Session 6: Managing Small-Pelagic Fisheries within an Ecosystem Approach

Navigating Changes in Small Pelagic Fish and Forage Communities: Climate, Ecosystems, and Sustainable Fisheries
May 4 – 8, 2026 | La Paz, Mexico

PICES ICES CIEM Food and Agriculture Organization of the United Nations
Endorsed by 2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Assessing the Lilang Fishery of Miagao, Iloilo, Philippines: *Ecosystem-Based Insights on Catch Dynamics and Sustainable Fisheries Management*

Tiffany C. Xu & Jerry Ian L. Leonida

Institute of Marine Fisheries and Oceanology
College of Fisheries and Sciences
University of the Philippines Visayas

THE CHALLENGE

In the Philippines, **municipal fisheries** contribute **~39% of national production**, yet artisanal SPF gears remain underdocumented and under-assessed.

Tropical artisanal SPF fisheries face converging pressures: **climate variability**, **growth overfishing**, **commercial fishing encroachment**, and **socioeconomic vulnerability**.

Sources: PSA 2019; DA-BFAR 2023

THE LILANG FISHERY

*A locally derived, **fine-mesh** and **light-aided pushnet** in the town of Miagao, Iloilo, Philippines.*

KNOWLEDGE GAPS

- ✓ Small-scale, artisanal gear
- ✓ Tropical, multi-species system
- ✓ Forage species beyond major SPF
- ✓ Light-aided fisheries dynamics
- ✓ Climate-fishery socioeconomic linkages

STUDY OBJECTIVES

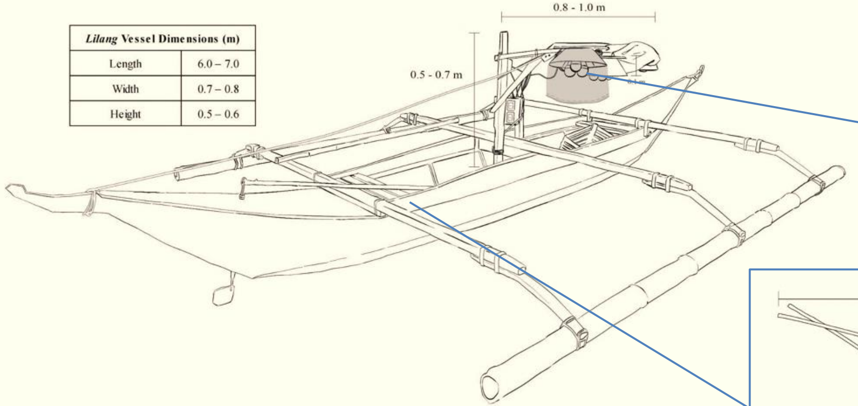
*To assess the **gear characteristics**, **catch composition**, and **socioeconomic dimensions** of the lilang fishery, providing an integrated foundation for ecosystem-based management.*

Study Context: The Lilang Fishery

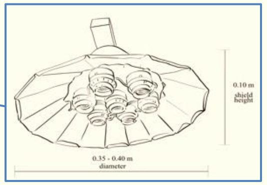
A traditional fine-mesh and light-aided pushnet in the Philippines

GEAR CHARACTERIZATION

- Modified pushnet with scoopnet-style operation
- Operates at night in shallow nearshore waters (40-1,000 m)
- 1-3 fishers per vessel; LED light lures
- Targets *maragbas* and *gurayan* (**anchovies** species)
- Subject to 6-month closed season (May-Oct) for fine-mesh nets

