

CLIMATE CHANGE

Preparing for Resettlement Associated with Climate Change

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Although there is agreement that climate change will result in population displacements and migration, there are differing views on the potential volume of flows, the likely source and destination areas, the relative role of climatic versus other factors in precipitating movements, and whether migration represents a failure of adaptation (1, 2). We argue that climate change mitigation and adaptation (M&A) actions, which will also result in significant population displacements, have not received sufficient attention. Given the emergence of resettlement as an adaptation response, it is critical to learn from research on development-forced displacement and resettlement (DFDR). We discuss two broad categories of potential displacement in response to (i) climate impacts themselves and (ii) large-scale M&A projects. We discuss policy approaches for facilitating migration and, where communities lack resources to migrate, suggest guidelines for organized resettlement.

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China water transfer resettlement problems. An elderly resident stands outside her home in the village of Shizigang, China, near the Danjiangkou Dam, part of China's vast South-North Water Transfer Project that will channel southern rivers to meet water needs in the dry and urbanized north.

parties agreed that, beginning in 2020, the Green Climate Fund will finance large-scale projects. Projects may be developed for many reasons, with the M&A benefits being more or less evident in different cases, but the policy

Climate Change, Mitigation, Adaptation

Should temperatures increase by 2° to 4°C this century, in the range of estimates by the United Nations Intergovernmental Panel on Climate Change, resettlement in response to climate impacts would become virtually unavoidable in some regions of the world (3). Warming of this magnitude would result in dramatic changes to water availability, ecosystems, agricultural productivity, disaster risk, and sea level (4). Climate-related resettlement is already under way in the Mekong River delta of Vietnam (1), along the Limpopo River of Mozambique (1), on the coast of Alaska (5), in the Inner Mongolia Autonomous Region of China (6), and from the Carteret Islands to Bougainville Island in Papua New Guinea (7). Although resettlement should only be considered in cases where in situ adaptation is impossible, planning and capacity building should be undertaken to minimize disruptions if resettlement becomes necessary.

In the same way that infrastructure and development projects have induced massive population displacement and resettlement (8), large M&A projects have the potential to lead to comparable outcomes. At the 2009 and 2010 UN climate change conferences (Copenhagen and Cancún), there was consensus on implementing a sizable number of climate change M&A projects. At Cancún,

impetus created by climate change is likely to increase the number of large projects globally. Examples include large dams for hydro-power and water storage, biofuel plantations, seawalls, coastal defenses, and water reallocation projects (e.g., China's South-North water transfer scheme) (see the image) that respond to regional drying trends. Yet effectiveness of such large-scale projects is debatable, their climate benefits have often been exaggerated [e.g., (9)], and environmental and social disruptions can be enormous [e.g., (10)].

Facilitating Migration and Relocation

Migration has long been a response to climate variability and environmental change (2, 11), yet impediments to migration can and should be removed. The Asian Development Bank found that "reducing the barriers to migration on a regional scale and facilitating regional mobility could greatly benefit the migrants [and] the origin and destination countries in the context of climate change" (12). Temporary protected status, such as provided to Haitians in the United States after the 2010 earthquake, and legislative measures taken by some EU countries, as well as temporary work visas (1), may assist those affected by natural disasters.

Assisted relocation entails financial compensation and incentive mechanisms that

allow households impinged on by climate hazards or infrastructure projects to leave affected areas and choose their destination. This has been used mostly in the case of displacement from natural hazards, but assisted relocation could also be considered in areas affected by M&A projects or direct climate impacts. The Guiding Principles on Internal Displacement, the 2011 Nansen Principles, and UN High Commissioner for Refugees' deliberations on climate change and displacement provide valuable guidance on protecting the rights of those displaced by climate hazards (13–15). These address the rights of internally displaced peoples and international refugees but do not provide recommendations concerning resettlement, to which we turn next.

Resettlement

Given the many commonalities between development-related and future climate displacement (16, 17), the body of knowledge accumulated in the literature on DFDR (8, 10, 18) offers lessons. This is vital because the scale of displacement is likely to be much greater than in the past, yet resettlement praxis is only beginning to benefit from systematic study of past resettlement efforts (10), let alone application of this knowledge to the peculiarities of climate-related resettlement.

More than just spatial relocation combined with material transfers, resettlement is a complex process, with major challenges emerging immediately after displacement. The widely cited Impoverishment Risks and Reconstruction model (18) identifies eight basic risks: loss of land, employment, shelter, and access to common resources; economic marginalization; increased morbidity and mortality; food insecurity; and negative cultural and psychological impacts. Resettlement strategies must include economically feasible reconstruction of productive activities [e.g., jobs and education (8)], with sufficient income generation, restoration of livelihoods, and adequate cultural integration with hosts.

An example of research relevant for resettlement associated with climate change is a meta-analysis of 50 resettlement cases associated with large dams completed since 1936 (10). Success was linked to measures such as adequate staffing of agencies and training of officials responsible for resettlement activity, adequate funding, political will to promote development of communities rather than simple restitution, clear lines of authority and responsibility, and efforts to involve affected people in assessments and decision-making. Similar analyses are needed for other DFDR projects and are now being formulated for disaster-related resettlement (19).

Even with the best social safeguards, the complexity of resettlement may confound good planning. For example, large dams and palm oil plantations may create jobs that are more quickly exploited by outsiders than those who are resettled or may create unanticipated health issues (e.g., malaria outbreaks) and environmental losses (e.g., deforestation) (20, 21). Although livelihood reconstruction is possible and may even lead to higher levels of prosperity after relocation (10), such benefits may be offset by health, cultural, and social costs. Long-term success can only be determined by follow-up studies with the second and subsequent generations post resettlement (10). Care needs to be taken to avoid resettling communities in areas where preexisting ethnic antagonisms exist or marginalized populations reside.

