Willingness to pay for water charges in communal governance irrigation systems:

An empirical study on rural irrigation system in the Lao PDR

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International Conference
Sustainability on Food, Feed, Fiber, Water, Energy: Science, Technologies, and Global Strategies
(ICSA2008), Hokkaido University, 2-6 July 2008

Organization of the presentation

- Section 1: **Introduction**
- Section 2: **Background of study area**
- Section 3: **Analytical method and data**
- Section 4: **Result and Discussion**
- Section 5: **Conclusion**

Section 1: Introduction

- *Free-gift water or paid water?*
  - *Climate changes*
  - *Population growth*
  - *Water resource scarcity*
  - *Need of water use efficiency*
- *Right tools and measurements for water use efficiency*
  - *Technology improvement: biogenetics, water supply technology, improved practices and etc..*
  - *Economic instruments: water markets, pricing and etc..*
  - *Policies and Institutions*

Section 1: Introduction (cont.)

- *Laos is Monsoon country:*
  - *Wet season: June-October (rainfall > 1500mm)*
  - *Dry season: November-May (rainfall < 100 mm)*
- Irrigation is essential for dry season cultivation
- *Laos starts Irrigation Reform since early 1990s:*
  - *Irrigation Management Transfer (tested in 1993)*
  - *National IMT starts in 2000:*
    - *900 (2,600 schemes) transferred*
    - *Electric pump scheme shares more 80 percent of transferred schemes*
  - *Water charges have been applied and called Irrigation Service Fee with a flat rate of saving fund for 150 kgs of paddy*
  - *Water is priced to cover O&M, but farmers are willing to Pay?*

Section 2: **Analytical method and data**

- Limited quality and quantity data on water delivered to farmland
- Lack of information on soil quality and cultivated variety
- Insufficient data on inputs
- How to define farmer willingness to pay (WTP) for water charges?
- The study consider WPT=Water Demand (Griffin, 2006)
- Simple double log demand function is used for simplicity with Pooled data of 2005 and 2006 surveys
- 2 stages of analysis:
  - *Cross-section model:*

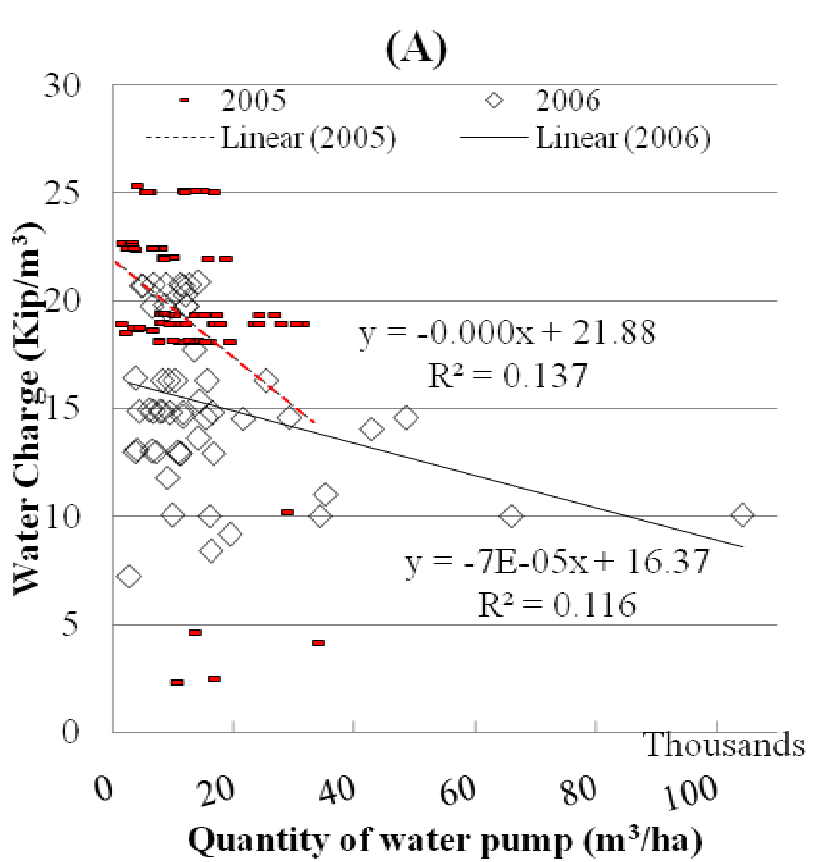
    (Y) = X1 + X2 + X3 + Dummies **(1)**
  - *Pooled Cross-section model:*

