SOCIAL ECOLOGICAL RESILIENCE TO DISASTERS:

British and Brazilian Perspectives Handbook

BRITISH COUNCIL
RESEARCHER LINKS

Newton Fund

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London South Bank University

FURB
UNIVERSIDADE DE BLUMENAU

SOCIAL ECOLOGICAL RESILIENCE TO DISASTERS:
British and Brazilian Perspectives
Handbook

Edited by
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Image 1. Morro do Baú /Photo: Grupo KOT6000+

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Summary

Summary

Summary

4. Abstracts

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PREFACE

Flooding combined with landslides has been a major threat in Brazil compared to other types of disasters where most of these floods caused human lives and economic losses. Recent UK flooding indicates that it's likely to happen yearly and the UK government has taken several initiatives to tackle the risks. The impacts and subsequent economic losses have significantly increased in the past decade due to the country's socio-economic development activities in urban areas. Improving social-ecological resilience is imperative in the context of both Brazil and UK.

The workshop on 'Social Ecological Resilience to river floods and coastal disasters' provides a platform for early career researchers from Brazil and UK to work collaboratively towards a common goal of improving social-ecological resilience to disasters. The workshop will facilitate tow case studies, River case study in Blumenau and Coastal case study in Itajaí, in order to understand the environment and dynamics of water resources, problems faced by low income and vulnerable population and to help to improve social-ecological resilience.

The workshop will contributes to capacity building of early career researchers, through interactive workshops. The activities such as keynote speeches, group activities, poster presentations, breakout sessions and panel discussion will enhance to improve communication, team working, time management and problem solving skills of early career researchers while boosting their level of confidence.

This event Handbook provides the objectives of the workshop. It consists of the comprehensive details about both Blumenau and Itajai case studies, including the tasks that are expected to be performed by the early career researchers. The research works that have been carried out by the early career researchers are also summarized in the form of Book of Abstracts as part of this workshop.

We hope the participants will benefit from feedback on their research and ideas and will gain insights from the works of others. This workshop, in our view, will help to foster long term collaborations among the participants within and between countries and we hope that you will find this workshop useful, ingesting and valuable for your career development.

Dr. Cristiane Mansur de Moraes Souza
Universidade Regional de Blumenau (FURB)
Workshop coordinator – Brazil

Dr. MenahaThayaparan
London South Bank University (LSB)
Workshop coordinator - UK

AKNOWLEDGEMENTS

As the coordinators of the UK- Brazil partnership event, we are delighted to have the opportunity to organise this workshop on Social Ecological Resilience to River Floods and Coastal Disasters.

We thank the Researcher Links scheme offered within Newton Fund with support of British Council and the National Council of State Foundations for Research Support (Confap) for giving us this opportunity to organize this workshop and our thanks go to the members of the British Council Researcher Links Programme team in the UK and in Brazil for their timely responses for all our queries. We gratefully acknowledge the support and financial assistance provided by Foundation for Research and Innovation of the State of Santa Catarina (FAPESC).

We are enormously grateful for the support from Professor João Pollido Natel (Dean -FURB), Professor Charles Egbu (Dean, School of the Built Environment, LSBU), Udo Schroeder (Second Dean FURB), Marcia Sardá (Director of the technological Centre - CCT- FURB), Dr. Alexandre Vibrans (pró-reitor de post-graduation programmes - FURB), Professor.Clovis Reis (PPGDR Dean-FURB), and Prof. David Bisland (International Relations FURB), for provided unwavering backing and encouragement for the success of this workshop. We also thank the guest speakers Dr. Juares José Aumond (geoscience - FURB), and Juliana (Local Defesa Civil- Blumenau) for their willingness to stimulate invaluable discussions and debate around the workshop theme.

We would like to extend our appreciation to Oklinger Mantovanelli Jr (FURB), IVO Marcus Theis, postgraduate Programa FURB (FURB) for providing valuable support for the workshop organising activities.

Further, we would particularly like to acknowledge the support of our mentors Prof Marcos Antonio Mattedi (FURB), Prof. Marcus Polette (UNIVALI), Prof. Yamuna Kaluarachchi (LSBU), Prof. Charles Egbu (LSB), for their continuous support in organizing the workshop and their invaluable guidance.

