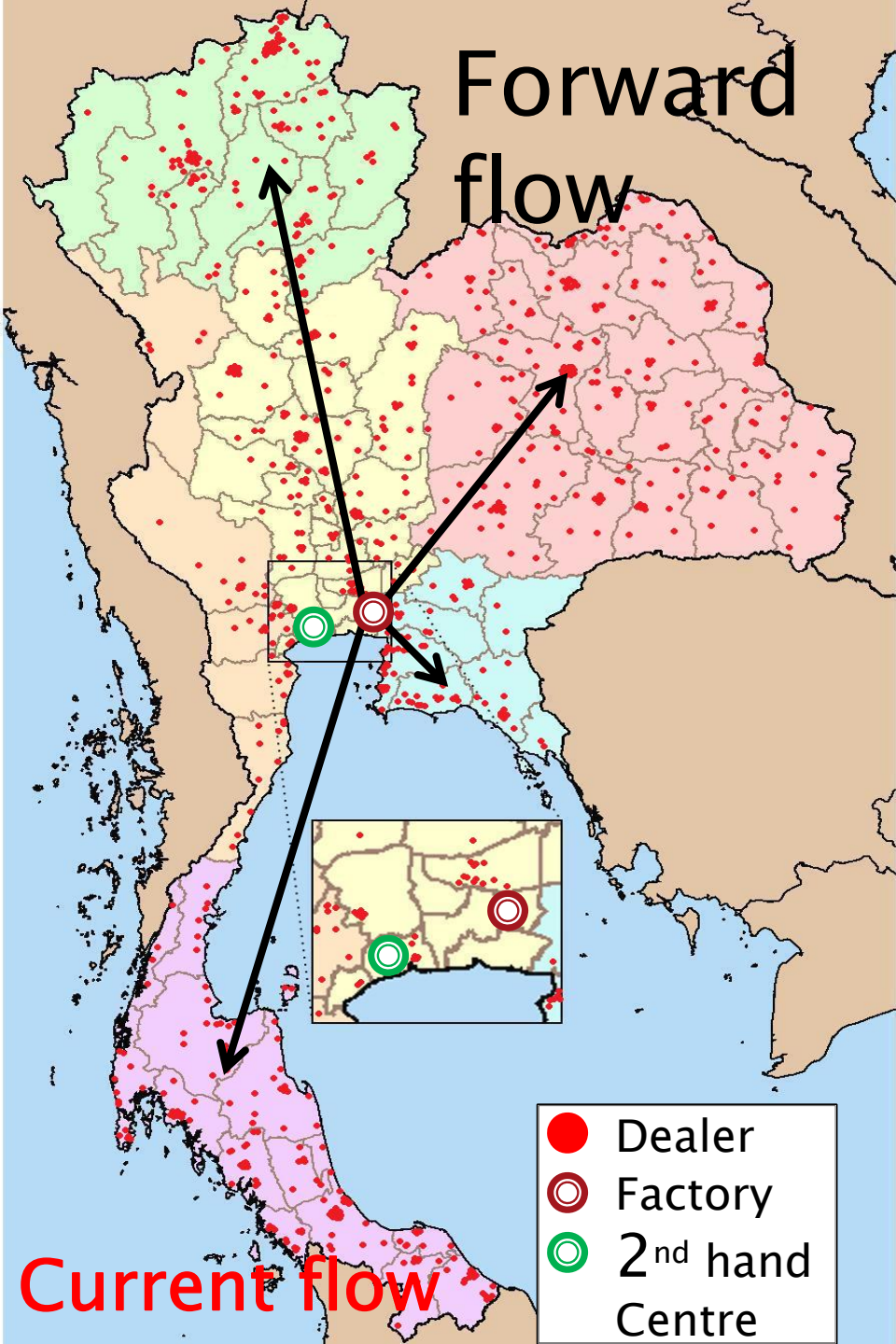
# Current motorcycle transportation in Thailand

