

Urban Valuations of Rural Ecosystem Services

A Transboundary Agenda for Fostering Pro-Environmental Action in Southeast Asia

Michelle Miller

Asia Research Institute, National University of Singapore

Michelle.Miller@nus.edu.sg

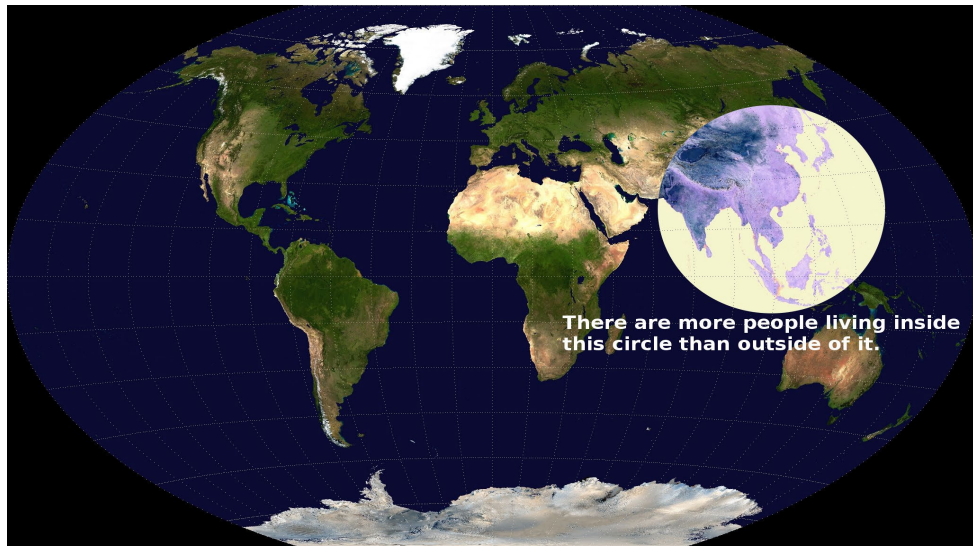


Premise

Cities need to be better understood as **extractive nodes within broader ecosystems** for effective **transboundary governance** of **urban-rural resource dependencies**.

Cities as extractive nodes within broader ecosystems

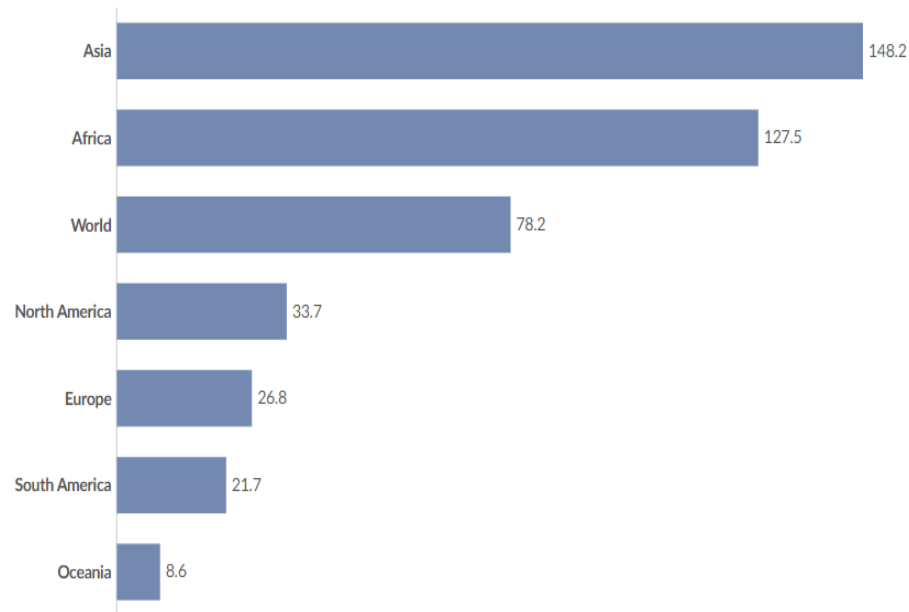




Urbanisation + climate change = two intersecting megatrends of 21st century.

Population density, 2100

The number of people per km² of land area



Data source: HYDE (2023); Gapminder (2022); UN WPP (2024); UN FAO (2024)

OurWorldinData.org/population-growth | CC BY

- Urban century **disrupts conventional ‘North-South’ cleavages** by **widening urban-rural disparities** in income, emissions, food, water, energy security (Sethi & Oliveira, 2015).
- By 2008, **over half world’s human population** lived in urban areas, projected to increase to 70% by 2050, with most global urban residents concentrated in Asia (Seto & Shepherd, 2009).
- Implications for urban well-being, consumption etc. Globally, urban populations contribute ~ **70% total emissions** (United Nations, 2019).

Cities will become more vulnerable to climate risks & impacts as they consume natural resources in rural and remote areas at unsustainable rates.

Cities as extractive nodes in broader ecosystems

Grounded in theories of **extraction, expansion & enclosure**.

- **Resource extraction frontiers** special economic zones & borderland spaces that foment spaces of exception for urban-based capital accumulation & rural dispossession (e.g., Bennett & Faxon, 2021).
- **E.g., Carbon territories** exploit tenurial rights/ resource insecurities in rural environments to capture carbon rights & offset benefits for urban consumers (e.g., Rice, 2010; Dalby, 2020; Miller, 2025).





Urban drivers of rural ecosystem loss remain poorly understood.

- In Southeast Asia, ASEAN's (2023) environmental report emphasises **growth-directed climate solutions/ sustainable production & consumption**, but downplays pressures urban populations place on rural ecosystems.
- Climate governance work on rural-urban connections heavily emphasises **financial flows** (e.g., migration & urban consumer preferences about forest carbon offsetting, Kuncoro et al., 2025).



Cities need to be better understood as extractive nodes within broader ecosystems for effective **transboundary environmental governance** of urban-rural resource dependencies.

Transboundary environmental governance

Governing Compound Disasters in Urbanizing Asia.

Ministry of Education Academic Research Fund Tier 2 [MOE2014-T2-1-017].

Climate Governance of Nature-based Carbon Sinks in Southeast Asia.

Ministry of Education Social Science and Humanities Research Thematic Grant Type B [MOE2021-SSRTG-021].

