Methodologies for Sustainability Science Roundtable Discussion
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Lennart: Important problem is that we have to overcome the disconnect between natural and social science. There is no silver bullet, but can we identify what the silver 'buckshot' is? Climate change is a problem – for the engineer, finding new energy, market failure, economic system – so many angles, how do we approach this problem

JS: To escape the trap of vocabulary fights between different disciplines we can build teams from different disciplines and use modeling to help participants build and elaborate their different perspectives. At MIT group model building has been improved over three decades of consulting to help corporations analyze dysfunctions, explore alternative policies and then implement them before the companies collapse. We need to expand this effort into the much wider domain of society and ecosystems where conflicting motivations and lack of data and information are serious challenges.

Mike Burns: Modeling, as a general methodology through which science can inform sustainable development, provides a platform not only for prediction but also for *enabling* dialogue between (and beyond) disciplines - to test and explore overlapping/non-overlapping understanding of social-ecological systems. Modeling facilitates learning and, thereby, the capacity for adaptive self-organization within social-ecological systems.

PH: models essential tools – flaw is that there is a model horizon (something with predictive value) – don't see far into the future; nature is not built that way. Uses a method where looks at questions from whole process point of view from period of growth to period of decay as planning

model for any question. For example, with documenting soils, pass peak soils 10,000 years ago and all measures are of depletion rates and soil management is depletion management. Not a problem a model can answer, but scientific knowledge can answer. Need another form of reasoning for whole system issues.

Josef: See a model that LO talked about as something that gears different people around table to look at same phenomena, but decide how to look at these areas – modeling is more a way of getting the people to discuss things in same terms than predicting something – predicting is not possible, but getting people in same line of.

LO: Eisenhower said planning is everything, but the plan is nothing – so modeling is everything. Models are great, but not everyone shares this conviction.

MB: My perception of 13 years of carrying out a grad program in sustainability science. Movement every 2 years, change the main issue (ie. Now talking about energy). One issue that has survived is modeling – trying to find the universal formula to solve all problems. I like models, but problem is that the better a model is, the worse it is (can only be specific to a situation). Dilemma – general overall model, or specific. Trying to find methodologies to deal with sustainability – try to find key words that are important for us. Discussion going on in Europe for 10 years – restructuring the university system. 3 key issues invoked: the university has to take into account interdisciplinary, mobility, and employability. Experience we have had is that we run towards interdisciplinary, then get really specialized. How do we find methods to build interdisciplinary capabilities? Mobility is important in terms of people – find a way to create opportunities to stay within central core – have to find bridges.

PG: If define the idea of modeling broadly in quantitative way, missing from this table – ASU brings local water managers into discussion. Human debate over what the important drivers of model are. People who are going to implement these models early enough in process (and model is flexible enough), ASU hopes this will lead to more effective solutions. Not really looking for predictive, perfect model, but one that will produce outcomes that political community is ready to embrace. Neither social or natural scientist happy with 'contingent' process

RM: Alternative way of thinking – want to talk about epistemology of science first, then ask about methodologies. When look at science as normally construed, it is an inquiry to gain greater knowledge. Engage in a practice to achieve a change in conditions of reality – implied is reality is not static. Different than traditional models, but part of shift between natural and social sciences. Social sciences shouldn't aspire to be physics – no input set of values that will yield sustainability. Sustainability is core challenge of life itself. Rather than model, develop frameworks.

LT: Industry goal is to reverse some issues that have happened. Struggle that being measured against industry that is doing same thing. Science not moving as fast. What are assumptions going into life-cycle models.

JS: Since 1970 the relative strengths of qualitative vs quantitative modeling has been a huge controversy in system dynamics. Quantitative models allows us to challenge predictions based

on people's assumptions. However, sometimes there is no data, on which to build a quantitative model, and the public's urgent problem cannot be ignored. In that case, qualitative models at least allow different parties to negotiate the meaning of their terms, and discuss what relationships they feel contribute to the problem. It is a triumph even to get some parties to talk, even if they only learn together by instructing each other in what they mean. This is "modeling for learning", not for prediction, and it helps us raise questions that scientists and policy makers are normally too scared to raise.

LO: European Environmental Agency – want measurements from leaking of nutrients from agriculture. Using models, can get better estimates (because data scare). EEA refuse to use models.

