Chapter 7

Case Study: Grassroots Mapping in Lima, Peru

7.1 Introduction

In the interest of basing tool development and design on real-world applications, and due to an ongoing conversation with Carla del Carpio of Lima-based Manzanita 'A', I travelled to Lima, Peru in January 2010 to work with residents of several informal settlements and a number of NGOs on Grassroots Mapping projects. From the start, this was considered an experimental program, where Peruvian collaborators would help to better define needs and to iterate and improve upon the balloon and kite imaging techniques.

The program was also explicitly educational in its goals, and with educators from Lima-based CEDRO and Manzanita 'A', a curriculum was developed to involve local youth in the mapmaking process. We placed emphasis on examining the cartographic process with students not only in the sense of recording the present layout of students' communities, but with the intent to depict and discuss geography in the context of their history and future. We devised a series of exercises were devised to situate mapping as a way to examine and reflect upon rapid urban growth and participatory urban planning such as occurs in the partner communities.

Figure 7.1: Children capturing aerial imagery in Canta Gallo, Lima, Peru.

This alignment of mapmaking with education and youth empowerment was not new to the project, but for the first time it was one of the primary goals. Mappers often ask me why I work with kids; educators, on the other hand, rarely ask why I focus on mapping. To answer the former, one of the main reasons is that kids are

good mappers. They represent a wealth of knowledge about the very details of a community which adults are likely to gloss over. They have the attention span, the patience, and the enthusiasm, and are often more open-minded and creative than their adult cartographic colleagues. They bring a unique point of view to mapmaking, taking less for granted about their geography, and stand to learn a great deal from such a combination of the physics of flight, the mathematics of cartography, the history of urban development, and the political implications of their physical world. Roger Hart emphasizes in 'Children as Community Researchers' the potential for children to 'learn to see themselves as competent and confident members of their community', pointing out that 'Children and adolescents appreciate the opportunity to feel that they can play a useful role in community or environmental improvement.' [34]

Making maps of such quality and utility with school children also highlights the ease with which such maps can be made to skeptical adults, and pragmatically speaking, it can be hard to use balloons and kites in any populated area *without* including kids, as they usually come out of the woodwork, eager to participate. Finally, there is a sense that everyone becomes a child when flying balloons and kites, and certainly the presence of a large group of eager kids tends to ease the inhibitions of curious adults, encouraging them to loosen up and take part in the fun.

The selection of Lima as a site for prototyping and collaboration was also due to its history of informal settlement, and the project was intended to provide easy and inexpensive alternative means for communities to produce maps specifically for tenure claims. My colleagues in Lima and I believed that it would be possible for partner communities to submit such maps to the relevant authorities[1] as part of official petitions for land title. However, we felt that this agenda should be secondary to the educational goals we established, and to emphasize the benefits of process over end product. Further discussion cemented our belief that as non-residents — who would not be affected by the legal outcomes — it was not our place to aggressively advocate such uses.

7.1.1 The Other Path: Lima's history of informal settlement

Lima's history made it an especially suitable choice for participatory mapping on a cultural level as well, as it has expanded over the last century to include a full third of the population of Peru, in what has become a process of continuous and transformative growth. The result is a city in which large tracts of land have been settled 'extralegally', a term borrowed from Hernando de Soto's exhaustive history of the city in 'The Other Path'. These settlements are known locally as 'invasions' due to their inhabitants' sense of having not only literally seized the land from private landowners or the government, but of having unilaterally constructed a working alternative to the official municipal government, including public works, tax collection, and education. These communities, typically made up of only a few hundred people, are truly independent from the central government, and only through a years-long process are able to gain title to their land along with basic services such as plumbing and electricity.

De Soto paints a picture of a government and bureaucracy entirely overwhelmed by floods of immigrants from rural areas, and entirely unable to accommodate these newcomers in a coherent or efficient legal process. 'We appear to be witnessing', he writes, 'the most important rebellion

[1] An organization known as Organization for the Formalization of Informal Property (COFOPRI), whose mission is to 'Execute the creation of property rights such that they provide sustainable, judicially secure ownership titles.' ('Ejecutar las acciones de generacin de derechos de propiedad predial que otorguen seguridad jurdica permanente y que sean sostenibles en el tiempo.') [18]

against the status quo ever waged in the history of independent Peru.' The numbers are stunning; even at the time of his writing in 1987, he describes in detail how '...through invasions or illegal aquisitions of land, neighborhoods sprang up which today account for 42.6 percent of all housing in Lima and are home to 47 percent of the city's population.' [23]

