

The Making of a **BLUE REVOLUTION** in Bangladesh

{ Enablers, Impacts, and the Path Ahead for Aquaculture }

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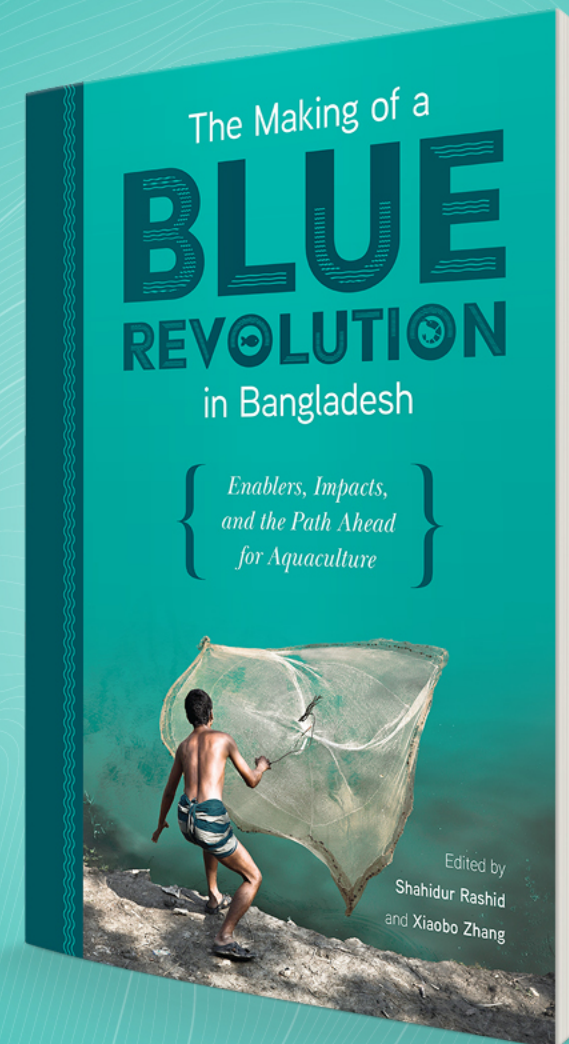
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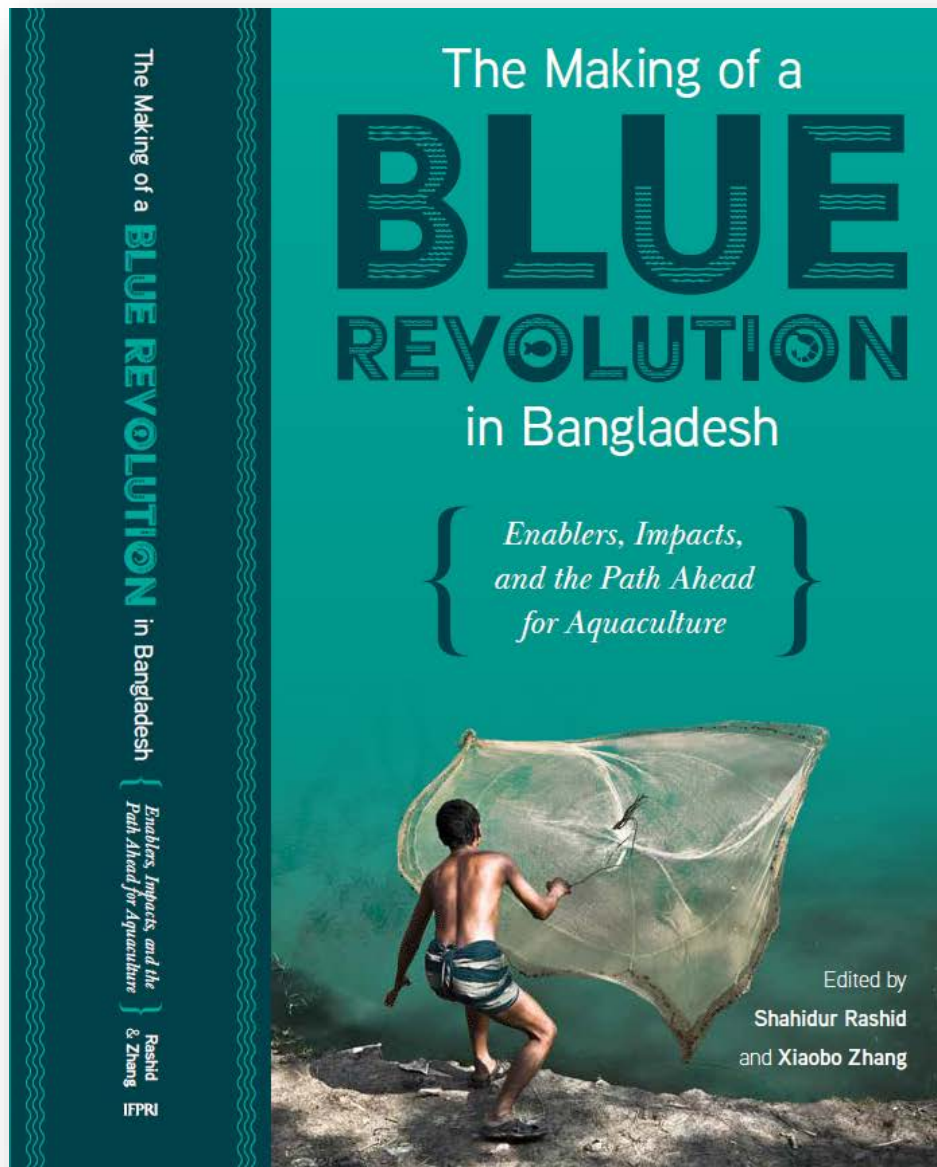
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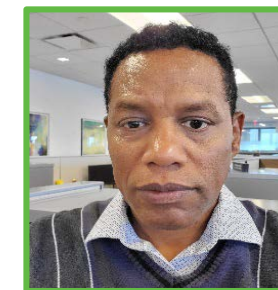


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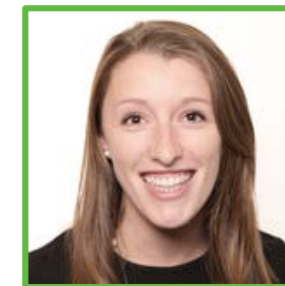


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Introduction

The context

■ The global context

1. Fisheries and aquaculture feature prominently in the SDGs, with direct links to SDG-14 & critical indirect links to others (e.g., SDG-12, 13, and 3)
2. Globally, fish accounts for about 20% of animal source protein consumption by humans

