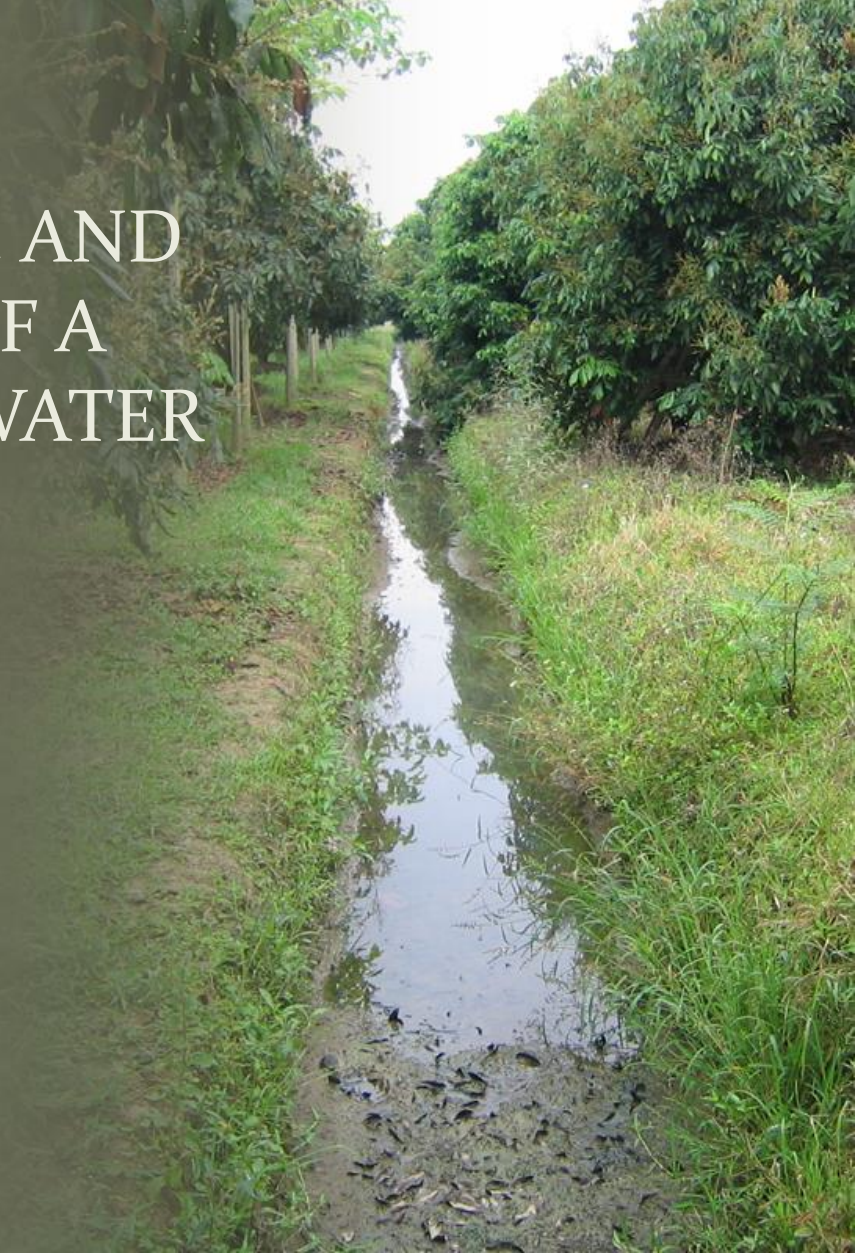
ESTIMATING THE ECONOMIC AND ENVIRONMENTAL BENEFIT OF A TRADITIONAL COMMUNAL WATER IRRIGATION SYSTEM: THE CASE OF *MUANG FAI* IN NORTHERN THAILAND



