BioOne COMPLETE

GIS as a Tool in Participatory Natural Resource Management

Author: Bussink, Coen

Source: Mountain Research and Development, 23(4) : 320-323

Published By: International Mountain Society

URL: https://doi.org/10.1659/0276-4741(2003)023[0320:GAATIP]2.0.CO;2

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

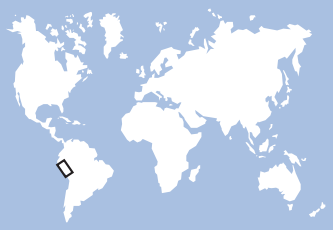
Downloaded From: https://complete.bioone.org/journals/Mountain-Research-and-Development on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

Mountain Research and Development Vol 23 No 4 Nov 2003: 320–323

Coen Bussink

GIS as a Tool in Participatory Natural Resource Management

Examples from the Peruvian Andes



Geographic Information Systems (GIS) are often seen as incompatible with participatory processes. However, since the late 1990s, attempts have been made in numerous projects around the world to define "best practices" for improved natural resource management projects that integrate participation and accurate spatial information, using GIS (for example, see www.iapad.org/participatory_gis.htm). This article describes a project in the Peruvian Andes where spatial information played a key role. Can GIS help narrow the gap between professionals and farmers or local officials? Or is it really a top-down tool that requires too much expert knowledge; and are investments too great for remote rural areas? Examples of successful use of GIS are provided in this article, while practical complications and methodological constraints are highlighted.



FIGURE 1 The geographic locations of the 3 project catchments in Peru. (Map by Henry Juarez, CIP)

Three case studies in Peru

Enhancement of natural resource management (NRM) in the Peruvian Andes depends principally on farmers, who are the main land users. Although decision-making processes take place principally at the farm and parcel level, farmers' decisions affect larger areas—a district or a catchment. It is often at these higher levels that NRM problems are observed. The challenge, then, is to solve problems on a greater scale by working with decision makers who manage only small parts of an area.

From May 2000 until May 2002, the Consortium for the Sustainable Development of the Andean Ecoregion (CONDESAN) and collaborating NGOs (Table 1) implemented a project that applied geographic information systems (GIS) to improve NRM and to help design rural development projects using participatory processes. The project was initiated in 3 catchments, 2 in the northern department of Cajamarca and 1 in the southern department of Puno, with 1 NGO working in each catchment (Figure 1).

During the project, NGO staff participated in training workshops on the use of GIS. Inexpensive software (IDRISI) and, as far as possible, existing, secondary data were used to make the methodology convenient and replicable for local organizations in the Andes. GIS aspects of the project were further supported by a GIS specialist from the International Potato Center (CIP) and by GIS students who did internships with the NGOs.

In each catchment, committees were organized consisting of stakeholders such as municipal authorities, community leaders, and local institutions. A series of workshops were held in selected communities and Participatory Rural Appraisals (PRAs) were carried out to analyze problems related to NRM and agricultural production.

Downloaded From: https://complete.bioone.org/journals/Mountain-Research-and-Development on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

TABLE 1 Characteristics of the three project catchments.

Catchment	Mañazo	Cuzcudén-Cardón	Asunción
Participating NGO	Centro de Investigación de Recursos Naturales y Medio Ambiente (CIRNMA)	Centro Ecuménico de Promoción y Acción Social (CEDEPAS)	Asociación para el Desarrollo Rural de Cajamarca (ASPADERUC)
Area of catchment (hectares)	26,915	4240	8516
Elevation range (m)	3860–4850	1220–3275	1650–4130
Average annual rainfall (mm)	280–980	360–920	500–1000
Number of households	1700	733	1300

To feed the GIS, a "minimum data set" on natural resources was defined and constructed. It included climate data, maps and databases on soil and ground cover, as well as altitude data from contour line maps. In addition, available socioeconomic and agricultural production data were collected.

If information was insufficient or unavailable, primary (new) data had to be collected. For example, few preexisting detailed data were available on hydrological networks, location of springs, irrigation canals, and community boundaries. These data were collected by project members with GPS receivers, accompanied by community representatives.

Practical complications with data collection

A common problem in gathering data is that databases are not freely available. Frequently, success in accessing data depends on able diplomacy or interpersonal relations with the staff of an institution. Because of the NGOs' lack of experience in digitizing information and the relative complexity of IDRISI, it took 1 year to complete the minimum data sets.

The NGOs in the 2 Cajamarca catchments were compelled to produce primary data on soils and ground cover because of the lack of sufficiently detailed data. A soil specialist from the University of Cajamarca was hired to carry out this task (Figure 2). Generating information rather than using existing information offers the advantage of rapid collection of information with standardized (formal) methods for the entire study area. But it is also a relatively expensive approach that may not always be possible. In Mañazo, only existing studies on natural resources were used; this led to problems due to the incompatibility of studies done in different years, with different coverage, at different scales, and elaborated with different methods, legends, and classifications.

