



Agnes Jane Soto Gómez

Portfolio

ABOUT ME

I am an architect and physical geographer.

Why?

Because I love to create new things.

Not for creation's sake but to fulfil people's needs, wishes, and dreams. When I create something, I love to see the final product but also the learning, experimentation and creative process behind it.

Architecture is, to me, a way of understanding and shaping the human world; an opportunity to contribute to the development of our today and our tomorrow. And it is a great responsibility too.

I want to contribute to creating pleasant, sustainable and resilient cities, where people can live, work, enjoy themselves, and be safe. And this is why I also became a physical geographer. I believe that architects and planners need to have knowledge about the behaviour of the physical world to fully comprehend the setting, constraints, and possibilities of each project and location. This is even more important in a context of climate change and its many potential consequences.

I have worked with both the theoretical and practical sides of architecture, I have taught future architects, and I have done research on urban development and natural sciences. I have enjoyed every one of my tasks and projects. In hindsight, I think that they were all interrelated: an architect needs to be able to look beyond the practicalities of the task at hand and understand the interconnections and complexities of the human and physical worlds. It is, after all, not the structures but the people who are at the centre of our work!



MY RESUME

EDUCATION

2009 - 2015

Uppsala University and the Centre of Natural hazards and Disaster Science (CNDS), Sweden
PhD, Physical Geography

2006

Universidad Politécnica de Madrid, Spain
MSc, Natural Environment and Bioclimatic Architecture
Sustainable architecture, passive solar building design, ecological design, low-energy housing

1994 - 2001

Universidad de San Carlos de Guatemala, Guatemala
Architecture degree (Recognised by the Swedish Council for Higher Education as Bs + MSc equivalent)

RELEVANT EXPERIENCE

2016 - 2017

Planning department, Lidingö City, Sweden
Intern. Urban development planning within the *Lidingö Centrum* project

2011 - 2016

Earth Sciences Department, Uppsala University, Sweden
Graduate Teaching Assistant. Course coordination, scheme planning, course communication, report grading, process administration.

2009 - 2015

Earth Sciences Department, Uppsala University, Sweden
Graduate Research Assistant. Spatial analysis, data scarcity, population dynamics, natural disasters, climate change impacts, societal vulnerability and resilience.

2002 - 2008

Universidad de San Carlos de Guatemala, Guatemala
Lecturer. Design fundamentals, descriptive geometry, technical and hand drawing, physics, mathematics, and studio project courses. Pedagogical planning and evaluation.

2001 - 2002

ADYCO Constructions, Guatemala
Architect. Design, planning, budgeting, and supervision of architectural projects.

SKILLS

AutoCAD

Revit

InDesign

ArcGIS

MatLab

Sketchup

3D Max

Lightroom

Photoshop

MS Office

Basic

Pascal

LANGUAGES

Spanish

English

Swedish

Catalan

HOBBIES

Arts and Crafts

Hiking

Music

Dancing

Cooking

MY WORK

ARCHITECTURE

01

Los Cuchumatanes ecotourism network
Huehuetenango,
Guatemala - 2001
Architecture, Landscape Architecture

02

Bioclimatic urban revitalisation
Madrid, Spain - 2006
Architecture, sustainable cities, urban redevelopment

03

Hospital expansion in a historical city
Quetzaltenango,
Guatemala - 2008
Architecture

04

Urban development of Lidingö centre
Lidingö, Sweden - 2017
Architecture, urban development

05

House expansion
Sundsvall, Sweden - 2021
Architecture

RESEARCH

06

**Shaping natural disasters:
landscape vs people**
Samala River catchment,
Guatemala - 2015
Urban matters, physical geography

07

Connecting urban growth with natural disasters
Samala River catchment,
Guatemala - 2015
Urban matters, physical geography

01

LOS CUCHUMATANES ECOTOURISM NETWORK

Sierra de los Cuchumatanes,
Huehuetenango, Guatemala

Project type: Academic project – Architecture degree thesis work

Object: Ecotourism facilities for lodging and dining, hiking, environmental education and sightseeing

Year: 2000-2001

Discipline: Architecture, landscape architecture



Vegetation at Puerta del Cielo



Laguna los Ordoñez, Huehuetenango



Vegetation and geological formations at Sierra de los Cuchumatanes,

The place

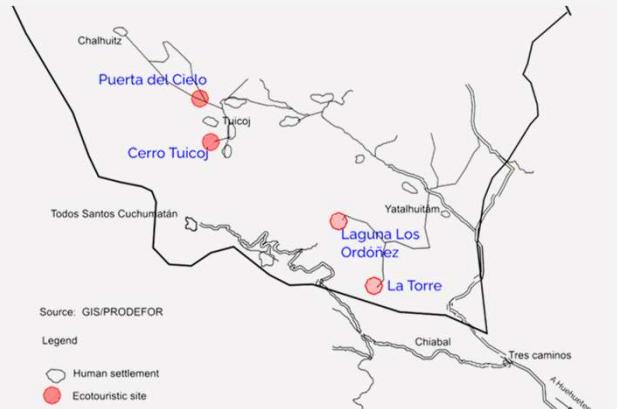
The Sierra de los Cuchumatanes is the highest mountain range in Central America, reaching over 4000 meters above sea level. The unique geological and biological beauty of this area, offering stunning panoramic views, unique karst formations, and multitude of endemic species, opens up for numerous ecotourism opportunities. Tourism can promote local development and the establishment of economic activities other than agriculture. Raising awareness of such natural wealth could also contribute to the protection of the fragile local ecosystems.

Aim and challenges

Creating a network of ecotourism sites that can provide a complete offer of services in the region.

The local communities in this area are among the poorest in the country and this project could contribute to improving their economic situation in a sustainable way.

Local building materials and construction techniques, which are currently at high risk of disappearing, were selected because of their cultural value. Additionally, based on thermal studies, they are more appropriate than modern materials with regards to the local climatological and environmental conditions. Alternative, low-impact technologies also had to be used since there is no water, drainage, or waste management infrastructure in the area.

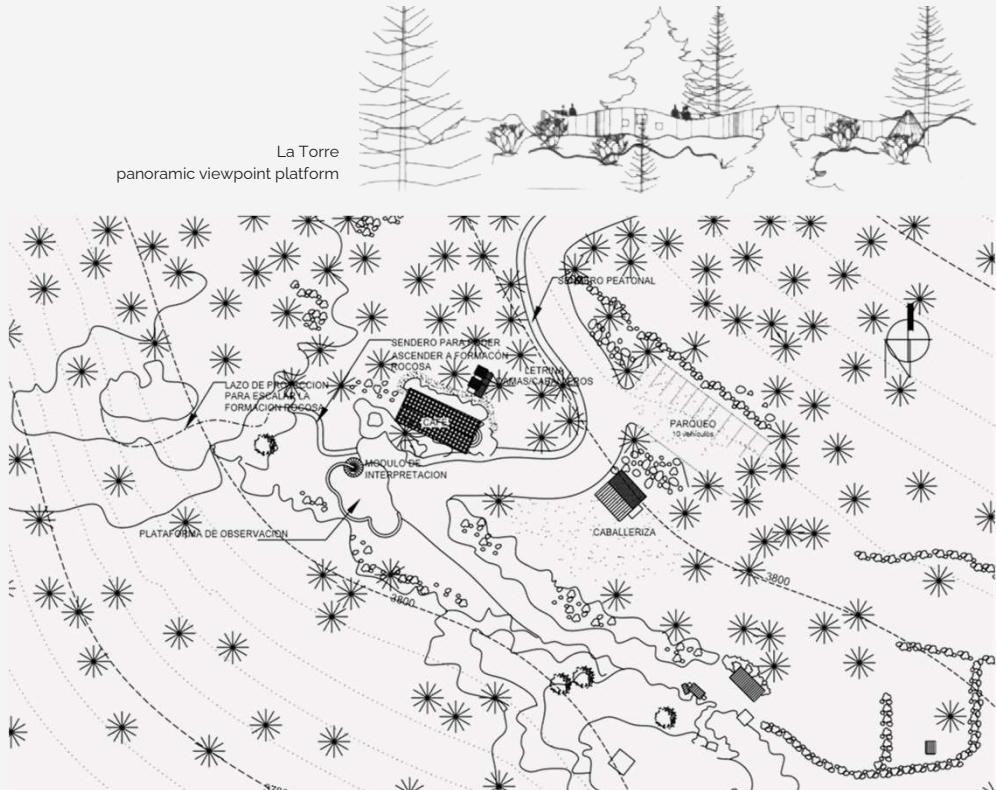


Los Cuchumatanes ecotourism network sites schematic location

The proposal

Four places were found to be suitable for tourism and were analysed further to determine the most appropriate uses according to their potential and physical capacity. Three places – Puerta del Cielo, Laguna los Ordóñez and La Torre – were designed for sightseeing. Cerro Tuicoj was selected to host a regional ecotourism centre for panoramic observation, education, dining, and lodging services. A low-impact transportation system – horse riding – was promoted for visiting the sites, thus minimising the impact of the tourism. For this reason, the proposal includes stables at each of the sites.

Site 1: La Torre scenic viewpoint



La Torre scenic viewpoint proposal plan view



Huehuetenango valley, view from La Torre

The highest point of the mountain range (4 000 m.a.s.l.).

Comprises a coffee shop, a panoramic viewpoint platform with an interpretation module, parking spaces, a stable, and hiking trails.