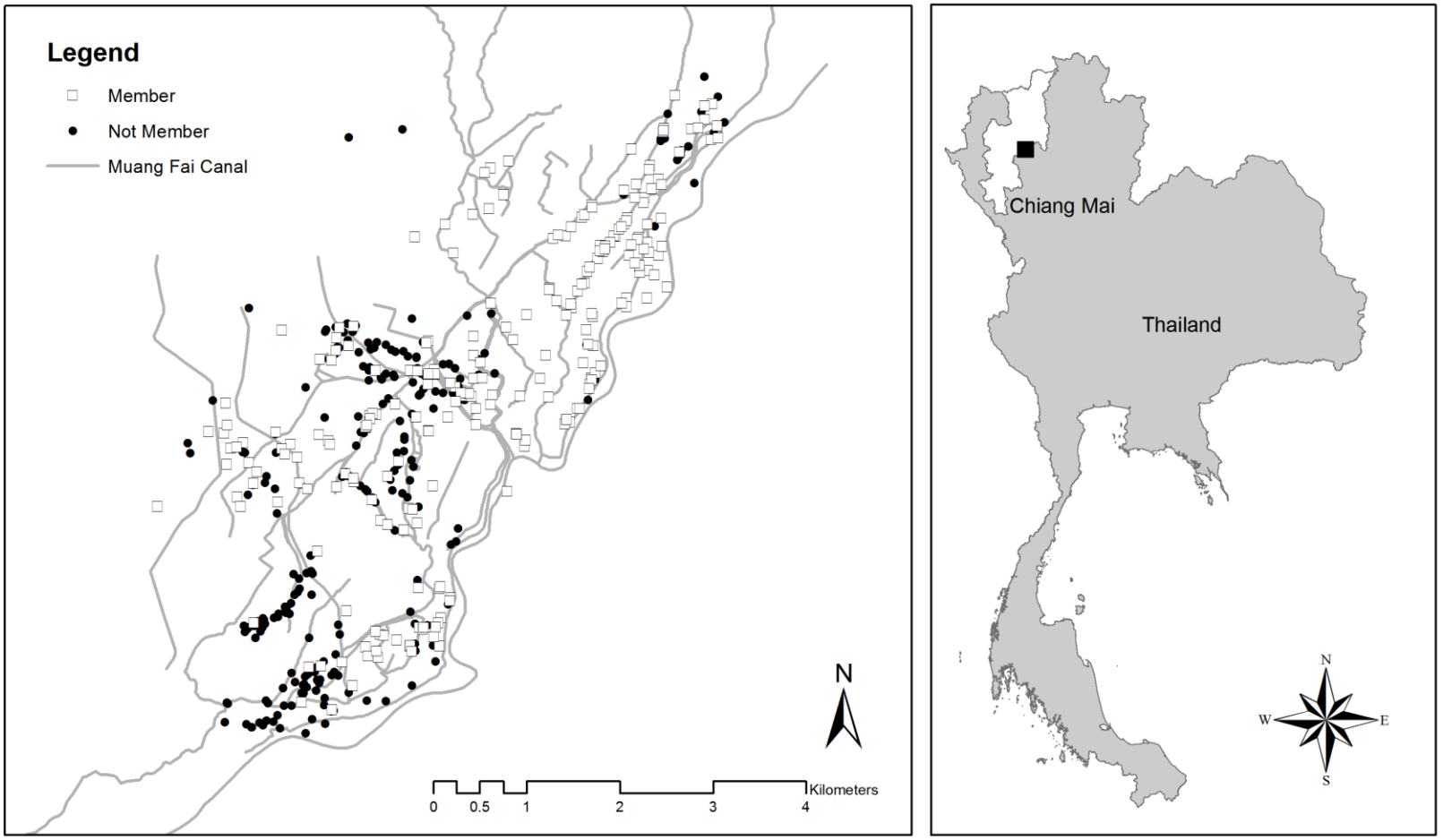
ARRIYA MUNGSUNTI
KEVIN PARTON

Charles Sturt University
EEPSEA
Economy and Environment Program for Southeast Asia
Institute for Land, Water and Society
Charles Sturt University

Presentation Outline:

1. Background
2. Objectives
3. Methodology
4. Results
   - Study Site
   - Determinants of Participation
   - Impact of Participation
5. Concluding Remarks

Study Area:


Legend
Member
Not Member
Muang Fai Canal
N
0 0.5 1 2 3 4
Kilometers
Chiang Mai
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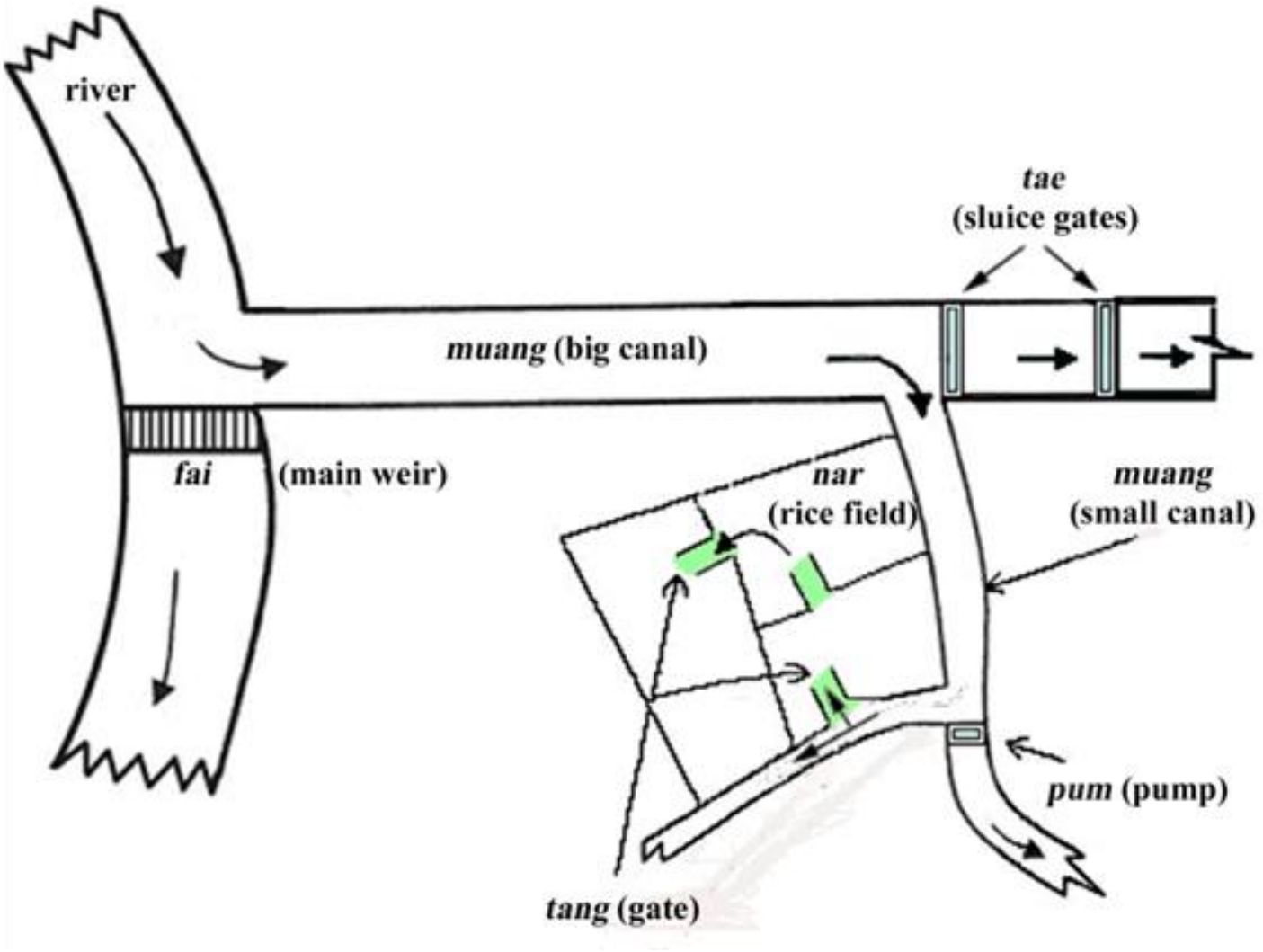
Muang fai Irrigation System