2017–2022

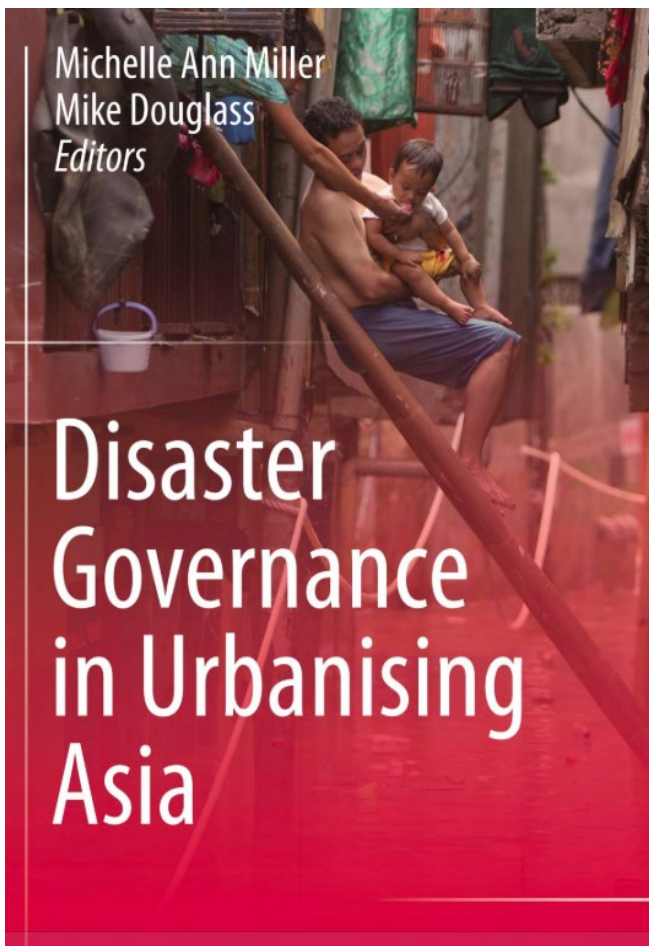
2014–2017

2022–2027

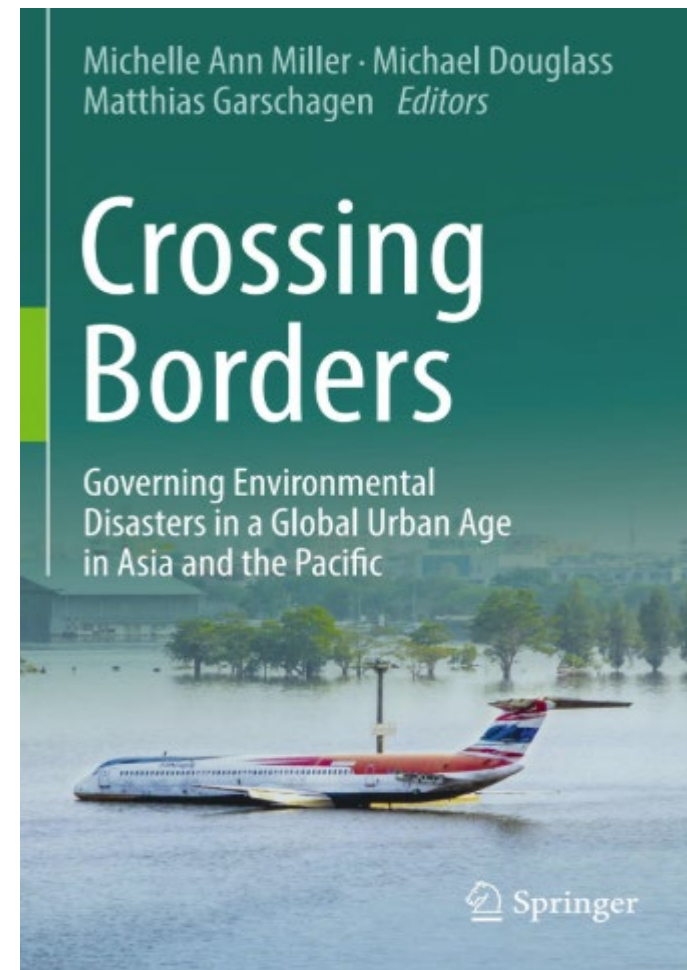
Sustainable Governance of Transboundary Environmental Commons in Southeast Asia.

Ministry of Education Social Science and Humanities Research Thematic Grant Type B [MOE2016-SSRTG-068].

Governing Compound Disasters in Urbanizing Asia (2014 – 2017)



- Compound disasters have **cascading & far-reaching** impacts (i.e., cross-border).
- **Boomerang effects** for urban populations.
- **Spatially & socially uneven risks + impacts** of environmental disasters, requiring transboundary, inclusive forms of environmental governance.



Sustainable Governance of Transboundary Environmental Commons in Southeast Asia (2017 – 2022)

* COVID-19 progression contributed to new region-wide pattern of **urban-to-rural migration**.

* Economic recovery from pandemic recession **jeopardised key transboundary environmental governance arrangements**.

* These pressures **threaten nature-based carbon sinks** & well-being of urban + rural societies dependent upon them.

Progress in Human Geography

ELSEVIER

Political Geography
Volume 97, August 2022, 102646

Impact Factor

Open access | Research article | First published online March 19, 2019

B/ordering the environmental commons

Michelle Ann Miller [View all authors and affiliations](#)

Volume 45, Issue 3 | <https://doi.org/10.1177/0309132519837814>

Selective border permeability: Governing complex environmental issues through and beyond COVID-19

Michelle A. Miller ^a, Rini Astuti ^b, Philip Hirsch ^c, Melissa Marschke ^d, Jonathan Rigg ^e, Poonam Saksena-Taylor ^f, Diana Suhardiman ^g, Zu Dienle Tan ^f, David M. Taylor ^f, Helena Varkkey ^h

TRANSBOUNDARY ENVIRONMENTAL COMMONS IN SOUTHEAST ASIA

TECSEA

ARI
ASIA RESEARCH INSTITUTE
National University of Singapore

Policy Brief

February 2022

POLICY RECOMMENDATIONS FOR SUSTAINABLE PEATLAND MANAGEMENT

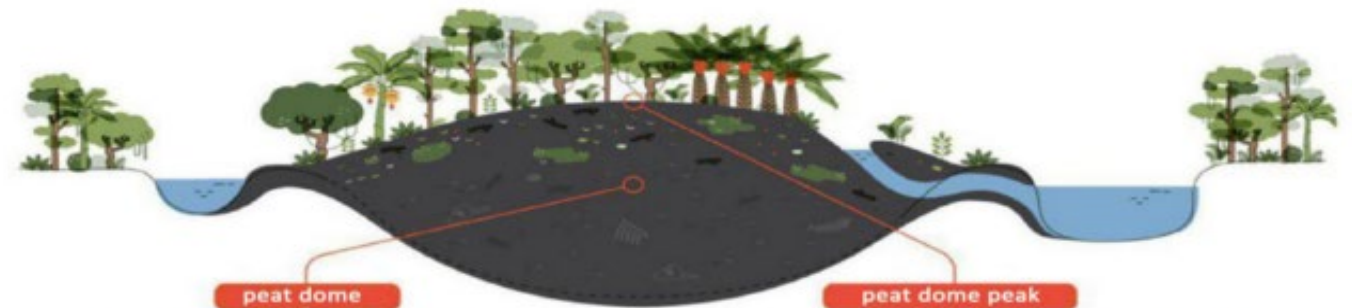


Figure 1. A simplified ombrotrophic peat landscape (Translated and used with permission from Hamzah et al, 2019)