Site 2: Laguna los Ordoñez geological and biological viewpoint

Laguna los Ordoñez
geological and biological wealth features

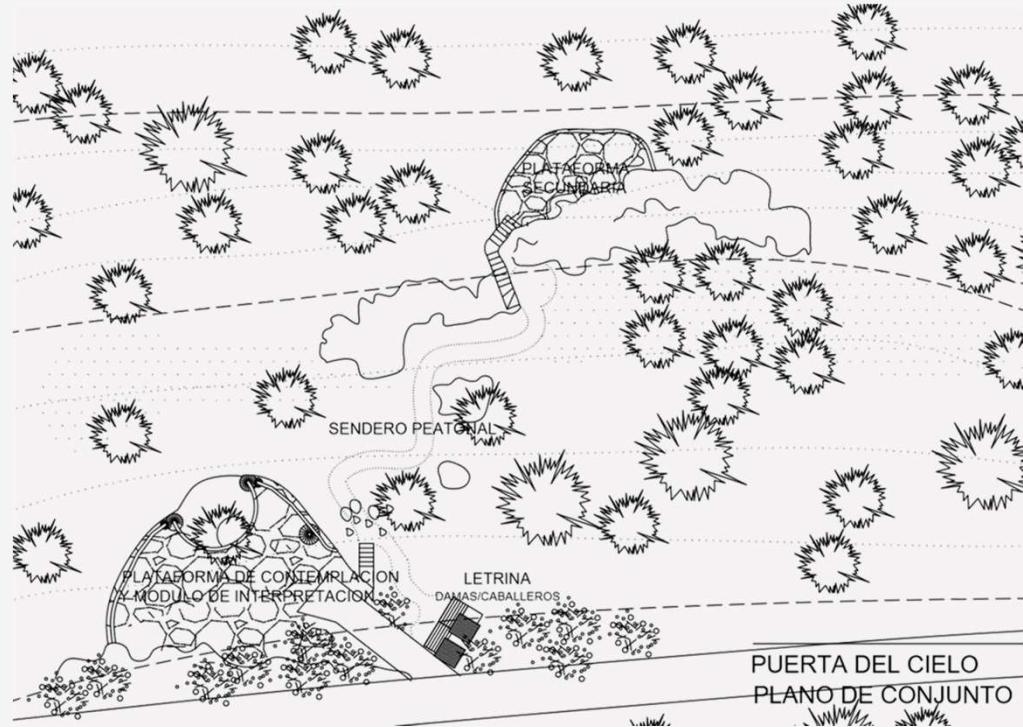


Laguna los Ordoñez, proposal plan view



The most fragile site. Comprises observation decks with no railings, defined trails to preserve the fragile soil surface and vegetation, an interpretation module, and an area for services containing parking spaces, a stable, and dry toilets.

Site 3: Puerta del Cielo scenic viewpoint



Puerta del Cielo proposal plan view

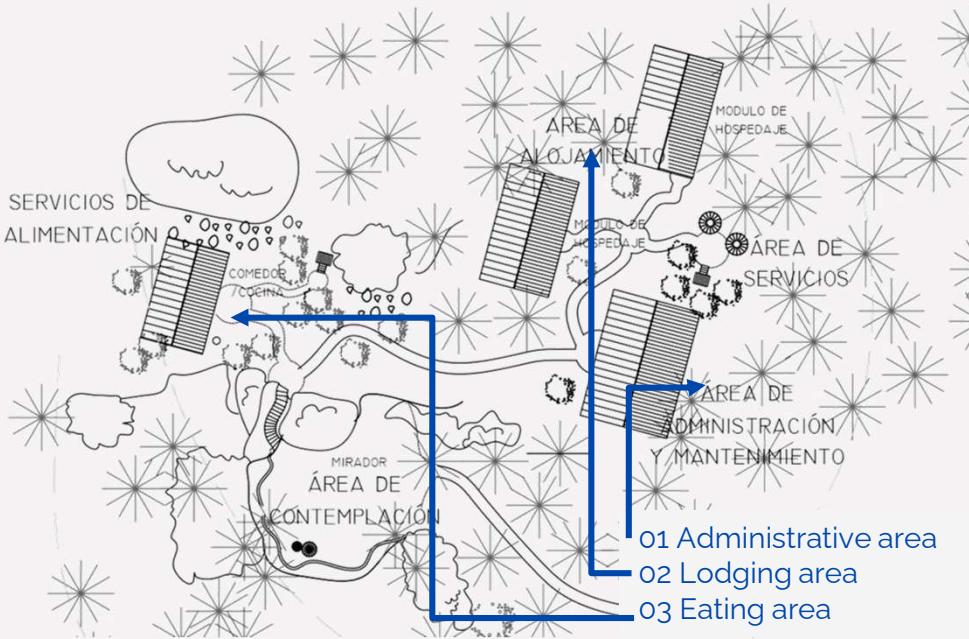
Puerta del Cielo
vegetation and setting



Two abandoned structures containing partial floors made of stone from an old house are reconditioned to contain panoramic viewpoint platforms with an interpretation module and dry toilets. Accessible by foot or on horseback from the main regional ecotourism centre (ca. 2 km).

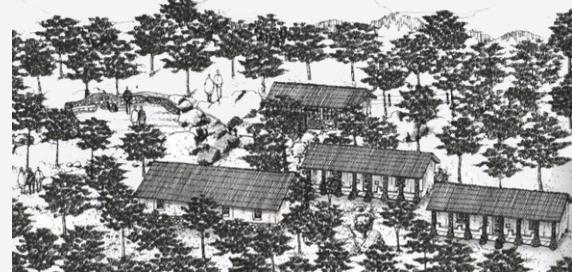
Site 4: Cerro Tucoj regional ecotourism centre

Main site



Cerro Tucoj regional ecotourism centre proposal plan view

The structures shown here are located at the summit. The centre consists of an access control point, parking spaces and a stable, located at the lower area. A hiking trail connects both areas.



Cerro Tucoj regional ecotourism centre proposal perspective view

The Cerro Tucoj regional ecotourism centre is the main unit of the network. The centre consists of a scenic viewpoint area, a lodging area, a collective kitchen and, sanitation facilities (dry toilets and temazcals – a traditional Maya low heat sweat lodge that is used as a bathing alternative when water is scarce), an administrative area with reception, an information centre and souvenir store, a staff area with service storage, cleaning areas, and a room for one on-duty agent.

Site 4-01: Cerro Tucoj regional ecotourism centre *Administrative area*

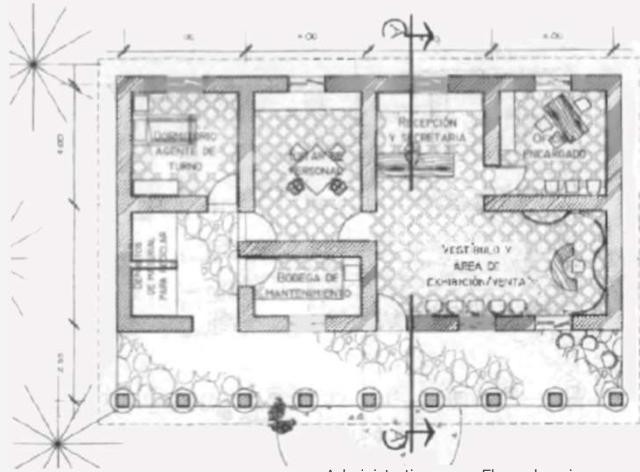


Administrative área - Perspective view

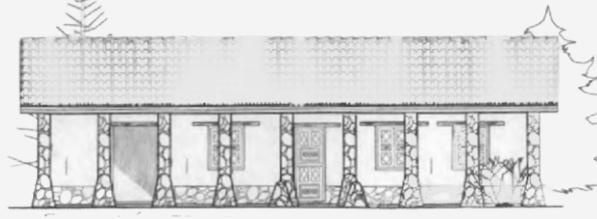


Administrative area - Cross section

The administrative area for both the centre and the network consists of a public space with information and souvenirs, offices for the manager and receptionist/secretary, and a quiet area for the staff. A separate entrance leads to the bedroom for the on-duty agent and a storage area with bins to collect and sort recyclable material to be later transported to the city. The promotion of local building techniques and materials are of special importance for this area.



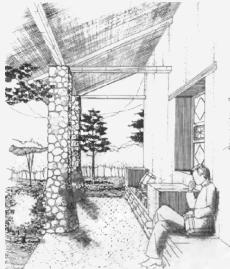
Administrative area - Floor plan view



Administrative area - Elevation view

Site 4-02: Cerro Tucoj regional ecotourism centre *Lodging area*

Collective dorms (with two bunk beds and two single beds in each) provide the opportunity to spend several days exploring the area. The building materials and techniques used here are selected to keep warmth inside without requiring any electric equipment. Collective dry toilets and temazcals (traditional Maya steam bath houses) are provided in separate buildings.



