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Integration of Human Dimensions in Climate Change Assessments

Plenary Address

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Chair Elena Nikitina, Mr. Youba Sukona, Ladies and Gentlemen. I would like to begin by thanking the Brazilian Academy of Sciences and the International Human Dimensions Program for providing me with this opportunity to address the integration of human dimensions research in climate change assessments. We only need to look at the agenda for this conference to appreciate the vast landscape of issues that fall under "human dimensions". Similarly, "climate assessments" encompass considerable diversity and come in many different flavors. There are now about twenty reports and technical papers produced by the Intergovernmental Panel on Climate Change (IPCC); probably a hundred volumes published by international organizations, government agencies and advisory panels in various countries; and several hundred other reports that range from NGO publications to conference proceedings - all of which fall under the rubric of climate assessments. In terms of scope there is carbon dioxide and climate, energy and climate, climate change in Europe, climate change in Bangladesh, climate change in New York City, climate change and world food supply, economics and climate change, equity and climate, human choice and climate change - just to provide a few examples.

In this talk I will first trace the interlocking of various strands of human dimensions research with growing concern over the problem of climate change, particularly from the 1970s to the late-1980s. The plurality of efforts during this period will help place our current priorities in context. Next, I will focus on some key aspects of human dimensions research during the IPCC era – both within and outside the assessment volumes of Working Groups II and III. Finally, I would like to share a rather personal perspective on the opportunities and challenges facing us as we seek to make insights from human dimensions research more relevant in the post Kyoto-era.

This first slide (Figure 1) provides a framing of the climate problem from the 1995 Second Assessment Report of the IPCC. We can see changes in atmospheric composition, ocean atmosphere processes, land-use, energy consumption, land-biomass coupling, changes in the hydrologic cycle, and cloud cover. "Human influences" do merit a place on this diagram, though in a rather restricted role through land and energy use.

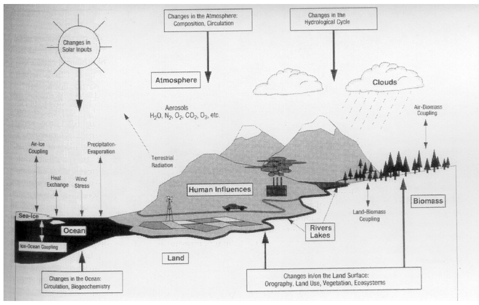

Figure 1: The Climate System (IPCC 1995)

The next slide (Figure 2) is a variant of the previous figure. It is in color, and in three-dimensions, with a lot more detail on salinity exchange and vertical mixing within oceans. The diagram even distinguishes between cirrus, stratus and cumulus clouds. But now there is no mention of human influences. And, this figure comes from the US National Assessment, published in the year 2000, five years after the previous figure from the IPCC Second Assessment.

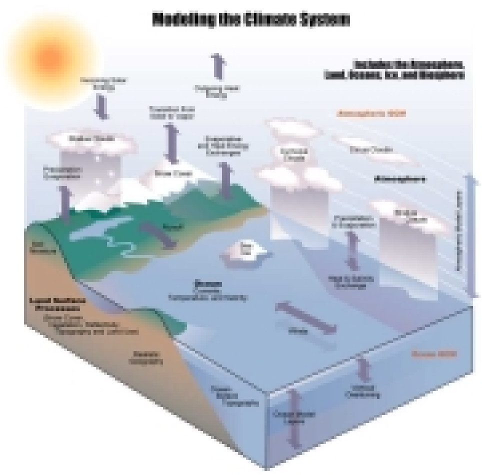

Figure 2: The Climate System (US National Assessment 2000)

So how are we doing in terms of integration of human dimensions within climate change assessments? If pictures were worth a thousand words, then clearly not very well.

