



Participatory Approach to Community Based Water Supply System

- An empirical research in Indonesian rural area -

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Outline

- 1 . Research Background & Objective
- 2 . Collective Action Model
- 3 . Case Study
- 4 . Conclusion & Future Perspectives



1. Research Background

- Lack of access to a clean water supply
 - Around 600 million people in the Asia-Pacific region (NARBO, 2007)
 - Around 100 million people in Indonesia (43% of total population in 2007)
- Inadequate water governance
 - The future water crisis in Asian countries, it will not be because of physical scarcity of water, but because of inadequate or inappropriate water governance (AWDO, 2007)
 - Singosari district of Malang regency consists of 17 villages covering 140.245 inhabitants. It has several natural water resources (wellspring, river and ground water), however, the number of population with water connection is only 28% of total inhabitants

1. Research Background

— Water resource in communities —



River



Individual (& public) well

Public
hydrant



1. Research Background

— Water resource in communities —



PDAM (A Local Company of Drinking Water)



A water supply system by regional government, a kind of conventional water supply system



HIPPAM

(Resident Association of Drinking Water User)



A community based water supply system based on voluntary participation of resident in the community level

1. Research Background & Objective

- Community based water supply system (HIPPAM) is one of strong alternatives to existing water supply system by the public sector
- Research Question:
 - Why do people join or not join HIPPAM ?
- Hypothesis
 - households with stronger community tie have ability to organize “community based” management system
- Research Objective
 - to investigate effects of social networks to the mechanism of the spontaneous collaboration of HIPPAM based on a field survey in Indonesia

2. Collective Action Model

— Model formulation —

Collective Action model = Discrete choice model for analyzing whether a household joins HIP PAM or not

→ $y_i = \begin{cases} 1 & \text{when household } i \text{ belongs to HIP PAM} \\ 0 & \text{when household } i \text{ does not belong to HIP PAM} \end{cases}$

→ $y_i = \begin{cases} 1 & \text{if } u_{i1} > u_{i0} \\ 0 & \text{if } u_{i1} \leq u_{i0} \end{cases}$

u_{i1} : utility derived from joining HIP PAM
 u_{i0} : utility derived from not joining HIP PAM

→ $y_i = \begin{cases} 1 & \text{if } z_i > 0 \\ 0 & \text{if } z_i \leq 0 \end{cases}$

latent variable $z_i = u_{i1} - u_{i0}$

How should it be defined ?

2. Collective Action Model

— How to define z —

Probit Model : explained by household's attribute X

$$Z = X\beta + \varepsilon \quad \varepsilon \sim \mathcal{N}_n(0_n, I_n)$$

$X = (x_i : i = 1, \dots, n)'$: Household's attribute

$\beta = (\beta_K : k = 1, \dots, K)'$: Parameters vector



Collective Action Model : explained by X and social interaction term θ

$$Z = X\beta + \theta + \varepsilon \quad \varepsilon | \theta \sim \mathcal{N}_n(0_n, I_n)$$

$\theta = (\theta_i : i = 1, \dots, n)'$: Social interaction term

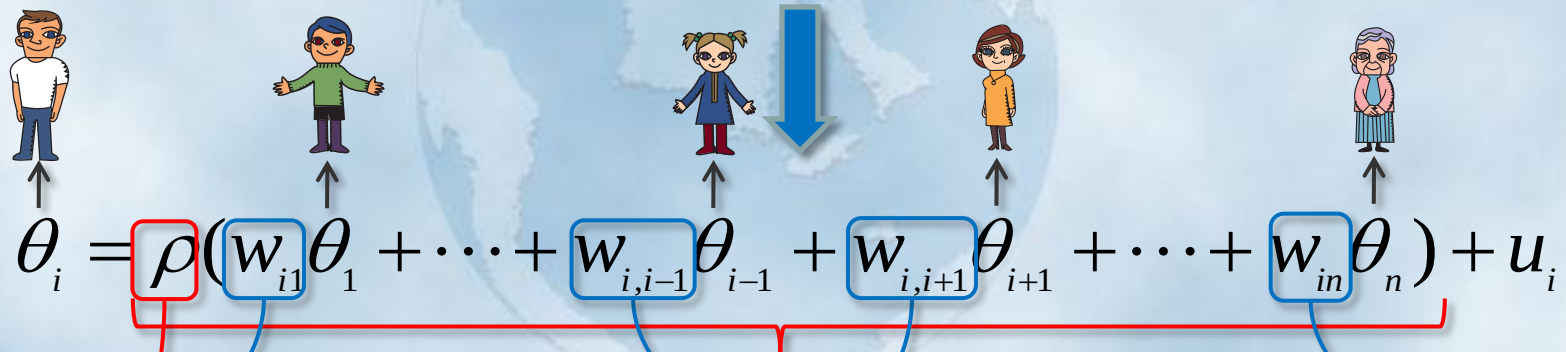


Express the effect of social interaction among households

2. Collective Action Model — specifying θ —

Social interaction term θ  introduce a spatial autoregressive structure

$$\theta = \rho W \theta + u, \quad u \sim N_n(0_n, I_n)$$


$$\theta_i = \rho (w_{i1} \theta_1 + \cdots + w_{i,i-1} \theta_{i-1} + w_{i,i+1} \theta_{i+1} + \cdots + w_{in} \theta_n) + u_i$$