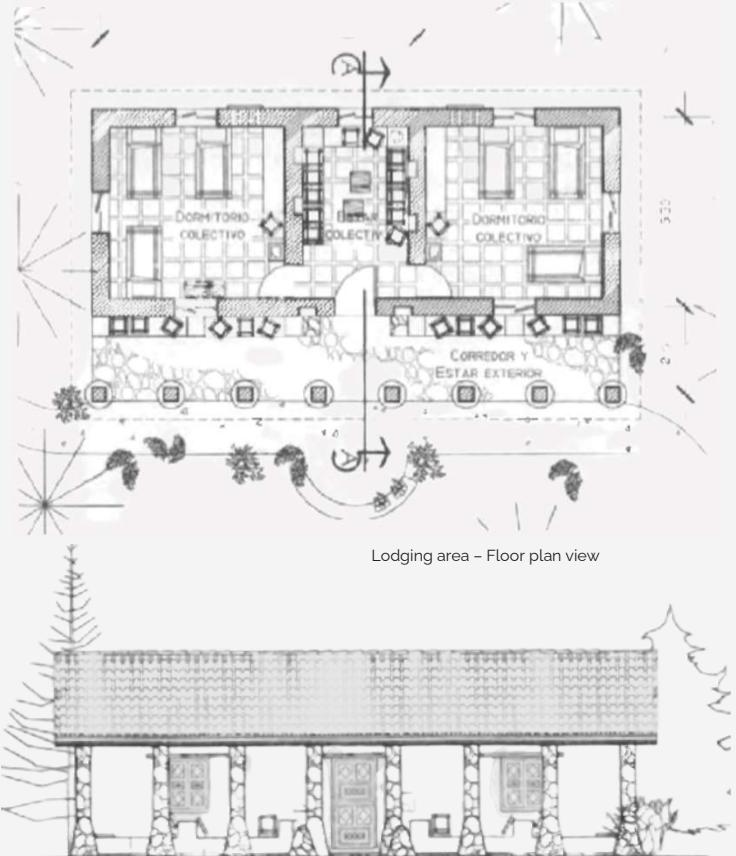
Lodging area - Exterior view



Lodging area - Interior view

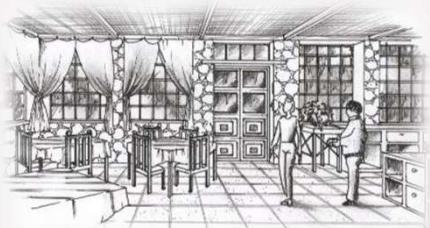


Lodging area - Cross section

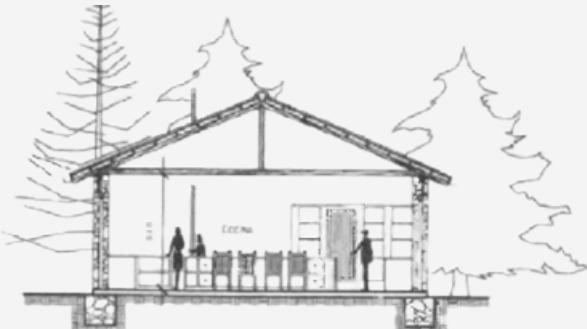


Lodging area - Elevation view

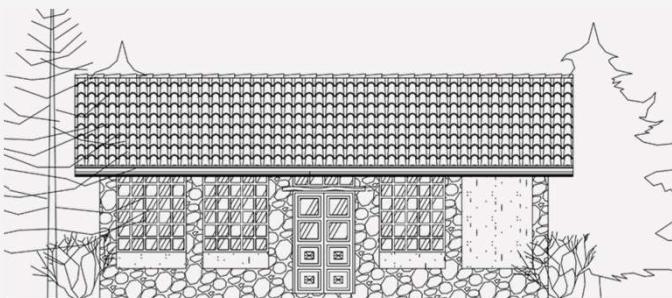
Site 4-03: Cerro Tucoj regional ecotourism centre
Dining area: Collective kitchen and dining room



Dining area – Interior view



Dining area – Cross section



Dining area – Elevation view



Dining area – Floor plan view

A collective kitchen and dining area offers the opportunity to prepare simple meals while visiting the ecotourism network. The kitchen works with propane gas and the food is stored in a passive cooler.

O2

BIOCLIMATIC URBAN REVITALISATION

Canillas neighbourhood, Madrid, Spain

Project type: Academic project – Msc in Natural Environment and Bioclimatic Architecture

Object: Housing in diverse building formats

Designers: Agnes Soto, Ainara Diaz, Beatriz Carballal, Cecilia Blanco, Diamantina Calderon, Francisco Arcos, Marta Arlanzon

Year: 2006

Discipline: Architecture, sustainable cities, urban redevelopment

The place

The intervention area is a part of the Canillas neighbourhood, located in the Hortaleza District in Madrid, Spain. The buildings included in the project were originally designed in the 1950s by a team led by Luis Cubillo de Arteaga as part of an experimental project to explore the possibilities of social housing in Madrid.

Without many protected green areas, cars took over the neighbourhood, reducing the possibility of social interactions in the area.

The challenge

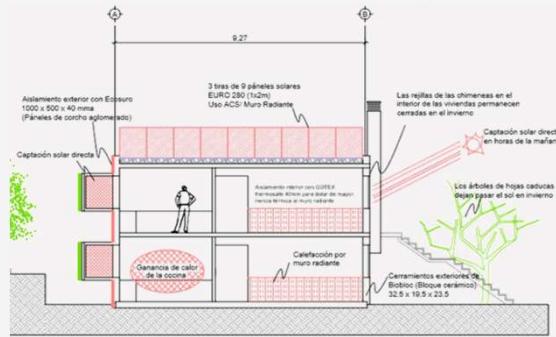
Analysing the function and energy efficiency of the existing buildings with respect to the local climate and selecting the appropriate technologies, materials and systems to be used in the intervention. Additionally, defining a sustainable urban revitalisation plan for the neighbourhood.



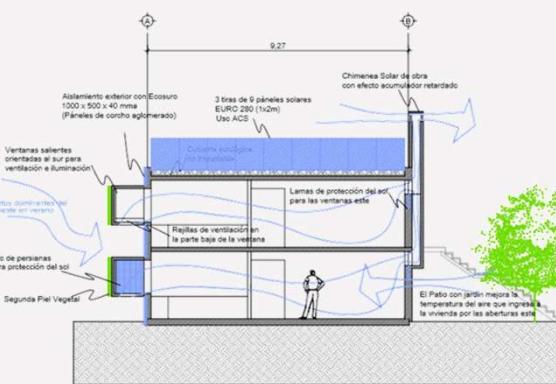
The proposal

This proposal focused on redistributing the living space of three different types of residential buildings to provide more comfortable spaces, create suitable living places for people with reduced mobility, and diversify the uses of the urban area and its buildings to boost the social dynamics and, ultimately, make the neighbourhood more attractive.

The bioclimatic strategies used in this proposal were seasonally-dependent: during the winter, solar radiation would be captured into heat storage. During spring and autumn, solar radiation would be captured during the morning and blocked during the afternoon while redistributing the stored heat. During the summer, cooling strategies and shading elements would be in place all day.



Cross section (heating strategies during the winter months in pink)



Cross section (cooling strategies during the summer months in blue)

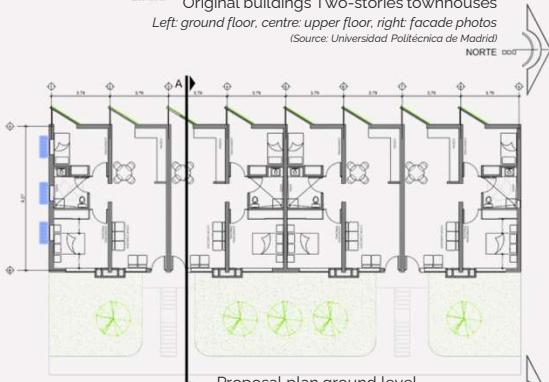
Terraced houses (townhouses)

The original buildings, two-stories high by 3.5 m wide townhouses, were transformed into single-story apartments to make room for accessible housing on the ground floor. Our proposal removed the staircases from the interior of the buildings, allowing for more spacious living areas. New exterior staircases to access the upper apartments were located at the side to provide a means of entrance.

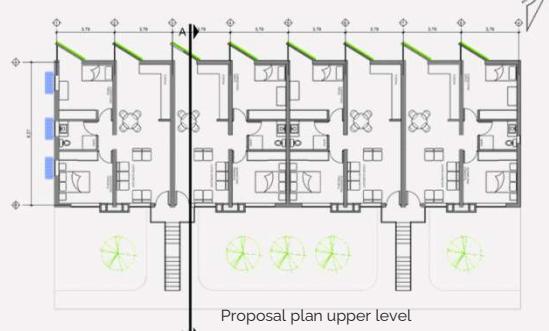
Since the long axis of the buildings has a north-south orientation, the longest facades have east-west orientation. The northern facade was insulated to promote stable indoor temperature conditions. New windows were planned on the southern facade to capture solar radiation, with elements to block direct solar radiation during the hottest months of the year. Similarly, mobile shutters were planned on the eastern facade for the same purpose. The windows on the western facade were reoriented to redirect the openings to the south, thus allowing to capture heat during the winter. An insulating wall with a green facade was planned for the western side of the openings to reduce the risk of overheating due to the afternoon sun.



Original buildings Two-stories townhouses
Left: ground floor, centre: upper floor, right: facade photos
(Source: Universidad Politécnica de Madrid)



Proposal plan ground level
Two units were merged per housing unit



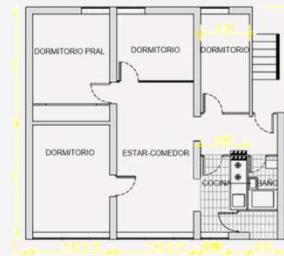
Proposal plan upper level
Access through a new outdoor staircase

Four-stories high residential buildings

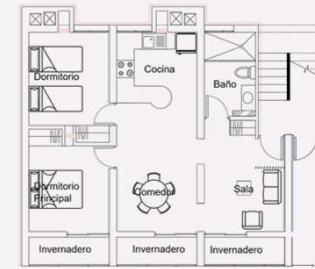
The long axis of these buildings is east-west and therefore the longest facades have north-south orientation.