(A)
Headwork Area (rock-filled weir) of *Muang fai* Sop Rong irrigation system

(B)
Small irrigation canal (or "*muang*") at *Muang fai* Sop Rong irrigation system

Muang fai Sop Rong

Hundreds of years old system

Water distribution

- Set rotation schedule when water is limited (dry season)
- A queue system (with queue card)

Management

- A manager
- Village's delegates
- Regular meeting

Fees

- Annual fee (small)
- Labor for maintenance

Institutional setting: typical of Ostrom's CPR

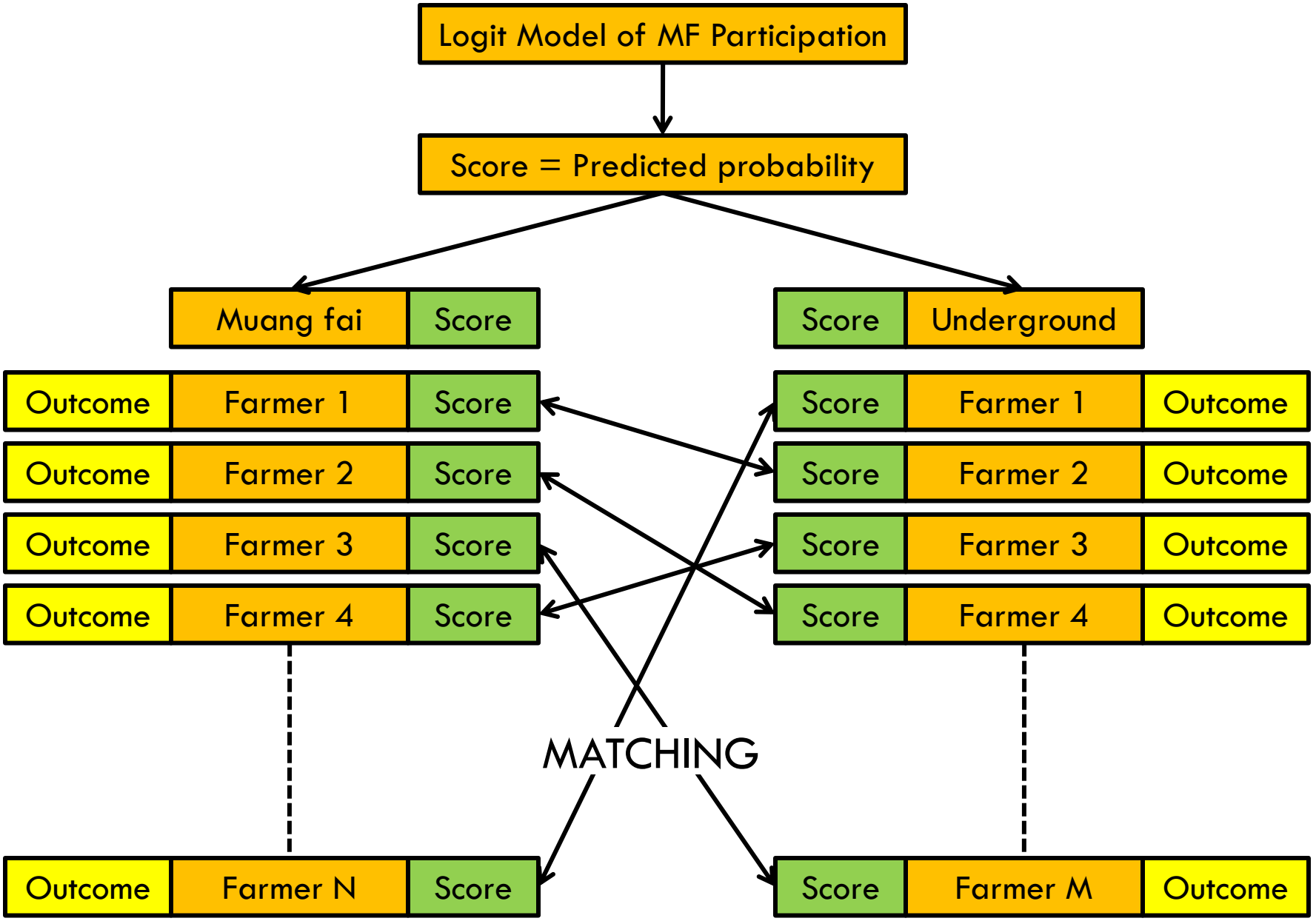
Objectives

1. To find out what is the benefit of participating in the *muang fai* irrigation system by estimating the productivity gain from adopting *muang fai* instead of non-irrigated or underground irrigation.

2. To find out whether or not farmers who are members of *muang fai* irrigation system use water more efficiently than farmers with alternative sources of irrigation.