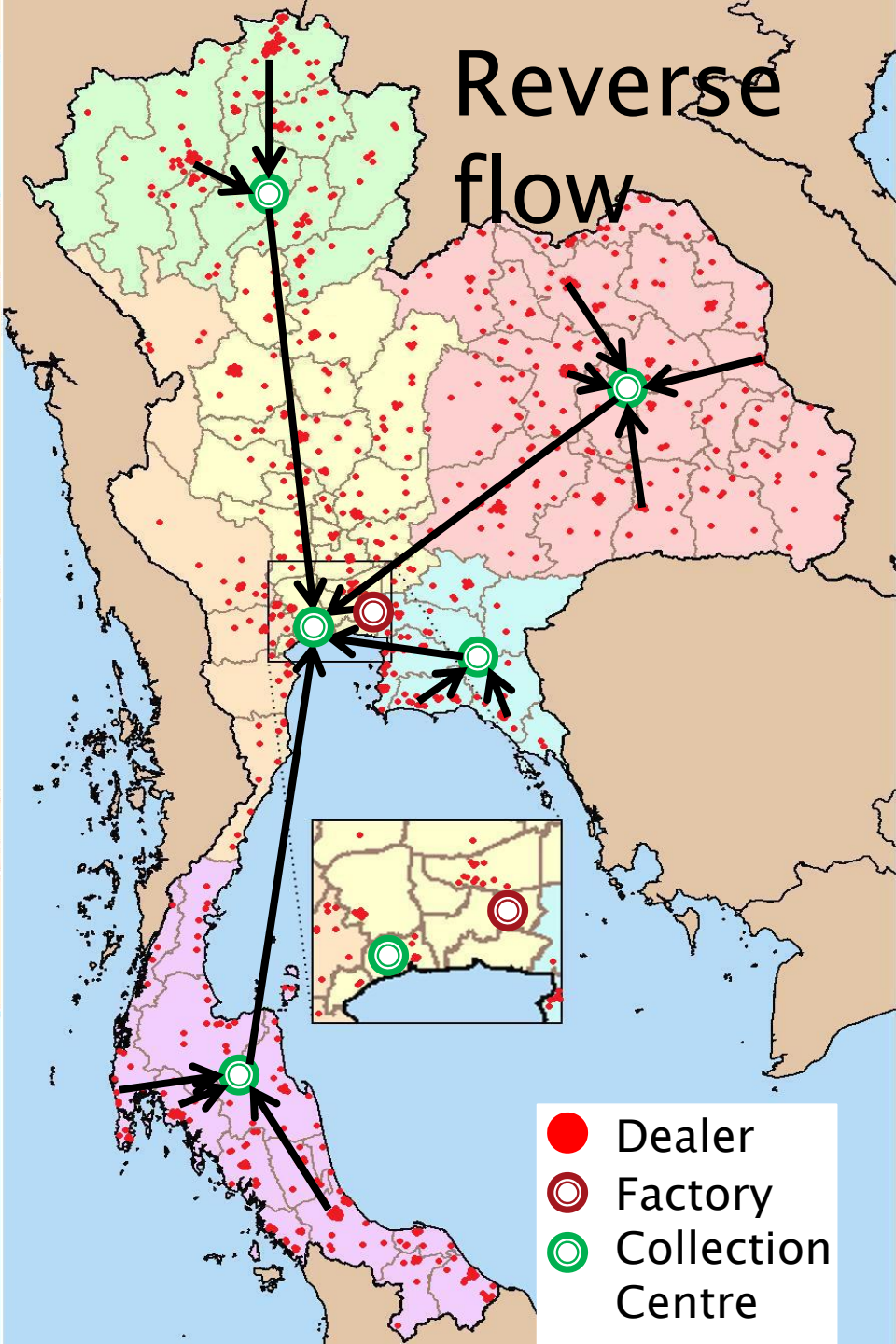
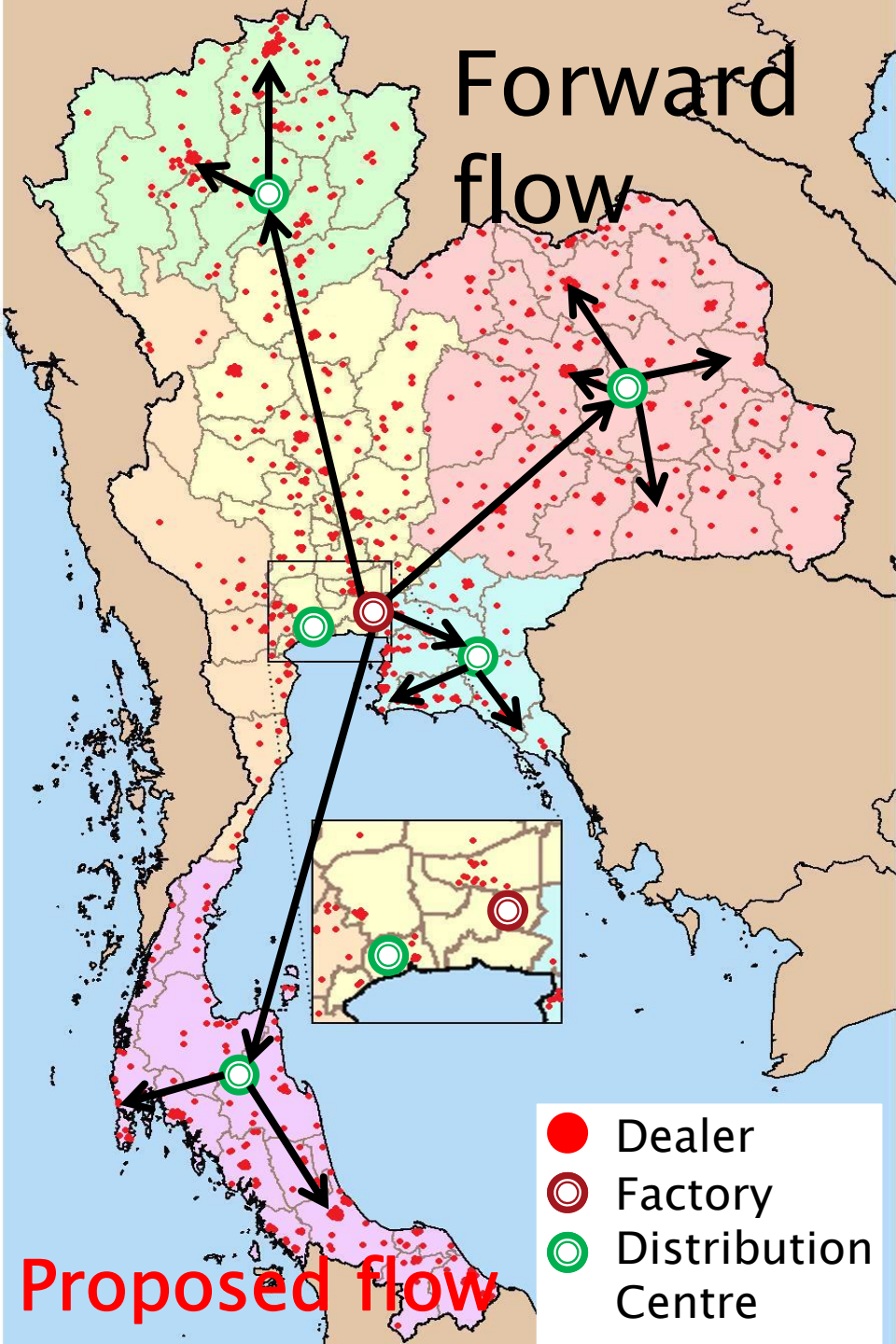
Number of new and 2<sup>nd</sup> motorcycles sales (Bangkok)



2%











# ESTIMATION OF MOTORCYCLE TRANSPORTATION DEMAND IN THAILAND

$$P_t = (P_{t-1} + N_t) - \left( N_{t-1} + \sum_{n=1}^n \alpha_n N_{t-n-1} \right) + \sum_{n=1}^n \alpha_n N_{t-n} - (S_t + C_{per,t} + C_{temp,t}) + T_t$$

suspended

Where

$t$  : year  
 $n$  : vehicle age

Currently possessed

New registered

Survival rate

Transferred

- $P_t$  : Number of motorcycles being registered in year  $t$
- $S_t$  : Vehicle that registration suspended in year  $t$  due to being unable to pay the tax for consecutive 3 years, enacted in year 2004
- $C_{per,t}$  : Vehicle that registration was inquired to cancel from user permanently in year  $t$
- $C_{temp,t}$  : Vehicle that registration was inquired to cancel from user temporarily in year  $t$