Let me now take a step back to very briefly trace the interlocking of various strands of research with growing concern over the problem of climate change. Although the greenhouse effect was hypothesized in 1827, interest in climate research picked up in the wake of a diverse range of activities spurred by the International Geophysical Year (IGY) of 1957, such as the monitoring of atmospheric carbon dioxide concentrations by Charles Keeling. Suki Manabe began pioneering work on general circulation modeling around this time at Princeton, while Bert Bolin developed a model for the carbon cycle.

The prolonged drought in the Sahel during the late 1960s and early 1970s, the 1972-73 El Niño, drought in the Soviet Union in 1972, the failure of the Indian monsoons in 1972 and 1974 all focused considerable interest on the impacts of climate *variability*. The (first) World Climate Conference of 1979 reflected a dual focus on the climate problem, with physical science research on modeling of anthropogenic climate change, while the limited human dimensions research was on societal impacts of climate variability. The early 1980s marked a steady decoupling between climate change and variability. Climate variability remained primarily a research enterprise focused on monitoring and modeling of the tropical Pacific ocean, but subsequent advances in forecasting phenomenon such as El Niño has now lead to recent growth on operational capability to apply seasonal climate forecasts. Climate change meanwhile emerged as a global policy concern towards the end of the 1980s, leading to the establishment of an intergovernmental assessment mechanism, the IPCC, in 1988 and the start of formal negotiations first for a framework convention leading to the Rio Earth Summit, and later a binding protocol negotiated at Kyoto in 1997. And the band plays on.

The era of organized climate assessments began in the early 1970s. In addition to the physical aspects of the climate system, such assessments have intersected with discourses on two related aspects: energy and society; and, climate and society. Figure 3 shows only a very partial listing of some of the most prominent climate assessments, starting with the Study of Man's Impact on Climate in 1971, to the National Academy of Science report of 1979, to the first major international assessment Greenhouse Effect, Climate Change and Ecosystems published in 1986, and of course the IPCC assessments.

Some Climate Assessments

Man's Impact on Climate (1971)
Climate Impact Assessment Program (1971-74)
Carbon-dioxide & Climate (1979)
World Climate Conference (1979)
Greenhouse Effect, Climatic Change and Ecosystems (1986)
Responding to Climate Change (1990)
IPCC First Assessment (1990)
IPCC Second Assessment (1995)
IPCC Third Assessment (2001)

Headline Messages

1.5-4.5 C equilibrium response to CO_2 doubling (NAS 1979)
CO_2 equivalent doubling will be several decades prior to CO_2 doubling (Villach '85)
"Discernible human influence.." (IPCC 1995)

Figure 3: Climate Assessments and Key Findings

In terms of headline messages: the famous 1.5-4.5 C range for the equilibrium temperature response to CO_2 doubling first appeared in NAS 1979; the significance of other greenhouse gases and how that might advance doubling time of carbon dioxide equivalent was first mentioned in Villach 1985; and the IPCC Second Assessment first pointed to a discernible human influence on observed climate patterns.

Human dimensions research relevant to climate has a long and rich history, which precedes current interest in climate change (Figure 4). From Hippocrates in the 4th century BC to Alexander von Humboldt in the 18th century, several thinkers have linked climate to the human condition. But the most virulent extension of this school of thought was championed by Ellsworth Huntington in the first half of the twentieth century who linked racial and cultural stereotypes to climate. Although climate determinism subsequently fell out of favor in the social sciences by the 1950s, shades of it are evident in modern day impacts research where, as Bill Riebsame once observed, the primary focus is still to develop "transfer functions" between climate and variables of interest to human condition: food, human health, and economic output. Climate-society linkages came into sharper focus within the context of natural hazards research since the 1930s through the work of Gilbert White on flood plain management, and his collaborators and students who have made significant contributions to vulnerability research.