■ Bangladesh context

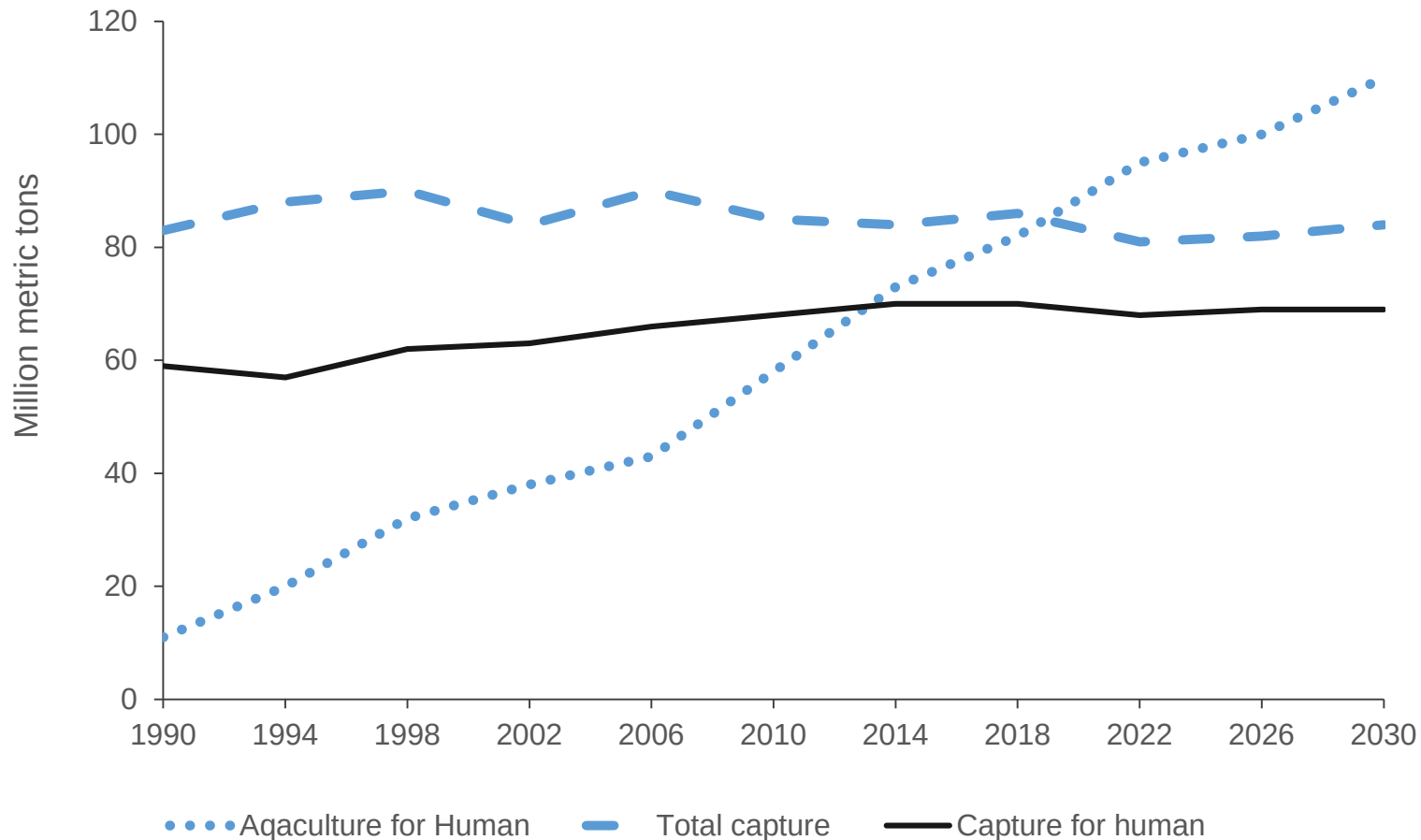
1. Related SDG targets are critical for Bangladesh—particularly nutrition and climate change
2. Bangladesh' experience has broader development implications (in terms of Global Public Goods (GPGs) perspectives)

The global context



The global context

Trends in Aquaculture & Capture Fish Production

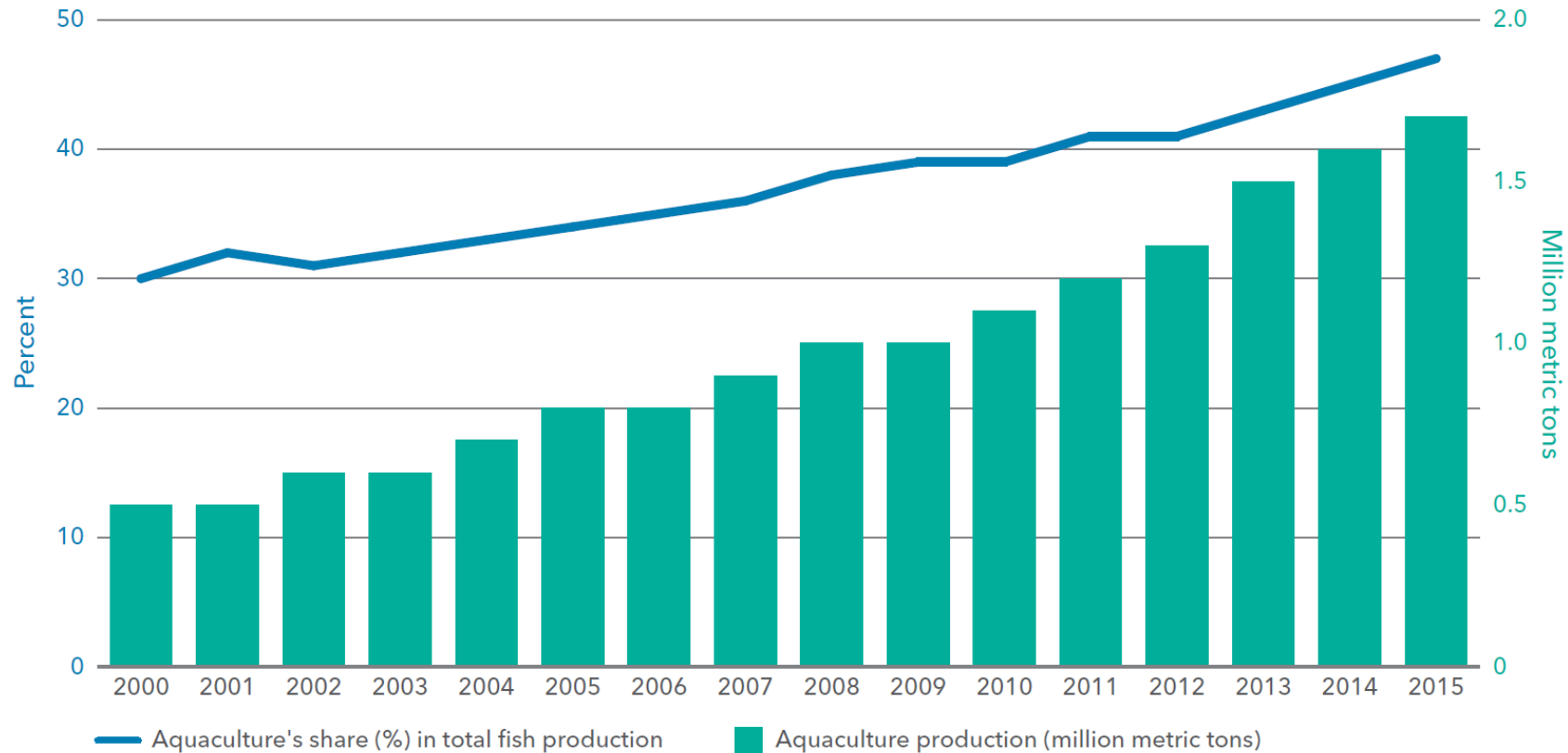


Imagine what would have happened if aquaculture production stopped / stagnated in the 1990s.

