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PROJECT highlights

Destruction of a house caused by a rainfall-triggered landslide in an urban community - Castries, Saint Lucia.

Management of Slope Stability in Communities (MoSSaiC) in Saint Lucia

The Challenge: Reducing Landslide Risk

In many developing countries, landslide risk is increasing as unauthorized housing is built on already landslide prone hillslopes surrounding urban areas. This risk accumulation is driven by growing population, increasing urbanization, and poor and unplanned housing settlements, which result in increased slope instability for the most vulnerable populations. In addition, the combination of steep topography of volcanic islands in the Eastern Caribbean and the climate patterns of heavy rains and frequent cyclonic activity, are also natural conditions contributing to the high level of landslide risks.

The Project: Community-Based Risk Reduction

The Caribbean island of Saint Lucia is a success story in the long-running efforts to mitigate disaster risk since the government began introducing low-cost community-based interventions for vulnerable hillside communities. Castries, the capital of Saint Lucia, is the most populated city and surrounded by mountainous topography and is inhabited by populations commonly affected by heavy rains and hurricanes. Even "everyday" low magnitude rainfall events can trigger devastating landslides. For the city's inhabitants, this has meant frequent loss of property and livelihoods, and even loss of lives. As with any disaster risk, this also means that the island is constantly under threat of reversing whatever economic progress and improvements to livelihoods it has made. Yet, by taking a community-based approach to landslide risk management, Saint Lucia has shown that even extreme rainfall events, such as Hurricane Tomas in October 2010, can be weathered by urban hillside communities.

Saint Lucia's success in addressing landslide hazards in urban communities is a result of the innovative and solution-oriented engagement of community members, landslide researchers, and government practitioners and policy-makers. The Management of Slope Stability in Communities (MoSSaiC) approach was established by researchers from the University of Bristol committed to providing a community-based and scientific approach for delivering landslide hazard reduction measures on the ground. Following a successful pilot study in 2004, the government of Saint Lucia funded MoSSaiC projects in five vulnerable communities in which the community members became the lead project managers to reduce their landslide risk.

Research, development, and implementation continued with the support of government agencies, international development partners, and in close collaboration with the World Bank's Disaster Risk Management (DRM) Team. Under the World Bank-sponsored Second Disaster Management Project, the government and project committee identified six more vulnerable communities to implement the MoSSaiC approach. Each of the communities received technical, financial and project management support to install drainage systems, rainwater harvesting techniques and catchments to divert rainfall from saturating the soil and foundations to homes that instigate landslides.

MoSSaiC continues to work with the World Bank and communities to develop a handbook and online resources to make the approach more widely available and useful to the general population and related ministries. The Global Facility for Disaster Reduction and Recovery (GFDRR) is financing the production, publication and dissemination of these materials, which are expected in early 2013.

An Innovative Approach to Landslide Hazards

Current policies for landslide risk reduction often focus on vulnerability reduction without always investigating ways to address the landslide hazard. The MoSSaiC approach explicitly addresses landslide hazard reduction. It is based on the MoSSaiC vision that (i) disaster risk management pays, (ii) engaging existing government expertise for risk reduction can build capacity, embed good practice and change policy, and (iii) ensuring community engagement from start to finish can enable community ownership of solutions. The MoSSaiC approach aims to lay sustainable foundations for community-based landslide risk reduction. These foundations are a scientific base for reducing landslide hazard, a community-based approach for delivery of mitigation measures on the ground, and an evidence base demonstrating that such an investment both pays and works.

MoSSaiC is science-based:

- Localized physical causes (often poor drainage) of landslide hazard are identified.
- Appropriate mitigation measures are designed to address these causes.
- Scientific methods are used to justify solutions.

MoSSaiC is community-based:

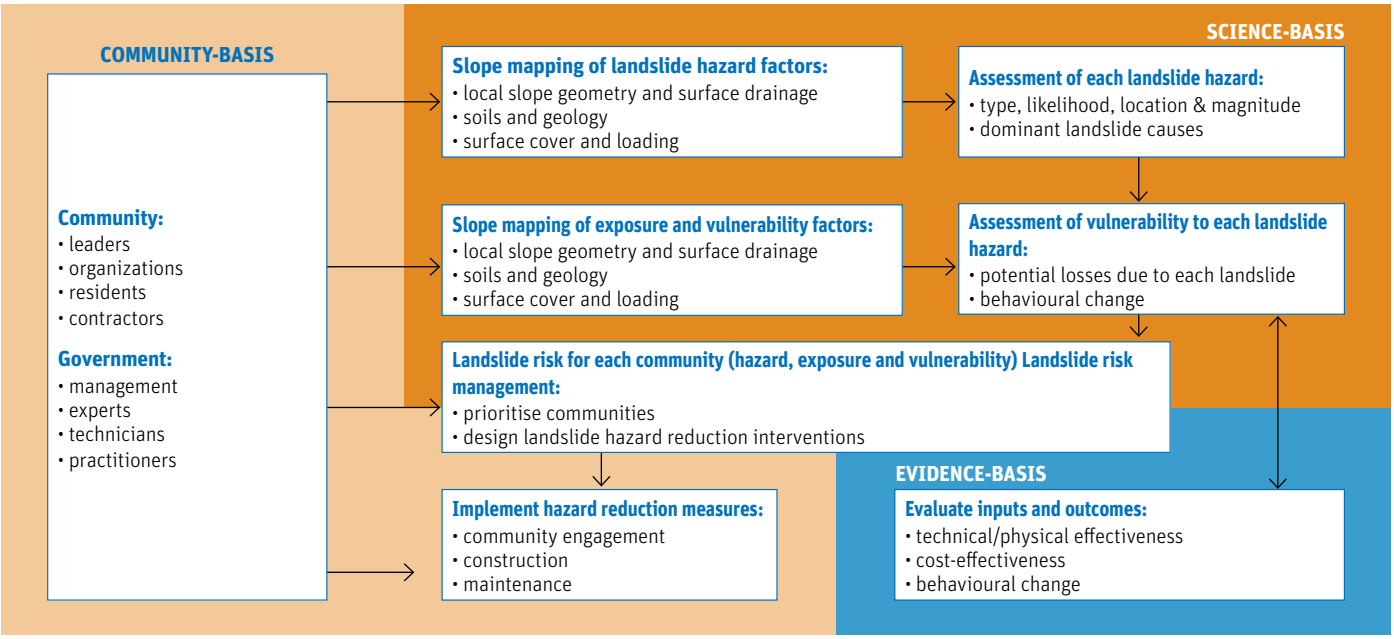
- Community residents are engaged in identifying landslide risk causes and solutions.
- Contractors and workers from the community are employed in constructing drainage solutions.
- Government managers and practitioners form teams with the necessary expertise to work with communities and deliver mitigation measures.
- The vision is shared and championed in communities and by governments.

MoSSaiC is evidence-based:

- Appropriate physical works are delivered to reduce landslide hazard.
- MoSSaiC design standards and trainings are used to maintain rigorous and effective quality.

Communities Tackle the Causes of Landslide Risk

MoSSaiC is designed to address a very significant subset of landslide types: rotational and translational slides in soils that are principally triggered by rainfall, but which are exacerbated by rapid urbanization. Often, the most socioeconomically vulnerable inhabit these landslide-prone slopes—thus increasing their exposure to landslide hazards and



The MoSSaiC Architecture: A holistic structure combining the three core scientific, community, and evidence components.

Typical urban hillside community in Saint Lucia.

Discussing the surface water and slope stability issues and potential drainage solutions at a community meeting.

sometimes increasing the hazard itself. MoSSaiC focuses on the most economically, socially, and physically vulnerable of these urban hillside communities.

During the initial project steps, community residents and government technical teams create detailed maps of slope features such as previous landslides and altered slope geometry (cut and fill), loading (buildings), drainage, and vegetation. Engineering judgment and scientific tools are used to interpret the effect of such features on slope stability and confirm local landslide causes. Typically, the dominant instability mechanism in these densely constructed communities is infiltration of rainfall and household water into slope material. Based on that information, drains are designed to intercept overland flow of rainfall and capture household water (roof water and grey water), thus reducing landslide hazard. Finally, these public works are bid out to local contractors in the community.

MoSSaiC's activities engage community participation in a holistic approach in every step of the project including planning, executing, and maintaining surface water management on high-risk slopes. Contractors and workers are from the communities and trained on MoSSaiC design standards. They gain short-term employment, capacity building and work experience in effective slope drainage construction practices. As a result, the vision for proactive landslide risk management is shared, championed, and owned by the communities themselves, not only by the government or implementing agency. At the same time, the community becomes a classroom for the government teams to develop their expertise, and establish good technical and managerial practices with respect to landslide hazard.

