The role of innovative global institutions in linking knowledge and action

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It is becoming increasingly recognized that our collective ability to tackle complex problems will require the development of new, adaptive, and innovative institutional arrangements that can deal with rapidly changing knowledge and have effective learning capabilities. In this paper, we applied a knowledge-systems perspective to examine how institutional innovations can affect the generation, sharing, and application of scientific and technical knowledge. We report on a case study that examined the effects that one large innovative organization, The Global Fund to Fight AIDS, Tuberculosis, and Malaria, is having on the knowledge dimensions of decision-making in global health. The case study shows that the organization created demand for new knowledge from a range of actors, but it did not incorporate strategies for meeting this demand into their own rules, incentives, or procedures. This made it difficult for some applicants to meet the organization's dual aims of scientific soundness and national ownership of projects. It also highlighted that scientific knowledge needed to be integrated with managerial and situational knowledge for success. More generally, the study illustrates that institutional change targeting implementation can also significantly affect the dynamics of knowledge creation (learning), access, distribution, and use. Recognizing how action-oriented institutions can affect these dynamics across their knowledge system can help institutional designers build more efficient and effective institutions for sustainable development.

aid financing | governance | HIV/AIDS | knowledge transfer | science-policy interface

The importance of flexible, adaptive institutions in tackling complex problems is becoming increasingly recognized, and there is a call for institutional change that highlights the key role of knowledge and learning in the context of action and implementation (1, 2). As a result, institutions for sustainable development are undergoing rapid change. Existing centralized international and state-based systems are increasingly being complemented and challenged by new forms of collaboration, including public–private partnerships, multisector collaborations, and demand-led funding mechanisms (3). These changes are largely driven by dissatisfaction with the perceived inability of traditional institutions to move toward more sustainable development trajectories (4, 5) and pose new opportunities to link knowledge with action.

In this study, we examined how one innovative, action-focused organization has affected the dynamics of knowledge sharing, generation, and application across their network of stakeholders using a theoretical framing based on the concept of knowledge systems. Building on work by Cash et al. (6) and van Kerkhoff and Lebel (7) for this project, we defined a knowledge system as a network of actors connected by social relationships, formal or informal, that dynamically combined knowing, doing, and learning to bring about specific actions for sustainable development (8). We were interested to understand the role such institutional changes did or could play in reshaping the connections between research-based knowledge and action, which was experienced by key actors in the system. Our research questions were:

How do innovative, action-oriented organizations mobilize, draw on, or use scientific and technical knowledge in making decisions?

How do their formal rules and informal norms or conventions affect the ways in which scientific and technical knowledge is produced, shared, applied, or used within the organization or by the other organizations or actors with which it collaborates?

How do these knowledge-based interactions help or hinder efforts to link scientific and technical knowledge with action toward sustainable development?

The case study we chose is a major global health financing organization, The Global Fund to fight AIDS, Tuberculosis, and Malaria (The Global Fund). Although health is not typically regarded as a central component of sustainability, we view global public health as integral to the goal of meeting human needs for sustainable development (9). The global health sector has been particularly active in institutional change (3). The Global Fund is a public–private partnership founded in 2001. Since starting operations in January 2002, it has approved expenditure of $10.1 billion for interventions on HIV/AIDS, tuberculosis, and malaria in 136 countries (10).

The formal rules and structures implemented by The Global Fund are crafted to answer two critiques of aid financing: that aid is typically directed to meet donor priorities rather than recipient priorities and that aid expenditure rarely undergoes rigorous independent scientific or technical review (4). The organizational design that resulted has been described as a major institutional innovation in global health (3, 11). This case study illustrates that a knowledge-systems approach can help to identify and unravel both the disconnects that hinder effective learning and change and the relationships that support them.

In the next section, we discuss our methodology and present the structure and background for our case study. In *Background to the Case Study*, we describe the actors, the rules that shape their interactions, and the implications of these rules for the role of scientific and technical knowledge. In *Findings*, we present our results, which are discussed in *Discussion: Learning Knowledge Systems*. In *Conclusions*, we report observations on the ways action-oriented organizations can influence the linkages between knowledge and action. Policy implications of this study have been presented elsewhere (8).