This situation, though not unique in the world, is especially appropriate as a place to attempt a mapping project which acts both outside of traditional cartographic means of production, and outside the conventional framework of GIS. In the months that followed the Lima project, I began to refer to the tools and techniques which were prototyped in Lima as a 'DIY satellite', and that seems fitting given that in the invasions of Lima, residents are accustomed to Doing Everything Yourself, from constructing roads to building and maintaining their own plumbing. In addition, any means to reduce the barriers to acquiring tenure is of high value; de Soto's research shows that the market value of a plot of land increases ninefold when its owner receives official title. As in many urban slums worldwide, most residents do not have a bank accounts; the home itself represents the primary means of storing wealth. Land title therefore becomes a form of valuation, and makes it possible to sell one's plot, or use it as collateral for a loan. More than anywhere else, cartography is inextricably connected to basic systems of value in the invasions, making them an exciting place to test a more participatory means of making maps.

Additionally, we identified a number of more immediate applications for an up-to-date map. Both CEDRO and Manzanita 'A' looked forward to using maps for research and planning purposes for their ongoing projects in the settlements. The maps could also be used to support decision making amongst community leaders, for public works projects, land use discussions, and even for promotional purposes. Simply providing another means for community members to gain access to a map would allow them to compare it to the 'official' version, or to independently verify that the community was in fact built to their agreed plot divisions. Finally, the process of making the map would build literacy in cartography and give participants more say in how their community is represented to the outside world.

Figure 7.2: Measuring homes with a paper measuring tape in Juan Pablo II, Lima, Peru.

7.2 Mapping with Juan Pablo II

Both Manzanita 'A' and CEDRO were enthusiastic about the potential of a mapping project from the outset, and Carla del Carpio coordinated with CEDRO's Ernesto Fernandez to set up a 6-day program, or 'Projecto Integral' with a group of approximately a dozen students in the Juan Pablo II settlement in Lima's Villa el Salvador district at the south end of the city. Each day of activities, held between January 12 through 28th, lasted from 11am until approximately 3pm. 4-6 CEDRO

instructors and 2 from Manzanita 'A' attended, and the students ranged from 8 to 14 years old. The Juan Pablo II community consists of approximately 6 blocks of homes arranged in a loose grid, though this was not apparent from the Google Maps imagery, which we dated to approximately 2006, or 4 years earlier. The community was 5-6 years old, and many but not all of the students remembered when their families had first come to the site.

We began the workshop with an introduction to map making, by asking students to work together to draw their community. This resulted in a variety of means of representation, though as we continued to discuss maps, they tended toward a birds-eye view. Even then, some experienced difficulty in collaborating on a drawing at a common scale, with some adjustments and redrawings occurring once each student's map intersected their neighbor's. An attempt to show the existing Google Maps imagery and to ask students to identify their homes or even the entire community in a map were not successful; the maps did not seem relevant to participants, as most students seemed not to have a high degree of computer literacy or exposure to the internet. Next, students enthusiastically constructed measuring tapes and we broke into groups to literally measure the homes.

First flights in Juan Pablo II

Interested in quickly capturing aerial imagery and moving on to analysis, we begin flying balloons on the 14th of January. Four balloons, each approximately 3 feet in diameter, were attached to a Picavet suspension (see Subsection 6.1.4) and launched on a 500 foot tether of nylon kite string. Winds of over 10 mph prevented us from capturing many images from high altitude, and frustratingly, this continued to be the case for several subsequent sessions.

Involving the students as full participants, or actors, in the process was also difficult, as only one or two people could hold the balloon at a time, and it required several minutes of experience before students were confident enough to reel the tether on their own. Juan Pablo II is located on a southward facing hillside, and the kites flew at a very shallow angle — close to the ground – as wind blew northward over the ridge. We attempted a variety of kites and launch locations.

On the 26th, after several more attempts with both balloons and kites, we captured several uesable images of the community, and together with Carla del Carpio and Ysabel Luisa of Manzanita 'A' I stitched together the images into the best and most up-to-date map yet of Juan Pablo II.

Figure 7.3: Initial balloon flights in Juan Pablo II.