We acknowledge the valuable contributions made by the organising committee members who are working hard behind the scene in order to make this workshop a success.

Finally, we would like to thank all the participants from Brazil and the UK for their valuable contributions made towards the workshop in making it a success. If not for their contributions, the workshop would not be successful.

Dr. Cristiane Mansur de Moraes Souza
Regional University of Blumenau, Brazil
Workshop coordinator – Brazil

Dr. MenahaThayaparan
London South Bank University (LSBU)
Workshop coordinator - UK

MESSAGE FROM THE HEAD OF THE REGIONAL DEVELOPMENT POST-GRADUATION PROGRAMME, UNIVERSIDADE REGIONAL DE BLUMENAU

On behalf of the Graduate Programme in Regional Development at the Universidade Regional de Blumenau (FURB), we would like to thank and welcome the participants of the Social Ecological Resilience to River Floods and Coastal Disasters Workshop.

For us this workshop is both a challenge and an opportunity. On the one hand, the challenge of bringing together and integrating researchers from very heterogeneous origins and expertises; on the other, the opportunity for improving regional learning.

Disaster issues accompany the development process of the region. They have been the subject of a truly large number of management strategies. However, their impacts continue to intensify in recent years.

In this sense, it is expected to develop new perspectives on the problem of disasters from the exchange of experiences and ideas. More precisely, the multiplicity of perspectives can support new forms of disaster management.

For this reason, it is firmly believed that this event is a starting point for a fruitful long term relationship between Brazil and UK. It may constitute an international network of research in disasters and resilience and, in this way, stimulate the internationalization process of this Graduate Program.

In particular, we would especially like to thank the contribution of the funding agencies and the engagement of the British and Brazilian coordinators, without which this event would not have been possible. Thank you very much.

Dr. Clovis Reis
Head of the Regional Development Programme – FURB

MESSAGE FROM THE MENTORS

The natural disasters globally continue to rise creating increased social-ecological challenges to urban envrionemnts. The resilient capacities of cities are dependent on the natural, physical, social, built, economical and political environment of the respetive cities. As such improving social ecological resilience to minise the risks and impact by disasters is still considered as a challenge due to the complex and interdependent nature of social and ecological systems.

We, as the mentors of this woekshop, are very pleased to welcome all the early career researchers from Brazil and UK. The early career reaserchers come from different knowledge backgrounds ranging from scientific to social sceinece, hence this colloboration will contribute to a multidisciplinary research while bringing their knowldge and expertise to a common platform to achieve a common goal.

Brazil and UK are two of the many countries which are subjected to requlat flooding. The workshop on social ecological resilience to river floods and coastal disasters provides a unique opportunity to the early career researchers for knowledge sharing and best practice transfers between Brazil and UK with the aim to enhance the capacity of social-ecological systems to adapt to floods and associated risks.

The partership established between these two countries is a stepping stone for long term colloboration between Brazil and UK. We insisit everyone of you to make use of this opprotunity to develop your career in terms of joint publications, partnerships, research supervision, staff exchange programmes and other long term colloborations between insitutions.

We wish you all the particpants to have a succesfull workshop and we hope you all will find this workshop enjoyable. Good luck.

Professor Charles Egbu,
London South Bank University, UK

Professor Marcos Antônio Mattedi,
Regional University of Blumenau, Brazil

Professor Marcus Polette,
Regional University of Vale do Itajaí, Itajaí, Brazil

Assoc. Professor Yamuna Kaluarachchi,
London South Bank University, UK

Mentors – Workshop on Social Ecological Resilience to River Floods and Coastal Disasters

MESSAGE FROM THE BRITISH COUNCIL RESEARCHER LINKS PROGRAMME

Researcher Links was launched in 2013 with the aim to give early career researchers across 20 countries the opportunity to form international connections through fully funded workshops and travel grants. Since the launch, thousands of researchers from across the various countries have benefited from Researcher Links. New international collaborations, networks and projects have already been formed directly from the first round of workshops. From 2014 onwards, Researcher Links has continued in its original form and has also been included in the Newton Fund, with new partner countries and new match funding strategy. New calls under the Newton Fund will be announced in 2019. The British Council Researcher Links workshop in Brazil will provide opportunities for early career researchers to interact, learn from each other and explore opportunities for building long-lasting research collaborations in the area of social-ecological resilience to disasters. We hope that the workshop will be a fruitful experience for all.

