LESSONS, IMPACT AND FUTURE PROSPECTS AFTER THE IMPLEMENTATION OF A DISASTER-RISK MANAGEMENT SDI IN THE ANDEAN COMMUNITY

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KEY WORDS: Interoperability, Disaster, Metadata, Open Systems, Spatial Infrastructures, International, Sustainable

ABSTRACT:

The Andean Information System for Disaster Prevention and Relief (SIAPAD) is a thematic SDI promoted by the Andean Committee for Disaster Risk Prevention and Relief (CAPRADE) and financed by the PREDECAN project, a joint undertaking by the General Secretariat of the Andean Community (SG-CAN) and the EuropeAid Programme. The SIAPAD was conceived and implemented as a Spatial Data Infrastructure (SDI) providing recommendations, services and tools for discovery, visualization and access to data available in a number of technical organizations within the four CAN countries (Bolivia, Colombia, Ecuador and Peru). SIAPAD includes four national geoportals which offer specialised search tools and information to support decision making for disaster risk management (prevention, mitigation, preparation, relief). Although SIAPAD was recently set up, it has already had some identifiable impacts in the region, and has provided valuable lessons to be taken into account when planning for future developments of information systems for disaster-risk management in the Andean Community and elsewhere.

1. THE PROJECT

1.1 Context of SIAPAD

The Andean region in South America presents environmental and socioeconomic conditions which make disaster risk reduction a priority. Significant factors causing a high risk associated to disasters are the recurrence of dangerous natural phenomena (earthquakes, volcanoes, floods, etc.), together with a growing vulnerability as urban population expands without appropriate planning. The recently published Atlas of Disaster Dynamics and Exposure in the Andean Community clearly identifies and quantifies these risk factors (SGCAN, 2009a).

To address this challenge, the Andean Community developed the EAPAD (Andean Strategy for Disaster Prevention and Relief) (SGCAN, 2009b) as a strategic framework implemented by the Andean Committee for Disaster Prevention and Relief (CAPRADE), and it is closely related to the Hyogo Framework for Action 2005-2015 (ISDR, 2005). In this context, the PREDECAN project (Prevention and Mitigation of Disasters in the Andean Community), supported by the European Union and the General Secretariat of the Andean Community, aimed at implementing the provisions of the EAPAD by building capacities for disaster risk management in the region.

One of the goals of the PREDECAN project has been the implementation of an Andean Information System for Disaster Prevention and Relief (SIAPAD, standing for *Sistema de Información Andino para la Prevención y Atención de Desastres*). SIAPAD was designed to provide tools for information discovery and visualization, facilitating the access of a variety of users to the data available in the different technical organizations within the Andean countries.

1.2 SIAPAD as a thematic SDI

SIAPAD was conceived and developed following a decentralized architecture based on the concept of Spatial Data Infrastructure (SDI), defined as a set of policies, technologies, standards and resources involved in the acquisition, processing, storage and distribution of geographical information by means of open standards (Coleman, D.J. & McLaughlin, J., 1997). In practice, this means establishing a network of Web services among different entities and users, following international standards for geoinformation interoperability.

The SIAPAD network includes two types of nodes (see Figure 1): server nodes and facilitator nodes. Server nodes are the primary-information-providing nodes, hosted by the institutions generating disaster-related information (e.g. geographic, meteorological or geological institutes, infrastructure end environmental ministries, etc.). These nodes publish standard Web Map Services as well as Catalogue Services.

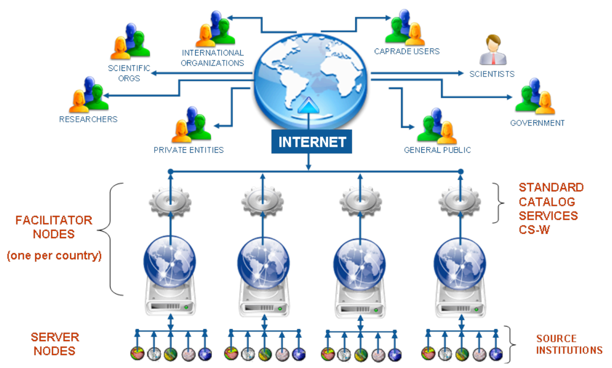

Figure 1. SIAPAD as an SDI network

Each institution hosting a server node is responsible for producing and maintaining the published information, including documents, geodata and metadata. At this moment, geodata are

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only accessible via map services, that is, a map image is transmitted to client applications across the network while the original vector or raster data remains in the server node. The metadata catalog in the server node allows external users to discover the information published, which can then be directly used by Geographical Information Systems or Web geoportals supporting the standard OGC/ISO protocols.