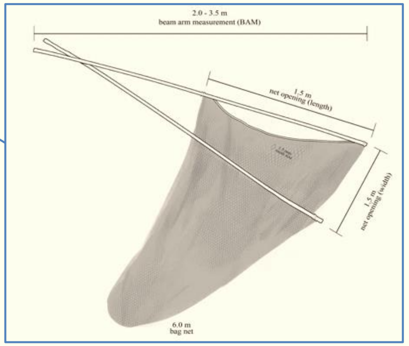


Lilang Vessel Dimensions (m)	
Length	6.0 – 7.0
Width	0.7 – 0.8
Height	0.5 – 0.6

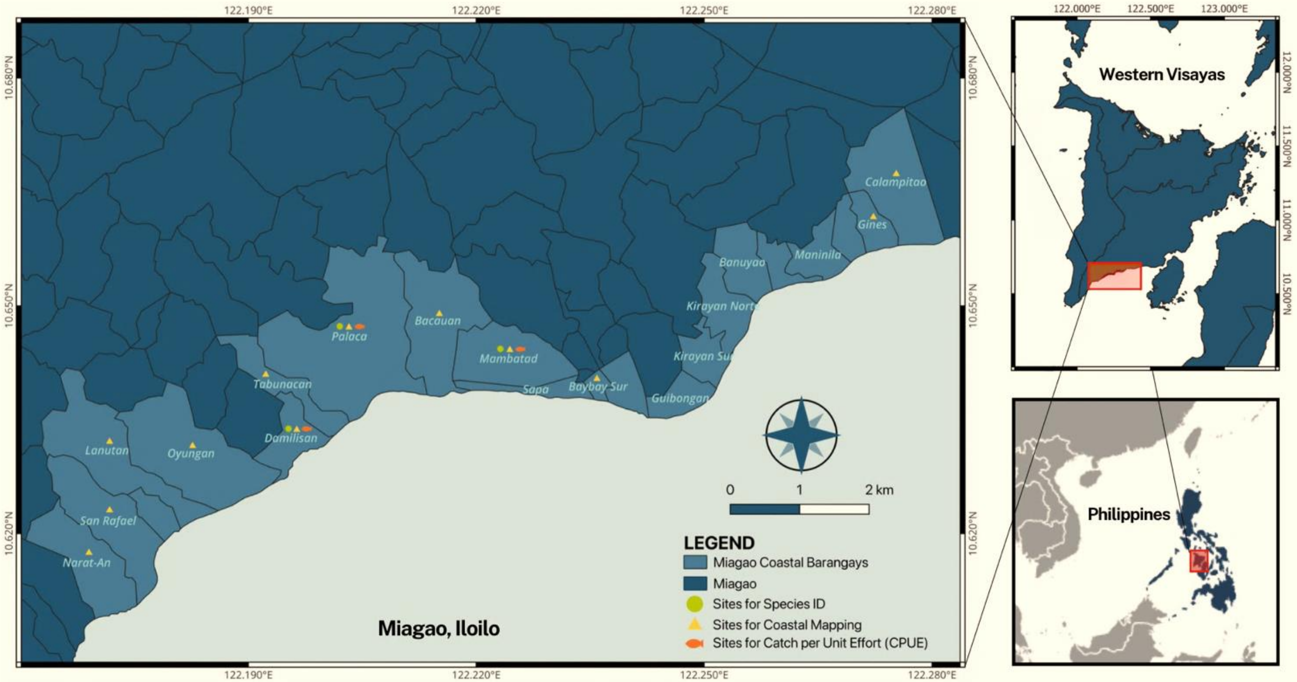


12-18W LED bulbs

Gear Name: **Modified Scoop Net**
ISSCFG: **10.6**
Net Dimensions: **1.5 m x 1.5 m x 6 m**
BAM: **2.0 m**
Mesh Size: **1.5 mm**
No. of crew: **1-3 pax**



Fine-mesh Pushnet (1.5 mm)



Study Site: Miagao, Iloilo, Panay Gulf (FMA 4) Western Visayas, Philippines

REGULATORY MISMATCH

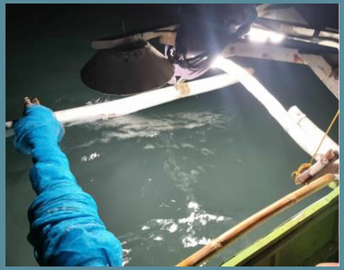
- ~300 active fishers estimated (Miagao-MAO)
- Only ~32 officially registered (in Oct 2024)