Methodology

Applying a Knowledge-Systems Approach. We used the concept of a knowledge system as presented in the Introduction to frame our methodological approach (more details of knowledge systems in relation to existing literature are presented in *SI Text*). This perspective had three main theoretical implications. First, knowledge is taken to be embodied by actors within the system, rather than to be existing independently. This actor-centered approach directed us to focus on interviewees' interpretations of knowing, doing, and learning rather than attempting to evaluate these activities from an external perspective. Second, knowledge is regarded as inherently dynamic, where interactions within a knowledge system result in the constant evolution of knowledge-based resources. The emphasis on dynamics led us to explore the potential for synergies or conflicts between different forms or contexts for ongoing learning across the system. Third, the focus on specific action served as a reference point from which to view the success or lack of success of the knowledge system. We specifically were not seeking to evaluate individuals or organizations according to criteria that we had set independently. Rather, we sought to understand the key actors' own action-oriented goals and assess the performance of the knowledge system in terms of how well the institutional structures allowed those goals to be met.

In keeping with our research questions, our focus within the broad domain of knowledge is on scientific and technical knowledge. We define scientific and technical knowledge as beliefs that are justified by virtue of being acquired within, or endorsed by, formal research or education settings. However, the first implication of the actor-centered approach also highlighted the importance of remaining open to our interviewees' interpretations of what was important in the knowledge system in which they were participating. Consequently, although we applied the theoretical constructs noted above and focused on the role of scientific and technical knowledge in line with our research questions, we also encouraged interviewees to consider and present alternative perspectives.

Case Study Selection and Description. As noted in the Introduction, our driving interest in this study was the effect that new organizations were having on the use of scientific and technical knowledge in the global health arena. We selected The Global Fund as our case study, because it was widely held to be one of the most innovative and ambitious programs to transform the production of global public goods in recent years (3). (Other scholarship on The Global Fund is presented in *SI Text*) Specifically, in relation to our research questions, an explicit and significant part of that transformation lies in changing the way in which scientific and technical knowledge is applied.

The Global Fund is innovative in a number of ways. First, applications are required to be submitted through national-level committees that include representatives of government, civil society, technical agencies such as the United Nations Joint Program on HIV/AIDS (UNAIDS) and the World Health Organization (WHO), academics, and the private sector. Under conventional aid structures, these groups are often in adversarial relationships with each other, so their cooperation represents a bold break with existing institutional arrangements. Second, The Global Fund requires that all applications be assessed by an independent review panel based on their scientific and technical merit. This shows a clear commitment to the use of scientific and technical knowledge in The Global Fund's core decision-making process. Finally, as a financing mechanism for global health interventions, The Global Fund is explicitly not a research organization. Responsibility for the design and implementation of programs lies with the applicants, a strategy designed to foster national ownership of the projects. This again represents a sig-

nificant departure from conventional multilateral and bilateral models of aid, which are often seen to be "donor-driven" projects.

These characteristics of innovation featuring a role for scientific and technical knowledge made the Global Fund an exemplary case for the purposes of our study. Within The Global Fund's operations, we focused our data collection and analysis on the application process and decisions to approve or not approve proposals, because this was the key process where the goals of scientific soundness and national ownership were negotiated and assessed.

To incorporate the perspectives of applicants, we selected two recipient countries as subcases. These countries, China and Haiti, were chosen because they showed very different scientific and technical capabilities (12). China has a functional public health system, many universities, stable government, and good general education levels compared with many other developing countries. Haiti has few or none of these attributes combined with low human and financial resources. This was not meant to enable direct comparison but to allow us to examine the different experiences and challenges faced by countries with different scientific and technical capacity in dealing with The Global Fund.

Sample and Methods. Our focus on the application process allowed us to identify a set of key actors: those who set the rules of applications, contributed to creating applications, and were involved in their assessments. We conducted 28 in-depth semi-structured interviews that were purposively selected so that each of the groups of key actors listed below were represented:

The Fund Secretariat (three interviewees)
The Governing Board (two interviewees)
The Technical Review Panel (three interviewees)
Country Coordinating Mechanism groups from our subcases in China (six interviewees) and Haiti (three interviewees)
Independent technical advisers/consultants (five interviewees)
The technical agencies (e.g., WHO and UNAIDS who provide advice to The Global Fund as well as to individual countries applying to The Global Fund; six interviewees).