The bioclimatic strategies were defined for the buildings as a whole.

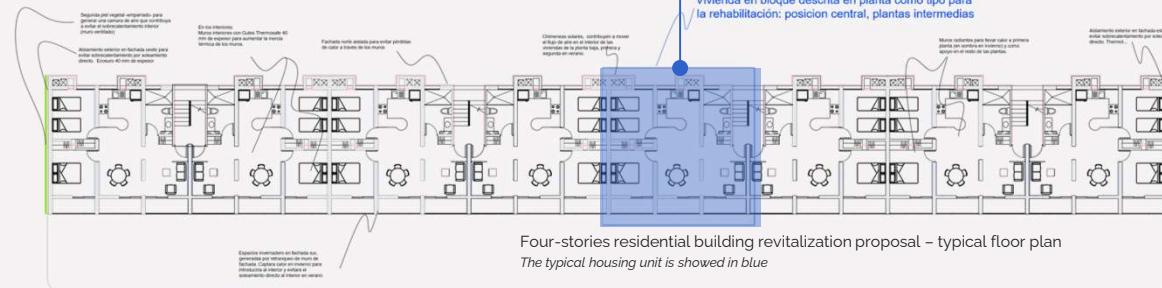
- Insulation of the eastern and western walls to avoid overheating and to keep stable indoor temperatures.
- Creation of "greenhouse spaces" on the southern facade to act as temperature control devices, keeping heat in or out depending on the season. The existing wall slabs function as shading elements blocking the sun during the summer.
- Addition of a green facade on the eastern wall to control the incoming solar radiation by creating an air space that would act as a barrier to heat transfer.
- Enlargement of the north-facing windows and diminishing of the south-facing windows. All windows are designed with double glazing and shutters to allow for cross-ventilation and therefore efficiently controlling the indoor temperature.
- Creation of a green (tree) wall on the back of each building to promote wind circulation in the area, thus improving the air quality and comfort level in the apartments.



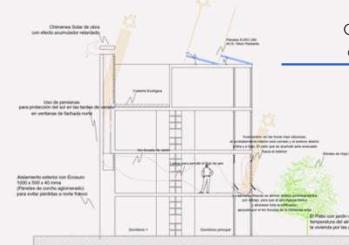
Original housing unit plan and building view
(source: Universidad Politécnica de Madrid)



Proposal plan – typical housing unit

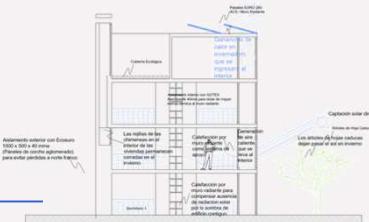


Four-stories residential building revitalization proposal – typical floor plan
The typical housing unit is showed in blue

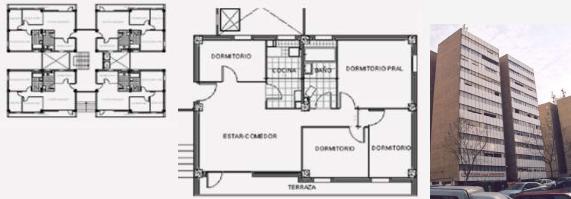


Cross section (heating strategies
during the winter months in orange)

Cross section (cooling strategies
during the summer months in blue)



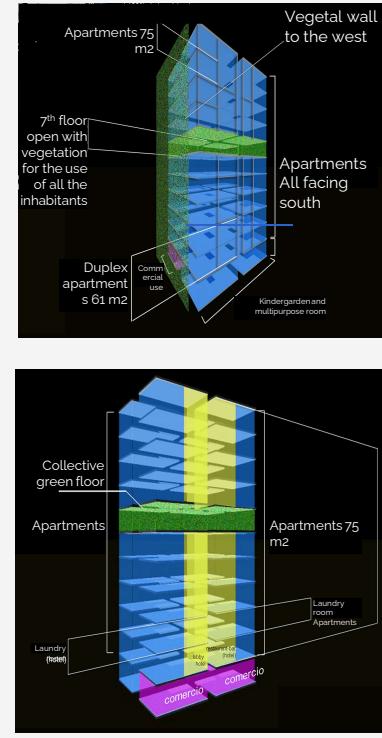
Tall residential buildings



Original tower general plan, typical housing unit plan, and building facade

The existing 11-floor buildings are composed of apartments of somewhat reduced size, half of them oriented south and the other half to the north. Our proposal changed the single-use of these towers to multifunctional buildings in order to boost social diversity in the area and promote a better quality of life for the entire neighbourhood.

On the ground floor, the project included commercial areas towards the main street, a nursery school and a multipurpose room towards the back of the building. The upper floors were planned to contain full duplex apartments (61 m²), apartments (75 m²), and a low-cost hotel with restaurant/bar. Different access points were planned for the hotel and the apartments with their services. Finally, one entire open floor with abundant vegetation (7th floor) was considered as a semi-open space for the inhabitants of the building.



Housing in tall buildings general plan

Top: south facade

Bottom: north facade

03

HOSPITAL EXPANSION IN A HISTORICAL CITY

San Rafael Hospital,
Quetzaltenango, Guatemala

Project type: Professional project

Object: Private hospital, expansion

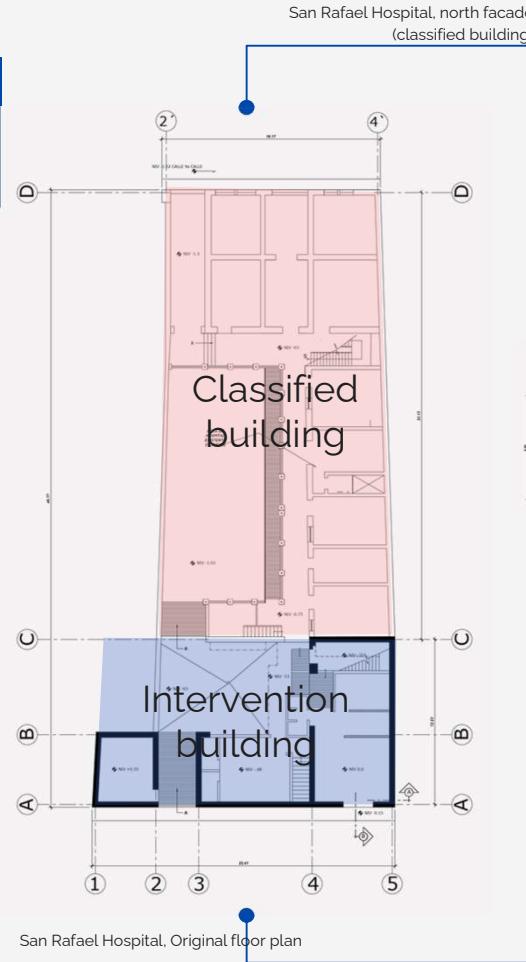
Designers: Agnes Soto and Cecilia Santisteban

Year: 2008

Discipline: Architecture

The place

Two adjoining buildings connected at their back ends, each accessed from a different street in the historical centre of the city of Quetzaltenango had been turned into a small private hospital. Most of the hospital functions (hospitalization and clinics) were concentrated in the north building. This building was however classified for its historical value and, therefore, subject to special restrictions. The second building housed a diagnostic centre and had no historical classification, but it was nevertheless subject to facade and height regulations because of its location within the historical limits of the city.



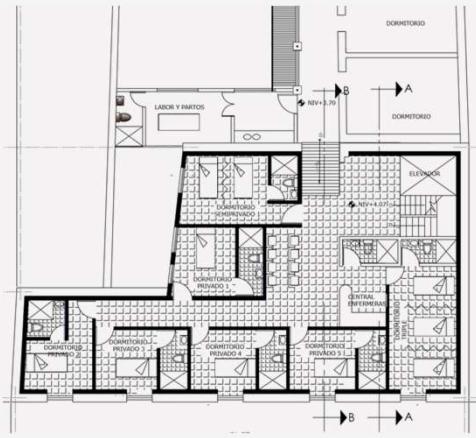
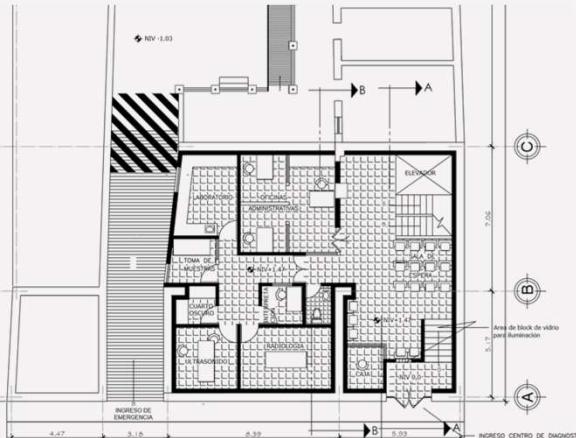
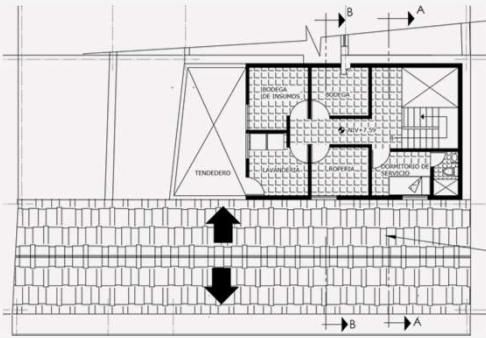
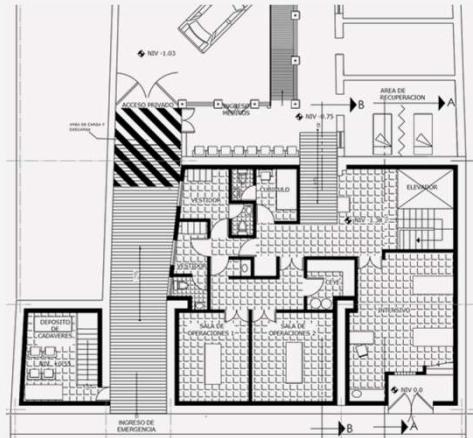
San Rafael Hospital, south facade