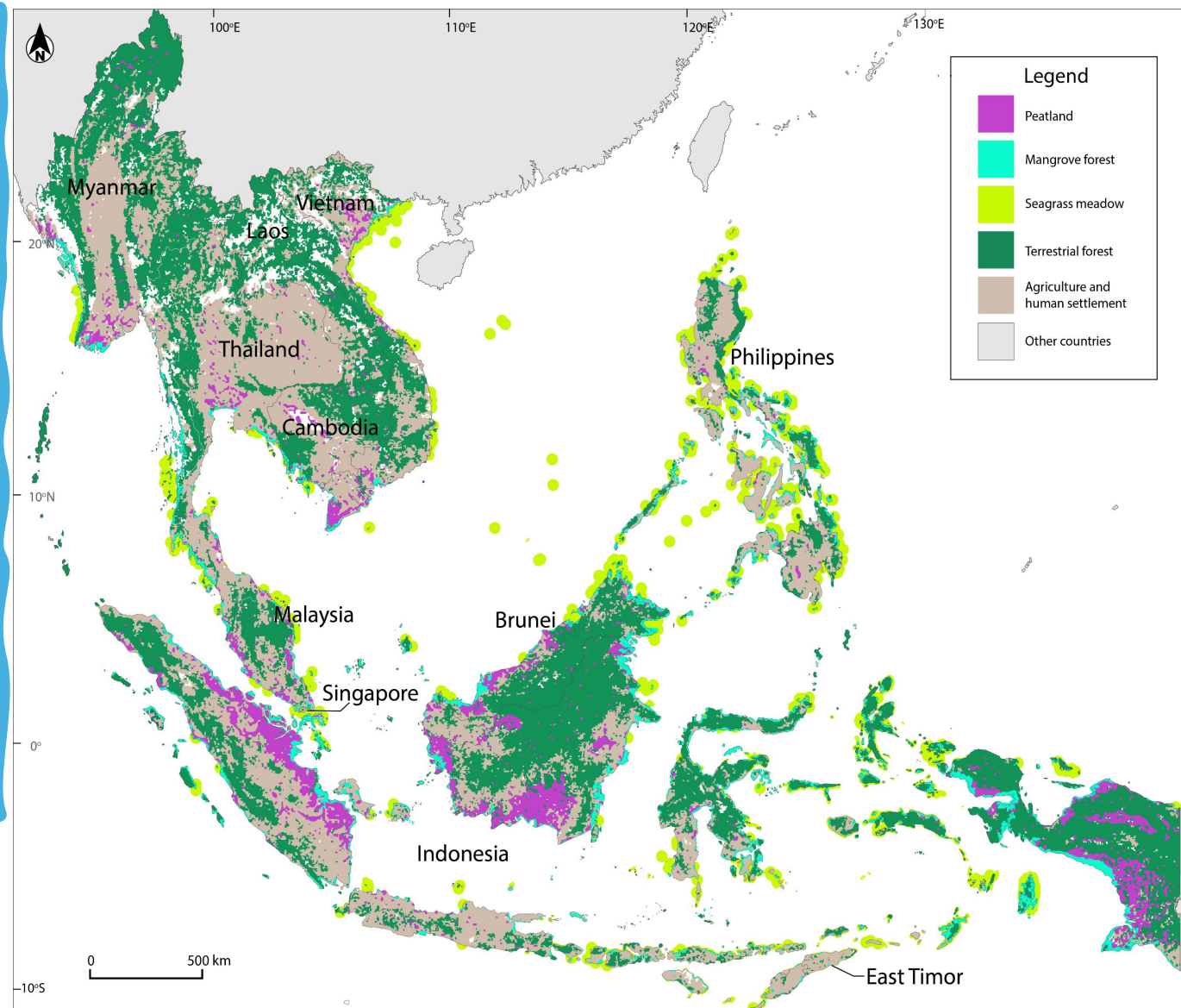
Climate Governance of Nature-based Carbon Sinks in Southeast Asia (2022 – 2027).

Transboundary governance of nature-based carbon sinks has multiple implications for urban systems.

- * **Impermanence** (future carbon loss) & **leakage** (displaced emissions to other areas);
- * Urban health & well-being in **anticipating/ building resilience to cross-jurisdictional shocks & crises;**
- * **Carbon inequality** – inequitable spatial & societal distribution of emissions & carbon benefits.



Website: cgsea.org

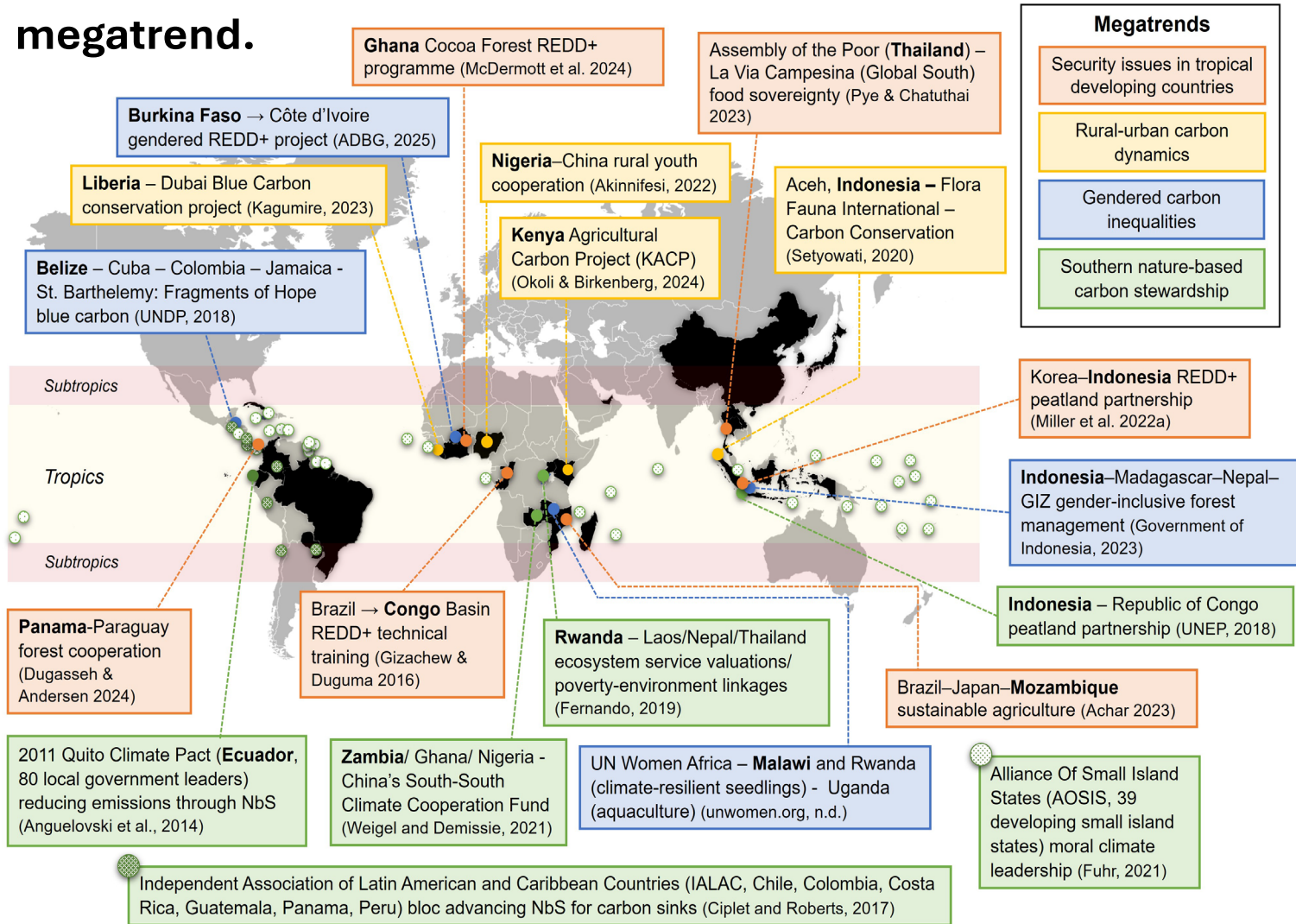


Source: Miller MA & Taylor D (2024) A transboundary agenda for nature-based solutions across sectors, scales and disciplines: Insights from carbon projects in Southeast Asia. *Ambio* 53, 534-551.

Cities need to be better understood as extractive nodes within broader ecosystems for effective transboundary environmental governance of **urban-rural resource dependencies.**



Examples of South-South and triangular cooperation by megatrend.



- Recognition that cities are **first responders/ agents of climate change mitigation** in environmental stewardship (e.g., Fuhr, 2021).
- But, **most research treats “rural” and “urban” separately**, with few studies bridging urban-rural divide.

Effective rural-urban cooperation can reduce environmental pressures (Sethi and Oliveira, 2015).

Typical implementing mechanisms in rural-urban climate partnerships:

- Rural livelihood diversification
- Greening agrifood value chains
- Urban donor-backed rural conservation programs.

Source: Miller MA, Quevedo JM, Rice W & Lau Y. South-South and triangular cooperation for nature-based carbon governance: Megatrends and sector-level insights from the tropics [under review].

