Fig. 1. Study Area: Southeast Asia (SEA), its major cities, and bench mark cities of Tokyo, Taipei, and Shanghai in East Asia
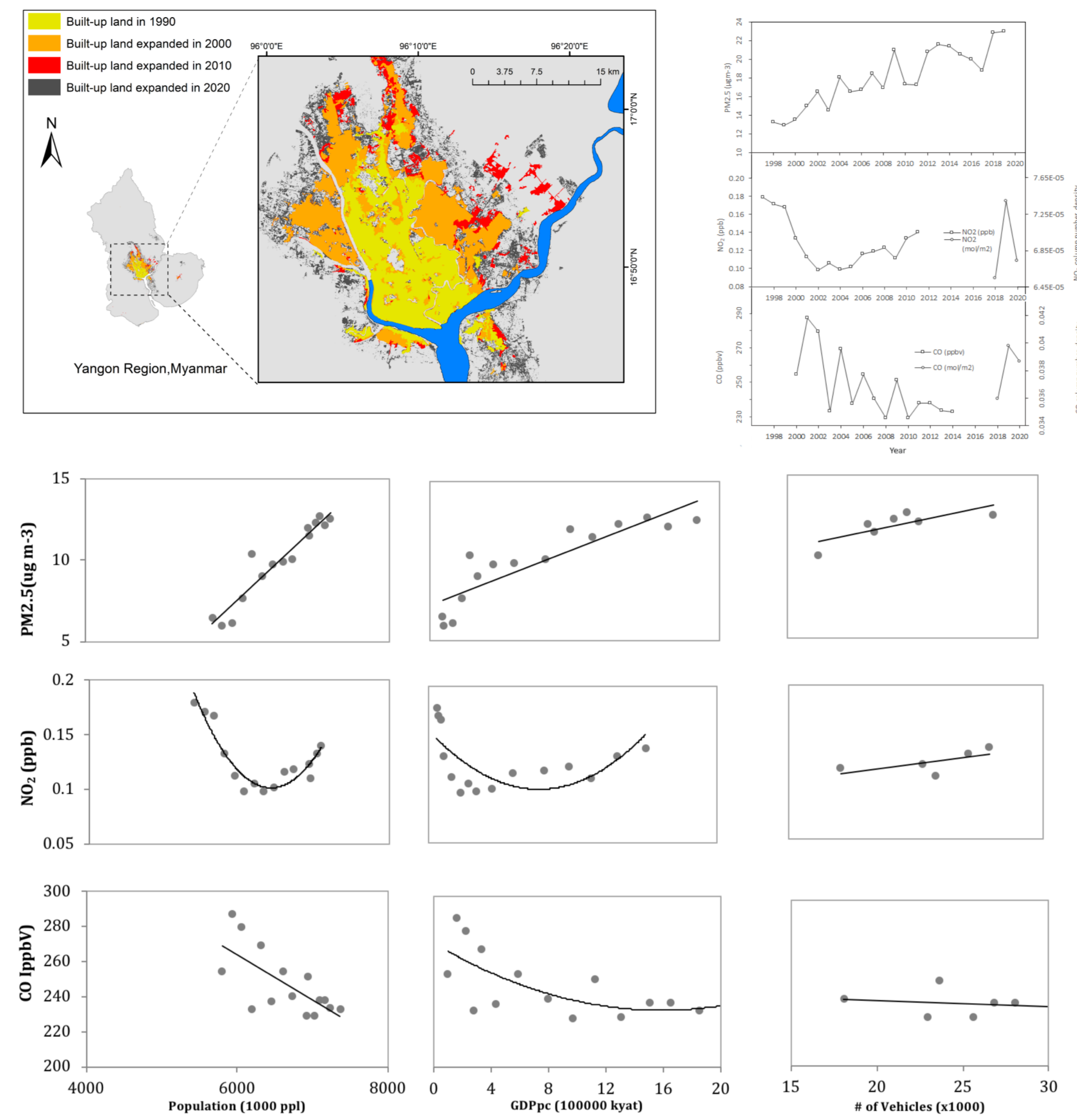

