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Measuring Micronutrient Productivity in Integrated Aquatic Farming Systems for Nutrition Sensitive Agriculture

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Previously titled: *Productivity of Micronutrients from Integrated Aquaculture-agriculture Systems: Evidence from Bangladesh*

CGIAR Securing the Food Systems of Asian Mega-Deltas for Climate and Livelihood Resilience

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Background

Nutrition-sensitive agriculture (NSA): Programs to address the underlying causes of malnutrition

Why the recent push for NSA programs?

Triple burden of malnutrition persisted even after green revolution

A key component of NSA is *crop diversification*

→ *Improved diets and nutrition*

NSA within **aquaculture** → Integrated aquaculture-agriculture (IAA)

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Setting

Bangladesh: IAA is common

→limited research on whether these practices improve productivity of micronutrients

RQ: What is the nutritional productivity of different integrated farming systems?

Data sets:

- Fish Innovation Lab, collected December 2020 and January 2021
  - Production amounts and value per sample pond
- Bangladesh Food Composition Tables
- Bangladesh Department of Fisheries report 2020
- Bangladesh Housing and Population Census 2022

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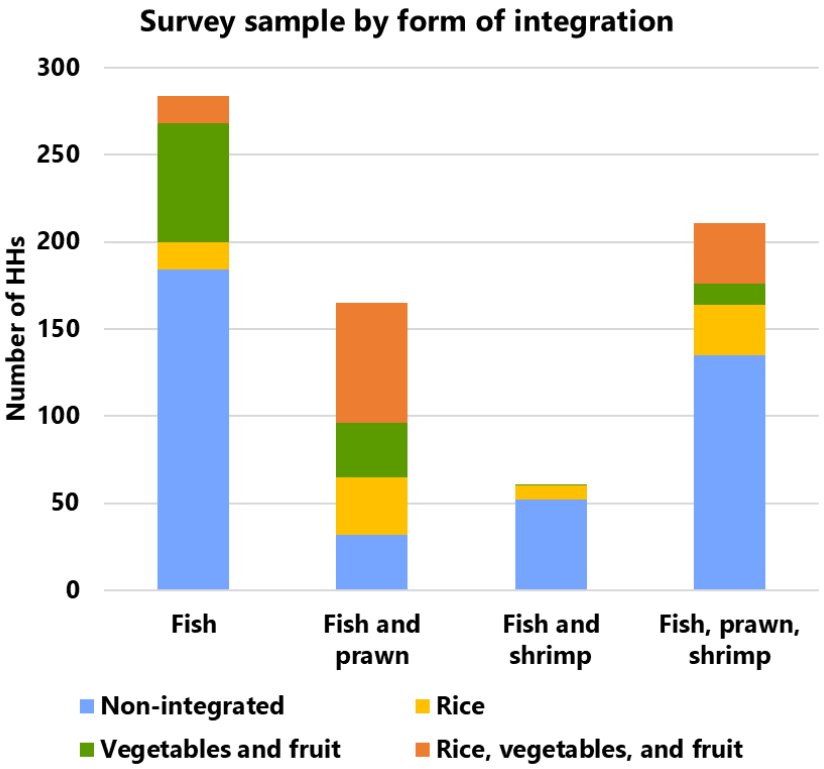
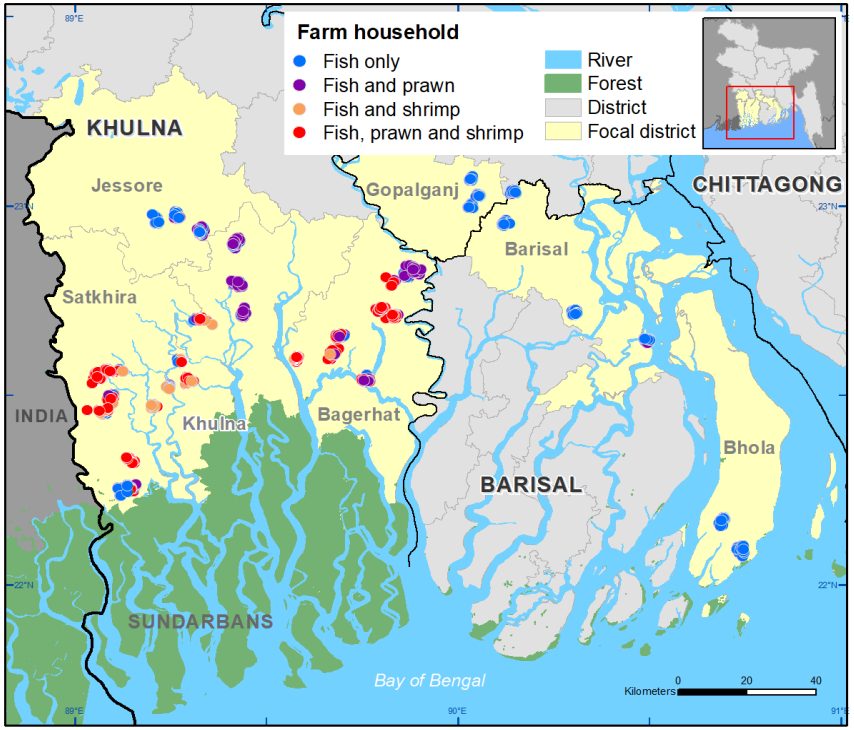
Survey sample





