Population, Consumption, and Environment: Lessons Learned and Future Research about Coastal and Marine Ecosystems

Roundtable Discussion

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Introduction

The editors of this special issue have put our minds to disentangling the complexity of the Population, Consumption, and Environment (PCE) connections. Drawing conclusions about the insights from the preceding case studies, wondering about future research and policy recommendations to be generated from them, and imagining how interdisciplinary research about PCE issues is best done. Our various disciplinary perspectives and research experiences reflect the array of people included among the case studies’ research teams. What follows is a sampling of our discussions. Much of the material comes from a roundtable discussion held on 28 February, 2002, at Cambridge University, United Kingdom. We begin with Anuradha Kumar’s description of the MacArthur Foundation’s PCE initiative and goals, and combine it with comments from others about how difficult it is to conduct interdisciplinary research. From there we move to discussing, why coastal and marine ecosystems are challenging sites for research and policy, but are very important foci of future work. Finally, we discuss the conceptual issues of grappling with population, consumption, and environment. We conclude with a modest set of policy recommendations.

THE MacArthur’s PCE INITIATIVE: STRUCTURING INTERDISCIPLINARY RESEARCH

SC: Anu, would you please describe the initial goals and objectives of MacArthur’s PCE initiative?

AK: In designing the grants program, it was decided that sponsored projects would have to satisfy several criteria. They had to be: multidisciplinary; originating from a Southern institution, or involving a collaboration between Northern and Southern institutions; and, useful for policy formation at the local, national, or regional level. Proposals were reviewed by an advisory committee (1) that made recommendations to Foundation staff. In the course of this six-year funding program the committee grappled with numerous issues, such as the role of the donor in providing technical assistance, how to extract lessons across projects, whether standardized protocols should be used, how to encourage greater interest in this topic, and how to gauge the quality of collaborative relationships.

At the heart of many of the discussions was the issue of how to conduct good research that is respectful of the people and places that are the object of study, and that is scientifically rigorous to answer the many questions we have about the relationships between human populations and their environments. Some of the lessons we learned are discussed below. These lessons include: the difficulty of asking the right research question in an interdisciplinary project; making data collection decisions that meet scientific standards for each discipline; the viability of North-South scholarship and institutional collaborations; and conducting good research in an interdisciplinary and cross-cultural setting.

SC: From your vantage point, what were some of the difficulties in trying to structure the research projects and research outcomes?

AK: Framing hypotheses is surprisingly difficult in multidisciplinary projects. The tendency is to compose questions that are broad, in the belief that a multidisciplinary research team will be able to answer them. After all, if social scientists and natural scientists are working together then the human and natural worlds are covered, which makes it possible to address the "big questions." In the absence of precise, testable questions, study results tend to be generalized as descriptions. While this is not a problem in a field that is nascent, in the PCE field, which has a history of case study descriptions of particular ecosystems or communities, the need is to compare findings across sites and draw general lessons.

The difficulty research teams have in formulating the right questions has a lot to do with the compartmentalization of

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experts and overspecialization of knowledge, especially in academia. This increasing specialization renders it difficult for researchers to go beyond their immediate discipline, partly because academic institutions simply do not reward this behavior and its resultant products. Students are encouraged to select a narrow topic within a discipline and dedicate their scholarship toward elucidating a limited number of relationships, thereby becoming experts in their field. This requires time and energy that is subsequently not available to devote to learning about other disciplines, except in a cursory manner. Thus, even a col-
aborative project is often broken into units of work that repre-
seatives from particular disciplines can undertake. This is a utilitarian approach that does not require sharing of ideas or methods, and is not conducive to synthetic thinking, theory build-
ing, or policy making. It also means that key questions in any situation are not addressed if they lie outside disciplinary exper-
tise.

SC: Do disciplinary constraints also affect the way information is disseminated—and whether it actually becomes policy-relevant?