Method: Propensity Score Matching (PSM)

- PSM is used to estimate the difference in productivity and water use efficiency between MF member and non-MF member attributed to MF participation only.
- PSM correct the biased simple mean comparison by controlling for participation endogeneity.
- PSM calculate only the difference in productivity and water use efficiency between MF members and non-MF members who have similar characteristics i.e. similarity in the likelihood of participation (matching).


Logit Model of MF Participation
Score = Predicted probability
Muang fai
Score
Score
Underground
Outcome
Farmer 1
Score
Score
Farmer 1
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Outcome
Farmer 2
Score
Score
Farmer 2
Outcome
Outcome
Farmer 3
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Farmer N
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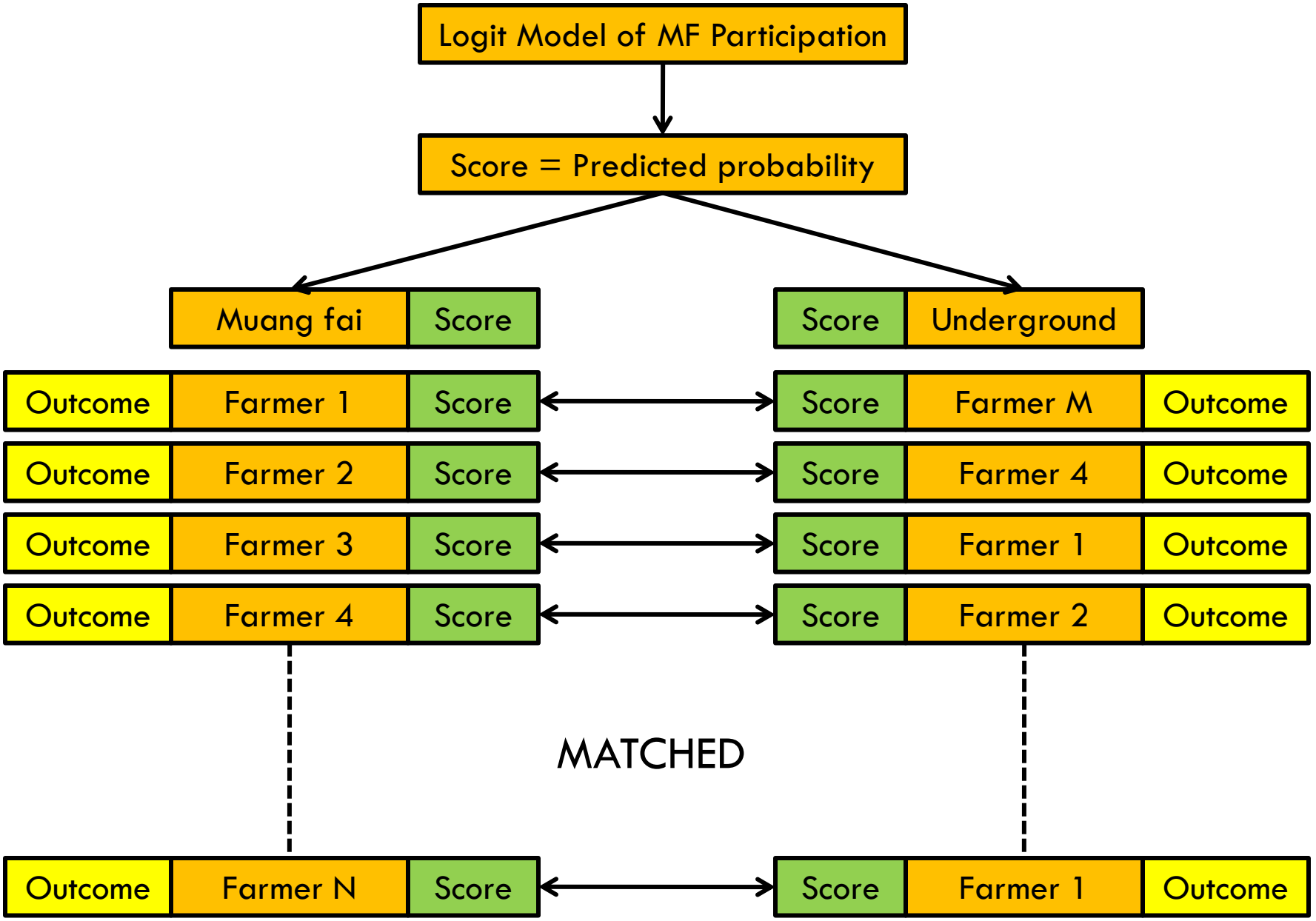