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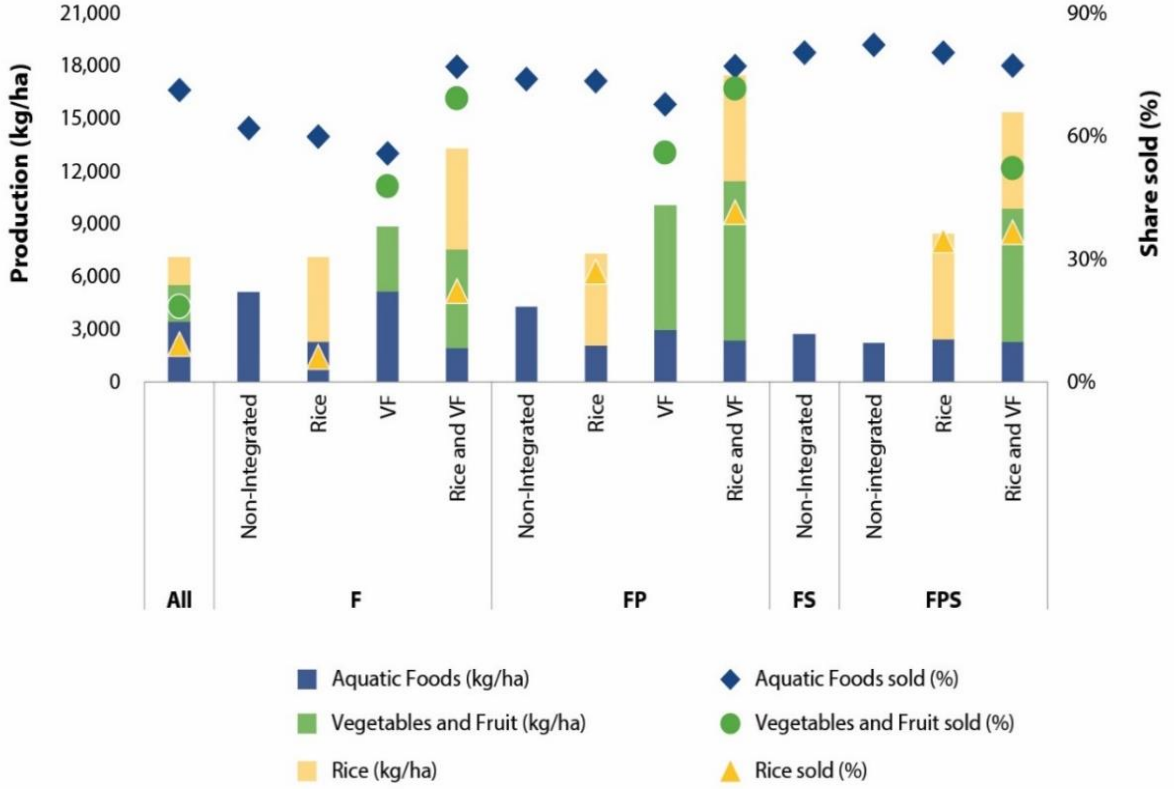
Quantities of aquatic foods, rice, and vegetables and fruit produced (kg/ha) and shares sold (%), by farming system