Figure 7.4: Completed balloon map of Juan Pablo II, produced with Adobe Photoshop CS4. The map is overlaid on imagery from Google Maps for comparison.

Situating mapping practice

Establishing a rapid feedback loop with participants is of paramount importance, especially when they are dependent on external aid for part of the mapmaking process. In Juan Pablo II, the lines between 'researcher', 'cartographer', and 'participant' were blurred, as all parties were learning to create maps together in a novel process. Throughout the flights, we made regular prints of the aerial imagery we were able to capture and shared these with the participating students. Many of the most popular were taken from only a few dozen feet above the ground, but showed the students and their immediate environment from a new perspective.

However, while we awaited a major success in capturing imagery (a success which took 14 days to achieve), the students were engaged in other projects. Beyond discussing and drawing maps of Juan Pablo II, students interviewed their parents and presented drawings and short reports on the history of the settlement. This resulted in some cases in very detailed accounts of how homes began as straw 'caracoles' or tents, and progressed to wooden, metal, and even brick structures.

One student named Frank recounted what year his family received electricity and when they began planting a garden. While these details may be exciting to hear from a historical, anthropological, or aid perspective (I had received specific requests from a cartographer from the World Bank for details on house construction), for myself and my fellow teachers, it served the more important role of contexualizing the current state of the settlement — for the students — in a years-long process of construction and reinvention. It also emphasized the time dimension of mapping, so often neglected, which in areas of such rapid change can render mapping efforts obsolete within just a few years. Indeed, the maps we were beginning to produce from aerial imagery showed that those available on Google Maps were so old as to omit entire roads and buildings.

We then asked students to produce similar work — drawings and written reports – on how they imagined the community might look in the future. We asked in this case for a depiction of the entire settlement, and were surprised when two students brought back a three dimensional model of Juan Pablo II, as it might appear seven years in the future. While the early aerial images and mapping exercises had prompted many students to depict their community in a bird's-eye view, this maquette revealed many details related to wealth and quality of life, and an awareness of family needs. Unlike in present-day Juan Pablo II, the model depicted many two or three-story buildings – signs of long-term tenure and financial stability, and perhaps rental income. The buildings were largely depicted as brick, and many had stores, such as a hair salon or a flower shop, on their ground floors. An especially interesting feature was a 'Wa wa wasi', or day care center, which does not exist in present-day Juan Pablo II, but which allows two parents to work longer hours while their youngest children are cared for. Paved roads, plantings, and a soccer field completed this ambitious plan for the settlement.

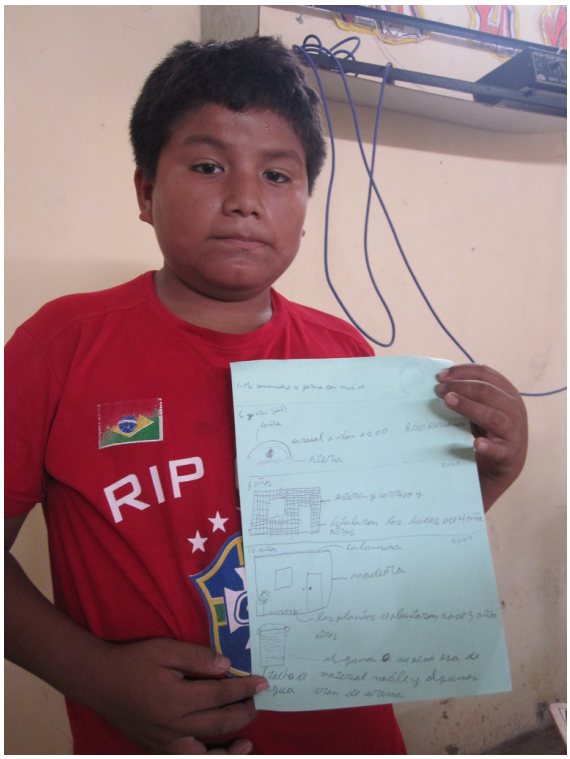

Figure 7.5: Frank, a student from Juan Pablo II, presents a detailed history of infrastructural improvements to his home.

This kind of mapmaking recalls the 3D Model Mapping or Ground Mapping traditions of PGIS practice, with an emphasis on community assets and the explicit link between mapping and urban planning. The ability to view the model both from above as we were doing with balloons in the **real** Juan Pablo II, as well as from a first-person perspective by planting one's head amongst the buildings, bridged the gap between the abstracted god's-eye view and the situated personal view of the settlement. The model was extremely popular amongst not only the rest of the students and teachers, but amongst the parents and community leaders who attended our final presentation.