Integrated Methodology

Mixed-methods design combining ecological, molecular, and socioeconomic data

Study Period: November 2024 – April 2025

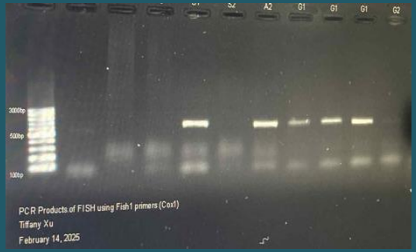
CATCH MONITORING


- 10 days/month × 6 months
- 3 priority barangays (villages)
- National Stock Assessment Program (NSAP) methodology

MOLECULAR IDENTIFICATION

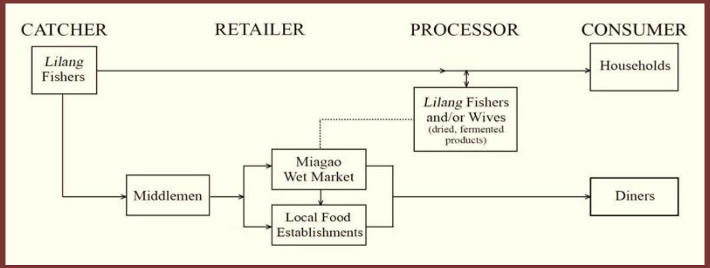




- COI gene barcoding
- Ward et al. (2005) primers
- QIAGEN extraction; BLAST analysis

SOCIOECONOMIC ANALYSIS *(WITH GEAR CHARACTERIZATION)*



Total *Lilang* Costs

Fixed Costs (PHP)	Variable Costs (PHP)
Municipal Vessel (35,000 - 60,000)	Ice (0 - 100 per trip)
Rechargeable Battery (12 V, 17-plate) (7,000 - 10,000)	Food (0 - 50 per trip)
Lilang Gear (1,500 - 5,000)	Fuel (30 - 120 per trip)
Lights (1,500 - 7,000)	Electricity (20 - 50 per trip)
Registration (600 - 1,500)	Large Plastic Bags (0 - 25 per trip)

- 55 fishers across 12 barangays (villages)
- Semi-structured questionnaire
- UPV REB ethics approval