AK: Certainly they do. Another consideration in selecting ap-
propriate questions is the audience for reporting interdisciplinary research results. Typically, scholars attempt to please peers, do-
nors, policymakers, the NGO community, themselves, and more senior scholars. The same spectrum of audiences is found in both the global North and South.

Each of these audiences has different, and sometimes oppos-
ing, interests. For example, policymakers often want an imme-
diate answer to a question, such as how to manage a marine park, while the scientific community may wish to understand the motivations of different stakeholders in managing the marine park. Research studies typically do not consider their audience until the findings are available and they are planning dissemi-
nation activities. However, these same audiences need to be con-
sidered while selecting the research questions and designing the protocol.

Finally, if collaborative research projects are being carried out across institutions in a variety of settings, this also adds to the complications in defining research questions. Academic schol-
ars or individuals from purely research organizations may not share the same perspectives and motivations as those coming from NGOs or government. The North-South divide can also be difficult.

WL: It is not enough to hope and expect that people who come from very diverse backgrounds could really come up with the appropriate conceptual framework. I think that's useful in the beginning to have a group of people who have been the field, and know the state of the art well to help design re-
search strategies.

MW: I firmly believe that there should be conceptual frameworks set up with some control over choosing sites and some of the variables—in order to make some genuine hypothesis testing between different sites and get meaningful comparisons.

SC: One of the very laudable goals of the MacArthur Foundation’s PCE initiative was to encourage North-South collaborations. Why? What were the problems? Should these kinds of collaborations be encouraged in the future by other funding agencies? What is the best way to do this?

AK: The majority of projects supported by the MacArthur Foun-
dation consisted of collaborations among several institutions from the global North and South. These are difficult relation-
ships to establish and nurture for a number of reasons. First, there is the simple fact that distance makes communication hard, de-
spite our E-mail and fax capabilities. Electronic communications are only useful for places that have reliable phone lines and a consistent supply of electricity, something that cannot be taken for granted in the developing world. The time-consuming and
delicate intellectual work that is needed to craft a research pro-
tocol and proposal together is best accomplished through face-
to-face interaction—which may not be possible without fund-
ing support.

Second, the power dynamic between Northern institutions and Southern ones can be unbalanced. Northern groups, especially universities, are far wealthier in terms of physical resources such as libraries and computers, and human resources such as expe-
rienced research mentors, research assistants, and information service specialists, than their Southern counterparts. Thus, there can be a biasing on the part of the Southern organization that they are being exploited because of their proximity to the data source.

Third, the motivations of Northern and Southern institutions to carry out the research can be different. Project participants may be motivated by a desire to contribute to scholarship in the field, to generate practical findings for immediate program use, to create a relationship with government and policymakers for their institution, to establish their credentials in a particular lo-
ation or sector, to generate more funds for their institution or project, or a combination of these. Matching motivations, skills, and institutional capacity is a daunting task, and managing this throughout the life of the project can be a full-time job in itself.

Fourth, experienced and promising researchers in Southern in-
sstitutions are much in demand for collaborative work both by those in their own countries and internationally. This frequently leads to over-commitment of time and a reduced ability to de-
 deliver on all the collaborations.

COASTAL AND MARINE ECOSYSTEMS AND THE POPULATION

SC: Would you discuss why coastal and marine ecosystems are such challenging but critical sites for understanding population, consumption, and environment concerns?

MW: Coasts have figured prominently in the relentless march of human development. For millennia, the oceans and coastal waters were the routes for trade and dissemination of culture. Around many coasts, the pace of the spread of ideas, goods, and technology depended on a combination of ocean currents and winds, sailing and navigation technology, and knowledge. The importance of the coastal regions began to rise sharply when shipping trade became more prevalent in the 18th century, and rose even more sharply from the last half of the 19th century.
when world commodity markets began to integrate as a result of the reduction in transport costs. Subsequent global economic development and population growth, especially during the past 50 years, have not only caused a dramatic increase in the popu-
lations along coasts and linked coastal and inland populations
more strongly, but have also caused the redefinition of how coastal
waters and their resources are managed.