Within each group, we drew on key informants and publicly available information to identify those who were most actively or explicitly engaged in knowledge-based activities in relation to the application processes. Interviews were conducted in English in person or as a telephone interviews. Our interview protocol focused on the knowledge-related aspects of the application process with particular attention to changing knowledge needs and activities and the effects of The Global Fund's rules on the use of scientific and technical knowledge. We also encouraged interviewees to offer broader commentary on their engagement with The Global Fund and to reflect on the state of scientific and technical knowledge in relation to their activities. This structure aimed to strike a balance between generating data targeted to our research questions and allowing topics to emerge.

Interviews were transcribed and analyzed using open coding and thematic qualitative data-analysis techniques. We also analyzed written material, including applications, reports, and other documents, predominantly sourced from the Internet and including, but not limited to, The Global Fund's web site. The primary data collection took place from April to July 2005.

Background to the Case Study

In this section, we present the different groups engaged in the application process and the rules that governed it. We first present the rules for applications as set up by The Global Fund and then describe the main actor groups engaged in producing and reviewing applications.

Setting the Rules—The Global Fund. The application process starts when the Board issues a new call for proposals. The guidelines specify that the application must come from a Country Coordinating Mechanism (CCM), unless exceptional circumstances can be shown. All CCM members formally hold a right of veto over the application. This is the foundation for The Global Fund's aim to support programs that are devised by the recipient countries.

The Guidelines for Proposals for Round 5 (the round underway at the time of this study) noted 17 assessment criteria. These include using interventions that are consistent with international best practices, providing strong evidence of feasible implementation arrangements, and showing that interventions are evidence-based. The Global Fund also requires that projects "strengthen and reflect high-level, sustained political involvement and commitment" (13). These rules send a clear signal to applicants that The Global Fund seeks applications that balance scientific soundness with national-level cross-sector engagement and commitment.

Applications are directed to the Technical Review Panel (TRP) for assessment. The TRP recommends approved projects to the Board as a group to remove conflicts of interest that may arise if Board members were to approve individual countries.

Consequently, The Global Fund's formal governance arrangements effectively decentralize the scientific and technical knowledge functions by granting countries autonomy to decide what knowledge they need and how they are going to get it. The change from being somewhat passive recipients of scientific and technical knowledge to being active knowledge seekers and generators can be regarded as a significant power shift in favor of recipient countries.

Creating Applications—CCMs. The Global Fund's website describes CCMs as "country-level partnerships [that] develop and submit grant proposals to The Global Fund based on priority needs at the national level" (http://www.theglobalfund.org/en/apply/mechanisms/). They bring together local actors with different experience, responsibility, and constituencies into a forum for negotiation. Consequently, the CCM needs to identify projects that are politically and practically feasible across that diverse committee as well as meet The Global Fund's selection criteria.

In Haiti, the cross-sector relationships encouraged by The Global Fund already exist. Haiti's lack of central government resources meant that there was already an active non-governmental organization (NGO) sector that was providing most of the country's HIV/AIDS care. Their first application to The Global Fund drew on the country's existing National Strategic Plan for AIDS, which had been devised in collaboration between the government and NGOs in the 1990s; however, it had not been implemented, because the aid embargo in force at the time meant there were no funds available. The National AIDS Commission essentially became the CCM for that first proposal and therefore had an established history of working together with an established plan and set of priorities. Their application succeeded in the first funding round.

In contrast, the political process that the CCM imposed was very challenging to many of the participants in China. For the first time, government officials, technical advisors, and representatives of NGOs were forced to discuss budgets and program content in a setting where each had equal decision rights regarding the proposal. China had little or no history of engaging with civil society in determining policy priorities; indeed, there is no recognized legal standing in China for NGOs, and HIV/AIDS activists have until recently been arrested and jailed for protesting against the government's HIV/AIDS policies. Their applications in rounds 1 and 2 were rejected but were followed by successful applications in Rounds 3 and 4.

Therefore, at the country level, scientific and technical considerations were entangled with the political processes of setting health-care priorities and action strategies. Although The Global Fund's governance arrangements changed the power relations among participants in the CCM, they also broadened the kinds of knowledge and expertise available to the decision-making process, integrating political and scientific negotiation.

