The Effect of Fish Farmers' Association on Technical Efficiency: An Application of Propensity Score Matching Analysis

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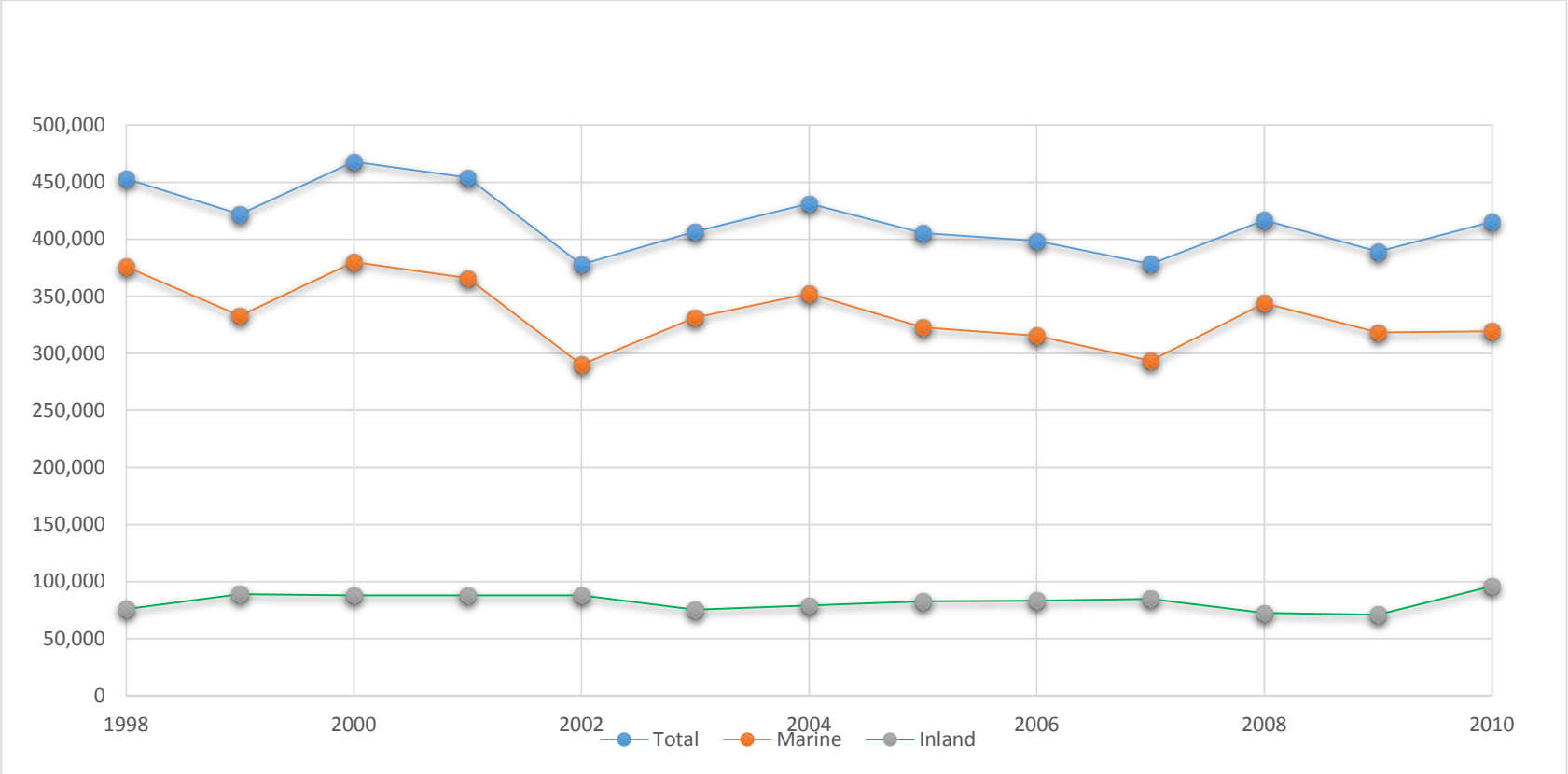
Outline of Presentation

- Background and Motivation
- Objectives
- Methodology
- Results and Discussions
- Conclusions

