

IGA-904 Sustainability Science: An interdisciplinary introduction

Fall Term 2010 – Monday, 4-6pm

(Shopping: Aug. 30; First Full Meeting: 13 September)

Location: Harvard Kennedy School, Room 280

Lead Instructor: William C. Clark (william_clark@harvard.edu)

Target audience: Research students, fellows from throughout the university

Seminar web site: <https://groups.nceas.ucsb.edu/sustainability-science>

Objective:

This is a research seminar on the core scholarly literature of sustainability science -- an emerging field of problem-driven research dealing with the interactions between human and environmental systems. The focus is on understanding how those interactions affect the challenge of sustainability: meeting the needs of present and future generations in ways that conserve the planet's life support systems over multiple generations. Its goal is to introduce active researchers interested in sustainability science to the field's principle themes, cutting-edge findings, active debates and unresolved research questions. Participants will critically discuss a set of presentations and papers covering the field in a systematic way, drawing on and integrating contemporary research from earth systems science, resource economics, institutional analysis, geography, and development studies. Participants' critiques of and additions to the presented material will contribute to a set of curriculum materials on sustainability science being developed by an international team of leaders in the field for open-access use by the global community.

Motivation:

Sustaining the planetary systems that support life while meeting human needs is one of the greatest challenges facing humanity in the 21st century. Sustainability science is a use-inspired program of research aimed at addressing this challenge. The field emerged in the 1990s at the intersection of earth systems science, the sciences of socio-ecological systems, and applied research on sustainable development. Over the last decade it has grown rapidly in multiple directions, spawning new schools and degree programs, multiple journals, and a host of symposia and conferences (see the virtual [Forum on Science and Innovation for Sustainable Development](#) hosted by the AAAS for an up to date account of the current state of play).

Like any healthy new field, sustainability science today is somewhat anarchic, inhabited by multiple views of what it is and should try to become. A little anarchy is not necessarily a bad thing, particularly when it is so clear that there are great differences in the knowledge relevant to sustainability challenges such as improving energy efficiency of the US economy and sustainability challenges such as improving the performance of agroforestry in Nepal. But several workshops conducted over the past decade¹ have nonetheless called for the construction of a core body of sustainability science -- theory, methods, and data – that would be relevant

¹ Friberg 2000 [Sustainability Science](#), Dahlem 2003 [Earth Systems Analysis for Sustainability](#), San Servolo 2006 [Grand Challenges of Sustainability Science](#), Airlie House 2009 [Toward a Science of Sustainability](#).

across particular problems and places, and that all scholars working in the field – regardless of their home discipline or issue focus -- would benefit from knowing. The same workshops pointed out the need to build a community from the somewhat isolated individuals and small groups of researchers from around the world now working on sustainability science from their own disciplinary, applications, and regional perspectives. This seminar is part of one concerted effort to build both a body of core knowledge in sustainability science, and an extended peer community that will share, critique, and strengthen that core.

Strategy:

The seminar will pursue its goals by bringing together two strands of work. The first strand is an effort by a group of leading scholars in sustainability science to prepare a monograph and selection of core readings on the subject that, together, could serve as an integrated, interdisciplinary introduction to the field for interested researchers. This group² -- all members of the National Academy of Sciences -- has completed a first draft of both the monograph and the reader, and agreed to make these available as the core “syllabus” literature for our seminar. Members of the group will lecture to the seminar (some in person, some remotely) on selected topics covered in the draft material. The group as a whole is anxious to use the seminar for critical feedback and suggestions to strengthen their final products. In addition videos of lectures, supporting materials, and summaries of discussion available on a public web site will be made available so that others interested in sustainability science can use them in shaping their own curricula.