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Farmer 3
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Farmer 4
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Farmer 2
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MATCHED
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Farmer N
Score
Score
Farmer 1
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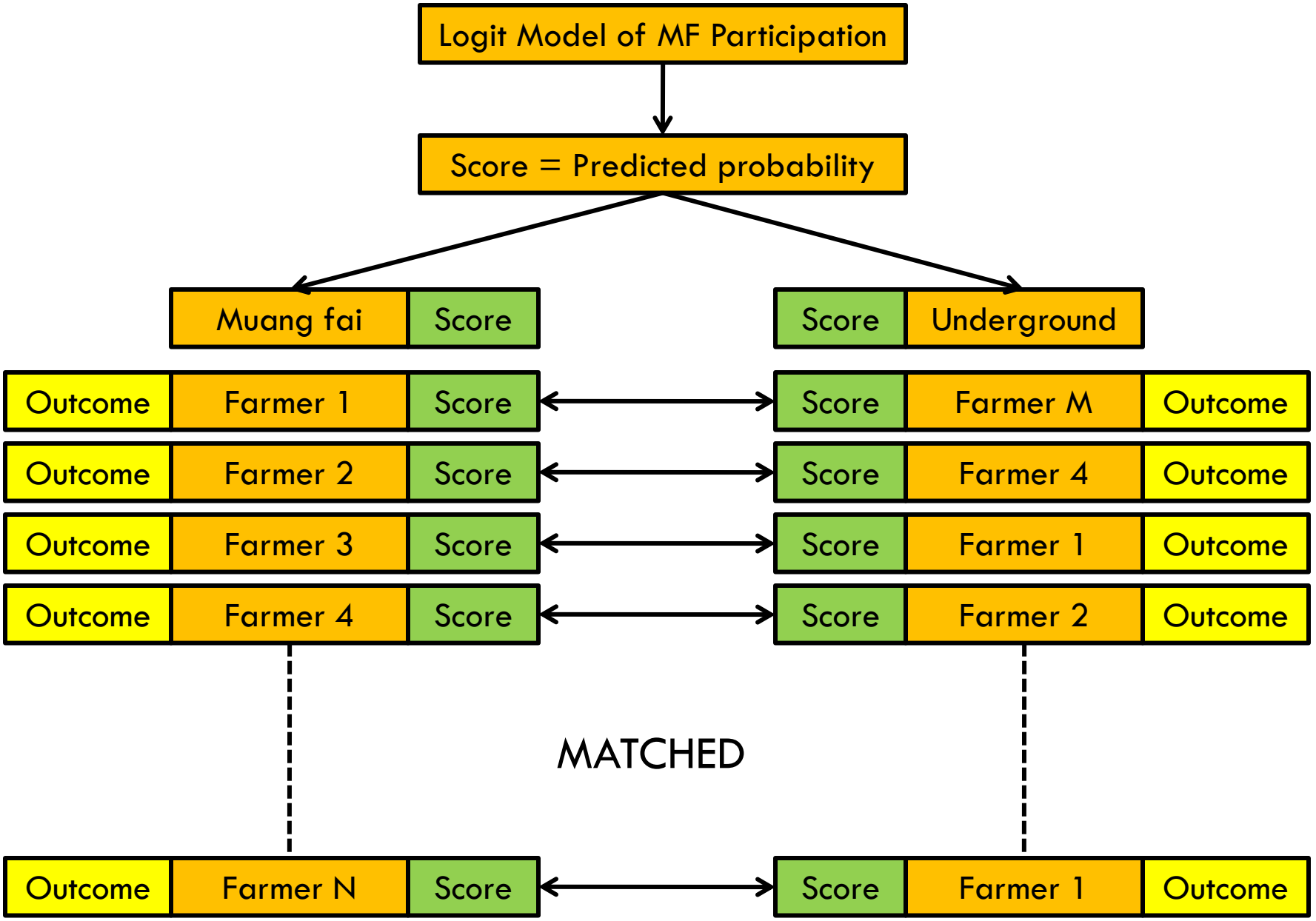
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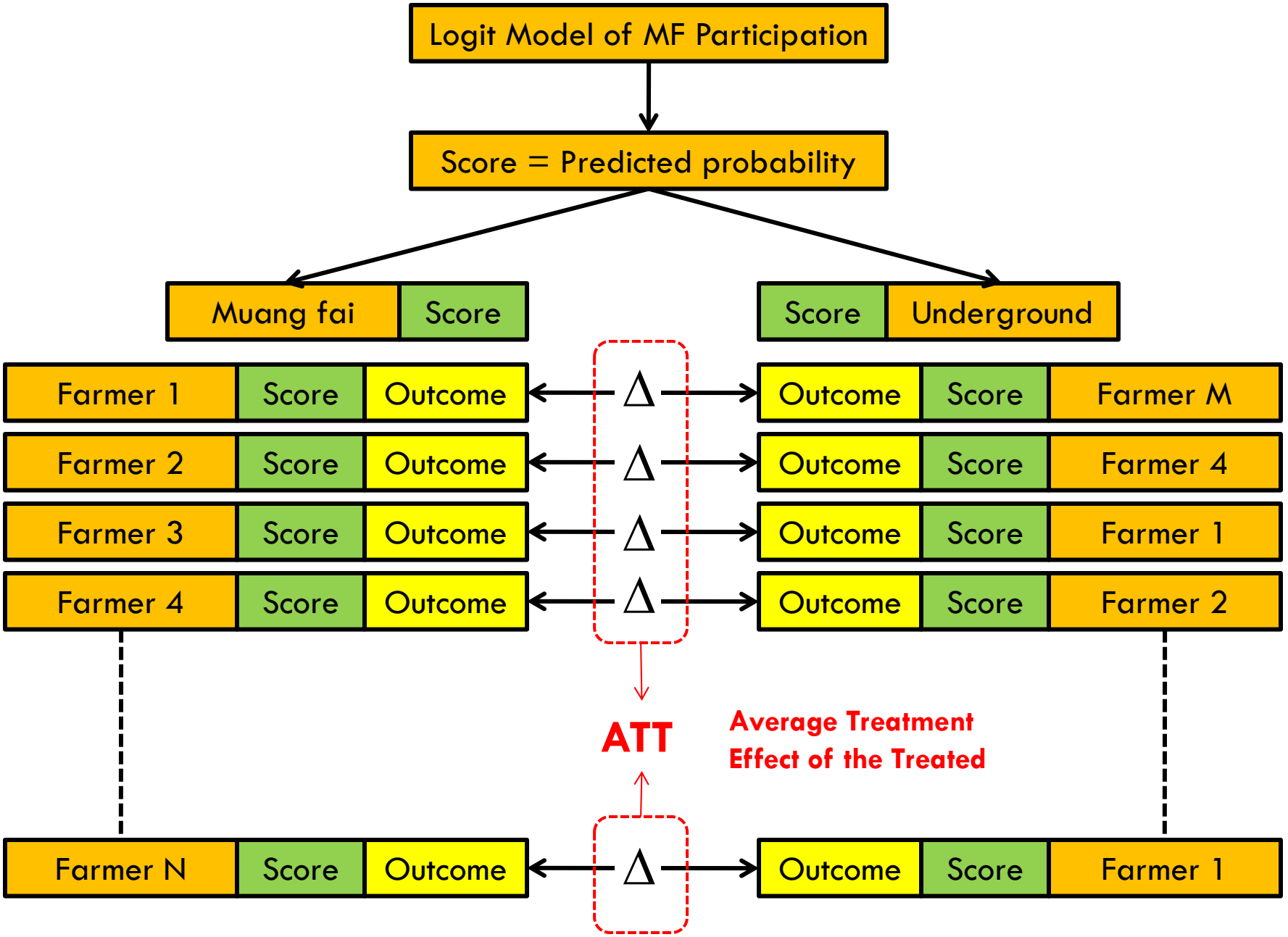
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Farmer 3
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Farmer 1
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Farmer 2
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ATT
Average Treatment
Effect of the Treated
Farmer N
Score
Outcome
Outcome
Score
Farmer 1

