Open access to information bridges science and development in Amazonia: lessons of the SIAMAZONIA service

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Abstract
Access to and availability of accurate information has often been stated to play an important role in sustainable environmental management. There is a growing trend of setting up internet-based information services to support the availability of relevant information. The current initiatives that aim to facilitate such information sharing through the web are still, however, often premature and unable to ensure constant flow of data from producers to users. We examine these common challenges by using as an example a network-based facility of biodiversity and environmental information about the Peruvian Amazon region called SIAMAZONIA. Launched in 2001, the service includes data provided by 13 different nodes. The experiences of this initiative have been both encouraging and confusing. A good professional level has been reached, but participation by large information holders is impeded. Participation is obviously considered an additional task rather than an attractive option for enhanced performance at the individual or institutional levels. This dilemma reflects a genuine problem in the modern scientific community, which still lacks agreed ways to reward those who share their data and results through the web. If these problems are solved, internet-based information sharing may become a vital resource for environmental management in Amazonia and also elsewhere.

Keywords: Amazon, data service, internet, information portal, open access, biodiversity

1. Introduction
Access to existing and current information is a basic condition for scientific development and multiparty environmental planning. Limited access to relevant information may lead to biased or delayed progress and unwise decisions. This simple notion is particularly valid in the megadiverse Amazonian rainforests, for several reasons. Despite human development having already influenced many parts of the region and accelerating deforestation having induced serious environmental effects (e.g. Skole and Tucker 1993, Silveira Soares-Filho et al 2006), the Amazon Basin still holds some of this planet’s least human influenced wilderness areas with the highest existing levels of biodiversity (Mittermeier et al 1998). Considering the complexity of ecosystems and the limited amount of scientific research carried out in the region, the overall depth of scientific understanding about these lowlands is critically low (Schulman et al 2007), particularly when compared to the strong environmental problems to be faced, such as accelerating deforestation, deficient societal development and intricate resource management.

Pressures on Amazonia are getting harder due to migration from the overpopulated fringes of the surrounding areas and the deeper integration of the Amazon region into the world economy. Land use planning is under way over broad regions, but unlike in most developed countries, it is being applied to almost untouched areas. The planning activities have benefited greatly from advancing remote sensing techniques during
In the recent decades, as Earth observation effectively reveals environmental conditions over vast extensions (Tuomisto et al. 1995, Boyd and Danson 2005, Toivonen et al. 2007). Despite the improved inventory tools, however, experiences of modern development in Amazonia do not provide very encouraging experiences, as many management investments have led to uncontrolled and opportunistic land use with severe losses in nature (e.g. Fearside 2005).

Also, alternative development pathways can be envisioned (Carvalho et al. 2001, Mäki et al. 2001, Nepstad et al. 2002, Oliveira et al. 2007) and they should be promoted by supportive mechanisms. Ecological–economic zoning is a particularly highlighted procedure that aims to contribute to sustainable development by viable economic, social and environmental solutions that allow the use of Amazonia’s natural resources without destroying its ecosystems (e.g. Sombroek and Carvalho 2002). To achieve this, a sound understanding of the region’s prevailing environmental conditions and processes is critical. This requirement implies that the zoning practitioners should have good access to all relevant existing information, and these should be provided in a form that is easy to understand. Open access to solid information also supports many other societal needs, such as science, education, biotrade, national legislation and the fulfilling of the duties posed by international environmental agreements.

With information being as intense as it is, conservation-sensitive development would indeed benefit from a mechanism between academia and the decision-makers (Laihonen et al. 2004, Cleary 2006). In Amazonia, the collection of relevant information and its transformation into knowledge is mostly in the hands of foreign scientists from different disciplines. A challenge thus lies in bridging the gaps between scientific discussion and land use practices (Norton 1998). A well-functioning joint forum would allow people with different backgrounds to meet and mingle, and thus contribute to sustainable development.

In Peru, the internet-based information portal SIAMAZONIA was launched to combat these challenges in 2001 (figure 1). The service is based on the principle of voluntary sharing of information among scientists and scholars, civil servants, companies, NGOs, students and other parties interested in the Peruvian Amazon region and its environment. In the present article we use this service as an example case of an international environmental information system which has a distributed architecture and an objective to support science and responsible development. We will evaluate the role, potential, pitfalls and significance of this information-sharing effort in the context of the Amazon development. Furthermore, we will reflect on the gained experiences with regard to the overall potential of open access information sharing in terms of participation and impact.
2. SIAMAZONIA: information through integrated network