The second strand of work informing the seminar is the need to begin integrating the various communities working on sustainability science. The fragmentation of the community – partly by discipline, partly by institution, partly by applications focus – was noted as a major impediment to its growth and maturation by the recent workshop held by NSF to identify priority needs in the field.³ In response to this finding, two participants in the workshop -- Profs. Jeannine Cavender-Bares (evolutionary biology) and Steve Polasky (environmental economics), both from the Univ. of Minnesota – proposed to develop a distributed, interdisciplinary graduate seminar on sustainability science that would begin to bring together different groups in discussion of key concepts, findings and controversies in the field. Their proposal, initially involving 6 universities from the USA and Mexico⁴, was funded by the National Center for Ecological Analysis and Synthesis (NCEAS). Teams of graduate students, fellows and faculty from each of those universities will participate in this seminar, connected via video conferencing and a dedicated collaborative web site hosted by NCEAS. The seminar is thus also an experiment in developing approaches to the sorts of collaborative, distributed, travel-minimizing networking that almost certainly must be part of any sustainable future. Evaluation of the distributed seminar concept and its supporting technologies will be an additional objective of our work.

² Authors and affiliations (see Appendix 1 for biographical notes): John Bongaarts (demography, The Population Council), Stephen Carpenter (ecology, University of Wisconsin-Madison), William Clark (policy, Harvard University), Partha Dasgupta (economics, Cambridge University), Robert Kates (poverty and development, Independent Scholar, Maine), Pamela Matson (biogeochemistry, Stanford University), Elinor Ostrom (political science, Indiana University, Arizona State University), Hans Joachim Schellnhuber (earth systems science, Potsdam Institute for Climate Impact Research), B. L. Turner II (land use science, Arizona State University).

³ Airlie House 2009 [Toward a Science of Sustainability](#).

⁴ Member institutions: Arizona State University; Universidad Nacional Autonoma de Mexico; Florida International University; Harvard University; Princeton University; University of Minnesota

How the course will work:

The seminar will meet once a week in virtual space, with seminar members from each of the participating universities assembled in a classroom and connected by appropriate information technology. (A preliminary schedule is included at the end of the syllabus as Appendix 2). Most weekly sessions will focus on a chapter or group of chapters from the draft “*Sustainability Science...*” monograph, which will be made available to participants in advance on the seminar web site. Supplementary readings from the “Reader...” plus additional papers suggested by seminar participants will also be available (see below). (In addition to the “chapter” based sessions, we plan a couple of sessions focused on worked examples of sustainability science research performed by individual researchers in the group: E.g., environmental services in rural Mexico; resiliency in African pastoral systems). Each session will begin with a formal presentation of 20-30 minutes on the topic of the designated chapter, usually delivered by one of the authors of the monograph. This will be followed by prepared discussant remarks and student commentary followed by general discussion. Chairing responsibilities for each session will rotate among faculty of the participating institutions.

Lead responsibility for each of the sessions will lie with one the participating university teams. Rotations have been established to assure that each team leads two sessions in the course of the term. Each student must participate in one session in which Minnesota is the lead institution. For the others session, students may choose to participate with another institution, logistics permitting. The lead team for each session will have 4 responsibilities, divided as the team sees fit among its local members:

- 1) *Designate supplemental readings* for their session at least a week in advance of the session. The team will be asked to select a few readings – say 3 to 6 – that complement the assigned book chapter and Reader entries for the day. The team should try to assure that between its suggestions and the selections from the Reader, there is at least one paper available that is more basic than the designated book chapter (for those who find the book chapter too far from their formal training to be digested without help), plus at least one paper reflects exciting advanced research on a theme central to the chapter. In addition, it will be very useful for broadening our collective vision of sustainability science if each team can use the resources and connections of its members to find one or more research papers or case studies originating from different parts of the world. The team should post citations to and copies of its selected readings to the seminar web site, together with a brief annotation for each reading that describes why the team thinks the paper is especially worthy of attention.
- 2) *Identify three central topics* for discussion (together with the session moderator/chair) and post these on the web site by the Thursday (at the latest) prior to the Monday session. Annotate these sufficiently so that they will serve as the framework for the web discussion following the session.
- 3) *Present ‘discussant’ remarks* on the designated chapter and initial presentation, immediately following that presentation. These remarks should include an assessment of what the team finds compelling about the chapter and presentation, what does not make sense, and what is missing or needs further development either in terms of theory, data or application. The discussant remarks should usually involve several members from the responsible team. Discussants will be expected to have

coordinated their remarks ahead of time for maximum impact. The total time used in all the discussant remarks should be less than 15 mins.