Luca Magri
Project Officer Education Services - British Council

1. About the Workshop: Social Ecological Resilience to River Floods and Coastal Disasters

A workshop on 'Social-Ecological Resilience to River Floods and Coastal Disasters' will be held from 16th to 20th July 2018 in Blumenau, Brazil. The workshop is coordinated by Regional University of Blumenau, Brazil and London South Bank University, UK under the Researcher Links scheme offered within Newton Fund with support of British Council and the National Council of State Foundations for Research Support (Confap). British Council Researcher Links programme provides opportunities for early career researchers from the UK and internationally to interact, learn from each other and explore opportunities for building long-lasting research collaborations. As such the workshop will provide a unique opportunity for sharing research expertise and networking. During the workshops early career researchers will have the opportunity to present their research in the form of a poster presentation and discuss this with established researchers from the UK and Brazil. There will be a focus on building up links for future collaborations and participants selected on the basis of their research potential and ability to build longer term links.

1.1. Objectives

The workshop will create a platform for knowledge sharing and best practice transfers between UK and Brazil with the aim to enhance the capacity of social-ecological systems to adapt to floods and associated risks. Lack of social-ecological resilience to flood risks has been an ongoing problem in Itajaí Valley´s history. The urban sprawl at river waterfront, harvest of wood resource to build shanty neighbourhood and the climate change with intense rain lead to high environmental risk and erosion of social ecological systems. In this contexts the objectives of the workshop are:

1. To improve social-ecological resilience to river floods, coastal disasters and other associated risks;

2. To contribute to capacity building of early career researchers by supporting their personal and professional development;

3. To establish and sustain the partnership between UK and Brazilian partner institutions;

1.2. Objectives of the Handbook

The purpose of this Handbook is to present a landscape of landslides and susceptibility to floods in the Itajaí Valley, Santa Catarina, Brazil

