Comments to the Stern Review on the Economics of Climate Change

Submitted by
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1. These comments respond to your invitation to submit comments on the discussion paper (DP) issued 31 January 2006.

2. The Stern Review should examine the opportunity costs of economic and human resources that would otherwise be devoted to mitigation and adaptation.

   2.1 Evaluating opportunity costs is particularly important given that numerous outstanding global problems suffer from a lack of adequate funding. Such evaluation is even more critical if serious resources are going to be devoted to controlling low probability, high impact outcomes when the same resources could be used to reduce higher probability, negative outcomes that are critical to well-being.

3. Climate change will affect the poorest nations the most not only because they are least able to cope, but also because climate change will exacerbate many of the hurdles they currently face in their quest for sustainable economic development. These hurdles include specific climate-sensitive hazards such as hunger, malaria and other climate-related diseases, water shortage, and coastal flooding.

4. Reducing their vulnerability to these climate-sensitive hazards in the near to medium term should therefore not only advance their sustainable economic development, it should also help them cope with the impacts of climate change as and when they occur.

5. In a previous submission (Goklany 2005c), it was shown the benefits associated with halting climate change — and more — can be obtained at an annual cost of $10–$20 billion through efforts taken now to enhance adaptive capacity through activities focused on reducing vulnerabilities to climate-sensitive problems that are urgent today and would, moreover, be exacerbated by climate change. For lack of a better term I label this approach, “focused adaptation.”

   5.1 Focused adaptation is more effective than mitigation over the foreseeable future because: (a) it would address both the climate change and the non-climate-change related contributions to the risks associated with the above noted climate-sensitive hazards, (b) the total risks to these hazards will, for the most part, continue to be dominated by non-climate change related factors through at least 2085 if DEFRA-sponsored Fast Track Assessments of the global impacts of climate change are to be trusted, (c) the technologies, processes, systems, and human and social capital needed to reduce climate-sensitive hazards (such as malaria, hunger, coastal flooding and water shortage) today will also help reduce the same problems in the future whether they are caused by climate change or other factors, and (d) the benefits of emission reductions will be delayed for decades because of the inertia of the climate system.

6. Alternatively, adaptive capacity can also be advanced by broadly advancing sustainable development

in developing countries through, for instance, adherence to the Millennium Development Goals (MDGs) (Goklany 2005a, 2005c, 2006). Studies by the UN Millennium Project and the IPCC indicate that an additional $150 billion per year could reduce global malaria by 75 percent; hunger, poverty, and lack of access to safe water and sanitation by 50 percent (each); reduce child and maternal mortality by at least 66 percent; provide universal primary education; and reverse growth in AIDS/HIV.

6.1 For approximately the same cost as the Kyoto Protocol, which will at best have a marginal impact in terms of reducing risks from climate change, the overall reduction in risks from climate-sensitive hazards using such a "broad development" approach will – through 2085 at least – substantially exceed what can be obtained through a complete halt in climate change (Goklany 2005c, and references therein).

6.2 The benefits associated with the focused adaptation approach outlined in paragraph 5.1 would also apply to and would be subsumed by the broad development approach.

7. The discussion paper (DP) suggests that the Stern Review could use a broader and more careful evaluation of the concept of "adaptive capacity," the factors that influence it, and how it might change in the future at time scales relevant to the climate change debate (see Goklany 2006).

7.1 Para 30, for instance, claims not inaccurately that "modern society is potentially quite vulnerable." However, while all societies have their vulnerabilities, the vulnerability of modern society needs to be put into context, namely, that it is probably much *less* vulnerable now than it used to be (Goklany 2006). First, a smaller fraction of economic activity is now based on climate-sensitive economic sectors. Second, we have far more technological options to draw upon to finesse or cope with the impacts of climate change (e.g., satellite-based early warning systems, more robust building materials, and so forth) than we used to have. Third, trade enables weather-related food deficits to be compensated for through imports from areas that have a surplus. Moreover, if the IPCC's scenarios are borne out (Arnell et al. 2004), then future societies ought to be wealthier and have greater access to economic, human and social resources than today's society, which should mean more options for adaptation which, then ought to lower impacts.

7.2 While it's true that poorer societies are "least able to cope", the DP overlooks the fact that under the various IPCC scenarios that are used to drive emission scenarios, today's poorer societies should be substantially wealthier in the next few decades. Moreover, because of secular technological change, they ought to have access to a wider range of technological options (because technology generally grows with time; Goklany 2006). Thus, the adaptive capacity of today's developing countries (that is, their ability to cope) should be much higher in the future.