Figure 7.6: 3D paper model of the future of Juan Pablo II.

Stitching maps with Juan Pablo II

Throughout the balloon and kite flights, we employed various techniques to process the aerial imagery into maps. Starting with the Map Warper software available at http://warper.geothings.net with teachers from Manzanita 'A', we switched to Adobe Photoshop after a few attempts. Designed for printed maps, Warper experienced difficulty successfully warping some of the more oblique or distorted imagery, and in order to compensate, GCPs had to be placed at deliberately incorrect position in a laborious trial-and-error process. (See Subsection 6.1.4 for an overview of Map Warper). Additionally, Warper uses OpenStreetMap tiles as a base layer, but in Juan Pablo II and other areas we worked in around Lima, there was no data available, and we were forced to use a JavaScript hack to insert Google satellite imagery or another viable source. Even then, it proved difficult to successfully stitch a map, as multiple steps separated an assignment of GCPs with the feedback that an image was successfully warped. This is not to say that Map Warper is not a valued tool for its intended use, and in fact Shekhar Krishnan more recently applied it successfully in digitizing paper maps of Mumbai. However it was not suitable for much of the aerial imagery we gathered, and proved difficult for those with limited computer fluency.

Our next tool was Adobe Photoshop CS4, which can yield impressive results for an experienced user (see GonzoEarth, Subsection 5.3.2). This proved to be a workable alternative, where we used the Distort and Warp tools to align images in separate layers over a base image taken from Google Maps or another source. The total process for stitching 12-15 images took approximately 2-3 hours. Though not a GIS tool, Photoshop has the benefit of being fairly easy to obtain, though in fact none of the teachers I worked with had a copy. Still, the use a generalized tool has the benefit of encouraging the learning of generalizable skills, and can result in a more inclusive process. PGIS researcher Peter Poole notes in his own projects that in order to build a mapmaking capacity in areas of low computer literacy, 'tracing was chosen over digitisation, and simple graphics software over geographic information systems (GIS).' [63]

Figure 7.7: Demonstration of JavaScript hack to insert Google satellite data for warping in areas with low feature density. [82]

Most of these tools were inaccessible to the students we worked with, who were largely without computer access, however in order to help them understand the process we organized an activity to try fitting printed images together in a kind of puzzle, suggesting that they imagine the images were printed 'on rubber sheets'. This was so readily understood by all that it inspired the choice of a 'rubbersheeting' interface paradigm for the Cartagen Knitter software I developed after the Lima project concluded. (See Section 6.2.3)

Figure 7.8: Students collaborate in a semi-imaginary 'rubber sheeting' map stitching session.

7.3 Mapping with San Ignacio Loyola

With Carla del Carpio, I began working with a second community called San Ignacio Loyola, approximately 1 mile southeast of Juan Pablo II. Our local partner was a teacher named Hector, who had a class of very young students, aged 5-10. Though we had limited success in mapping exercises with the class, Hector proved to be an ideal collaborator, and actively sought to internalize the skills needed to produce balloon maps, with the intention of teaching the techniques to older students in the fall. While members of San Ignacio Loyola already have both title to their land and a completed survey of their lots, Hector saw the applicability of low-cost aerial mapping to informal settlements, and showed a lot of enthusiasm and energy in organizing flights with us

despite his heavy workload as both a teacher and a community leader.

Hector experienced similar if more pronounced difficulty in using Photoshop to stitch maps, but the imagery we captured with him over two 3-hour flights was superior to that of our Juan Pablo II flights. This may have been due to more favorable local wind conditions or our greater experience, but the result was a highly detailed and largely complete aerial map of the San Ignacio Loyola settlement. It became clear to us that building alliances and friendships with interested and energetic local partners was key to successful mapping.

Figure 7.9: A balloon and kite map of San Ignacio Loyola, produced with Prof. Hector and Carla del Carpio. The map is overlaid on the existing Google Maps imagery for comparison, and also includes the surveyed lots of which Hector had a printed copy.