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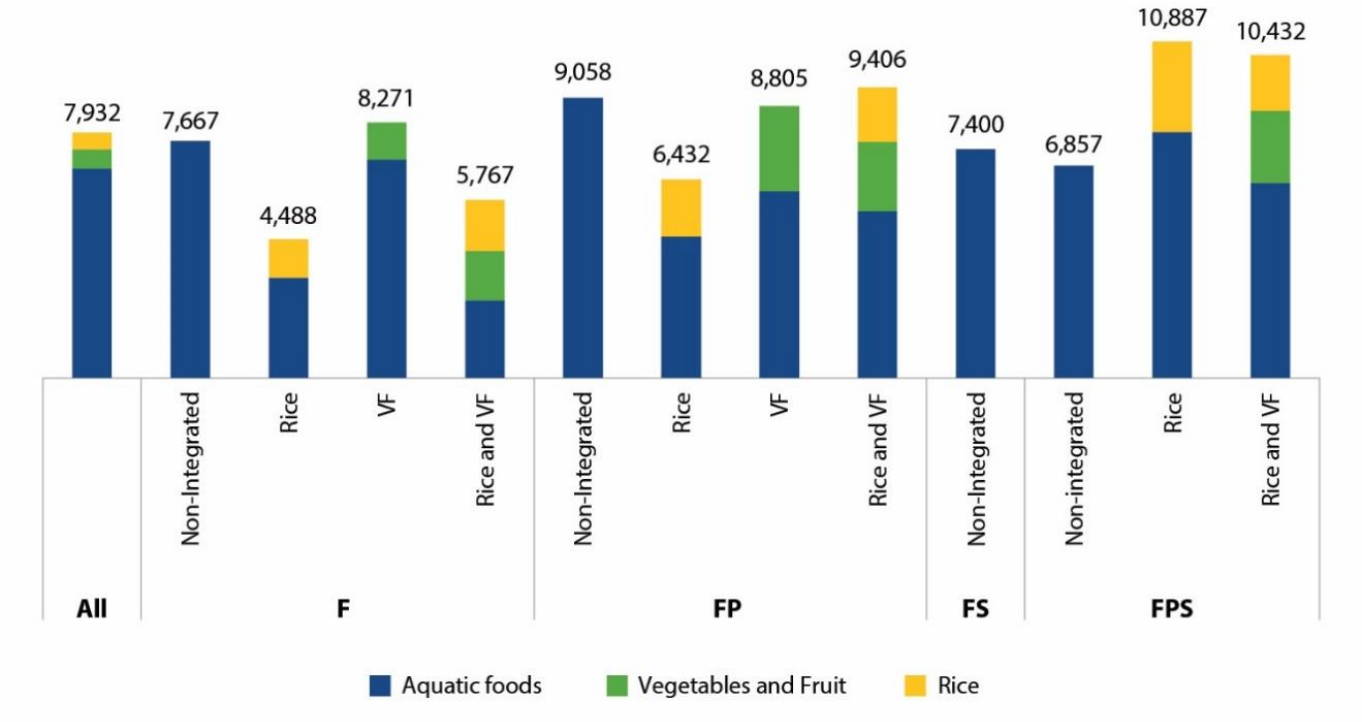
Average gross revenue (USD/ha) by farming system and crop group



Nutrient productivity

- Measured by annual Adult Equivalents (AEs) per Ha

- An AE is the minimum nutrient intake needed for the average adult
  - Recommended Daily Allowances (RDAs) used in this analysis are **2,200 kcal, 55 g protein, 1000mg calcium, 13mg iron, 10mg zinc, 900µg RAE vitamin A, and 2.5mg vitamin B12**