Climate & Society

B.C. to 1950s	*Climate as setting (determinism) – Hippocrates to Huntington*
1930s -	*Climate as hazard –White, Kassas, Kates …*
1970s -	*Climate, drought, and famine – Glantz, Jodha, (Sen) …*
Late 1980s -	*Climate change and world food supply – Parry, Rosenzweig …*
Late 1980s -	*Economic costs and integrated assessment models– Nordhaus..*
1990s	*Reflexive studies of climate science, assessments and policy - Glantz (1979), Rayner, Harvard-GEA, FNI/CICERO …*

Five Human Dimensions Driven Climate Assessments
The Atmosphere: Endangered and Endangering 1975 (Mead and Kellogg)
Social Science Research and Climate Change 1983 (Chen, Boulding & Schneider)
Climate Impact Assessment 1985 (Kates et. al)
Societal Responses to Climate Change: Forecasting by Analogy 1988 (Glantz)
Human Choice & Climate Change 1998 (Rayner&Malone)

Figure 4: Human Dimensions Research and Assessments

Drought, meanwhile, was the subject of some very exciting research during the 1970s. In his research on the famine in the West African Sahel, Mickey Glantz demonstrated how the net societal impacts were caused as much by poor land-use practices in the worst eco-setting, as they were by shortfalls in rainfall. In 1975 the International Crop Research Institute for Semi-Arid Tropics initiated a remarkable longitudinal study of farm level coping mechanisms to climate variations in three agro-climatic zones in India. Adaptation, in these studies was not an offsetting parameter to an abstract damage function in some integrated assessment model - rather it was based upon actual coping strategies employed by real farmers systematically observed in field visits to forty villages every three weeks over a ten year period. These studies, and many others, have important implications for us as we rediscover vulnerability and adaptation two decades later within the current stalemate of the climate negotiations.

I would also like to briefly allude to Amartya Sen's work on famines from the 1970s and early 1980s that has never really factored in modern climate change assessments. This figure from 1984 (Figure 5) shows that food availability in India and particularly the state of Maharashtra was consistently lower than in the Sahel, and yet India avoided having a famine precisely when the Sahelian countries experienced the well-known famines of the early 1970s. Food security, in other words, is intimately tied to food *access* and entitlements, and not necessarily to food production.

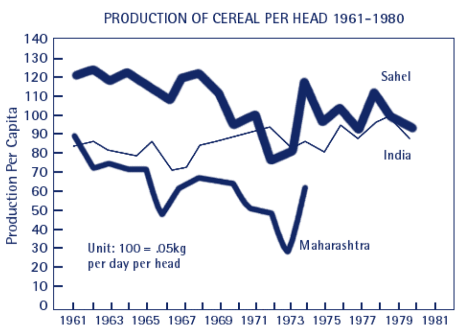

Figure 5: Food Availability in India and the Sahel (Dreze and Sen 1984)

Yet, the dominant framing of food security within climate change assessments all the way to the IPCC has been within the restricted context of climatic influences on food production, as modeled by the linking of outputs of general circulation models to crop impact and trade models, through intermediate steps that involve downscaling, weather generators, and the like.

In terms of fundamental conclusions, there hasn't been much change since the IPCC First Assessment way back in 1990, that reported "in the face of estimated climate change global food production can be maintained at essentially the same level as would have occurred without climate change...(however) there may be severe effects in some regions, particularly in regions of high present day vulnerability" (IPCC 1990). But there now are a lot more regional analyses, using more standardization in terms of assumptions that underlie this conclusion. Nevertheless, there still are considerable challenges faced in generalizing from narrowly focused studies that often study different impacts on different exposure units and by using differing assumptions about future climates (equilibrium vs. transient responses; carbon dioxide vs. carbon dioxide equivalent doubling; inclusion/exclusion of carbon dioxide fertilization). The following chart (Figure 6) from the IPCC Second Assessment is particularly revealing in that it shows the diversity in estimates of yield impacts in response to a doubling of carbon dioxide.

Other human dimensions components of IPCC assessments, particularly on social impacts essentially have varying renditions of the last straw argument, that "human-induced climate change represents an important additional stress... to many systems already affected by pollution, increasing resource demands, and non-sustainable management practices" (IPCC 1996).

