# Faculty Spotlight

Jie-Sheng Tan-Soo

# Next 30 minutes...

Convince you that I:

- Am an expert on environmental issues in developing countries

- Have integrated behavioral theories from social sciences into environmental topics to recover important and useful insights

- Showcase consistency, independence, & creativity in my research

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# About myself

- Degree in Environmental Policy from Sanford School of Public Policy and Nicholas School of Environment @ Duke University in 2015

- Research themes
  - Explore tradeoffs that individuals face in choosing between better environment and economic opportunities
  - Predict and examine impacts of environmental policies based on incentives and preferences

# About myself

- Degree in Environmental Policy from Sanford School of Public Policy and Nicholas School of Environment @ Duke University in 2015

- Research approach
  - Pair theoretical framework from various branches of social sciences(e.g., economics, psychology) with micro-level datasets
  - Examine linkages between the environment, government policies, and individuals' and societal outcomes by using various empirical methods

# Indoor air pollution

- Mostly during doctoral studies

- Close to three billion people worldwide burn biomass fuel indoors using inefficient stoves as their primary cooking method

- Large environmental, and health payoffs if they switch to clean fuel (e.g., gas, electric) and/or switch to improved cooking stoves (ICS)

- Puzzle: Interventions by World Bank, NGOs, J-PAL to provide free ICS mostly end in failures (Barnes et al., 1994; Jeuland et al., 2018; Jeuland & Pattanayak, 2012)

# Indoor air pollution

- Possible explanation: Preferences for cookstoves not well understood

- To better understand preferences for cookstoves, we conducted two experiments in rural India

**J.S. Tan-Soo** (with M.A. Jeuland, S.K. Pattanayak, F. Usami) (2019), "Preferences and the effectiveness of behavior-change interventions: Evidence from adoption of improved cookstoves in India" *Journal of the Association of Environmental and Resource Economists* 7(2), 305-43.

# Indoor air pollution

- To better understand preferences for cookstoves, we conducted two stove purchases experiments in rural India
  - 1st part: Discrete choice experiment (stated preference)
  - 2nd part: Field experiment (revealed preference)

- Conclude that preferences for cookstoves is not as straightforward as imagined by policymakers and NGOs
  - Rural households do not only value reduced smoke emissions, but also fuel type (e.g., electric, gas), number of cooking surfaces, etc…

- Hence, ICS interventions need to be aligned with local preferences and needs

# Outdoor air pollution

- Came across outdoor air pollution (OAP) while working on IAP

- An important issue that deserves just as much attention, if not more
  - Over 4.2 million premature deaths attributed

- Start of an independent research agenda

# OAP (long-term effects of early-life exposure)

**J.S. Tan-Soo** (with S.K. Pattanayak) (2019), Seeking natural capital projects: Forest fires, haze, and early-life exposure in Indonesia, *Proceedings of the National Academy of Sciences* 116(12), 5239-5245. (*First author*)

- Massive literature on health impacts of OAP

- However, very little is known about impacts of early-life exposure

- Conducted study on a familiar setting → 1997 forest fires in Indonesia

- Find that pre-natal exposure to haze causes stunted growth even at 17 years old

- Policy implications:
  - Overall welfare gain to society if firms switches to mechanical logging
  - However, firms' profits will be severely impacted
  - Need very strict enforcement (which is unlikely for Indonesia) or subsidies (which violates the "polluters pay" principle)

# OAP (valuation)

- Continue working on OAP issues after graduation

- Attention shifted to China where it is a perfect setting for me to conduct research

- One particular strand is on non-market valuation of air quality where I monetize preferences for clean air: Stated preferences (Tan-Soo, Finkelstein, et al., 2022), Revealed preferences (Chen et al., 2020, 2021; Tan-Soo, 2018), and Hybrid methods (Chen et al., 2018)

- Commissioned to write a review on air quality valuation in developing countries for REEP

# OAP valuation (short-term travels)

**J.S. Tan-Soo** (with S. Chen, Y.Y. Chen, Z.T. Lei) (2020) "Chasing Clean Air: Pollution-Induced Travels in China". *Journal of the Association of Environmental and Resource Economists* 8(1), 305-43, https://doi.org/10.1086/711476. (*Corresponding author*)