7.4 Mapping with Cantagallo

It soon seemed as if 'word was getting out' about our mapping efforts, as we were soon invited by Lima-based art, technology, and society foundation Escuelab, to collaborate on a mapping project with their partners in a central Lima community called Canta Gallo. Escuelab's work, led by Barcelona artist Daniel Miracle, consisted of a series of workshops with a Canta Gallo art collective

known as Shuawa[2]. Canta Gallo is a community of Amazonian Shipibo who have invaded a plot of land along the bank of the Rimac river; a breathtaking site in the center of metropolitan Lima. Made up of several distinct groups, the settlement includes Shipibo and mixed heritage members who did not move to the site together, but have slowly migrated from around Lima. They have spent the last 10 years seeking legal title to the land, and different factions are at different stages in the process.

The group we began working with was situated on a large hill of rubble — a landfill which leaked methane and around which residents had strewn concrete blocks to stop further dumping. Despite their difficult situation, the settlement seemed cheerful and was brightly painted with murals. An electric guitar and keyboard played in a local hangout, while posters on the communal meeting house indicated each family's dues toward land registration fees.

Figure 7.10: The standard street map of Lima shows only a vacant lot owned by the city's roads administration, SETAME. The reality is a community of hundreds of people who have sought legal title for the last 10 years.

In the midst of this, Escuelab had sought to establish a neutral space by working with local artists to develop a series of arts workshops and activities for the children of Canta Gallo. Based in a state-funded school in the settlement, Daniel Miracle and others collaborated with residents such as Layner Mori to lead students in the production of digital films, animations, and incredibly, a live broadcasting news show (in the Shipibo language, no less) using a low-cost analog television transmitter. Escuelab's interests tended towards the political, as evidenced by their engagement in Shipibo/Spanish langauge issues amongst their students[3], as well as their close attention and sensitivity to the complex tenure situation and other sources of tension in the community. However, their preference for an implicit treatment of these topics and their exploration through educational and artistic works was well matched with my own approach.

On my first day in Canta Gallo, we repeated some of the exercises I had used in Juan Pablo II, though in a shorter format. With help from Layner, we drew a large map of the settlement in rough outlines, and asked the students to draw their homes and place them on the map. The group, aged 6-12 and approximately 20 in number, produced a quantity of highly detailed drawings, though some students drew two or even three copies of their houses. One student drew one picture of his home in Canta Gallo and a second of his home in 'la selva' — presumably the home in the Amazonian region of Peru from which he had moved to Lima. While the non-literal nature of this

[2] An interesting choice of names given that Shuawa is the name of the bird from Shipibo legend which links 'maestros' in a kind of global communications network. Members of Esceulab referred to it as the 'satellite bird'.

[3] The desire of some families to preserve the Shipibo language and others to raise their children with only the Castilian Spanish language was one facet of a larger ethnic division between full-blooded Shipibo and mixed-heritage members of the community. See also Zavala and Bariola's study of Cantagallo in 'Enra kopiai, non kopiai: Gender, ethnicity, and language use in a Shipibo community in Lima'. [87]

kind of mapping presents challenges for data veracity, it is clear that children can produce a wealth of physical, historical, and culturally relevant detail, and I caution map-makers not to sacrifice this in favor of purely quantifiable information.

Flying balloons with Cantagallo

After our sketching activities, we attempted to fly kites, as there was a light breeze. While the students were very assiduous and talented kite flyers, we eventually opted for a balloon flight, which resulted in a complete imaging of the settlement in less than two hours, from about 400 feet. To attempt a faster and more automated stitching technique, I used the open source program **hugin** and the **Autopano-SIFT** algorithm to stitch the images together, and overlaid the result on existing Google Maps imagery as well as a copy of the settlement boundaries supplied by one of the community leaders. This was our fastest time yet for the completion of a map, and was the first map — of any kind — of the settlement.

Figure 7.11: Paper mapmaking activities with children in Canta Gallo, Lima

The rest of Canta Gallo and local geographic dispute

Following the completion of the initial map of Canta Gallo, Sara Gomez of CEDRO suggested that we attempt to map the adjacent settlement, which I was surprised to find was also part of Canta Gallo. Collaborating again with Daniel Miracle and Escuelab, we met with Sr. Ricardo, the leader of the lower part of Canta Gallo and spent a day mapping that area as well. I worked with Layner Mori using Photoshop to stitch the resulting imagery over a map supplied by Sr. Ricardo, and we printed a paper copy. In a discussion with Sara, Layner, and Daniel, we decided to combine the two maps — which showed some overlap – and distribute the combined map.