Bangladesh context

- Let's recall the premise of the structural adjustment programs:
 - If policy restrictions (distortion to economic incentives) are eliminated, *the economy will grow, leading to higher household incomes, lower poverty, and overall improvement in food security.*
- In the 1980s, incomes in many Asian countries were indeed increasing. The green revolution took root, real prices of rice and wheat declined, and the region enjoyed overall growth.
- Around the same time, a strong strand of research came out arguing that **income growth does not lead to nutritional improvement** (e.g., Pitt, et al. 1983, Behrman and Deolalikar, 1987, 1990, Bouis and Haddad, 1992)

Aquaculture production and its share in total fish production

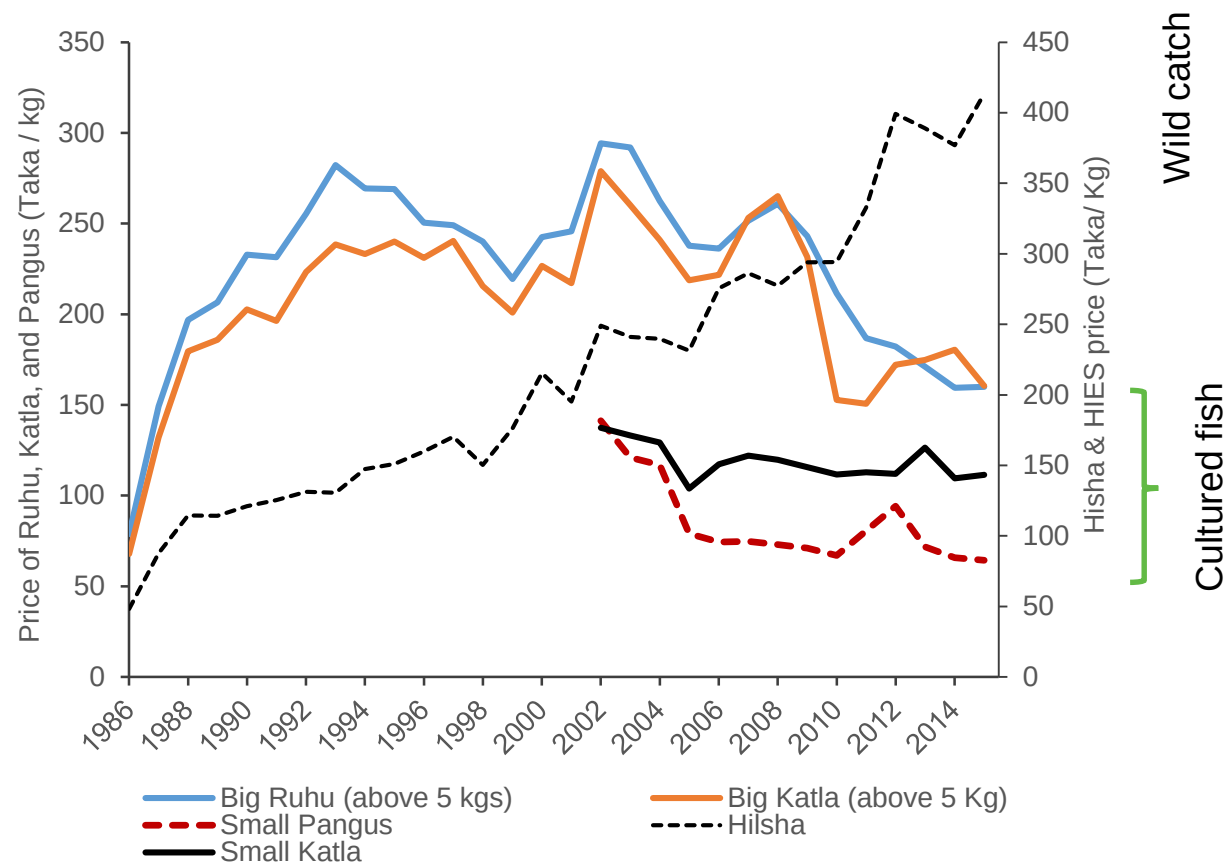


From 2000 to 2015, the sector's annual growth rate was **8.6 percent per year**, higher than the per capita GDP growth rate.

Aquaculture's share in fish production increased from 30 percent to 47 percent.

Bangladesh context: Fish prices have declined lately

- Earlier studies were right—real prices most fish varieties were rising sharply.
- However, there has been a reversal in trends since early 2000s.
- Prices of all major fish varieties (except Hilsha, which is a marine fish) have declined significantly since then.



Questions Addressed

- **Our book asks the following three questions:**

1. How did the price trend turn around?
2. What implications does this trend reversal have for food security, poverty, and overall well-being (impacts)?
3. What possible policy options are there to accelerate / maintain the momentum (What is the path ahead)?

- **In addressing these questions, IFPRI has:**

1. Conducted a comprehensive value chain survey
2. Carried out set of econometric analyses on various dimensions
3. Implemented micro-simulations using HIES and BIHS to assess impacts
4. Conducted projection analysis under various scenarios

Drivers of Structural Transformation

IFPRI fish value chain survey 2013-2014

Sampling:

Four zones (East, North, Southwest, and Southcenter)

20 districts

102 upazilas

All mouzas under selected upazilas

Microlevel survey of all key actors in VC

25 farmers were randomly selected per primary sampling unit
Feed mills, feed dealers, fish traders, and hatcheries were also surveyed

A community-level survey

Gather meso-level information



Transformation: Extensive growth

- Fish pond area increased by 30.4% between 2004 and 2014;
- The number of fish farmers grew by 63%.



Transformation: Intensification

- Investing more in equipment: The capital to labor ratio in fish farms increased by 47% from 2008 to 2014.
- Farmers purchased more hatchery-produced seed and floating feed;



Fish production increased by 117.4% between 2004 and 2014, far greater than the expansion of pond area (30.4%).



Transformation: Commercialization

- The number of wholesale markets, feed dealers, and fish traders more than doubled between 2004 and 2014.
- In 2014, fish farmers sold 75% of their fish to the market (56% to local wholesalers), compared to 57% in 2008.



Transformation: Formation of fish clusters

- Feed dealers and traders are close to fish farmers.
- Wholesale markets and service providers are nearby.



TABLE 4.6 Regressions on the relationship between clustering and adoption of modern inputs

Variables	Adoption of modern inputs (OLS)		Cost of modern inputs per 1,000 acres (Tobit)		Share of the cost of modern inputs in total input cost (OLS)	
Initial value of the dependent variable in 2008	0.719*** (0.041)	0.710*** (0.041)	1.848*** (0.139)	1.846*** (0.139)	0.816*** (0.070)	0.815*** (0.070)
Clustering degree in 2008	0.131** (0.053)	0.097** (0.045)	15.653*** (5.881)	13.322*** (5.054)	0.039** (0.018)	0.035* (0.019)