Method: Data Collection

- Survey Population: Longan farmers who are located within 12 villages that are engaged in muang fai Sop Rong region.
- Stratified Random Sampling of 481 farmers.
- FGD, Pre-test, and Actual Survey conducted for 6 months (Feb – July, 2011)

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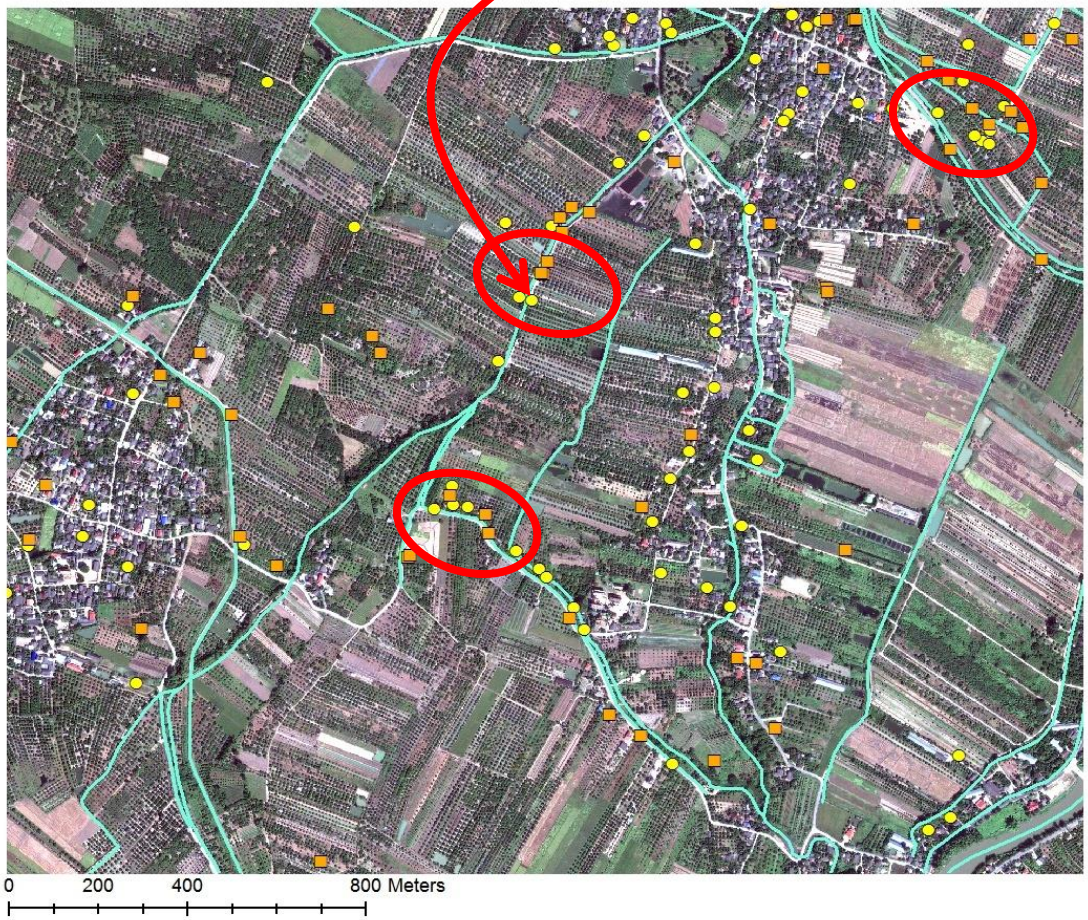
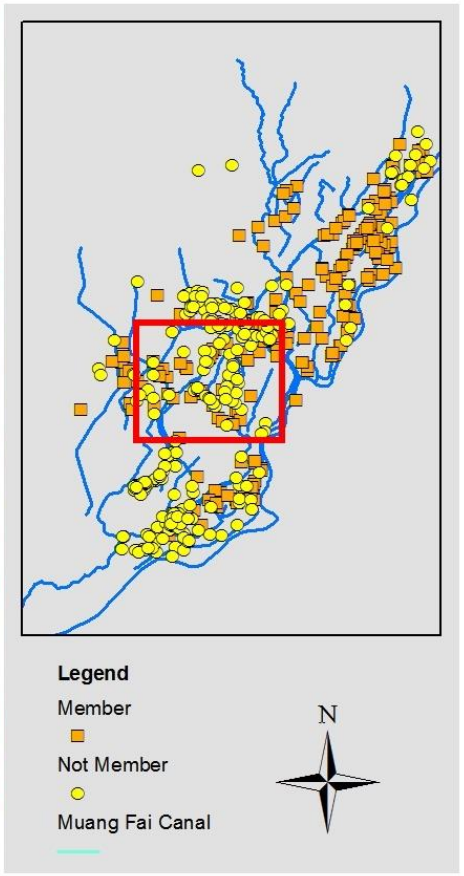
Study Area:

Distance to canal is not the sole determinants of *Muang fai* membership



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Quality of the Logit model: Pre-requisite for PSM

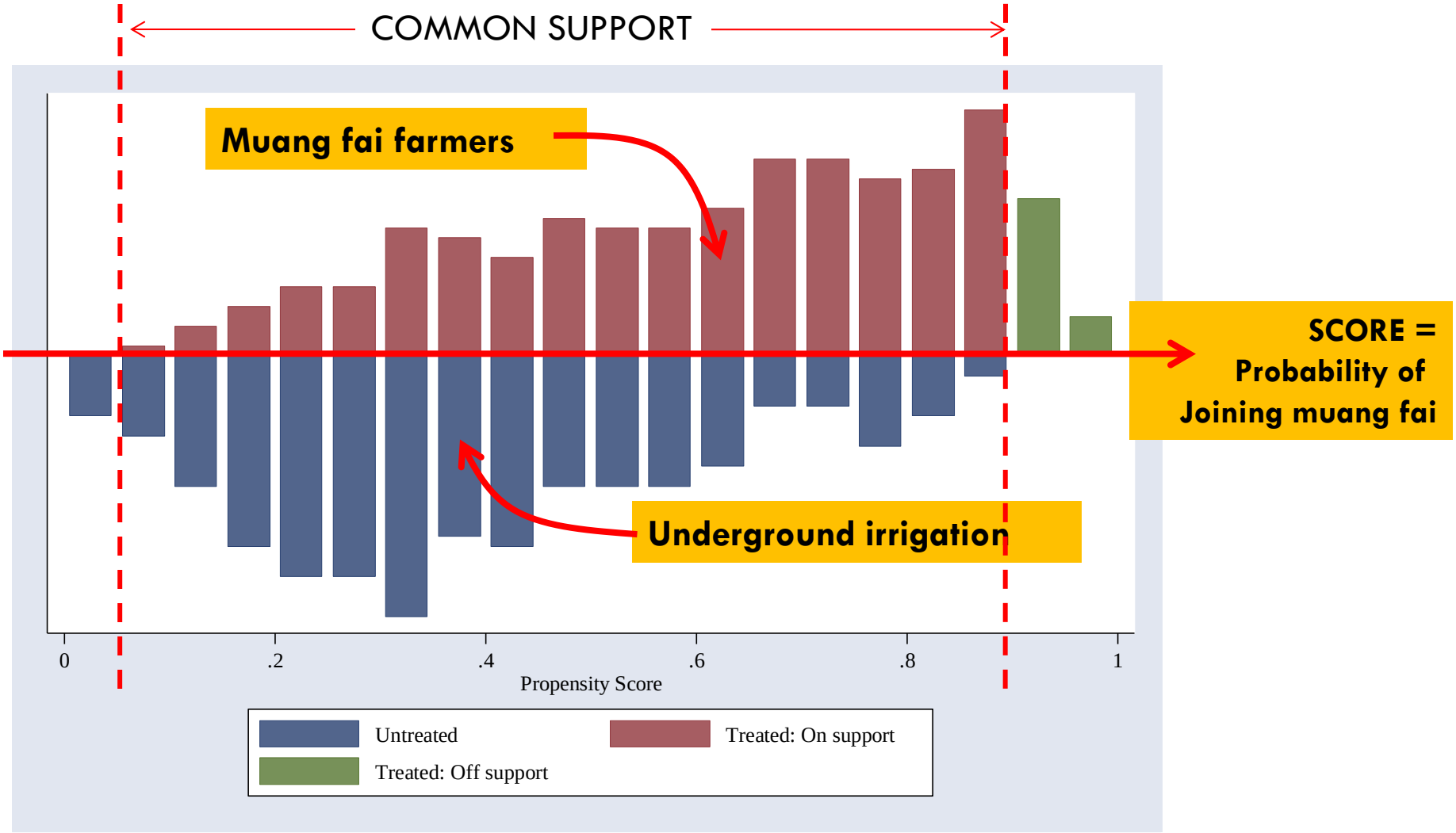
Correct prediction diagnostics

		Actual	
Prediction	member (D)	not-member (~D)	Total
muangfai member (+)	163	64	227
not-member (-)	72	166	238
Total	235	230	465

Sensitivity	Pr(+|D)	69.36%
Specificity	Pr(-|~D)	72.17%
Positive predictive value	Pr(D|+)	71.81%
Negative predictive value	Pr(~D|-)	69.75%
False + rate for true ~D	Pr(+|~D)	27.83%
False - rate for true D	Pr(-|D)	30.64%
False + rate for classified +	Pr(~D|+)	28.19%
False - rate for classified -	Pr(D|-)	30.25%
Correctly classified		**70.75%**

Goodness of fit test	Chi-squared(450)	P-value
Pearson's goodness of fit test	455.12	0.4238

