



7th Mangrove Macrobenthos and Management Conference (MMM 7)

A Participatory Mapping Study of
Community-Based Governance
in Riau Province, Indonesia



Authors

Andri Hendrizal ^{1, 3}

Amy Then Yee Hui ¹

Riska Fatmawati ²

Rina D'rita Sibagariang ³

Firdaus LN ⁴

¹ Institute of Biological Science, Faculty of Science, Universiti Malaya

² Utilization of Fisheries Resources Department, Faculty of Fisheries and Marine Science, Universitas Riau Universitas Riau

³ Aquatic Resources Management Department, Faculty of Fisheries and Marine Science, Universitas Riau

⁴ Magister of Biology Education, Faculty of Education and Teacher Training, Universitas Riau

KEY THEMES

- Socio-Ecological Systems
- Community Governance
- Participatory Mapping

Indonesia Holds the World's Largest Mangrove Estate - Yet Governance Diversity Remains Unmapped



~3.3M

hectares of mangrove
— world's largest estate

*Yet community governance
patterns remain unmapped*

Bimrah et al., 2022 · Arifanti et al., 2022



THE PROBLEM

Indonesia's immense mangrove estate is extensively studied ecologically, yet how communities spatially organise their own governance systems remains largely undocumented. Existing studies treat ecological and social dimensions in isolation, missing the integrated socio-ecological picture critical for effective management policy.

THIS STUDY

Documents



Community-defined mangrove management zones as articulated by local governance actors

Compares



Spatial configurations and livelihood strategies across 3 contrasting field sites

Develops



A typology of socio-ecological management models varying by institutional maturity

Three Guiding Research Questions

RQ1



How do coastal communities spatially delineate and organise mangrove management zones?

RQ2



What livelihood strategies and resource use patterns are embedded within these spatial configurations?

RQ3



How do these configurations reflect distinct socio-ecological management typologies?

Three Communities Representing a Gradient of Institutional Maturity

Purposive sampling: formally organised group · documented mangrove activities · variation in institutional age

MATURE

Pangkalan Jambi

Est. 2004 · Bengkalis



Over two decades of operation.
Highly integrated multi-zone
system incorporating silvofishery,
ecotourism, rehabilitation & direct
utilization zones.

MATURE

Bandar Bakau

Est. 2001 · Dumai City



Over two decades. Product
diversification with women-led
NTFP processing enterprise.
Located adjacent to active
industrial corridor.

YOUNG

Purnama

Est. 2022 · Bengkalis



Newly established (2022).
Conservation-dominant mandate.
Strict protection zone with
externalised livelihood strategy.
Pre-existing tenure complexity.

Key Informant Spatial Elicitation: A Four-Step Protocol



Elicitation

Semi-structured interview with community group leader (~2 hrs). Conducted in Bahasa Indonesia.



Sketching

Informant delineates zone boundaries, land-use rules, and management purposes on a printed Google Earth base map.



Digitisation

Zone boundaries digitised in QGIS over georeferenced Google Earth imagery for spatial precision.



Validation

Digitised maps returned to each site. Three community members per site confirm accuracy of leader accounts.

Three Distinct Socio-Ecological Management Models Identified

Community	Est.	Model	Zones	Key Livelihood	Resource Intensity	Gender in Utilization
Pangkalan Jambi	2004	Multi-Zonal Integration	5 (complex)	Silvofishery + Silvofishery + chips, syrup, dodol + ecotourism	HIGH	High (women-led)
Bandar Bakau	2001	Product Diversification	4 (moderate)	Syrup, dodol, tea (NTFP processing)	MEDIUM	High (women-led)
Purnama	2022	Strict Conservation Core	1 (single)	Mangrove tea (external inputs)	LOW	Not documented



Multi-Zonal Integration Model: Five Functionally Differentiated Zones

Est. 2004 · High complexity · Institutional learning over 2 decades

Strict Conservation



Ecological core. No extraction permitted. Provides ecosystem service baseline.

Silvofishery



Oreochromis niloticus cultivation integrated beneath mangrove canopy.

Ecotourism



Educational tourism. Cultural ecosystem service provision.

Rehabilitation



Active replanting for long-term ecological recovery.