Producing a combined map was a potentially controversial decision, as the two settlements were experiencing some tension due to both ethnic and territorial issues. The lower settlement, spread over a much flatter and larger area, was presumably further advanced in its bid for land title, as they had a surveyed map with well-defined lots, whereas the upper settlement with whom we had first worked had only a map of its outer boundaries. However, in an attempt to avoid involving ourselves in local political issues, we deemed it more fair to provide maps and mapping tools to both communities equally. In retrospect, I feel that to attempt to position ourselves as neutral parties may have been misguided, as producing maps and teaching mapmaking workshops are by no means a neutral acts. However, I do believe that providing open access to these tools and techniques, as well as to the geographic information they can produce, is a constructive goal. One aspect of maps which I value highly is their ability to reconcile differing mental models of a geography, and to make

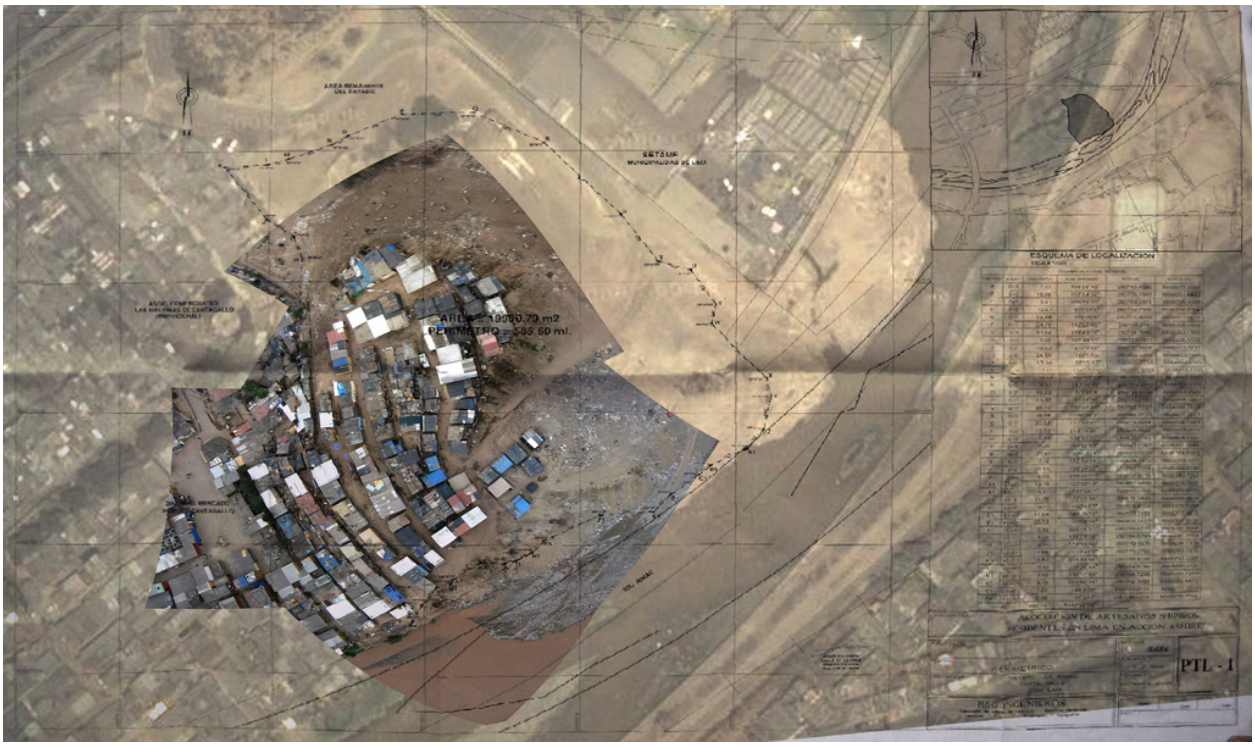

Figure 7.12: A balloon map of Canta Gallo, produced with Shuawa, Escuelab, and Carla del Carpio. The map is overlaid on the existing Google Maps imagery for comparison, and also includes the settlement boundaries, taken from a printed copy contributed by community leaders.

explicit the differences between those models. My hope is that we helped to do so in an inclusive manner.