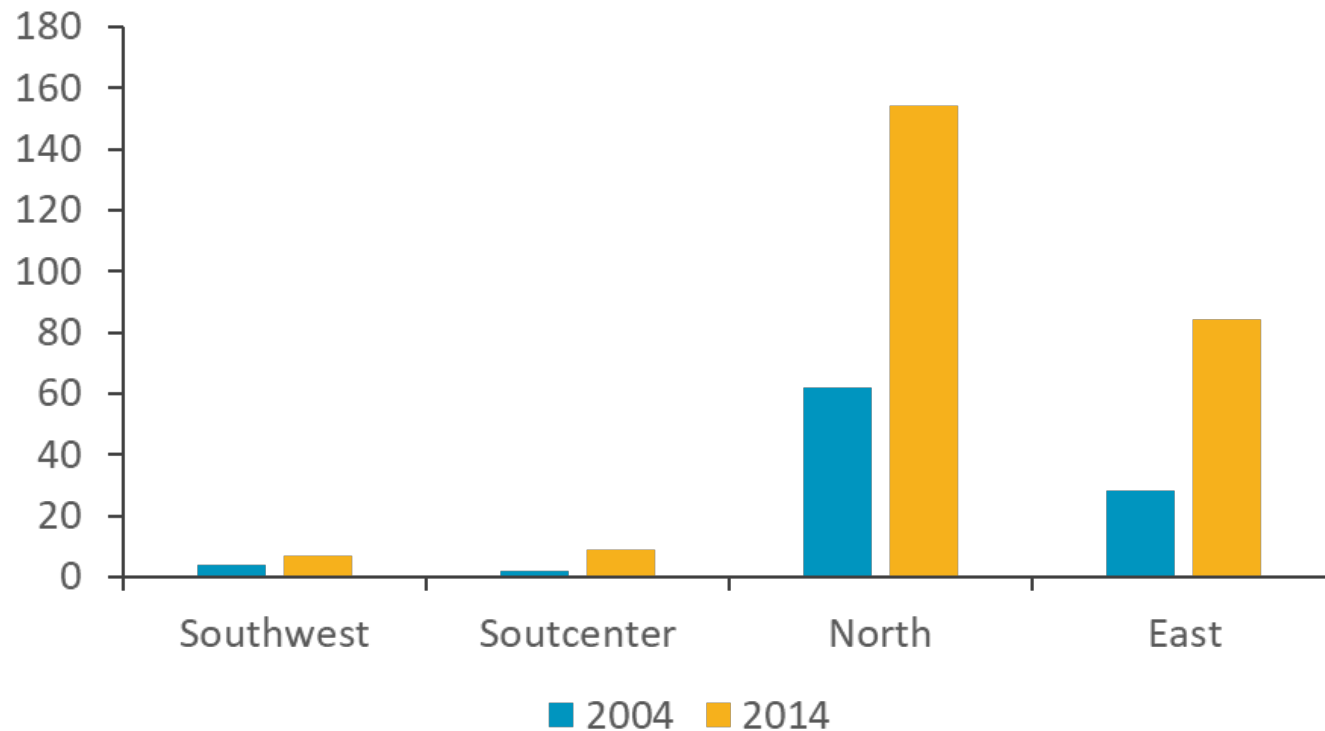
In highly clustered areas, fish farmers use more modern inputs.

In addition, actors in fish value chains are more likely to collaborate:
Share market information, tools, and labor.

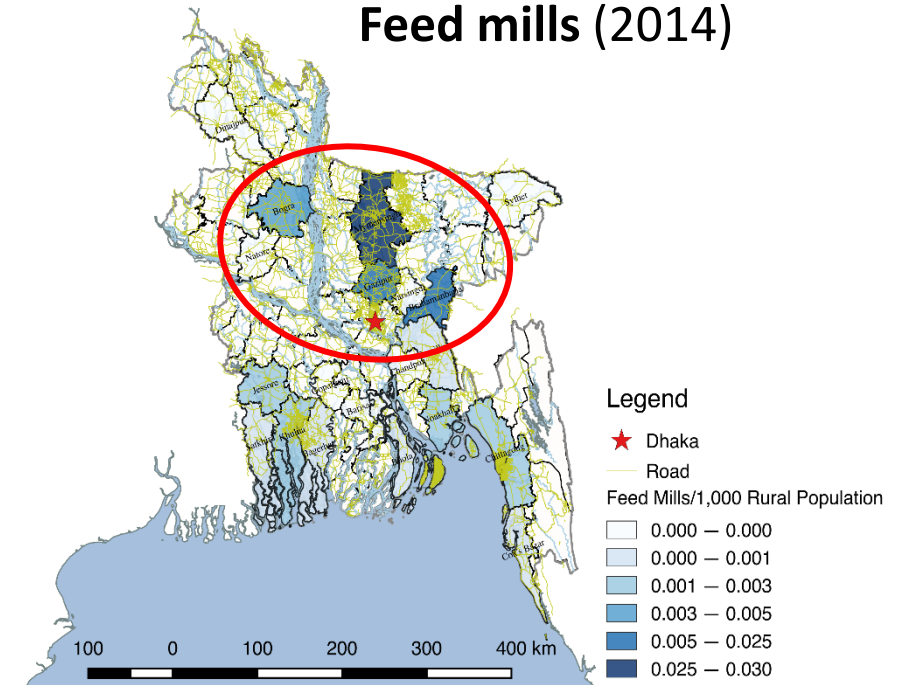
Transformation: Spatial concentration

62 percent of the country's feed mills were located in the north in 2014.

Number of feed mills in 2004 and 2014



Feed mills (2014)



Major drivers: Better infrastructure

- Expansion of rural road network since the 1980s played a great role in the “blue revolution”.
- Between 2000 and 2010, the decade in which aquaculture experienced the most growth, rural households with electricity went from 20 to 50 percent, and cell phone ownership soared from 0.2 percent to about 75 percent.



Major drivers: Rising income

The real wages in Bangladesh, particularly in rural areas and for female workers, have escalated in recent years.



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Escalation of Real Wages in Bangladesh: Is it the Beginning of Structural Transformation?

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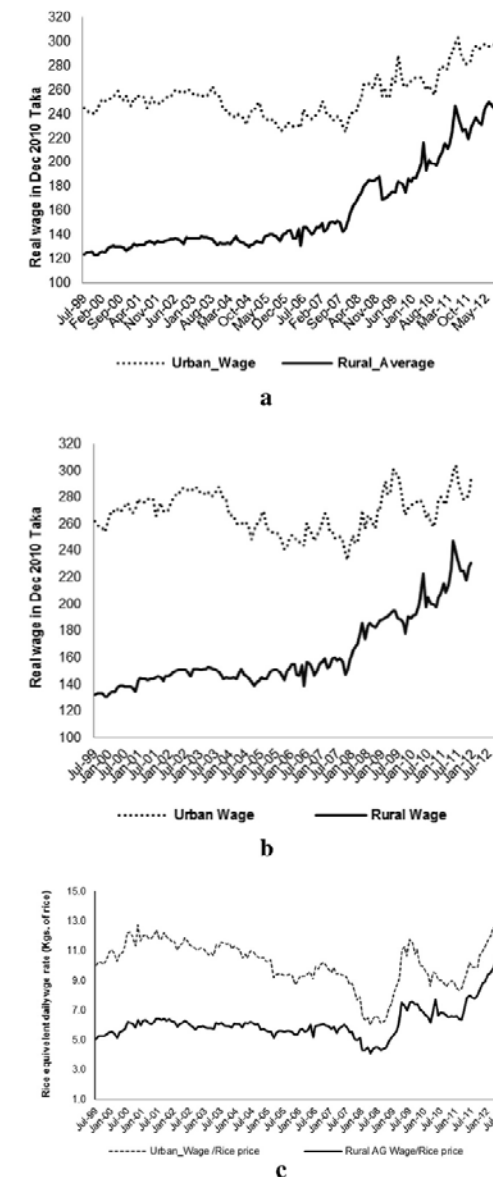


