Open Geographic Data for Disaster Risk Reduction in Nepal
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Glossary of Terms

Geographic Information System (GIS): A GIS integrates hardware, software, and data to capture, manage, analyze, and display digital data that are geographically referenced.

Open Data: “Open data” is an idea that data should be freely available for anyone to use and republish without restrictions from copyright, patents or other mechanisms of control.

Document Information

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Cover Photos (all photos by Shadrock Roberts): Clockwise from upper left – Kathmandu Living Labs survey of a local school; external façade supports in Kathmandu; OpenStreetMap of Kathmandu; Kathmandu skyline.

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Executive Summary

Background
The Kathmandu Valley is home to 2.5 million people and shows population increases of 5-7% a year: it is one of the fastest-growing metropolitan areas in South Asia. Unplanned urban development, substandard housing, and location make it one of the most earthquake-vulnerable areas on the world. Creating disaster risk reduction (DRR) programs to address this urban growth and build resiliency requires robust and accurate data to inform decision making. Identifying which portions of a city will be inaccessible after an earthquake and planning transportation corridors to allow for the delivery of humanitarian response are questions that require access to timely geographic data.

The Open Cities Project & the Scope of Work
The Office for Disaster Risk Reduction and the Program Office of the USAID Mission Nepal requested USAID’s GeoCenter to explore participatory methods for creating geographic data and provide high resolution satellite imagery to support the “Open Cities” project in Nepal: supported by the World Bank’s Global Facility for Disaster Risk Reduction (GFDRR). Open Cities requested support from the GeoCenter to organize a “crowdsourcing” event in which volunteers could map Kathmandu by tracing satellite imagery online. The GeoCenter is supporting Open Cities by:

- Acquiring and processing high spatial resolution satellite imagery in partnership with the State Department’s Humanitarian Information Unit and their “Imagery to the Crowd” process;
- Organizing a “crowdsourcing” event to map building footprints in Kathmandu;
- Contributing to an Open Cities “Field Guide” which can serve as a resource for replication by others.

Data Sharing in Nepal
During a temporary duty assignment to support Open Cities in May of 2013, I found two duplicative efforts to produce essentially the same data by organizations that receive some USAID funding. Current efforts to create data useful for DRR do not build upon one another and exist in organizational silos. Primary data needs have not been identified. Two primary areas of duplicative work are:

- Open space analysis to identify and prioritize open spaces that could be used for humanitarian purposes following a major disaster event.
- Building footprint data to better understand which portions of the population are at most risk and how an earthquake may render certain portions of the city inaccessible.

Recommendations
1. USAID should take a leadership role in convening stakeholders to define data needs and promote open data as soon as possible. The meeting can also be used to identify needed capacity for the Government of Nepal to access and publish open data.
2. Determine how open data can be part of future requests for proposals and contracts: USAID partners should have clear support for and guidelines to publish open data.
3. Capitalize on existing open data (specifically open spaces and school locations) to demonstrate the value of data sharing to address DRR challenges.
Background

About the GeoCenter

The GeoCenter is a specialized team within the Office of Science and Technology dedicated to helping USAID staff visualize geographic relationships between programs, people, and the environment. The team works directly with Missions and operating units to apply geographic analysis to development challenges. The overarching goal of the GeoCenter is to improve the effectiveness and efficiency of USAID’s work by augmenting the Agency’s capacity to incorporate geography into the design, implementation, monitoring, and evaluation of USAID’s development programs. GeoCenter services are focused on:

- Requests for specific mapping and analysis;
- Building Geospatial Capacity (Training, contract language, guidance for hiring GIS staff, etc.);
- Establishing Resources and Methods to Collect, Manage & Share Data; and
- Exploring innovative approaches to gathering and using geographic data.

There is no fee for service. The GeoCenter can be reached at geocenter@usaid.gov.