Region	Crop	Yield Impact (%)	Comments
Latin America	Maize	-61 to increase	Data are from Argentina, Brazil, Chile, and Mexico; range is across GCM scenarios, with and without CO_2 effect.
	Wheat	-50 to -5	Data are from Argentina, Uruguay, and Brazil; range is across GCM scenarios, with and without CO_2 effect.
	Soybean	-10 to +40	Data are from Brazil; range is across GCM scenarios, with CO_2 effect.
Former Soviet Union	Wheat Grain	-19 to +41 -14 to +13	Range is across GCM scenarios and region, with CO_2 effect.
Europe	Maize	-30 to increase	Data are from France, Spain, and northern Europe; with adaptation and CO_2 effect; assumes longer season, irrigation efficiency loss, and northward shift.
	Wheat	increase or decrease	Data are from France, UK, and northern Europe; with adaptation and CO_2 effect; assumes longer season, northward shift, increased pest damage, and lower risk of crop failure.
	Vegetables	increase	Data are from UK and northern Europe; assumes pest damage increased and lower risk of crop failure.
North America	Maize Wheat	-55 to +62 -100 to +234	Data are from USA and Canada; range is across GCM scenarios and sites, with/without adaptation and with/without CO_2 effect.
	Soybean	-96 to +58	Data are from USA; less severe or increase with CO_2 and adaptation.
Africa	Maize	-65 to +6	Data are from Egypt, Kenya, South Africa, and Zimbabwe; range is over studies and climate scenarios, with CO_2 effect.
	Millet	-79 to -63	Data are from Senegal; carrying capacity fell 11–38%.
	Biomass	decrease	Data are from South Africa; agrozone shifts.
South Asia	Rice Maize Wheat	-22 to +28 -65 to -10 -61 to +67	Data are from Bangladesh, India, Philippines, Thailand, Indonesia, Malaysia, and Myanmar; range is over GCM scenarios, with CO_2 effect; some studies also consider adaptation.
China	Rice	-78 to +28	Includes rainfed and irrigated rice; range is across sites and GCM scenarios; genetic variation provides scope for adaptation.
Other Asia and Pacific Rim	Rice	-45 to +30	Data are from Japan and South Korea; range is across GCM scenarios; generally positive in north Japan, and negative in south.
	Pasture	-1 to +35	Data are from Australia and New Zealand; regional variation.
	Wheat	-41 to +65	Data are from Australia and Japan; wide variation, depending on cultivar.

Note: For most regions, studies have focused on one or two principal grains. These studies strongly demonstrate the variability in estimated yield impacts among countries, scenarios, methods of analysis, and crops, making it difficult to generalize results across areas or for different climate scenarios.

Figure 6: Crop Yield Impact Estimates for $2xCO_2$ (IPCC 1995)

Another generic pattern found in most sectoral assessments can be summarized in the following figure (Figure 7). Essentially what this figure conveys is that while globally averaged impacts might be modest at best, there are likely to be significant regional variations that could range from very negative to at least moderately positive. And, over the years, we have made considerable progress in documenting what some of these negative and positive impacts might be for various regions of the world. In particular, there is considerably more information on developing country impacts, particularly in the IPCC Third Assessment Report.

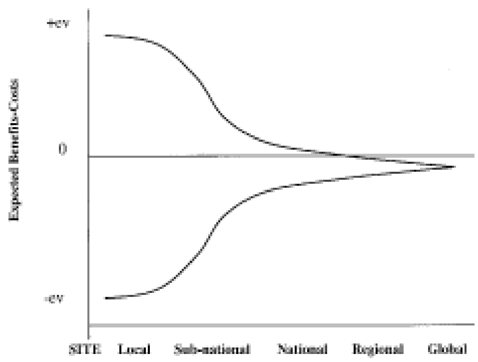

Figure 7: Climate Impacts as a Function of Scale (Environment Canada 1997; Cash and Moser 1999)