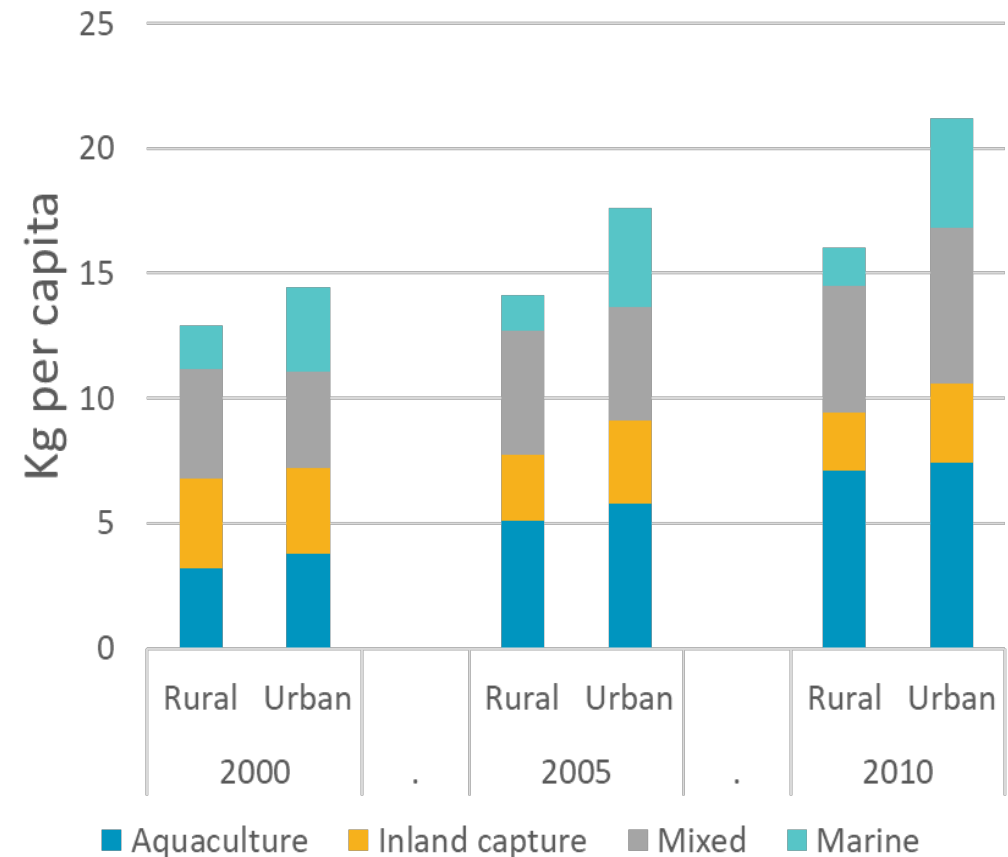
Figure 2. Monthly real wages of rural and urban workers in Bangladesh, June 2001–12. (a) Urban and rural real wage at December 2010 Price (Deflated by general CPI), (b) Urban and rural real wage at December 2010 price (Deflated by food CPI), and (c) Nominal daily wages/Coarse rice price. Sources: The monthly wage data are obtained from Monthly Statistical Bulletin (2001–2011), Department of Agricultural Marketing (DAM), Bangladesh. The real wages are deflated by general consumer price index. Note: The rural sample excludes the rural wage from the mega-cities. Urban wages are for the unskilled workers (such as, helpers in construction sites, carpenters, and other sectors). The base year is set to 2009–10.

Welfare Implications

Impact of rise in aquaculture

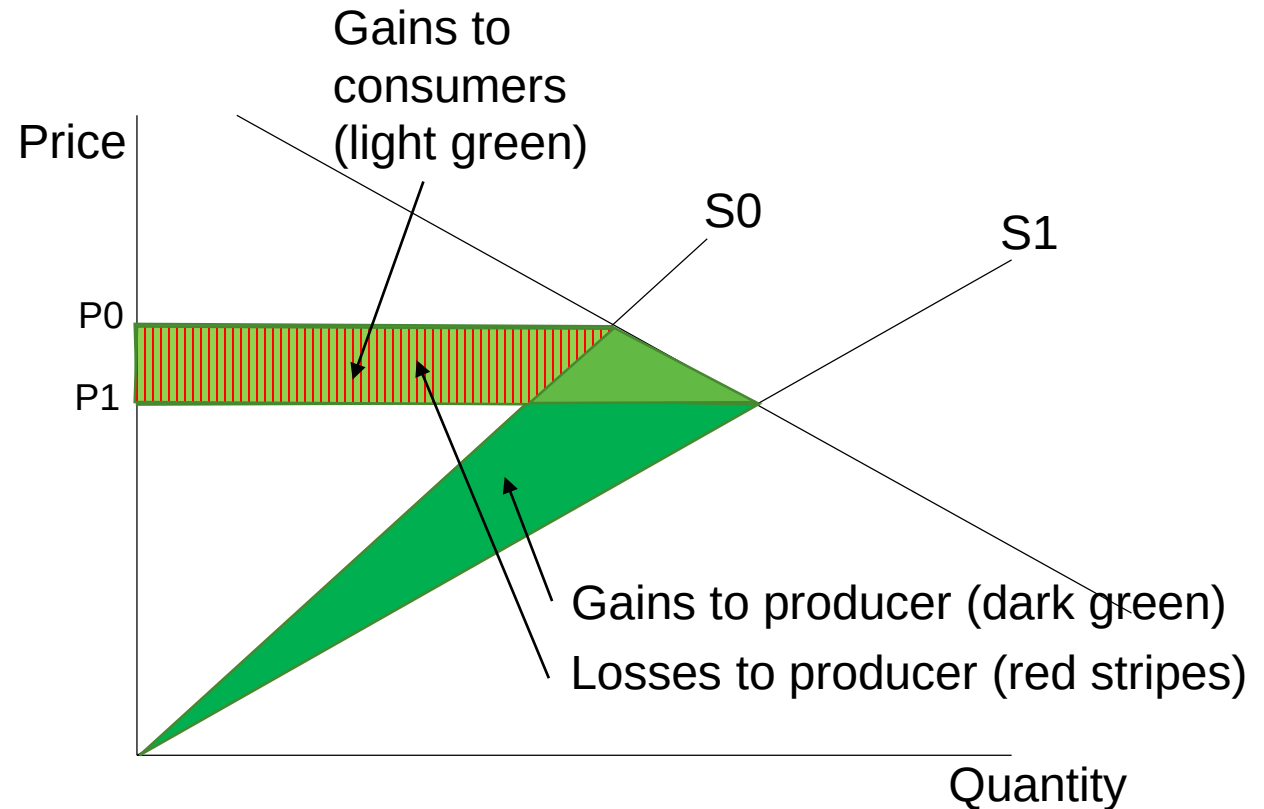
- Reduction in consumer prices of fish of 45% over 2000-2010
- Per capita annual fish consumption jumped from only 7.7 kg in 1980 (FAO 2014) to 13 kg in 2000, and to over 23 kg in 2017, compared to 6.6 kg in India.
- Fish consumption has grown across lines of gender and income, with poorer households experiencing higher growth than other groups.
- About 17.8 million Bangladeshis, including 1.4 million women, work in the sector, including full time and part time (FAO 2016), translating into about 11 percent of the total population and more than 23 percent of the working population. By comparison, the better-known garment sector employs about 4 million workers.

Rise in per capita consumption of fish



What is the welfare impact of the rise of aquaculture?