Effect of social interaction among households

W : spatial weight matrix about households' network

ρ : degree of dependent on social capital

2. Collective Action Model

— Model estimation —

Collective Action Model → Maximum likelihood estimation is difficult since the likelihood function of this model has complicated form



Markov Chain Monte Carlo (MCMC) estimation

- Gibbs sampling method
- Metropolis-Hastings method



Metropolis within Gibbs sampling method

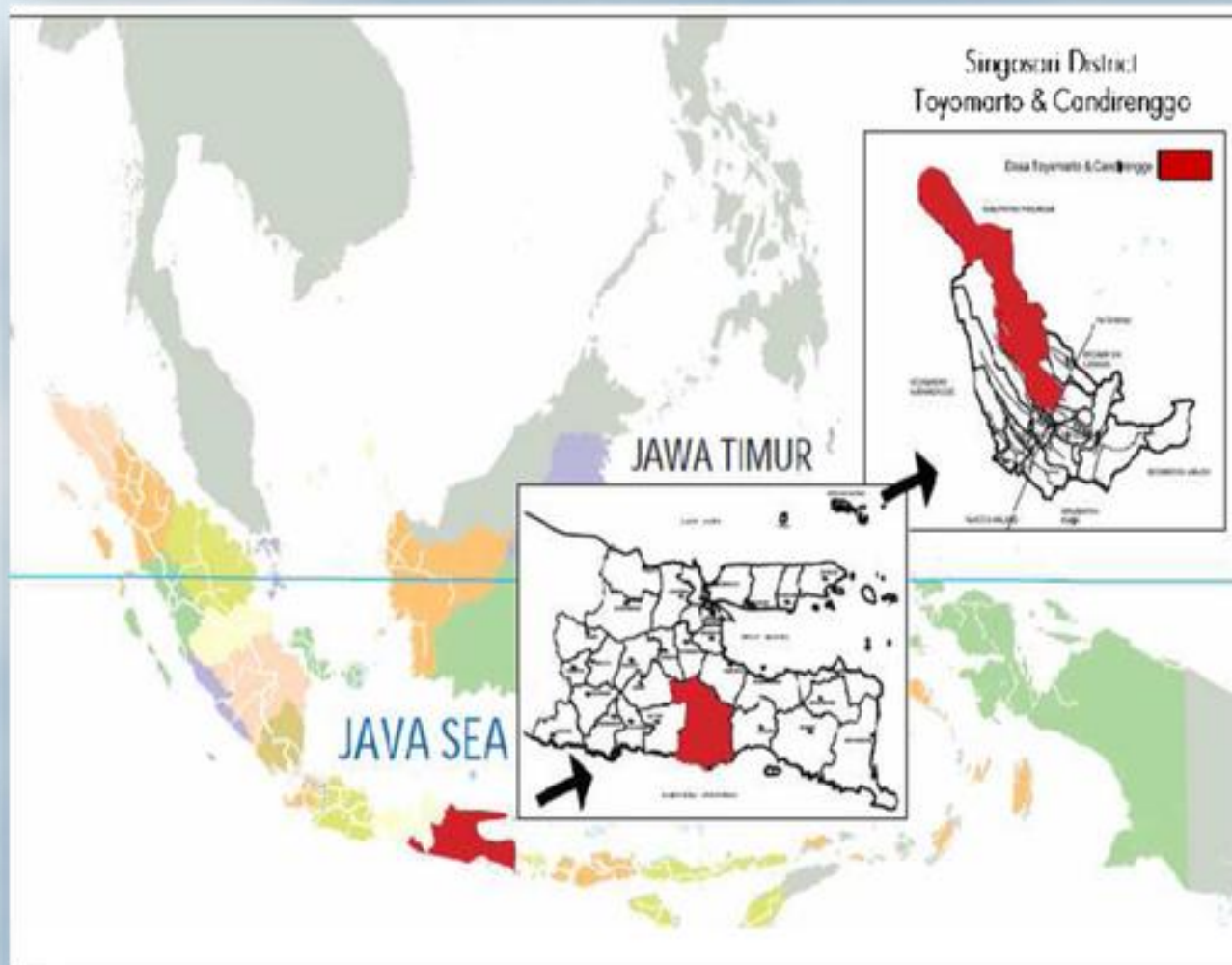
3. Case Study

— Description of the Field Survey —

- 1st survey: December 2008
- To test the hypothesis, following items are asked through face to face questionnaire interview
 - Water usage
 - Satisfaction to the water supply
 - Level of social capital, community network
- 500 households living at Toyomarto village and Candi Renggo village, Singosari district, Malang regency, East Java province