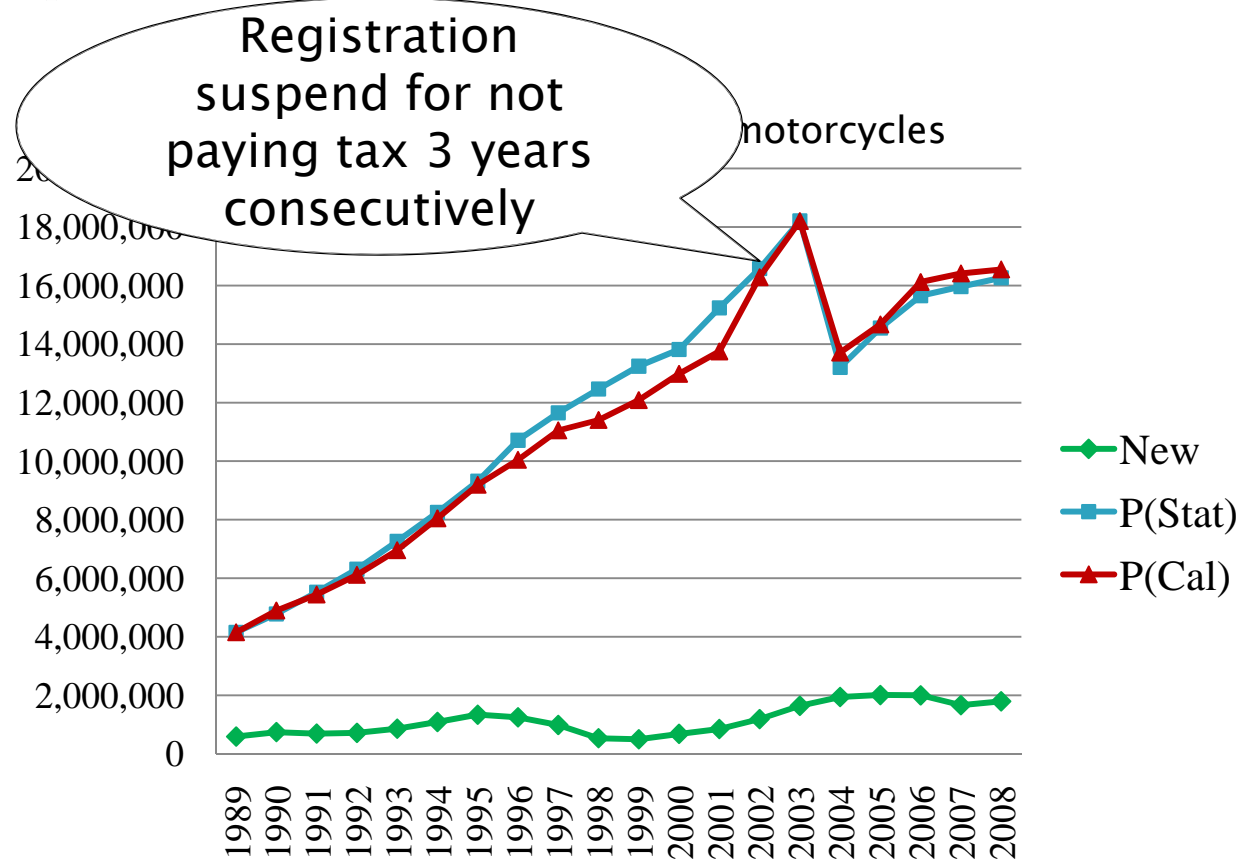
# ESTIMATION OF MOTORCYCLE TRANSPORTATION DEMAND IN THAILAND



Survival rate

Survival rate $\alpha_n$	$1-\alpha_n$
$\alpha_1$	1
$\alpha_2$	0.95
$\alpha_3$	0.85
$\alpha_4$	0.85
$\alpha_5$	0.8
$\alpha_6$	0.8
$\alpha_7$	0.7

No. of motorcycles

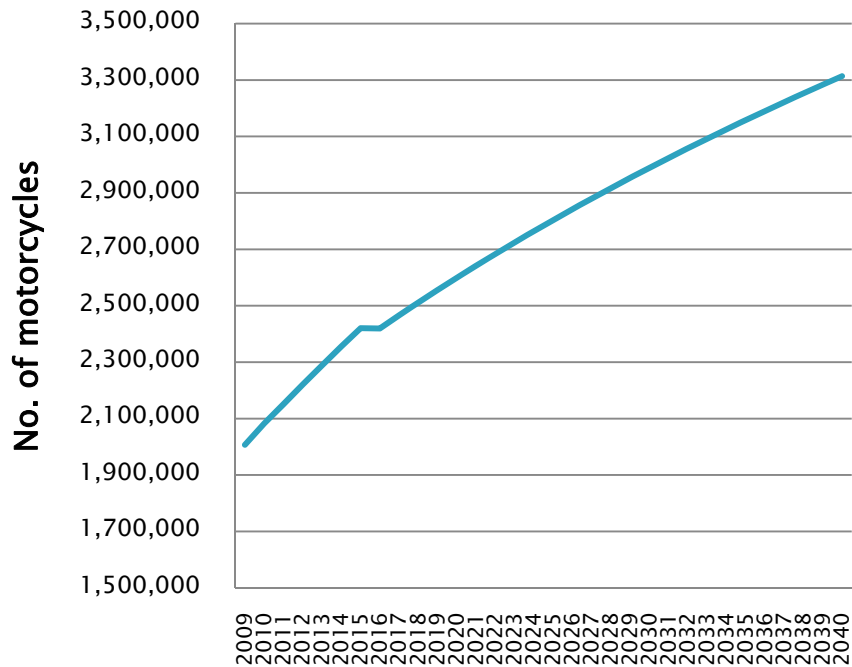


- Minimum error = 1.8%.
- The sudden drop in year 2004 is caused by the regulation that suspend the registration for those who do not pay tax for consecutive 3 years was first started.