- Focus on rise in productivity and resulting reduction in prices
- Measure welfare impact over 2000-2010
- Partial equilibrium analysis of aquaculture sector, assuming no effect on wages or other factor prices
- Microsimulation approach – estimate impact on each household in a large household survey



Data and methods to measure welfare impact

- 2000 Bangladesh Household Income and Expenditure Survey (HIES)
 - Two-stage stratified random sample of 7,440 households
- Shift in supply of 76% based on per capita production increase
- Supply elasticity of 1.33 (Kumar, Dey, & Paraguas, 2006)
- Hicksian demand elasticity of -0.47 (Dey, Alam, & Paraguas (2011))

$$\frac{dY}{Y} = \frac{P_p Q}{Y} \pi \frac{dQ}{Q} + \frac{P_p (Q + dQ)}{Y} \frac{dP_p}{P_p} + \frac{1}{2} \varepsilon_s \frac{P_p Q}{Y} \left(\frac{dP_p}{P_p} \right)^2 - \frac{P_c C}{Y} \frac{dP_c}{P_c} - \frac{1}{2} \varepsilon_{HD} \frac{P_c C}{Y} \left(\frac{dP_c}{P_c} \right)^2$$

where

Y is household income,
P_p is the producer price of fish,
Q is the household production of fish,
π is the ratio of producer surplus (profit) to gross revenue,
ε_s is the elasticity of supply,
P_c is the consumer price of fish,
C is the quantity of fish consumed by the household, and
ε_{HD} is the Hicksian price elasticity of cassava demand.

Results

- NBR = net sales as % of income
 - Most groups are fish deficit except Khulna and fish farmers
- Change in income
 - 2.1% growth nationally
 - Benefitted all income groups
 - Fish farmers gain the most
- Change in poverty
 - 1.7 pct point reduction in poverty overall
 - Poverty reduction in all five regions and both urban & rural areas
 - More poverty reduction in rural areas

Category	Share (%)	Net benefit ratio	Change in income (%)	Change in poverty (pct pt)
Rural	80	-1.38	2.23	-1.91
Urban	20	-2.96	1.63	-0.85
Male head	91	-1.59	2.12	-1.70
Female head	9	-2.86	1.88	-1.71
Barisal	7	-0.10	1.31	-2.15
Chittagong	23	-2.60	2.38	-1.79
Dhaka	33	-2.09	2.10	-1.56
Khulna	12	1.64	2.45	-1.87
Rajshahi	25	-2.36	1.87	-1.56
Fish farmer	23	4.12	3.33	-2.63
Other	77	-3.42	1.70	-1.39
Poorest	20	-1.63	1.70	0.00
2 nd quintile	20	-1.45	2.05	0.00
3 rd quintile	20	-1.81	2.27	-8.49
4 th quintile	20	-1.49	2.36	0.00
Richest	20	-2.13	2.15	0.00
Bangladesh	100	-1.70	2.11	-1.70

Summary

- Growth in aquaculture has been inclusive
 - Benefits to fish farmers through higher productivity and others through lower prices
 - Benefited all income groups, urban & rural, male & female-headed
- Responsible for reduction in poverty of 1.7 percentage points
- Official statistics show poverty declined from 48.9% in 2000 to 31.5% in 2010 or 17.4 pct points
- This implies that the “blue revolution” in Bangladesh is responsible for almost 10% of the poverty reduction over the period 2000-10



Impacts: Growth in aquaculture in Bangladesh has been inclusive

- It benefited households across income groups (incomes increased in all income quintiles)
- Benefited households across geographic locations (rural, urban, administrative divisions, etc.)
- **Female headed** households benefitted as much as the male headed households.

The Bangladesh Fish Economy

Future Scenarios

Model simulation assumptions: Fish productivity growth

Average growth rate				
	Aquaculture	Inland capture	Mixed	Marine
Base	3.7%	0.0%	1.5%	0.0%
High productivity	5.3%	0.8%	2.1%	0.0%
Very high productivity	6.7%	0.8%	2.1%	0.0%
Cumulative growth				
Base	71.5%	0.0%	25.0%	0.0%
High productivity	118.0%	12.7%	36.6%	0.0%
Very high productivity	163.1%	12.7%	36.6%	0.0%

Note: Productivity growth rates for aquaculture in the base scenario are set equal to 5 percent for 2016 to 2020 and 3 percent for 2021 to 2030. For the high-productivity scenarios, productivity growth rates for aquaculture are set equal to 5 and 3 percent for 2016–2020 and 2021–2030 periods. Similarly, for the very high-productivity growth scenarios, aquaculture productivity growth is set equal to 8 and 6 percent in the two periods, respectively

