

Lessons Learned on Health Adaptation to Climate Variability and Change: Experiences Across Low- and Middle-Income Countries

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BACKGROUND: There is limited published evidence of the effectiveness of adaptation in managing the health risks of climate variability and change in low- and middle-income countries.

OBJECTIVES: To document lessons learned and good practice examples from health adaptation pilot projects in low- and middle-income countries to facilitate assessing and overcoming barriers to implementation and to scaling up.

METHODS: We evaluated project reports and related materials from the first five years of implementation (2008–2013) of multinational health adaptation projects in Albania, Barbados, Bhutan, China, Fiji, Jordan, Kazakhstan, Kenya, Kyrgyzstan, Philippines, Russian Federation, Tajikistan, and Uzbekistan. We also collected qualitative data through a focus group consultation and 19 key informant interviews.

RESULTS: Our recommendations include that national health plans, policies, and budget processes need to explicitly incorporate the risks of current and projected climate variability and change. Increasing resilience is likely to be achieved through longer-term, multifaceted, and collaborative approaches, with supporting activities (and funding) for capacity building, communication, and institutionalized monitoring and evaluation. Projects should be encouraged to focus not just on shorter-term outputs to address climate variability, but also on establishing processes to address longer-term climate change challenges. Opportunities for capacity development should be created, identified, and reinforced.

CONCLUSIONS: Our analyses highlight that, irrespective of resource constraints, ministries of health and other institutions working on climate-related health issues in low- and middle-income countries need to continue to prepare themselves to prevent additional health burdens in the context of a changing climate and socioeconomic development patterns. <https://doi.org/10.1289/EHP405>

Introduction

Climate variability and change are increasing the burden of climate-sensitive health outcomes and have the potential to affect the ability of health systems to maintain or improve health burdens over coming decades in the context of changing climate and development patterns (Smith et al. 2014). The health risks of climate change range from morbidity and mortality due to extreme events to migration because of the impacts of environmental degradation on human health and livelihoods. Climate-sensitive health outcomes cause preventable morbidity and mortality now, despite the considerable progress achieved in reducing their burdens over past decades through strategies and policies implemented by international, regional, and national organizations and institutions; development partners; and civil society. However, the effectiveness of these policies varies considerably, with many low- and middle-income countries still needing improved surveillance and monitoring systems for climate-sensitive health outcomes, laboratory services, and other public health and healthcare capabilities. Further, health policies were not designed and

implemented taking climate change into consideration, so policies are likely inadequate to manage changing health burdens over coming decades, such as those associated with increasing under-nutrition and extreme weather and climate events associated with climate change (Smith et al. 2014). The magnitude and pattern of future health burdens attributable to climate change until at least mid-century will be determined primarily by adaptation (Smith et al. 2014). However, there are few published evaluations of the effectiveness of health adaptation projects or of the extent to which these projects can be scaled from local to national levels (Bouziid et al. 2013). Judging the effectiveness of adaptation is difficult because it will not be apparent for decades whether changes to policies and programs will actually decrease projected health impacts. Surrogate measures focus on health-outcome specific morbidity and mortality (e.g., burden of climate-sensitive health outcomes); general health system preparedness; or the process of adaptation. Therefore, to support development by the World Health Organization (WHO) of a global operational framework for climate-resilient health systems, we reviewed multinational health adaptation projects in low- and middle-income countries and conducted key informant interviews to identify lessons learned and good practice examples (WHO 2015b). We use the information collected to discuss the potential for scaling up, including identifying key barriers and challenges.

Methods

We conducted two activities for this study. One author (KLE) reviewed and synthesized project reports, program and project evaluations, and related documents, such as communication materials, for the first five years of implementation (2008–2013) of multinational health adaptation projects in low- and middle-income countries worldwide. One author (MOB) collected qualitative data through targeted interviews and a focus group discussion to identify barriers, challenges, and opportunities for implementation and scaling up of adaptation interventions.