Assessing Applications—The TRP. The TRP members are professionals independent from The Global Fund that are selected on the basis of their expertise. They are instructed to act in their personal capacities rather than as representatives of their employers. The assessment criteria used by the TRP also reflect the integration of scientific and technical considerations with political considerations. Although some have suggested that the political and institutional criteria mentioned in *Setting the Rules—The Global Fund* go beyond a technical mandate (14), members of the TRP defended their inclusion, because they are widely accepted as critical to the success of a project. Projects that reflect international best practice and high-level political commitment are more likely to achieve good results than those that show only one of these attributes. To assess the scientific and technical aspects, members could draw on resources provided by the technical agencies as needed.

Supporting Actors—The Technical Agencies. In both the application development process and the assessment process, the technical agencies, notably WHO and UNAIDS but also others in key partnerships such as StopTB, provided knowledge-based support. An important feature of the scientific/technical knowledge landscape was the work formalized by these agencies as best practice. UNAIDS defines their best-practice guidelines as "accumulating and applying knowledge about what is working and not working in different situations and contexts [including] both the lessons learned and the continuing process of learning, feedback, reflection and analysis" (15). These documents carried significant authority, because they were used as formal guides by the TRP when assessing projects; therefore, they underpin The Global Fund's claims to an independent decision-making process. More broadly, they offered a key context and process for distilling and disseminating knowledge.

However, technical agency staff was also often heavily involved in designing and writing country applications. In China, for example, the WHO's country officer was on the CCM; in Haiti, CCM members were also members of WHO advisory committees. This dual role of the technical agencies in providing both independent sources of scientific and technical knowledge regarding the diseases and advice to applicants was an important aspect of the knowledge system.

Findings

Dynamic Dimensions of the Knowledge System: Learning. As noted earlier, we examined our data to understand the role of scientific and technical knowledge and specifically, understand the dynamics between generating, sharing, and applying that knowledge.

Although The Global Fund effectively decentralized decisions regarding knowledge to the applicant countries, we found that decentralizing decisions does not necessarily decentralize the production of scientific research or technical training to those countries. Interviewees reported a rapid expansion of demand for scientific and technical knowledge with no accompanying increase in resources to meet that demand. This was experienced differently by our two case countries. Haiti met this demand by drawing on both existing work (in the form of the National Strategic Plan for HIV/AIDS) and on their NGO network. This made the proposal process relatively straightforward, because they had an existing political consensus that extended beyond government that also showed scientific and technical consensus. Because three NGOs represented on the CCM were also actively affiliated with North American universities, the approaches described in their proposal were already well-established in international scientific circles and recognized by the technical agencies (8); therefore, the CCM was well-placed to meet that demand from existing knowledge resources.

In China, however, there was a lack of extant data and tested approaches. Combined with the political schisms present in the CCM, this resulted in fierce debates that blended technical, political, and cultural issues, including whether or not internationally accepted approaches to preventing the spread of HIV/AIDS, like policies targeting injection drug users, were culturally appropriate to China. Their second-round proposal to The Global Fund was rejected, in part, on the basis of it not addressing this population. Their third-round proposal was successful when commitments were clearly stated to target injection drug users in future proposals. This represented a significant shift in Chinese public health policy to accept the international position that marginalized and vulnerable groups needed to be acknowledged and targeted. Their proposal for round 4 followed through on this commitment and included such well-established approaches as methadone replacement and needle-exchange programs.

Another dynamic aspect of the knowledge system surrounded the concept of best practice. Technically, The Global Fund application criteria limit the contribution that countries can make to their own applications to those that conform to accepted practice, as illustrated by China. However, not only is the idea of best practice contested, it is also recognized that best practice must evolve over time to reflect successful innovations (16, 17). Recipient country experiences are crucial to this evolution; therefore, the increased demand for existing knowledge was accompanied by an increased demand for learning from experience as projects were implemented. Capturing these lessons and codifying them in best-practice repositories depended in turn on effective evaluation and learning processes, as noted in the earlier definition. But resources for this evaluation and learning were scarce, because technical agency staff who would take this task on were reportedly overloaded with assisting CCMs in writing proposals. As one interviewee described it, "Who is paying for the technical assistants? Not The Global Fund, they have to come from the existing budget of the existing agency. So as a result the whole GF application process is a drain on financial and technical resources from technical agencies." Furthermore, The Global Fund's own nascent monitoring and evaluation processes were concerned primarily with administrative and procedural assessments rather than substantive assessment of the quality of the programs and their implementation. The Global Fund staff publicly encouraged academic institutions to "step up" to fill the gap, but at this stage, there had been little uptake. In a published editorial, a former Executive Director of The Global Fund explained this failure: "In programs that focus on implementation, the needs for operational research and for the proper spending of the operational research budget allocation will never feature highly in the priorities of the program managers, either in the recipient organization or in the funding agency. In addition, the individuals . . . responsible for achieving the goals of the programs will typically not be researchers, not have well-honed judgments in the field of research, and not be well connected with the research community" (18). As several interviewees noted and evidence from Haiti confirmed, long-term research partnerships can be a useful bridge for countries with little or no research capacity, connecting research, evaluation, and learning with innovation in practice.