# ESTIMATION OF MOTORCYCLE TRANSPORTATION DEMAND IN THAILAND

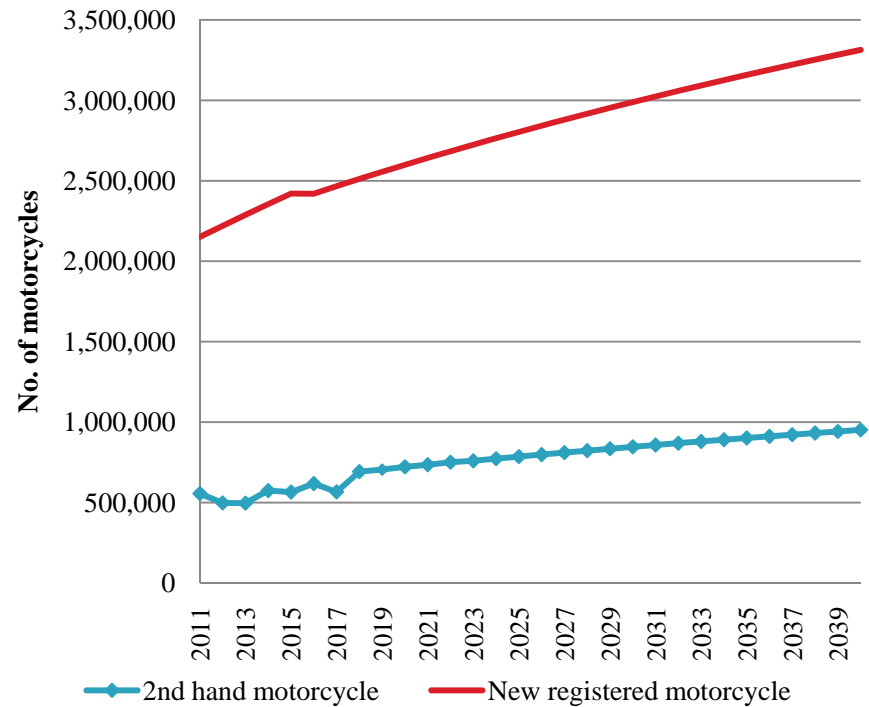


Estimated number of new registered motorcycles



New registered motorcycles

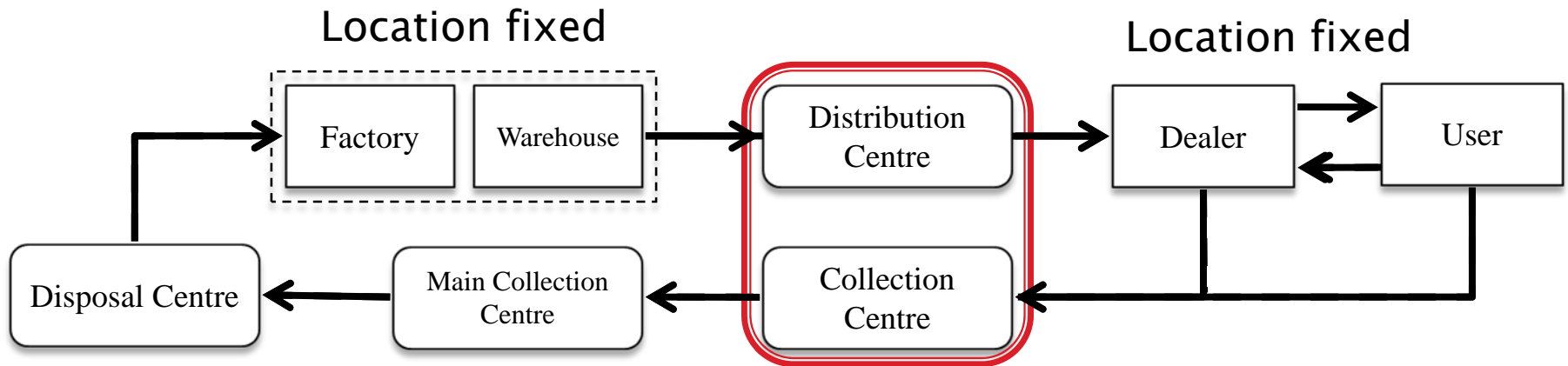
Estimated number of second hand motorcycle