PSM Validity – Common Support



PSM Results: Impact on Productivity

	Un-matched	Neighbor (1)	Neighbor (5)	Caliper (0.01)	Caliper (0.06)	Kernel	Radius	Ties
Quantity - Kg per rai								
Muang fai (treatment)	1070.2	1078.5	1078.5	1053.6	1078.5	1078.5	1078.5	1078.5
Underground (control)	972.2	952.6	892.6	985.2	952.6	929.2	972.2	952.6
Difference (ATT)	98	125.87	185.85	68.36	125.87	149.26	106.23	125.87
s.e.	(94.38)	(183.75)	(147.77)	(194.95)	(190.48)	(134.82)	(99.62)	(180.03)
Difference (%)	10.1	13.2	20.8	6.9	13.2	16.1	10.9	13.2
Sales - Baht per rai								
Muang fai (treatment)	20650.6	21039.8	21039.8	20688.4	21039.8	21039.8	21039.8	21039.8
Underground (control)	15682.9	15617.5	14640.2	15966.9	15617.5	14959.1	15682.9	15617.5
Difference (ATT)	4967.7	5422.27	6399.55	4721.48	5422.27	6080.65	5356.89	5422.27
s.e.	(1,384.65)***	(2,110.95)**	(1,809.77)***	(2,152.09)**	(2,124.78)**	(1,705.36)***	(1,478.99)***	(2,091.16)**
Difference (%)	31.7	34.7	43.7	29.6	34.7	40.6	34.2	34.7

Note: numbers in parantheses are standard errors from bootstrapping with 1,000 replications.

***) significant at 1%; **) Significant at 5%; *) Significant at 10%, ATT = Average Treatment effect on the Treated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Results: Impact on Water Conservation

	Un-matched	Neighbor (1)	Neighbor (5)	Caliper (0.01)	Caliper (0.06)	Kernel	Radius	Ties
Cubic meter per rai								
Muang fai (treatment)	883.8	887.7	887.7	898.5	887.7	887.7	887.7	887.7
Underground (control)	1727	1789.4	1560.6	1754.5	1789.4	1592.3	1727	1789.4
Difference (ATT)	-843.2	-901.73	-672.95	-855.98	-901.73	-704.57	-839.3	-901.73
s.e.	(145.11)***	(233.54)***	(179.09)***	(249.75)***	(225.16)***	(151.10)***	(146.36)***	(246.62)***
Difference (%)	-48.8	-50.4	-43.1	-48.8	-50.4	-44.2	-48.6	-50.4
Cubic meter per kg sold								
Muang fai (treatment)	1.932	1.962	1.962	2.065	1.962	1.962	1.962	1.962
Underground (control)	3.805	3.406	3.627	3.396	3.406	3.502	3.805	3.406
Difference (ATT)	-1.873	-1.44	-1.66	-1.33	-1.44	-1.54	-1.84	-1.44
s.e.	(0.53)***	(0.85)*	(0.70)**	-0.96	(0.86)*	(0.56)***	(0.56)***	(0.86)*
Difference (%)	-49.2	-42.3	-45.8	-39.2	-42.3	-44	-48.4	-42.3

Note: numbers in parantheses are standard errors from "Bootstrapping " with 1,000 replications.

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Cross-Validation: Water Quality Testing

	Non-Muang Fai (Underground)	*Muang Fai*	Ratio
pH	6.95	7.4	0.94
Electrical Conductivity (EC) (muS/cm)	547.7	250.6	**2.19**
Nitrate (mg/L)	4.94	6.33	0.78
Phosphate (mg/L)	0.56	0.35	1.63
Sodium (mg/L)	46.77	10.79	**4.33**
SAR	1.66	0.62	2.67
Iron (mg/L)	6.42	0.71	**9**
Manganese (mg/L)	1.12	0.32	3.48
Boron (mg/L)	0.15	0.14	1.13

"**Iron** coating can be deposited in leaves affecting photosynthesis, and also in fruits affecting the quality, which in turns determine the sales value of the fruits."

"The adverse effects of the high **salinity** of irrigation water on the crops can be minimized by irrigating them frequently. More frequent irrigations maintain higher soil water contents in the upper parts of the root zone while reducing the concentration of soluble salts." -- FAO (1994)

Concluding Remarks:

- The *muang fai* is a traditional irrigation management that has been practiced for generations.

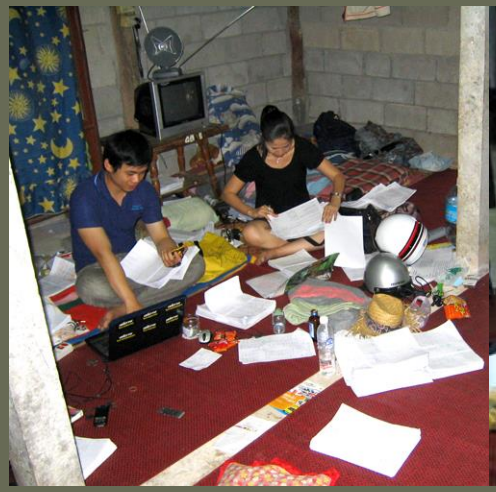
  However, research on the value of this system from environmental economics perspective is lacking.

- *Muang fai* participation is determined by various factors not only physical accessibility such as distance to the canal.

  Other factors include farm size, economic status, and social influences.

- *Muang fai* is found to have both economic and conservation value.
  - It increases farm productivity and farmer's livelihood (at least 30% improvement)
  - It use water a lot more efficiently (around 40% more efficient)

- As MF is characterized by common property management, under which a set of pre-established rules are used to distribute water among members, this study demonstrate how the traditional value in resource management still has relevance in this modern society.



THANK YOU

COMMENTS ARE WELCOME!

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