- 4) *Write a brief initial summary* of the discussion on the week's topic. This should be on the order of 3 pages or less, and be posted on the seminar web site within one week of the session in which the discussion occurred. The written summary should include the formal discussant's remarks, as well as key themes and questions raised in the general discussion and Q&A following the discussants' remarks, plus any subsequent web-based discussion on the week's topic. The summary should include identification of ideas in the assigned chapter that need further or clearer development, as well as evaluation of the adequacy of the readings.
- 5) *Write a final summary* of the assigned topic. This should be on the order of 5 pages or less, and be posted on the seminar web site within one week of the end of the course. It should be based on the initial summary detailed in (4) above, but also i) incorporate subsequent discussion germane to the assigned topic that develops during other sessions of the seminar or in off-line discussions, and ii) identify linkages and relations of the topic to other topics discussed in the seminar. This means, of course, that the team has an ongoing responsibility throughout the semester to capture or provoke relevant commentary and connections on its assigned topic.

Seminar members who are not part of the designated lead group for a particular session are nonetheless expected to participate fully. This means at least:

- 1) *Carefully read, in advance*, the assigned chapter and, where appropriate, selected supplemental material. Maintaining high standards for doing the background reading in advance will alleviate the inevitable tension between needing to get up to speed in material outside our domains and aiming the discussion at a cutting edge level.
- 2) *Participate actively in the general discussion* and Q&A following the prepared lecture and discussant remarks for each session (time permitting).
- 3) *Post written comments*, questions, responses and suggestions of key literature relevant to each session on the seminar web site. While written discussion on any topic is encouraged throughout the semester, each participant is expected to post something about the subject matter of each session within 3 days after the session is held. (This gives the team with lead responsibility for the session the opportunity to include individual written materials in their initial summary of the session, due a week after the session is held.

Additional expectations of students taking the course for credit:

Students taking the course for credit at Harvard will be expected to contribute substantially to each of the tasks outlined above. These contributions will constitute 50% of your grade. In addition, you will be expected to submit a longer paper developing a critical review of some aspect of sustainability science that interests you. The paper may be in the form of a standard academic review paper (or thesis "theory" chapter), summarizing and critiquing the state of the literature, highlighting major advances and controversies, and pointing to key research needs. Alternatively, the paper can bring the knowledge of sustainability science to bear on a particular applied problem of sustainability, critiquing current practice, identifying alternatives, and recommending and justifying a path forward. A short (100-300 word) prospectus should be submitted to the instructor by mid term (1 November). A final version (5-

10K words), reflecting the instructor's comments on the prospectus, must be submitted by the end of Reading Period (17 December). This paper may be solo authored, or jointly authored with any member(s) of the seminar from any of the participating universities. Joint authorship with participants from universities other than your own will not get extra credit, but will be looked upon with special enthusiasm and interest. Coauthors, if any, must be designated in the prospectus. All coauthors will receive the same grade.

Additional information:

Available from Prof. Clark, william_clark@harvard.edu , and the seminar web site: <https://groups.nceas.ucsb.edu/sustainability-science> .

Appendix 1: Brief Biographies of the authors of “Sustainability Science: An Introduction” and “The Sustainability Science Reader” (August 2010)

John Bongaarts

<http://www.popcouncil.org/staff/johnbongaarts.asp>

John Bongaarts is a Population Council vice president and Distinguished Scholar. He has worked at the Population Council since 1973. His research focuses on a variety of population issues, including the determinants of fertility, population–environment relationships, the demographic impact of the AIDS epidemic, population aging, and population policy options in the developing world. Bongaarts is a member of the U.S. National Academy of Sciences, the Royal Dutch Academy of Sciences, and the Johns Hopkins Society of Scholars. Some of the awards that he has received include the Robert J. Lapham Award and the Mindel Sheps Award from the Population Association of America and the Research Career Development Award from the National Institutes of Health. He served as chairman of the Panel on Population Projections of the National Academy of Sciences. Bongaarts has a master's degree from the Eindhoven Institute of Technology, Netherlands, and a Ph.D. in physiology and biomedical engineering from the University of Illinois.