- Fixed vs. variable cost analysis
- Net income per fisher
- Audited Computation

Species Identification: A Key Molecular Finding

DNA barcoding resolves the maragbas / gurayan misconception

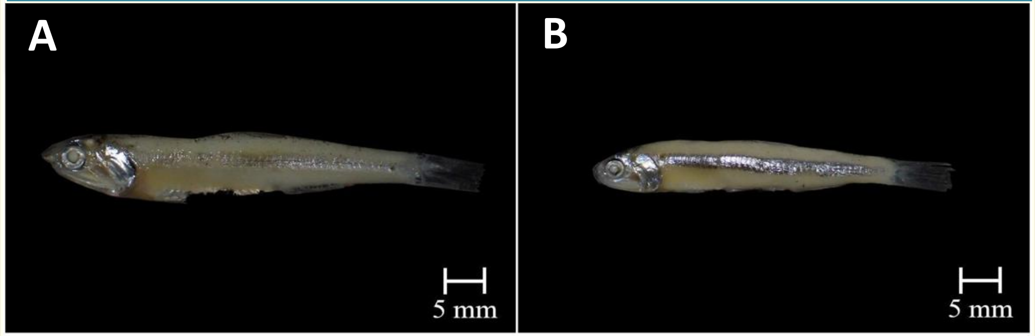
MOLECULAR RESULTS (BLAST) WITH MORPHOMETRIC CONFIRMATION

Same anchovies species *(Encrasicholina* spp.*)* — different life stages

Maragbas (Larvae)	*Gurayan (Juveniles)*
	

Local Name	Species	% Identity
A - Maragbas / Gurayan	*Encrasicholina heteroloba*	**100%**
B - Maragbas / Gurayan	*Encrasicholina punctifer*	**100%**
C - Lupoy	*Herklotsichthys quadrimaculatus*	**100%**
D - Sapsap	*Leiognathus panayensis*	**100%**
E - Hipon	*Acetes* spp.	**morphometric**

Target Species



Recorded Bycatch Species

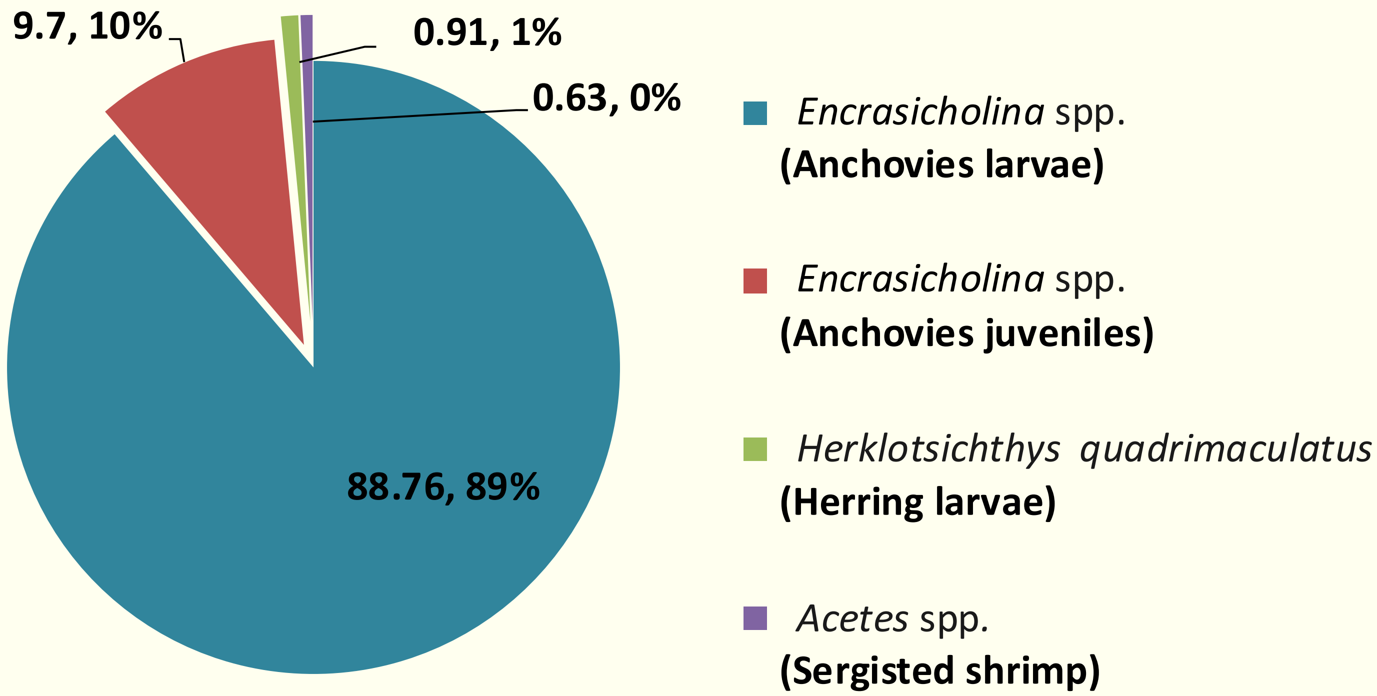
KEY IMPLICATION

Maragbas and *gurayan* are not separate species as traditionally known — they are respectively the **larval** and **juvenile** life stages of at least two anchovies (*Encrasicholina* spp.); the fishery harvests **pre-mature life stages**.