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Three projects were included in this study:

1. A UNDP/WHO GEF-funded project “Piloting climate change adaptation to protect human health.” The countries involved were Barbados, Bhutan, China, Fiji, Jordan, Kenya and Uzbekistan. These countries were chosen because they included small island nations (Barbados and Fiji), drought-prone countries (Jordan and Uzbekistan), and countries with mountainous regions where vector-borne diseases could change their geographic range with climate change (Bhutan and Kenya). China was included because it faces a wide range of potential challenges with climate change that could adversely affect human health.
2. Countries funded by the Millennium Development Goals Achievement Fund (MDG Fund) that included a health component; these countries were China, Jordan, and the Philippines.
3. A WHO Regional Office for Europe (EURO) project “Protecting health from climate change: A seven-country initiative” funded by the International Climate Initiative of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). The countries included were Albania, Kazakhstan, Kyrgyzstan, Russian Federation, Tajikistan, Republic of Macedonia, and Uzbekistan.

The supplemental material summarizes the projects in the 14 countries.

Document Evaluation

We critically evaluated: (1) a midterm evaluation of the United Nations Development Programme (UNDP)/WHO project conducted in May 2013; (2) midterm and terminal evaluations of the health components of MDG Fund projects; and (3) summaries of the BMU project (2013). Three countries (China, Jordan, and Uzbekistan) were included in two multi-country projects. The UNDP/WHO project was the first project developed, but the last funded. The countries capitalized on the preparatory efforts for the UNDP/WHO project during the funding delay to participate in other adaptation projects (MDG Fund projects for China and Jordan; BMU project for Uzbekistan).

One author (KLE) evaluated the available documents for evidence and examples of the extent to which the projects within each country achieved their stated objectives for health adaptation interventions, sustainability, stakeholder participation and community engagement, country ownership and sociopolitical constraints, human resources and capabilities, replicability and scalability, and monitoring and evaluation. We focused on extracting lessons learned and good practice examples from the project evaluations and summaries to increase the effectiveness and efficiency of future health adaptation projects and to facilitate scaling up health adaptation from local projects to national efforts.

Qualitative Data Collection

One author (MOB) collected qualitative data through in-depth semi-structured interviews with purposive sampling and a focus group consultation, in Nairobi, Kenya, in May, 2014. The interviews were with 19 key informants selected based on their current and previous leadership roles at institutions and organizations that implement initiatives on climate variability and change, public health, and health-adaptation programs and interventions. The informants were also identified based on their expertise in adaptation and their experience in governmental (including representatives involved in climate and health projects and national health adaptation plans and processes within ministries of health), nongovernmental, and multilateral organizations. They included project and program managers, project representatives from the

UNDP/WHO project, and technical officials in the fields of health adaptation to climate variability and change, and climate and health risk management. The informants were of different sexes, ages, and nationalities, including participants who implemented activities in Albania, Barbados, Bhutan, China, Fiji, Jordan, Kazakhstan, Kenya, Kyrgyzstan, the Philippines, the Russian Federation, Tajikistan, Republic of Macedonia, and Uzbekistan.

The interviews used open-ended questions (see Supplemental Materials) that elicited the interviewee’s knowledge, personal views, and experiences from their work in health-adaptation implementation. The interviews lasted between 30 and 65 minutes. After 13 interviews, the range of feedback and perceptions on successes, barriers, and opportunities for implementation and scaling up were captured and saturation was reached.

One author (MOB) facilitated a focus group consultation with a Kenyan stakeholder group comprising 11 men and women of different ages and responsibilities, selected for their experience as public health professionals (further information provided in Supplementary Materials). The group included health-data records officials, officers in charge of malaria-prone areas, and individuals working in health centers on climate health risks and malaria preparedness, control, and response. The interviewer (MOB) explained the research objectives, the purpose and nature of the questions to be discussed, and the ways that the results could be used. All informants (interviewees and focus group participants) formally agreed to be interviewed and consulted and gave written permission to use the content of the interviews and focus group consultation. Except in one case, all informants gave permission to audio-record the sessions. Confidentiality was assured throughout the process.