The Role of Geographic Data for Disaster Risk Reduction

Disaster risk reduction (DRR) is a broad term that envelopes preventative measures to reduce the damage caused by natural hazard such as earthquakes, floods, droughts, and storms. Disasters and development are inexorably linked since the former can be seen as a consequence of insufficient development to reduce exposure to hazard (Collins, 2009). One focus of DRR in Nepal is seismic risk for the city of Kathmandu. The Kathmandu Valley is the home to 2.5 million people and shows population increases of 5-7% a year: it is one of the fastest-growing metropolitan areas in South Asia and due to unplanned urban development, substandard housing, and location it is one of the most earthquake-vulnerable areas on the world (Muzzini and Gabriela, 2013).

Managing urban growth and building resilient and sustainable societies requires robust and accurate data to inform decision making for both DRR and development planning. The technology that underpins urban planning is geographic information systems (GIS), which rely on access to timely geographic data. In 2007, the National Research Council (NRC) found that:

“Improvements in subnational data are vital to enhance decisions on humanitarian intervention, disaster relief, and development assistance to populations vulnerable to a wide range of hazards potentially leading to disasters. Yet various acute, but in many cases resolvable, limitations in geospatial data, methods, and tools for improvements of subnational demographic data often preclude their use under normal conditions for planning, let alone during periods of crises” (NRC, 2007:149).

This unfortunate finding was illustrated by the 2010 earthquake in Haiti in which an inability to access baseline data about the city and lack of capacity to handle a variety of new data streams hampered humanitarian response efforts (HHI, 2011). The creation of timely, accessible, geographic data is a critical need to establish evidenced-based DRR and development policies and programs.
Original Request from the Mission
The USAID Mission in Nepal has used GIS and geographic data to support both programmatic decision making and communications for some time. The Mission’s Program Office had asked the GeoCenter to explore participatory methods for creating geographic data in general and the Mission’s DRR Office specifically expressed interest in the work of the “Open Cities” project being implemented by the World Bank’s Global Facility for Disaster Risk Reduction (explained below). Open Cities engages local university students and volunteers to create up-to-date city maps by tracing satellite imagery, thus providing geographic data about the cities in which the project operates. The Nepal Mission is interested in use-cases for participatory data such as these for DRR and contingency planning but also the broader applicability of using local geospatial capacity and volunteers to map phenomena and events in host countries. In consultation with the Mission Program and DRR Offices, the GeoCenter agreed to support the project with technical assistance and to document this process for potential replication by USAID Missions.

About the Open Cities Project

Open Cities: part of a larger open data initiative
The Open Cities project is part of a larger Open Data for Resilience Initiative (OpenDRI), which aims to reduce the impact of disasters by empowering decision-makers with better information and the tools to support their decisions. The project is a concrete example of how OpenDRI can be implemented. OpenDRI is supported under the World Bank’s Global Facility for DRR (GFDRR) and implements the first policy recommendation of the joint World Bank / UN report, “Natural Hazards, UnNatural Disasters, the Economics of Effective Prevention,” which establishes the importance of data sharing to reduce vulnerability to disasters.

The launch of Open Cities includes case studies in three cities: Kathmandu, Nepal; Dhaka, Bangladesh; and Colombo, Sri Lanka. In each of these cities, the World Bank is building local geospatial capacity to conduct field surveys about specific buildings and critical infrastructure that can be used for risk modeling and urban planning; thus encouraging local ownership and use of open data.

Open Cities will ensure that these data can be gathered through participatory methods using platforms such as OpenStreetMap, with participation from local government agencies, universities, technical communities, and the private sector. This open and participatory approach allows a broad range of members in society to participate in improving urban resilience. In addition to collecting data about urban infrastructure, Open Cities, will develop protocols to ensure data accuracy and consistency.

Open Cities: Kathmandu
Open Cities has been active in Kathmandu since 2012 in order to build a local team that could create open geospatial data using a variety of tools and methods. This team has now registered as a local non-governmental organization (NGO) named Kathmandu Living Labs (KLL). KLL is composed of Dr. Nama
Budhathoki (PhD. University of Illinois at Urbana-Champaign) and approximately 15 young Nepalese – many from the Kathmandu University’s Civil and Geomatics Engineering Department. Five of these students are paid while the others are unpaid interns.