- We multiply AE by 365 to calculate annual AEs
  - Example, average HH in our sample produced enough kcal/Ha for 22 adults to meet their energy requirements for a year

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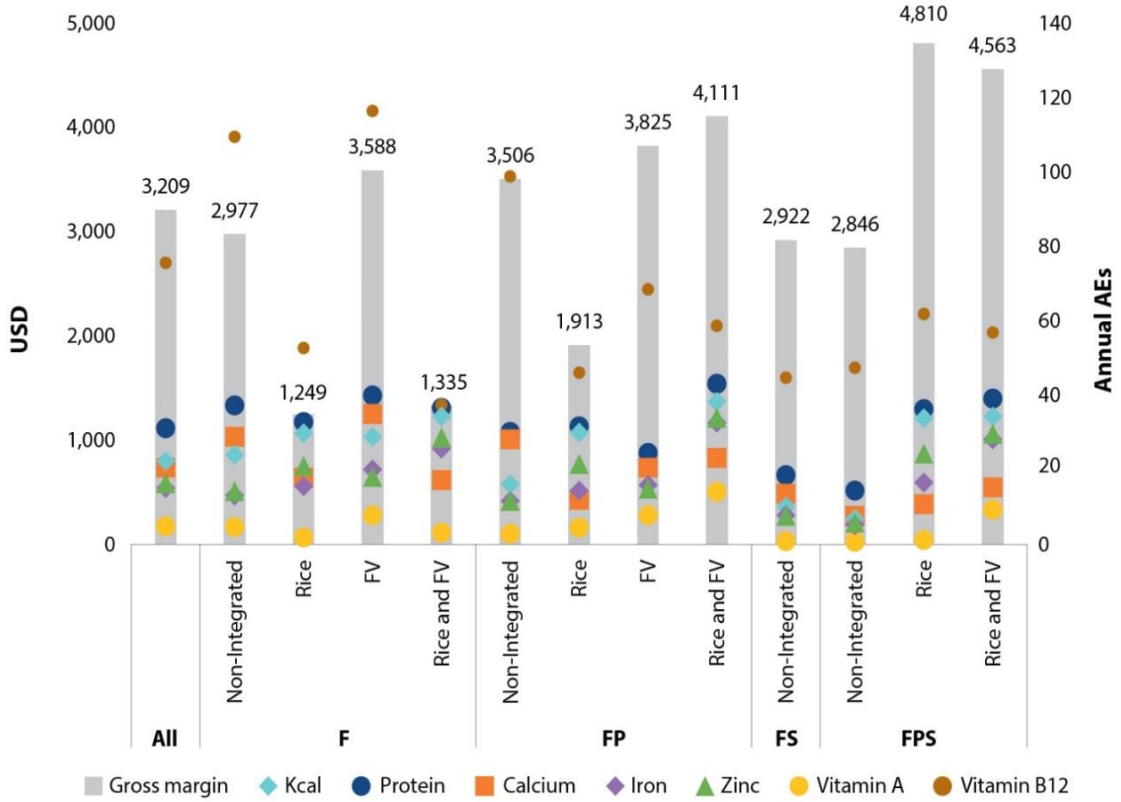
Economic productivity (gross margin, USD/ha) and nutrient productivity (AE/ha of energy, protein, and selected minerals and vitamins), by farming system



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OLS regression analysis: correlates of economic and nutritional productivity