CC: Also, it is the extensive and borderless nature of coastal eco-
systems that makes them important. Within shared coastlines, for
example, regulations and practices to control fish harvest-
ing in one community would have benefits that other commu-
nities share. By allowing the fishery to regenerate through lim-
its on the size of fish catch, benefits may accrue as well to nearby
areas where the fish migrate. At the same time, pollutants from
domestic and industrial waste are carried by ocean currents
worldwide. Because no coastline is immune from contamination,
with the effects of untreated effluents traveling across water bod-
ies, responsibility for water management is often aried outside
the community. The extensive and global impacts from coastal
degradation are cumulative over the long-term as population

The second characteristic is the ecological interdependence of the
"coastal zone" as part of an eco-regional landscape—incldud-
ing the upland watershed; the series of rivers, streams, and
agricultural lands; and the coastline and offshore areas. This is the
broadest possible definition of the coastal zone, as described in
the Noordwijk Guidelines adopted at the World Coast Confer-
eence in 1993. It includes the "corridor where terrestrial and ma-
niner trends interact in their influence on natural and human-al-
tered systems, consisting largely of coastal plains, river deltas,
waterways, lakes, beaches and dunes, mangroves, reefs, and
other coastal features." In this perspective, coastal development
becomes as much a function of good management of the land-
scape as it is the management of community-wide fishing regulat-
ions and common property. Similarly, "coastal population growth
is dependent on the conditions affecting population growth and
migration within the eco-regional landscape. By including ur-
ban areas, the population pressures translate into increased do-

The point I want to add, which explains one of the
reason why populations along coasts might be marginal, is
property relations. If you cannot bound, build walls, and con-
trol investments and grow your investments, your productivity
will not increase at such a great rate and you cannot translate
that productivity into control over territory and building a na-
tional state and being in charge. I really do believe that coastal
and marine ecosystems are the place to focus for investigating
the link between population and environment. We are going to
make the most theoretical headway for all these reasons, because
it is poor people, because a lot of people are moving to the coast,
and because of the unbounded character of the system.

W2: Counterweighted by the fact that the primary urban areas
and many of the capitals tend to be along the coast as well. Of
course those areas around the capital or major cities are in a
stronger economic position. Taken altogether, effects and rela-
tionships may be in different directions, and it will be impor-
tant to differentiate between the rural sparsely populated coast
and those that are part of the metropolitan area.

SC: Wolfgang you are right, and it is interesting about how you
have those global cities like Sao Paulo, Bangkok—all located
on coasts—competing with these marginal populations in a very
dynamic and delicate ecosystem.

W1: In our research we have to more clearly distinguish between
these two types—the more urbanized coastal regions and less
urbanized, more rural ones—because the mechanisms are quite
different. They are only joined by their common access to the
oceans, and in that sense when you talked about the agricultural
economists destroying the fence around the study area, the so-
tion came to my mind that the coastal ecosystems are maybe the
most globalized ecosystems. We really cannot control in and out
flows, which prevents us with a globalization challenge.

CC: At the risk of being an environmental determinist here, what
I was also driving at was that the nature of the resource some-
times determines the property and social relations that emerge.
These are really all common pool resources, and sometimes we
make the mistake that the solutions are always common prop-
CONCEPTUAL DILEMMAS: CONSUMPTION, SUSTAINABILITY, INTERCONNECTIONS AND SCALE

SC: One of the assumptions in both policy and research about population and environment concerns is that of time horizons - in particular, that poor resource decisions can be linked to shorter time horizons. Most often this idea is applied in contexts where poverty is prevalent or livelihoods are at stake - situations that are primarily represented by the case studies in this special issue.