2<sup>nd</sup> hand motorcycles



# Development of evaluation model for reverse logistics network

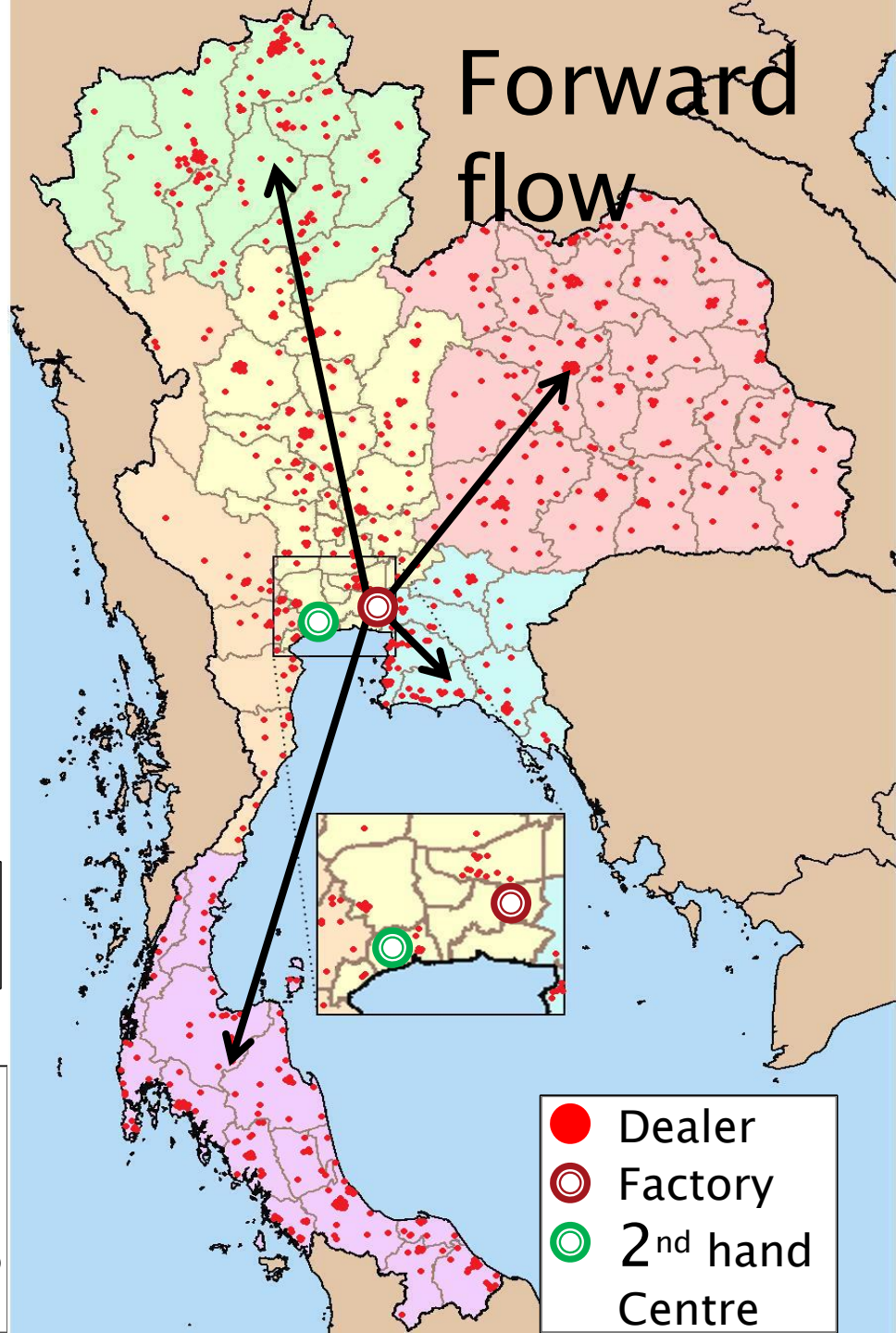
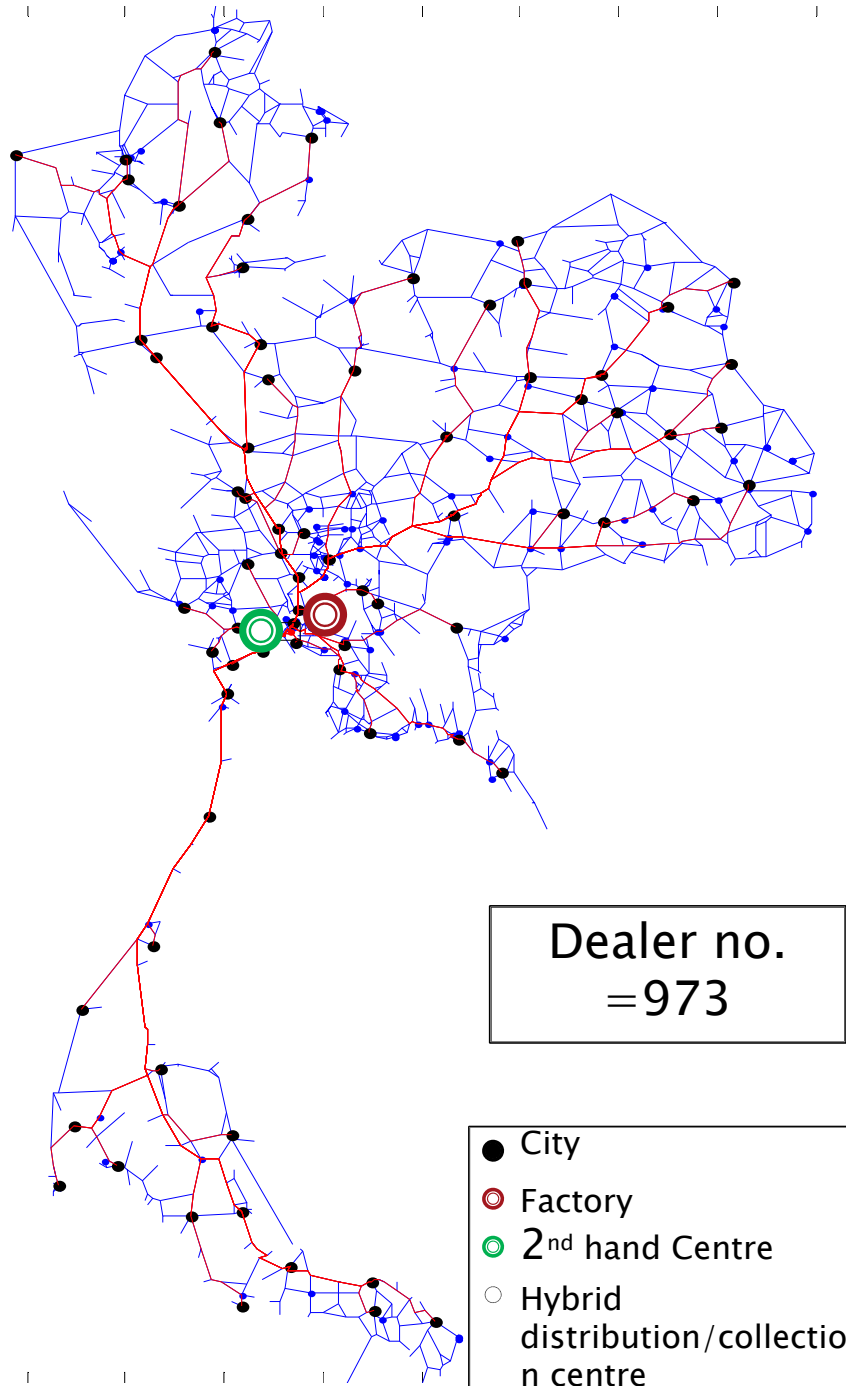