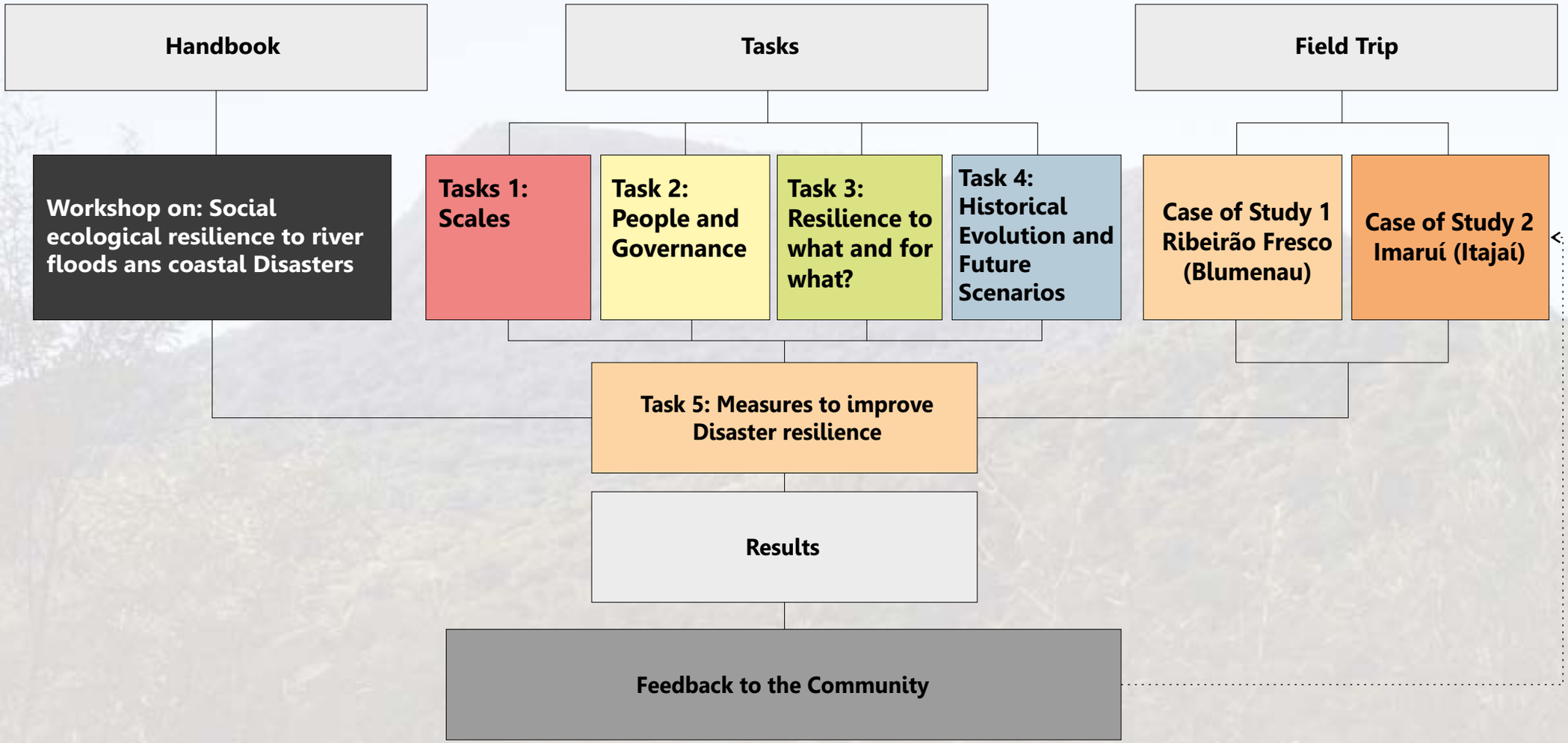
1.3. Objectives of the Tasks

The objective of the Tasks is to undertake an interdisciplinarary study of the themes related to scales, governance, resilience, historical evolution and the future scenario of the vulnerability in question at this workshop.

1.4. Objectives of theFirld Trip

The Field Trip aimed at getting to know the territories of the Ribeirão Fresco in Blumenau and the Imaruí oin Itajaí, Santa Catarina, Brazil with the purpose of observing socioecological and environmental aspects of these regions.

Workshop's Methodology



Source: graphic 1, Workshop's methodology C. Mansur de M. S & Mattedi, 2018 adapted from Walker & Salt, 2012.

2. Vale do Itajaí (Itajaí Valley)

Its colonization occurred mainly in the 19th century by German immigrants. The Germans first arrived in 1828 and came in large numbers after 1850. The immigrants received land lots and engaged in agricultural activities in colonies that became important cities, such as Brusque, Itajaí and Blumenau - the largest cities in the region. With less influence than the Germans, Italians began to reach the region in the last decades of the 19th century and colonized cities like Itajaí, Rodeio, and Nova Trento, one of the largest Catholic centers in Brazil.

Colonization: Sec. XIX

German Colonization

Italian Colonization

Language: Portuguese

1.514.312 inhabitants

Area: 13.003,018 km²

Density: 116,0 hab/km²

Elevation: 0 a 1.100 m

IDH 0,806 Very High PNUD/2010

Most populous cities of Itajaí Valley

Blumenau	334.002 inhab.
Itajaí	212.615 inhab.
Brusque	125.810 inhab.
Balneário Camboriu	66.255 inhab.
Rio do Sul	62.289 inhab.

Oldest cities:

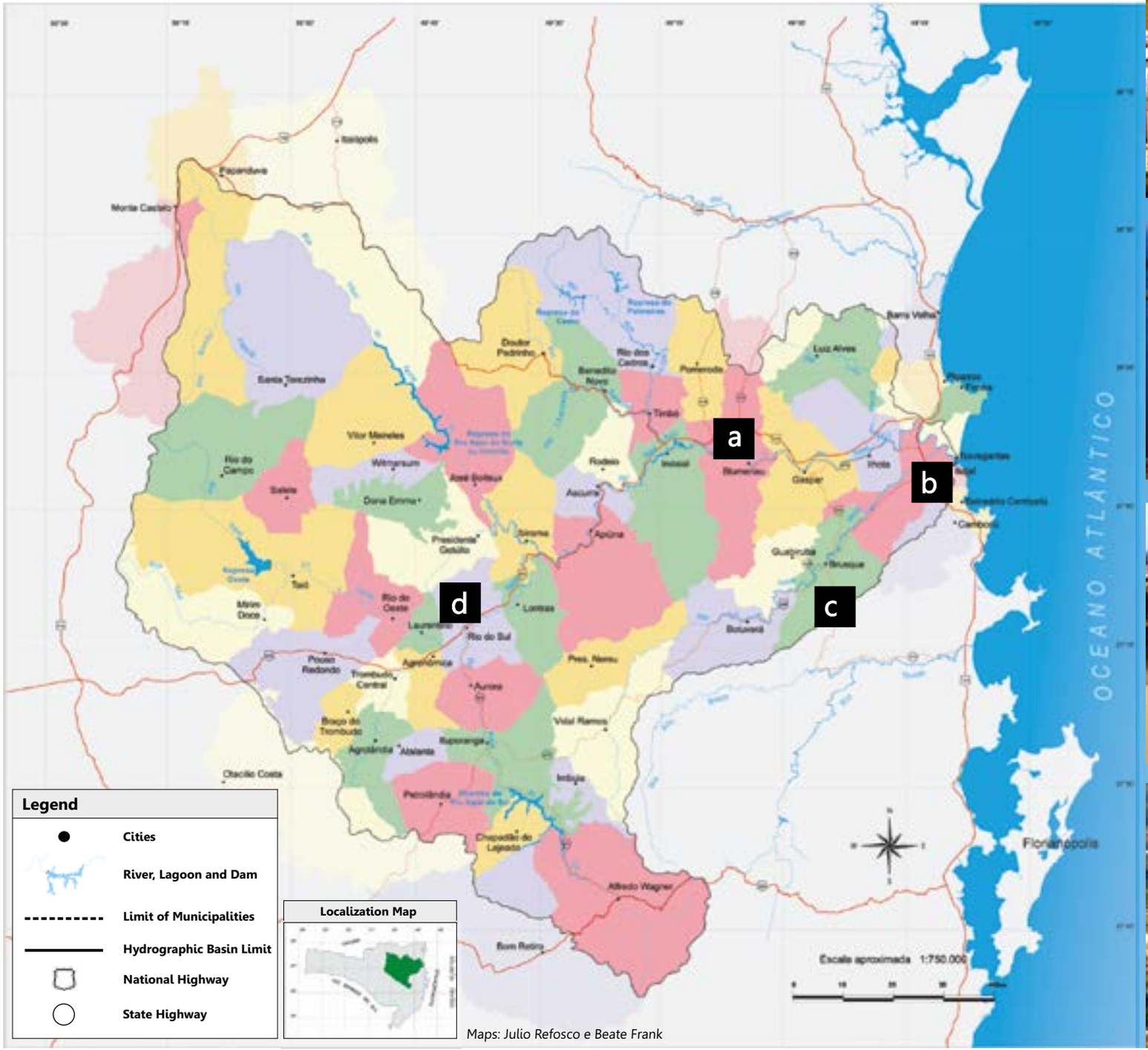
1850 - 1900
1901 - 2000

Highest mountain:
FUNIL Mount
1062mts

Image 4: Funil Mount - Walter_rsl/Tripadvisor

Image 5: Overview of the middle Itajaí Valley (Médio Vale do Itajaí)