In addition to contribution to impacts research, one social science discipline that has really come of age within the IPCC is economics. Like second generation immigrants already well settled on the Promised Land, economists have sought to distinguish themselves from the rag-tag group of more recent social science migrants to the shores of the IPCC. That the sub-title of the Working Group III Second Assessment distinguishes between "Economic and Social Dimensions" rather than viewing the former as a subset of the latter, is not entirely an accident. Unlike more "analog" social science researchers, economists tend to rely on formal mathematical models that can be designed to link up to climate or impacts models, making them naturally attractive to end-to-end climate assessments like IPCC. And, indeed economic studies reviewed by the IPCC do produce eye catching numerical estimates, such as the near consensus that damage estimates from a doubling of carbon dioxide equivalent would amount to about 1-2% of GDP in the OECD, with somewhat higher values in the developing world. This consensus covers only a handful of studies that extrapolate from estimates for only a small number of sectors and countries, overlook transient impacts and surprises, and of course imply that GDP is a good measure for societal impact.

All this of course came to a head over the Statistical Value of Human Life in the IPCC Working Group III Second Assessment. Value of life estimates actually have a long history - but they are used within *very specific* project evaluation contexts. For example, programs in the US spend anywhere from $3600 to $10 million to reduce mortality by one. As James Risbey and colleagues have observed "if one cannot meaningfully assign a single value (of human life) within a society, just how does one do this across different societies with different cultural and imperial histories, political systems, and income levels?" Yet, a few economists within Working Group III overlooked both ethical and methodological concerns voiced both within and outside the IPCC, and assigned point values of $1.5 million for a human life in the industrialized world, compared to $150,000 for the developing world.

I would however argue that the *real* contribution of economics in climate change assessments is not in this search for headline messages based upon value laden assumptions, but rather in the remaining 90% of this particular assessment that provided a rather thoughtful treatise on the strengths and limitations of various tools of economic analysis - the value judgments implicit in the choice of particular discount rates, the limitations of portfolio theory, why marginal benefit curves are so hard to construct, and why one cannot aggregate from individual utility functions. No pithy numbers here, but a "things are more complicated" message that seems oddly reminiscent of the "softer" social sciences.

One final pattern that has characterized most climate change assessments, at least until the IPCC Second Assessment Report is the relative absence of discussion on adaptation. Starting with the Toronto Conference of 1988 when a 20% cut in carbon dioxide emissions reductions was advocated as a policy target, climate change responses have always been dictated by an agenda to reduce greenhouse emissions. Thus assessment after assessment, while containing detailed catalogs of demand side management options and mitigation technologies, tended to under-emphasize adaptation, lest it lessen the pressure on emissions reduction. A major contribution of human dimensions research, and quite frankly the political reality of the stalemate on negotiating cuts on greenhouse emissions, has been to grant vulnerability and adaptation a more prominent position within climate assessments.

Has the IPCC made a difference? My review of climate assessments in this talk should make it abundantly clear that progress in the content of IPCC assessments has been "evolutionary, not revolutionary" as Bill Clark and Jill Jäger have observed. Nevertheless, when coupled with the added legitimacy of the assembled expertise within IPCC as well as the governmental endorsement of its assessments, IPCC outputs have indeed had significant impact on the policy process. But far more important than what is said between the covers of IPCC reports is the assessment process itself that has been so critical to entraining previously under-represented groups such as developing countries and human dimensions experts.

Furthermore, in a policy arena characterized by notoriously short attention spans, it is the ongoing nature of IPCC assessments that helps sustain policymaker and public interest. Figure 8 shows some work Steinar Andresen and I have done examining the number of lead stories on global warming in the New York Times and the Washington Post.