Studies of urban-rural linkages need household-level data on ecosystem service valuations among demographic subgroups

Three main findings in rural-urban differences in ecosystem service valuations:

- Urban residents **value ecosystem services more** than rural residents (e.g., Hassan et al., 2019);
- Urban residents **lack ecological knowledge/ awareness** compared to rural residents (e.g., Lapointe et al., 2019);
- Urban & rural populations **value different services**, even within same ecosystem (e.g., Yang et al., 2019).



Southeast Asia Case



Hypothesis

Urban residents who receive **repeat educational messaging** are more likely to value rural ecosystem services and **adopt pro-environmental behaviours**.

Interdisciplinary collaboration with **Alberto Salvo** (economist), **Helena Varkkey** (international relations scholar), **Gan Ningchang** (economics undergraduate), **Muhammad Shehryar** (anthropology undergrad), **David Taylor** (physical geographer).



Two urban populations



Category	Kuala Lumpur	Singapore
Urban Density (per km ²)	8,235	8,207
Land area (per km ²)	243	735.7
Individual carbon footprint annually	8 tonnes	9.5 tonnes
Green space/ forest cover	5.4%	21%
Urban design	Sprawling, car-centric layout, more terraced houses than apartments, few greenbelts.	80% households within 10-min walk to park, more apartments than houses.

Scales of transboundary resource dependencies



Kuala Lumpur: City administrative borders with few green belts or other urban boundaries to prevent encroachment into rural areas.

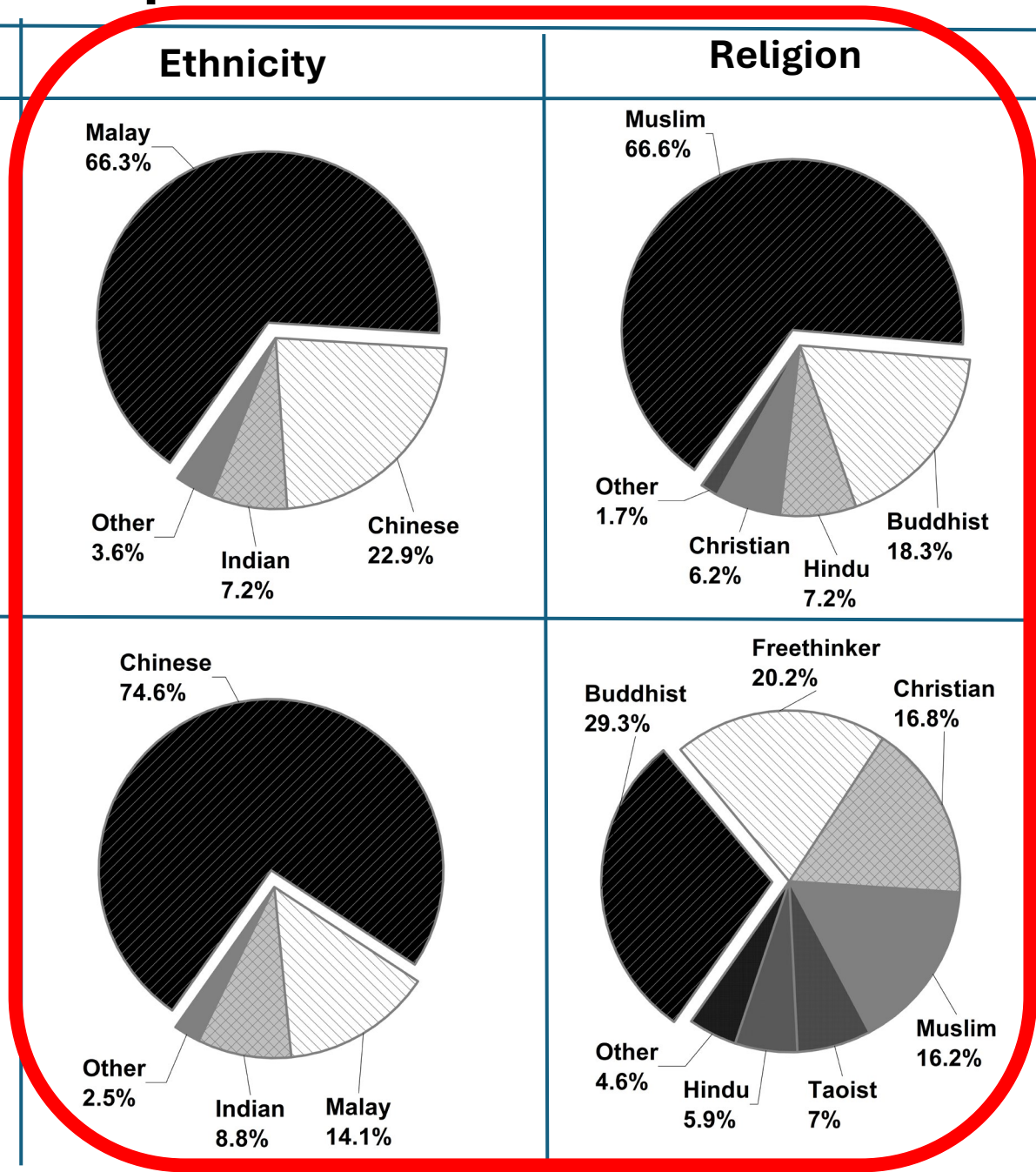
- Connected to national resources & culturally to “people like us”/ intergenerational kampung connections.

Singapore: Wealthy but land-scarce city-state dependent on resources across national boundaries.

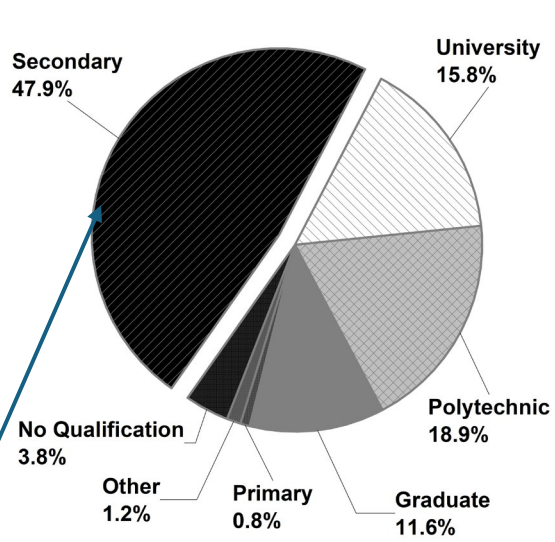
-Removed from direct ecosystem service access but risk-insulated & can afford alternatives.

Demographic snapshot

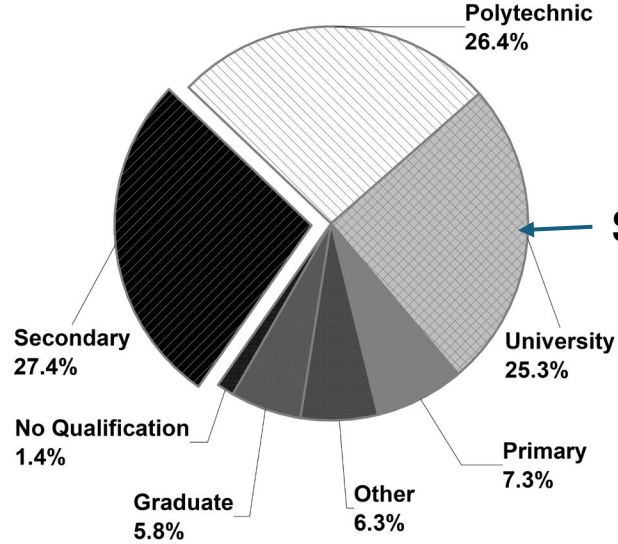
	Citizenship	Gender	Ethnicity	Religion
Kuala Lumpur	<p>Citizen 92.8% Permanent Resident 7.2%</p>	<p>Male 51.3% Female 48.7%</p>	<p>Malay 66.3% Chinese 22.9% Indian 7.2% Other 3.6%</p>	<p>Muslim 66.6% Buddhist 18.3% Hindu 7.2% Christian 6.2% Other 1.7%</p>
Singapore	<p>Citizen 87% Permanent Resident 13%</p>	<p>Male 48.8% Female 51.2%</p>	<p>Chinese 74.6% Malay 14.1% Indian 8.8% Other 2.5%</p>	<p>Buddhist 29.3% Freethinker 20.2% Christian 16.8% Muslim 16.2% Hindu 5.9% Taoist 7% Other 4.6%</p>



