POLICY FORUM

Planned relocation: Pluralistic and integrated science and governance

Knowledge for just and effective planned relocation will emerge from entangled action, learning, and capacity building

By **R. H. Moss[1,2], P. M. Reed[3], A. Hadjimichael[3], J. Rozenberg[4]**

Although relocation of human populations is nothing new, global environmental changes such as climate change, sea level rise, and land use change are increasing the likelihood of relocation for potentially millions of people, especially in coastal regions. Globally, sea level rise alone could place 340 million people on land projected to be below annual flood levels by 2050 (*1*). The need for relocation will increase because of such risks, the lack of funding for protection and accommodation strategies, and/or the reality that sea walls and other measures will eventually be ineffective. Thus, current approaches to planned relocation such as buyouts for individual households are likely to be "woefully inadequate" in the future (*2*). We discuss how science, governance, and their interactions need to evolve to make planned relocation a strategic option that leaves people, communities, and the environment better off. The starting point is to acknowledge that relocation involves a physical transition away from locations exposed to global change hazards, as well as the need for transformation of institutions, social networks, cultural associations, economic relationships, and other aspects of a community's way of life.

Given that relocation is a life-altering change, organizations such as the United Nations (UN) High Commission on Refugees mandate that it needs to be planned and implemented with meaningful engagement of affected parties and carried out to improve (or at least maintain) their quality of life. To ensure responsiveness to changing conditions and preferences, relocation should be part of a flexible, nested, and interconnected set of adaptation strategies that also include coping (reactive, short-term risk-reduction measures) and incremental adjustments (measures to increase resistance and/or resilience) (*3*). How to combine these different measures into a strategic portfolio of policies and actions places demands on science and governance to support open-ended adaptive planning processes that manage trade-offs across interests, uncertainties in knowledge, and institutional ambiguity created by overlapping jurisdictions, authorities, and expertise.

Planned relocation is a complex social dilemma that involves many structural, perceptual, economic, and interpersonal dynamics that discourage collective action. It will involve resolving fraught questions such as what decision processes are used, who relocates (and when), how are they compensated, where will they move, what assistance is provided (and to whom) in receiving communities, how abandoned wastes and environmental legacies are remediated, and how agreements are monitored and enforced. There is no single best approach to move a community—stakeholders with conflicting objectives will see it differently even when they share basic world views. The interaction of social and environmental triggers and lack of a preferred pathway make planned retreat similar to other global change dilemmas. But the potential scope, existential character of needed transformations, and complexity of governance challenges make it especially demanding.

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A $48 million grant from the US Federal government in 2016 is aimed to assist relocation of the residents of Isle de Jean Charles, Louisiana, including members of the Biloxi-Chitimacha-Choctaw tribe.

GOVERNANCE PARTNERSHIPS

Despite the immensity of the challenge, it is vital now to constructively engage science and governance to plan physical transitions and socioeconomic transformations that reduce risk and make people, communities, and the environment better off. Here, we offer several ideas for improving governance partnerships in developing strategies for planned relocation.

Eliminate perverse incentives and establish inclusive governance

Existing institutions and processes of governance will be stretched to address the challenges of planning and implementing relocation in a way that meets basic humanitarian principles and good practices. This is because current mixes of policies, institutions, and relationships are responsible for producing the prevailing distribution of privilege and vulnerability in society. Although climate change plays a role, it amplifies present challenges that are an amalgam of past governance, entrenched inequities, and norms. The sheer potential scale of relocation globally is beyond anything our modern global society has experienced. For example, the megacity Jakarta is actively considering relocation because of growing climate hazards, aquifer subsidence, and the density of a highly vulnerable low-income population. These challenges are not limited to the developing world, as evidenced by the mounting annual damages and recovery costs of climate extremes on populations in the United States.