In terms of the dynamics of knowledge activities within the knowledge system, these findings point to inefficiencies that are generated when increased resources for actions are not accompanied by adequate resources for learning. "Lessons being lost" was a common refrain from all groups of interviewees. This is not the case for The Global Fund itself—as an organization, they have embraced a learning paradigm and are well-known for responding quickly to changing information. But the governance processes set in place by The Global Fund had not succeeded in encouraging practitioners to invest in learning in a systematic way, despite the ability to include operational research in their applications. Haiti stood out as an example of the positive benefits to be gained from generating knowledge from previous efforts to tackle these dis-

eases and explicitly sharing that with the international technical agencies and academic institutions. With technical agencies stretched to the limit in providing assistance to applicants and The Global Fund itself not taking on the mandate to do or require this form of evaluation, overall capacity to learn at the international level was limited. These findings indicate several disconnects in the knowledge system—areas where relationships between actors have not been well-established, incentives for collaboration are not present or well-recognized, and the dynamic interactions required for effective learning have largely failed to develop in significant areas.

Evaluating Success. As mentioned earlier, the case study focused on the application process as the key point at which the dual goals of scientific soundness and national ownership were negotiated. The success or otherwise of countries' experiences in meeting these goals could be taken as an indicator of the success (or otherwise) of the knowledge system's functionality.

China's shift to conformity with international practice in their fourth-round proposal was welcomed by many in the CCM but was regarded by others as a major compromise in national autonomy. Despite its considerable intellectual resources, China had not invested early in knowledge generation and sharing, and as a consequence, those opposed to the international models of treatment and care had no convincing evidence to support an alternative approach. Thus, they eventually adopted a model that reflected international consensus rather than Chinese consensus.

Haiti, in contrast, maintained a strong sense of national ownership. Despite apparently few in-country knowledge-based resources and intense political upheaval, they retained their sense of ownership: "If you ask me why did [the National Strategic Plan for HIV/AIDS] survive I say it's because Haitian's did it. I took part in it, my neighbor took part in it, so and so took part in it . . . I decided, we decided together." This was reinforced by their ability to draw on knowledge resources that documented their own innovative treatment and care approaches, ensuring that there was no compromise between the two goals of scientific soundness and national ownership.

Consequently, the effect of demand for scientific and technical knowledge was determined in part by the extent to which applicants could meet that demand from within their own experience. Where recognized knowledge resources existed and political consensus reflected them, country ownership was achieved. Where recognized knowledge and political consensus did not exist, there was a paradoxical recentralizing effect, a return to conventional international sources. This could also be driven by The Global Fund itself. Describing a change in the TRP's policy regarding acceptable malaria treatment, one interviewee said that it "has been a highly artificial process, where countries change their policies because they sense that The Global Fund will completely cancel their grants altogether if they do not put [the new drugs] into them," regardless of the countries having legitimate reasons to stay with the older treatments, at least in the short term. The Global Fund's assessment processes can open up opportunities for change but may also shut down innovation and efforts to learn from local-level experience. For some, The Global Fund's dual goals of fostering national ownership and scientific soundness posed real contradictions.