Background and Motivation

Marine and Inland Capture Productions



Background and Motivation

- Fish farm - a major alternative for fish production
- Lack of adequate resources to boost production, thus, improvement in technical efficiency is paramount

- The role of fish farmers' associations has become important
- Due to institutional failure in the public sectors, Donors and NGOs often prefer to deal with fish farmers through FFAs
- GPRS II, 2006-2009, MNDPF, GSGDA, FASDEP II all place emphasis FFAs

- While the role of FFAs is widely recognized, its impact on technical efficiency among their members remain unproven

Objective of Study

- This study adopts the stochastic frontier model and the propensity score matching:
  - To analyse FFA member and non-member fish farmers on their productivity and technical efficiency levels

- The study also identifies the determinants of technical efficiency

Methodology

Study Area & Data

- Two districts each in Greater Accra, Ashanti, Western and Volta regions of Ghana
- The study employs 80 farmers in each Region making a total of 320 observations through a random selection.

Variables

- ***Output variable:*** Harvest/Ha (Kg)
- ***Input variables:*** Fingerlings/ha (Kg); Feed/ha (GH¢); Labour/ha (man-days); Other Cost/ha (GH¢).
- ***Inefficiency variables:*** Age, Gender, HhSize, Extension, Experience, Education, Full Time, Pond Type, Ownership, FFFE, Market Access, VR, AR, WR

Theoretical Models

- Frontier Model:

$$LnY_i = \beta_0 + \sum_{n=1}^{4} \beta_n LnX_{ni} + \tfrac{1}{2} \sum_{n=1}^{4} \sum_{m=1}^{4} \beta_{nm} LnX_{ni} LnX_{mi} + (v_i - u_i)$$

- Inefficiency Model:

$$\mu_i = \delta_0 + \sum_{m=1}^{13} \delta_m Z_{mi}$$

- Explanatory variables expressed above

Propensity Score Matching Method

$$ATE = E[E\{Y_i^1 \mid D_i = 1, p(Z_i)\} - E\{Y_i^0 \mid D_i = 0, p(Z_i)\}]$$

$$ATT = E[E\{Y_i^1 \mid D_i = 1, p(Z_i) - E\{Y_i^0 \mid = 0, p(Z_i)\} \mid D_1 = 1]$$

$$ATU = E[E\{Y_i^1 \mid D_i = 1, p(Z_i) - E\{Y_i^0 \mid = 0, p(Z_i)\} \mid D_i = 0]$$

- Where $D = \{0,1\}$ is the indicator of exposure to belong to FFA and Z is vector of pre-membership characteristics
- Estimates of models were computed using STATA

Results and Discussion

Table 1: Descriptive statistics for the membership of fish farmers to Fish Farmers Association

Variable name	Variable definition	Members N = 111 (35.02%) Mean	Members N = 111 (35.02%) S.d	Non-Members N = 206 (64.98%) Mean	Non-Members N = 206 (64.98%) S.d	Difference in Means
Treatment Variable						
FFA Membership	1 if farmer is a member of FFA, 0 otherwise					
Outcome Variables						
TE	Technical Efficiency level of fish farmers	0.76	0.22	0.67	0.27	**0.09*** **
Yield (Kg/ha)	Quantity of fish harvested per hectare	71,878.00	15,515.80	26,110.28	69,094.55	**45,767.73*** **
Independent Variable						
Household Characteristics						
Age	Age of fish farmer (in years)	48.44	10.89	46.29	11.43	**2.16***
Gender	1 if fish farmer is a male; 0 if a female	0.76	0.43	0.73	0.44	**0.02**
Education	Years of formal education of fish farmer	11.14	4.67	8.84	5.59	**2.30*** **
HHS	Household size (in numbers)	7.59	5.25	7.37	3.70	**0.23**
Experience	Years a farmer has engaged in fish farming	7.14	6.78	11.03	11.03	**-3.89*** **
Institutional and Farm-level Characteristics						
Training	1 if farmer receives training; 0 otherwise	0.57	0.50	0.42	0.50	**0.15*** **
Extension	1 if receives extension services; 0 otherwise	0.66	0.48	0.55	0.50	**0.10** **
Market	1 if has access to market; 0 otherwise	0.50	0.50	0.50	0.50	**0.00**
Ownership	1 if farmer owns the farm; 0 otherwise	0.63	0.48	0.50	0.50	**0.13** **
Full Time	1 if into full time fish farming; 0 otherwise	0.28	0.45	0.22	0.41	**0.06**
Pond Type	1 if farmer uses cage; 0 if uses earthen pond	0.67	0.47	0.53	0.50	**0.14*** **
Location Dummies						
Greater Accra	1 if farmer is located Greater Accra; 0 otherwise	0.07	0.26	0.34	0.47	
Volta Region	1 if farmer is located in Volta; 0 otherwise	0.44	0.50	0.16	0.37	
Ashanti Region	1 if farmer is located in Ashanti; 0 otherwise	0.18	0.39	0.28	0.45	
Western Region	1 if farmer is located in Western; 0 otherwise	0.31	0.46	0.22	0.09	