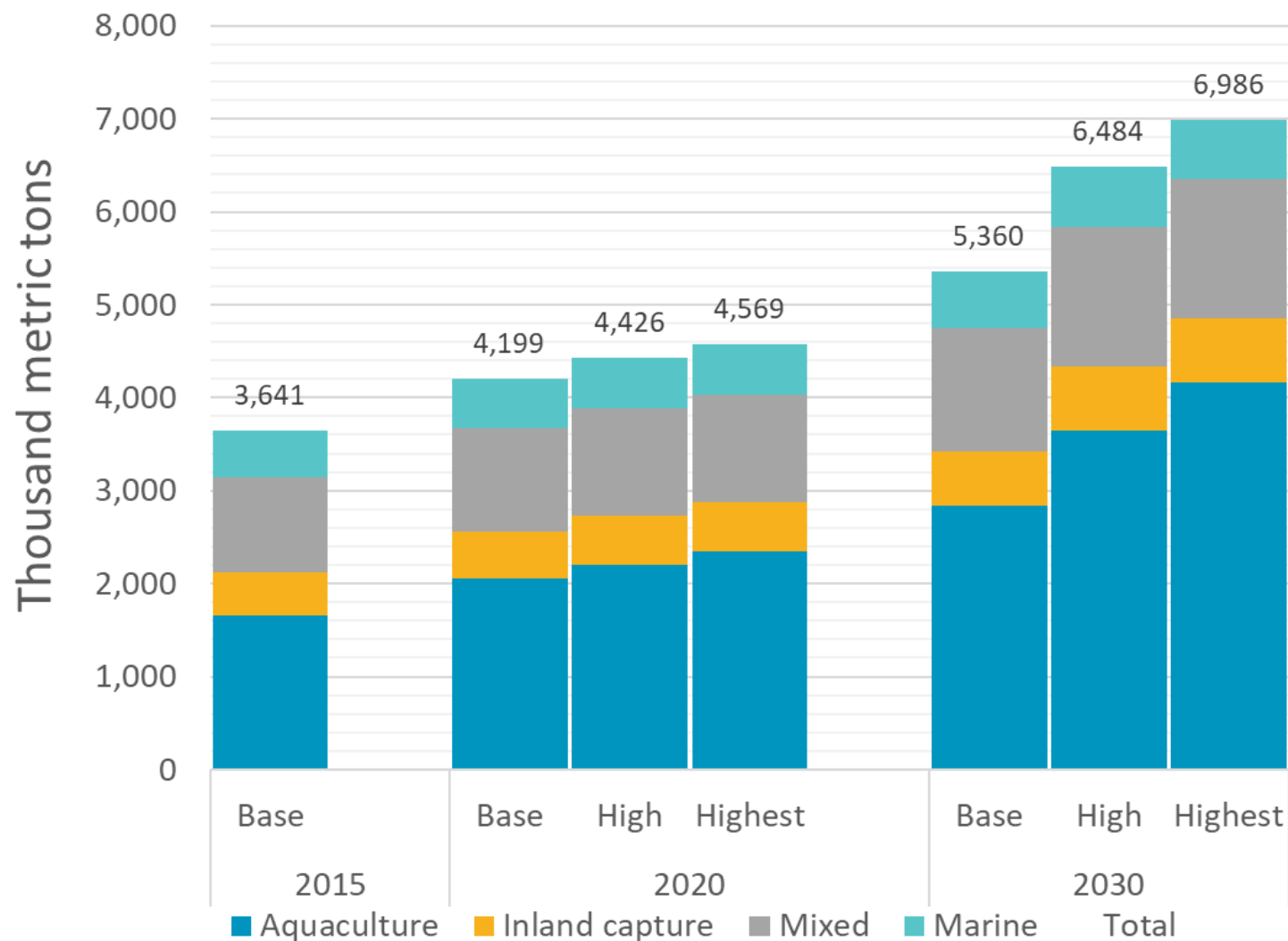
Source: Author's calculations

Model simulation assumptions: Population and income growth

	Urban		Rural		Total
	Poor	Nonpoor	Poor	Nonpoor	
Base					
Population 2010 (millions)	20.5	18.8	52.5	57.5	149.3
Population growth (%)	3.0	3.0	0.4	0.4	1.1
Income growth (%)	6.0	4.0	3.0	2.0	4.2
Per capita income growth (%)	2.9	1.0	2.6	1.6	3.1
High demand					
Population growth (%)	3.0	3.0	0.4	0.4	1.1
Income growth (%)	8.0	6.0	5.0	4.0	6.5
Per capita income growth (%)	4.9	2.9	4.6	3.6	5.4