WL: Yes, it seems to me a key thing really is the time horizons that people have. In economic terms, as you mentioned, these people need immediate incomes, and discounting factors apply rather heavily. Their income today is worth more for them than income in ten years time. Whereas the ecosystems do not really have any discounting - a fish today is not heavier than a fish ten years ago - and this mismatch is the main reason for many of the problems that we see.

PD: I don't know that there is much evidence of poor people applying large discount rates to their future incomes. Admittedly, some investigators have reported findings to that effect, but there is a good deal of ambiguity in the way the empirical investigations were designed. One problem I have with the claim is that poor people discount future incomes at high rates is that most people, even in the West, were poor in the past, but they would seem to have saved for the future. They may have eaten into their surrounding natural capital, but they simultaneously created other forms of capital as substitutes. And they may have done this effectively, because they grew richer, at least in the West. It seems to me that if poor households degrade their natural capital and remain poor, it is probably because they are very uncertain about whether their property will remain their own. Suppose you currently own a piece of land, but there is a 20% chance that it will be taken away from you by force during the next year (because, say your country is suffering from civil war). Would you sweat and invest in your property? I rather doubt if you would. In short, a more plausible explanation for the poor degrading their natural capital while remaining poor lies in insecure property rights.

WL: Since the notion of sustainable development is concerned with the well being of future generations in addition to that of the current population, I wonder whether models of sustainable development should have some discounting built in. How do you see this?

PD: Economists are right. Discounting net marginal additions to future income is not the same as discounting the "future," if you see what I mean. You could be neutral over the present versus all future dates, and yet favor an additional Euro today over an additional Euro at a future date if you are convinced that you will be richer in real terms at that future date. The reason is that, being richer in the future, your need for that additional income then will be less than it is today. One reason you may be richer in the future has to do with the productivity of capital. For every Euro of resources you invest today, you expect to receive more than a Euro in return. If the rate of return on investment is positive (say, 2% per year with certainty), then, assuming you are managing your portfolio efficiently, you would so arrange your consumption pattern that your discount rate would be 2% per year. As an example of the productivity of capital, consider the case of a fishery. If the fishery is pretty well depleted, refraining from fishing would add to the fish stock at a rate greater than one fish. For every fish you do not catch, there will be more than one additional fish in the pool next year.

WL: But the overfishing is a good example.

PD: Sure, but the cases of overfishing that I know of are due to inadequate property rights (for example, free access to ocean fisheries). Fishermen would discount future catches at a high rate if they were less than sanguine that there would be enough fish to be caught in the future. Overfishing in open access fisheries is formally identical to under-investment in land during civil wars.

MW: I am of the school that thinks that property rights are absolutely pivotal.

PD: I agree. Private property rights are not the only efficient form of property rights. Communitarian property rights can be effective, provided, of course, that the circumstances are right. Under stable political circumstances local communities have been known to manage their common property well.

SC: Yes. It is the issue of stability the ability to manage risk, or minimize uncertainty that allows individuals to have longer time horizons.

SC: One of the most challenging aspects of coastal and marine ecosystems is its very fluid and unbounded nature. This means that externalities are more likely, and by definition less attributable. How would you begin to understand the nature of these externalities and the linkages between systems and people?

CC: When the public goods or the common pool resource characteristic of the coastal eco-region comes in, it is difficult to use standard economic tools for defining the market. That's why I agree that the time horizon is important. The standard Gordon Schaeffer yield effort curve you have some sort of diminishing return after some sort of sustainable yield, but a lot of the PCE studies essentially used a production function that covered only a small portion of that curve.

And yet, the impacts we are talking about, both on the market and on the environment side, over the entire curve. These researchers have been trying to explain everything by looking at this small portion of the curve and relating the whole social and institutional setting to how the curve has shifted or has changed by institutional and other factors.

The second issue is the sector versus nonsector one. A lot of the things that affect the character of the curve are outside the sector. So, many of the markets, the trade policies concerning fisheries, demographic trends that affect migration, and so on, are all outside of the community.