7.5 Evaluation

Any comprehensive evaluation of the mapmaking work I and my local partners performed would need to include a long-term examination of the maps' uses; legal, urban planning, educational, and political applications were among our hopes, but many of these processes occur on a timeline of years or even decades. Still, in the half year since their creation, the maps of Canta Gallo have been used for subsequent projects by Shuawa, and Helder Solari, one of the activists involved in the original mapmaking, asserts that 'in fact even now there is none better than yours. In other maps Canta Gallo simply doesn't exist.' While I look forward to hearing of as well as advocating further uses of these maps, the immediate evaluation I can attempt will have to rely upon the maps' reception among participating community members and in the qualitative and quantitative measures which can be made today.

On a resolution basis, these maps are far superior to any which have been made before (see Figure 7.1). However their most important quantitative advantage is their recency; in comparison, those available on Google Maps are hopelessly obsolete, sometimes showing only a small percentage of

Figure 7.13: A balloon kite map of all of Canta Gallo, produced with Shuawa, Escuelab, Sara Gomez, Carla del Carpio, and residents of Canta Gallo. The map is overlaid on the existing Google Maps imagery for comparison, and also includes printed maps contributed by community leaders. Note that a small area is missing; unfortunately the balloons popped near the end of the day and we lacked enough helium to continue.

the buildings which exist today. Due to these impressive numbers, a variety of individuals and organizations have suggested uses for the data, ranging from tracing and import into OpenStreetMap to use in World Bank needs assessment or municipal datasets. While I think these are generally good ideas, I also believe that the decision to publish any map data is one which community leaders and those involved in the creation of the data should make. My own publication of these maps for educational and research use was only after explicit permission was granted by all involved parties.

Finally, and far more importantly than the technical evaluation, I was careful to record the reception and discussion of this project amongst its participants, and especially amongst the residents of the areas we mapped.[4] This took the form of informal interviews with partner organizations and residents, as well as my notes and observations, but due to the speculative nature of the project, it followed no specific plan, and was by no means an attempt to develop a formal scientific or ethnographic study. Rather, I used the information to develop a more comprehensive and measured approach in subsequent case studies, and to identify shortcomings in the mapping process.

7.5.1 Needs (Re)assessment

The Lima project demonstrated the feasibility of participatory mapmaking projects with low cost tools such as balloons and kites. However, it also highlighted the need for a simplification of available tools and for new, easier interfaces, especially for the digital post-processing steps, in order

[4]For a more thorough discussion of my evaluation strategy, see Section 9.1.

Table 7.1: Comparison of maps produced in January 2010 project in Lima, Peru with those available in Google Maps for the same period.

Site	Criteria	Grassroots Mapping	Google Maps	Percent change
Juan Pablo II	Resolution	4.4cm	29cm	+659
	Recency	new	2-3 yrs old	
San Ignacio Loyola	Resolution	3.4cm	29cm	+853
	Recency	new	2-3 yrs old	
	Roof count			
Canta Gallo	Resolution	7cm	29cm	+411%
	Recency	new	2-3 yrs old	

to increase inclusion and avoid dependency on outside assistance. Specifically, the orthorectification and publication tools we tested were inadequate. The feedback and brainstorming we conducted with various collaborators led me to begin work on a new tool which eventually became the Cartagen Knitter discussed in Section 6.2.2. This tool would need to be easy to install or run in any internet cafe (I opted to a web-based tool). It would need to make use of an intuitive mental model for orthorectification; rubbersheeting, as explored with students from Juan Pablo II, was a good fit. It would need to export maps in a format which could be easily printed, and finally, it would need to be tested in the field with a diverse group of users.

The difficulties we experienced in flying balloons and kites in Juan Pablo II underlined the importance of good equipment, timing, and a good understanding of local weather conditions. Still, the exceptional maps we were able to produce at every site were encouraging, and the speed with which we were able to map a given site suggested that repeated periodic mapping, or mapping much larger areas, could be possible.

Above all, I learned the importance of building capacity amongst local partners, and the need to address the pedagogical challenges of this kind of participatory mapmaking. My experiences teaching others to use these tools, and working with them to adopt, internalize, and improve the necessary skills to create maps, highlighted the need for better teaching materials, guides, and a more structured approach to skills transfer. These would be major themes in the following case study in the Gulf of Mexico, where many of the lessons learned in Lima were put to the test.

Figure 7.14: Comparison of scales and level of detail between Grassroots Mapping imagery and existing Google Maps/GeoEye imagery at San Ignacio Loyola.