The interview guide for the interviews was adapted for the focus group discussion to create a series of open-ended questions that took two hours to complete. The interviews and focus group collected informants’ (Ki onwards) knowledge and experiences on the following topics:

- The success of health adaptation projects, not just in terms of whether the projects themselves were successful, but also whether the project activities facilitated resilience to the health risks of climate variability and change through implementation, policy, or social change over longer temporal scales
- Good-practice examples of success of the overall projects in achieving their objectives
- Other specific contributions towards successful adaptation
- Opportunities to enhance the effectiveness of ongoing and future adaptation projects and of programs for scaled-up adaptation; and
- Barriers and challenges, including what did not work well in the implementation process and what were the perceived barriers for adequate scale-up.

Interviews and the focus group consultation were manually transcribed and coded by one author (MOB) to identify emerging themes related to successes, potential for scale-up, and barriers to implementation and scale-up. Coding was conducted using the method of Strauss and Corbin (Strauss and Corbin, 1990) following detailed analysis of information divided into meaning units, to compare, categorize, and label the data. After all interviews were coded once, a second round of coding verified codes to check the accuracy of ideas captured, continuously comparing the data until one theme emerged, similar to the method described by Furberg et al. (2011). These themes were organized into information categories adapted from existing typologies of scaling up and components of scaling-up processes (Simmons et al. 2007; Yamey 2012; Hanson et al. 2003).

Criteria for Determining Success and Potential for Scaling Up

The peer-reviewed literature contains a wide variety of possible criteria for determining whether a project successfully increases

adaptation past the project lifetime, with evaluations taking different approaches depending on their goals and use. Based on the expert judgment of the authors, we considered a project successful if implementation included activities that would likely increase longer-term resilience based on observable, concrete measures (e.g., an early warning system implemented and number of people trained). Whether outcomes and outputs will actually increase resilience will depend on how long the projects remain national priorities after completion.

There is no agreed definition for scaling up, although scaling up of evidence-based health interventions from pilot projects to regional and national scales is widely acknowledged to be important. The potential for scaling-up was evaluated using expert judgment based on more than two decades of experience in estimating the extent to which the projects could, through deliberate efforts, be implemented more broadly in the country or region.

Results

We independently used the results of the document review and the qualitative data collection to identify lessons learned and good practices to overcome barriers to health adaptation implementation and to scaling up. The results of the independent assessments were then combined and refined into a set of recommendations.

Lessons Learned and Good Practices

At the start of the projects, the 14 countries had a wide range of knowledge of the health risks of climate change and experience with adaptation. In some countries, the starting points included at least some knowledge of climate variability and change, strong support within the ministry of health or department of health, and good connections with other government ministries working on climate change (e.g., meteorological services). In other countries, we observed limited knowledge, less interest in the health risks of climate change in the ministry or department of health, and weak connections with other ministries. Despite different starting points, all projects achieved most objectives (as identified in project logframes), and all developed strong partnerships for implementation.

The documents evaluated statements that all countries created new and/or formalized existing institutional arrangements with assigned responsibilities for using meteorological and other environmental information for early warning systems, and all countries were in the process, although at different stages, of developing early warning and response systems. We verified these arrangements for most countries through country visits and other activities.

We identified six key themes, as described below:

More effective projects had a clear vision of how the adaptation project fit within country development goals and had strong country ownership. The extent of engagement of the ministry or department of health with the national climate change team varied considerably. Some countries, such as Bhutan, have national-level committees that coordinate climate change work across sectors, ensuring alignment with development goals. Actively engaging national actors helped align projects with country development and adaptation objectives. External experts supplemented expertise in the context of strong country ownership that institutionalized results.

More effective projects ensured that targeted communities fully participated in project implementation. Six key informants considered community involvement key for successful implementation of adaptation measures. An example is a home-based malaria case-management program in 113 hard-to-reach villages in Kenya.

Trained, supervised, and incentivized volunteer community-health workers provided malaria treatment to young children with fevers, decreasing malaria prevalence over time, increasing healthcare access, and reducing pressure on healthcare facilities.

More effective projects focused on the policies and measures needed to facilitate a country's vision of what being adapted to climate change would look like. Projects were more successful when they shared a vision of how to move from the current situation, typically with very high vulnerability to climate variability, to a future better able to prepare for and manage climate change, as illustrated by the example from Bhutan. This meant not just focusing on delivering activities identified in the project logframe. Initial workshops where stakeholders discussed and agreed on goals and specific activities to achieve them helped ensure the greatest possible buy-in with the project objectives, facilitating implementation.

