Sustainability Science: A Short Course for Researchers

Venice International University, May 18-23, 2014

An **Advanced Short Course in Sustainability Science** was offered in May of 2014 by Venice International University in cooperation with the Sustainability Science Program at Harvard University and the Italian Ministry of the Environment.

- The **goal** of the course was to provide a comprehensive, interdisciplinary perspective on the emerging field of sustainability science: its theory, research horizons, and practical applications.

- **Participants** invited to the course are active researchers in the natural and social sciences, health sciences, and engineering who wish to understand how multiple disciplines are contributing to our understanding of interactive social-environmental systems and to our capacity for guiding such systems in a transition toward sustainability. Thirty participants were selected from a large group of candidates nominated by international leaders in the field.

- **Faculty** for the course are listed below. Short bios are provided in an appendix to this note.
    - William Clark (Harvard University and co-director of its Sustainability Science Program)
    - Partha Dasgupta (Cambridge University and Science Advisor to the *Inclusive Wealth Report*)
    - Ann Kinzig (Arizona State Univ. and chief of research at its Global Institute of Sustainability)
    - Éloi Laurent (Sciences-Po & Stanford Univ., former staff to Stiglitz-Sen-Fitoussi Commission)
    - Kira Matus (London School of Economics and Grantham Inst. on Climate & the Environment)
    - Charles Perrings (Arizona State University and director of its Ecoservices Group)
    - Alicia Harley (Teaching Fellow; Harvard Kennedy School and Research Fellow in the Sustainability Science Program)

- **Topics covered** in the course include sustainability as "inclusive human well-being," a capital assets perspective on the determinants of sustainability (including natural capital, manufactured capital, human capital, social capital, and knowledge capital), the dynamics of social-environmental systems (with special attention to cross-scale connections, tipping points, resilience and vulnerability), challenges of linking knowledge with action, and governance for sustainable development. Applications across regions and sectors will be woven into discussions of the conceptual material. A detailed syllabus and list of readings follows.

Syllabus and Readings

Day 1: Monday

Session 1: Overview of the course (*Professor Bill Clark*)

a) Clark, W. and Dasgupta, P. 2014. Sustainability science: An overview of the course at VIU. Unpublished manuscript.

b) Kates, Robert W. 2011. "What Kind of a Science is Sustainability Science?" *Proceedings of the National Academy of Sciences* 108 (49): 19449-19450.

c) Kates, Robert W., Thomas M. Parris and Anthony A. Leiserowitz. 2005. "What is sustainable development?" *Environment*. 47 (3):9-21.

Session 2: Social-environmental systems as complex adaptive systems (*Professor Ann Kinzig*)

a) Levin, S., Xepapadeas, T., Crépin, A.-S., Norberg, J., de Zeeuw, A., Folke, C., Hughes, T., Arrow, K., Barrett, S., Daily, G., Ehrlich, P., Kautsky, N., Mäler, K.-G., Polasky, S., Troell, M., Vincent, J.R. & Walker, B. (2013) Social-ecological systems as complex adaptive systems: modeling and policy implications. *Environment and Development Economics*, 18, 111-132.

b) Steffen, Will, Paul J. Crutzen, and John Robert McNeill. 2007. "The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature." *AMBIO: A Journal of the Human Environment* 36 (8): 614-621.

c) Lansing, J. S. 2003. "Complex Adaptive Systems." *Annual Review of Anthropology* 32, no. 1 (10): 183-204.