Education

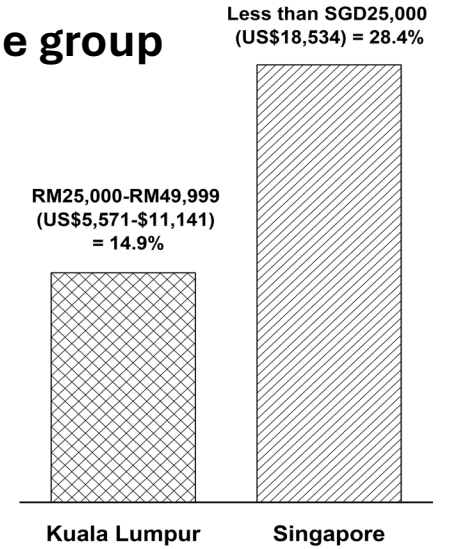


Kuala Lumpur

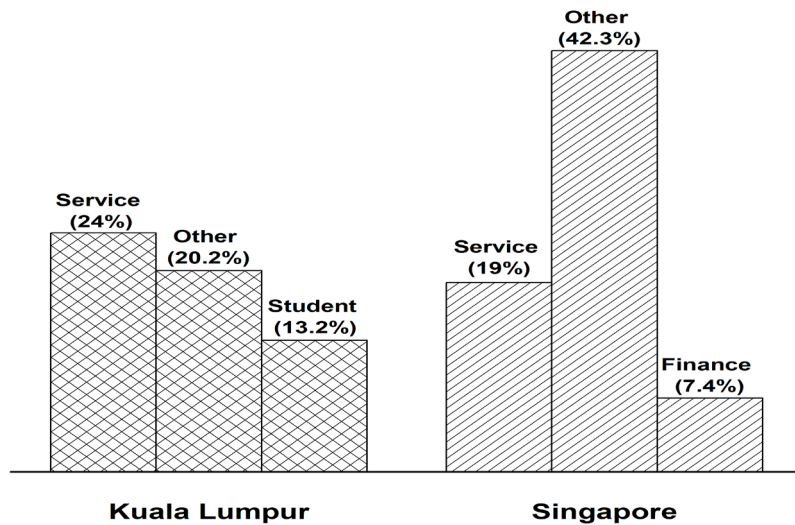


Singapore

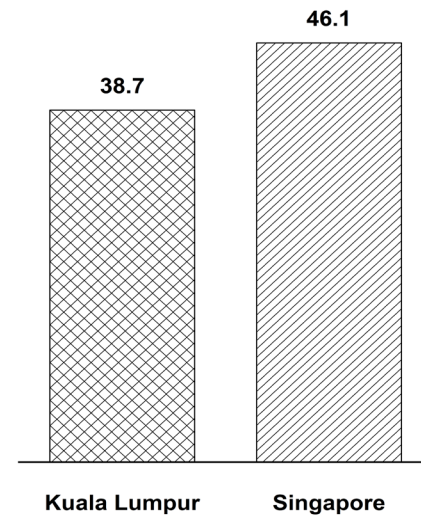
Largest reported annual income group



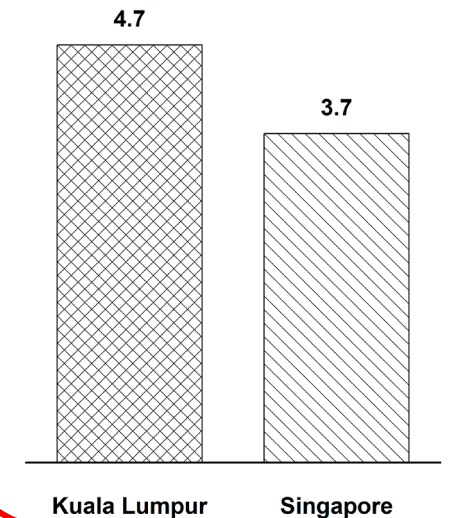
Three most common occupations



Median age



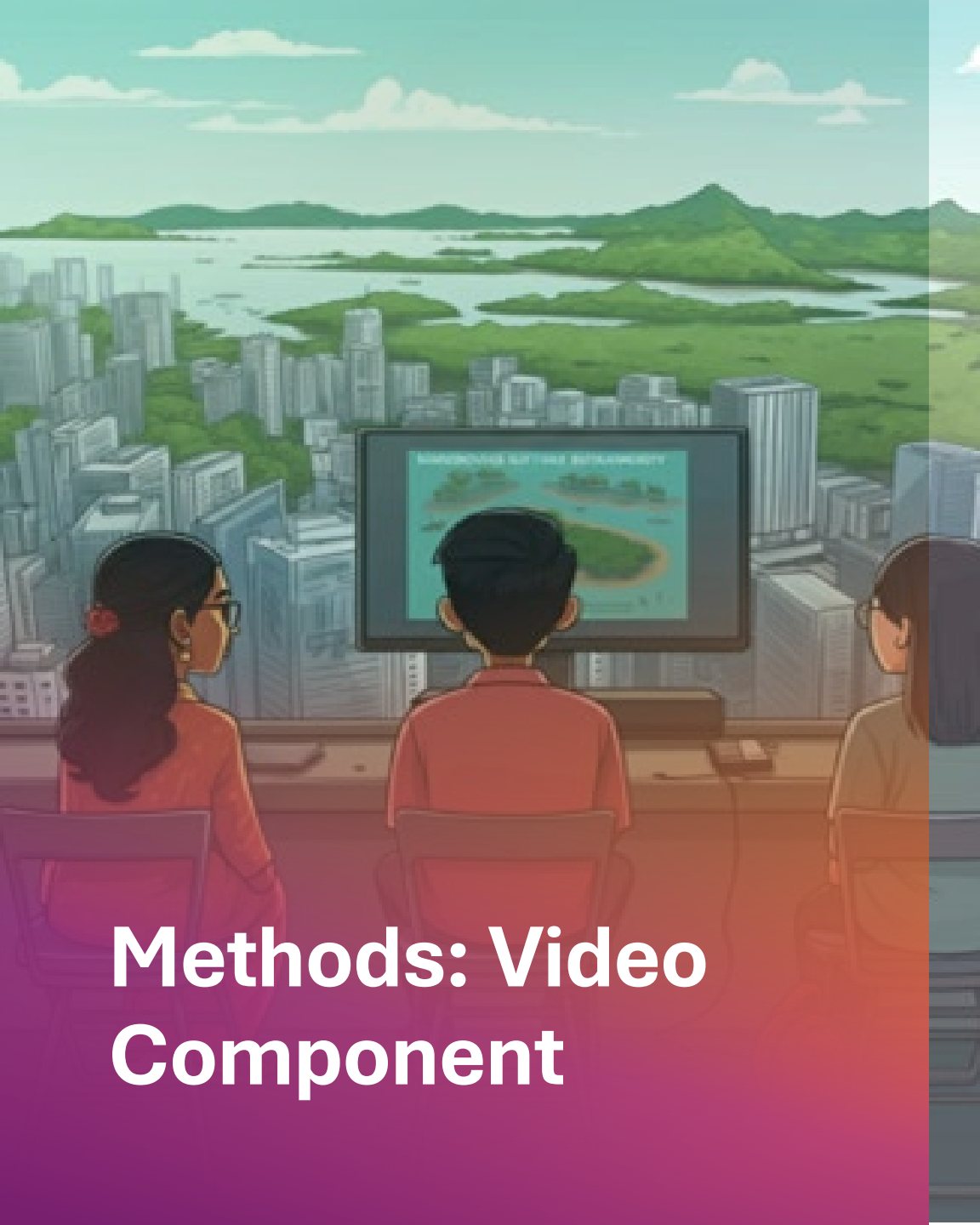
Average household size



A woman in a light blue uniform is showing a tablet to two women in a city at night. The background shows a city skyline with a prominent tower.