A challenge noted in the key informant interviews was the limited availability and even less use of the projected health risks of climate change to identify policy modifications to prepare for changes in the magnitude and pattern of climate-sensitive health outcomes to increase health system resilience (K4, K5). Projections of how climate-sensitive health outcomes could increase or decrease were infrequently used to prioritize adaptation projects or to inform specific activities undertaken in a project, primarily because very few projections of the risks of future burdens of climate-sensitive health outcomes are available at the country level. For example, drought-associated migration from rural to urban areas was more often responded to than prepared for.

Successful projects either had capacity in climate change and health or built it before project implementation began. The importance of spending time and resources before or at the very beginning of projects to build capacity and stakeholder engagement was highlighted in the reviews of the MDG Fund projects and in the key informant interviews. Project evaluations and interviews strongly stated that these activities were so critical to success that they should be promoted, even if it means projects achieve fewer outcomes and outputs. For example, in the Philippines project, an iterative process of design and piloting activities, including adopting alternative options and making necessary adjustments, was followed before activities were initiated. This process was viewed as essential for success, leading to the conclusion that a consultative process in the design, planning, and implementation of project activities can not only generate ownership but also incorporate the local context, another critical determinant of success. The trade-off was that a longer period was required for project completion.

For many of the projects, an entry point (and often an output) was conducting a vulnerability and adaptation assessment. Such assessments typically have a strong stakeholder component to build capacity and ensure project ownership across stakeholders. Once complete, another critical step was incorporating the results into a climate change strategy and plan. In the Philippines and in other projects, these plans were then institutionalized into ministry (or department) of health strategies and programs.

The key informant interviews highlighted the value countries placed on sharing experiences and discussing challenges (K1, K15); doing so built capacity and contributed to implementation. A majority of respondents strongly supported educational campaigns and training aimed at improving awareness, knowledge, and capacities in climate and health among targeted communities, health workers, and decision-makers (K1–3, K7–10, K13, K14, K16–19). Having sufficient national capacity in climate change and health could have avoided challenges that arose in several projects when personnel changed.

Institutionalizing the management of the health risks of climate variability and change is one basis for resilient health

systems. The key informant interviews and the document review highlighted the value of incorporating (e.g., mainstreaming) climate adaptation planning into health systems and the overall national planning processes (K4–5, K12–13). Examples included a health strategy for climate change adaptation adopted by ministries of health; accounting for health risks in a national climate change action plan; and working with national environmental commissions on protocols for health adaptation.

Projects such as those in Jordan for the MDG Fund and UNDP/WHO projects focused on establishing national enabling conditions. In Jordan, the UNDP/WHO project was designed to ensure that wastewater reuse was a sustainable management option for the country's water scarcity problems. The UNDP/WHO project built on the MDG Fund by increasing coherence across the fragmented and overlapping responsibilities among the ministries involved in wastewater collection, treatment, and reuse. The project strengthened monitoring and surveillance capacity, developed the necessary institutional and regulatory framework for safe use of wastewater, and increased the capacity to implement health-protection measures. This process included developing guidelines and good practices for safe wastewater reuse.

One-third of key informants (K5, K6, K12, K13, K15, K17) highlighted the importance of adequate policies, particularly a climate change policy and a legislative framework that recognized the health implications of climate variability and change. The informant interviews (K3, K5, K12, K19) also noted that the adaptation projects resulted in a slow but steady increase in institutional support for adaptation planning and implementation, particularly within the ministry of health. The interviewees reported that because many health professionals still did not perceive weather and climate to be health risks, ministry support was particularly important to reduce resistance to directing human and financial resources to understanding and managing climate-related risks (K2, K15).

Multisector collaboration was key to success. At a minimum, projects needed hydro-meteorological services to provide data on weather trends and projected climate change. For example, key to the UNDP/WHO Uzbekistan project was close collaboration between the Uzbekistan Ministry of Health and UZHydromet, with data collected on cases of cardiovascular, intestinal, and respiratory diseases entered into an existing database of weather and climate data. These integrated surveillance data will be used by the Ministry of Health to inform programs that manage climate-sensitive diseases. Across all the projects, capacity was built by fostering dialogue, regular interactions, and support across sectors and government departments, and by having a plan for engagement.