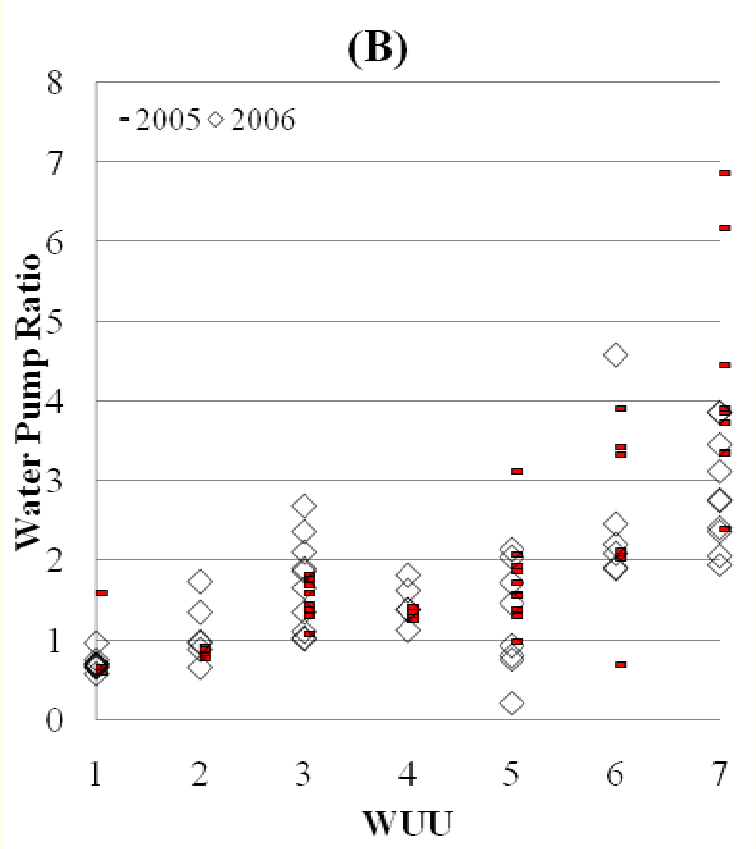
    (Y) = Year + X1 + X2 + X3 + (Year * X1) + (Year * X2) +
    (Year * X3) + (Year * X4) + Dummies **(2)**

    Where, (Y) *=log(waterpump)*; *Year* = Survey year; *X1= log(ISF); X2=log(AnnRev); X3=log(hhsize);* and *dummies=Wud1-Wud6* and *headdum.*

Section 2: **Analytical method and data** (cont.)

Figure 1. Quantity of irrigation water pump and efficiency in Ban Vuen-Tohen WUA





Section 2: **Analytical method and data** (cont.)

Table 1 Descriptive of data

Variable	Description	Unit	Mean	Std. Dev.	Min	Max
Y	Log of water pumped per hectare	M^3/ha	9.195	0.820	6.165	11.553
Year	Dummy Year (2005=0; 2006=1)	Binary	0.444	0.499	0	1
X1	Log of water charge per m^3	Kip/m^3	2.804	0.396	0.814	3.230
X2	Log of annual household revenue	Kip	14.037	0.719	11.290	15.499
X3	Log of household size	Person	1.721	0.309	0.693	2.565
HeadDum	Dummy for farm land location (head=1; other=0)	Binary	0.677	0.469	0	1
Wud1	Dummy for Water user unit 1 (WUU 1=1; other=0)	Binary	0.153	0.362	0	1
Wud2	Dummy for Water user unit 2 (WUU 2=1; other=0)	Binary	0.105	0.308	0	1
Wud3	Dummy for Water user unit 3 (WUU 3=1; other=0)	Binary	0.185	0.390	0	1
Wud4	Dummy for Water user unit 4 (WUU 4=1; other=0)	Binary	0.113	0.318	0	1
Wud5	Dummy for Water user unit 5 (WUU 5=1; other=0)	Binary	0.169	0.377	0	1
Wud6	Dummy for Water user unit 6 (WUU 6=1; other=0)	Binary	0.113	0.318	0	1

Notes: 1). Number of sample was 124.