7.4 Because many adaptation studies do not fully account for increases in adaptive capacity that would occur with economic development and secular technological change, they have a tendency to overestimate socioeconomic impacts. I recommend that evaluation of such studies be cognizant of this potential failing.

7.3 For the same reason, i.e., likely advances in adaptive capacity with economic development, it cannot be assumed that the scenarios with the highest temperature increases will necessarily result in the highest adverse socioeconomic impacts (see Goklany 2005b). This is because the scenarios that result in the highest temperature change are also frequently the ones having the highest rates of economic growth.

7.4 Increasing adaptive capacity also advances mitigative capacity (Goklany 2006).

8. While over the long haul adaptation may not be a substitute for mitigation (see, e,g., DP, para 66), in the short term it can reduce damages from climate change more effectively than mitigation. Hence over the short term, it can serve as a substitute. Increasing adaptive capacity, moreover, could raise the level at which GHG concentrations might become "dangerous" and/or allow mitigation to be postponed. In either case, the overall cost of mitigation could be reduced, especially if measures are taken in the interim to improve the cost-effectiveness of mitigation technologies (Goklany 2006c). (See also paragraph 7.4.)

8.1 Under either the focused adaptation or the broad development approaches, we have at least until 2035 before undertaking mitigation efforts that would go beyond no-regret actions (see Goklany 2005a, 2005c)

9. This discussion paper (DP) presents as settled issues matters that have yet to be resolved. In particular, it claims that GHG emissions are "causing" the current warming phase, but that needs to be proven, rather than asserted (e.g., DP, page 3, para 20). To prove this, one should, as a start, also be able to explain why some areas have cooled, while others have warmed, and to reproduce the past and present spatial and temporal patterns of temperature, precipitation and other climatic variables, and not just reproduce average global values for these variables. I should note that the law of gravity, for instance, is accepted because it operates at all times and at all places, and not just most of the time at most of the places, or on average everywhere.

10. The DP gives greater deference to climate and impact models than seems their due them based on their track record. GCMs, for instance, have a relatively poor record in simulating Indian summer monsoon rainfall (Gadgil et al. 2005) even when the data fed into the models were from an initial state just prior to the monsoon season.

10.1 Before using model results we would recommend a reality check. For example, if a model assumes – or, for that matter, estimates – an annual increase in GHG concentrations of, say, 1% in the near future, we would recommend verifying that rate against past empirical increases. Similarly, for modeled increases in temperature, changes in hydrological intensity, extreme events, and so forth.

10.2 DP, para 18 claims that "the science models (covering a broad range of phenomena, not just temperature) are essentially based on the laws of physics and chemistry." This is part of the problem with models. To model the earth's climate, especially at the regional and local/watershed scales at which impacts have to be determined, a little bit of biology – and knowledge of land cover and land use – is also necessary (e.g., Friend and Kiang 2005, Eastman et al. 2001, Marshall et al. 2004, Pitman et al. 2004).

11. The DP claims climate change is "serious and urgent" (p. 3). While one can see why it could be "serious", the support the DP offers for the proposition that it is "urgent" is tenuous at best. Even if

emission reductions are inevitable, it does not follow that now is the best time to embark upon aggressive reduction efforts. That would be similar to insisting that since death is inevitable, we might as well end it now. In fact, there are numerous things that can be done in the meantime to improve well-being in the near-to-medium term while getting ready to solve longer term problems.

12. The notion that climate change is urgent seems to be based on:

a) Cherry picking of scientific information. For example, the DP notes in para 1 on page 3, that "some of the risks are more serious than had first appeared." But the converse is equally true, namely, some of the risks are *less* serious than previously thought. The complete shutdown of the thermohaline circulation probably falls into this latter category (see below). Sea level rise (SLR) could also fall into this category. In the IPCC's First Assessment Report , the estimated SLR between 1990 and 2100 was pegged at between 0.31 and 1.10 m with a best estimate of 0.66 m (FAR Scientific Assessment, page 277), and the Third Assessment Report's estimates were between 0.09 and 0.88 m with a "central value" of 0.48m (TAR Scientific Assessment, page 671). Recently Church and White (2006) came out with an estimate of between 0.28 and 0.34 m. Other examples of cherrypicking:

- On Figure A5, the first entry is titled "more heatwaves". [See also DP, para 32.] By the same token, there ought to be fewer coldwaves. We should note that in Britain and perhaps in much of the northern latitudes, more people die during the winter than in other seasons (see, e.g., Kelly and Lawes 1999). According to provisional statistics published by the UK Office of National Statistics (2005), during the winter of 2004/2005 (December-March) there were about 31,600 more deaths in England and Wales compared with the average number of deaths during the non-winter period.
- Noting "…historical precedents for the harmful impacts of pronounced climate change" [DP, para 64], but neglecting to cite examples of positive impacts following from climate change – and not just from any climate change but a warming in particular. But in fact the warming accompanying the Medieval Warming Period helped increase harvests in many areas. Fagan (2001) suggests that the erratic and lower harvests during the Little Ice Age might have been a contributing factor to the French Revolution
- Para 28 (DP) cites a study noting that "climate change is very likely to cause major water shortages for hundreds of millions of people in Asia and South America whose dry-season supplies come from melting snow and glaciers." However, there are other studies that suggest climate change could reduce the overall number of people suffering from water stress by hundreds of millions (Arnell 1999, 2004; see also, Goklany 2003, 2005a).

b) Confusing a large biophysical impact with a large adverse socioeconomic impact. Examples include:

- The treatment of the potential melting of the Greenland and West Antarctic Ice Sheets (Figure A6). If these ice sheets collapse, that would clearly be a geological catastrophe, but a geological catastrophe, while unfortunate, does not always a socio-economic catastrophe make. Even if that raises sea levels by 12-14 meters, such an increase would occur over centuries, if not millennia. I suspect that given the lead times involved humanity would be able to avoid catastrophe, particularly if the situation is monitored carefully, and measures are taken to avoid loss of life and property (such as retrenchment of populations in due course of time away from vulnerable coastlines). A millennium — or half that — ought to be sufficient to prepare for such an event. This is an issue that the Stern Review should explore more thoroughly.

- Para 66 (DP, page 6) notes that “we are already seeing significant impacts.” This essentially equates “impacts” with “adverse impacts”. But there will also be positive impacts (see, e.g., IPCC 2001, pp. 940-943, which indicates that for modest amounts of climate change, net global economic product might increase, a result that will affect cost-benefit analysis and the timing of when aggressive controls ought to be initiated). This too is one more facet that we believe the Stern Review should explore rather than take for granted.
- Treatment of the melting of glaciers on water resources. If “accelerated melting of glaciers… lead[s] to flooding in the spring if the melt takes place too rapidly followed by water shortages in the summer from a depleted stock” (per para 28), we should expect that the society/people affected will respond, particularly since human beings have faced such problems before and dealt with them in the past – granted with uneven success. Nevertheless, such biophysical impacts are likely to result in commensurate socioeconomic impacts only if actions are not taken in advance to forestall or cope with the latter. While there would be costs associated with such actions, one should also note that according to the IPCC scenarios, societies should also be wealthier and, therefore, their adaptive capacities ought to be greater. In other words, while the biophysical impact may be inevitable, it doesn’t follow that the future socioeconomic impacts are unmanageable, or will necessarily be very large.

c) Confusing what is plausible with what is “likely.” In particular, paragraphs 28 through 32 offer a list of items as “likely impacts” which, in fact, seem plausible at best. For example:

- Some of these impacts are “likely” only if one assumes that people in distress will not undertake measures to counteract negative effects. While this might be a useful fiction in developing a “paper” analysis, the reality is that people will respond – and the greater the effect the greater the likelihood of a response. For example, as noted in the foregoing, it is less likely that the biophysical impacts noted in para 28 will translate into unmanageable socio-economic risks.
- While para 29 equates changes in the strength of the Indian monsoon season in any direction with “adverse impacts”, it also suggests that models may not be all that useful – or reliable -- in determining impacts (see above). If different models give different results, perhaps the resulting uncertainty merely reflects that the effect may not be very large.

13. DEFRA-sponsored Fast Track Assessments of the global impacts of climate change indicate that through 2085, the contribution of climate change to risks from various climate-sensitive hazards (specifically, malaria, hunger, water shortage, habitat loss) will for the most part be overshadowed by the contribution of non-climate-change related factors (see Goklany 2003, 2005a, 2005b). [The exception to this rule is coastal flooding. However, through the remainder of this century, at least, it should be more cost effective to protect against coastal flooding than to reduce climate change (Goklany 2003, 2005a).]

13.1 Thus, if there is any urgency at all to address climate change because of additional risks from these hazards, it ought to be more urgent to address non-climate change problems that contribute to those risks. This is one reason for the emphasis on opportunity costs.

14. Para 31 leaves the reader with the erroneous impression that climate change had something to do with the 2000 flood in Mozambique—perhaps it did, or may be it was natural variability in the climate. In any case it's worth noting that worldwide deaths and death rates due to extreme weather events, which is a testament to the increase in society's adaptive capacity in general. See Goklany 2005c).