In addition, the SIAPAD network includes facilitator nodes, one for each participating country (Bolivia, Colombia, Ecuador and Peru). Each facilitator node collects automatically the metadata catalogues from all server nodes in the country, and provides integrated search and visualization tools focused on disaster risk management. These tools are implemented as a Web application (the GEORiesgo portal).

2. IMPLEMENTATION

2.1 GEORiesgo portals

The Web portals running at each national facilitator node are named GEORiesgo ('geo-risk'), because of their capability to search and display georeferenced information, as well as documents and Web links. The entry point to the application is the search tab, where users can query for data related to specific disaster-related words, topics or questions. Internally, the queries are transformed to logical search expressions based on a semantic system including synonyms and logical operators. This search expression is then compared to the node's metadata catalogue, collected from all national servers, to find the matching information sources (maps, documents or links).

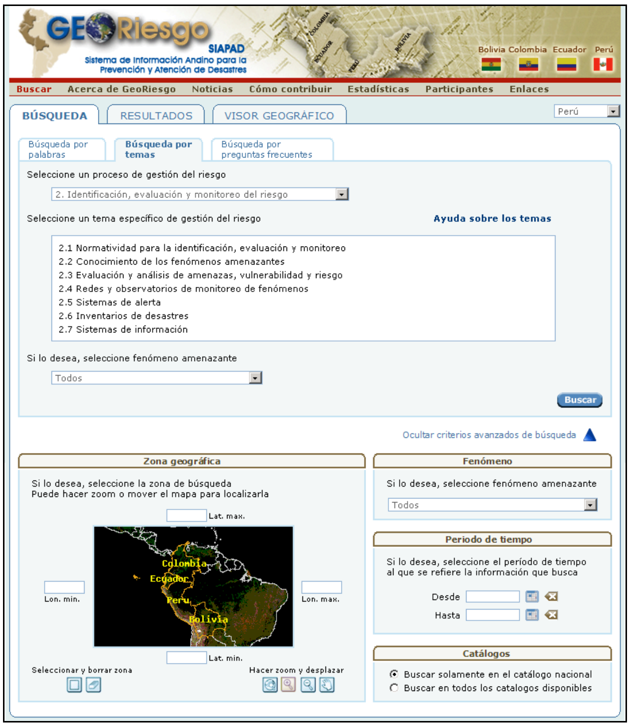

Figure 2. GEORiesgo's search tab with topic selection

The results of the catalogue search process are shown in separate tabs for map services and links/documents. Users can select map services from this list (coming from different institutions) to be displayed in the GEORiesgo viewer tab (see Figure 3). Any layer published in other national GEORiesgo catalogues, as well as any external WMS service, can also be added to this interactive geographic viewer.

Figure 3. GEORiesgo's viewer tab

2.2 Capacity building and institutional servers

It is essential to the SIAPAD functionality that enough quality information is available through the SDI network and that it is properly catalogued (specifically, significant keywords must be used in the metadata), so that the search system can find and correctly access the published documents and geoservices.

To ensure the availability of information, the implementation of SIAPAD included a number of activities focused on building capacities in the technical institutions, enabling them to publish and catalogue disaster-related data, and host the server computers running these services. A number of courses and workshops were offered which provided the system administrators and technicians at the organizations with knowledge of open source tools to create geodatabases and publish map and catalogue services.

In addition, detailed recommendations on web services configuration and metadata creation were produced and distributed, and continuous technical support was provided both in situ and remotely. A Web platform was set up to organize learning materials and serve as a space for discussion and communication between all the participants.

These activities allowed 40 institutions (about 10 per country) to participate in SIAPAD by publishing maps, documents and links to their web pages, where information like weather forecasts, seismology and hydrology reports could be found.

2.3 Results

The SIAPAD network was built with 26 server nodes (some institutions hosted their data together in a single server because of lack of own infrastructure). In addition to these servers, data from the BiVa-PaD project (Virtual Libraries for Disaster

Prevention and Relief) and the DesInventar project (Historical Inventory of Disasters and their Effects) were published as standard Web services using these project's own servers.

As a result, more than 5000 information products are now accessible through the GEORiesgo portals, covering all risk management processes (see Table 1).