Stephen R. Carpenter

<http://limnology.wisc.edu/personnel/carpenter/>

Stephen Russell (Steve) Carpenter is an ecosystem ecologist known for his leadership of large-scale experiments and adaptive ecosystem management. His work has addressed trophic cascades and their effects on production and nutrient cycling, contaminant cycles, freshwater fisheries, eutrophication, nonpoint pollution, ecological economics of freshwater, and resilience of social-ecological systems. Carpenter serves as the Director of the Center for Limnology at the University of Wisconsin-Madison, where he is the Stephen Alfred Forbes Professor of Zoology. He is co-Editor in Chief of Ecosystems, and a member of governing boards for the Beijer Institute of Ecological Economics, Resilience Alliance, and South American Institute for

Resilience and Sustainability Studies. Carpenter is a member of the U.S. National Academy of Sciences, a Fellow of the American Academy of Arts and Sciences, and a foreign member of the Royal Swedish Academy of Sciences. He has received many awards for distinguished research. Among these are a Pew Fellowship in Conservation and Environment, the G. Evelyn Hutchinson Medal of the American Society of Limnology and Oceanography, the Robert H. MacArthur Award from the Ecological Society of America, the Excellence in Ecology Prize for Limnetic Ecology, the Naumann-Thienemann medal of the International Society for Limnology, many honors from the U.W.-Madison campus, and election to the Ralf Yorke Society. Carpenter is a former President of the Ecological Society of America. From 2000-2005 he served as co-chair of the Scenarios Working Group of the Millennium Ecosystem Assessment. He led the North Temperate Lakes Long-Term Ecological Research program at U.W.-Madison from 1999-2009. Carpenter has published 5 books and about 300 scientific papers, book chapters, reviewed reports and commentaries. He received a B.A. from Amherst College (1974), M.S. from University of Wisconsin-Madison (1976), and Ph.D. from U.W. Madison (1979). From 1979-1989 he served as Assistant and then Associate Professor at the University of Notre Dame. He joined the U.W.-Madison faculty in 1989. A full biographical sketch and publication list may be viewed on the Internet at <http://limnology.wisc.edu/personnel/carpenter>.

William C. Clark

<http://www.hks.harvard.edu/about/faculty-staff-directory/william-clark>

William C. Clark is the Harvey Brooks Professor of International Science, Public Policy and Human Development at Harvard University's John F. Kennedy School of Government. Trained as an ecologist, his research focuses on the interactions of environment, development and security concerns in international affairs, with a special emphasis on the role of science and technology in shaping those interactions. Clark is co-author of *Adaptive Environmental Assessment and Management* (Wiley, 1978) and *Redesigning Rural Development* (Hopkins, 1982); editor of the *Carbon Dioxide Review* (Oxford, 1982); and coeditor of *Sustainable Development of the Biosphere* (Cambridge, 1986), *The Earth as Transformed by Human Action* (Cambridge, 1990), *Learning To Manage Global Environmental Risks* (MIT, 2001), and *Global Environmental Assessments: Information and Influence* (MIT, 2006). He serves on the editorial boards of the *Proceedings of the US National Academy of Sciences*, and *Annual Review of Environment and Natural Resources*. Clark is a member of the U.S. National Academy of Sciences, where he serves on the Roundtable on Science and Technology for Sustainability and co-chaired the study *Our Common Journey: A Transition Toward Sustainability* (National Research Council, 1999). At Harvard, he co-directs the Sustainability Science Program at the University's Center for International Development. Clark is a recipient of the MacArthur Prize, the Humboldt Prize, and the Kennedy School's Carballo Award for excellence in teaching.

Partha Dasgupta

<http://www.econ.cam.ac.uk/faculty/dasgupta/>

Partha Dasgupta, who was born in Dhaka (at that time in India) and educated in Varanasi, Delhi, and Cambridge, and is the Frank Ramsey Professor of Economics at the University of Cambridge, Fellow of St John's College, Cambridge, and Professor of Environmental and Development Economics at the University of Manchester (2008-). He taught at the London