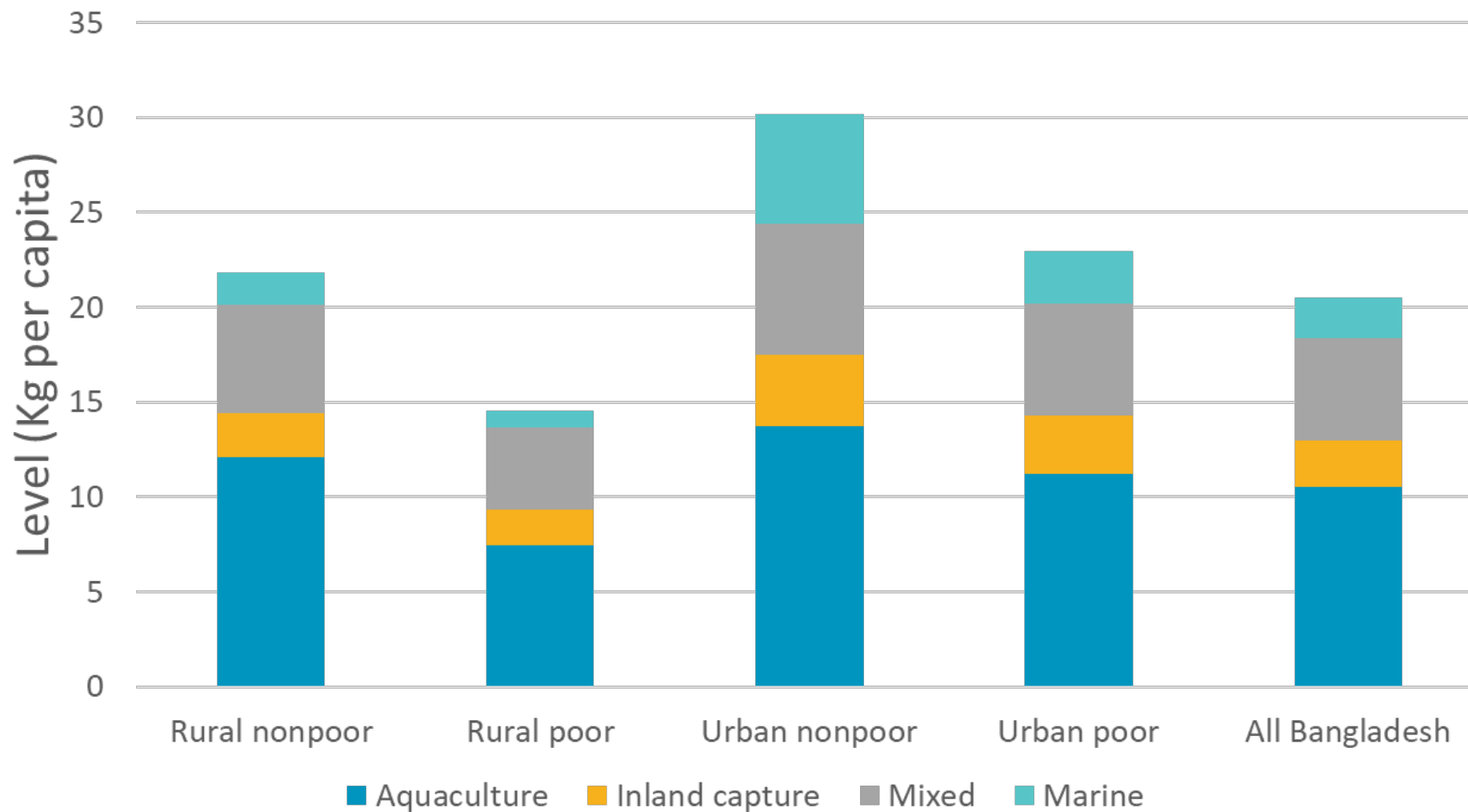
Source: Author's calculations

Simulation results: Bangladesh fish production



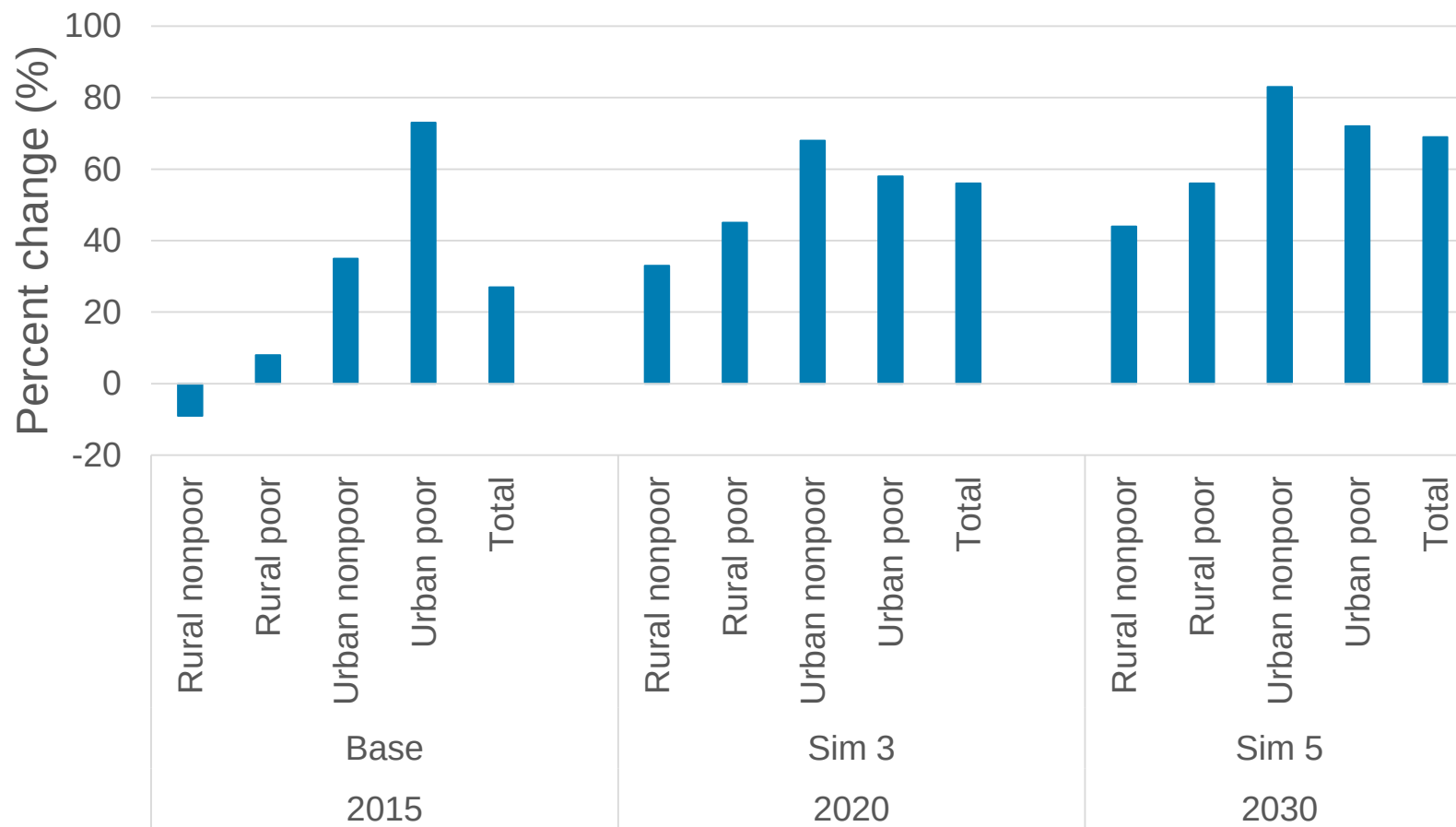
Source: Model simulations

Simulation results: Bangladesh per capita fish consumption



Source: Model simulations

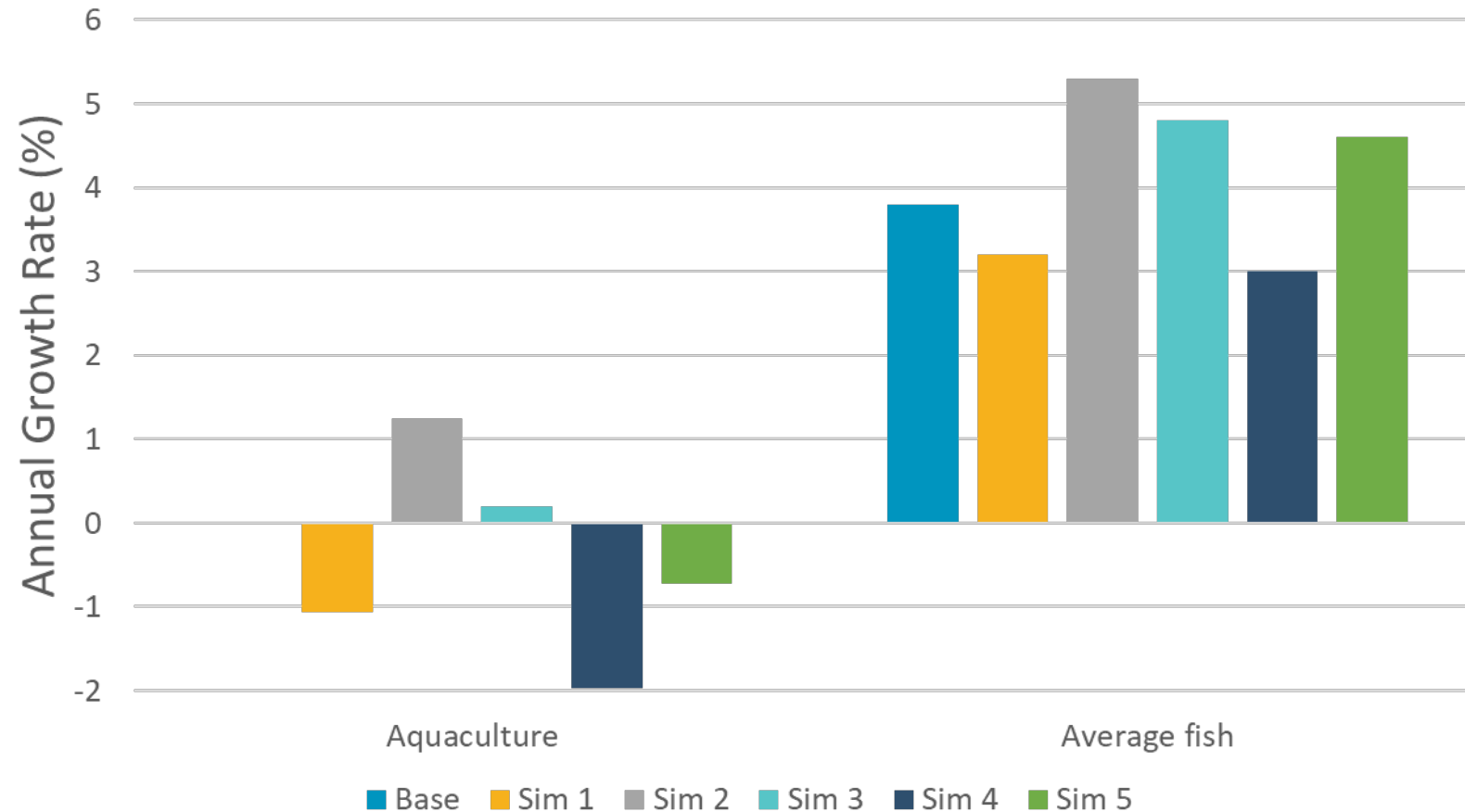
Bangladesh per capita fish consumption: (Percent change 2015-2030)



Note: Sim 1: High productivity, all systems.
 Sim 2: Increased household fish demand.
 Sim 3: Sim 1 with increased household demand.
 Sim 4: Sim 1 with extra aquaculture productivity gains.
 Sim 5: Sim 4 with increased household demand.

Source: Model simulations

Bangladesh Fish Prices Simulation Results: Annual Growth Rates 2015-2030



Note: Sim 1: High productivity, all systems.

Sim 2: Increased household fish demand.

Sim 3: Sim 1 with increased household demand.

Sim 4: Sim 1 with extra aquaculture productivity gains.

Sim 5: Sim 4 with increased household demand.

Source: Model simulations

Conclusions

The path ahead: Potential for growth

- Despite the progress of the last two decades, Bangladesh's full potential for growth in aquaculture productivity has yet to be realized. Aquaculture productivity was 60–70 metric tons per hectare in Bangladesh as compared to 300 or more metric tons per hectare in Vietnam (Phan et al. 2009).
- If investment in aquaculture increases, total production can increase by as much as 120% between 2016 and 2030. In a high productivity (~6%) scenario, which is achievable, total production will increase by 152%, equivalent to total production of 7 million tons.
- Both prices and consumptions are expected to grow in the medium term (until 2030).

The path ahead: Challenges

- Missing institutions: Fishing and aquaculture are risky businesses. There is a need to strengthen insurance and credit institutions to reduce farmers' risks.
- Growth in domestic demand, which has been a main major driver, will likely slow down. The next step is to sell fish in international markets.
- Knowledge gaps: Extent of negative externalities and strategies to overcome them; effects of habitat degradation; other environmental consequences.

The path ahead: Challenges



More affluent domestic consumers and export to OECD countries will demand that fisheries policy and safety regulations are updated to ensure fish quality and safety

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