Session 3: Common cases: Water temples, ozone holes and mosquitos (*Professor Bill Clark*)

a) Lansing, J. S. and James N. Kremer. 1993. "Emergent Properties of Balinese Water Temple Networks: Coadaptation on a Rugged Fitness Landscape." *American Anthropologist* 95 (1): 97-114.

b) Haas, Peter M. 1992. "Banning Chlorofluorocarbons: Epistemic Community Efforts to Protect Stratospheric Ozone." *International Organization* 46 (1) : 187-224.

c) McNeill, John Robert. 2010. "The argument (and its limits) in brief." Ch. 1 in Mosquito Empires: Ecology and War in the Greater Caribbean, 1620-1914. New York: Cambridge University Press

Session 4: Common cases: Venice and its lagoon (*Professor Ignazio Musu*)

a) **Musu, I. 2001. "Venice and its Lagoon: A Problem of Local Sustainable Development" Chapter 1 in Sustainable Venice: Suggestions for the future, DORDRECHT, Kluwer Academic Publishers, 2001.**

b) Rinaldo, Andrea. 2001. "On the Natural Equilibrium of the Venice Lagoon. (Will Venice Survive)" in *Sustainable Venice: Suggestions for the future, DORDRECHT,* Kluwer Academic Publishers, 2001.
c) Venice Sustainability Advisory Panel.2009. Final Report prepared for Thetis S.p.A.

Day 2: Tuesday

Session 5: Cross scale effects (*Professor Charles Perrings*)

a) Levin, S., Xepapadeas, T., Crépin, A.-S., Norberg, J., de Zeeuw, A., Folke, C., Hughes, T., Arrow, K., Barrett, S., Daily, G., Ehrlich, P., Kautsky, N., Mäler, K.-G., Polasky, S., Troell, M., Vincent, J.R. & Walker, B. 2013. Social-ecological systems as complex adaptive systems: modeling and policy implications. *Environment and Development Economics*, 18, 111-132. [*****Note to readers: This paper was also assigned for Session 2. Review it as the assigned reading for this class. Refer to the location for session 2 in the binder.**]**

b) Polasky S., Nelson E., Camm J., Csuti B., Fackler P., Lonsdorf E., Montgomery C., White D., Arthur J., Garber-Yonts B., Haight R., Kagan J., Starfield A. & Tobalske C. 2008. Where to put things? Spatial land management to sustain biodiversity and economic returns. *Biol Conserv*, 141, 1505-1524.
c) Liu, J., V. Hull, M. Batistella, R. DeFries, T. Dietz, F. Fu, T. W. Hertel, R. C. Izaurralde, E. F. Lambin, S. Li, L. A. Martinelli, W. J. McConnell, E. F. Moran, R. Naylor, Z. Ouyang, K. R. Polenske, A. Reenberg, G. de Miranda Rocha, C. S. Simmons, P. H. Verburg, P. M. Vitousek, F. Zhang, and C. Zhu. 2013. Framing sustainability in a telecoupled world. *Ecology and Society* 18(2): 26.

Session 6: Tipping points and regime shifts (*Professor Ann Kinzig*)

a) Scheffer, M., Bascompte, J., Brock, A., Brovkin, V., Carpenter, S., Dakos, V., Held, H., Nes, Egebert. 2009. "Early Warning Signals for critical transitions." *Nature* 461, no. 7260 : 53-59.

b) Kinzing, A., Ryan, P., Etienne, M., Allison, H., Elmqvist, T., Walker, B. 2006. "Resilience and Regime Shifts: Assessing Cascading Effects" *Ecology and Society* Vol 11 (1): 20. http://www.e cologyandsociety.org/vol11/iss1/art20/.
c) Lade, S., Tavoni, A., Levin, S., Schluter, M. 2013. "Regime shifts in social-ecological system" *Theor Ecol* 6:359–372.

Session 7: Resilience and stability (Professor Perrings)

a) Ives, A.R. & Carpenter, S.R. 2007. Stability and Diversity of Ecosystems. *Science*, 317: 58-62.

b) Holling, C.S. 1973. Resilience and stability of ecological systems. *Annual Review Ecology and Systematics*, 4, 1-23.