School of Economics during 1971-1984 and moved to the University of Cambridge in 1985 as Professor of Economics, where he served as Chairman of the Faculty of Economics in 1997-2001. During 1989-92 he was also Professor of Economics, Professor of Philosophy, and Director of the Program in Ethics in Society at Stanford University; and during 1991-97 he was Chairman of the (Scientific Advisory) Board of the Beijer International Institute of Ecological Economics, Stockholm. Since 1999 he has been a Founder Member of the Management and Advisory Committee of the South Asian Network for Development and Environmental Economics (SANDEE), Kathmandu. In 1996 he helped to establish the journal *Environment and Development Economics*, published by Cambridge University Press, whose purpose has been not only to publish original research at the interface of poverty and the environmental-resource base, but also to provide an opportunity to scholars in developing countries to publish their findings in an international journal. Professor Dasgupta's research interests have covered welfare and development economics, the economics of technological change, population, environmental and resource economics, the theory of games, and the economics of undernutrition. Professor Dasgupta is a Fellow of the Royal Society (2004), Fellow of the Third World Academy of Sciences (2001), Foreign Member of the Royal Swedish Academy of Sciences (1991), Foreign Honorary Member of the American Academy of Arts and Sciences (1991), Foreign Associate of the US National Academy of Sciences (2001), Foreign Member of the American Philosophical Society (2005), Foreign Member of Istituto Veneto di Scienze, Lettere ed Arti (2009), Honorary Fellow of the London School of Economics (1995), Honorary Member of the American Economic Association (1997), Honorary Professor at the University of Copenhagen (2008-), and Andrew D. White Professor-at-Large (2007-) at Cornell University. He was co-winner (with Karl-Goran Maler of the Beijer International Institute of Ecological Economics, Stockholm) of the 2002 Volvo Environment Prize and of the 2004 Kenneth E. Boulding Memorial Award of the International Society for Ecological Economics; and was the recipient of the John Kenneth Galbraith Award, 2007, of the American Agricultural Economics Association.

Nancy Dickson

<http://www.hks.harvard.edu/centers/cid/programs/sustsci/people/steering-group/nancy-dickson>

Nancy Dickson is a Senior Researcher at Harvard University's Kennedy School of Government and co-directs the Sustainability Science Program at the Center for International Development. Her research addresses how science, technology, and knowledge can be more effectively brought to bear on creating solutions to problems of public policy. Her work focuses on two areas. The first is on knowledge-action systems for decision support – understanding how the choice of institutions and procedures for linking practitioners and experts influences knowledge production and its effects. The second is on sustainability science – problem-driven, interdisciplinary scholarship that seeks to facilitate the design, implementation, and evaluation of effective interventions that promote environmentally sustainable human development. Dickson manages projects and directs the Sustainability Science Fellows Program at Harvard, an interdisciplinary, international group of doctoral, post-doctoral, and mid-career fellows who come to Harvard for one year. She has served as a Committee member for the National Academy of Sciences, see Assessment of the NASA Applied Sciences Program and as an external reviewer of Canada's International Development Research Council's Rural Poverty and the Environment Program. Her publications include *Global Environmental Assessments: Information and Influence* (Mitchell et al, 2006), *Sustainability science* (Clark & Dickson, PNAS, 2003), and *Learning to Manage*

Global Environmental Risks (Social Learning Group, 2001). She holds a Masters degree in regional planning from Cornell University.

Robert Kates

<http://www.rwkates.org/>

Robert W. Kates (born 1929) is an American geographer and independent scholar in Trenton, Maine, and University Professor (Emeritus) at Brown University. In 2008, he was appointed the inaugural Presidential Professor of Sustainability Science at the University of Maine, Orono. Kates was born in New York City. He never took an undergraduate degree, but while working in Illinois, he sought study advice from Gilbert F. White at the University of Chicago. White recognized his abilities and steered him through an MA and eventually a PhD in Geography. Kates taught at the Graduate School of Geography, Clark University from 1962 until the mid 1980s. From 1986 to 1992 he was Professor and Director of the World Hunger Program at Brown University. Kates's research focuses on long-term trends in environment, development, and population, and he is particularly known for his work on natural hazards mitigation, driven by a Quaker belief in relevance to human society. Kates defines his central question as "What is and ought to be the human use of the Earth?" Since retiring from Brown University he has continued to work on: the sustainability transition; long-term population dynamics; global environmental change; the prevalence and persistence of hunger. Following the devastation of New Orleans after Hurricane Katrina, Kates returned to his earlier work on hazards and published a research perspective on the reconstruction of New Orleans (Kates et al., 2006). Kates helped to establish the international Initiative for Science and Technology for Sustainability, was Executive Editor of Environment magazine for many years, and is still a Senior Associate at Harvard University. In previous years, he worked in Africa with Clark colleagues, and also developed and directed a resource assessment centre at the University of Dar Es Salaam, Tanzania. At Clark University he founded CENTED (the centre for technology, environment, and development), now part of the Marsh Institute, where he remains a Distinguished Scientist. Among several honors he is a recipient of the 1991 National Medal of Science, and the MacArthur Fellow (1981–85). He is a member of the National Academy of Sciences, the American Academy of Arts and Sciences, and a fellow of the American Association for the Advancement of Science and the Academia Europaea. He was awarded an honorary DSc from Clark University for his many contributions to hazards research.