15. The notion that we should be striving toward a "stable climate" is, frankly, bizarre (see DP page 4, paragraphs 82 and 99). What exactly is a "stable climate", and when has the earth, or for that matter mankind, ever had it? Would recreating the Little Ice Age meet the definition of maintaining a stable climate? How about the Last Glacial Maximum? Why not the Medieval Warm Period? How exactly does one fine tune the climate to be stable? Moreover, the notion that the current warm phase, or departure from the climate of the pre-industrial era, is itself a problem seems rooted in the notion that prior to the change the climate was optimal.

16. The DP puts some emphasis on heatwaves, particularly the 2003 European heatwave. It should be noted that there are numerous ways that society can cope with such heat waves other than through emission reductions. The latter might be the least economic method of reducing damages from heat waves, certainly over the short to medium term. In fact, one could argue with some validity that the enormous toll of the heatwave was as much the result of a breakdown in the social safety net as it was on meteorological factors. [The same could probably be said about the U.S. hurricanes in 2005, although its death toll was an order of magnitude lower.] Had European authorities spent a fraction of the resources expended on the Kyoto Protocol on deploying social and human capital to cope with the heat wave, it is possible that its toll would have been much reduced (which also illustrates the importance of opportunity costs). In any event, it's doubtful that over the next several decades mitigation will do as much to reduce the toll of heatwaves, as greater reliance on adaptive measures.

17. Based on current information, fears of the shurdown of the thermohaline circulation seem to be overblown. First, most of the winter warming of Western Europe seems to be due to atmospheric circulation and seasonal release of heat stored in the ocean rather than heat transported by the ocean circulation (Seager et al. 2002; see also Weaver and Hilaire-Marcel 2004, and Wunsch 2004). Second, although recent data from 1957 to 2004 indicate that the conveyor belt may have slowed by 30 percent, this is "uncomfortably close" to the uncertainties in the observations (Bryden et al. 2005). Third, Gregory et al. (2005) compared the response of the THC to a quadrupling of CO_2 concentrations over 140 years using 11 different models. All the models indicated a gradual decline in the strength of the THC by between 10 and 50 percent. However, none showed a rapid or complete collapse. None of the models shows a cooling anywhere that would more than offset any resulting warming.

18. Recent studies do not support a rapid melting of the Antarctic or Greenland Ice Sheets. Measurements from 1992 to 2003 using the European Remote Sensing Satellites (ERSS) indicate that the:

- Ice sheets in the Antarctic Peninsula and West Antarctica are thinning but the East

Antarctica, a much larger region, has been thickening. As a result the total volume of ice in Antarctica has increased, and the net contribution of the Antarctic ice sheets is to lower sea level ever so slightly (by 0.02 millimeters per year) (Davis et al 2005).

- The Greenland Ice Sheet is acquiring mass (Johannessen et al. 2005). Despite shrinking at the margins, its interior is apparently growing due to higher snowfall.

18.1 Two recent papers, however, apparently contradict the above results derived from the 11-year long satellite record. One, based on 34 months of data, found that Antarctic Ice Sheets are losing 152 cubic kilometers (km^3) of ice each year, which would raise sea levels by 0.4 mm/year (or 1.6 inches a century) (Rignot and Kanagaratnam 2006. The other, based on a 9-year record and a combination of empirical data and model results, estimates that the Greenland Ice Sheet is losing 224 km^3 per year. At that rate, it will take 5,400 years to melt the remaining 1,200,000 km^3 in that particular ice sheet. If that raises sea level by 7 meters, that is equivalent to a sea level rise of 5 inches per century.

18.2 Notably, none of these studies suggest that a catastrophic melting of the ice sheets is in the offing soon. But the contradictory results of the different studies suggest that it would be imprudent to base long term policies on short term data. Neither a 34-month period nor a 11-year period is sufficiently long to have captured the extent to which melting may be driven by natural or anthropogenic factors. See also paragraph 12 (b), above.

References

Arnell, N. W. 1999. Climate change and water resources. Global Environmental Change 9, S31-49.

Arnell, N. W., et al. 2002. The consequences of CO2 stabilization for the impacts of climate change. Climatic Change 53, 413-446.

Arnell, N. W. 2004. Climate change and global water resources: SRES emissions and socio-economic scenario. Global Environmental Change 14, 31-52.

Arnell, N. W., et al. 2004. Climate and socio-economic scenarios for global-scale climate change impacts assessments: characterising the SRES storylines. Global Environmental Change 14, 3-20.