The SIAMAZONIA service, or Sistema de Información de la Diversidad Biológica y Ambiental de la Amazonía Peruana (Peruvian Amazon environmental and biodiversity information system), aims to provide a fast and reliable reference to diverse kinds of information about the Peruvian Amazon biota and environment (http://www.siamazonia.org.pe/). It constitutes two logical components: a network of nodes and an internet portal that can be modified to support a variety of media forms (cross-media concept). The network is formed by academic institutions or NGOs providing information, and the portal is the channel to share the presented information with anyone interested (figure 2). SIAMAZONIA operates in close interaction with the Peruvian Amazonian Biodiversity Promotion Centre (PromAmazonia, http://www.promamazonia.org.pe/), which contributes to biotrade issues within the same area. They both are outcomes of the Peruvian-Finnish environmental development cooperation project BIODAMA (Biodiversidad de la Amazonía Peruana, 1999–2007, www.iiap.org.pe/biodamaz).

The rationale of SIAMAZONIA comes from the general notion that decentralized multiparty organization catalyses joint actions. Having the primary information holders distributed widely across the world, their interaction in person is hindered, but electronic networking can be used to overcome this isolation. Both the coordination and the computer services of SIAMAZONIA were thus implemented in the city of Iquitos, which is an important regional centre in the lowland rainforest area of north-eastern Peru. While the service was initiated as a national attempt, it has grown to meet with international ambitions. This situation contrasts with the top-down approach of many international players that have only their local task forces in the Amazonian countries.

The early development of SIAMAZONIA was also considered topical because the Convention on Biological Diversity (CBD, http://www.cbd.int/default.shtml) obliged countries to facilitate the exchange of information on biodiversity and its sustainable management through the Biodiversity Clearing House Mechanism (CHM; Juma 1997, CBD 1999, Silva 2004). In Peru, the National Environmental Council (Consejo Nacional del Ambiente; CONAM) is responsible for the Peruvian CHM, and it was positive about the establishment of a specific solution for Peruvian Amazonia. Biodiversity exploration has seen many biases and imbalances geographically, and also for this reason an information facility that is operated within the region itself was welcomed. Furthermore, SIAMAZONIA was well timed nationally, as internet cafés were becoming increasingly accessible and widely used by ordinary citizens.

Technically, SIAMAZONIA has passed through three phases of evolution. The pre-launch planning involved the general framework and development policy for the network and its portal (Miyakawa Solís et al. 2004). The second phase started with the inauguration of the portal in static hypertext markup language in 2001. The third evolutionary phase started in 2005 when many new information services and tools were developed, including dynamic page formation technology that allows effective queries and some key elements of Web 2.0 technology (e.g. RSS, mesh up pages, abundant extensible markup language schemas). Also, the constant
accumulation of new information content and the promotion of the system have kept the implementing team busy, particularly those working in the facilitating node, the Peruvian Amazon research institute IIAP (Instituto de Investigaciones de la Amazonia Peruana, www.iiap.org.pe). This work does not, however, involve substance checking since each data provider is responsible for the quality of its own information.

At present, SIAMAZONIA has 13 nodes of different categories. The facilitating node IIAP provides the coordination and the main web services. The principal nodes that are committed to SIAMAZONIA form the directive committee that steers the development of both the SIAMAZONIA network and the portal. The other nodes are collaborators that provide valuable information but they may not regard SIAMAZONIA as their primary channel of information delivery. Being steered by its committed nodes, SIAMAZONIA expects to attract the confidence of the national and international scientific community to contribute to the network with their data and other output.

The current information content provided by the SIAMAZONIA portal include textual, pictorial, map-form and database materials. Online access to databases of herbaria or zoological museums, and Amazon-specific map servers are enabled via distributed service architecture. All zoning maps of Peruvian Amazonia can be reached through SIAMAZONIA, in addition to a mosaic of Landsat Thematic Mapper (TM) imagery that gives unique possibilities to explore the spatial variability of the Peruvian Amazon lowlands, unrivalled even in the times of Google Earth. Other information contents include an annotated list of the Peruvian legislation relevant to the Amazonian environment, statistics, region-specific grey literature archive, tools to find other relevant bibliography, an expert roster, a discussion arena and photo galleries. Furthermore, the portal includes instructions to set up interoperable and accessible databases.

3. Many of the goals have been reached

The use of SIAMAZONIA has been monitored using indicators provided by Google analytics and in-house server log follow-ups. Although these tools contain some limitations, they provide important insights into the actual use of the portal.