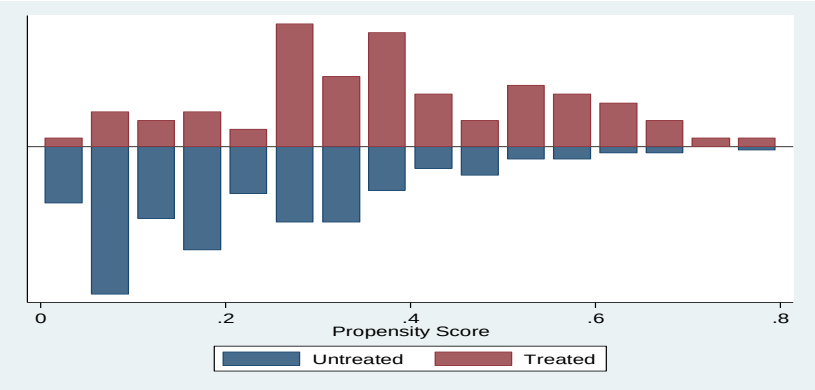
Source: Field Survey, 2013.

* Denotes significance at 10%; ** Denotes significance at 5%; *** Denotes significance at 1%.

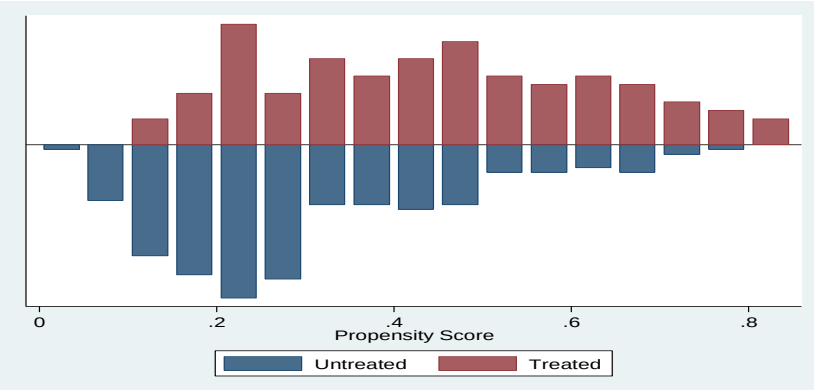
Figure 1: Distribution of propensity scores for unmatched and matched samples