Methods: Survey Component

- **Survey Coverage:** 600 households (Kuala Lumpur – 300 pax; Singapore – 300 pax).
- **Data Collection:** 3 waves over seven months (total 1,800 encounters)
 - Wave 1: 26 Jul – 14 Oct 2024 (946 encounters)
 - Wave 2: 25 Oct – 18 Dec 2024 (810 encounters)
 - Wave 3: 20 Dec 2024 – 28 Feb 2025 (600 encounters)Overall Attrition: 37%.
- **Consistency:** Identical survey questions in three languages (English, Malay, Mandarin).
- **Mode of Delivery:**
 - Wave 1: In-person with interviewer
 - Waves 2 & 3: Web-based, self-administeredRationale: Mixed modes maximize response rate & minimize bias.



Methods: Video Component

50% households (150 respondents in each city = 450 total encounters) participated in video intervention.

Consistency: Same 3-minute video shown to both groups in respondent's preferred language (English narrator + Malay/ Mandarin subtitles).

Video respondents asked 2 extra questions:

- (a) Did video motivate lifestyle change?
- (b) If yes, what change?

Methods: Voucher Component

- Informed choice task after each encounter.
- Respondents received voucher to spend on shopping or forest carbon donation.
- Sliding scale allowed flexible allocation.
- To eliminate national bias, unnamed 3rd country in Southeast Asia selected for donation to rural reforestation project.



Collectively home to over 14 million people,

Menti quiz



Results

Four interrelated categories:

- **Material values:** What influences purchasing choices & Willingness to Pay (WTP) for rural ecosystem services;
- **Nonmaterial values:** How individuals value ecosystem services that are difficult to monetise;
- **Motivations:** Why people support specific environmental issues;
- **Pro-environmental behaviour:** What people do to help the environment.

ALL important for designing policies that balance urban resource demands with wider ecosystem stewardship.

Material values

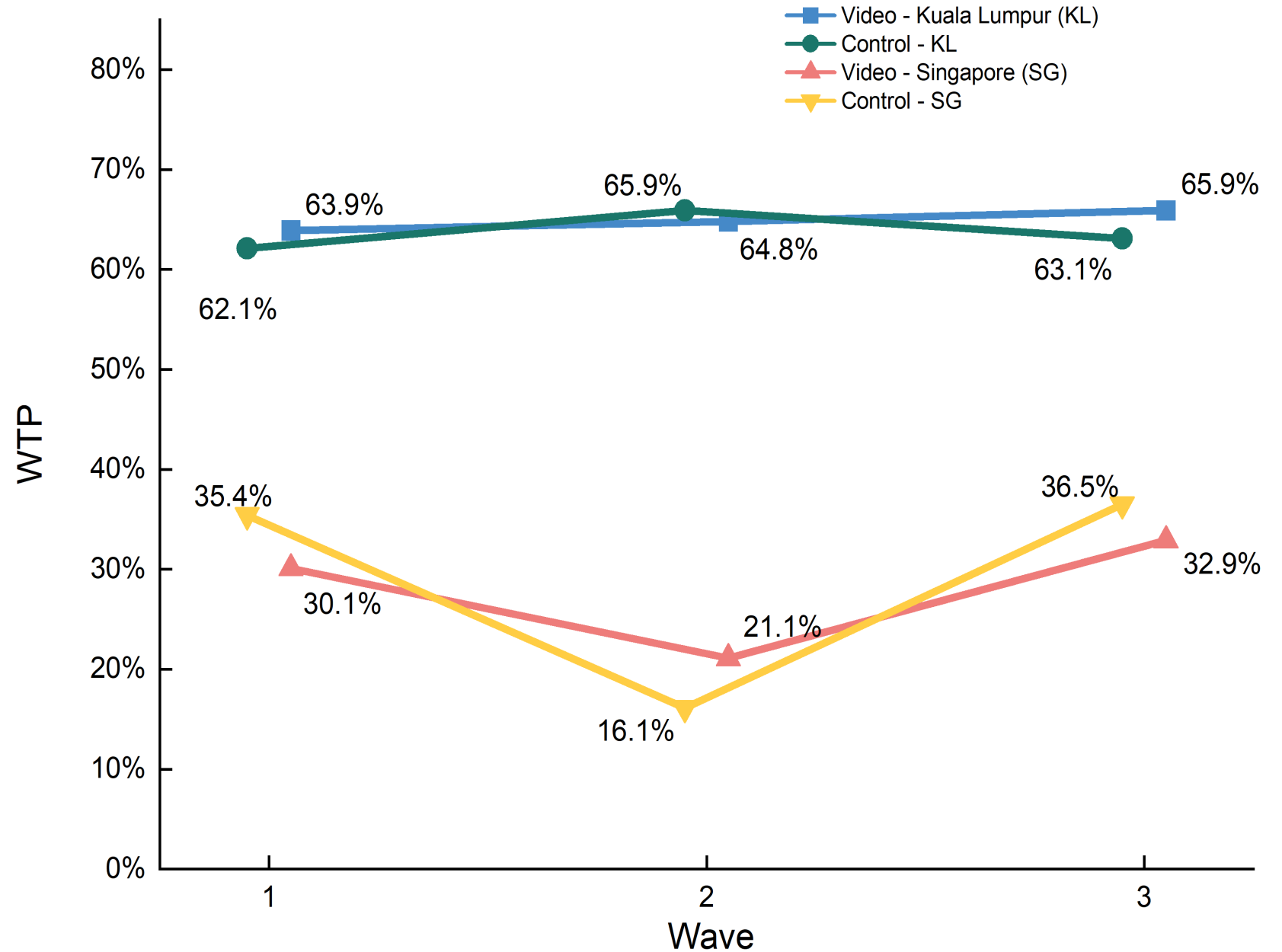
Urban Willingness-to-Pay (WTP) for rural reforestation project

Variable	Kuala Lumpur	Singapore	Both Cities
Video	100% donated at least part of voucher twice; 98% donated each time.	8% donated consistently; 30% gave nothing.	Overall, slightly lower WTP among video respondents compared to control group.
Income & Education	Higher income households (84%) & graduate degree holders (83%) more WTP	University degree holders (45%) more WTP.	Higher household income & higher education = more WTP.
Other demographic predictors	Indians (80%), Hindus (80%) & large households (69%) more WTP.	N/A	N/A

Fig.1. Willingness To Pay (WTP) over time by group.

Respondents were allocated voucher worth 10 MYR (in Kuala Lumpur) or 10 SGD (in Singapore) per encounter.

Percentages represent average proportion of vouchers donated to rural reforestation project.



Non-Material Values

Threats to wellbeing & environmental concerns

Both cities: pollution impacted wellbeing (88%) Concerned about climate events (89%).

Perceived **vulnerability** more pronounced in **Kuala Lumpur** (84%) than in Singapore (56%).

Experience of **extreme climate event in past 2 months** (57% in KL vs. 44% in Singapore) made KL respondents more motivated to change lifestyle + WTP for rural ecosystem services.

Concerns about environment shifted over time: KL respondents grew 7% less concerned; Singaporeans became 5% more concerned.