Catch Composition and CPUE Dynamics

High taxonomic selectivity, high variability

CATCH COMPOSITION (% by weight)



CPUE: HIGHLY VARIABLE

0.0 – 24.0	kg/day range
0.41 – 6.21	kg/trip mean monthly
0.0 – 1.0	kg/operation median
45-59%	operations with zero catch

KEY OBSERVATION

- ~98% anchovies (*Encrasicholina* spp.); ~1.5% non-target species; no reported discards
- Right-skewed distribution → non-parametric analysis is more appropriate

Size at Capture vs. Length at Maturity

Quantifying growth overfishing through length-based indicators

LENGTH-BASED ANALYSIS

Species	Lc (TL, mm)	Lm_{50} (mm)	References	Lc/Lm
E. heteroloba	10-25	62	*Tiews et al. (1970)*	**0.16-0.40**
E. punctifer	10-25	45-70	*Froese and Pauly (2025)*	**0.14-0.56**
H. quadrimaculatus	larval-juvenile	85-99	*Robertson and Green (2021)*	**<0.30**

ICES sustainability reference: Lc/Lm ≥ 1.0

OBSERVED: Lc/Lm ≈ 0.2 – 0.4

- 60-80% below the sustainability threshold
- Meets the Beverton-Holt definition **of GROWTH OVERFISHING**
- Yield-Per-Recruit theory: ~50-60% potential yield improvement with size-based management

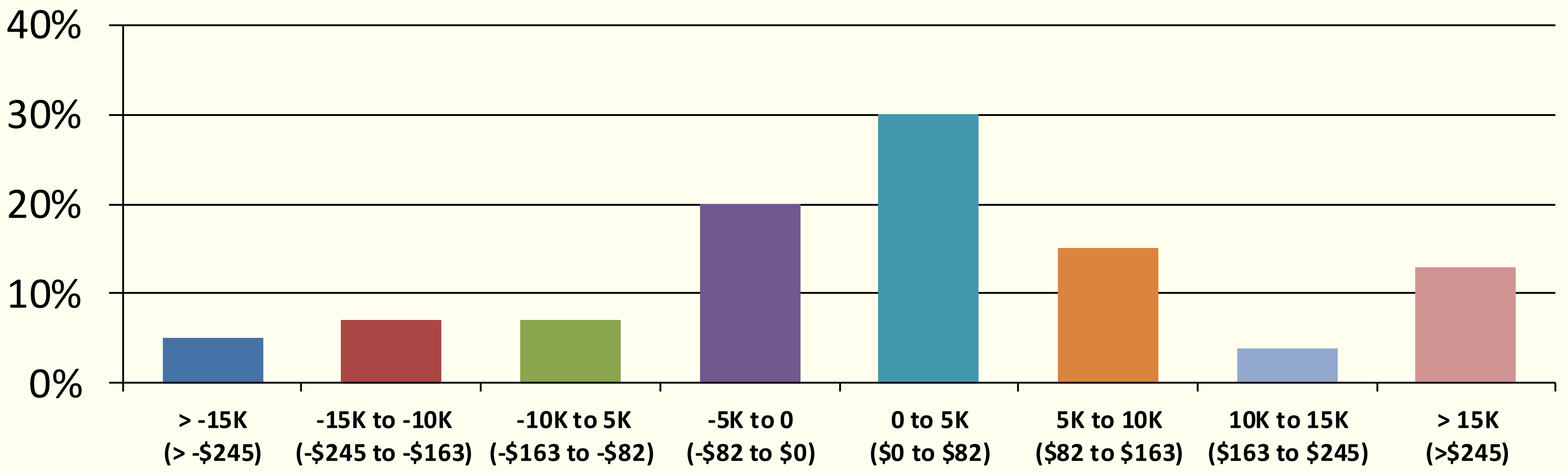
Socioeconomic Realities

Audited income analysis: a marginal supplementary livelihood

FISHERS (n = 55)

