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How Expectations, Information, and Subsidies Influence Farmers' Use of Alternate Wetting and Drying in Vietnam's River Deltas

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Introduction

Ratifying the Paris Agreement resulting from the 21st Conference of Parties, the Vietnamese Government committed to an eight percent reduction of greenhouse gas (GHG) emissions by 2030 as compared to the estimated business as usual scenario [1]. This intended nationally determined contribution (NDC) of eight percent is reflective of using only domestic resources and the NDC could increase to as much as a **25% reduction in GHGs** with international support [1]. Agriculture is the second largest annual GHG-emitting sector in Vietnam behind the energy sector, representing 23% of total annual GHG emissions in Vietnam with 54% of all agricultural emissions coming from rice production [2]. GHG emissions from rice are primarily from methane (CH_4) gas that is created through anaerobic fermentation of organic matter by bacteria in the soil (see figure 1).

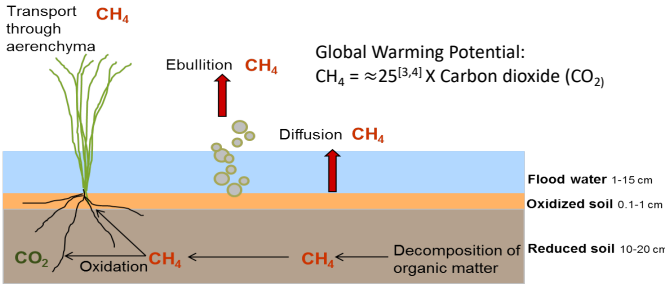

Figure 1: Methane production process in rice paddies (REF: IRRI Rice Knowledge Bank)

The methane process seen in Figure 1 shows the paddy environment in the standard practice of continuously flooded (CF) rice. This process can be disrupted by following the irrigation management practice, **Alternate Wetting and Drying** (AWD), in which water in rice paddies follow periods of saturation by aeration. Using a single aeration can reduce methane emissions by 40% [4] and multiple aerations can **reduce methane emissions by 48%** [5]. While AWD appears to be a viable option for Vietnamese farmers in the deltas, factors that influence a farmer's decision of whether or not to use AWD are not well understood. The objectives of this study are to try to better understand factors that influence farmers' decisions to use AWD or not with a specific focus on expectations of AWD, sources of agricultural information, and the perception of receiving an irrigation subsidy. Furthermore, this study investigates whether or not those expectations match reality by looking at the production data of AWD and CF farmers.

Methods and Materials

This study analyses producer's decisions on whether or not to use AWD with primary data collected in the Mekong and Red River Deltas of Vietnam (Figure 2) using **McFadden's conditional logit model**. Since producers face only two decisions in this model, practice AWD or do not practice AWD, McFadden's model simplifies to the standard logistic regression model in the form:

$$Y_i = F\left(\beta_o + \sum_{k=1}^{n} \beta_k x_{ik}\right) + \mu_i,$$

Where Y_i is the choice outcome of a farmer using AWD and takes the value:

$$Y_i = \begin{cases} 1: farmer\ practices\ AWD \\ 0: farmer\ does\ not\ practice\ AWD \end{cases}$$

F denotes the use of a standard logistic distribution function, x_i is a vector of k independent variables, and μ_i is the error term for each individual i. The regressors in this model are attributes of the individual respondents (n=225) or of the objects of choice that are included if it is expected that they will have an impact on the outcome of the decision maker, particularly expectations of AWD, information, and perceived subsidies for irrigation.

Results / Discussion

Results indicate that **information sources, expectations of increased weeding cost, and perceived water subsidy are all significant factors in farmers' decisions to use AWD** or not (Table 1). Farmers who received agricultural information from local staff, non-government organizations (NGO), and neighbors were all more likely to use AWD. The largest cost of implementing AWD is additional weed management, and expectation of this cost reduced the likelihood of using AWD. Conversely, the largest savings of implementing AWD – decreased water use – was not significant. AWD was shown to **reduce water use by 30% in Vietnam** [6] but this was not a significant factor in AWD use. This could be partially explained by the positive and significant marginal effect (20.5%) of perceived water/irrigation subsidy. While the government provides similar support for all farmers in the Mekong Delta and Red River Delta, perceptions of the water subsidy varied across households and the prices paid on average varied based on perceived support. Farmers who reported 'yes' had significantly lower irrigation costs than farmers who reported 'no'.

Table 1 Conditional logit model and marginal effects.

	Logistic		Marginal Effect	
Variable	Coef.	Std. Err.	$\Delta Y/\Delta X^{\ddagger}$	Std. Err.
Primary school or less	-0.109	0.480	-0.016	0.069
HH income from farming (%)	0.014*	0.007	0.002**	0.001
Technology awareness	0.702***	0.222	0.100***	0.029
Self-reported risk preference	0.577***	0.208	0.083***	0.028
AWD water use expectation	-0.250	0.264	-0.036	0.038
AWD fertilizer expectation	-0.224	0.227	-0.032	0.032
AWD pest expectation	0.050	0.202	0.007	0.029
AWD weed expectation	-0.531**	0.217	-0.076**	0.030
AWD weather loss expectation	0.334	0.214	0.048	0.030
AWD costs expectation	-0.128	0.222	-0.018	0.032
AWD lodging expectation	-0.308	0.221	-0.044	0.031
AWD harvest expectation	-0.186	0.185	-0.027	0.026
AWD soil quality expectation	-0.098	0.230	-0.014	0.033
AWD yield expectation	0.317	0.224	0.045	0.032
AWD calendar expectations	-0.125	0.211	-0.018	0.030
Ag info TV / radio	-1.002*	0.523	-0.143**	0.073
Ag info local staff	1.370**	0.574	0.196**	0.078
Ag info company	-0.751*	0.457	-0.107*	0.064
Ag info NGO	2.464***	0.580	0.352***	0.071
Ag info neighbor	0.864**	0.405	0.124**	0.056
Perceived water subsidy	-1.432***	0.469	-0.205***	0.062
Constant	-1.918**	0.798		