Practices in the catchments

Concurrent with the data collection process, the NGOs tried to identify useful GIS applications on the basis of the priority settings that resulted from the PRA exercises. Experiences in the 3 catchments are described below.

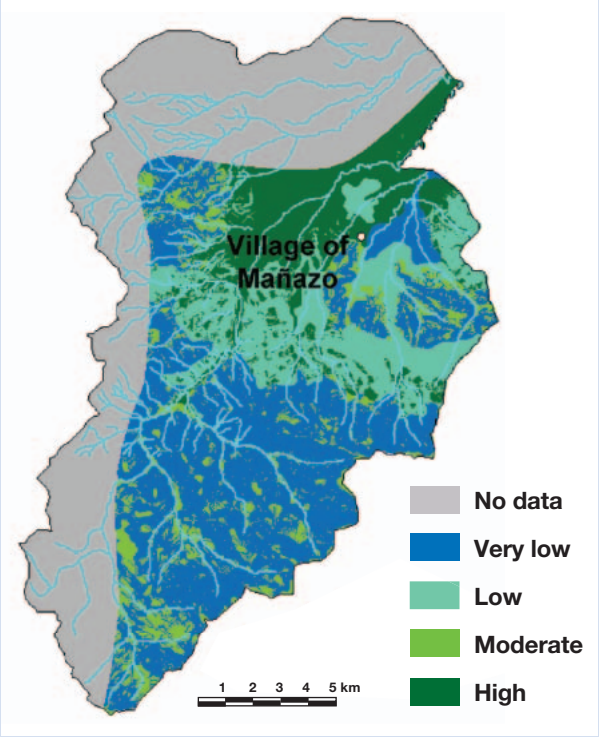
Mañazo: Because of the high altitudes in the Mañazo catchment, there is not



FIGURE 2 Data collection on soils in the Cuzcudén-Cardón catchment. (Photo by author)

Downloaded From: https://complete.bioone.org/journals/Mountain-Research-and-Development on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

FIGURE 3 A final map of the potential for pasture improvements in the Mañazo catchment. (Map by Mathieu Plantecoste and Juvert Coila, CIRNMA)



much crop production and most of the land is used as pasture grazed by cows, llamas, alpacas, and sheep. It was thus no surprise that local communities identified improvement of pasture production as a priority. In IDRISI, different biophysical criteria were combined to create a map showing the potential for pasture improvements. The analysis included slope, drainage, salinization risk, and soil acidity data that were integrated by classification as high, medium, and low in terms of profitability. The resulting map (Figure 3) was presented to the local authorities and farmers. They agreed on the outcome, although the results were not a surprise to them. "We know where to grow a specific crop, or where not, but we didn't know how large these areas are and that the reason why some areas do not produce well is the acidity or salts in the soil," was the general reaction of the farmers in the community of Canllocollo (cited in the final project report by CIRNMA). The farmers recognized the importance of prioritizing areas when large investments must be made to improve productivity. Unfortunately, there were no funds available to actually carry out real improvements.

Farmers particularly appreciated parcel-level maps, such as current land use maps, because these reflected their day-to-day reality most closely and helped them calculate exact parcel areas (at 1:5000 scale). Nevertheless, the scale of the natural resources data (1:25,000) did not allow any spatial modeling at this detailed level.

Cuzcudén-Cardón: The Cuzcudén-Cardón catchment is a semiarid catchment with mixed production systems and severe constraints on water for irrigation. CEDEPAS made a participatory inventory of the water sources and canals, using GPS receivers and streamflow measurements. Because of lack of data on a comparable scale, spatial modeling was not possible on this scale. GIS, therefore, was mainly a tool to register and visualize the available resources.

Catchment-level data, such as the soil and topography maps, were used to identify soil conservation priority areas and potential production areas, such as the potential for different timber tree species and pastures. As in Mañazo, the stakeholders did not dispute the results, but these results were not implemented. Farmers and local authorities stated that they first needed more explicit plans.

Asunción: The Asunción catchment is another area with mixed production systems but it is less dry than the Cuzcudén-Cardón catchment. ASPADERUC has put great effort into developing participatory methods to support community-based NRM—by developing participatory soil maps and using aerial photographs in community workshops.

The results of this approach motivated stakeholder groups that worked on practical environmental issues (integrated pest management, soil conservation). Although the use of aerial photographs gives stakeholders a feeling of being "in the picture," it requires expert knowledge for geometrical correction of spatial distortions and displacements that occur in aerial photos in mountainous areas when using GIS.