The role of technical agencies in advising countries on their proposals also had the potential to divert countries from their own preferred action agenda to one endorsed by the agency or organization involved. Within the countries, the technical agency staff often acted as brokers, translating the application requirements into a health program that was more likely to be funded. However, these brokers can also use The Global Fund's rules to push applicants in the direction supported by the international agencies. As one agency-based interviewee described it: "In the countries we have very knowledgeable people. But they are necessarily confined

in their focus based on the local setting. And you need somebody from outside to open their eyes to alternatives. On best practices, to say, what can we learn, where can we change, what can we adjust? So it can work for you guys here." Although this can have very positive outcomes, some interviewees were concerned whether or not applicants could maintain their own agendas in the face of those external advisors.

Different Forms of Knowledge. Although the previous findings related to our theoretical interests, another key issue raised by interviewees was the importance of other forms of knowledge—we called them managerial knowledge and situational knowledge. They highlight that the connections between science, policy, and action cannot operate in a vacuum but must depend on different forms of technical and practical knowledge.

The need for managerial knowledge, the knowledge required to effectively meet the administrative and financial requirements of The Global Fund projects, was consistently cited by our interviewees. Indeed, many of the technical issues that interviewees were asked to assist with required managerial rather than health-related expertise. The Global Fund's rules imposed a corporate style of management and accountability with which many recipients were unfamiliar and that they found difficult to implement. An interviewee from a Haitian NGO recounted their practice of sending their accounts back to their head office in the United States, where their accounting staff generated their report for The Global Fund, which was then sent back to the project managers in Haiti, who then collated it with others and sent it on to The Global Fund. The implications of these shortcomings in terms of the kinds of knowledge that were necessary, but typically missing, were often unanticipated. These ranged from the simple difficulty of getting accounting staff to the project sites ("it's hard to get accountants to live in Central Haiti") to the complex challenges of trying to strategically plan a national health program when the key funding sources are uncertain. Importantly, lack of managerial expertise directly affected health-care provision; one interviewee noted that, in the absence of skilled administrators, the burden of accounting and reporting typically falls to those who have the most education: the doctors and nurses.

Situational knowledge was knowledge of the specifics of the local situation—it may encompass elements of scientific/technical, managerial, or political knowledge but could not be reduced to any of these categories. Situational knowledge was more informal or tacit and was closely tied to particular contexts and the actual experience of individuals regarding the ways that these different factors and others came together in a particular place and time. By devolving a significant portion of decision-making power to the countries, The Global Fund brought the applicants' situational knowledge to the fore. The cross-sector structure of the CCMs can be viewed as a device for expanding the situational knowledge that was brought into the decision-making processes—not only governments, who understand politics acutely but can be far removed from the practicalities of the field, but also practitioners and those who span the boundaries between local and global contexts, such as the WHO country officers and the Haitian NGOs. By bringing these groups together, The Global Fund's rules encouraged projects that were more closely aligned with the political, practical, and technical realities of implementation in the field than might have emerged from government-to-government bilateral negotiations, for example.

Taken together, these categories show the inevitable intertwining of formal knowledge (scientific and managerial) and informal knowledge (political and situational) required for action. This represents a significant shift in what might be called the knowledge capability needed for good health programs. The knowledge and skills needed to implement these health programs are multidimensional and extend well beyond scientific and technical expertise.

Discussion: Learning Knowledge Systems

The findings in the previous section show that by applying a knowledge-system perspective to the complex relationships across The Global Fund network, the issues surrounding learning (dynamics), scientific soundness, and national ownership (success) and the multifaceted forms of knowledge required were highlighted. In this section, we examine the broader implications of these findings on our understanding of efforts to link scientific and technical knowledge and effective action in sustainable development.

The challenge of linking research with action is not new to the field of global health, and it is commonly referred to as the "know–do gap" (19). The Global Fund was constructed on the basis of the view that we know what to do to reduce the impact of the three diseases (4). This has downplayed the need for efforts and resources to be directed at learning from implementation experience as programs unfold (how to do it) and overlooked the importance of the multidimensional nature of knowledge required. The findings indicate that their conception of the relationship between knowledge and action did not take into full account the complexity of the structure of the knowledge system or the dynamics of knowledge generation, sharing, and application.