Session 8: Innovation (*Professor Kira Matus*)

a) Moon, Suerie, Jorge Bermudez, and Ellen't Hoen. 2012. "Innovation and Access to Medicines for Neglected Populations: Could a Treaty Address a Broken Pharmaceutical R&D System?" *PLoS Medicine* 9, no. 5 (05): 1-5.

b) Mowery, David C., Richard R. Nelson, and Ben R. Martin. 2010. "Technology Policy and Global Warming: Why New Policy Models Are Needed (or Why Putting New Wine in Old Bottles Won't Work)." *Research Policy* 39, no. 8: 1011–23.

c) Berkhout, Frans, Geert Verbong, Anna J. Wieczorek, Rob Raven, Louis Lebel, and Xuemei Bai. 2010. "Sustainability Experiments in Asia: Innovations Shaping Alternative Development Pathways?" *Environmental Science & Policy* 13, no. 4: 261–71.

Day 3: Wednesday

Session 9: The idea of sustainable development (*Professor Partha Dasgupta*)

Dasgupta, P. 2013. "The Nature of Economic Development and the Economic Development of Nature," *Economic & Political Weekly*, 48(51): 38-51.

Anant, T.C.A. et al. 2013. Green National Accounts in India: A Framework (A Report by an Expert Group Convened by the National Statistical Organization, Ministry of Statistics and Programme Implementation, Government of India).

Session 10: Natural capital (*Professor Ann Kinzig*)

a) Cardinale, Bradley J., J. Emmett Duffy, Andrew Gonzalez, David U. Hooper, Charles Perrings, Patrick Venail, Anita Narwani, Georgina M. Mace, David Tilman, and David A. Wardle. 2012. "Biodiversity Loss and its Impact on Humanity." *Nature* 486 (7401): 59-67.

b) Reid, W., Mooney, Harold A., Cropper, A., Capistrano, D., Carpenter, S., Chopra, K., Dasgupta. P., Dietz, T., Duraiappah, Anantha., Hassan, R., Kasperson, R., Leemans, R., May, R., Pingali, P., Samper, C., Scholes, R., Watson, R., Zakri, A., Shidong, Z., Ash, N., Bennett, E., Kumar, P., Lee, Marcus., Hearne, C., Simons, H., Thonell, J., Zurek, M. 2005. *Ecosystems and Human Well-Being*: Synthesis. Island Press: Washington D.C

c) Diaz, S., Lavorel, S., Bello, F., Quetier, F., Grigulis, K., Robson, T. 2007. "Incorporating plant functional diversity effects in ecosystem service assessments." *Proceedings of the National Academy of Sciences of the United States of America* 104, no. 52: 20684-20689. doi:0704716104

Session 11: Manufactured Capital (*Professor Kira Matus*)

a) **OECD. 2010. "Framing Eco-innovation: The Concept and the Evolution of Sustainable Manufacturing", in Eco-Innovation in Industry: Enabling Green Growth, OECD Publishing.** [*****Note to readers: This is a big report. Read carefully the "Introduction" and the section on "The rise of sustainable manufacturing" (pp. 22-46), and then read as much as interests you in "Understanding eco-innovation" (pp. 38-47) and "Eco-innovation as a driver of sustainable manufacturing" (pp.47-51). For context, you may find it useful to print out the figure on pg. 37 and use it to guide your reading**].**

b) Esty, Daniel C., and Michael E. Porter. 1998. "Industrial Ecology and Competitiveness.: Strategic Implications for the Firm." *Journal of Industrial Ecology* 2, no. 1: 35–43.
c) Johnson, Rebecca, Alice Kodama, and Regina Willensky. 2014. "The Complete Impact of Bicycle Use: Analyzing the Environmental Impact and Initiative of the Bicycle Industry." [*Note to readers: This is a master's thesis project, but it is an interesting example of beginning to think about how to measure impacts of manufacturing, and is especially interesting given that the finished product is one that has sustainability benefits from its use bicycles]