Impact on Technical Efficiency of Fish Farmers

Unmatched

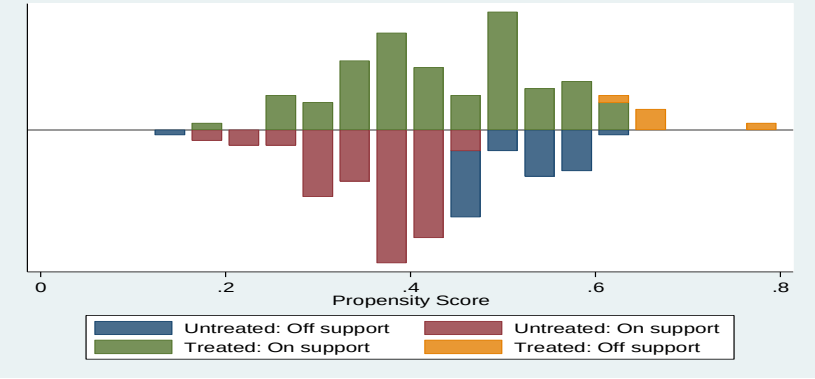


Matched

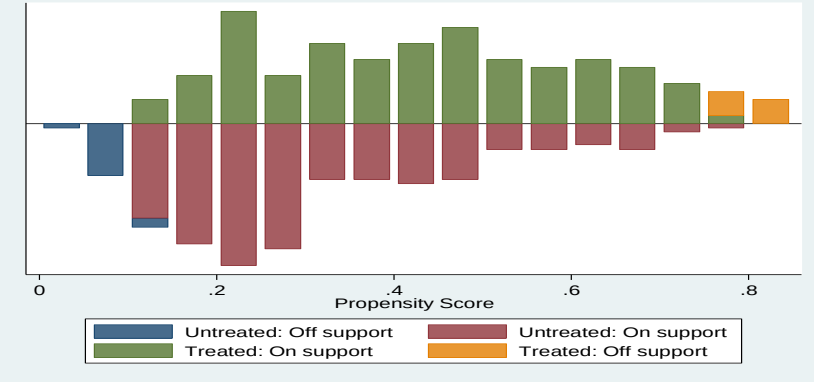


Impact on Yield (Quantity of fish harvested in Kilograms/ha)

Unmatched



Matched



Treatment Effects Analysis of Fish Farmers Association Participation

Outcome Indicator	PSM			Critical value of (hidden bias)
	ATT	ATU	ATE	
Technical Efficiency (TE)	0.12 (3.44)	0.07 (2.14)	0.09 (2.83)	1.60
Quantity Harvested (Kg/ha)	3,436 (2.02)	3,146 (1.97)	3,249 (2.09)	1.75

Frontier Model Estimates

Variable	Coefficient	t-value	p-value
Stochastic Frontier			
Constant	-0.0404	-0.36	0.723
LnFingerlings	0.3389***	3.22	0.002
LnFeed	0.1017	-1.47	0.143
LnLabour	0.3560***	3.75	0.000
LnOC	0.3661***	4.44	0.000
½(LnFing)^2	0.0988	0.90	0.369
½(LnFeed)^2	-0.0055	-0.07	0.943
½(LnLabour)^2	0.0683	0.57	0.572
½(LnOC)^2	-0.1175*	-1.70	0.091
LnFing*LnFeed	-0.1174*	-1.68	0.095
LnFing*LnLabour	0.0358	0.49	0.626
LnFing*LnOC	0.1006	1.37	0.174
LnFeed*LnLabour	-0.0274	-0.38	0.701
LnFeed*LnOC	0.0724	1.13	0.263
LnLabour*LnOC	-0.0557	-0.74	0.460
Variance Parameter			
$\gamma = \sigma_u^2 / (\sigma_u^2 + \sigma_v^2)$	0.89		
Log likelihood function	-174.69		
Mean efficiency	0.78		

Source: Field Survey; *, **, *** Denote significance at 10%, 5% and 1%, respectively

Inefficiency Estimates

Variable	Coefficient	t-value	p-value
Constant	3.5881	1.41	0.161
Age	0.4108***	3.09	0.002
Gender	-0.2243**	-2.24	0.027
Household Size	0.0286	0.80	0.428
Extension	-7.4335***	-3.45	0.001
Experience	0.2453***	2.66	0.009
Education	-0.2289**	-2.35	0.020
Full Time	-5.7923***	-3.02	0.003
Pond Type	-6.8156***	-2.95	0.004
Ownership	-8.5791***	-2.97	0.004
Training (FFFE)	-0.2830	-0.58	0.563
Market Access	-18.4157***	-5.32	0.000
Volta Region	-0.3514***	-2.94	0.000
Ashanti Region	-0.0433*	-1.68	0.095
Western Region	-0.0119*	-1.67	0.097

Source: Field Survey; *, **, *** Denotes significance at 10%, 5%, and 1%, respectively

Conclusions

- The study demonstrate that all input variables positively influence fish farm output except feed at a increasing returns to scale

- Participation in FFA exerts a positive and statistically significant impact on technical efficiency and yield

- Joint effect of exogenous variables significantly influence efficiency of farmers, whilst it is observed that cage pond farming was more technical efficient than earth pond farming

Acknowledgement

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Thank you for your attention