Longitudinal section: original state

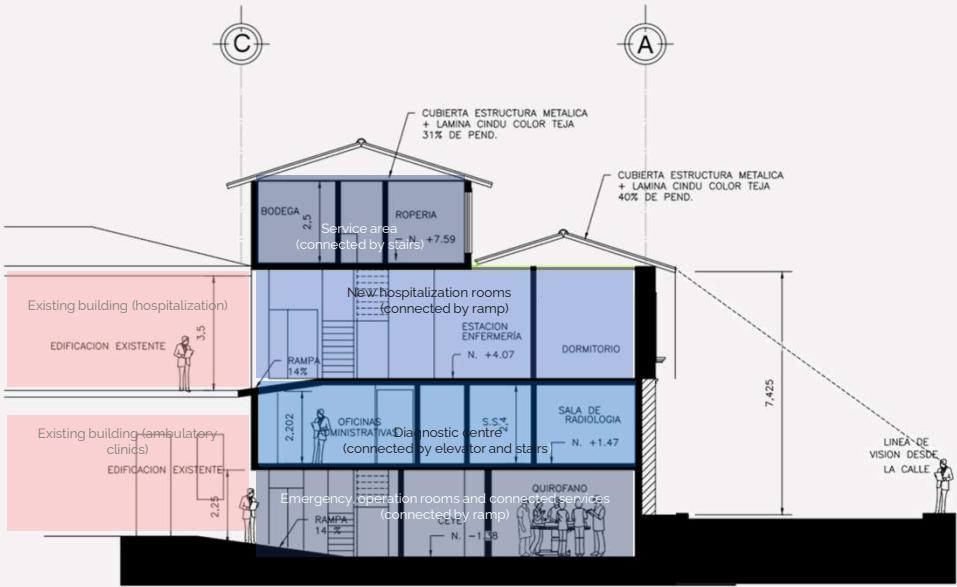
The challenge

Although small, the hospital needed several additional services to complete its functions, such as full operation rooms and delivery rooms, and it was therefore in need of thorough revision, remodelling and expansion. At the same time, this intervention had to meet the regulations and limitations imposed by the office for the protection of the city's history and cultural heritage.



The proposal

The hospital was analysed as a whole system, including both buildings. All the essential functions were reorganized and a new 4-story high building substituting the south building was proposed. As the only element preserved from the old building was its facade (due to legal limitations), the elements of the new building followed its original design and materials. This new building would have enough space for most of the required hospital services.



Cross section (indicated with B-B' in the floor plans)

Shows the connection with the preserved building, the internal function of the new building and the height limitation required by the office responsible for the protection of the city's historical and cultural heritage: the fourth plan should not be visible from the street.

Some of the hospital functions, such as the ambulatory clinics, most of the hospitalization rooms, and the general administration offices continued to be located in the historical building (north building). This building was not subject to any structural modification due to its historical value, but a thorough restoration plan was designed to preserve it and improve the comfort and function of the facilities.



South facade



Emergency entrance

04

URBAN DEVELOPMENT OF LIDINGÖ CENTRE Lidingö, Sweden

Project type: Professional project

Object: urban development

Year: 2017

Discipline: Architecture, urban development

The place

Lidingö is a dynamic municipality in Stockholm County and part of Greater Stockholm. In 2016, the municipality, together with the owners of the commercial areas in the city centre, started working on a plan to redevelop the city centre. The main objective of the project was to boost city life in the centre by enhancing the commercial offer, increasing housing density, and redesigning the public spaces to make it a pedestrian-friendly area.



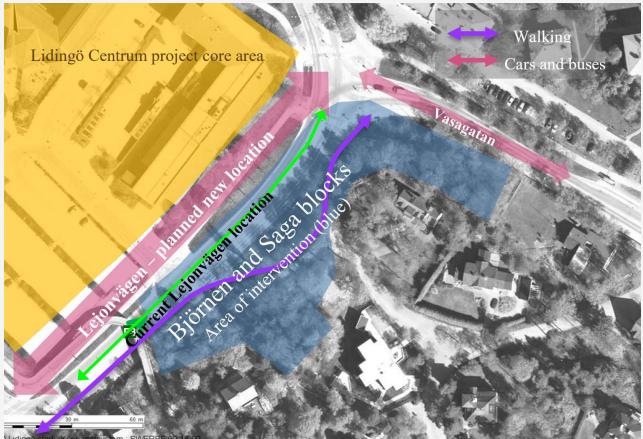
Lidingö Centrum project in 2016

The numbers show the planned stages of the development project. Numbers 4 and 5 identify the sites included in this project

The aim

Analyse the function and volumetric potential of two areas surrounding the city centre, the Björnen and Saga blocks to the east, and the Idun block to the northeast. These areas would further expand urban development of the city centre, which was the target of the main *Lidingö Centrum* project.

Björnen and Saga



Björnen and Saga blocks general situation
According to the Lidingö Centrum project in 2016

Lejonvägen road was planned to be moved towards the city centre in order to make space for new areas. The rationale behind this was to complete the urban landscape around this road, which is planned to become a mixed street for cars, bicycles and pedestrians. Initially, the idea was for this area to be composed of buildings with a maximum of 5 floors with commercial areas on the ground floor and housing on the upper floors. Smaller residential buildings would then be constructed as a transition towards the villa-dominated areas further away from the centre. Open plan solutions were recommended to allow sunlight into all the buildings and to protect the already existing vegetation as much as possible.



Björnen and Saga analysis plan
The potential location of green areas, max-5-floor buildings (in blue), and max-3-floor buildings (pink) is shown. Yellow arrows represents sunlight



Björnen and Saga analysis: New Lejonvägen urban landscape
The new location of Lejonvägen with restructured sidewalks (grey and yellow shaded areas) together with buildings of maximum 5 floors on the east side (blue volumes) would create an attractive new urban landscape around the centre.
Left photo: view towards south-west, right photo: view towards north-east.

Björnen and Saga

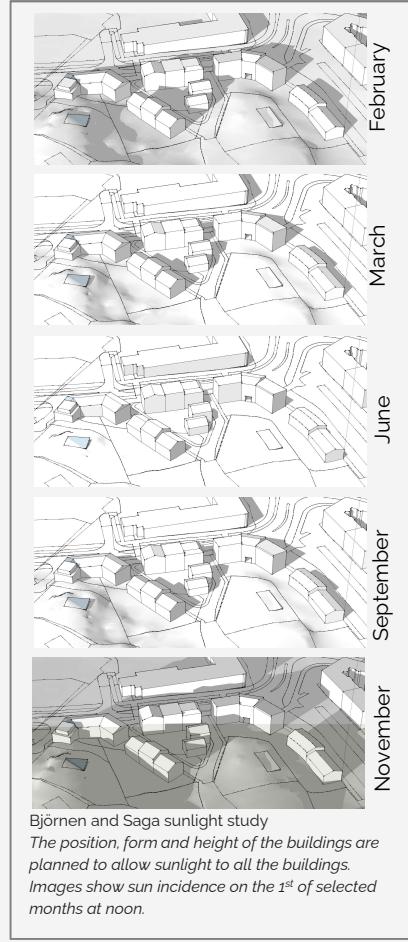


Björnen and Saga volumetric analysis
View from Lejonvägen/Vasagatan corner



Björnen and Saga volumetric analysis
Perspective from Sagavägen

A set of guidelines for this area were devised as part of the main Lidingö Centrum project. Following these guidelines, basic volumes for the buildings were created to explore the balance between the expected revenue from the area and the creation of a pleasant urban environment for its inhabitants and visitors. Thereafter, the sunlight potential in the area was studied to ensure that the new buildings have pleasant and bright interiors. The final step was to create more realistic perspectives to get a feeling of the final outcome from the results of the different analyses.