Unlike past resettlement, destination areas will need to be screened to identify current and future climate impacts; localities expected to experience increased impacts would only place resettled communities at continued risk. Rural-to-rural resettlement is likely to be supplanted by rural-to-urban resettlement with an emphasis on small industry creation and employment, such as is increasingly practiced in China (22).

In the spirit of the Cancún agreements, which promote “measures to enhance understanding, coordination and cooperation with regard to climate change induced displacement, migration and planned relocation” (23), we recommend:

1) Establishing legal frameworks for climate change resettlement to protect welfare and human rights of affected populations [useful principles are articulated in (16–18)];

2) Involvement of affected communities, in both source and destination areas, in assessments and decisions regarding resettlement locations, compensation, and development programs [e.g., hurricane affected Mayan populations in Santiago Atitlan, Guatemala, designed their resettlement in culturally appropriate ways (24)];

3) In cases where resettlement is deemed the best option, the process needs to be fair and equitable for the community, with every effort made to improve livelihoods [e.g., Egyptian Nubians resettled owing to construction of the Aswan High Dam benefited from irrigation works (10)];

4) Interdisciplinary training for resettlement professionals that includes economics, anthropology, public health, and case studies;

5) Baseline environmental, health, and social impact assessments to establish benchmarks for evaluating resettlement performance through monitoring and evaluation

programs [e.g., Nam Theun 2 hydropower station in Laos (25)];

6) Research to adapt existing knowledge on resettlement to the special case of climate-related resettlement, with particular reference to disaster-related resettlement and learning from incipient climate-related resettlement (1, 5–7); and

7) Establishment of financial mechanisms for capacity building and anticipatory planning in developing countries exposed most to climate risks, with joint funding by donors (e.g., the Green Climate Fund) and the exposed countries themselves, since many M&A projects will not generate revenues that could offset costs.

References and Notes

1. A. de Sherbinin *et al.*, *Sci. Am.* **304**(1), 64 (2011).
2. R. Black *et al.*, *Environ. Plan. A* **43**, 431 (2011).
3. F. Gemenne, *Philos. Trans. R. Soc. London Ser. A* **369**, 182 (2011).
4. M. New, D. Liverman, H. Schroder, K. Anderson, *Philos. Trans. R. Soc. London Ser. A* **369**, 6 (2011).
5. R. Bronen, *Forced Migra. Rev.* **31**, 30 (2008).
6. S. Rogers, M. Wang, *Popul. Environ.* **28**, 41 (2006).
7. Displacement Solutions, Bougainville Resettlement Initiative Meeting Report, Canberra, Australia, 11 December 2008; <http://displacementsolutions.org/wp-content/uploads/BG.pdf>.
8. M. Cernea, in *Compensation in Resettlement: Theory, Pitfalls, and Needed Policy Reform*. M. Cernea and H. Mathur, Eds. (Oxford Univ. Press, Oxford, 2008), pp. 15–98.
9. P. M. Fearnside, *Mitig. Adapt. Strategies Glob. Change* **10**, 675 (2005).
10. T. Scudder, *The Future of Large Dams: Dealing with Social, Environmental, Institutional and Political Costs* (Earthscan, London and Sterling, VA, 2005).
11. R. McLeman, B. Smit, *Clim. Change* **76**, 31 (2006).
12. Climate-induced migration, Asian Development Bank; www.adb.org/SocialDevelopment/climate-migration/.
13. Guiding Principles in Internal Displacement, global database; www.idpguidingprinciples.org/.
14. Nansen Principles, www.regjeringen.no/upload/UD/Vedlegg/Hum/nansen_prinsipper.pdf.
15. UN High Commissioner for Refugees, www.unhcr.org/4da2b5e19.pdf.
16. E. Ferris, M. Cernea, D. Petz, *On the Front Line of Climate Change and Displacement* (Brookings Institution, Washington, DC, 2011).
17. A. Oliver-Smith, in *Anthropology and Climate Change*, S. A. Crate and M. Nuttall, Eds. (Left Coast Press, Walnut Creek, CA, 2009), pp. 116–136.
18. M. Cernea, in *Risks and Reconstruction. Experiences of Resettlers and Refugees*, M. Cernea and C. McDowell, Eds. (World Bank, Washington DC, 2000), pp. 11–55.
19. E. Correa, *Populations at Risk of Disaster A Resettlement Guide* (World Bank, Washington, DC, 2011).
20. J. Keiser *et al.*, *Am. J. Trop. Med. Hyg.* **72**, 392 (2005).
21. S. Merti, *Losing Ground* (LifeMosaic, Falklands, Fife, UK; with Friends of the Earth, UK; Sawit Watch, Indonesia, 2008).
22. Y. Tan, *Resettlement in the Three Gorges Project* (Hong Kong Univ. Press, Hong Kong, 2008).
23. Enhanced action on adaptation, UN Framework Convention on Climate Change, <http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf#page=4>.
24. E. A. Cantero, in *Preventive Resettlement of Populations at Risk of Disaster: Experiences from Latin America*, E. Correa, Ed. (World Bank, Washington DC, 2011), pp. 85–106.
25. G. Guerrier *et al.*, *Science* **334**, 38 (2011).
26. Authors acknowledge funding from the Rockefeller Foundation and the Agence Française de Développement.

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Science **334** (6055), 456-457.
DOI: 10.1126/science.1208821

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