TA: Can we go back to the initial question of consumption? Was there a consensus I missed? How does consumption relate to externalities? Are we really talking about production, or are we really talking about use of resources in the broadest possible sense? In fact, you can consume resources without producing. I had been thinking all along that we were considering the very broadest sense of consumption of
all types, not just in the process of formal production of goods or services.

CC: Do you mean the consumptive and nonconsumptive use?

TA: Yes. For instance, tourism, you could argue, is a noncon- sumptive use. Let's say of the beach.

PD: Isn't a tourism a leisure activity? Isn't that "consumption"?

CC: Not in an economic sense, but in an ecological sense.

SC: So tourists go to a beach, they buy goods associated with it, and enjoy the beach. That means that the effect of their go- ing to the beach degrades certain aspects of the beach. So it is argued that it would be in some form consumption of the beach environment.

WE: When we did an in-depth population-development-environment case study on the island of Mauritius, we found that tour- ism actually helped increase the awareness of local authorities about environmental degradation. They understood that rich tour- ists would not come if the beaches and the water in the lagoon were clean. Hence, there was an important economic reason to fight water pollution. Without this quick economic feedback, the learning process about environmental preservation would proba- bly have been slower.

PD: Yes, demand for an amenity could be the saving of that amenity. The demand could be by people living far away. If the income tourists spend on viewing game animals were to go to those living near the reserves, the inhabitants' incentives to pro- tect the animals would be strong. On the other hand, you do need regulations to discipline behavior (for example, ensuring that tourists do not damage a site). This is another instance in which externalities raise their potential head.

It's about time we define the term. By an externality econo- mists mean effects on people of activities to which they are not a party. For example, Wolf and I could agree to a joint venture, on which Chona is not consulted, but if Chona is affected by the venture, we have a case in which the venture inflicts an ex- ternality. Of course, if she were compensated, (say, because the effect on her is adverse), the externality would disappear.

TA: So there is no externality if there is no human impact? In other words, if you have a change in the environmental outcome, but that change doesn't immediately affect the human popula- tion, is there an externality?

PD: No, externalities are experienced by people in your example.

TA: If it is global well being? ...

SC: Or future generations, who certainly cannot be included in the discussions about how and whether to consume today.

TA: Given this discussion, then how do we understand sustainability? Remember, I am coming from the perspective of an ecologist. How do you actually monitor that? And how do you identify thresholds beyond which the use of a resource would no longer be sustainable for consumption in the broadest sense of the term?

AK: Based on the PCE project portfolio, there seems to be a ten- dency to want to collect data on too many variables. Indeed, a major unknown in this field is determining which variables are more important than others.

The American Association for the Advancement of Science suggests that a systems approach to PCE issues is most likely to mirror reality and be less inclined to assign "blame" to one factor for all. While this is probably true, a systems approach can result in models that are so complicated that they do not point out which factors are more important than others, or so simplistic as to be meaningless. An attempt was made dur- ing the course of the PCE initiative to develop systems models for each project. The models developed did indeed demonstrate the complexity of the issues being studied, but also their diver- sity. The experience of the PCE initiative was that the field was still too early in its development to derive unifying systems prin- ciples and, through this, more tractable yet satisfactory models.

Other confounding factors in conducting PCE research are time and scale. The processes of population and environmental change can often occur over long periods of time, and at a vari- ety of levels; that is, at the community, regional, national, or in- ternational levels, not to mention species, ecosystem, or biome. Defining exactly what the geographic and time parameters are is often tricky, and can be based more on availability of data than on scientific or theoretical considerations. This hampers our efforts to understand the full dimensions of PCE interactions in any one place through time, and limits our ability to determine what constitutes sustainable use or consumption.

SC: I am reminded of the Alaska case, where they finally have enough data about all the linkages among species.

MW: This is the story of the sea lions, the orcas, and the otters...