2). Exchange rate was 9,600 kip/USD.

Source: Farm survey 2005 and 2006.

Section 3: **Background of study area**

- A common medium size of electric pump scheme found in central and southern Laos
- Designated area 500 ha
- Shared by 3 villages (merged from 5 villages) with 7,800 people
- Scheme experienced with severe floods and droughts
- Collectively constructed in 1980s, but failed
- In 1993 the scheme was selected for a pilot program of IMT
- By 1997, the scheme was fully transferred to WUA
- Highest achievement was 423 ha in 1997/98, but gradually decreased
- Pumps broke down 3 times in 00/01-02/03
- Caused by FLUCTUATED electric supply
- ISF charged by area base, from 36,000 kip (3.7USD) to 841,000 kip (87.5USD) per hectare
- Cross-sectional with DOI estimation, water charges:

  2.3 kip to 40.4 kip per m^3 (exchange rate 9,600 kip per USD)

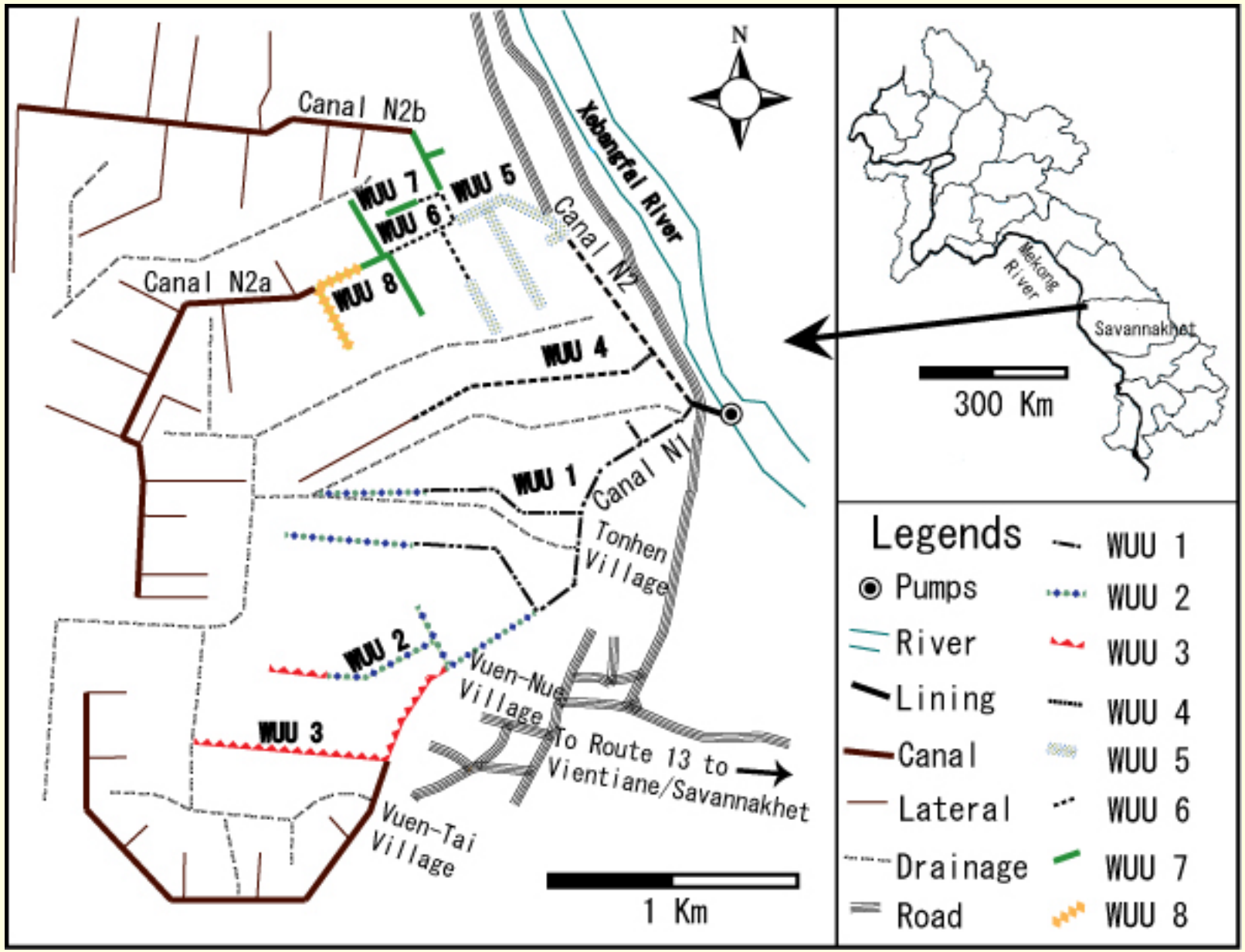
Section 3: **Background of study area** (Cont.)