Session 12: Human Capital (*Professor Bill Clark*)

a) Smith, Kirk R. and M. Ezzati. 2005. "How environmental health risks change with development: The epidemiologic and environmental risk transitions revisited." ***Annual Review of Environment and Resources.*** **30:291-333.**

b) Lutz, Wolfgang and Samir KC. 2011. "Global Human Capital: Integrating Education and Population." *Science* 333 (6042): 587-592.
c) Myers, Samuel S., Lynne Gaffikin, Christopher D. Golden, Richard S. Ostfeld, Kent H. Redford, Taylor H. Ricketts, Will R. Turner, and Steven A. Osofsky. 2013. "Human Health Impacts of Ecosystem Alteration." *Proceedings of the National Academy of Sciences of the United States of America* 110 (47): 18753-18760.

Session 13: Intangible Capital: Knowledge capital and social capital *(Professor Eloi Laurent)*

a) Required: Ostrom, E. 2009. "What is social capital?" pp. 17-38 in Viva Ona Bartkus and James H. Davis. Eds. Social capital: Reaching out, reaching in. Edward Elgar Publishing.

b) Morrone, A., N. Tontoranelli and G. Ranuzzi, 2009. "How Good is Trust? Measuring Trust and its Role for the Progress of Societies", OECD Statistics Working Papers, 2009/03, OECD Publishing.
c) Hamilton, K. Liu, G., 2013. "Human Capital, Tangible Wealth, and the Intangible Capital Residual". Policy Research Working Paper 6391. Washington, DC: World Bank, Development Research Group, Environment and Energy Team.

DAY 4: Thursday

Session 14: Governance for sustainable development: The challenge (*Professor Partha Dasgupta*)

a) Dasgupta, Partha. 2014. "Impediments to Sustainable Development: Externalities in Human-Nature Exchanges" University of Cambridge, 2014.

b) Dasgupta, Partha. 2005. "Economics of Social Capital" *The Economic Record,* Vol 81 (no. 225): S2-S21.

Session 15: Equity and sustainability (*Professor Eloi Laurent*)

a) Required: Laurent, E., 2014. "Social-Ecology: Exploring the missing link in sustainable development", New Approaches to Economic Challenges, OECD.

b) Human Development Report 2011. "Sustainability and Equity: A Better Future for All", United Nations Development Program, Human Development Report Office, United Nations: New York.

c) Motesharrei S., Jorge Rivas, Eugenia Kalnay. 2014. "Human and nature dynamics (HANDY): Modeling inequality and use of resources in the collapse or sustainability of societies", *Ecological Economics.* 101:90-102.

Session 16: Managing externalities and public goods (*Professor Charles Perrings*)

a) Barrett, C.B., Bulte, E.H., Ferraro, P. & Wunder, S. 2013. "Economic instruments for nature conservation." *Key Topics in Conservation Biology* 2: 59-73. John Wiley & Sons.

b) Parson, Edward A. and Eric L. Kravitz. 2013. "Market Instruments for the Sustainability Transition." *Annual Review of Environment and Resources* 38, no. 1 (10/17; 2014/05): 415-440.

c) Stavins, R.N. 2003. "Experience with Market-Based Environmental Policy Instruments." *Handbook of Environmental Economics* (ed. by K.-G. Mäler and J.R. Vincent), pp. 355-435. Elsevier, Amsterdam.

Session 17: Social norms and cooperation (*Professor Ann Kinzig*)

a) Kinzing, A., Ehrlich, P., Alston, L., Arrow, K., Barret, S., Buchman, T., Daily, G., Levin, B., Levin, S., Oppenheimer, M., Ostrom, E., Saari, D. 2013. "Social Norms and Global Environmental Challenges: The Complex Interaction of Behaviors, Values, and Policy" in *BioScience*, Vol 63 (No.3): 164-175. doi:10.1525/bio.2013.63.3.5

b) Fehr, E., Fischbacher, U. 2004. "Social norms and human cooperation" in *Trends in Cognitive Science*, Vol 8. No 4: 185-190.

c) Ehrilch, P., Levin S. 2000. "The Evolution of Norms" *PLoS Biology*, 2005, Vol 3 (no. 6): e194.

d) Ostrom, Elinor. "Collective Action and the Evolution of Social Norms." *The Journal of Economic Perspective*; Vol 14, 3:137-159.