‡: Marginal effects are taken at the means of all variables

Table 2 Cost and Return results by AWD use

	AWD	CF	Difference‡
Yield (kg/ha)	6,498.11 (946.41)	6,044.61 (1,037.84)	453.5***
Rice price (USD/kg)	0.30 (0.05)	0.30 (0.06)	0.00
Gross income	1,907.02 (234.32)	1,749.14 (245.89)	157.88***
Cost-land prep	135.23 (85.85)	131.4 (93.76)	3.83
Cost-planting	96.19 (61.46)	94.19 (59.1)	2.00
Cost-fertilizer	201.47 (83.14)	200.73 (74.01)	0.74
Cost-weeding	20.93 (18.83)	13.67 (10.71)	7.26***
Cost-pest control	38.25 (32.67)	31.19 (29.65)	7.06**
Cost-irrigation	34.88 (29.97)	37.33 (29.01)	-2.45
Cost-harvest	117.13 (52.02)	114.05 (38.95)	3.08
Cost-post harvest	3.04 (8.03)	4.57 (10.45)	-1.53
Total costs	647.12 (195.2)	627.13 (175.98)	19.99
Net income	1,259.9 (284.94)	1,122.01 (300.41)	137.89***

Note: '***', '**', and '*' are significant at the 1%, 5%, and 10% level, respectively
‡: difference is AWD minus CF and all significance tests determined using t-test
Values in parentheses are standard errors
All values reported in USD per hectare unless otherwise indicated

A cost and return analysis (shown in Table 2) confirmed producers' expectation from the logit model that AWD increases weeding costs. AWD farmers spent on average **USD 7.26/ha more on weeding**, as well as **USD 7.06/ha more on pest control**. However, there was no significant difference between AWD and CF farmers with respect to total costs. Furthermore, higher yields from AWD farmers resulted in a significantly **higher net income of USD 137.38/ha**. Even though AWD reduces water use by 30% [6], these savings were not seen in Table 2.

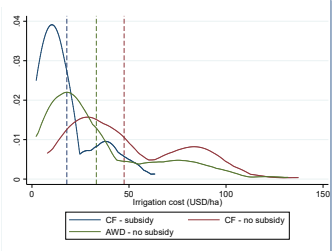

Figure 2: Irrigation cost by AWD and subsidy

These cost savings could be offset by water subsidies. When CF farmers' irrigation costs are bifurcated by their response to receipt of a subsidy and compared to AWD farmers, **no-subsidy** farmers pay **USD 14.31/ha more** and **yes-subsidy** farmers pay **USD 15.21/ha less** than AWD farmers. It appears that the irrigation subsidy cancels out any economic savings realized by farmers who used AWD.

Conclusions

The Vietnamese government is working towards meeting their stated NDC of a 25% reduction in emissions. Rice is a major contributor to GHG emissions and nearly 50% of GHG emissions can be abated by using AWD. The **main economic benefit** of AWD, lower irrigation costs, are **not realized by farmers** when irrigation water is subsidized. This can be seen in this study where **AWD use is reduced by as much as 21% when farmers reported receiving an irrigation subsidy**. A reduction in irrigation subsidies can increase AWD use and decrease GHG emissions from rice production, moving Vietnam closer to meeting their NDC.

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References

1. Government of Viet Nam. (2015). Intended Nationally Determined Contribution of Viet Nam. Hanoi, Vietnam.
2. USAID. (2016). Greenhouse Gas Emissions in Vietnam. Washington DC.
3. Aulakh, M. S., Wassmann, R., & Rennenberg, H. (2001). Methane emissions from rice fields—quantification, mechanisms, role of management, and mitigation options. Advances in Agronomy, 70, 193–260.
4. Wassmann, R., Neue, H. U., Lantin, R. S., Makarim, K., Chareonsilp, N., Buendia, L. V, & Rennenberg, H. (2000). Characterization of methane emissions from rice fields in Asia. II differences among irrigated, rainfed, and deepwater rice. Nutrient Cycling in Agroecosystems, 58(1–3), 13–22.
5. Sander, B. O., Wassmann, R., & Siopongco, D. L. C. (2015). Gas Emissions from Rice and Empirical Evidence. In C. Hoanh, V. Smakhtin, & R. Johnston (Eds.), Climate Change and Agricultural Water Management in Developing Countries (pp. 193–207). Wellingford, United Kingdom: CABI Publishing.
6. Quicho, E. (2013). Evaluation of the Adoption and Economic Impacts of Alternate Wetting and Drying Technology in Irrigated Rice-Growing Areas in An Giang Province in the Mekong Delta, Southern Vietnam, 2007(M), 90–92.

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