- When faced with air pollution, a natural response is to escape

- Permanent migration relatively easier to track. However, short-term travels are much more difficult

- Use cell-phone signals from the largest mobile phone operator in China to track inter-city movements of subscribers

- Confirms that Chinese residents move to nearby cleaner cities when their home city is forecasted to have poor air quality

- Translate this finding into valuation for clean air

# Climate change

- Latest shift in research agenda

- Many parallels between climate change and OAP
  - Both are air "pollutants"
  - Both impose large societal costs

# Climate change

- Latest shift in research agenda

- Many parallels between climate change and OAP
  - Both are air "pollutants"
  - Both impose large societal costs

- Many important differences as well
  - OAP mostly cause immediate direct harms whereas climate change has a range of direct and indirect harms that are short- and long-term
  - Policies to manage OAP only has local effects whereas policies to mitigate climate change has global effects
- Implications: Fresh research approach and insights needed

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# Climate change (Co-benefits)

- Most greenhouse gas (GHG) mitigation policies are unbalanced
  - Costs are borne by implementing country/city while benefits are diluted globally
  - Will never pass the cost-benefit test

- Concept of co-benefits where GHG mitigation policies has additional local benefits
  - E.g., Switch from coal to clean energy not only reduce GHG emissions, but also local air pollutants (e.g., $SO_2$, $NO_X$)

- Many studies use simulations to show that GHG mitigation policies can pass a cost-benefit test if co-benefits are included (e.g., Karlsson et al., 2020; Li et al., 2018; Markandya et al., 2018)

# Climate change (Co-benefits)

- I question these findings based on my understanding of OAP policies
  - Governments typically address OAP before GHG, e.g., China implemented ultra-low emissions standards on their power stations
  - Extent of co-benefits may also depend on context of GHG mitigation policies

# Climate change (Co-benefits)

**J.S. Tan-Soo** (with Li, L., Qin, P., & Zhang, X. B.) (2021) "Do $CO_2$ emissions trading schemes deliver co-benefits? evidence from Shanghai", *Climate Policy* 22(1) 64-76. (*First author*)

- Pair smokestack-level emissions data with an actual $CO_2$ emissions trading scheme in Shanghai

- Negative correlation between $CO_2$ permit prices and $SO_2$ emissions

- However, co-benefits exist only for non-power stations (e.g., ferrous metal, chemicals, cement)

- Temporal dimension as well where co-benefits exist only during audit months where permits need to tally up with annual emissions

- Policy implications:
  - Simulated models are too optimistic, China's nationwide ETS (which only involves power stations) are unlikely to yield co-benefits

# Climate change (individuals' responses)

- To bend the GHG emissions curve, we also need behavioral changes from individuals (Stoddard et al., 2021)

- Existing literature found that interest and belief in climate change, and support for mitigation policies increase with exposure to extreme weather events

- I question this conclusion as the last decade of record-breaking temperatures have not translated into meaningful mitigation policies or behavioral shifts

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# Climate change (individuals' responses)

**J.S. Tan-Soo** (with Li, J., Qin, P., & Quan, Y.F.) (2023). Using Protection Motivation Theory to examine information-seeking behaviors on climate change. *Global Environmental Change*, forthcoming. (*Corresponding author*)

- Most theories in social sciences predict that individuals act to improve their welfare/well-being given circumstances

- Based on Protection Motivation Theory from psychology, I hypothesize that exposure to adverse weather will instead cause heightened attention on climate adaptation rather than climate mitigation topics

# Climate change (individuals' responses)

- Use city-level daily internet search volume on climate change-related keywords on *Baidu* – China's Google to proxy for public interest

- Categorize keywords into "knowledge", "mitigation", "adaptation"

- Main finding: Searches on "adaptation" increase greatly on days that are abnormally hot or cold. No impact on "mitigation".

- Places that are predominantly hot (e.g., Southern parts of China) search more on "adaptation" on cold days while *vice versa*

- Implications:
  - As climate change intensifies, attention and resources will switch toward adaptation
  - Window of opportunity to reduce emissions is getting smaller (not just from a physical science viewpoint)

# Conclusions

- Research agenda tightly weaved around environmental issues in developing countries

- Combine theories from social sciences with empirical methods to test hypothesis, evaluate policies, and understand preferences about environmental issues

- New research topics build on earlier findings, methods, and knowledge