Fig 2. Yangon Case Study, (a-top left) Urban expansion of Yangon, Myanmar during 1990–2020. The urban built-up area expanded from 161 km² in 1990 to 289 km² in 2000, 329 km² in 2010, and 217 km² in 2020. (b-top right) The changes in $PM_{2.5}$, NO_2, and CO concentrations in Yangon from 1997 to 2020. (c-bottom) Changes in concentrations of three air pollutants ($PM_{2.5}$, NO_2, and CO) with three socioeconomic variables (population, GDPpc, and # of vehicles) in Yangon. PM2.5 was positively associated with all three socioeconomic variables; NO_2 decreased and increased with population and GDPpc, respectively; and CO declined with population and GDPpc. (Fan et al., In Review)
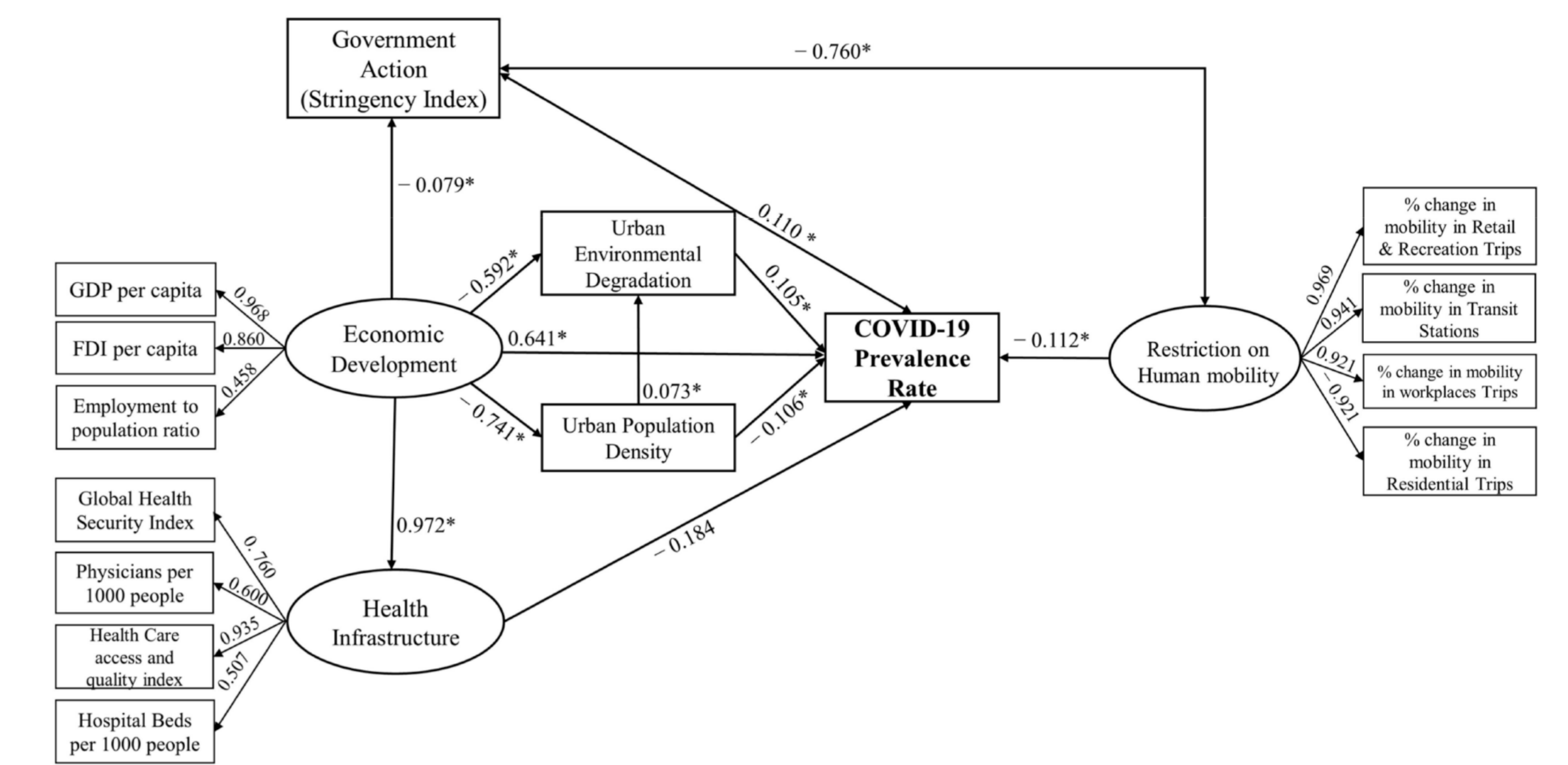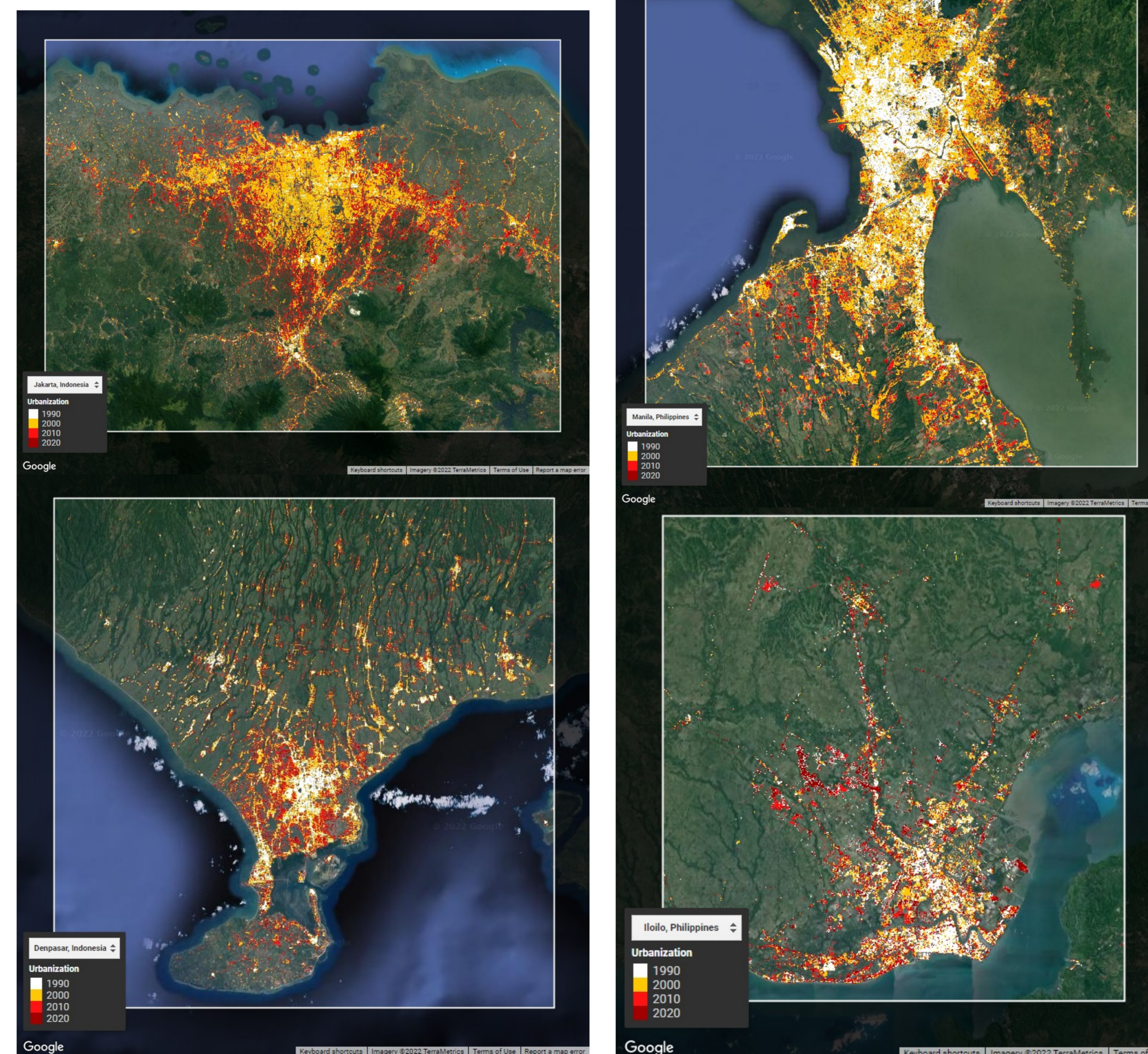