100%	Male ♂
45%	Aged 48-59 years
45%	College-educated
78%	Own their vessel
100%	Maintain 1-6 alternative livelihoods

6-Month Net Income Distribution (PHP & USD)



KEY IMPLICATION

- Lilang is a marginally viable SUPPLEMENTARY livelihood, not a primary income source
- ~34-39% of fishers operate at **financial loss** (usually combined with alternative activities)

100% have an alternative livelihood

47 of which engage in other fishing methods (longline, gillnet, etc.)

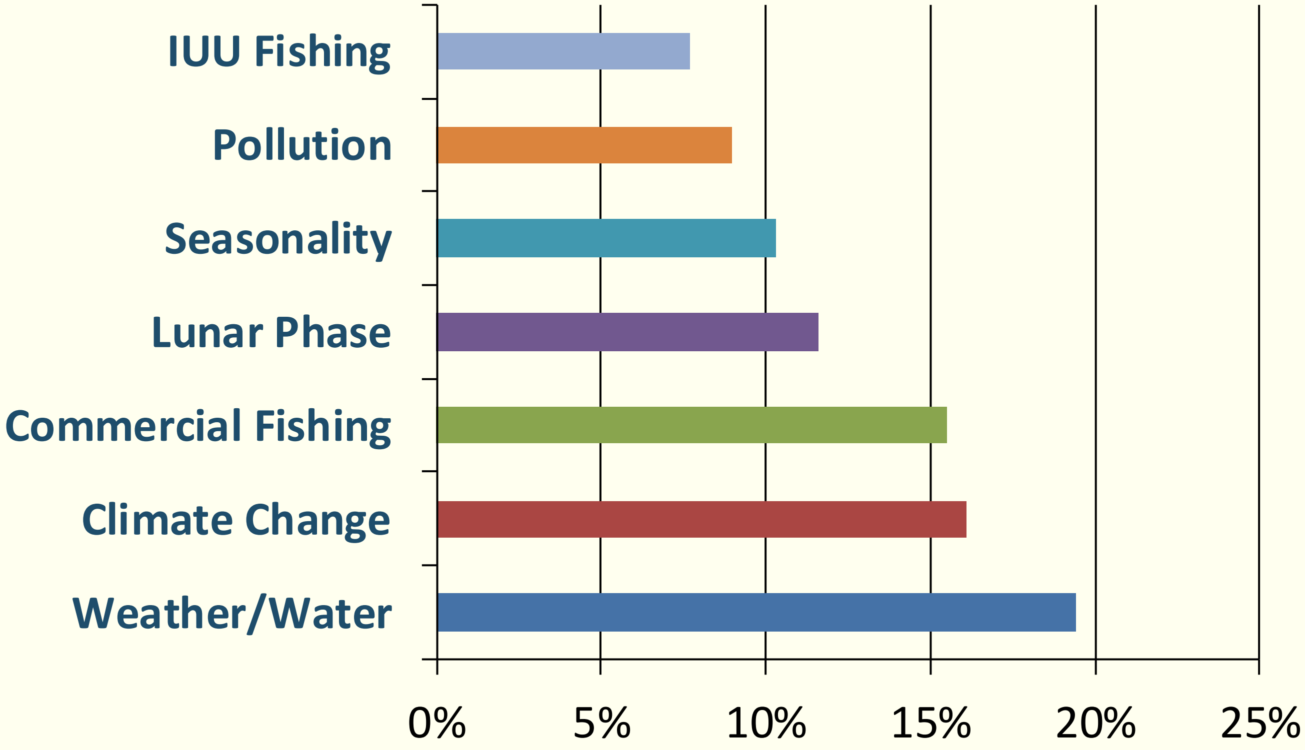
25 engage in construction work

14 engage in farming and livestock

Perceived Drivers and Local Ecological Knowledge

LEK convergence with peer-reviewed science

Top Drivers Identified by Fishers (n=55)