Björnen and Saga perspective view. Lejonvägen looking south-west

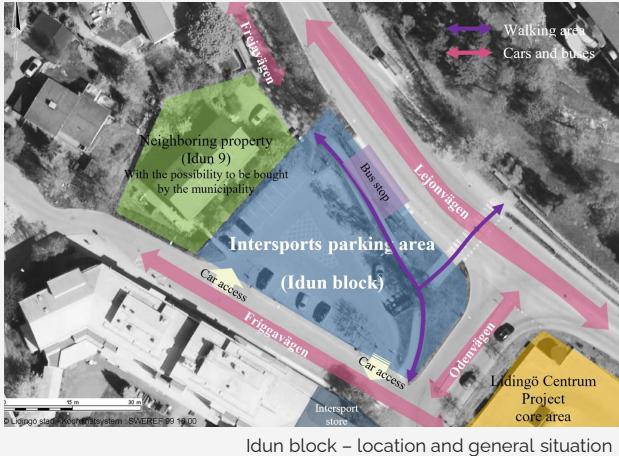


Björnen and Saga perspective view, Lejonvägen looking north-east



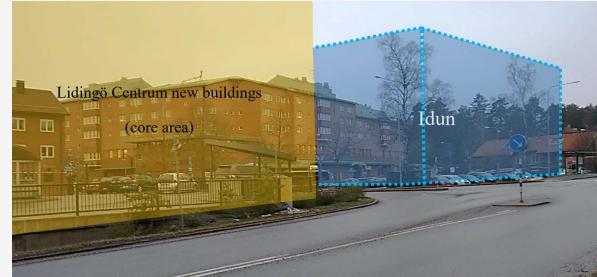
Björnen and Saga perspective, perspective from Sagavägen

Idun

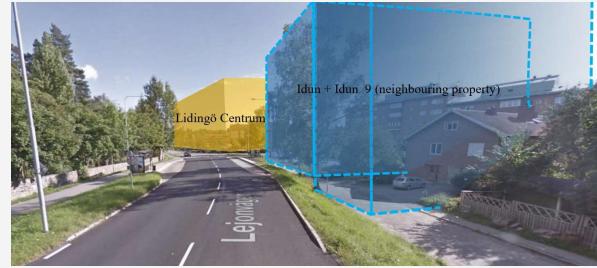


The intervention area – Idun block – is located northwest of the core of the city centre. Currently occupied by a parking lot, the area has big potential to be part of the city centre dynamics, even if it currently feels devoid of any city life. It has good connections and the right dimensions to accommodate activities to complement the city centre, both in terms of residential and commercial purposes.

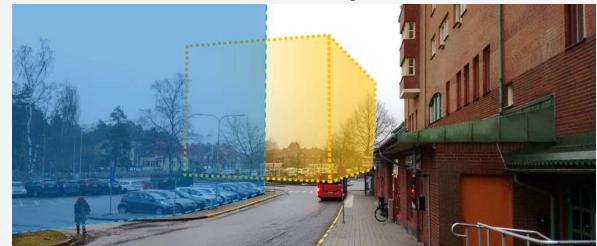
First, the physical possibilities of the plot were studied. A 5-floor building is located across Friggavägen road, immediately to the south of Idun, and a wide street is located to the north (on Lejonvägen road). This way, the plot would have the capacity to accommodate a building as high as 5 floors while maintaining a good proportion with its surroundings.



Idun analysis, height and volume study – Lejonvägen, view toward the south



Idun analysis: height and volume study Lejonvägen, view towards the south-east



Idun analysis: height and volume study - Friggavägen
From all perspectives a 5-floor volume would maintain a good proportion with its surroundings.

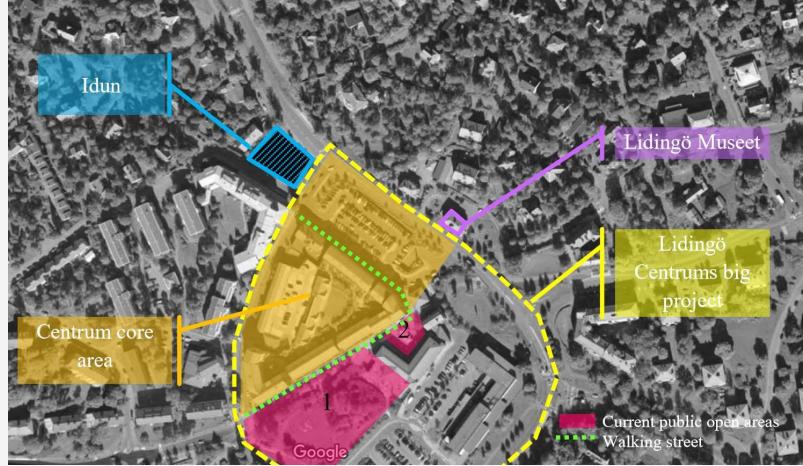
Idun

Next, the circumstances and urban needs at and around Idun were analysed. A new building at Idun would be the first object to be seen when approaching the city centre from the northwest. Since a 5-floor building is already located immediately to the south of Idun, placing the new building along the northern side of the plot, and an open space along its southern side, would allow for the best possible sunlight in the interior spaces.



Idun analysis: general use proposal

Placing the proposed building at the north side of the plot (in yellow) would allow for an open area in connection to the city centre and for the possibility of sunlight to reach the interior spaces of the building.



Idun analysis: urban needs in the area

Housing and commercial are the main uses in the Centrum core area. Cultural and education areas are available as well. Only two open areas are available and they are mostly park like.

Nevertheless, most of the surface of the city centre is already being occupied by buildings dedicated to commercial and residential purposes. Even if there is also a library and other cultural equipment, pedestrian areas and other types of open public spaces are scarce. A new meeting public place could thus create a lively area and, therefore, enhance and complement the city centre landscape. The Idun block has ideal characteristics to take on this role and, with that, create a new pedestrian axis right in the middle of the centre.

Idun

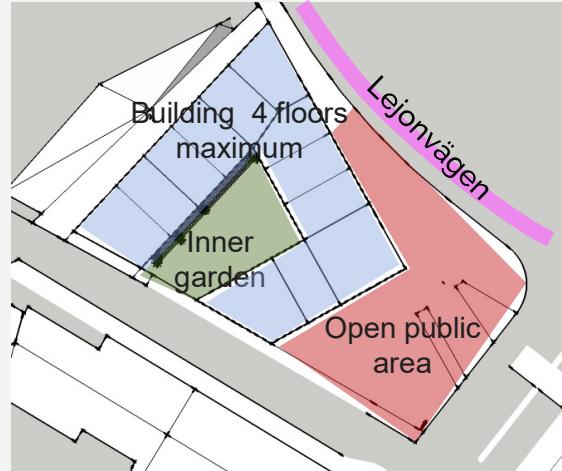


Idun volumetric proposal: View from Odenvägen



Idun volumetric proposal: View from Lejonvägen

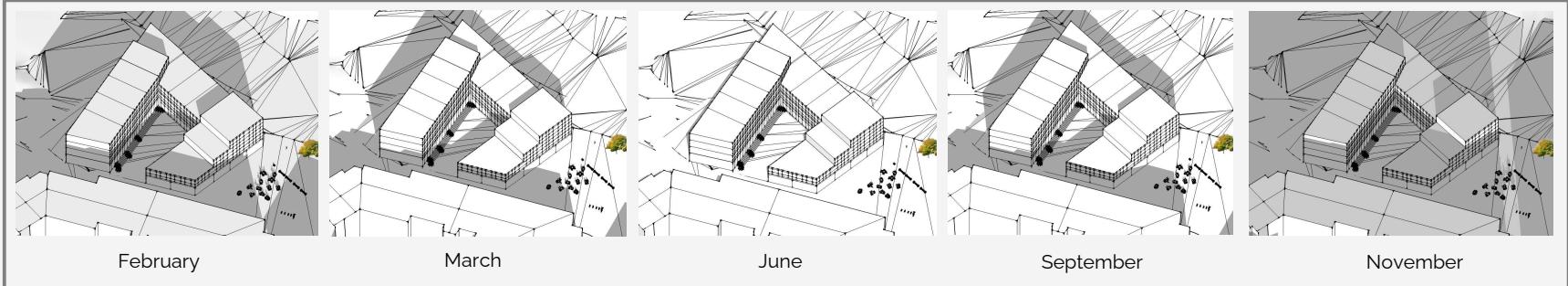
Idun analysis volumetric proposal
A stepped building with open shape containing a public square creates a new "door" to the Lidingö city centre.



Idun analysis: volumetric proposal plan view
A commercial/housing use building with an open shape and variable height is suggested to allow sunlight into all interiors. The open public area completes the functions of the commercial areas in the ground area as well as those of the city centre.

Having studied the urban circumstances and having put forward the recommendations for the area of intervention, a volumetric proposal was then carried out to explore which characteristics could maximize the economic and social benefits in the area, while contributing to the urban landscape in the city centre. A stepped open-shaped building with an open public space was proposed to fulfil the need of increasing the residential and commercial areas in the city centre while enhancing their social component. This way, restaurant terraces, sitting places, bicycle parking, and greenery could be created.

Idun



Idun block sunlight study

The stepped volumes and the open shape are planned to allow sunlight into all areas, creating bright and comfortable interiors. The images show sun incidence on the 1st of selected months at noon.

The final step in the potential analysis for the Idun block was to study the sunlight on the volumetric proposal to evaluate its climatic response and, this way, ensure that comfortable interiors would be created.

The analysis of the Idun block is especially interesting because it deals with finding synergies between public and private interests to enhance the appeal of this area. The analysis and following proposal showed a way in which such interests can complement and boost each other.

05 HOUSE EXPANSION

Sundsvall, Sweden

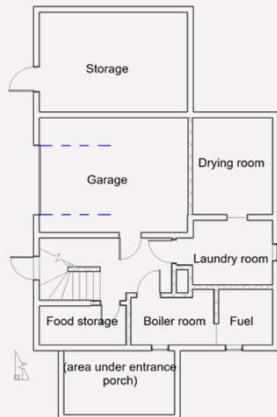
Project type: Professional project

Object: Private house, expansion

Year: 2021

Discipline: Architecture

This house was bought by a young couple in 2019. They really liked its size and the neighbourhood, but most of all its location next to the forest at Södra Berget. In 2020, while they were welcoming a new member of the family, they felt the need for additional space, e.g., for a home office due to the COVID-19 pandemic. At the moment, though, they have no rush with this plan so this proposal might change according to their needs.