3. Case Study

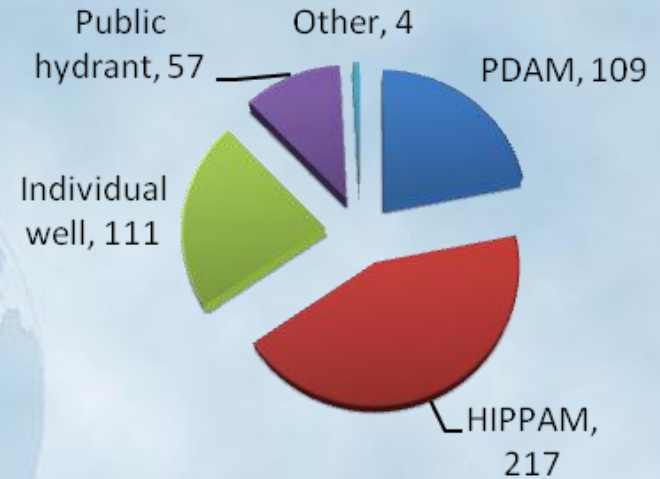
— Location of the research area —



3. Case Study

— Water source in the research area —

- There exist 5 types of water source



- The dependent variable

$$y_i = \begin{cases} 1 & \text{when household } i \text{ belongs to HIPPAM} \\ 0 & \text{when household } i \text{ belong to PDAM} \end{cases}$$

	HIPPAM	PDAM
Toyomarto (n=159)	141	18
Candi Renggo (n=141)	56	86
Total (n=301)	197	104

3. Case Study

— Explanatory variables —

- FAM : family members in the household (2 – 7 members)
- GENDER : male and female (dummy variable for male → 1)
- AGE : age of the head of household (20 – 73 years)
- EDU : junior school & below, and high school & upper (dummy variable junior school & below → 1)
- OCCU : agriculture & manufacturing, and service & unemployment (dummy variable agriculture & manufacturing → 1)
- INCOME : household's monthly income
(0.25, 0.75, 1.25, 1.75, 2.25, 2.75, 3.25 million Rupiah)
- LENGTH : years of living in the area
- COST : water charge per day (Rupiah)

3. Case Study

— Spatial weight matrix —

- Hypothesis: households with stronger community tie have ability to organize community based water supply system
- We define a spatial weight matrix using the data of people who join in a certain community group

Candi Renggo	1. Religious	2. Cultural /Social	3. Community organization	4. Finance
respondent A				
respondent B				
⋮				
Total (n=142)	87	36	41	

$$w_{AB} = 1 + 1$$

$$= 2$$

$$w_{ij}^k = \begin{cases} 1 & \text{if household } i \text{ and household } j \text{ join the same community group } k \\ 0 & \text{otherwise} \end{cases}$$

$$w_{ij} = \sum_{k=1}^4 w_{ij}^k$$

3. Case Study

— Estimation result (CR: n=142) —

Significant

	Probit Model					Collective Action Model				
Variables	Parameters	Standard error	90% confidence interval		Geweke statistic	Parameters	Standard error	90% confidence interval		Geweke statistic
Constant	-1.272	0.749	-2.501	-0.045	1.634	-1.376	0.800	-2.714	-0.092	0.509
FAM	0.199	0.119	0.006	0.394	1.360	0.196	0.123	0.002	0.404	0.711
GENDER	0.554	0.351	0.005	1.144	0.003	0.594	0.370	0.001	1.216	3.406
AGE	-0.026	0.014	-0.048	-0.004	0.787	-0.026	0.014	-0.050	-0.004	0.519
EDU	0.865	0.340	0.312	1.446	0.740	0.939	0.362	0.351	1.544	0.578
OCCU	1.059	0.363	0.478	1.661	1.053	1.157	0.397	0.497	1.819	1.683
INCOME	0.129	0.181	-0.168	0.426	0.059	0.149	0.193	-0.170	0.476	0.544
LENGTH	0.039	0.011	0.020	0.058	0.831	0.041	0.013	0.021	0.063	0.866
COST	-0.001	0.0002	-0.001	-0.0003	1.147	-0.001	0.0002	-0.001	-0.0004	0.903
σ^2	-	-	-	-	-	0.127	0.026	0.091	0.175	0.274
ρ	-	-	-	-	-	-5.092	3.222	-10.121	0.067	0.412

Insignificant

4. Conclusion & Future Perspectives

- We proposed “Collective Action Model” which considers the effect of social interaction among households, and the MCMC estimation method
- Case study by using the data from the field survey in Indonesian rural area
- Future Perspectives
 - Further analysis by using dataset from 2nd field survey (February 2010)
 - Another approach to get spatial weight matrix
 - ➡ geographical or psychological distances among households



THANK YOU FOR YOUR ATTENTION