	Bolivia	Colombia	Ecuador	Perú
Policy instruments	285	260	311	357
Identification, evaluation and monitoring	239	551	484	840
Education and socialization	75	135	124	256
Reduction of risk factors	80	68	124	213
Emergency response	63	28	98	271
Recovery and reconstruction	82	27	71	89
TOTAL	824	1069	1212	2026

Table 1. Metadata records per process and country

Additional geoservices, like the maps created for the Atlas of Disaster Dynamics and Exposure in the Andean Community, and the new harmonized cartography and statistics coordinated by the General Secretariat, are expected to be published soon in the SIAPAD network.

3. IMPACT

SIAPAD is the most extensive SDI implemented in South America, and a pioneer example in the area of disaster risk management. The establishment of the geoservices network and the GEORiesgo portals is just the beginning of a process that in the near future should integrate more and better information and focused applications into the system.

We can, however, already identify some relevant impacts on the region:

- A clear shift in the policies regarding information access. Disaster risk management is an obviously interdisciplinary field which requires sharing of information between institutions. No efficient mechanism for such sharing existed, other than coordination committees and some individual agreements. For many institutions, selling data is part of their business model and it was not easy for them to accept the need to spread their information across the network. The use of map services (which do not transfer data themselves, but map images) contributed to the relaxation of the communication barriers.
- Related to the former, the initiatives for implementing national SDIs have been reinforced by the development of SIAPAD, which has provided a working example of data infrastructure and provided a large number of basic and specialised geoservices. In some countries, larger information systems (not limited to risk management) are now being built based on the SIAPAD model and data.
- The system has greatly increased consciousness of the possibilities and benefits of integrating data from different institutions and territories. Relevant analysis can now be carried out (albeit only visually) by superimposing layers related from different themes (e.g. infrastructure and resources, population, hazards, occurrence of emergencies, etc.). Also, the integration of data from neighbouring countries enables analysis and actions associated to phenomena spreading across the borders, like hydrometeorological or seismic phenomena

The SIAPAD has also had clear benefits for the participating institutions:

- The generation of standard catalogue and map services has been a drive to improve information organization and quality within the organizations. In some cases, data were unknown or inaccessible to some departments within the institution itself. In many cases, data were duplicated and it was not clear which was the official, most updated version of the information.
- The use of standards for Web services now allows institutions to publish the results of their activities and projects to a wide audience, increasing their visibility and social recognition. In many cases, the organizations have also created their own geoportals by using the same services generated for SIAPAD.
- Through the capacity building activities, institutions have acquired the technical knowledge to publish information and, specifically, to use open source software to do so. Open source software has been instrumental in providing many organizations with the means to setup server nodes, which would have been unaffordable otherwise.

4. LESSONS

As if often happens in any pioneer project, lessons have been learned that can be useful in the replication of the experience in other geographic areas, or in the expansion of SIAPAD to other institutions and topics.

- For any information system to be useful, as important as having the information published, is to properly catalogue it and provide a good search system. In the case of SIAPAD, this had two implications:
    - Metadata creation guidelines (especially keyword assignation) were extremely important, and had to be enforced as strongly as possible. Conversion tools for legacy metadata were implemented in some cases.
    - An ontology of disaster-related terms had to be defined including synonym terms, and used in the search system to facilitate finding information by different techniques (word search, disaster-related topics, questions appropriate for each user profile). This ontology was partly based on the Controlled Vocabulary of Disaster Terminology by the CRID (CRID, 2009).
- A worrisome finding of the project was how often the same work in disaster risk management is replicated in parallel initiatives and projects which don't share or build upon each other, despite their geographical proximity. SIAPAD tried to integrate as much as possible the results of other projects, by using open standards as the key to their interoperability. For instance, the work done in the BiVa-PaD project (López, 2007) to create national virtual library of documents related to disaster risk management provided SIAPAD with valuable resources, but only after conversion tools were developed to transfer the virtual

library records to ISO 19139 standard. Similarly, the maps generated by the DesInventar project (OSSO, 1998), containing disaster effects statistics, could be accessed by SIAPAD after publishing them with the WMS standard, and properly catalogued.