Local Ecological Knowledge (LEK) ↔ SCIENCE

Anchovy thermal stress *(Checkley et al. 2009)*	**increased risk; larvae prefer deeper and colder waters**
Larval depth distribution *(Moyano et al. 2014)*	**matches depth distribution of anchovies (10-30 m)**
Vessel encroachment *(Beniga & Regalado 2019)*	**verified by VIIRS satellite-based vessel monitoring**
Diel vertical migration *(Shima et al. 2021)*	**contribute to trends in lunar-periodic growth rates**

Lilang fishery has a strong LEK foundation for participatory adaptive management

Ecology and Equity: Aligned Objectives

Resolving an apparent paradox in fisher attitudes

APPARENT PARADOX

64%
support closed seasons

vs.

64%
favor extending the open season

RESOLUTION

Fishers support conservation in principle but perceive disproportionate burden:

- Economic precarity without social protection
- Inequitable enforcement (commercial vs. municipal)
- Limited participatory authority

ECOLOGY AND EQUITY ARE ALIGNED, NOT COMPETING

- Growth overfishing reduces both ecosystem health AND long-term fisher income
- Stock recovery via size-based management would INCREASE future catches
- The **barrier** is **transition support**, not the conservation principle itself

Integrated EAF Recommendations

Three pillars: ecological, social, governance

ECOLOGICAL

- Length-based stock assessment (ICES LBI/LBSPR/LBB)
- Closure recalibration based on reproductive biology
- Size-based gear management (graduated mesh)

SOCIAL

- Closed-season social protection (e.g., Brazil Seguro-Defeso)
- Alternative livelihood programs
- Gear transition support

GOVERNANCE

- Activate MFARMC with genuine authority
- Equitable cross-sector enforcement
- Climate-integrated monitoring + citizen science

INTEGRATED IMPLEMENTATION

- *No single pillar suffices*
- *Ecological measures without social protection → non-compliance*
- *Social protection without ecological measures → perpetuates overfishing*
- *Governance without scientific grounding → locally legitimate but ecologically counterproductive decisions*

Cross-Scale Learning: Anchovy Management Globally

Lessons from the Peruvian anchoveta paradigm

COMPARATIVE PERSPECTIVE

PERUVIAN ANCHOVETA	PHILIPPINE LILANG
Industrial; world's largest SPF	Artisanal; supplementary livelihood
Documented growth overfishing	Documented growth overfishing
Climate-sensitive (ENSO)	Climate-sensitive (monsoon, ENSO)
Real-time adaptive management	Calendar-based closure
Decades of management refinement	Early-stage management

LESSON

*Even with extensive resources and decades of experience, growth overfishing in juveniles persists. Early adoption of **length-based monitoring** and **adaptive management** is more effective than reactive correction after crisis.*

Synthesis

Three takeaways for ecosystem-based management of tropical artisanal SPF fisheries

The lilang fishery exemplifies the integrated EAF challenges and opportunities of tropical artisanal small pelagic systems facing climate change and growth overfishing.

THREE TAKEAWAYS

1. **Taxonomic selectivity ≠ ecological sustainability**

   Size-based assessment reveals growth overfishing despite minimal species-level bycatch.

2. **Ecology and equity are aligned, not competing**

   Growth overfishing harms both ecosystem health and long-term fisher income.

3. **Integration is empirical, not aspirational**

   Ecological measures, social protection, and participatory governance each fail without the others.

ACKNOWLEDGMENTS

Lilang Fisherfolk of Miagao | LGU-Miagao MAO | UPV-IMFO/CFOS | Philippine Genome Center–Visayas

Contact: jlleonida@up.edu.ph