Production (t/ha)	Gross margin (USD/Ha)	Kcal (AEs/ha)	Protein (AEs/ha)	Calcium (AEs/ha)	Iron (AEs/ha)	Zinc (AEs/ha)	Vitamin A (AEs/ha)	Vitamin B12 (AEs/ha)
Carp	1410.3***	3.6***	7.3***	6.5***	2.6***	2.9***	0.2*	24.9***
	(66.4)	(0.1)	(0.0)	(0.3)	(0.1)	(0.1)	(0.1)	(1.2)
Oth. stocked fish	460.2***	7.2***	7.1***	2.3***	1.8***	2.0***	1.1***	21.6***
	(48.8)	(0.1)	(0.0)	(0.2)	(0.1)	(0.0)	(0.1)	(0.9)
Unstocked fish	-209.9	4.6***	7.7***	12.5***	5.0***	4.2***	3.7***	-1.2
	(395.6)	(0.8)	(0.3)	(1.7)	(0.7)	(0.4)	(0.7)	(7.3)
Crustaceans	3899.6***	0.5	5.0***	1.2	2.3***	2.5***	-0.3	31.1***
	(180.1)	(0.4)	(0.1)	(0.8)	(0.3)	(0.2)	(0.3)	(3.3)
Rice	553.2***	4.3***	3.3***	-0.2	1.7***	3.0***	0	0.2
	(42.0)	(0.1)	(0.0)	(0.2)	(0.1)	(0.0)	(0.1)	(0.8)
Leafy vegetables	-26	-0.2	1.8***	3.3	3.4***	3.3***	10.5***	0.8
	(604.1)	(1.3)	(0.4)	(2.5)	(1.0)	(0.5)	(1.0)	(11.2)
Vit. A-rich veg	351.0***	0.1	0.6***	1.2**	1.1***	0.2**	8.9***	-0.5
	(114.6)	(0.2)	(0.1)	(0.5)	(0.2)	(0.1)	(0.2)	(2.1)
Root crops	-3222.9	-0.7	-1.1	5.8	-1.6	4.0**	-3.2	3.8
	(2236.1)	(4.7)	(1.6)	(9.4)	(3.7)	(2.0)	(3.7)	(41.3)
Nuts/oilseeds	384.1**	3.9***	2.0***	5.5***	6.7***	1.6***	1.5***	2.6
	(174.0)	(0.4)	(0.1)	(0.7)	(0.3)	(0.2)	(0.3)	(3.2)

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Do the households in our sample produce enough food from aquaculture to feed themselves a healthy diet?

All ponds on farm	All farms	Fish				Fish/prawn				Fish/ shrimp	Fish/prawn/shrimp		
		NI	R	VF	RVF	NI	R	VF	RVF	NI	NI	R	RVF
Avg. AEs per HH	*3.9*	*3.9*	*4.1*	*3.6*	*4.1*	*3.5*	*4.0*	*3.8*	*4.2*	*4.0*	*3.8*	*3.6*	*4.1*
Pond area (Ha)	*0.58*	*0.31*	*0.36*	*0.22*	*0.54*	*0.43*	*0.63*	*0.45*	*0.59*	*0.84*	*0.88*	*1.15*	*0.94*
Share of HH AE's produced (%)													
Kcal	293	189	282	196	441	113	875	194	499	110	172	726	572
Protein	386	267	295	273	441	216	878	310	538	203	374	784	656
Calcium	199	173	125	245	179	165	240	248	261	96	200	228	244
Iron	188	87	137	135	292	72	400	202	394	79	135	357	448
Zinc	217	96	199	119	351	83	612	196	428	86	150	520	475
Vitamin A	49	29	9	56	28	30	69	107	133	7	17	19	147
Vitamin B12	920	757	441	1043	371	794	1169	825	706	412	1384	1423	1106

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What is total amount of nutrients produced by aquaculture in this region?

District	Kcal (%)	Protein (%)	Ca (%)	Fe (%)	Zn (%)	Vit A (%)	Vit B12 (%)
Bagerhat	176	214	103	129	145	42	409
Barisal	15	21	16	9	9	4	74
Bhola	18	23	13	8	9	2	52
Gopalganj	7	11	10	5	5	1	26
Jessore	37	54	58	30	28	14	146
Khulna	58	75	41	41	47	7	157
Satkhira	51	90	58	35	38	5	232
All district total	49	68	44	33	36	10	166

Estimated 521,892 HHs practice aquaculture ≈ 16% of population

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Conclusion

- Supply side approach to estimate the nutrient productivity of diverse farming systems in Southwest Bangladesh
- Include nutrition sensitive metric for agricultural productivity, expressed as production of kcals, protein, and micronutrients, relative to human nutritional requirements (AEs/ha)

Main finding: IAA can be beneficial for both economic and nutritional productivity

- We use this finding to identify and promote crop combinations to optimize both outcomes

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Thank You

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