Pamela Matson

<http://pangea.stanford.edu/research/matsonlab/members/Matson.htm>

Pamela Matson is the Richard and Rhoda Goldman Professor in the Department of Geological and Environmental Sciences, a senior fellow at CESP, and the Chester Naramore Dean of the School of Earth Sciences. Her research focuses on the effects of land use changes on biogeochemical cycling and trace gas exchange in tropical forests and agricultural systems. Before coming to Stanford, from 1993-1997, she was a professor of ecosystem ecology at the University of California, Berkeley. Until 1993, she was a research scientist at NASA/Ames Research Center. She is currently the co-chair of the National Academies Roundtable on Science and Technology for Sustainability, and serves on Boards for the World Wildlife Fund US, the

National Parks Conservation Association, and the Institute for Ecosystem Studies. She is also a science advisory committee member for the International Geosphere-Biosphere Programme and numerous other committees. She was elected to the American Academy of Arts and Sciences in 1992 and to the National Academy of Sciences in 1994. In 1995, Dr. Matson was selected as a MacArthur Fellow, and in 1997 was elected a Fellow of the American Association for the Advancement of Science. She received a BS in biology from the University of Wisconsin in 1975, a MS in environmental science from Indiana University in 1980, and a PhD in forest ecology from Oregon State University in 1983.

Elinor Ostrom

<http://elinorostrom.indiana.edu/>

Elinor Ostrom is an American political scientist. She was awarded the 2009 Nobel Memorial Prize in Economic Sciences, which she shared with Oliver E. Williamson, for her analysis of economic governance, especially the commons. She is the first woman to win the prize in this category. Ostrom is Distinguished Professor at Indiana University and the Arthur F. Bentley Professor of Political Science and Co-Director of the Workshop in Political Theory and Policy Analysis at Indiana University in Bloomington, as well as Research Professor and the Founding Director of the Center for the Study of Institutional Diversity at Arizona State University in Tempe. She has studied how self-organization and local-level management works to keep common resources, whether natural (e.g., forests) or man-made (e.g., police forces), viable. Combining data from diverse sources ranging from classical techniques such as surveys to modern advances such as satellite imagery, Ostrom has uncovered numerous principles that govern successful sustainability and that defy conventional beliefs. She received a B.A. (with honors) in political science at UCLA in 1954. She was awarded an M.A. in 1962 and a Ph.D. in 1965, both from UCLA Department of Political Science. She was elected to the National Academy of Sciences in 2001.

Hans Joachim (John) Schellnhuber

<http://www.pik-potsdam.de/john/>

Hans Joachim (John) Schellnhuber was born in 1950 in Ortenburg (Germany). He trained in physics and mathematics with a scholarship for the exceptionally gifted at Regensburg University. He received his Doctorate in Theoretical Physics in 1980. He has spent various periods of research abroad, in particular at several institutions of the University of California system (USA). He received his Habilitation (German qualification for professorial status) in 1985. In 1989 he became Full Professor at the Interdisciplinary Centre for Marine and Environmental Sciences (ICBM) of Oldenburg University, and was later Director. In 1991 he was the Founding Director of the Potsdam Institute for Climate Impact Research (PIK) and since 1993 has been Director of PIK and Professor for Theoretical Physics at Potsdam University. From 2001-2005 he was Research Director of the Tyndall Centre for Climate Change Research and Professor at the Environmental Sciences School of the University of East Anglia in Norwich (UK). From 2005 - 2009 he was Visiting Professor in Physics and Visiting Fellow of Christ Church College at Oxford University as well as Distinguished Science Advisor for the Tyndall Centre. Since 2010 he has been External Professor at the Santa Fe Institute. Professor Schellnhuber was the Chief Government Advisor on Climate & Related Issues for the German