Basement original plan



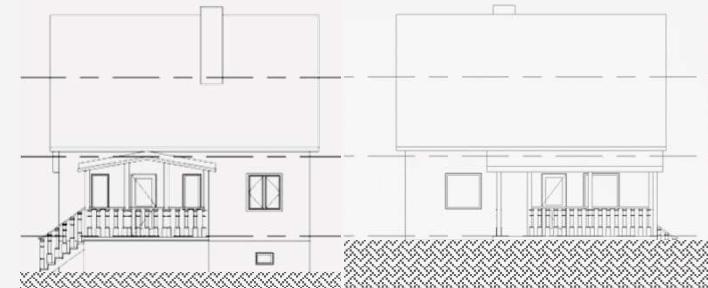
Ground floor original plan



Second floor original plan



Perspective view (source: Google Maps)



Front Elevation (North-east)

Back Elevation (South-west)

"More room space, more light and if possible to be able to look to the forest."

New dormers in the existing roof allowed the sun to get into the rooms, in addition to providing beautiful views of the forest. The sunroom at the back of the house was upgraded to a new terrace with double glazed walls allowing for a cosy covered room with an outdoors feeling. A new room with a private bathroom and storage/wardrobe provided a new flexible space for guests, hobbies or work. This room was located on top of the new covered garage with capacity for up to two cars.

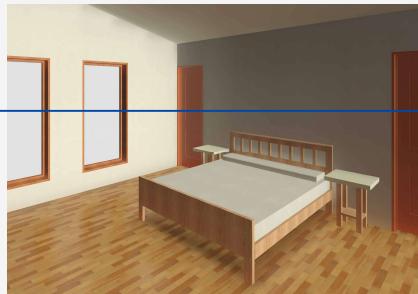
This new addition used similar visual elements to those from the existing house but with a contemporary feeling, using large windows that allow for plenty of light into the rooms.



Perspective front view



Perspective back view



06

SHAPING NATURAL DISASTERS: LANDSCAPE VS PEOPLE

Samala River Catchment, Guatemala

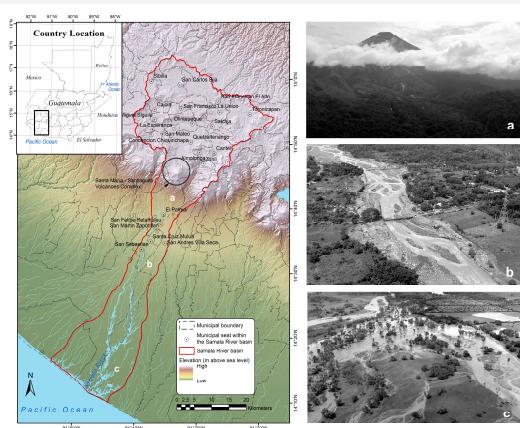
Project type: Research project

Object: Peer-reviewed research article. Original title: *Spatial distribution of disasters caused by natural hazards in the Samala River Catchment, Guatemala*. Published in *Geografiska Annaler: Series A, Physical Geography*, 97, 181-196.

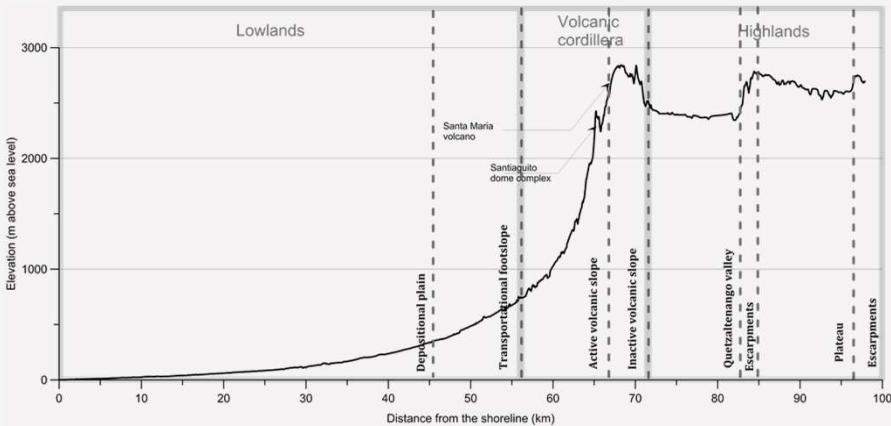
Authors: Agnes Soto, Allan Rodhe, Veijo Pohjola and Jan Boelhouwers.

Year: 2015

Discipline: Physical geography, urban matters



The Samala River catchment (Copyright, SSAG 2015)



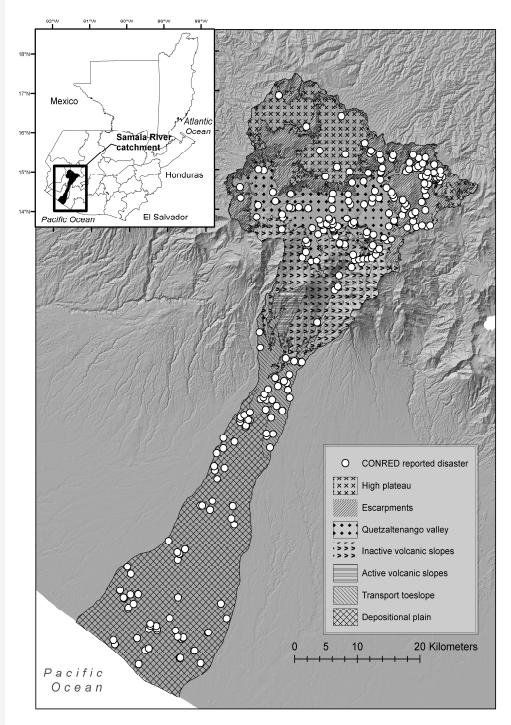
The complexity of the Samala River catchment – section from south to north (Copyright: SSAG 2015)

The place

The Samala River catchment is located in a steep and densely populated area of Guatemala. This catchment contains the second most populous city in the country as well as many other small towns and agricultural land. Additionally, the most important national roads cross this territory. For these reasons, the effects of natural disasters taking place in this area not only directly hit local people but also impact the national economy.

Aim

Understanding the importance of the physical characteristics of the landscape as a potential cause of water-related disasters in an area that showcases the landscape complexity of Guatemala and the high impact of natural hazards in the country and in the wider Central American region.

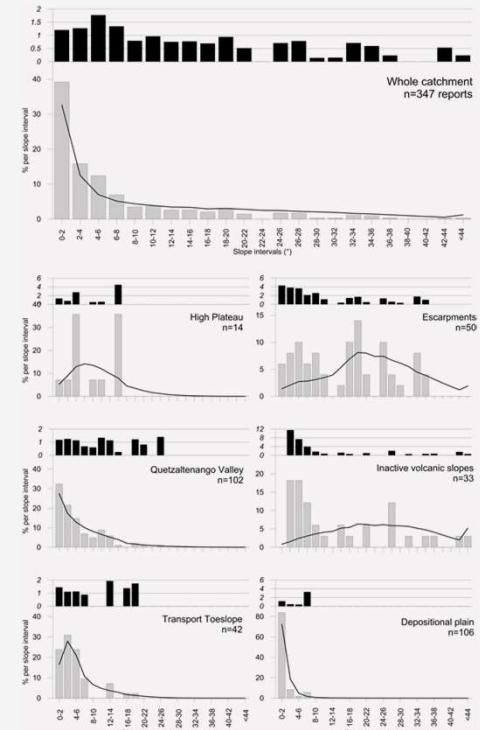


The study

We developed a new method to study the physical characteristics of the places where disasters were reported. First, we classified the study area into unique geomorphological units (subdivisions with similar physical characteristics). Then, we compared disasters occurring within any given unit with the slope and precipitation for that area. This comparison allowed us to determine if water-related disasters had any correlation with terrain steepness and soil saturation (during the rainy season).

Results

Our results showed that, in steep geomorphological units, water-related disasters tended to occur in the flattest areas. This points to the existence of other drivers, such as social and urban development factors, that have a strong influence on the occurrence of disasters. This is a particularly important result for architects, planners, and other stakeholders because it shows that the way cities are being planned exacerbates the impacts of water-related disasters. When it comes to heavy rainfall, the results showed a higher occurrence of disasters when the soil was saturated, as might be expected.



Frequency of disasters in the Samala River catchment, classified by geomorphological units (Copyright: SSAG 2015)

07

CONNECTING URBAN GROWTH WITH NATURAL DISASTERS Samala River catchment, Guatemala

Project type: Research project

Object: Peer-reviewed research article. Original title: *Remotely sensed nightlights to map societal exposure to hydrometeorological hazards*. Published in *Remote sensing*, 7, 12380/122399.