SC: ... and the killer humpback and the subsequent erosion or break- down of the whole coastal ecosystem, the evidence for which I find really compelling. But it's a situation in which they just hap- pen to have a lot of data that they had been collecting for a long time about this particular ecosystem, and they know enough about the otters and the sea archipel and the kelp, and they can draw the linkages.

TA: The reason I think this discussion of sustainability is useful is that it helps organize the thinking of how the patterns of use affect the resource base, and the ability for the ecosystem to pro- vide the good or the service. Sustainability can also describe in- stitutional arrangements — whether they are sustainable over time. The term embraces all the various intervening variables that we've seen people try and address in the case studies. In effect, all of these case studies are examining the question, "When do patterns of resource use or consumption actually turn from the sustainable to the unsustainable?" Defining these thresholds is critical, yet most people actually haven't thought about it in that way. In the future it would be useful to more fully explore how to design research that gets at these questions of sustainability thresholds. This is a necessary part of the conceptual framework that has yet to be developed. Would you agree?
FUTURE RESEARCH DIRECTIONS, OR LESSONS LEARNED FROM THESE CASE STUDIES

TA: Given what we now know from these case studies and the entire MacArthur PCE initiative, where do we go from here? Are there directives you might give to the next wave of researchers and funding organizations interested in pursuing population and environment concerns?

AK: The complexity of the issues and the variables involved have often fueled vigorous debates on population-consumption-environ-
ment linkages. Population change alone is comprised of mor-
ality, fertility, and migration, with many more layers of detail
beyond this. However, there is at least some sense that basic in-
formation about a population, such as age and sex, must be col-
lected for our understanding of any changes to be meaningful.
Similarly, when researching a given ecosystem, such as a coastal
zone, there is some clarity on the part of natural scientists as to
what kind of data needs to be collected, depending on the eco-
system—for example, fisheries, mangroves, or shrimp farms.
Consumption is perhaps the least understood of the three, with
no standard-data collection yet established (2). Furthermore, P-
C- and E all comprise independent and robust fields of inquiry
in and of themselves, with differing, although not necessarily
competing, theoretical perspectives and methodologies. Those
from different disciplines tend to have different views on
which is the dominant versus the embedded system.

In addition to the complexity within the P-C- and E issue ar-
eas, there is the monumental task of linking the three together.
In order to do this effectively, the research design must reflect
the major concerns of each of the disciplines, incorporate these
into the methodology employed, and find ways of analyzing the
data so that the social science data meshes with the natural sci-
ence data. Recent work using Global Imaging Systems (GIS) in
conjunction with demographic data is an example of this kind of
Collaboration.

CC: We need a new research agenda based on investigating the
human communities and the small social processes that go on
there. Then we can look at how to aggregate the findings from
these small scale studies to draw conclusions that can be gener-
alized and provide direction for policy recommendations. Ob-
serve, if we just use these small case studies, we cannot say a
lot relating to the bigger picture.

MP: For me, what I found frustrating was the lack of standard
demographic or ecological data or descriptions in the case stud-
ies. I think it is especially important for authors of social sci-
ence studies to put in the scientific name of the main species
being considered, especially in the case of fisheries/studies. This
will make it easier to link the papers through search engines with
biological and biophysical studies. The many marine fishery spec-
ies and other taxonomic groups of environmental or scientific
importance are well covered now by massive Web-

available databases containing basic information about their bi-
ology, ecology, status, and fishery/environmental importance.

I also would have liked to have had better demographic in-
formation for the human target and comparison group(s), espe-
cially fertility and age/sex structures. The comparison group
could either be the national average, or the district or regional
averages, or some other meaningful group.

There is also almost nothing in all the studies that allows us to
say a lot about how the intervening variables affect the rela-
tionship between population and environment. Let me give you
a simplistic view. To be able to say that, we would have to be
able to answer questions like, "What would happen if the popula-
tion in this area was twice as big at it is now and behaving in the
same way? What would happen to the environment?" And along
the lines of Chona’s comments earlier about the time scales—
we need to develop a more longitudinal versus the cross-sectional
picture that we currently have. We do not have too many be-
fore and after perspectives, with populations changing envi-
ronmentally and in relation to the environment. We have quite a
bit about changes in the nature of populations through im-
migration. But we need to develop some case studies in which population
differences might be the main defining variables between the dif-
ferent cases.