The key informant interviews noted the importance of improved multisector collaboration for successful outcomes, particularly collaboration between the meteorological department and the ministry of health, where data sharing has traditionally been challenging (K1, K2, K8, K12, K13, K15, K19). They also emphasized the importance of strengthening integrated surveillance systems and improving early warning mechanisms. Doing so led to more interventions using climate information to improve adaptation, particularly at community levels (K3, K7, K10, K17, K19). Positive synergies were created at the national level from involvement in the project.

Data access was an issue for many countries. Interagency agreements were needed on data sharing, particularly for meteorological and air pollution data. Some national meteorological services charge for access to weather data, constraining development of early warning systems. Some key informants noted that their country considered air pollution data potentially sensitive and

restricted data access. Data access issues affected the implementation of evidence-based adaptation policies, limiting the project potential (K1–K3).

Key informant interviews noted that regional agreements, such as the Libreville Declaration on Health and Environment in Africa and the Parma Declaration on Environment and Health, committed countries to acting on the challenges of climate change, although limited progress has yet to be made on achieving the commitments (WHO 2008, 2010). Effective adaptation required binding agreements for better joint operational working collaborations among all entities (K1–2, K19).

The key informants noted that, institutionally, effective adaptation required a cross-sectoral national coordinating body on climate change (K5, K13, K15, K17). Developing the mandate for an institutional home for climate change within ministries of health and more broadly across ministries was complicated in some countries because of limited awareness of the risks. Developing national adaptation plans was viewed as helpful to increase understanding and overcome barriers, although no formal evaluations of these plans have been conducted.

Adaptation projects can facilitate mitigation. Based on national needs and on the interests of donors and development partners, all projects implemented adaptation projects to increase resilience. The significant adaptation deficit in the health sector means such projects will be critically needed for years to come. In addition, some countries in the BMU projects took the opportunity to explore renewable energy sources to increase reliability of electricity and to reduce their greenhouse gas emissions, and through such measures to reduce the magnitude of climate change to which health systems will need to adapt later in the century. For example, to address intermittent power to healthcare facilities in Kyrgyzstan, five pilot hospitals conducted energy-efficiency assessments. One hospital installed a solar water heater and four hospitals installed solar photovoltaic power plants. This was the first large-scale implementation of renewable energy sources in the health sector.

Common Needs

Three common needs were identified across the projects: indicators for monitoring and evaluation, continuing training and capacity building of country expertise in climate change, and sufficient human and financial resources.

Defining indicators for the health risks posed by climate change is an emerging field without a standardized system (e.g., English et al. 2009). An agreed set of minimum indicators is needed, similar to the indicators used to measure meteorological and climatological variables, along with means of verification. These indicators are needed to establish baselines, to measure the degree of success of health adaptation activities, and to facilitate future comparisons and evaluations.

The key informants reported insufficient attention to monitoring and evaluation in the initial stages of projects, which meant that initiatives to measure adaptation effectiveness could not be conducted as planned (K3, K9). They highlighted possible indicators, including: *a*) decline in disease incidence; *b*) reduced frequency of climate-sensitive disease outbreaks; *c*) existence of control measures for climate-sensitive health outcomes; *d*) number of health adaptation projects designed and implemented; *e*) climate resilience incorporated into water safety plans; *f*) number of health personnel or general practitioners trained; and *g*) community behavior indicators.

Evaluations of the MDG Fund projects noted that monitoring frameworks with large numbers of indicators were burdensome and ineffective in measuring progress. The BMU and UNDP/WHO projects had fewer achievable and time-bound indicators

tied to specific outcomes. The 16 outcome indicators used in the BMU projects were developed through a process facilitated by EURO and evaluated every two years; an example was the number of heat wave deaths avoided.

