High-yield Variety Adoption in Shrimp Aquaculture in Indonesia:
Are Poor Farmers Excluded?

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Introduction

- The central role of HYVs in shifting household farms out of low-productivity traps has been well established for staple crops such as rice and maize. However, little is know regarding the adoption of HYVs for higher-value crops, such as shrimp.

- Since the introduction of the HYV shrimp in Indonesia, there has been a large increase in production as the new technology spread (Figure 1). The majority of growth in shrimp production in Indonesia appears to have stemmed from the introduction and spread of the new HYV.

Figure 1. Aggregate output in Indonesia by variety.
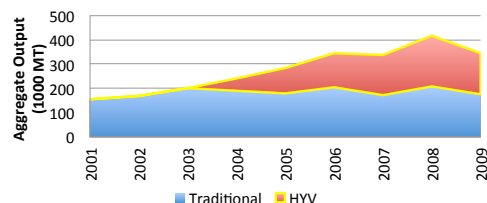
- However, very little is known regarding who these HYV adopters. It is unknown if land poor, asset poor, natural resource poor, or public good poor farm households are excluded from the adoption process.

Objective

The main objectives of this study are:

- To tests if farm scale and asset holdings are barriers to the adoption of shrimp HYV.

- To test if village level mangrove and water resource spur adoption

- To test if both public sector and private sector extension services are facilitating adoption

Methods

- Cross-section data from a survey of 1000 shrimp farming households in South Sulawesi and Central Java provinces of Indonesia are used in analysis.

- The farm household's adoption decision (D) is modeled as a short-run factor input choice that depends on output and input prices, capital and land holdings of the household.

- The model is expanded to include village level covariates such as the village mangrove endowment (M) and presence of extension branch (E)

Empirical Model & Results

$$D_i = 1[X_i\beta + \gamma L_i + \delta K_i + \theta N_v + \mu E_v + \varepsilon_i > 0]$$

$$Prob(D_i = 1) = \Phi(X_i\beta + \gamma L_i + \delta K_i + \theta N_v + \mu E_v)$$

D_i is a binary variable indicating adoption of shrimp HYV
L_i is a vector measuring the area of ponds and land the household operates
K_i is a vector measuring the households endowment of capital
N_v is a vector measuring the status of village mangrove and water resources
E_v is a vector of binary variables indicating access to extension services
X_i is a vector containing control variables (prices, risk, HH characteristics, Social capital)

Table 2. MLE Adoption Models – Selected Results.

	Coef.	SE
Land (γ)		
Pond area operated *(lagged)*	0.00	(0.023)
Crop land area operated *(lagged)*	0.02	(0.046)
Natural Resources (θ)		
Number of farmers polluting into canal	-0.01**	(0.003)
Village has mangroves	0.72**	(0.162)
Extension (μ)		
Village has extension office	-0.29	(0.258)
Village has received private extension	1.86**	(0.52)
Capital (δ)		
# of pumps owned *(lagged)*	0.22**	(0.065)
# of electricity generators *(lagged)*	0.83**	(0.302)
# of trucks owned *(lagged)*	0.41**	(0.156)
Observations	995	
Wald χ^2	257.7	

Table 3. Adoption Rates by Capital and Pond Area Terciles.

Pond Area tercile ↓	Capital tercile → First	Second	Third
First	12.9%	12.3%	44.6%
Second	12.5%	19.0%	21.9%
Third	7.3%	22.1%	35.5%

Discussion

- **Adoption Rate (Table 3)**
Households with high Land and low Capital endowments had the lowest adoption rates while households with low Land but high Capital endowments had the highest rates of adoption. HYV adopters tend to have higher capital to land ratios than non-adopters.

- **Land (γ)**
A major finding is that farm size – either in ponds or in non-aquaculture land – does NOT have a significant effect on shrimp HYV. This is implies that, when holding other factors constant, small holder farms are not being excluded from the adoption of HYV.

- **Natural Resources (δ)**
The presence of mangroves along the village coast is observed to significantly increase the probability that a farmer will adopt HYV. Households appear to take the erosion mitigating effects of mangroves into consideration when deciding to adopt the HYV.

The pollution in shared water resources are also found to deter HYV adoption. A village's ability to manage common resources will be important for the dissemination of the HYV.

- **Extension (μ)**
While public extension was not observed to have a significant impact on adoption, private sector extension was found to have a very strong positive impact.

- **Assets (δ)**
We find that capital endowments significantly increase the probability of adoption. Farm households appear to face an investment barrier in the adoption of shrimp HYV.

Conclusion

- Small farms are not being excluded from HYV adoption and are equally capable of adopting as their larger counterparts. However, households may face capital barriers to adoption.

- The status of mangrove and shared water resources are important in the household's HYV adoption decision. The conservation of these resources are important to the dissemination of the technology.

- Private extension services are effective in stimulating varietal shift. Donor agencies and governments can also aid households in overcoming barriers with the design extension programs.