CW: Way we hold people's attention in science museum is a mirror. Want to do exhibit on science of resources. 4 resource groups – natural resource, present labors, past results of human labor, time, knowledge.

RM: Scientists tend to be people who want to answer questions, but have difficulty communicating to other people have different motivations. Need to think in terms of motivations – larger framework is needed.

LT: In order to make science real and touchable. Need to communicate complexity of sustainability.

CW: Key ingredient for quality life is how are you helping? Defined by resources you need to live.

RM: 12-year old communicates over the internet with simulated virtual worlds. Literally doing modeling of sustainability. Perhaps what we should be doing is working 2 sides of game proposition.

PH: Concerned that political establishment is controlling models that we can/cannot discuss. How do you get permission to talk about longevity of solutions?

Mike Burns: Sustainability science deals with complex social-ecological systems problems that cannot be approached from within single disciplines. Methods must, therefore, be developed to enable dialogue between (and beyond) multiple disciplines (natural and social sciences, other epistemologies including local and tacit knowledge). For such dialogue to be effective, this presupposes that methodologies can be devised - e.g. methods of facilitation, modeling (see earlier point) - that enable participants engaged in dialogue to suspend their worldviews, closely held values, assumptions, prejudices, etc. within a space that is created for emergent knowledge to form. This doesn't imply the abandonment of worldviews, etc. – merely that they are *suspended* during in the course of dialogue to allow for the possibility of new knowledge to emerge. The book I am editing on sustainability science (a southern African perspective) includes some chapters covering this topic.

RM: Physical sciences assumption that there is a reality – social science, everyone constructing their own reality. Every wants to help someone, but nobody talks about who they want to hurt. Talking about value created by scarcity v. value created by access. 2 indepented by connected value paradigms – at heart of the challenge of bringing together natural and social sciences. Once way of getting at this – science at conventional way is trying to get more precise, accurate, reliable. Public has its own purposes to accomplish. Is it possible to construct a game that scientists create real natural parameters to, and social science adds, and public can play base on real purposes to see what happens with outcomes – through that process can engage public in a 'new' kind of science

Jon – MIT would model behavior at corporations – people don't think circularly, only lineally. One things in modeling – can make a model based on different perspectives, outcome is wonky and can see world view in a different way (can't do it directly – must do it in a process). Working with a French researcher who is working with role playing games. I.e. what is it like to share water in Senegal? Like a flight simulator – not exactly predictive, but will show you what may happened based on changes.

Tim McClanehan – works with local people in Africa on how to make information applicable (what and what not to fish), applied reef ecologist

LO: One fundamental difference between airplane and ecosystem – share idea of what a failure of an airplane, but don't share same idea of failure of ecosystem

CW: Society needs a clean cut way of deciding what they can't do anymore.

PG: Phoenix is one of the most unsustainable cities in America. 2 years ago would have subscribed to sustainability being a public sector issue. But private sector are pushing for sustainability and where investments are being made. Need to capture private sector to change public sector.

LO: Ironic when it comes to private sector – founder of IKEA is leading environmental responsiveness. Have no shareholders so can be radical. Real capitalist becomes most responsible.

LT: Inventions in sustainability are cost effective. Real win is new development in sustainability science that allows industry to deliver product in more effective and efficient way.

TM: World models oscillate between 2 states – exploitative (with rationalizations) and steady state model. Can we explain these 2 models in clear way to convince people that time to make transition is upon us.

LO: Pre-conclusion – modeling is a key to communication across disciplines. Participatory modeling has a great future – still in its infancy. If can harness software skills coupled with scientific understanding may be a great way forward. But who plays these games? Models can be very important, but how do we make sure they are played by the right people?

Life-cycle analysis is a well accepted model. There is a straight-forward method that has been standardized and used to make products more efficient. When scientists want to improve it (because things are left out), then LCA community is reluctant to use.

BN: When wanted to include social issues in LCA model, laughed out of journal. How do we include socio-economic issues? Stringent framework adopted for economic issues (life-cycle costing).

PH: LCA leaves out energy impacts. Threshold of accountability is short-term. Need to distinguish between temporary fixes and lasting solutions.

RM: Part of what gets revealed in inherent complexity in problem. Epistemology question – we need to expand the meaning of science. Science looking at models of reality instead of reality itself. Need to get people get re-engaged with reality. Need to expand science as action from inquiry.

CW: Science is the acquisition of reliable knowledge about the world.