Session 18: Voluntary standards (*Professor Kira Matus*)

a) Cidell, Julie and Miriam A. Cope. 2013. "Factors Explaining the Adoption and Impact of LEED-Based Green Building Policies at the Municipal Level." *Journal of Environmental Planning and Management*(10/10; 2014/05): 1-19.

b) Ostrom, Elinor. 2010. "Beyond Markets and States: Polycentric Governance of Complex Economic Systems." *American Economic Review* 100, no. 3: 641–72.

c) Steering Committee of the State-of-Knowledge of Standards and Certification. Towards Sustainability: The Roles and Limitations of Certification. Washington, DC: RESOLVE, Inc., 2012. http://www.resolv.org/site-assessment/towardsustainability/. [Executive Summary is good background; also Chapter 4, pages 73-89 for a more advanced treatment of interactions between certification and other types of governance].

Day 5: Friday

Session 19: Indicators of well-being (*Professor Eloi Lauent*)

a) Costanza, R., I. Kubiszewski, E. Giovannini, H. Lovins, J. McGlade, K. E. Pickett, K. Ragnarsdottir, D. Roberts, R. De Vogli, and R. Wilkinson. 2014. "Development: Time to Leave GDP Behind." *Nature* 505, no. 7483: 283-285.

b) Stiglitz J., Sen A., Fitoussi J.-P., 2009. "The measurement of economic performance and social progress revisited", OFCE Working Paper.

c) OECD 2013. How's Life? 2013: Measuring Well-being, OECD Publishing.

Session 20: Retrospective evaluations and risk (*Professor Partha Dasgupta*)

a) Dasgupta, Partha. 2014. "Pricing Climate Change". Forthcoming in *Politics Economics & Philosophy.*

b) Arrow, K.J. et al. 2012. "Sustainable Development and the Measurement of Wealth," *Environment and Development Economics*, 17(3), 317-353.

c) K.J. Arrow et al. 2013. "Sustainable Development and the Measurement of Wealth: Further Reflections," *Environment and Development Economics*, 18(4), 504-516.

d) Pindyck, Robert. 2011. "Fat Tails, Thin Tails and Climate Change Policy". *Rev Environ Econ Policy* 5(2): 258-274. <doi: 10.1093/reep/rer005>.

Session 21: Prospective evaluations (*Professor Kira Matus*)

a) Lawler, Joshua J., David J. Lewis, Erik Nelson, Andrew J. Plantinga, Stephen Polasky, John C. Withey, David P. Helmers, Sebastián Martinuzzi, Derric Pennington, and Volker C. Radeloff. 2014. "Projected Land-use Change Impacts on Ecosystem Services in the United States." *Proceedings of the National Academy of Sciences* 111, no. 20: 7492-7497. <doi:10.1073/pnas.1405557111>.

b) York, Richard, Eugene A. Rosa, and Thomas Dietz. 2003. STIRPAT, IPAT and ImPACT: Analytic tools for unpacking the driving forces of environmental impact. *Ecological Economics* 46: 351-365.

c) Guidance on Sustainability Impact Assessment. OECD Publishing, 2010. (Note the discussion on types of capital on pages 19-20)

d) National Research Council (U.S.). 2011. Sustainability and the U.S. EPA. Washington, D.C: National Academies Press (Start with the summary, pgs 1-6).