TA: So you think future research should include design of
longitudinal studies to investigate population and environ-
ment concerns?

WE: Yes, by all means. We must try to anticipate possible fu-
ture trends. For this we need longitudinal information. If we are
ultimately interested in developing better policies, we need to
be able to anticipate what the world will look like when these poli-
ties become effective, and how they might change the world.
Since we are in the midst of rapid changes, it would be wrong to
produce policies for the future based just on an analysis of the
past. When trying to anticipate the future, it is important to
think of and describe the system along the lines of comprehen-
sive scenarios. You really have to try to think of all key driving
forces, and not zoom onto one particular mechanism that you
are interested in.

SC: I think one of the things we are learning from the case stud-
ies is that it is a very complex situation, and we need to con-
sider how population change might affect the institutions
that govern the resource allocation processes. We might also expect
that such processes may affect the ability of the ecosystem to
provide the services needed for human beings, which may be a
result of declining ecosystem health. Further, these changes in
the characteristics of the ecosystem and its services may influ-
ence the resource allocation institutions, or create the demand
for new technologies, or change the pricing mechanisms for the
ecosystem services. This is what we meant by Figure 1 in the
Introduction to this issue of Ambio.

Developing future scenarios would allow us to propose the di-
rection in which populations and therefore institutions might
change, and how ecosystem services might require new institu-
tional responses. This is shown in the Aswani case study, which
is actually quite elegant in that you have particular types of set-
tlement patterns that disrupt sea tenure arrangements, and sub-
sequent ecosystem services and ecosystem health. One kind of
settlement pattern could be disruptive to common property re-
source management, and another could be more coherent and
cohesive and assure common property management of a re-
source. If you have particular movements of population that are
potentially disruptive to an institution, then you would predict
these negative outcomes. So we might be able to make a stronger
statement that these case studies are giving us some evidence on
how population movement and change structure affect these
institutions, which in turn affects resource degradation.

For me this is the take home message from this whole issue,
and what really needs to be emphasized in future research agen-
cas. This is the trouble we’ve had with past research, and it’s a
message that appeals to politicians’ concerns. In other words,
what these case studies are suggesting is that institutional ar-
rangements are central. Politicians can change institutions. It is
much harder to change the quality or availability of ecosystem
services or human behavior through policy.

WE: Meryl, you expressed some frustration that none of these
case studies are really modeling, for instance, the fish
populations. It is also true that none of these studies models the
human population.
Unfortunately, there are a lot of people looking at various environmental parameters, but not necessarily the meaningful ones—it's the path of least resistance. The kinds of studies that are being done are usually trying to quantify parameters for which the data are easily obtained. Often the data will not tell you anything at all about either significant environmental change or the ability of the ecosystem to provide goods and services to humans—which is ultimately our interest. Unfortunately, the things that are easy to measure are not really good indicators of ecosystem health or productivity.

Very critically important on the environmental side is, of course, to think through the scales and the linkages between the scales, even more so than on the population models side. If we really want to understand the dynamics of this system and be able to model it in the most rudimentary way, we need to talk about geographically large-scale systems. We are essentially talking about large marine ecosystems, and are not anywhere near understanding how they function. It's 50 years down the line probably. I think, in the end, what we need to state is very grossly. I think it's very basically to say we need to more clearly and better understand the community of researchers to try to model these systems and the way that they function, and look at the very large scale interactions so that we really get a sense of the big picture and understand how the smaller-scale human population fits within that. We must remember that humans are bona fide members of natural ecosystems.