KLL has developed a process to combine high resolution satellite imagery and field surveys, to map the built environment of Kathmandu. Specifically, KLL has focused on mapping schools, health facilities, and government buildings to support a larger building retrofitting project funded by the World Bank and the UK Department for International Development (DFID). Operationally, a KLL surveyor will begin with a known location of a building (gathered through official sources such as a register, or alternative sources (such as crowdsourcing)); proceed to the location and conduct both an interview and field survey – taking GPS enabled photographs all the while; use “snowballing” (a survey technique to find out where other schools or hospitals are that may not be yet known); then compile this information in OpenStreetMap. The result is a building footprint, in an open mapping platform, with a significant amount of associated data (building characteristics, number of occupants per day/night, etc.) that can then be used by anyone. The survey form was created in partnership with Nepal’s National Society for Earthquake Technology (NSET).

KLL also conducts trainings on their survey techniques and the use of OpenStreetMap as a tool for data creation, storage, and sharing. These trainings target a variety of users, ranging from specific need of
government officials to those of the general public, in which any interested individual or group may come for assistance in starting a mapping project. During my field visits with KLL in May of 2012 I was impressed with their survey methodology; their quality assurance process; and the volume of buildings mapped.

**Work to Date**

To date KLL has mapped over 2,800 schools and health facilities. Because a school may be composed of more than one individual building this represents a large data set of individual building footprints and will be the first ever comprehensive map of schools in the Kathmandu Valley. KLL will complete a dataset of approximately 3,000 school, health, and government facilities by the end of July 2013.

**Moving Forward**

KLL would like to scale up its mapping efforts to include all buildings in the Kathmandu valley. A complete set of building footprints could allow for detailed analysis of earthquake-related risks such as:

- areas that would accumulate the most debris and rubble, complicating access for recovery;
- validation of current “open space” assessments to better understand access to and from the chosen sites; and
- areas where humanitarian corridors should be created for delivery of supplies and debris removal.

Mapping all buildings in the Kathmandu Valley is a large undertaking that requires additional mapping assistance from online volunteers and access to high resolution satellite imagery.

**USAID GeoCenter Support to Open Cities**

**The Scope of Work**

The GeoCenter has previously worked with online volunteer groups and leveraged crowdsourcing to produce geographic data and is committed to exploring innovative approaches for the application of geographic data to pressing development challenges. Also, USAID’s Office of Science and Technology has supported the creation of an open aid data portal for Nepal through a Higher Education Solutions cooperative agreement (HESN). The GeoCenter partnership with GFDRR for Open Cities in Kathmandu aligns well with our capacity and mandate to open and apply geographic information to USAID’s work.

GeoCenter support for Open Cities will be focused on the following:

- Acquiring and processing high spatial resolution satellite imagery for all three cities. The imagery will be delivered to the OpenStreetMap tasking server in partnership with the State Department’s Humanitarian Information Unit and their “Imagery to the Crowd” process; allowing volunteers and Open Cities team’s access to data for mapping the urban environment.
- Organizing a one-time event to recruit online volunteers for a set period of time (e.g. one week) to contribute to mapping building footprints online using the imagery provided and OpenStreetMap, thus densifying urban data and allowing KLL to focus on field surveys:
- Documenting and capturing the aspects of this process pertinent to USAID operations and contributing this information to the development of an Open Cities “Field Guide” which can serve as a resource for replication by others.
• Identifying additional users of the rich spatial database of resultant building footprints data. At the time of writing the GeoCenter and Open Cities are engaging: NSET, Global Earthquake Model, and the U.S. Geological Survey (USGS) for potential models and applications for the data.

**How does this relate to USAID?**

Partnership with Open Cities directly responds to one of the primary challenges identified in the U.S. Disaster Risk Reduction Strategic Framework for Nepal: “Hazard mapping was identified as necessary in many municipalities and districts, and data collection was identified as a challenge (pg. 6).”

Data collection of the built environment also aligns with USAID’s commitment to address the complex development challenges of urban environments. By generating license free, shareable data that can be used by local government and communities, Open Cities also offers the opportunity to:

• Use open data as a tool for mainstreaming DRR thinking in the Government of Nepal: when data remains inaccessible in specific ministries or organizations its value as a starting point for coordination or discussion is lost.