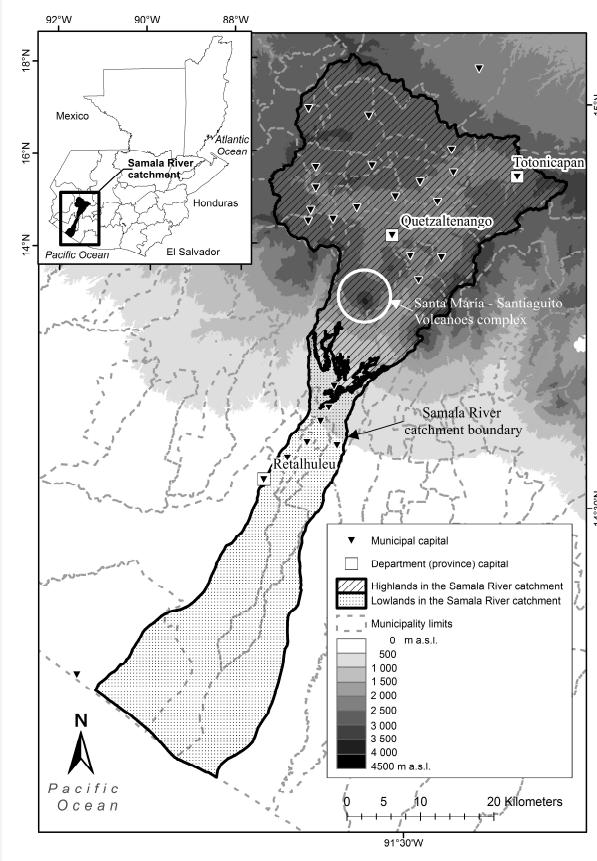
Authors: Agnes Soto, Giuliano Di Baldassarre, Allan Rodhe, and Veijo Pohjola

Year: 2015

Discipline: Physical geography, urban matters

The place

Containing the country's second largest city and crucial infrastructure, the Samala River catchment has a large socio-economic importance for Guatemala. Each year, a large number of natural disasters associated with significant losses are reported in this region and, with a rainy season that lasts 6 months, most of them are related to water. Furthermore, disaster-related losses have been increasing over time in this region.



The Samala River catchment, its location, and main physical features
(Copyright, the authors, 2015)

Aim

Understanding the drivers behind the increasing disaster-related losses by comparing trends in disaster losses with (i) the frequency of wet spells and (ii) urban growth in the region. This way, we could gain understanding of which causes – physical or social – were more likely to be the cause of significant losses.

The challenge

The available data on population and disasters for this area was scarce in terms of quantity, resolution, and time span. Additionally, the implementation of a long-term study on the causes of disaster-related losses was unfeasible. Consequently, alternative methods were relied upon to obtain the necessary information..

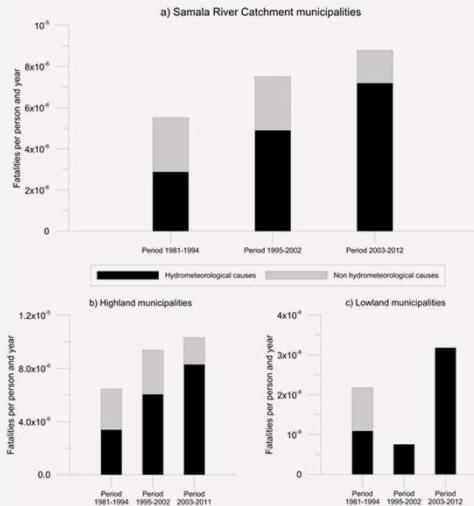
The study

We used the Desinventar Disaster Information Management System database to study the trends in the number of fatalities caused by water-related disasters in the Samala River catchment.

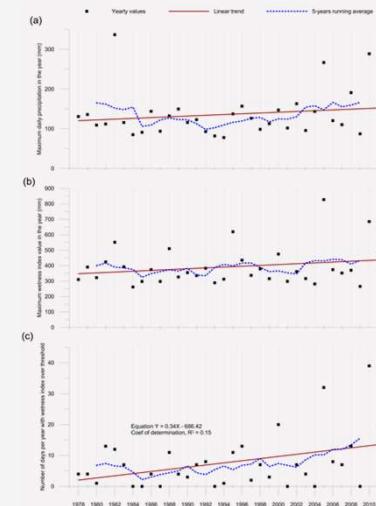
Additionally, we used the Guatemalan national meteorological records to study the trends in precipitation amounts in the area. We found out

that, even if the average daily rainfall amounts in the area had not increased significantly over time, wet spells had become more frequent.

Regarding urban growth, we used remotely sensed maps of nightlights which are produced by NASA at 1 km resolution on a yearly basis. These maps provide an indication of where people are settled:

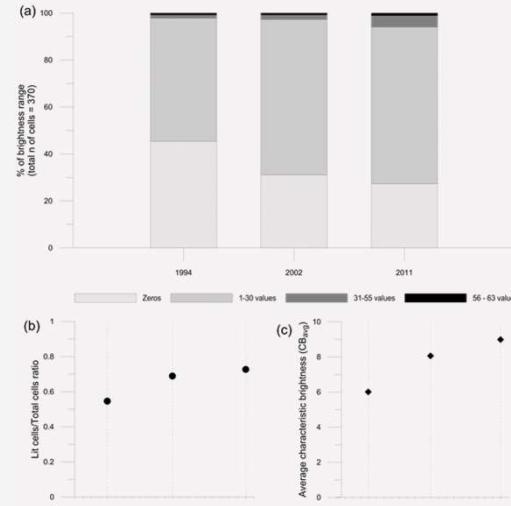


Trends in the number of disasters in the Samala River by (a) municipality and (b, c) landscape type (Copyright: the authors, 2015)



Trends in the precipitation and occurrence of wet spells in the Samala River catchment (Copyright: the authors, 2015)
For details of the method to calculate the wet spells (wetness index) and related information please
read the original study

the brighter the area, the more densely populated it is. This way, we could get an estimation of urban growth with a higher temporal resolution than if using census data, which are produced every 10 years.

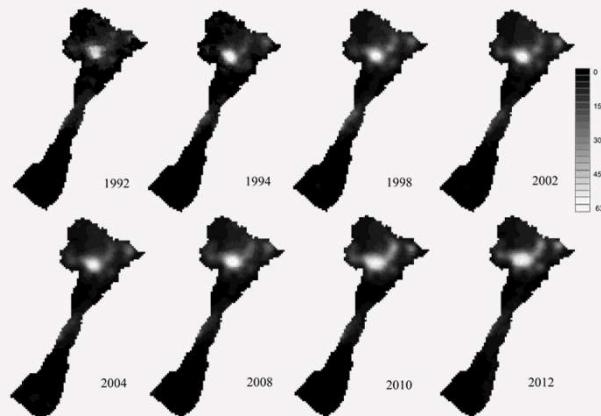


Trends in urban growth in the Samala River catchment showed by the increase in brightness value in the satellite nightlights imagery (Copyright: the authors, 2015)

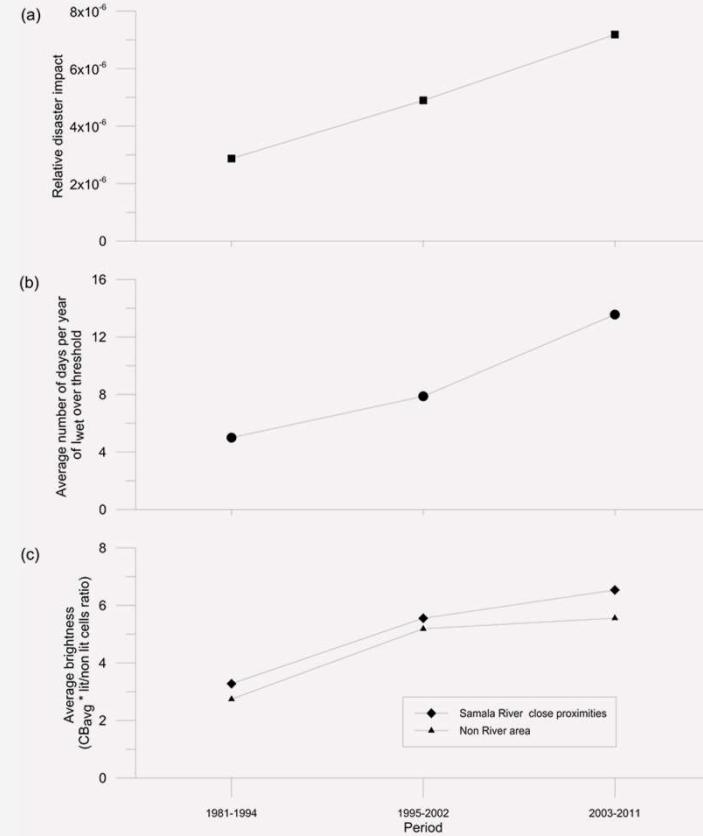
Results

Our analyses showed that losses from water-related disasters had increased over time. This increase can be explained by (i) an increased number of days with saturated soil conditions from wet spells and (ii) an increased human exposure to hazards (as observed by increasingly brighter areas over time in areas close to rivers).

Since it is not possible to modify the precipitation amounts and patterns in the region, the most sensible course of action to avoid unnecessary exposure to natural disasters is to revisit the location and planning of cities. Taking into account factors such as proximity to rivers, floodplains, preferential routes for debris flows, among other simple measures would go a long way in reducing vulnerability and disaster-related impacts.



Satellite images of nightlights in the Samala River Catchment – selected years
(Copyright of the original images, NASA)



Trends in disaster impact, wet spells and urban growth from 1981 to 2011, represented by the respective proxies in the study (Copyright: the authors, 2015)

THANKS!



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