Table 1 Record of electricity used with harvested area and number of WUU

Year of Production	Area (ha)	WUU	Electricity used				
			Total (Kwh)[1]	Average (Kwh/Ha)	Min	Max	St. Dev
99/00	353.60	19	1,752.52	4.9562	2.3451	11.1132	2.3355
00/01	357.50	14	1,486.84	4.1590	2.0303	7.3023	1.3493
01/02	285.27	14	1,353.26	4.7438	2.1948	9.6027	2.0458
02/03	270.01	14	1,442.00	5.3405	2.5460	9.5245	1.8989
03/04	237.26	14	1,266.09	5.3364	2.2631	11.3092	2.1937
04/05	100.92	8	808.55	8.0122	3.8781	21.0621	5.2524
05/06	150.72	7	850.10	5.6401	3.0803	10.8263	2.9081
06/07	211.35	8	1,101.90	5.2136	2.5262	15.0924	4.2169

Note: 1). Estimation of 1 Kwh used for pumping can discharge water roughly at 2,870 m^3 (DOI, 2007).
Source: Field Surveys, 2005, 2006 and 2007.

Figure 1. Map of B.Vuen-Tonhen WUA location and canal Layout



Source: Farm survey, 2005

Section 4: **Result and Discussion**

- Demand of water change over the year
- Water demand is very much inelastic to current water charge at -0.45
- However, very much elastic to household annual revenues and household size at 0.4 and 0.76, respectively
- Most of dummies are significant, except for *Headdum*
- Both stages of analysis conclude mostly similar effect except the interaction of *Year*WUD*

Table 3
Estimation result of water demand

Variable	Dependent Variable = Y (m^3/ha)			
	Coef.	t-statistic	Coef.	t-statistic
Constant	2.83 **	1.98	5.89 ***	3.48
Year	0.26 **	2.15	-6.80 *	-1.77
X1	-0.45 **	-2.56	-0.67 ***	-3.51
X2	0.40 ***	4.62	0.25 **	2.39
X3	0.76 ***	3.89	0.35	1.36
HeadDum	-0.07	-0.48	0.05	0.26
Wud1	0.56 ***	2.64	1.07 ***	3.52
Wud2	0.51 **	2.20	0.83 **	2.56
Wud3	0.75 ***	3.43	1.26 ***	4.30
Wud4	0.99 ***	4.32	1.50 ***	5.30
Wud5	1.13 ***	5.51	1.53 ***	5.78
Wud6	0.46 *	1.95	0.12	0.38
Year*X1			0.63	0.83
Year*X2			0.37	1.97
Year*X3			0.43	1.00
Year*HeadDum			-0.20	-0.71
Year*Wud1			-0.85 *	-1.82
Year*Wud2			-0.41	-0.90
Year*Wud3			-0.61	-1.34
Year*Wud4			-1.17 **	-2.40
Year*Wud5			-0.46	-0.94
Year*Wud6			0.79 *	1.72
Obs:	124		124	
R^2:	0.46		0.57	
Prob>F:	0.00		0.00	

Note: ***, ** and * indicate statistically significant at 1, 5 and 10 percent levels, respectively.

Section 5: Conclusion

1. Price elasticity of irrigation water demand is low as the price itself is also low.
2. Annual household revenue and household size have otherwise increased water demand.
3. Farmland located in the different water user unit (WUU) has different water demand patterns.
4. Early attempt to quantify irrigation water demand in rural area with limited information, need more constructive model and data to extend research for greater policy implication.