Direct Utilization

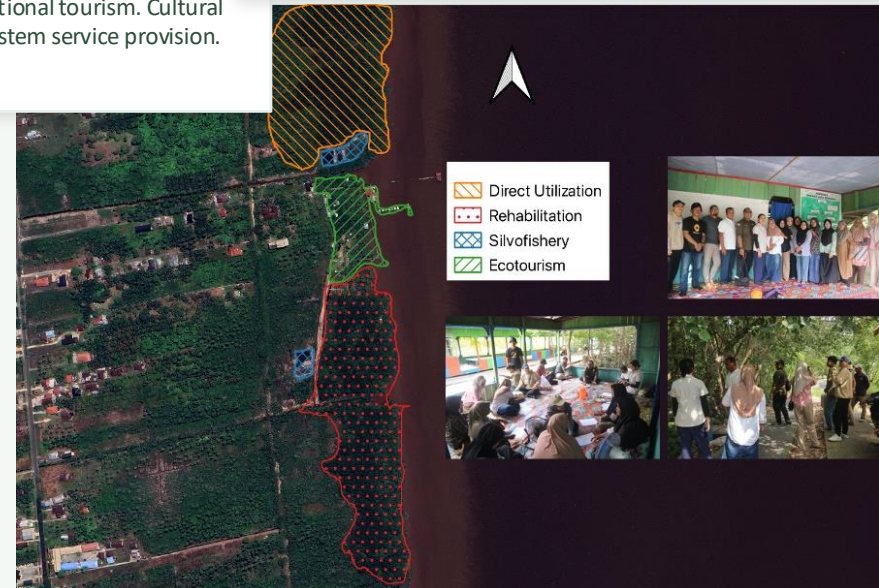


Mangrove leaf chips, syrup, and dodol production (non-timber forest products).



KEY INSIGHT

Five spatially distinct zones enable simultaneous conservation, food production, income, and tourism, reflecting ~20 years of accumulated governance learning.



Product Diversification Model: Conservation Under Industrial Pressure

Est. 2001 · Medium complexity · Women-led NTFP enterprise

Restoration

Largest spatial feature. Active replanting following historical degradation events.

Conservation

Strict protection zone. Overlaps with restored area for ecological reinforcement.

Ecotourism

Educational & recreational access. Sustains community conservation narrative.

Utilization

Syrup, dodol, and tea production from mangrove fruits, flowers & leaves.



KEY CONTEXT — INDUSTRIAL PRESSURE

Located within an active industrial corridor, petroleum storage facilities flank both sides of the managed mangrove area. Community resilience persists despite sustained external development pressure.

Strict Conservation Core: Spatial Homogeneity and Land Tenure Complexity

Est. 2022 · Simple zonation · Pre-existing tenure complexity

Well-Defined Boundary

Conservation zone is spatially precise and clearly delineated by the community leader. Boundary clarity reflects deliberate institutional design.

Third-Party Land Tenure

Discrete patches within the boundary are managed by an external party — these are not community management zones, but reflect pre-existing land tenure arrangements by other parties.

Externalised Livelihood

Mangrove tea raw materials sourced externally, community avoids all extraction within the managed zone, maintaining strict protection.

Institutional Choice

Strict conservation is a founding decision (2022), not an ecological or regulatory constraint. Reflects strategic choice for ecological legitimacy.



Resource Use Intensity and Livelihood Orientation Across Three Sites

Dimension	Pangkalan Jambi (est. 2004)	Bandar Bakau (est. 2001)	Purnama (est. 2022)
Resource Use Intensity	HIGH — integrated across 5 zones	MEDIUM — focused utilization zone	LOW — restricted within core
Mangrove Products	Leaf chips, Syrup, Dodol (Non-Timber Forest Product)	Syrup, dodol, tea (NTFP processing)	Mangrove tea (external inputs)
Livelihood Orientation	Integrated (ecology + aqua + tourism)	Diversified (NTFP + tourism)	Conservation-oriented
Local Resource Dependency	High	Medium	Low (external)
Gender in Utilization	High (women-led)	High (women-led)	Not documented

Women's Participation Shapes the Spatial Expression of Livelihood Zones

MATURE MODELS — Bandar Bakau & Pangkalan Jambi



Women are Central Drivers

Women play a central role in driving utilization zones. This shifts community strategy away from high-impact extraction toward resilient, value-added processing of non-timber forest products — a pattern consistent with CBNRM literature on gendered resource stewardship.