The Results: Stable Hillslopes – 'it works'

According to Françoise Clottes, World Bank Country Director for the Caribbean, "natural disasters such as Hurricane Tomas impose large costs on Saint Lucia's economy by seriously impacting tourism and agriculture, with particularly severe effects on the most vulnerable communities and households." For Saint Lucia, the most damaging feature of Hurricane Tomas was the torrential and sustained rainfall that it brought—totaling over 50 centimeters in just 24 hours. However, none of the vulnerable hillside communities that implemented MoSSaiC interventions experienced any landslides at all. Before the intervention, those same community slopes had frequently shown signs of instability, even during much lower magnitude rainfall events of less than 10 centimeters in 24 hours.

Cost-benefit – 'it pays'

Governments and donors agree that disaster mitigation is a good idea, but the question always remains 'does it pay?' This answer requires evidence of the likely returns on investments made in the communities. A particular challenge in assessing the direct benefits of disaster risk management lies in the fact that such benefits occur in the future as avoided costs, rather than as a continual flow of positive benefits. It is therefore vital that economic appraisal of landslide risk reduction projects be carried out, not only as a means of ensuring effectiveness, but also in order to build a case for low-cost, high-benefit landslide risk mitigation.

To start to build such an evidence base, a pilot cost-benefit analysis was undertaken for one of the MoSSaiC communities in St Lucia. Slope stability modeling showed that prior to the intervention a 1 in 5 year rainfall event would be likely to trigger multiple small landslides. Rainfall running off roofs and grey water from kitchens and bathrooms significantly contributed to this problem. After constructing new drains and captur-

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—Françoise Clottes, World Bank Country Director for the Caribbean.

Example of drain to collect and redirect surface water runoff to prevent soil saturation and landslides.

"[During Hurricane Tomas] the water was as high and gushing as I never seen before. The timing of the drains being installed was so right, just before the storm, as no landslides occurred as they did before."

—Eldrena St. Luce, Community Leader, Morne du Don – Castries, Saint Lucia.

ing household water, less water was able to infiltrate the slope; 35 percent of rainfall was intercepted by roofs and conveyed to new drains, while approximately 50 percent of the remaining rainfall was estimated to be removed from the slope from surface water runoff being intercepted by drains. This reduced the modeled probability of landslides by an order of magnitude (from 1 in 5 years to 1 in 50 years). The expected reduction in damage to houses of different construction types was calculated from predicted magnitude and location of landslides before and after the intervention. This study showed that directly addressing the physical causes of the landslide hazards in such communities can have a benefit-cost ratio of 2.7:1 – a low-cost, high impact approach to landslide risk reduction.

Complete Community Engagement

The MoSSaiC initiative demonstrates that community engagement and active participation - from project initiation through to post-project workshops – is effective in reducing landslide risk and building community capacities and awareness. Community members and local contractors can apply their experience and local knowledge with MoSSaiC design standards to integrate landslide hazard mapping and drainage design. In addition to reducing landslide hazard, many residents learn good construction practices through their involvement in drainage construction and on-site guidance from engineers and experienced local contractors. Communities also manage the procurement of materials, lead community meetings, and post-project maintenance. This level of community participation is a direct result of their initial engagement in the mapping process and involvement throughout the project. Finally, because governments have adapted and encouraged the community-based approach to landslide mitigation, donors continue to support the scaling up of MoSSaiC throughout the islands of the Caribbean.

Learning by Doing

The transfer of science into practice is both complex and moves in both directions. In consequence, MoSSaiC's community-based approach is that of "learning by doing" for all involved. In addition to mitigating landslide risk, a core advantage for all participants includes the rapid and highly focused education and training. Community residents and government teams alike broaden their knowledge and skill-base with enthusiasm because they can see the results that directly affect security. Familiarity with the science of hazard reduction is an integral part of the learning process; so much so that community members are subsequently able to participate in technical training and provide instruction to government staff.

As communities and governments adopt the methodology and MoSSaiC blueprint and by making adaptations that are relevant to local conditions (political, social, and physical), country ownership will follow. For that to happen, governments and donors will need to be policy entrepreneurs—identifying what works and what pays when it comes to urban landslide risk reduction, and making "smart" links between science, social science, and behavioral sciences.

While a community-based methodology may be suitable in terms of effective landslide hazard mitigation, there is every possibility of continued accumulation of landslide risk, driven by the trend of increasing urbanization. The poorest are moving to the least expensive land surrounding urban areas—often the most landslide-prone slopes. This trend, coupled with a substantial, unregulated housing stock, presents a major challenge in many countries, including small island developing states such as Saint Lucia. The MoSSaiC approach to reduce urban landslide hazards has the potential to decrease landslide risk accumulation, but it now requires a concerted program of dissemination and adoption of its methodology.