Both China and Haiti illustrated the critical importance of collecting, collating, and publishing research and evaluations to give the knowledge system the learning capability that could connect local experience with a global knowledge base. Important in this structure was the forum that the technical agencies provided for generating knowledge through ongoing evaluation and sharing that knowledge through their various best-practice publications. Their expert committees, staff, and consultants, in conjunction with country officer brokers, were key boundary spanners in this knowledge system, because they were able to connect across contexts, scales, and knowledge types. Their role has shifted from simple provision of technical knowledge toward blending technical and managerial knowledge with country priorities and situational knowledge, and connecting these efforts to a dynamic scientific knowledge base. This integrative capacity is largely overlooked in a field still rooted firmly in a technical conception of knowledge (20).

Although The Global Fund recognized that their processes demanded innovation, the ability to capture the lessons from that innovation was largely absent—Haiti was a notable exception. This was attributed by most interviewees to the lack of financial resources to evaluate and learn from practice, to improve implementation processes and strategies, and to build complementary managerial capacities. Although, given time, the "demand–pull" approach for building managerial knowledge skills may yield results, the lack of emerging supply reinforced the sense that learning was not keeping up with practice and innovation in the field at the time of this study. In this context, the overall efficiency of the knowledge system in linking innovation, evaluation, and ongoing action was low.

From a knowledge-systems perspective, however, lack of resources is an important, but not complete, explanation for lack of learning. Other impediments included the legacy of a technical concept of knowledge that obscures other necessary forms of knowledge; structural disincentives where funding rules encouraged conformity; strained relationships between The Global Fund and the key boundary organizations; and narrowly conceived monitoring and evaluation requirements. Improving the efficiency of the knowledge system in linking innovation, evaluation, and learning with action requires understanding of the importance of these knowledge processes and efforts to incorporate them into the design of governance arrangements. Understanding the key actors, the way that these actors understand and participate in knowledge-based activities, and the reasons and ways that they interact is a starting point for designing effective learning across a knowledge system.

Scholars in the field of institutional analysis have pointed to the centrality of knowledge and learning in effective polycentric (crossing multiple authorities and overlapping jurisdictions) natural-resource governance regimens. As Andersson and Ostrom (21) have written that a "key aspect of all proposals for increased polycentricity (as opposed to just centralization or just decentralization) is the effort to enable institutions of multiple scales to more effectively blend local, indigenous knowledge with scientific knowledge . . . The key to the successful design of such institutions is their multiple scales and their generation of information that allows participants operating at many different scales to learn from experience" (21). Yet, tools or concepts for explicitly integrating knowledge and learning dimensions into institutional analysis remain elusive. The knowledge-systems approach presented here may be usefully combined with polycentric governance analysis to more fully understand, evaluate, and design complex, action-oriented institutional arrangements.

Conclusions

Early proponents for the establishment of The Global Fund described the steps involved to implement their vision of recipient-country ownership and scientifically sound projects as "simply procedural, [recognizing] the truism that the most successful aid projects are those that are what the recipient country wants . . . and are scientifically sound, in that there is scientific evidence that the selected interventions are effective" (4). The possibilities that these two goals could conflict, that other forms of knowledge were needed, and that the decision-making processes associated with them is dynamic and embedded in broader knowledge systems were only accounted for partially. The potentially recentralizing effect of international advice, applicants' heavy reliance on technical agencies, and the lessons lost from early implementation all indicate that efforts to enhance country empowerment and ownership need to be supported by local and contextual knowledge production and structures to share that knowledge. More careful and collaborative planning for knowledge-based activities could have accelerated learning and increased efficiency in reducing the impact of these diseases.

More generally, this case study has illustrated that action-oriented organizations can be important drivers in knowledge–action relationships, having a significant impact on the ways in which knowledge is generated, accessed, shared, and used across a broad network of stakeholders. Although other work has pointed to the need to consider power and engagement as central factors in efforts to link knowledge with action in the context of sustainable development (7), this study has shown that that the reverse may also hold true. Governance structures that aim to redistribute decision-making power and to promote forms of engagement to improve action can also affect knowledge systems. These effects may help or hinder the overall achievement of the goals of the governance arrangements when viewed from a system-wide perspective.

Sustainability constantly presents challenges that are characterized by social, political, scientific, and technical complexity and that require institutional innovation. In these settings, understanding that the interactions between knowledge, action, power, and engagement are a dynamic, interconnected system—and learning how we can act more sensitively within this system—may prove to be critical to the effective pursuit of sustainable development. The concept of a knowledge system offers a constructive way of incorporating these considerations into institutional designs in a comprehensive, systematic way.

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