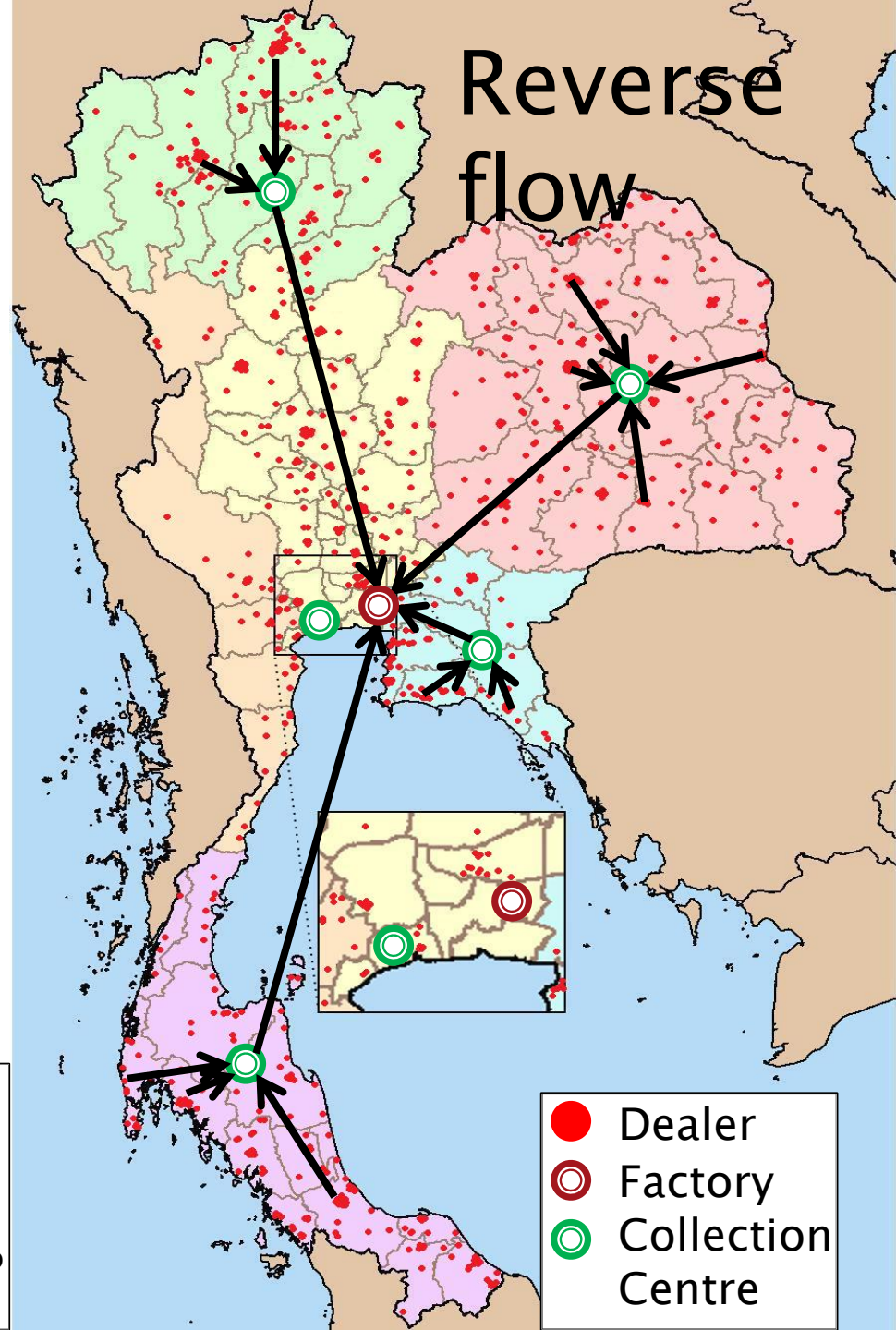
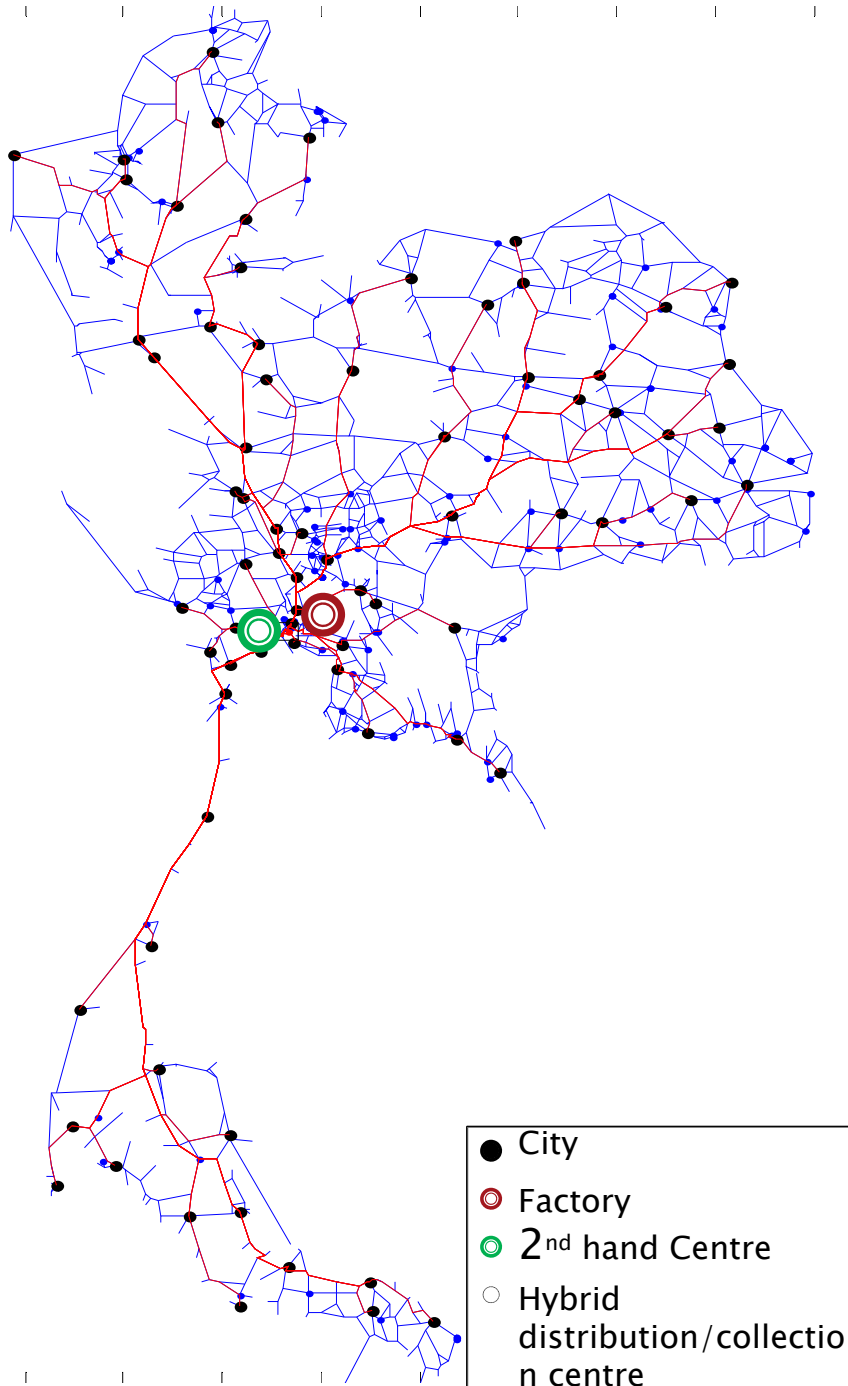
Design variable: Location and number of facilities

$$\sum_{t \in T} \sum_{d \in D} T_{wd} X_{wdt}^{f_1} + \sum_{t \in T} \sum_{d \in D} \sum_{s \in S} T_{ds} X_{dst}^{f_2} + \sum_{t \in T} \sum_{s \in S} \sum_{c \in C} T_{sc} X_{sct}^{r_1} + \sum_{t \in T} \sum_{c \in C} T_{cC_0} X_{cC_0t}^{r_2} + \sum_{i \in I} C_i Y_i + \sum_{t \in T} \sum_{i \in I} f_t Y_i$$