Another common need was for national evaluations of capacities that require strengthening for adaptation implementation, including additional and ongoing training in climate and health. The knowledge base of the workforce cannot meet the current and emerging needs in climate change; in-service education of environmental health staff was identified as critical. An experience of one author (KLE) in Uzbekistan was typical; the medical school there wanted to include a few lectures on climate change in the general curriculum but did not have the expertise to do so and did not know how to obtain it. The development of online courses will help to some extent, but in-person training continues to be the preferred approach. In the BMU projects, 35 capacity development meetings were organized, including how to conduct a vulnerability and adaptation assessment, data analysis methods, and training in infectious disease surveillance.

The consequences of limited human and financial resources were challenging for all projects. The key informant interviews highlighted specific opportunities lost because of limited resources, including scaling up and addressing adaptation and mitigation simultaneously through, for example, sustainable transport (K3, K5, K18). Managing the health risks of climate change is a new activity for most countries, which means limited resources have been mobilized to address the large mandate. In addition, stronger linkages and cooperation are needed among health practitioners, researchers, and personnel working on health adaptation to climate change. The types of support required to facilitate adaptation success and the percent of responses from key informants were: adequate capacities prior to implementation (42%); community involvement (32%); climate change policy (21%); political, WHO country representative, and other UN support (21%); data sharing, coordination, and cross-country exchange of practices (16%); and medium- and long-term funding (16%).

A related issue identified in the document review and the key informant interviews was ensuring adequate medium- and long-term funding, particularly to assess progress and measure impacts beyond the project timeline (K3, K9, K10, K13, K14).

Scaling Up: Opportunities and Challenges

Although all projects aimed to facilitate scaling up, no project included an explicit component to develop plans to do so, other than developing a climate change action plan for the health sector. However, some observations of the potential for scaling up are possible based on experiences in health systems with managing other issues. Key informants stated that scaling up should be understood as an expansion of the coverage of policies and programs to manage climate-sensitive health outcomes. In particular, special attention should be given to the expansion and strengthening of national environmental health systems both generally and specifically to address the challenges of climate change. Priorities for doing so will depend on national and regional contexts, including national adaptation priorities.

Because the health risks of climate change are not new, evidence-based interventions are available for all climate-sensitive health outcomes, although the extent of their implementation varies across countries; these interventions often need to be modified to take climate change into account. [Table 1](#) summarizes the main areas identified by key informants as having particular potential for scaling up, categorized into strategies, approaches, and interventions; activities; and tools.

The barriers and constraints to scaling up, and eventually to the sustainable integration of adaptation into longer-term national

Table 1. Areas identified by key informants as having particular potential for scaling up.

Strategies, approaches, or interventions
Community-level engagement through trained, incentivized, and supervised community health volunteers
Interventions proven effective in tackling air pollution
Interventions that jointly tackle adaptation and mitigation
Malaria control programs in collaboration with meteorological services
Crop and livestock insurance as an adaptation measure
Safe use of wastewater as a regular practice at the national level
Integrated approaches to programming, including water scarcity and nutrition/food security
Local to national level climate adaptation plans
Specific activities
Training of project implementers
Training of general health practitioners
Training of farmers in safe use of wastewater
Safe rainwater harvesting
Tools
Malaria early warning systems with proven accurate and effective weather forecasts
Software and technology for early warning systems
Preparedness tools and warnings for vectorborne and waterborne diseases
Broadening the evidence base through monitoring and evaluation of integrated surveillance

Note: Adapted with permission of the World Health Organization from *Lessons Learned on Health Adaptation to Climate Variability and Change: Experiences Across Low- and Middle-income Countries*. 2015b. WHO, Geneva, Switzerland. 72 pp.

goals, included limited political will and leadership; lack of technical consensus on implementation standards; financial and human resources; limited projections of the future health risks of climate change at the spatial scales of interest; and insufficiently developed methods, tools, and guidance documents. Efforts are underway internationally and nationally in some countries to address these barriers and constraints, through increasing understanding of the health risks of climate change, mobilizing resources for adaptation, and prioritizing research agendas to provide the information, methods, and tools needed. All such activities are needed urgently to increase resilience of communities and nations.