According to the log data, there has been a constant gradual increase in visitor numbers over time. To give an idea of the overall use level, during a monitored one year period (October 2006 to September 2007) SIAMAZONIA had a total of 20 970 visits by 15 756 unique visitors. The great majority of visits come from Peru (70% of visits), while the other frequent visitors are other Latin American countries (8.4%), USA and Europe. The visitors found their way to SIAMAZONIA in three almost equally important ways; i.e. through referring sites (37%), search engines (33%) and direct traffic based on a typed URL (30%). Approximately three quarters of the visits were new to this site. These and other logging data indicate that SIAMAZONIA succeeds in attracting a constant flow of new visitors, but the site is used for deep reading by only a few. This is somewhat as expected, since SIAMAZONIA is targeted to serve professionals and scholars, and thus the general public interested in the touristic attractions of Amazonia may find it less interesting. SIAMAZONIA also acts as a referral service through which the original internet sources of some specific information content can be found.

In terms of its national recognition, SIAMAZONIA has more or less reached its early set goals. It is considered as the leading provider of facts about tropical Peruvian Amazonia, as indicated by the typical monthly level of more than 1000 visits from Peru. It has been recognized as an inventive national site on the internet because of its information content and distributed structure. SIAMAZONIA has initiated discussions on some critical issues of internet information, such as use ethics and intellectual property rights. The possibility to consult maps, satellite imagery and related information that reflect the current status of the ecological and economical zoning is one of the much used services by Peruvian users. All in all, the importance of SIAMAZONIA in the Peruvian context cannot be denied, yet it may be difficult to define the specific implications of these uses in terms of the planning and management of the Amazon region.

Internationally, SIAMAZONIA is by far less known, yet it gets visitors from tens of countries each month. SIAMAZONIA’s experience is recognized most by neighbouring countries like Bolivia that are seeking to build up similar information facilities. SIAMAZONIA is the first Peruvian data provider in the GBIF (Global Biodiversity Information Facility, http://www.gbif.org/), and it has encouraged two other nodes in Peru to become independent data providers in the GBIF too. SIAMAZONIA also appears in many regional link lists and it is referenced as a source for additional information about the Amazonian rainforests in Wikipedia’s English and Spanish chapters. In the latter, SIAMAZONIA also appears as a topic by itself. NASA has nominated SIAMAZONIA as a regional reference in its Global Change Master Directory.

Despite these recognitions however, numerous specifically Amazon-related portals neglect SIAMAZONIA in their link lists and no international partner apart from the present nodes has turned to SIAMAZONIA to enrich its information resources. The search engine traffic directing to SIAMAZONIA shows that most often the service is found based on the brand name itself, or by some of its main contents in the Spanish language, such as ‘diversidad biológica’ or ‘Amazonía’. This is an indication of a rather biased recognition of the service by the internet community.

4. Factors of friction

The concurrent situation of SIAMAZONIA is both encouraging and challenging. Although it is one of the strongest decentralized information services concerned with the Peruvian Amazonian region, it is still neglected in many relevant instances. This notion implies that many hindrances still have to be overcome.

Visibility and speed. Although SIAMAZONIA succeeds in attracting hundreds of new visitors each month, the site is still hidden on the periphery of the internet in a global perspective. Technically, it is also slower to use than many other services on the internet. From the data provider’s
point of view, these hindrances reduce the attractiveness of SIAMAZONIA as a forum to come up with new information about the Amazonian environment. The emergence of new links from other relevant sites may, however, start a positive cycle of visibility. SIAMAZONIA can also be reinforced by links from other relevant sites may, however, start a positive cycle of visibility. SIAMAZONIA can also be reinforced by active promotion and technological updates.

**Restricted area interest.** For many international science and conservation actors, the Peruvian part of Amazonia is just too restricted an area to concentrate on. This constraint could be overcome by a wider-focused information service, such as the Amazon Basin Biodiversity Information Facility (ABBIF) that is planned by the GBIF organization (http://www.gbif.org/prog/ocb/abbif). SIAMAZONIA could be adjusted to form one of the key components of such a regional endeavour.

**Language.** Despite there being a large community of scientists working and publishing in the Spanish language and being active on the internet, the fact that SIAMAZONIA is available in only one language is a clear restriction. For an individual scientist working mainly in English, both providing content and utilizing SIAMAZONIA may be too laborious. Based on their browser settings, SIAMAZONIA visitors represent some 20–30 languages, but the portal is by far most visited by Spanish browser settings. This condition should not, however, be an issue for those organizations that have been actively working in the country for decades already and are consequently used to working in Spanish.

**Reliability.** Those who search for hard data from the internet tend to rely on the sites provided by institutions with a long research track-record in Amazonia. SIAMAZONIA may not yet have reached the required level of recognition. SIAMAZONIA’s very nature as an information portal operated within the Amazonian region may also appear suspicious in the eyes of international players. This is a contradictory situation, since operating within the same region that the portal is about could also be considered as an obvious strength.