Improving governance will require addressing structural inequalities and many perverse incentives and behavioral dynamics that continue to drive people to settle in areas exposed to hazards. Innovations are needed to address organizational silos, poor planning and risk communication, psychological attachments to place, and dependence on continued occupation for tax revenues. These challenges can be exacerbated with well-intentioned coping strategies (e.g., the "levee effect" that reduces accurate perception of risk). In the United States, for example, federal programs including subsidization of beach nourishment, the National Flood Insurance Program, and the federalization of natural disaster recovery encourage settlement of risky areas. Planned relocation toolkits (*4*) are beginning to emerge that orient the challenge within domestic legal frameworks and international organizations (e.g., the UN Office for Disaster Risk Reduction) and the experiences garnered from existing national efforts (e.g., Fiji's efforts to move 46 villages).

Making and implementing decisions in which communities voluntarily relocate will require inclusive, deliberative processes that emphasize transparency, engagement, trust building, accountability, and an interactive approach for engaging with science. Policy or legislative frameworks are critical to defining long-term targets and providing credible commitments to maintain the continuity of objectives across institutions and political mandates (*5*). Strategies will need to accommodate changing circumstances (new scientific evidence, technological change, new preferences) and the management of implementation tactics based on expert advice, monitoring and reporting, and accountability. In most countries, new institutions and funding are required to improve access to expert advice, coordination, and consultation. Governance frameworks for relocation will need to include periodic communication about future risks, engagement with private sector and civil society, and oversight mechanisms to monitor and enforce the implementation of agreed plans.

ACTION-ORIENTED KNOWLEDGE

Diverse perspectives in problem framing

Defining the problem and its context is the central challenge posed by planned relocation. Framing a problem establishes what is prioritized (and what is treated as unimportant), what the objectives are, and what questions will be asked and answered. Framing is often contested, and to avoid marginalizing communities, it needs to incorporate diverse perspectives, start from the specific local context of ongoing systemic challenges, enhance stakeholders' agency, and bring together diverse sources of knowledge (*6*, *7*).

It is particularly challenging to carefully analyze the diverse stakeholders and the types of knowledge that are pivotal to understanding and framing planned relocation (e.g., capturing perspectives from the relocating, receiving, and remaining populations). Problem framing could consider the need for expertise, tactical engagement, and sustained advocacy to catalyze plans into transformative actions (*6*, *8*). In addition, emerging innovations in computational social science and "coproduction" of research (in which stakeholder communities are involved in different aspects of the scientific process) offer opportunities for formalizing stakeholder analysis. Analyses could improve stakeholder identification, categorization, and relationship (power) mapping.

Account for power dynamics

Decades of research in planning, public administration, sustainability science, and science and technology studies have examined how to improve the relevance and effectiveness of science to inform planning and policy for a wide range of social, environmental, and sustainability challenges. Several prominent strands of this work focus on coproduction as being more than a means to produce science, providing a mechanism to generate public goods, services, and institutions (*7*). Accordingly, the design of coproduction processes is not just about how the interactions of policymakers, stakeholders, and scientists affect the usability of science. It is also about the process of social change—how epistemologies, social and cultural norms, institutions and policies, and power relationships among communities and stakeholders interact to determine who is involved in the process, which types of knowledge are seen as legitimate, what is produced, and what outcomes result.

For challenges as fraught as planned relocation, this more expansive approach provides a foundation for codeveloping knowledge and action. It requires engaging multiple perspectives on values and knowledge where the actors involved in coproduction of planned retreat must work together to explore normative and political differences inherent in their different visions of the future (*6*).

A critique of coproduction processes is that they can depoliticize discourse by using scientific arguments to evoke universalized ideas of what is "best." They can be structured as if all participants have an equal role when in fact governments, large nongovernmental organizations, and economic interests have disproportionate power and greater opportunities for participation (*7*). This is not just a process issue but can also affect the outcomes of coproduction—for example, favoring the use of narrow cost-benefit framings that conclude that protective measures such as beach nourishment or construction of sea walls are economically justified only for high-value assets.

Empirically informed awareness of the diverse roles and dimensions of power in coproduction and social change offers an avenue for rebalancing problematic relationships that lead to inequality or exclusion, or at least avoiding their unintended consequences (*7*). Modest steps such as providing funding to enable underserved communities to participate in coproduction, or formalizing the participation of Indigenous advisory councils, can also help level the playing field (*9*).