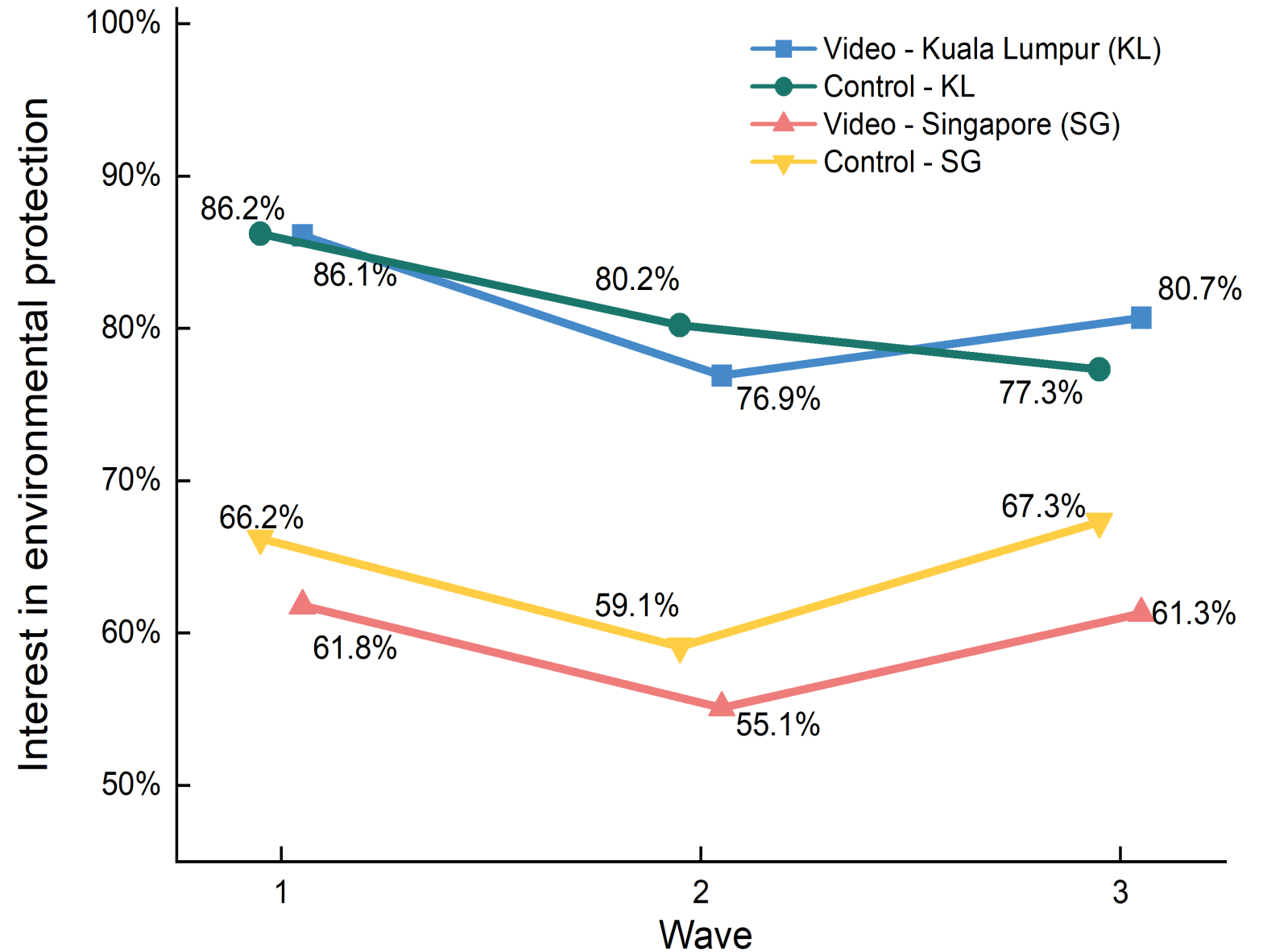
Kuala Lumpur main concerns: industrial waste pollution (66%) & deforestation (65%).

Singapore main concerns: rising temperatures (51%) & global warming (47%).

Lowest concerns in both cities: livestock production (27%) & overfishing (27%).

Interest in environmental protection over time.

Percentages represent proportion of respondents in each group who selected "Very interested" or "Somewhat interested" in protecting environment.



Motivation Results



Demographic profile of most motivated respondent in both cities: Indian Hindu from large household.

- Kuala Lumpur respondents far more motivated (64%) than those in Singapore (36%).
- Motivation strongly associated with both **positive + negative outcomes**:
- **Positively**, all Kuala Lumpur respondents perceived quality-of-life improvements from rural reforestation donations (72%).
- **Negatively**, respondents in both cities with recent experience of extreme climate event more motivated than others to change lifestyle (Kuala Lumpur: 21%; Singapore: 19%).

Reasons for pro-environmental action

NB: After counting fluctuations between encounters, these self-reported behaviours were much lower.

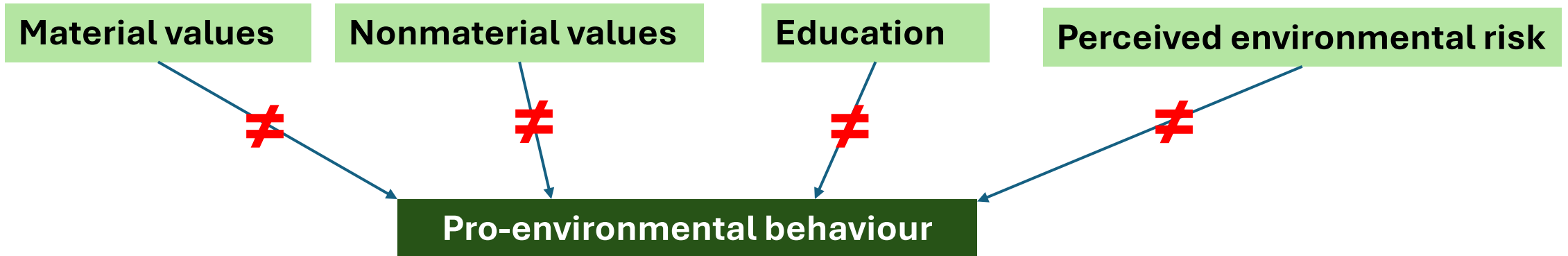
Pro-environmental behavior	Kuala Lumpur (%)	Singapore (%)	Main reason (KL, %)	Main reason (SG, %)
Recycling	10	37	–	–
Using reusable containers	68	64	Cost-saving (44)	Environmental (45)
Reducing meat intake	71	57	Health (42)	Health (36)
Reducing car usage	57	57	Walking (38)	Public transport (38)
Reducing air travel	43	32	No vacation leave (28)	No vacation leave (17)
Reducing air conditioning	59	47	Health (35)	Cost-saving (27)
Reducing electricity use	54	47	Environmental (29)	Cost-saving (30)



Constraints to pro-environmental behaviour

- **Inadequate infrastructure** (KL: 51%; Singapore: 30%)
- **Limited funds** for labelled purchases (KL: 20%; Singapore 33%).
- **Insufficient time** to make sustainable choices (KL: 22%).
- **Competing priorities** – e.g., eating meat as a core dietary component, despite knowing that livestock agriculture causes greenhouse gas emissions (Singapore: 29%).

Multiple Value-Action Gaps



Value-action gap literature emphasizes **why good intentions do not result in action** (Hoffmann et al., 2024).



Both our cities exhibited value-action gaps, in **opposing directions**.



High motivation doesn't ensure action, BUT low motivation doesn't rule it out!