• Promote open data in accordance with the Executive Order for making open and machine readable the new default for government information.

• Create precedents for using emerging tools, processes, and data in the humanitarian and development sector. In cooperation with USAID’s General Counsel the GeoCenter has previously established precedents for engaging volunteers for the production of geographic data and documented the process for replication by USAID operating units and Missions: likewise, the procedures and lessons from this project will be disseminated openly for replication within USAID.

• Build greater awareness of USAID’s work: analysis conducted by the GeoCenter found that crowdsourcing project that engage with online volunteers to produce geographic data for the Development Credit Authority’s (DCA) increased DCA’s follower base on social media and produced one of the most viewed web pages on the entire USAID.gov website.

**Key Dates**

The following is a notional schedule for support of the Open Cities project.

**June-July 2013:**

• Acquire and process satellite imagery for Dhaka and Colombo and deliver Satellite imagery to OpenStreetMap tasking server. (Imagery for Kathmandu has already been delivered)

• Define online tools for volunteer management; scope any tools to be designed.

• Conduct initial online digitizing assessment to determine how best to “crowdsource” online mapping of buildings in Nepal.

• Establish use scenarios for Open Cities data within USAID

**August-September 2013:**

• Finalize online environment for volunteer management.

• Begin simulations with volunteer leaders in preparation for event.

• Finalize volunteer workflow.

• Begin volunteer recruitment and messaging for event.

**October 2013:**

• Launch crowdsourcing event.

• Writing/editing field guide.
Opportunities for Data Sharing in Nepal

The problem of closed data
During a temporary duty assignment (TDY) to support Open Cities in May of 2013, I met with two, USAID-funded, producers of geographic data in Kathmandu to assess the availability of data that could be combined with KLL data to improve analysis for programmatic decision making. To my surprise, I found two duplicative – or at least disconnected – efforts to produce essentially the same data. It quickly became clear that local stakeholders in Nepal are working to create data useful for DRR; but that these efforts generally lack coordination and that greater data sharing could improve the quality and quantity of information about Kathmandu’s built environment. Two specific cases include:

Open spaces analysis:
The International Organization for Migration (IOM) is currently funded by USAID to identify and prioritize 83 open spaces that could be used for humanitarian purposes following a disaster. The location information has been shared with KLL to be made open via OpenStreetMap: a laudable step in open data. Separately, both NSET and the International Centre for Integrated Mountain Development (ICIMOD) have performed separate “open space” analysis. NSET has identified over 800 open spaces and ICIMOD has created a pilot analysis that is available for viewing (not downloading) online. While the NSET and ICIMOD data may be of an experimental, or “example” nature, there remains a great opportunity to engage the excellent analytical capacity to deepen open spaces analysis in conjunction with the IOM data. The following important questions could then be answered more readily:

- What are the average sizes of open spaces?
- How does population and building density differ at each of these sites and what are the implications?
- Which spaces are more likely to accommodate large-scale humanitarian response operations and which would likely be occupied by displaced persons? As seen following the earthquake in Haiti, even small spaces between buildings can become impromptu camps.
- Which of these sites are expected to be inaccessible?

Building Footprint Data:
One of the primary goals of the Open Cities project is to create freely available geographic data concerning building footprints. I found that at least one other data set of building footprints in Kathmandu had been created – and even made viewable online by ICIMOD – but it is not shared among the other groups I spoke with. Although I was not able to ascertain the owner of this data set (I was told alternately that it was either a product of the Ministry of Home Affairs or the Kathmandu Valley Development Authority) it was clear that the data did come from an “authoritative” source. Moreover, the proof-of-concept data viewer built by ICIMOD allows users to compare the data with the work of KLL: showing differences in both data sets that could be rectified and updated if the “authoritative” data were made open.

This example shows the inefficiency of closed data: KLL is recreating data when it could be updating and improving existing data. The authoritative data, meanwhile, are becoming increasingly outdated as informal settlements and in-migration continue to expand the city. If, on the other hand, the authoritative data were
shared, KLL and the GeoCenter could focus their efforts on harmonizing and updating a much more detailed and complete data set that would be valuable and available to all stakeholders.