Fig. 3. Empirical influences of major human system factors (economic, social, policy, health infrastructure, and urban environment status) on the prevalence rate (PR) of COVID-19 for the 151 countries from the 20-week study period (Fan *et al.*, 2022b). Note: Foreign Director Investment (FDI) has appeared to be an important factor for economic development, affecting urban environment as well as COVID-10 spread in our SEM model.

Fig 4. Urban expansion of 4 case cities in Maritime SEA: Jakarta, Denpasar, Manila, and Iloilo

Key research findings

(1) The **urbanization and environment changes** of Southeast Asia (also public health outcomes associated with that, Fig. 2) have been **driven by economic development (including globalization and infrastructure** dev., e.g., dam construction @ global scale, Fan et al. 2022a; SEA cities: Fan, 2022). This enriched our understanding of urbanization as they distinct from either developed countries whose urbanization was mainly pulled by industrialization or from low-income, developing countries whose urbanization was pushed by poverty in rural areas.

(2) **Globalization and the institutional force** appear to be key determinants for urbanization & environmental (health outcomes) changes through different types of local responses (e.g., urban expansion of Denpasar and Iloilo driven by international tourism Fig. 4).

(3) the **co-evolution of urbanization, economic development, and environmental/climate/health** (e.g. Yangon (env), Fig. 3; Global scale, Ouyang et al., 2022 (climate), & Fig. 3 (health))

- **urbanization affected global climate change through albedo changes** - The albedo decease from urbanization in 2018 relative to 2001 has yielded a 100-year average annual global warming of 0.00014 [0.00008, 0.00021] °C. Without proper mitigation, future urbanization in 2050 relative to 2018 and that in 2100 relative to 2018 under the intermediate emission scenario (SSP2-4.5) would yield a 100-year average warming effect of 0.00107 [0.00057,0.00179] °C and 0.00152 [0.00078,0.00259] °C, respectively, through altering the Earth's albedo. (Ouyang et al., 2022)

- concentrations of **air pollutants have different dynamics** to be associated with **population, GDPpc, and # of vehicles** in Yangon (Fan et al., in review)

Selected Publications

- Fan, P. (2022). *The Great Urban Transition: Landscape and Environmental Changes from Siberia, Shanghai, to Saigon*. Springer Nature.
- Fan, P., Cho, M.S., Lin, Z., Ouyang, Z., Qi, J., Chen, J., & Moran, E. (2022a). Recently constructed hydropower dams were associated with reduced economic production, population, and greenness in nearby areas. *Proceedings of National Academy of Science (PNAS)*.
- Fan, P., Chen, J., Sarker, T. (2022b). Roles of Economic Development Level and Other Human System Factors in COVID-19 Spread in the Early Stage of the Pandemic. Sustainability. 2022, 14, 2342.
- Ouyang, Z., Sciusco, P., Jiao, T., Feron, S., Lei, C., Li, F., John, R., Fan, P., Li, X., Williams, C.A., Chen, G., Wang, C. & Chen, J. (2022). Albedo changes caused by future urbanization contribute to global warming. *Nature Communications*, 13(1), 1-9.
- *Wang, Y., Chang, Q., Fan, P., & Shi, X. (2022). From urban greenspace to health behaviors: An ecosystem services-mediated perspective. *Environmental Research*, 113664.
- Yue, W., Yang C., Pham T.M.T., Fan, P., Liu, Y., & Zhang, W. (2020). Identifying urban vitality in metropolitan areas of developing countries from a comparative perspective: Ho Chi Minh City versus Shanghai. *Sustainable Cities and Society*, 102609.
- Fan, P., Chen, J., Fung C., Naing, Z., Ouang, Z., Nyunt, K.M., Myint, Z.W., Qi, J., Myint, S.W., Messina, J.P. (in Review). Urbanization, economic development, and environmental changes in transitional economies in the Global South: A case of Yangon.
- Peter, B. G., Messina, J. P., Breeze, V., Fung, C., Kapoor, A., and Fan, P. (in review). Modifiable Spatiotemporal Unit Problems in Remote Sensing of Agriculture: Evidence from Rice Production in Vietnam.

Published Datasets and Tools

- Peter, B., Messina, J., Raney, A., Principe, R., Fan, P. (2021). MSZSI: Multi-Scale Zonal Statistics [AgriClimate] Inventory. https://doi.org/10.7910/DVN/M4ZGXP, Harvard Dataverse, V3.
- Peter, B. (2020). Data visualization published to ObservableHQ showing changes in agricultural land (as a percent of the total land area) in Southeast Asia countries from 1961 to 2016. https://observablehq.com/@cartoscience/southeast-asia-globalization-urbanization-land-and-envir
- Boumis G., Peter B. (2021). Time-Series Matrix (TSMx): A visualization tool for plotting multiscale temporal trends", https://doi.org/10.7910/DVN/ZZDYM9, Harvard Dataverse, V1.