**Durability.** As in the case of many other information services, SIAMAZONIA has been developed under a project. It seeks to be a durable network that also supports other Amazon-specific biodiversity and environmental projects, but the true vitality of the system is measured only when self-standing sustainability is achieved. As participation in an information-sharing initiative is a long-term commitment, those who hesitate in participation as nodes may see a risk of too unstable ground.

**Interference between initiatives.** The Internet abounds in platforms of biodiversity informatics alone, and there is overwhelming environmental information to digest anyway (Carling and Harrison 1996). New project-based facilities emerge on the Internet frequently, but a collaboration culture supporting open access to information is underdeveloped. For many projects it is important to gain visibility, and the setting up of a new portal rather than contributing to an existing one may be a requirement by the funding organization. A number of different services and networks try to improve the interoperability of distinct biodiversity information initiatives in global architectures (Bisby 2000), but even their contribution may be confusing.

**Effort required by data providers.** Providing data to an information service is always an effort, and those who could come up with new data are very busy anyway. Why make additional effort for SIAMAZONIA? Fortunately, the current technological development that applies standard protocols smoothens the way for those who seek to contribute to different platforms, as one data-providing interface can simultaneously serve different portals. Thus, from the information provider’s point of view, a single investment may be utilized in many different occasions.

5. **Open access information sharing can support development**

Because information is fundamental to science and development, any effort toward information sharing is appreciated. The practical efforts may, however, be less influential than intended, and there is always a risk of misuse of the provided information. In our view, the pros are nevertheless greater than the cons.

Information-sharing facilitators have to be like jugglers who are able to keep many simultaneous processes moving (Kalliola and Toivonen 2007). Data providers must be activated and facilitated to participate, and the anticipated users must be alerted and satisfied with the provided content. The SIAMAZONIA service obviously still struggles with these challenges, as do many other efforts of biodiversity information sharing on a voluntary basis. No matter how wanted and promoted they are, many initiatives just do not draw the required level of attention within the scientific community, i.e. the primary data providers.

An example of this is the clearinghouse mechanism that was welcomed for a better discovery of biodiversity information right after the Rio summit in 1992. In most countries it was considered as only an administrative effort, and consequently the national clearinghouses have ended up with fairly effortless solutions with low participation by the scientists (Laihonen et al 2004). The GBIF initiative was launched as a more straightforward channel for the sharing of biological data, particularly among scientists (Edwards et al 2000), but it, too, struggles with problems of participation.

Some recent efforts of global Earth observation fortunately contrast with the experiences seen in biodiversity informatics. For example, the Global Earth Observation System of Systems (GEOSS, Lautenbacher 2006), which aims to produce societal benefits through coordinated Earth observations, data management and data sharing, brings together many environmental institutions worldwide. International networking is equally important in biodiversity, but the traditional work cultures in the academic community appear to be too individualistic and conservative compared to the Earth observation organizations with institutional ownership over data.

The data producer’s perspective for participation is that of motivation and resources. A regional undertaking such as SIAMAZONIA requires even a degree of idealism to lure national and international data holders to participate (see Peterson et al 2003). To be a node is an effort, so the question arises: what are the mechanisms of reward and how highly are they valued? Despite the scientific practices of publicity and transparency being agreed upon, they alone are not enough to
motivate scientists to share their data. It may even sound like giving it out for the benefit of other scientists. The development of appropriate ways to reward those who allow open access to their data must be solved within the scientific community itself. The solutions should be compatible with the overall scientific ethics that have been fundamental in science for hundreds of years.

Another major challenge lies in the bridging of scientific information with administrative planning and decision-making. In a civil society anybody may find her/himself in the position of making critical decisions that have an effect on the surrounding environment. This implies that reliable environmental information ought to be accessible and understandable. Scientific jargon is not easy to digest and its open-ended reasoning may be frustrating when practical solutions are searched for. Also, incomplete data sets, uncertainty and terminological pose real challenges for any practical user who seeks for clarity and deterministic solutions (Bradshaw and Borchers 2000, Mäki and Kalliola 2001, Narasimhan 2007). To meet the expectations of ordinary information users without sacrificing scientific precision is a dilemma that the current information networks and portals have not resolved.

Currently, the internet is increasingly becoming dominated by the large information-organizing giants such as Google, Yahoo or Lycos, and Wikipedia is an example of a volunteer-based information platform with a form of collective quality control. Despite these kinds of structures evolving quickly, there is still a niche to fill for the scientific community. In comparison with the free platforms, scientific initiatives on the internet should be characterized by their critical self-regulation ability based on scientific ethics, peer review, mechanisms of recognition and a useful interface to communicate with the rest of society.

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