Value-action gap 1:

Material values \neq pro-environmental behaviour

- **Kuala Lumpur:** High Willingness to Pay (WTP) for rural ecosystem services but low pro-environmental behaviour.
- **Financial valuations like WTP may be weak predictors of action.**
- Individuals more willing to commit to easy changes than significant behavioural shifts.
- **Cultural norms** around giving may have inflated WTP among demographic subgroups.

Value-action gap 2: Nonmaterial values ≠ pro-environmental behaviour



Kuala Lumpur: More connected to nature but fewer sustainable purchases.

Singapore: Less connected to nature but purchased more labelled products.

Cross-sectional correlation: environmental awareness + disposable income .

Successful Singapore government campaigns to enforce industry compliance with, & consumer trust in, eco-labelling/ recycling, unlike Malaysia.

Government campaigns may nurture pro-environmental behaviour, even when enabling infrastructure is lacking.





Value-action gap 3: Education ≠ pro-environmental behaviour

- **Graduate degree holders more willing to pay** for rural reforestation + **higher awareness of sustainability labels** in both cities.
- But, fresh produce still outranked environmentally-driven shopping, even among the informed.
- Graduates **least active in climate activities** (every 37 days compared to 20 days for lower educational attainment) – time constraints? Skepticism about individual impact? Disconnect between knowledge & empowerment?

Education may not equate to informed choices or actions.



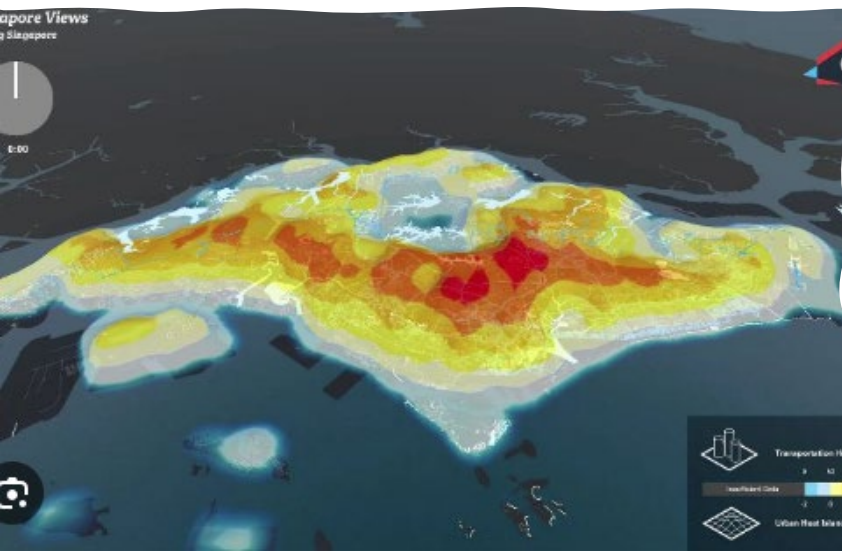
Value-action gap 4: Perceived environmental risk ≠ pro-environmental behaviour

Overall low engagement, despite strong awareness of climate change threats & impacts.

Kuala Lumpur: infrastructural constraints & entrenched habits likely hindered action.

Singapore: trusted, centralized system & reliable infrastructure foster sense of risk insulation.

Both cities: powerlessness & disengagement erode self-belief in individual impact.



Implications for future research on urban environmental behaviour

- Embed choice experiments within **holistic motivation–value–behavior frameworks**.
- **Investigate value–action gaps:**
 - Why does strong environmental concern yield little behavioral change in some urban contexts?
 - Why might some less-concerned individuals act more sustainably?
- **Disentangle demographic effects:** e.g., how ethnicity and religion (“cultural” values) shape ecosystem service values.
- Examine **systemic** enablers/ constraints (e.g., government campaigns, infrastructure) in specific urban contexts.
- Pursue **longitudinal research** to assess behavioral shifts/ optimal conditions for mobilizing urban populations as environmental stewards.

Future transboundary environmental governance research

- **Urbanisation + climate change megatrend convergence:** Investigate cities as extractive nodes that both incubate + are vulnerable to climate risks/impacts.
- Co-design **participatory climate-action frameworks** that align urban citizen agency with institutional support for rural ecosystem services.
- **Address demographic complexity** to create spaces for diverse ecosystem-service valuations across boundaries.
- **Educate urban publics on transboundary resource dependencies** to catalyze knowledge exchange and rural–urban institutional collaborations.



Thank you



Website: https://origin-thailand.wwf-sites.org/en/scp/reforestation_activity/flr_349/

References cited in presentation

- Anguelovski I & Corbera E (2023) Integrating justice in Nature-Based Solutions to avoid nature-enabled dispossession. *Ambio* 52: 45-53.
- ASEAN (2021) *Climate Change Report. Current Status and Outlook of the ASEAN region toward the ASEAN Climate Vision 2050*. Jakarta, Indonesia: ASEAN Secretariat.
- Bennett MM & Faxon HO (2021) Uneven frontiers: Exposing the geopolitics of Myanmar's borderlands with critical remote sensing. *Remote Sensing* 13: 1158.
- Buenavista, D. & Purnobasuki, H. (2023) People and mangroves: Biocultural utilization of mangrove forest ecosystem in Southeast Asia. *Journal of Marine and Island Cultures* 12(2): 95-115.
- Dalby, S. (2020) Bordering sustainability in the Anthropocene. *Territory, Politics, Governance* 8 (2), 144–160.
- Fuhr, H. (2021) The rise of the Global South and the rise in carbon emissions. *Third World Quarterly* 42(11): 2724-2746.
- Hassan, S., Olsen, S. B. & Thorsen, J. (2019). Urban-rural divides in preferences for wetland conservation in Malaysia. *Land Use Policy* 84: 226-237.
- Hoffmann, R., Kanitsar, G. & Seifert, M. (2024) Behavioural barriers impede pro-environmental decision-making: Experimental evidence from incentivized laboratory and vignette studies. *Ecological Economics* 225, 108347.
- Ide, T. (2020) The dark side of environmental peacebuilding. *World Development* 127, 104777.
- Kuncoro, A. H., Dwijatmiko, A., Aida, N., Nurliyanti, V. et al. (2025) Mapping the landscape of carbon trading & carbon offset research: A global and Indonesian perspective. *AIMS Energy* 13(1): 86-124.

Continued...

- Lapointe, M., Cumming, G. S. & Gurney, G. G. (2019) Comparing ecosystem service preferences between urban and rural dwellers. *Bioscience* 69(2): 108-116.
- Miller, M.A. (2025) Carbon territoriality at the land-water interface. *Global Environmental Change* 90, 102954.
- Miller, M.A. & Taylor, D. (2024) A transboundary agenda for nature-based solutions across sectors, scales and disciplines: Insights from carbon projects in Southeast Asia. *Ambio* 53(4): 534-551.
- Rice, J.L. (2010) Climate, carbon, and territory: greenhouse gas mitigation in Seattle, Washington. *Annals of the Association of American Geographers* 100 (4), 929–937.
- Seddon, N., Smith, A., Smith, P., Key, I. et al. (2021) Getting the message right on nature-based solutions to climate change. *Global Change Biology* 27: 1518-1546
- Sethi, M. & de Oliveira, J. P. (2015) From global ‘North-South’ to local ‘Urban-Rural’: A shifting paradigm in climate governance? *Urban Climate* 14: 529-543.
- Seto, K. C. & Shepherd, J. M. (2009) Global urban land-use trends and climate impacts. *Current Opinion in Environmental Sustainability*. 1, 89-95.
- United Nations. (2019) *World Urbanization Prospects: The 2018 Revision* (ST/ESA/SER.A/420). New York: United Nations.
- Yang, S., Zhao, W., Pereira, P. & Liu, Y. (2019) Socio-cultural valuation of rural and urban perception on ecosystem services and human well-being in Yanhe watershed of China. *Journal of Environmental Management* 251, 109615.