Session 22: Linking knowledge with action (*Professor Bill Clark*)

a) Cash, David W., William C. Clark, Frank Alcock, Nancy M. Dickson, Noelle Eckley, David H. Guston, Jill Jäger, and Ronald B. Mitchell. 2003. "Knowledge Systems for Sustainable Development." *Proceedings of the National Academy of Sciences* 100, no. 14 : 8086-8091.

b) Buizer, James L., Katherine Jacobs and David W. Cash. 2010. "Making short-term climate forecasts useful: Linking science and action." *Proceedings of the National Academy of Sciences.* <doi:10.1073/pnas.0900518107>.

c) Clark, William C., Thomas P. Tomich, Meine van Noordwijk, et al. 2011. "Boundary work for sustainable development: Natural resource management at the consultative group on international agricultural research (CGIAR)." *Proceedings of the National Academy of Sciences.* <doi:10.1073/pnas.0900231108>.

Session 23: Sustainability in a time of crisis and Informal group discussions (*All Professors*)

a) General discussion (no assigned readings)

Note: The syllabus for the course is organized according to the following nomenclature:

a) Readings listed as a) are ***required*** readings for the course.. All (a) readings are **bolded**.
b) Readings listed as b) are basic supplemental background readings.
c) Readings listed as c) and d) are advanced supplemental readings.

FACULTY

- **William Clark** is the Harvey Brooks Professor of International Science, Public Policy and Human Development at Harvard University's John F. Kennedy School of Government, where he co-chairs the Sustainability Science Program. Trained as an ecologist (PhD Univ. of British Columbia, Canada; BSc. Yale College), his research focuses on the interactions of environment, development and health concerns in global affairs. He has been actively involved in sustainability issues since leading the research program "Sustainable Development of the Biosphere" at the International Institute for Applied Systems Analysis (Austria) in the mid-1980s. He co-chaired the first exploration of the subject by the US National Research Council, resulting in the report *Our Common Journey: A Transition Toward Sustainability* (1999). He now serves on the editorial board for the sustainability science section of the Proceedings of the National Academy of Sciences. His current research is exploring institutions and processes for better harnessing science and technology to support sustainable development. Clark is a member of the U.S. National Academy of Sciences.

- **Partha Dasgupta** is the Frank Ramsey Professor of Economics at the University of Cambridge. He was formerly chairman of the scientific board of the Beijer International Institute of Ecological Economics of the Royal Swedish Academy of Sciences, as well as professor of economics and philosophy and director of the Program in Ethics in Society at Stanford University. Professor Dasgupta is a foreign associate of the U.S. National Academy of Sciences and in 2002 was named Knight Bachelor by Her Majesty Queen Elizabeth II. He has spent nearly most of his professional life working on poverty and inequality issues. His research covers welfare and development economics, the economics of technological change, population, environmental and resource economics, game theory and the economics of malnutrition. Much of his work has involved investigating the areas of sustainable development in which the interests of economics collide with ecological and social issues. Professor Dasgupta holds a B.Sc. (Hons.) in Physics from the University of Delhi, a B.A. (Hons.) in Mathematics and a Ph.D. in Economics, both from the University of Cambridge.

- **Ann Kinzig** is a Professor in the School of Life Sciences and the Chief Research Strategist at the Global Institute of Sustainability at Arizona State University (ASU). Her research and teaching focus broadly on ecosystem services, conservation-development interactions, the resilience of natural-resource systems, and transforming university research to be more socially relevant. Before arriving at ASU, Dr. Kinzig served for a year in the Office of Science and Technology Policy in the Executive Office of the President (1998-99) and was a post-doctoral researcher and lecturer at Princeton University (1994-1998). She received her B.A. in Physics from University of Illinois Urbana-Champaign (1986), her M.A. in Physics from University of California at Berkeley (1989), and her Ph.D. in Energy and Resources from Berkeley (1994).