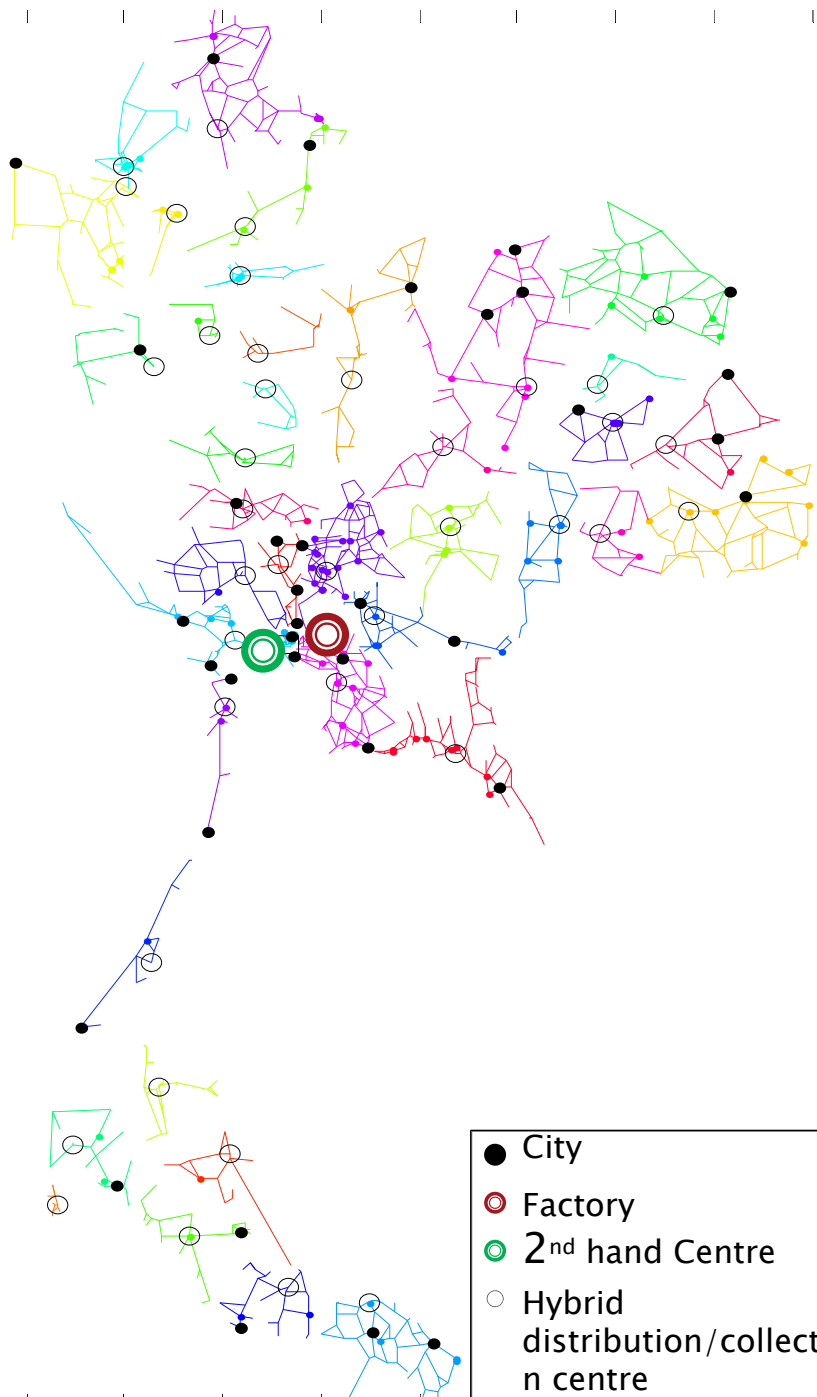
Forward transportation cost
Reverse transportation cost
Construction cost
Operation cost



