COMMENTARY:

Proportionate adaptation

Jim W. Hall, Sally Brown, Robert J. Nicholls, Nick F. Pidgeon and Robert T. Watson

Decision-makers need to be able to respond to the question 'how much adaptation is enough?' even though there is seldom a simple answer.

Adaptation is intended to reduce the harmful impacts of climate change. We expect to incur fewer climate-related losses after adaptation, so we are prepared to bear some cost to obtain the benefits of adaptation. The costs of adaptation take many forms, including the up-front expenses of building infrastructure, installing early warning systems and establishing effective institutions, but also the environmental impacts of some adaptations and the costs of foregoing development opportunities in locations at high risk, such as coastal floodplains. Economic theory suggests that we should be willing to pay for adaptation up to a point at which the marginal benefit of an increment of risk reduction is equal to the cost of buying that increment (Fig. 1).

Economic appraisals of projects to reduce flood risk are widely subject to this type of analysis, for example, in the USA, UK and the Netherlands. The UK's Climate Change Risk Assessment[1] sought to generate consistent estimates of risks for a range of different climate impacts. Yet there are rather fundamental limitations to risk-based decision-making as depicted in Fig. 1, due to: (1) the uncertainties, complexities and interactions in estimation of future risks and costs[2]; (2) problems of fully valuing costs and benefits[3], especially when these are incurred over a long time span and across differing spatial scales; and (3) questions of how costs, impacts and risks are distributed across society[4].

Although appraisal of risk-based options is amenable to the incorporation of uncertainty, it relies on quantification of uncertainties in terms of probabilities. In applied adaptation decisions we find that this type of probabilistic information is only rarely available in practice. The UK Climate Projections (UKCP09) are presented in probabilistic terms, so are a noteworthy exception, but are limited in the scope of uncertainties that are represented[5]. Some of the most severe uncertainties are not amenable to probabilistic representation[6].

When uncertainties are large, 'low-regrets' strategies that yield several benefits or keep options open are recommended[7], alongside strategies of adaptive management — 'learning by doing'[8]. Yet glib prescriptions of win-win options are unhelpful in the context of difficult adaptation choices that have to be made in the near term, are high cost and long lasting and involve quantitative choices ('how much?', 'when?' and so on). Commitments to infrastructure and land-use development are examples of these difficult classes of adaptation decisions. As the global financial crisis unfolds, with investment capital hard to come by and economic development an overwhelming priority, a hard-nosed case needs to be made for long-term adaptation. Adaptation financing and development assistance is subject to equally tough scrutiny: making the case rests on being able to estimate how much is an appropriate amount of financing for the risk in question, given the current adaptation deficit and future uncertainties.

Maximizing the efficiency of risk reduction is not the only way of thinking about adaptation. The adaptation decision problem can be recast as one of finding the least costly (where once again 'cost' is thought of in the most general terms) way of achieving a 'tolerable' level of climate risk that applies across a range of timescales. The idea of a tolerable risk threshold has proved to be useful in explaining adaptation strategies to policymakers. For example, Fig. 2 is adapted from the UK Environment Agency's flood-risk management strategy for London and the Thames Estuary[9] showing alternative strategies for managing flood risk in relation to thresholds of tolerability. However, identifying thresholds that are robust enough to be used for public policy decision-making is not straightforward. In fact the Thames Estuary is the only place in the UK where a level of protection against flooding (equivalent to a 1:1,000 year water level in 2030[10]) is defined in law. Elsewhere, if risk thresholds exist, they are implicit, for example in the criteria applied by insurance companies: if people are unable to insure their home against flooding and obtain a mortgage they may well consider the risk to be unacceptable.

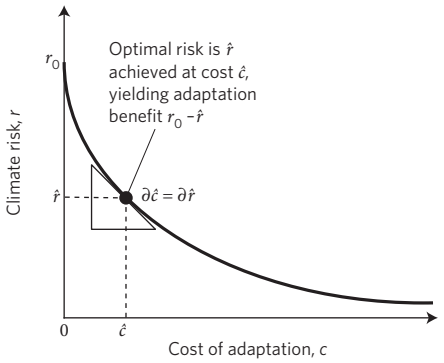

Figure 1 | Optimal adaptation in principle. The more adaptation is undertaken (and hence the greater the cost, c), the more adaptation benefit (in terms of risk reduction $r_0 - r$) is achieved. Optimal adaptation (which avoids under- and over-adaptation) corresponds to the point ($\hat{c}$,$\hat{r}$,) on the cost–risk curve where the slope is 45°, so a small increment in cost $\partial\hat{c}$ yields an equal small increment in risk reduction $\partial\hat{r}$.