Good Practices

We identified many examples of good practices from the project evaluation reports and qualitative data collection. Many projects incorporated outputs to address extreme weather and climate events because of the increase in the frequency, intensity, and duration of some events, and the significant (and preventable) associated health impacts ([Smith et al. 2014](#)). For example, China, Kazakhstan, Tajikistan, and the Republic of Macedonia designed and implemented heatwave early warning and response systems that guide the issuance of warnings, taking into consideration the needs of the most vulnerable, and outline response plans to facilitate timely coordination of resources and strategies when heatwaves occur. The multidisciplinary nature of these systems was illustrated by the plan of the Republic of Macedonia that involves health, transport, education, science, hydrometeorology, emergency management, and nongovernmental sectors.

Because rural and remote areas can be at particular risk from climate variability and change, projects included activities to improve health protection in regions with particularly limited human and financial resources. In Bhutan, for example, pre- and post-training knowledge tests and meetings with district health managers, basic health units, and village health workers demonstrated very high awareness of changing weather and disease patterns, and how climate change could exacerbate or ameliorate current health burdens. In the Russian Federation, a health adaptation strategy was developed with the local government

that facilitated communicable disease surveillance and control through providing equipment for detection of tick-borne encephalitis, for example.

Most countries included outcomes to augment surveillance and monitoring programs to increase the capacity to assess risk, promote diagnosis and treatment, and implement prevention programs. In Albania, the project activated two air pollution monitors and built local capacity for an air-quality alert communication mechanism.

Many projects mapped outputs of the vulnerability and adaptation assessment to identify where to invest greater efforts in managing risks. For example, the Kazakhstan project mapped vulnerable areas along with indicators of health system resilience. Many projects also mapped projected climate hazards; however, mapping hazards alone provides only some of the information needed to increase resilience (WHO 2015b).

The malaria early warning system established in the Kenyan project should serve communities well as the climate continues to change, including through monitoring changes in the geographical range and seasonality of the disease, and adjusting as locations of outbreaks change and technologies advance. The Uzbekistan project is developing a pilot system to warn of dust storms, to enhance resilience, and to raise public awareness.

Conclusions

Evaluation and key informant interviews of the first five years of implementation of multinational health adaptation projects offers lessons for initiating adaptation projects in other countries, and offers optimism on the extent to which health systems can move from their current situation of limited understanding and capacity to manage the health risks of a changing climate to a more resilient future where policies and programs protect population health as the magnitude and pattern of climate-sensitive health outcomes change. However, the latter will only happen with significant investment of human and financial resources (Ebi 2008; Pandey 2010).

The health risks of climate change cut across many departments within a ministry of health, including maternal and child health, vector-borne diseases, food- and water-borne diseases, air quality, and disaster risk management. Managing these health risks presents a challenge in that the mandate is broad and changing a wide range of policies and programs can be difficult to implement; and an opportunity in that greater integration within a health ministry and across ministries (e.g., ministries focused on hydro-meteorological services, agriculture, water, energy, and others) can increase protection of population health. Effectively and efficiently managing the health risks of climate change is a long-term issue, so establishing effective processes is of considerable importance.

The projects focused on initial country priorities to facilitate establishing institutional arrangements and processes that can support further efforts as countries begin tackling other climate-sensitive health outcomes. These priorities were not necessarily those associated with the highest health burden, but rather those where progress could be made within the time frame of a three- to four-year project and within the country context. The vulnerability and adaptation assessments conducted included identifying short- and medium-term priorities, with each country emphasizing criteria consistent with prioritizations conducted in other sectors for national adaptation planning purposes (e.g., national reports or National Adaptation Programmes of Action for least developed countries).

Adaptation to the health risks of climate change and actions to promote general development are mutually supportive, but not identical. Adaptation differs from general development in the

recognition that climate change will continue to change no matter the extent to which greenhouse gas emissions are reduced over the next few decades—although reducing greenhouse gas emissions is critical to protect population health later in the century (Smith et al. 2014). Therefore, climate change is working against achieving the targets set for the Sustainable Development Goals. The magnitude and pattern of climate-sensitive health outcomes may increase over coming decades even with additional interventions to improve population health, depending on the development pathway (Ebi 2014).