Potential production maps were developed for a number of crops such as *taya* (*Caesalpinia spinosa*) and *cherimoya* (*Annona cherimola*), but no further use was made of them. However, ASPADERUC experienced the value of GIS and the

Downloaded From: https://complete.bioone.org/journals/Mountain-Research-and-Development on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

maps as a stimulating contribution to dialogue on collective decision making and improvement of future project proposals.

Conclusions and recommendations

In the 3 catchments, GIS proved to be an effective tool for integrating and presenting environmental information that frequently existed but was not yet available or displayed in a GIS mapping format. Observing this information helped motivate stakeholders and is a useful way to build awareness regarding the environment at community workshops (Figure 4).

Nevertheless, stakeholders are interested in the parcel level and focus more on improvements in production than on catchment (communal) problems. The NGOs involved in the project tried to get closer to the reality faced by farmers. First, they attempted to be as participatory as possible (farmer field schools, participatory maps) and elaborate detailed georeferenced base maps that zoom in on the parcels. Second, they focused on production potential at the catchment level. In the first case, where a very basic GIS was applied, they achieved good responses from the farmers. However, the scale of the remaining databases (1:25,000) was not sufficiently detailed to exploit the full potential of GIS, in terms of multicriteria modeling exercises at the parcel level, for instance. Developing more detailed georeferenced information at parcel level is a very time- and money-consuming activity and would not be a realistic aim. The second effort—elaboration of production potential maps—had a limited effect, principally because of the lack of clients who could benefit from such analyses. This was primarily determined by the design of this project, where catchment data sets were generated without urgent demand. Local authorities will be important potential clients at the municipality and catchment level if they obtain greater power. For example, in neighboring countries such as Colombia and Bolivia, decentralization is more advanced, and municipal territorial planning with GIS has been more extensively applied.

Given the success of simple maps and the relative complexity of IDRISI, it is preferable to work with more user-friendly GIS. For communication purposes, easy generic and freely available GIS software (TatukGIS-viewer, Map Maker) is sufficient to combine map layers, visualize spatial characteristics, and make straightforward prints. Despite the difficulties in obtaining primary data, the increasing availability of free data on the Internet will facilitate this type of work, for example by using digital elevation data (with 90 m resolution) provided by the Shuttle Radar Topography Mission (www.jpl.nasa.gov/srtm).

NGOs have benefited the most from the GIS. They have learned to use the tools, which helped them analyze natural resources in a catchment. GIS maps have become important means of sustaining their project proposals and putting catchments on the donors' map. But the final impact on development has yet to be proven.

FIGURE 4 A farmer of the Canllocollo community and an NGO facilitator in the Mañazo catchment discuss a land use map. (Photo by author)



ACKNOWLEDGMENTS

This article is based on the work of 3 NGOs: CIRNMA, CEDEPAS, and ASPADERUC. I am especially grateful to their GIS specialists: Juvert Coila, Carlos Cerdán, Pablo Sánchez de Francesch, and community facilitators Hector Machicao, Mariano Godoy, and Luis Chuquiruna. I also wish to thank the farmers and other stakeholders in the Cuzcudén-Cardón, Asunción, and Mañazo catchments; Craig Ficenec, who did his Masters thesis on this subject; the CONDESAN coordinators during this project, Joshua Posner and Elias Mujica; Mathieu Plantecoste, who did his internship at CIRNMA; and Robert Jan Hijmans and David Yanggen at CIP. The project was financed by the Ford Foundation.

AUTHOR

Coen Bussink
Geographical Information Systems and Natural Resources Management, International Potato Center (CIP), Apartado 1558, Lima 12, Peru.
c.bussink@cgiar.org
coen_bussink@hotmail.com

Coen Bussink works with GIS and in the field of NRM. He was an associate researcher at the International Potato Center until August 2003. Besides the project described in this paper, he also worked on mapping of periurban agricultural areas, biodiversity mapping, and geographic impact targeting for poverty alleviation and crop production. He is currently a visiting researcher at the International Institute for Geo-Information Science and Earth Observation (ITC) in Enschede, The Netherlands.

FURTHER READING

Abbot JR, Chambers C, Dunn T, Harris E, De Merode G, Townsend Porter J, Weiner D. 1998. *Participatory GIS: Opportunity or oxymoron?* Participatory Learning and Action Notes. Volume 33. London: International Institute for Environment and Development (IIED). Also available at: www.iapad.org/publications/ppgis/participatory_gis_opportunity_or_oxymoron.pdf.

Craig WJ, Harris TM et al, editors. 2002. *Community Participation and Geographic Information Systems*. London: Taylor & Francis.

[IAPAD] Integrated Approaches to Participatory Development. 2003. *Participatory GIS.* http://www.iapad.org/participatory_gis.htm. Accessed in July 2003.

Various authors. 2002. GIS and the fingertips [Special issue]. *Asean Biodiversity* 2:10–52.

Downloaded From: https://complete.bioone.org/journals/Mountain-Research-and-Development on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use