The acceptability of risk varies in different cultures: the Dutch have well-established legal standards for design of flood defences. The tenfold increase in the standard of protection against flooding proposed by the Dutch Deltacommissie[11] in 2008 provided a bold global statement that the Netherlands will be open for business come what may — a noteworthy gesture at a time when global business confidence is so weak. Underlying these different cultural norms are the expectations, in different societies, that governments will take some responsibility for certain risks. These expectations and responsibilities may not be explicit in law or policy, but are part of the implicit social contract between citizens and their governments. When risks do materialize and governments are perceived not to have delivered on their side of the social contract then the political consequences can be acute, as they were in the aftermath of flooding in New Orleans in 2005, and food shortages in 2007 when exceptional weather resulted in high grain prices sparking riots in 48 developing countries. Crises can

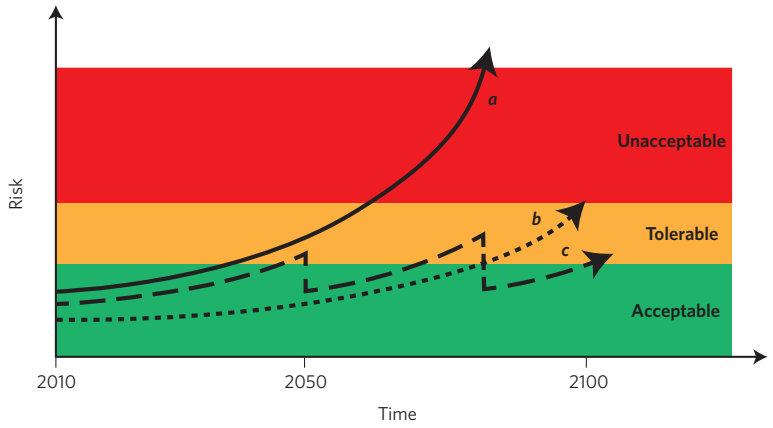

Figure 2 | Managing flood risk in the Thames Estuary. *a* shows the projected increase in flood risk; *b* indicates a strategy with up-front investment to keep risk within a tolerable limit throughout the twenty-first century and *c* is an incremental strategy involving periodic upgrades.

trigger the recalibration of risk providing the opportunity for policy innovation[12], such as the Millenium Drought, which stimulated water reforms in Australia[13].

Analysis of risks provides alternative approaches to addressing the question 'how much adaptation is enough?' Any unique answer would misrepresent the severity of uncertainty surrounding adaptation decisions. As with any complex problem, there are several perspectives on the impacts of climate change and the costs of adaptation. Working towards an adaptation decision should involve even-handedly exploring a variety of alternative interpretations[14]. Let's not allow 'paralysis by analysis' of adaptation decisions be an obstacle to action. Difficult decisions about adaptation are being made now, and harder choices are going to have to be made in the future. Yet for the time being, even in the most widely publicized examples of adaptation decision-making, such as the Thames Estuary 2100 study[9], we observe that the evidence needed to explore climate risks and the costs of adaptation from several perspectives is not transparently available. The decision-makers' toolkit needs to be equipped with a greater diversity of instruments, and their skills in deploying them need to be honed. ❐

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COMMENTARY:

Equity and state representations in climate negotiations

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Current United Nations structures are highly inequitable and obstruct progress towards international climate policy cooperation.

We have entered an era where ecosystems are dominated by humans in a globalized, interconnected and interdependent world — the Anthropocene[1]. Large-scale global environmental changes and their broader impacts transcend national boundaries and raise difficult issues of justice. This makes government interventions through conventional rulemaking highly problematic. Over the past five decades, multilateral institutions and global governance mechanisms have emerged to address those environmental challenges, but with mixed success[2]. To avert irreversible global change, fundamental and radical transformations of existing governance practices are now needed[3]. Indeed, state function has shifted from "a role based in constitutional powers toward a role of coordination and fusion of public and private resources," where states have become "increasingly dependent on other social actors"[4]. Also, the boundaries between who constitutes an 'authorized' representative (and who does not)[5] and who has agency[6] have shifted. Experts have explored the question of who are considered 'expert' or 'authority' agents to speak for the climate, and how they do so[7,8].