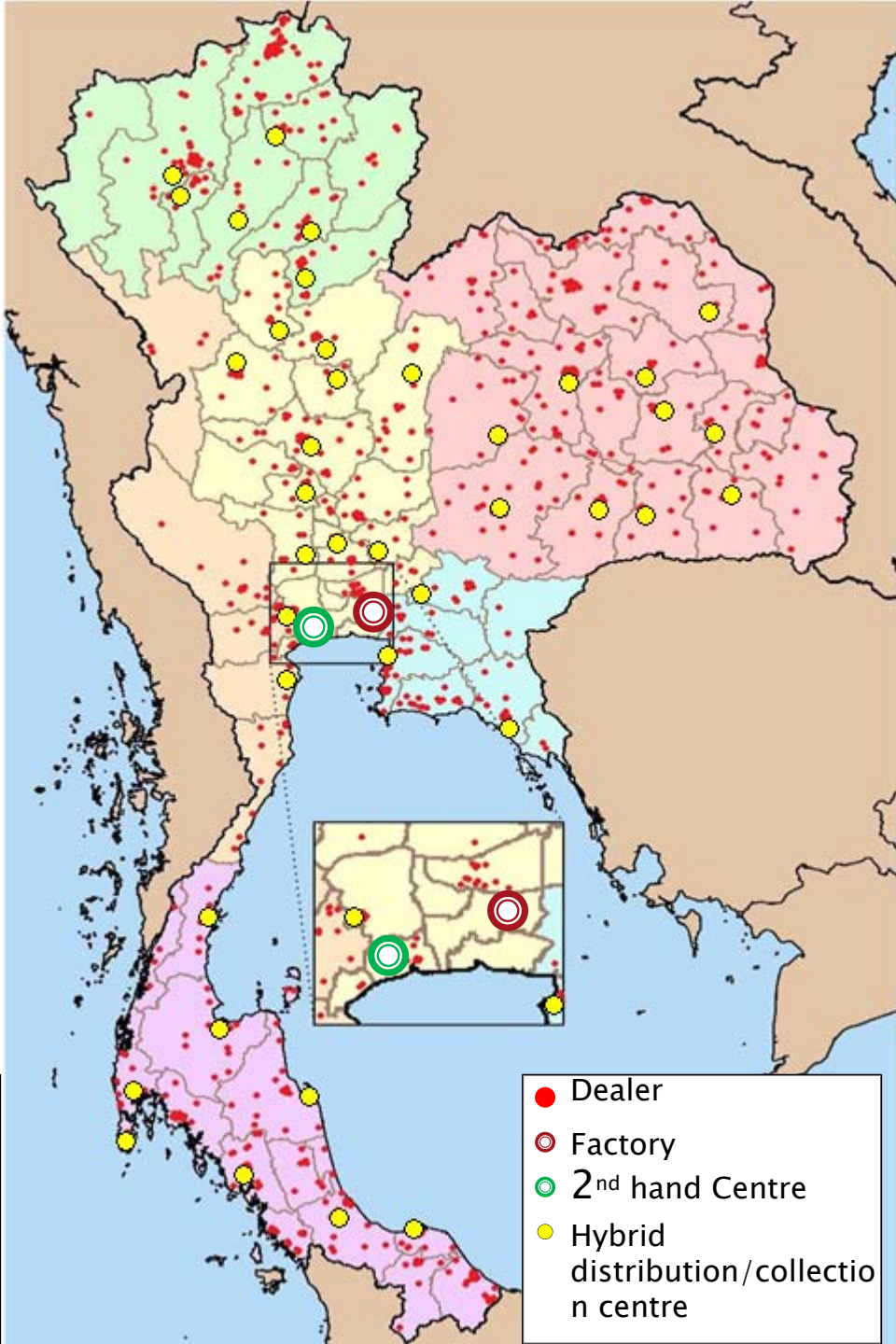








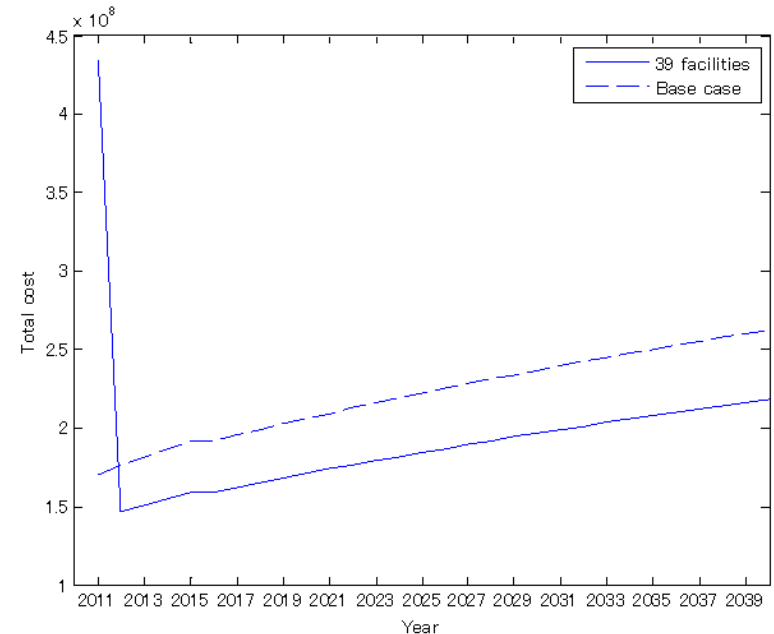
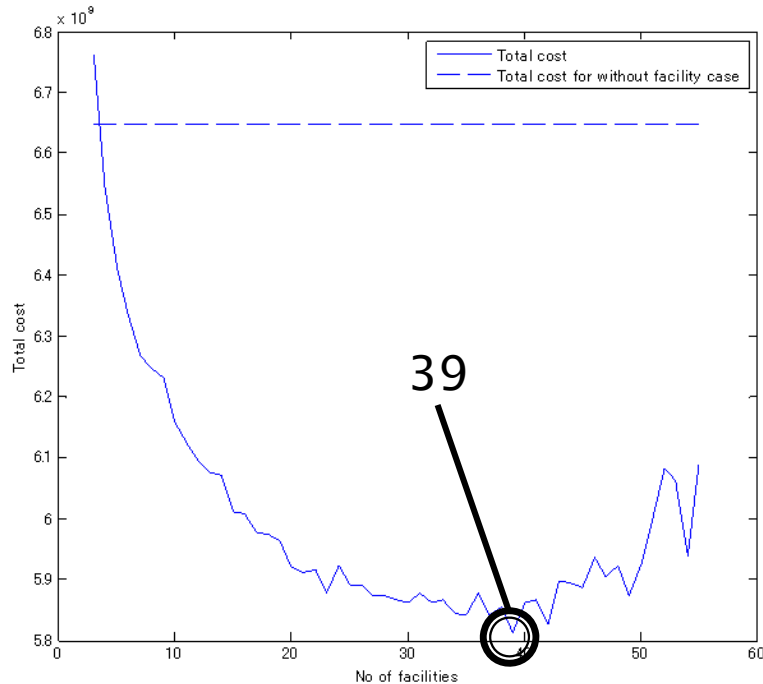
- City
- ⊙ Factory
- ⊙ 2<sup>nd</sup> hand Centre
- Hybrid distribution/collectio n centre



- Dealer
- ⊙ Factory
- ⊙ 2<sup>nd</sup> hand Centre
- Hybrid distribution/collectio n centre



# RESULTS



- ① The optimal number of Hybrid distribution/collection centre was found to be 39.
- ① Comparing with the current system, with Hybrid distribution/collection being established the total cost are reduced and more benefit can be gained.





## SUMMARY

- ▶ In this study, for motorcycle transportation as a case study, it has been found that by introducing distribution/collection facility in the logistics network, the cost can be reduced.
- ▶ As a further study
  - Regional cohort model should be performed
  - Stochastic demand should be applied

Thank you for your attention