![Figure 3: ICIMOD’s proof-of-concept web map application through which users can view building footprints created by KLL (gray) and authoritative building footprint data (yellow).](image)

To be clear: it does not appear that USAID is funding duplicative data projects, rather, organizations that receive some USAID funding produce data that are duplicative when – with better coordination and sharing – could instead build upon other work being done or create new data to support evidenced-based planning.

**Recommendations**

There is a clear need for improved geographic data for DRR in Nepal. There is also a lack of coordination among data producers. This gap could be addressed by leadership from the USAID Nepal Mission’s Office for DRR in coordination with the Office of Foreign Disaster Assistance (OFDA).

**Recommendation 1: Convene Stakeholders to Define Data Needs and Promote Open Data Sharing**

The goal of the meeting would be to define data needs; identify duplicative efforts to be harmonized; and send a clear signal that the donor community supports open data. *This meeting should take place as soon as possible.* A sample agenda for the meeting would cover (but not be limited to) the following topics:

- Summary by each attendee about their data holdings and activities:
  - What data would they like to see created or shared to improve decision making?
  - What data do they possess that would support DRR in Kathamandu?
  - What licensing or use-restrictions exist that may keep them from sharing data?
- Presentation by USAID, the broader donor community, and the Government of Nepal (GoN) regarding data needs to support DRR programming. Examples might include:
  - Open space planning
  - Debris Management
GeoCenter TDY report & recommendations: Nepal

- Data for use by city and local officials for improved urban planning.

- GoN Capacity to house and publish geographic data
  - How can open geographic data mainstream DRR across institutions and plans?
  - How can open geographic data act as a focal point for common DRR planning among different scales of government (e.g. National and local)
  - What GoN entities could play a role in fostering open geographic data?
  - What support for capacity building is needed in these entities?

Possible Attendees could include (this list is not exhaustive):

- GoN
  - Ministry of Home Affairs
  - Ministry of Urban Development/ Kathmandu Valley Development Authority
  - Ministry of Education (currently engaging with KLL to use the school data set)
  - National Information Technology Center

- Interagency, intergovernmental, and non-governmental organizations
  - ICIMOD
  - NSET
  - IOM
  - KLL

- Donor Community
  - USAID
  - The World Bank
  - DFID
  - Japan International Cooperation Agency – JICA

Recommendation 2: Determine how open data can be part of future requests for proposals and contracts

The use, creation, and sharing of open data for development and humanitarian investments should be viewed as standard operating procedure: USAID is in the process of publishing data under the International Aid Transparency Initiative (led by the Bureau for Policy, Planning, and Learning); and the Office of Science and Technology HESN is supporting the GoN’s capacity to capture and publish the geographic locations of donor activities throughout the country.

There are several executive orders and authorities that provide the conditions for collecting and disseminating data as part of USAID-funded contracts or grants. The Nepal Mission, together with colleagues in OFDA, should connect to existing efforts and open data working groups within the Agency to identify these authorities and identify the necessary tools to make open data a standard part of contracts.

Recommendation 3: Capitalize on existing open data

Two key pieces of data for DRR are already open: open spaces analysis by IOM and the KLL school and health facilities data set. Combining these two data sets could answer such questions such as what clusters of schools are furthest from identified open spaces. The resultant analysis should be made open to both encourage stakeholders to build up on the analysis and demonstrate how a greater range of questions – and a deeper level of understanding – results from combining and sharing data than from isolating it.
Citations


Inline Web Links
All links last referenced on June 28th, 2013.

i https://hiu.state.gov/ittc/ittc.aspx


iii https://www.gfdr.org/opendri

iv http://www.gfdr.org/


vi http://wiki.openstreetmap.org/wiki/About

vii http://mapmyschool.net/

viii http://www.nset.org.np/nset2012/


xi https://hiu.state.gov/ittc/ittc.aspx

xii http://www.globalquakemodel.org/


xiv http://blog.usaid.gov/2013/03/help-shape-usaid-policy-on-sustainable-urban-living/


xviii http://www.icimod.org/

xix http://apps.geoportal.icimod.org/KtmERM/index.html

xx http://www.nitc.gov.np/