Diversify knowledge sources and types

To support planned relocation, science needs to deliver not just technical solutions but also

knowledge of how to relocate and transform communities, including the willingness and capacities of different groups and institutions to support fundamental change over time (*6*). Providing this knowledge will require a transdisciplinary approach to research that broadens the array of scientific disciplines and other sources of knowledge engaged. Government bodies and stakeholders (e.g., real estate interests, businesses, community-based organizations) will need to be integrated into research not just as "users" but as knowledge holders and experts in community needs, preferences, norms, and evolving capacity to implement solutions. When relocation involves Indigenous communities, rather than integrating traditional knowledge into Western science, scientists involved in coproduction arrangements should foster mutual respect on the multiple ways of knowing, by engaging in tribal avenues, such as regional newsletters and talking circles at tribal meetings (*9*, *10*).

Informing social and economic transformation will require research into the capacities and values of different populations and institutions. This requires understanding issues such as what will motivate people to make changes, the capacity of individuals and institutions to act on their preferences, and how current conditions and path dependencies affect the viability of future options (*6*). It will be necessary to "think critically about outcomes as well as processes, about institutional and process designs, [and] about power and performance" (*11*).

Amiya Brunet sits outside her home in Isle de Jean Charles, Louisiana, 7 April 2016.

PHOTO: JOSH HANER/THE NEW YORK TIMES/REDUX

Sample from a range of plausible futures to evaluate decision options

Science can better inform action if it stops trying to predict inherently unpredictable phenomena. Currently, many decision-makers frame their questions to scientists as "what will happen," and scientists respond with "projections" (possibilities based on assumptions about future radiative forcing), which are often used as predictions. This framing, in addition to putting science in the dangerous position of speculating, is not necessarily as helpful to decision-makers as "what if" questions about the consequences of options under many plausible futures. Science can be more useful by changing the objective of collaboration from "predict then act" to the exploration of hypothetical questions about what short-term actions would be consistent with long-term objectives and perform well under a diverse range of plausible futures (*12*).

As a specific example, the State of Louisiana has been confronting sea level rise, land subsidence, accelerating losses of coastal lands, and increasing risks from storm surge. The state has initiated an innovative and collaborative planning process that budgets $50 billion in a portfolio of projects to be adaptively implemented over the next 50 years (*13*). Unlike traditional cost-benefit–driven risk planning efforts based on a specific expected future ("what will happen"), the Louisiana master plan has engaged broad stakeholder participation to map what project investments hold immediate benefits while providing flexibility to confront a broad range of plausible future scenarios that could reshape their investment priorities as well as future stakeholder needs ("what if" planning).

This approach recognizes that many types of uncertainty will impede judgment and decision-making (*12*). The natural stressors that can trigger the need for evacuation are uncertain because they are emergent, compounding, and cascading outcomes of complex human–environment interactions. But the implications of changes in future values and behaviors are also uncertain and arguably just as important for evaluating decision options. Even in well-documented historical instances of relocation, it is difficult to understand how outcomes emerged from the actions taken—let alone anticipate with any certainty how desired outcomes arise from future actions (*14*).

One important opportunity is to more widely apply decision-making under deep uncertainty (DMDU) methods (*12*). These exploratory approaches draw on local-scale stakeholders' knowledge of the key factors and dynamics (human and natural) and provide a promising mechanism for informing planned relocation. Models and scenarios serve as focal points to build shared understanding about the potential implications of the different values and options preferred by stakeholders.

Social learning to build local capacity

Relocation is a complex process that will benefit from expanding the range of intermediaries and services available to facilitate production and application of knowledge. Those involved will need to know not only what scientifically robust sources of information are available for the hazards they face, but also how this information should be used to assess vulnerability, revise flood maps or zoning, evaluate financial risks to reset insurance rates and bond ratings, redesign infrastructure systems, update capital improvement and other plans, or establish thresholds and monitoring systems to trigger the next phase of agreed measures. Much attention has focused on providing climate scenarios and data, but to meet the needs of relocation, the range of services must be expanded. Needed services include not only identifying good practices in engineering, financial risk, and other technical analyses but also supporting transformation, capacity building, and

establishment of standards for different types of deliberative and analytic processes.