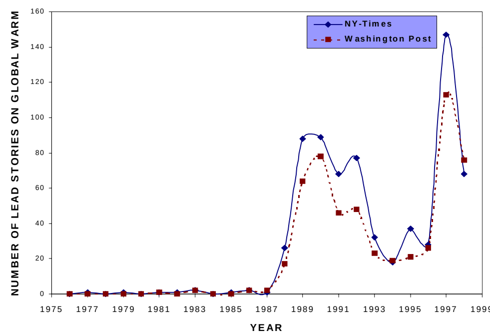

Figure 9: Lead stories on Global Warming in US Media (Agrawala and Andresen 1999)

Climate change has clearly got legs, even in the otherwise unforgiving news cycles of US media. This contrasts with interest in most other policy concerns, including biodiversity and desertification for which conventions were also negotiated at Rio. The initial surge in media interest in the US was primarily the result of the unprecedented hot summer of 1988, and some subsequent peaks have resulted from negotiation deadlines such as Rio and Kyoto. But our analysis shows that it is the release of IPCC assessments and interim reports, punctuated by key findings such as the "discernible human influence" on observed climate patterns from the IPCC Second Assessment, that has provided the glue that sustains interest and media coverage when there are no headline making political or weather events.

Finally, the IPCC also occasionally performs a masticating function that, while not directly leading to decisions, certainly contributes to enhancing decision-making efficiency. For example, former INC Chairman Jean Ripert once told me that a major factor contributing to the timely negotiation of the UNFCCC was the preparatory work undertaken within the erstwhile Response Strategies Working

Group of the IPCC that helped iron out elements of a possible climate convention. Thus, in the final analysis, the IPCC has indeed made a difference. Of course, there are a lot of unresolved problems. But I would argue that the glass is half or even three-quarters full.

And now some concluding thoughts on where we stand with regard to human dimensions and climate change assessments, and some priorities on the road ahead.

In a now famous lecture at Cambridge in 1957, physicist C.P. Snow observed:

"The intellectual life of western society is increasingly split into two polar groups … (with) literary intellectuals at one pole (and) at the other..the physical scientists. Between the two lies a gulf of mutual incomprehension – sometimes hostility and dislike, and most of all a lack of understanding. They have a curious distorted image of each other. Their attitudes are so different that, even on a level of emotion, they cannot find much common ground."

My own experience shows that the rift between Snow's "two cultures" is as evident as ever in climate change assessments, including the IPCC. Physical scientists such as climate modelers somewhat naively expect social science disciplines to provide *ex ante* insights on cognitive perceptions, institutional behavior, utility and value, and winners and losers - just to give a few examples. In reality, however, the predictive potential of many social science disciplines might be rather limited on account of several factors. Most social science problems have a much higher dimensionality than even very complex physical systems. There are no neatly partitioned control volumes or boundary layers, and one cannot take partial derivatives on social variables by holding everything else constant. Multidimensionality is only compounded by measurement problems and the frequent lack of formal mathematical models. What social scientists are good at however is in framing the problem, as they often take an ends (as opposed to means) driven perspective. Social scientists can also play critical reflexive roles by essentially serving as social sensors and assessing the impact and unintended consequences of scientific analyses - an exercise that physical scientists may view as armchair philosophy, or worse, as negativism.

Therefore, the integration of the more interpretive social sciences within the GCM-centric climate assessments is akin to forcing telephone jacks into a power socket. Either human dimensions research must carve out a more meaningful role outside of climate assessments, or the assessment paradigm needs to broaden beyond emissions-climate change-impacts-responses. Recent interest in adaptation and vulnerability is a step in the right direction. Second, social scientists must be reflexive and critical of their physical science counterparts, but without resorting to the "gotcha syndrome". Third, human dimensions researchers should employ the same reflexivity to their own work as they do to the work of climate modelers.

Finally, as a community, I think we put ourselves on the moral high ground given our focus on socially relevant "human dimensions", compared to the climate modelers who might be driven purely by a desire to apply their mathematical models. Yet, we too are seduced by esoteric concerns - such as food security in the year 2100 or the minutae of every conceivable acronym within the Kyoto process - that are far removed from the pressing concerns of human society. In other words, our greatest challenge and opportunity is not necessarily to how to better integrate human dimensions into climate assessments, but rather how to integrate human dimensions with the human condition.

Acknowldegments: It is a pleasure to thank Steve Rayner and Mickey Glantz for critical feedback.