Iterative risk management, with a continuous and, we hope, virtuous cycle of developing, modifying, and implementing adaptation measures, will contribute more to building resilience than the traditional health system approach of highly targeted interventions that are efficient by conventional standards and of low risk from the viewpoint of funders. Evaluation of the MDG Fund projects considered their country ownership and iterative processes positively, even though the projects developed more slowly and resulted in fewer outcomes and outputs than if a traditional approach had been used. The multinational funds supporting these projects recognized that the process of adaptation can be as important as the outcomes. It is widely accepted in adaptation that establishing effective processes may be more important for longer-term resilience than achieving shorter term objectives.

Overall, we concluded that scaling up would be facilitated by explicit consideration of how to do so from the onset of the adaptation process, whether through project-based activities or through national adaptation planning. Because of the importance of local and regional contextual factors, it is important to identify the factors facilitating the success of particular interventions are generic and so can be transferred to other regions (Ebi and Prats 2015). Some factors determining success will be unique to a location (such as the strong commitment of an individual policy-maker), raising the issue of how to work with stakeholders to build the necessary conditions for successful scaling up. Increasing resilience is likely to be achieved through longer-term, multifaceted, and collaborative (multidisciplinary) approaches, with supporting activities (and funding) for capacity building, knowledge communication, and institutionalized monitoring and evaluation. Managing risks that will change as climate and development proceed will be more effective using iterative approaches, with broad stakeholder engagement (Ebi 2011; Hess et al. 2011). Strengthened cooperation between the health sector and meteorological services in accessing and using climate and health data for preparedness and response remains a key element of successful health adaptation efforts (WHO 2015a).

Health protection to manage the risks of climate change needs to be mainstreamed and strengthened at all governance levels (Ebi 2011; Hess et al. 2011). Health plans, policies, and budget processes need to incorporate the risks of current and projected climate variability and change explicitly. Projects should be encouraged to focus not just on shorter-term outputs to address climate variability, but also on establishing processes to address longer-term climate change. Medium- and longer-term project funding would facilitate accurate assessments of project and program outcomes.

Mainstreaming health adaptation monitoring into planning stages, through establishing country-specific monitoring and evaluation systems (customized to country needs) would enable national and local health adaptation assessments of climate-resilient investment strategies (WHO 2015a). It would be helpful to identify a set of indicators for monitoring and evaluating climate resilience, creating baselines, and facilitating the process of longer-term adaptation.

Opportunities for capacity development regarding climate change should be created, identified, and reinforced for the full

range of actors, including public-health and health-care professionals, the general public, and decision- and policy-makers in the health sector and across ministries. This includes facilitating development of methods, tools, and guidance documents to support countries, not only as they implement adaptation programs and activities, but also prior to the implementation phase. In addition, developing a regular forum, including Web-based and in-person meetings, would facilitate international exchanges of experiences and lessons learned. Providing a budget for exchanges would facilitate South–South learning and cooperation and further strengthen capacity for adaptation.

Donors and development partners should be encouraged to invest sufficient time and resources during the development phase of adaptation proposals to maximize country ownership, an enabling environment, stakeholder engagement (with adequate mechanisms to involve communities), and other conditions that facilitate project success. This involvement includes ensuring that approaches and plans for documenting good practices and lessons learned are built into projects from the beginning, and that projects include an output to outline requirements for scaling up. These will strengthen the ability to implement adaptation.

The projects evaluated were focused on identifying and implementing adaptation options and, as such, had relatively small research components. However, research and development are components of longer-term capacity building. Needs include steps to further understand the health risks of climate change, including projections of risks across temporal and spatial scales and establishment of criteria to measure the success of programs and activities to facilitate avoidance of, preparation for, response to, and recovery from impacts (Smith et al. 2014). Operational research can identify actionable changes in practice and policy, facilitating greater cooperation between researchers in high-income countries and those in low- and middle-income countries. Research and development focused on supporting all aspects of implementation are vital for building the knowledge base and training the next generation of health system leaders. Furthermore, adaptation projects should be used as opportunities to identify co-financing for adding mitigation components.

Overall, irrespective of resource constraints, low- and middle-income countries need to continue to prepare themselves for the health risks of climate change through public education and awareness programs, including disaster preparedness measures, resilient infrastructure for effective resettlement of displaced people, and better understanding of health impacts on specific human settlements.

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