G8-EU twin presidency in 2007 and Member of the High-Level Expert Group on Energy & Climate Change advising J.M. Barroso, President of the European Commission. He is the author of 210 articles and more than 40 books in the fields of condensed matter physics, complex systems dynamics, climate change research, Earth System analysis, and sustainability science.

B. L. Turner II

<http://geoplan.asu.edu/turner>

B. L. (Bill) Turner II took his B.A. and M.A. degrees in geography from the University of Texas at Austin in 1968 and 1969 respectively, and his Ph.D. in geography from the University of Wisconsin-Madison in 1974. At ASU he is the Gilbert F. White Professor of Environment and Society. Turner came to ASU after 28 years in the Graduate School of Geography, Clark University, where he was Higgins Professor of Environment and Society, served as Director of that School for more than decade, and helped to create and administer the George Perkins Marsh Institute, which engages a range of human-environment problems. He previously held appointments at the University of Oklahoma and the University of Maryland, Baltimore County. Professor Turner is currently engaged in land change science focused especially on deforestation and sustainability in the southern Yucatán. Turner is a recipient of Distinguished Research Honors from the Association of American Geographers (1995) and the Centenary Medal, Royal Scottish Geographical Society (1996), among other honors. He is former Guggenheim Fellow (1981) and Fellow of the Center for Advanced Studies in the Behavioral Sciences (1994). He was elected to the National Academy of Sciences in 1995, the American Academy of Arts and Sciences in 1998, and the inaugural class of the Massachusetts Academy of Sciences in 2008. Professor Turner continues to engage in large range of research activities focused on the theme of human-environment relationships.

Appendix 2: Preliminary Schedule of Classes

(for current version, see class web site <https://groups.nceas.ucsb.edu/sustainability-science>)

PART I: OVERVIEW

Class 1 (September 13)

Introductions and organization

Class 2 (September 20)

Sustainable development and sustainability science

Bill Clark presenter; *Heffernan/Ogden* moderator/discussant; **MN** students

Class 3 (September 27)

Long-term trends and transitions in nature and society

Bob Kates presenter; *Ann Kinzig* moderator/discussant; **Princeton** students

Class 4 (October 4)

The human-environment system: A conceptual framework

Billie Turner presenter; *Elizabeth King* moderator/discussant; **Harvard** students

Class 5 (October 11; Harvard on holiday break)

The environmental services that flow from natural capital

Steve Carpenter presenter; **Patty Balvanera** moderator/discussant; **MN** students

PART II: CONCEPTUAL FOUNDATIONS

Class 6 (October 18)

Divergent vs. convergent development models

Ivette Perfecto (U. Michigan), **Cavender-Bares** moderator/discussant; **CIEco** students

Class 7 (October 25)

Human well-being, natural capital and sustainable development

Partha Dasgupta presenter, **Steve Polasky** moderator/discussant, **Princeton** students

Class 8 (November 1; Princeton missing)

Worked examples of concepts in human-environment systems

Elizabeth King presenter; moderator/discussant; **FIU** students

Class 9 (November 8)

Institutions for managing human-environment systems

Elinor Ostrom presenter; **Bill Clark** moderator/discussant; **ASU** students

PART III: INTERACTIONS

Class 10 (November 15)

Emergent properties of coupled human-environment systems

Bill Turner presenter; **Jim Heffernan** moderator/discussant; **Harvard** students

Class 11 (November 22)

Managing for sustainability

Pam Matson presenter; **Billie Turner** moderator/discussant; **FIU** students

Class 12 (November 29)

Metrics for sustainable development

Steve Polasky presenter; **Luis García Barrios & Omar Masera** moderator/discussant;
ASU/Cornell students

PART IV: LOOKING FORWARD

Class 13 (December 6)

Grand challenges and core questions of sustainability science

Robert Kates presenter; **Bill Clark** moderator; Open discussion

END