- Another critical topic, since it greatly affects the sustainability of the system, is the need of continuous support to the participating institutions. Capacity building has to extend over long periods of time, and the creation of permanent knowledge resources is key to maintain a working and updated information source. Some mechanisms to achieve this are:
    - Internal institutionalisation of processes and resources related to the system. The use of information systems must be formalized and adopted as an essential part of each institution's strategic plans and daily operations, and be connected to a knowledge management strategy. In the Andean Community, there is a high rate of personnel rotation in public institutions; qualified technicians stay for a few months and they leave to the private sector after acquiring the experience which makes them qualify for a better paid job. It has often happened that changes in the database or server location, without corresponding updating of the metadata records, has rendered all data inaccessible to the SDI network. Other than a strategic shift in government employment policies, this problem can only be tackled by creating strong knowledge management systems and standardizing procedures within the institutions.
- The capability of SIAPAD to integrated different information sources and territories has in turn showed the need to harmonize the methods, content and presentation of disaster risk information. For instance, different countries use different methods to calculate and display seismic risk, so when the corresponding map services are displayed together, they do not match at the borders and don't offer a clear, comprehensive view. Some work has been done to improve this in the region (SGCAN, 2009a). However, an important lesson here is that institutions should not wait until data are harmonized to start publishing the information. Many SDI initiatives don't go very far, or take too long to produce results, because they first try to harmonize different aspects of the information (e.g. spatial reference, metadata, map symbology), which is a long and difficult process. While it is important for disaster-related information to allow for clear and unequivocal interpretation, it doesn't need to be fully harmonized to be useful. Open standards for geoinformation do not require using the same spatial reference or symbology, and early publication can promote harmonization processes.
- A generic but not less important lesson is that, because of the social and political sensitivity to disaster-related topics, it is necessary to carefully manage expectations about what the system will do and won't do at a certain stage, making clear that building the system is a process without end, and that it will take time to reach some degree of practical, life-saving results. In the case of SIAPAD, it will be necessary to extend the information system to local levels and combine it with planning, emergency response and other tools to take advantage of the system's potential.

5. FUTURE PROSPECTS

After the development of SIAPAD in its first phase, a number of future progress areas have been identified and suggested to be supported by the CAPRADE and international donors (Bayarri, 2009). Some of these areas are:

- Completing the current map publishing (WMS service) with standard data geoservices (WFS, WCS). This is a necessary step to enable client desktop or Web applications to perform data analysis which can lead to more powerful risk and impact analysis applications, among others.
- As mentioned, the chance to integrate data from different sources makes more apparent the need to harmonize the methods and representation of the information, and publish it in forms that are closer to the actual user needs regarding content, scale, symbology, etc. A sample case is the publication of population statistics with the right levels of spatial and value aggregation.
- Easier ways to publish and search information must be provided for local institutions and stakeholders to participate in the SDI network, since they can't afford to implement or maintain information services themselves. In this regard, new tools to publish geoinformation in a cloud-based infrastructure instead of hosted nodes could be a great advantage.
- SIAPAD's network and tools should be integrated with specific functional modules for prevention, mitigation and response (see Figure 4), many of which already exist in some form in the Andean Community.

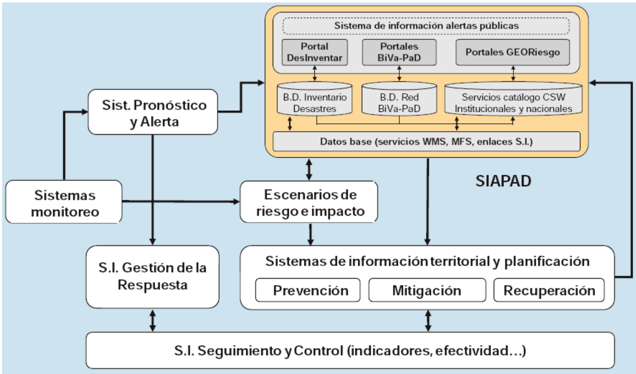

Figure 4. SIAPAD in the context of an 'ideal' information system for disaster risk management

- Especially interesting, because of the range of applications and services which can be built on it, is the integration of real-time sensor data and notifications. This information would enable critical monitoring, alert and early response applications. Existing world-wide space-based initiatives like UN-SPIDER and GEOSS, but also regional initiatives with emphasis on on-the-ground sensor networks (seismic, volcanic, hydrometric), must be explored to define possible integration strategies based on open standards like the Sensor Web Enablement (SWE) and Common Alerting Protocol (CAP) specifications.

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ACKNOWLEDGEMENTS

This article is based on work done during the implementation of the Andean Information System for Disaster Prevention and Relief (SIAPAD) and subsequent technical support. These activities have been possible thanks to the financial support of the European Commission and the General Secretariat of the Andean Community by means of the PREDECAN project (Support for Disaster Prevention in the Andean Community).