- **Éloi Laurent** is a senior economist at OFCE (Sciences-Po Center for economic research, Paris). He has a background in policy-making, as a former aide in the French Parliament and for the French prime minister. He presently teaches at Sciences-Po, in the Department of Civil and Environmental

Engineering (School of Engineering) at Stanford, in the Bing Overseas Program at Stanford University in Paris and in La Sorbonne (College des hautes études européennes). He was Professor invited in the University of Montréal (2010) and Visiting Professor at Harvard University (Fall 2013). He was a visiting scholar at NYU (2003), Columbia University (2002, 2004 and 2007), and at Harvard University Center for European studies (2005-2006, 2009-2010, Fall 2013). His research agenda in sustainability science focuses on two main dimensions: new indicators of well-being, resilience and sustainability (he was an assistant to the Stiglitz-Sen-Fitoussi Commission in 2008/2009 and teaches those new indicators in Sciences Po and Stanford) and the "social-ecological approach", which aims at connecting inequality, environmental degradations and ecological crises.

- **Kira Matus** is an Assistant Professor of Public Policy and Management in the Department of Government at the LSE. She is also a research associate of the Centre for the Analysis of Risk and Regulation (CARR), and the Grantham Research Institute on Climate and the Environment (GRI). At the LSE, she teaches courses on public policy, public management, the law and politics of regulation, and sustainability science. Her research focuses on the intersection of innovation, policy, and sustainable development, with a focus on sustainable production consumption systems, certification systems, and the interface of science and policy. She is the project co-director of the 'Innovation and Access to Technologies for Sustainable Development' project at Harvard's Sustainability Science Program. When she is not doing field work on the use of greener technologies in the chemical industry, she is also in the midst of a series of papers on how the politics of science as seen in the culling of badgers in the UK and possums in NZ as methods to control bovine TB. She has a PhD in public policy from the Kennedy School at Harvard (where she was a doctoral fellow in the Sustainability Science Program), an MS in Technology and Policy from MIT, and a BSc in Chemistry from Brown University.

- **Charles Perrings** is a Professor of Environmental Economics at Arizona State University, where he directs the Ecoservices Group—a research (and research training) group that focuses on ecosystem services. He was previously at the University of York and the University of California, Riverside, and was for several years vice-chair of the international biodiversity science research program, DIVERSITAS. More recently he represented the International Council of Science in negotiations with national governments to establish the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). He was also a member of the US President's Council of Advisors on Science and Technology (PCAST) working group on biodiversity and ecosystem services. He was the founding editor of the Cambridge University Press journal, *Environment and Development Economics*, and is a past president of the International Society for Ecological Economics. Specific research interests include biodiversity change and ecosystem services, international environmental public goods, the linkages between poverty-and environmental change, and the relation between the stability, resilience and sustainability of coupled systems.

- **Alicia Harley** (teaching fellow) is a doctoral candidate in Public Policy and a Giorgio Ruffolo Doctoral Research Fellow in the Sustainability Science Program at Harvard's Kennedy School of Government. She is interested innovation in agriculture systems and specifically how to govern innovation to

improve the well-being of the most vulnerable farmers. She uses a mix of qualitative and quantitative methods, relying heavily on organizational behavior and institutional approaches in political science. Her dissertation investigates the agriculture innovation system in India. Her two main projects investigate the agriculture innovation system first comparatively across several States in India focusing specifically on drip irrigation, and second within a single State (Bihar) where she works within a single village to understand the adoption dynamics and multiple State and Federal Policies in place to support agriculture development. Using a structural systems model of the innovation system, she aims to expand the literature in innovation studies to include a greater focus on innovation in the context of power asymmetries and inequality. Alicia leads the food and agriculture systems working group as part of a collaborative project with the Initiative on Innovation and Access to Technologies for Sustainable Development led by Professor William Clark. She received her BA, magna cum laude, in Environmental Science and Public Policy and a citation in Arabic from Harvard College in 2008 and subsequently worked as a greenhouse gas reduction program coordinator for Harvard's Office for Sustainability. Following that, she spent a year in Cairo as a Fulbright Scholar researching the political economy of agriculture and food security in Egypt before returning to graduate school to begin her PhD.