Brock, A., and Griffiths, C. 2003. Twentieth Century Mortality Trends in England and Wales. *Health Statistics Quarterly*, no 18, 5-17. Available at **http://www.statistics.gov.uk/articles/HSQ/MortalityTrends_HSQ18.pdf**

Bryden, H. L., H. R. Longworth and S. A. Cunningham. 2005. Slowing of the Atlantic meridional overturning circulation at 25° N. Nature 438: 655-657.

Davis, C. H., Y. Li, J. R. McConnell, M. M. Frey, E. Hanna. 2005. Snowfall-Driven Growth in East Antarctic Ice Sheet Mitigates Recent Sea-Level Rise. Science 308: 1898-1901.

Eastman, J. L., M. B. Coughenour, and R. A. Pielke Sr. 2001. The Regional Effects of CO2 and Landscape Change Using a Coupled Plant and Meteorological Model. Global Change Biology 7: 797-815.

Fagan, Brian. 2001. The Little Ice Age: How Climate Made History, 1300-1850 (New York: Basic Books).

Friend, A. D., and N. Y. Kiang. 2005. Land surface model development for the GISS GCM: Effects of improved canopy physiology on simulated climate. Journal of Climate 18): 2883-2902.

Gadgil, S., Rajeevan, M. and Nanjundiah, R. 2005. Monsoon prediction - Why yet another failure? Current Science 88: 1389-1400.

Goklany, I. M. 2006. Integrated strategies to reduce vulnerability and advance adaptation, mitigation, and sustainable development. Forthcoming in Mitigation and Adaptation Strategies for Global Change.

Goklany, I. M. 2003. Relative contributions of global warming to various climate sensitive risks, and their implications for adaptation and mitigation. Energy & Environment 14, 797-822.

Goklany, I. M. 2005a. A climate policy for the short and medium term: Stabilization or adaptation? Energy & Environment 16: 667-680.

Goklany, I. M. 2005b. Is a Richer-but-warmer World Better than Poorer-but-cooler Worlds" 25th Annual North American Conference of the US Association for Energy Economics/International Association of Energy Economics, September 21-23, 2005.

Goklany, I. M. 2005c. Evidence for the Stern Review on the Economics of Climate Change, December 9, 2005.

Gregory, J. M., et al. 2005. A model intercomparison of changes in the Atlantic thermohaline circulation in response to increasing atmospheric CO2 concentration. Geophysical Research Letters 32: L12703, doi:10.1029/2005GL023209.

Intergovernmental Panel on Climate Change [IPCC}. 2001. Climate Change 2001. Impacts, Vulnerability and Adaptation (Cambridge, CUP).

Johannessen, Ola M., Kirill Khvorostovsky, Martin W. Miles and Leonid P. Bobylev. 2005. Recent Ice-Sheet Growth in the Interior of Greenland. Science 310 (2005): 1013-1016.

Kelly, S., and Lawes, H. 1999. Weekly deaths in England and Wales. *Health Statistics Quarterly*, no 1, pp 40-43. Available at **http://www.statistics.gov.uk/cci/article.asp?id=1202**

Kerr, R.A. 2005."The Atlantic Conveyor May Have Slowed, But Don't Panic Yet," Science 310: 1403-1404.

Marshall, C. H., R. A. Pielke Sr., and L. T. Steyaert. 2004. Has the conversion of natural wetlands to agricultural land increased the incidence and severity of damaging freezes in south Florida?" Monthly Weather Review 132: 2243-2258.

Office of National Statistics. 2005. Excess winter deaths highest for five years. Press release 27 October 2005.

Pitman, A. J., G. T. Narisma, R. A. Pielke Sr., and N. J. Holbrook. 2004. The impact of land cover change on the climate of southwest western Australia. Journal of Geophysical Research 109 (2004): D18109, doi:10.1029/2003JD004347.

Rignot, E. and Kanagaratnam, P. 2006. Changes in the velocity structure of the Greenland Ice Sheet. Science 311: 986-990.

Seager, R., et al. 2002. Is the Gulf Stream responsible for Europe's mild winters?: Quarterly Journal of the Royal Meteorological Society 128: 2563-2586.

Velicogna, I. and Wahr, J. 2006. Measurements of time-variable gravity show mass loss in Antarctica. Sciencexpress: 10.1126science.1123785.

Weaver, A. J., and C. Hillaire-Marcel. 2004. Ice growth in the greenhouse: A seductive paradox but unrealistic scenario. Geoscience Canada 31: 77-85.

Wunsch, C. 2004. Gulf Stream safe if wind blows and Earth turns. Nature 428): 601.