I also think that regional differentiation is very important. Given the heterogeneity of the world it does not make sense to consider the population-environment interactions on different continents jointly. This is particularly important when it comes to human behavior with strong cultural differentials. We also do not have the old North-South divide, in which we used to assume that populations in the South are poor, grow rapidly, and have low per capita consumption, whereas in the North the rich high-consumption populations are stagnating or even shrinking. This simplistic picture is changing. For instance, in China, still a poor country by most standards, we expect an end to population growth within the next two or three decades. In contrast for the United States, the richest country with the highest consumption, we expect continued strong population growth mostly due to immigration. The picture becomes even more complex in that many developing countries have rapidly growing wealth segments in their populations that consume at the level of Western countries. These are some of the diverging trends. I am not sure how policies can address them. Are changing incentive structures the way to go?

Science and policy can address this issue of the incentive structure. We have a lot of incentive systems. I am not sure that they would really work. For instance, we have taxation systems and proposals for pollution taxes, etc. Some have proposed the marketing of pollution rights as a way of getting at externalities. I was wondering how Partha would react to those as solutions or as answers to negative externalities resulting from free market mechanisms.

Much work is currently being done by anthropologists, economists, and political scientists on social institutions, which are seen as mediating the allocation of resources. Markets are but one sort of institution. The family is another, the State still another, and there are all those informal, civic institutions we are part of. Co-existing institutions frequently result in externalities that is, transactions within one affect the workings of another. The nice thing is that social scientists in the relevant disciplines are reading one another these days. I think we have made considerable progress in our understanding of how environmental resources are used under various institutional regimes. Outside universities, such institutions ranging from the World Bank to the Abu Dhabi Environmental Center for Theoretical Physics in Tübingen are involved in pushing ahead this very exciting research and teaching agenda, to understand the way institutions interact, and the impact of such interactions on our use of the natural environment.

We can think of this as really exciting and challenging. What we were talking about earlier is this notion of ecosystem health as dynamic. At one point we might consider it healthy, and then it may change and become a different kind of healthy. It seems to me that to come up with a measure we would want to know all the exchanges between systems, the linkages. Ideally it would be good to come up with a way of measuring the character of the feedback mechanisms too.

While we are far from a conceptual framework that adequately incorporates all the variables in such complex relationships between humans and nature, there are common threads in the way researchers have addressed these questions. There seems to be a timely convergence of ideas and demand for empirical evidence toward understanding the relationships among population size, migration, consumption, and the health and productivity of ecosystems. In this issue, we have shown how this convergence has focused on coastal ecosystems, which are some of the most complicated, and increasingly most stressed, global environments. Thus, coastal areas and their inhabitants present the greatest challenge for scientists examining the population-environment nexus—and are the regions where learning about the relationship between humans and the environment is most urgently needed.

One of the weakest points in prior empirical studies tying together demographic analysis and ecological assessment has been the omission of how social networks and embedded relations evolve and relate to the physical environment. The studies in this issue of Ambio have, with varying success, either pointed to or attempted to elaborate upon the intermediary role of social institutions (such as kin, community, property relations, or the market). Unfortunately, the theoretical, conceptual, and measurement tools for understanding how to relate these intermediary institutions to population and environment have not been developed and could not be drawn upon for these studies. But the results of these studies do suggest ways in which a new paradigm might be developed. A new paradigm to replace Malthusian ideas of population will not arise until we develop a better understanding of human behavior and the drivers behind it, particularly how human behaviors are organized and predicted.

We must assume that the set of social relations—consumption, exploitation, management, investment—defining natural resource use by people is a critical intervening variable between population growth, migration, and environmental outcomes. The set of social relations defining natural resource use are described in the environmental literature generally as property relations. These can vary from open access, to common property with varying degrees of local and state participation; to private or market-based relations. As we embark on developing a rigorous conceptual framework investigating population and consumption effects on the environment, we must better define and understand these social relations, and how they ultimately affect the sustainability of resource use, long-term environment health, and human well-being. It is these social relations that are at once complex, but more reasonably addressed with policy.