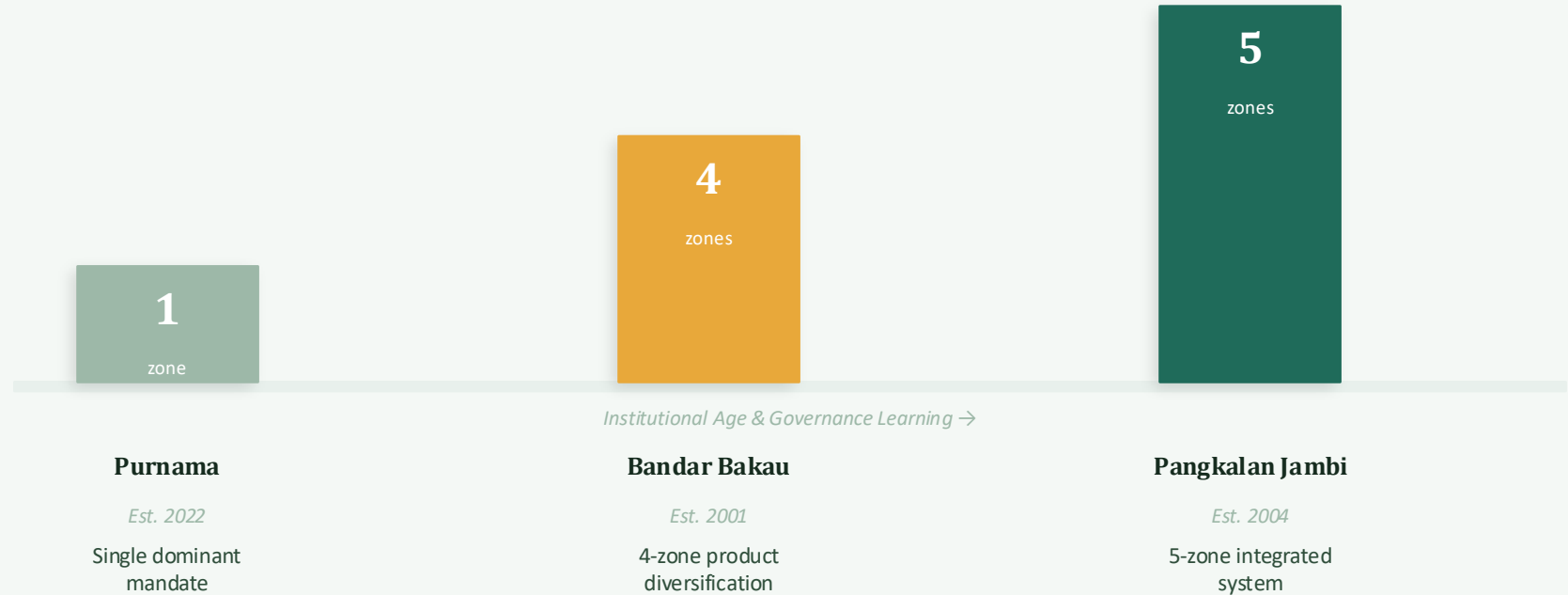
YOUNGER MODEL — Purnama



Documentation Gap

- Strict conservation mandate - no dedicated utilization zones
- Raw materials for mangrove tea sourced externally
- Gender composition not systematically documented
- An important gap for future research

Time Fosters Spatial and Functional Complexity



Insight: Older communities accumulate the social capital and negotiated rules needed to manage highly differentiated, multi-use landscapes. Newly established groups prioritise ecological legitimacy to build initial credibility.

Domastuti & de Groot (2017) - DasGupta & Shaw (2017)

The Spatial Displacement Paradox: A Novel Finding

Pangkalan Jambi

Internal Ecological Pressure **HIGH**

External Dependency **LOW**

Resource use stays within managed zone — intensity is high but governed by clear spatial rules.

✅ **Net landscape outcome: RESOLVED within zone**



PARADOX

Purnama

Internal Ecological Pressure **LOW**

External Dependency **HIGH**

Raw materials sourced externally, strict local protection displaces extraction to unmanaged areas.

⚠️ **Net landscape outcome: UNRESOLVED - potentially vulnerable**



SPATIAL DISPLACEMENT PARADOX

Strict local conservation perfectly protects the managed ecosystem but may displace extraction pressure to unmanaged, potentially less-protected mangrove areas elsewhere, the net landscape outcome remains unresolved.

Moving Beyond Uniform Policy Prescriptions

Young Groups (Purnama)

— Institutional capacity building

— Localised supply chain development to prevent spatial displacement

— Support for formal tenure clarity over third-party patches within managed zones

Maturing Groups (Bandar Bakau)

— Targeted investment in NTFP processing technology

— Expanded market access for value-added mangrove products

— Documentation of gender roles in governance for evidence-based support

Advanced Groups (Pangkalan Jambi)

— Formal state recognition of integrated silvofishery models

— Guarantees of tenure security for complex multi-use zones

— Replication frameworks to share governance learning with younger groups

Key Informant Spatial Elicitation: Between Participatory Mapping and Expert Interview

Full Participatory Mapping
(group negotiated)

← THIS STUDY →

Pure Key Informant Interview
(no spatial output)

✓ Strength

Captures authoritative institutional knowledge. Spatially coherent zone boundaries from leaders who know the system best, including informal rules not visible in official documents.

✓ Validation

Member checking by community members confirmed consistency between leader accounts and broader community understanding of management zones.

⚠ Limitation

Single key informants per site may not represent the full diversity of community views. Sketch-based boundaries remain approximate.

🔍 Future Direction

Multi-stakeholder workshops combined with GPS boundary surveys to strengthen both spatial precision and representativeness of zone delineation.

CONCLUSION

Spatial Configurations are Institutional Trajectories

Community-based mangrove mapping reveals far more than biophysical boundaries; it visualises the accumulated decisions, compromises, and maturity of local governance.



Three distinct SES management models identified across a gradient of institutional maturity



Spatial Displacement Paradox — a novel conservation-utilization trade-off in the literature



Women's participation shapes the spatial expression of livelihood zones in mature models



Differentiated policy support needed — not uniform prescriptions across governance stages

Thank you for your attention