Research, case studies, and pilot projects are testing approaches to meet these challenges, and a useful next step is to organize evaluation and social learning to establish good practices and technical guidance. One option is to incorporate evaluation into assessments such as the Intergovernmental Panel on Climate Change and the US National Climate Assessment to establish a knowledge foundation for climate services. This would create standards for services delivered through international organizations, the private sector, academia, and public agencies (to ensure availability of services for underserved, low-income communities) (*15*). Another is an open-source wiki for climate solutions that would enable a more diverse range of knowledge holders to interact and curate guidance on good practices on an ongoing basis, emphasizing sources of credible information.

Another opportunity is to expand the use of intermediaries—individuals and institutions that facilitate interactions between stakeholders and experts (*8*). Many intermediary skillsets are necessary for the different stages of deliberative planning, financing, tactical implementation, and ex-post monitoring of relocation actions. Given the potential for contested needs and values, it is important that intermediaries be aware of how they can unintentionally affect power relationships or outcomes—for example, by using types of knowledge, analysis metrics, or visualizations that favor the perspectives of one group or another. A "critical pragmatic approach" highlights the importance of this awareness and of designing and critically evaluating deliberative processes where conflicts between parties are not reduced to simple consensus-driven debates (*11*). A variety of measures are needed to increase the number and efficacy of intermediaries, including professional certification; greater recognition, including in promotion and tenure processes; and increased funding.

Harness emerging innovations in community science and data analytics

Innovations in community science, sensing, and data analytics hold great promise in providing insights for planned relocation if privacy, equity, and other concerns such as maladaptive applications of generic algorithmic or sensing tools are addressed (*15*). Combining these innovations with monitoring investments in socioeconomic data offers the potential to better capture the interdependent evolution of human and natural systems that shape the experiences and prospects of populations facing relocation. For example, high-resolution models of flooding magnitude and extent might be available for an area, but data are missing on how inequities in agency and justice interact with exposure to hazards to shape the prospects of using planned relocation to improve people's lives.

These innovations will increase the utility of standard modes of multidisciplinary scientific research that combine hazard predictions, engineering, financial, and other analyses to inform technical solutions that contribute to physical transitions. Additional methodological advances that have not yet been fully exploited include improved projections of hazards at various spatial scales; research on coastal habitat loss and nature-based solutions; new data sources, indicator-based assessments, and demographic modeling to identify vulnerable populations; and practice standards for using global change risk analytics in engineering and other professions. This contextualized technical knowledge can provide insights for sequencing transitional risk reduction and protection measures.

REALIZING JUST RELOCATION

Revolutionizing the role of science to focus on conditions that will affect the ability of society to identify just relocation pathways, build agency, and implement strategies under uncertainty will require a "pluralistic and integrated approach to action-oriented knowledge" (*6*). Such an approach will increase confidence in the ability of communities to successfully navigate planned relocation on the massive scales at which it is likely to be required. It must build a more ethical and responsible approach that serves those affected. ■

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Assessing human habitability and migration

Integrate global top-down and local bottom-up analyses

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Habitability loss is increasingly recognized as an important dimension of climate risk assessment and one with complex linkages to migration. Most habitability assessments, like climate risk assessments more generally, are based on "top-down" approaches that apply quantitative models using uniform methodologies and generalizable assumptions at global and regional scales, privileging physical sciences over social science–informed understandings of local vulnerability and adaptive capacity. Many assessments have focused on a single climate hazard threshold (such as permanent inundation or the 1-in-100-year flood), and a subset have implied that outmigration may be one of the few viable adaptation responses (*1*). There is a risk that such climate determinism minimizes the potential for human agency to find creative, locally appropriate solutions. Although top-down modeling can serve a useful purpose in identifying potential future "hot spots" for habitability decline and potential outmigration, only by integrating "bottom-up" insights related to place-based physical systems and social contexts, including potential adaptive responses, will we arrive at a more nuanced understanding. This integrated framework would encourage development of policies that identify the most feasible and actionable local adaptation options across diverse geographies and groups, rather than options that are deterministic and one-size-fits-all and encourage binary "migrate or not" deci-

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