2.1. Political Map and Major Cities



Maps: Julio Refosco e Beate Frank

Image 6 : Center of Blumenau / Francisco Fresard / Click RBS

Image 7: Center of Itajaí / Eduardo Marquetti

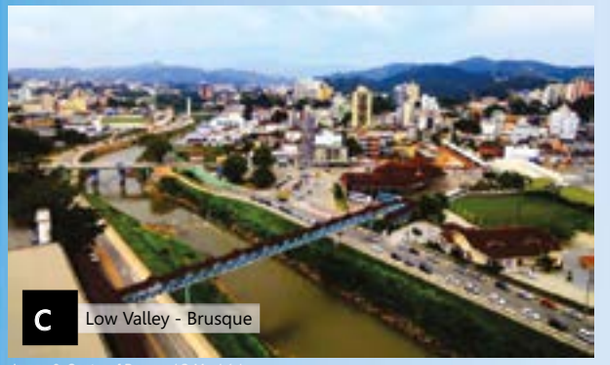
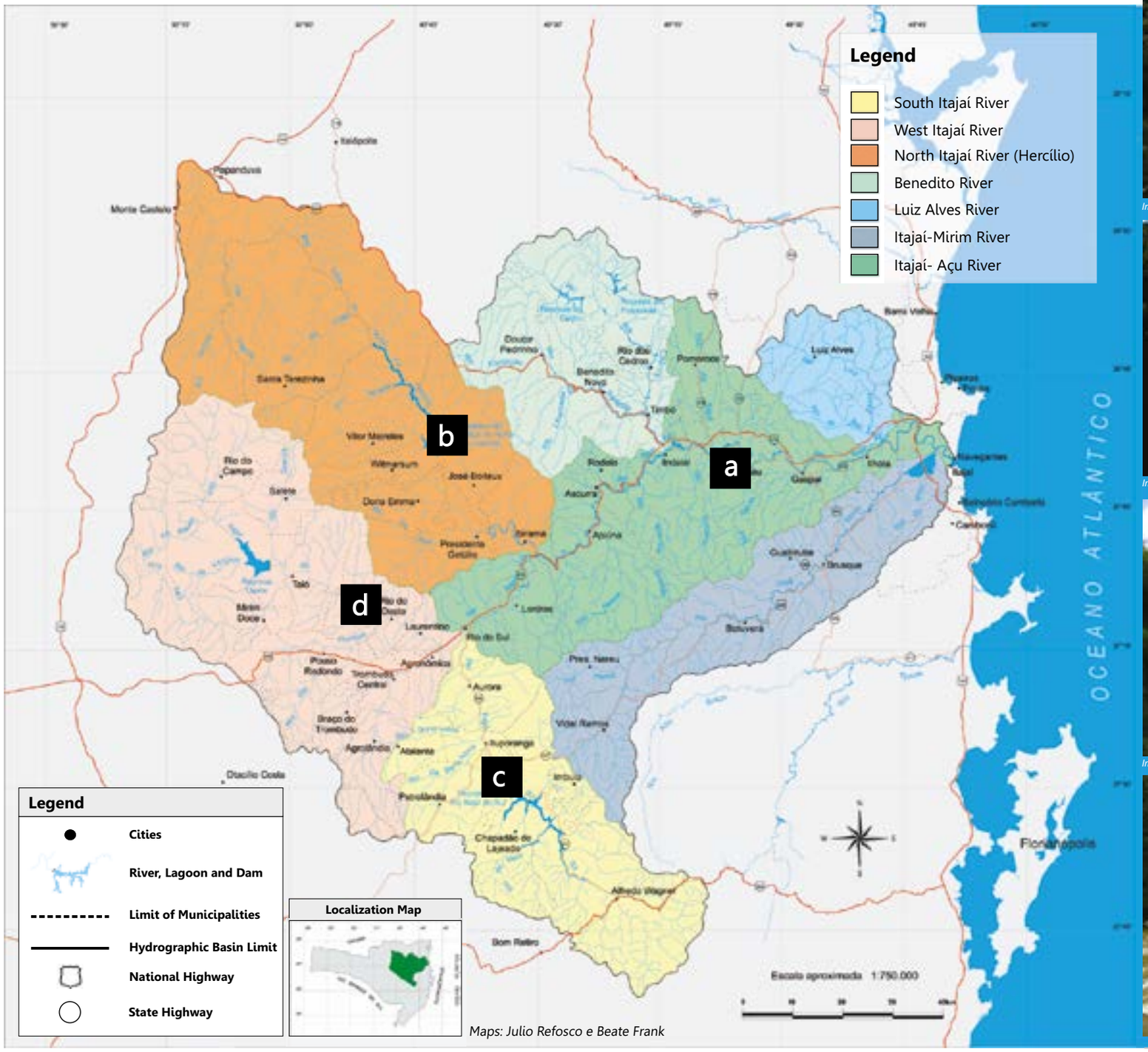


Image 8: Center of Brusque/ O Município

Image 9: Center of Rio do Sul / Humbolt - SC

2.2. Hydrographic ans Sub Basins Map



Maps: Julio Refosco e Beate Frank

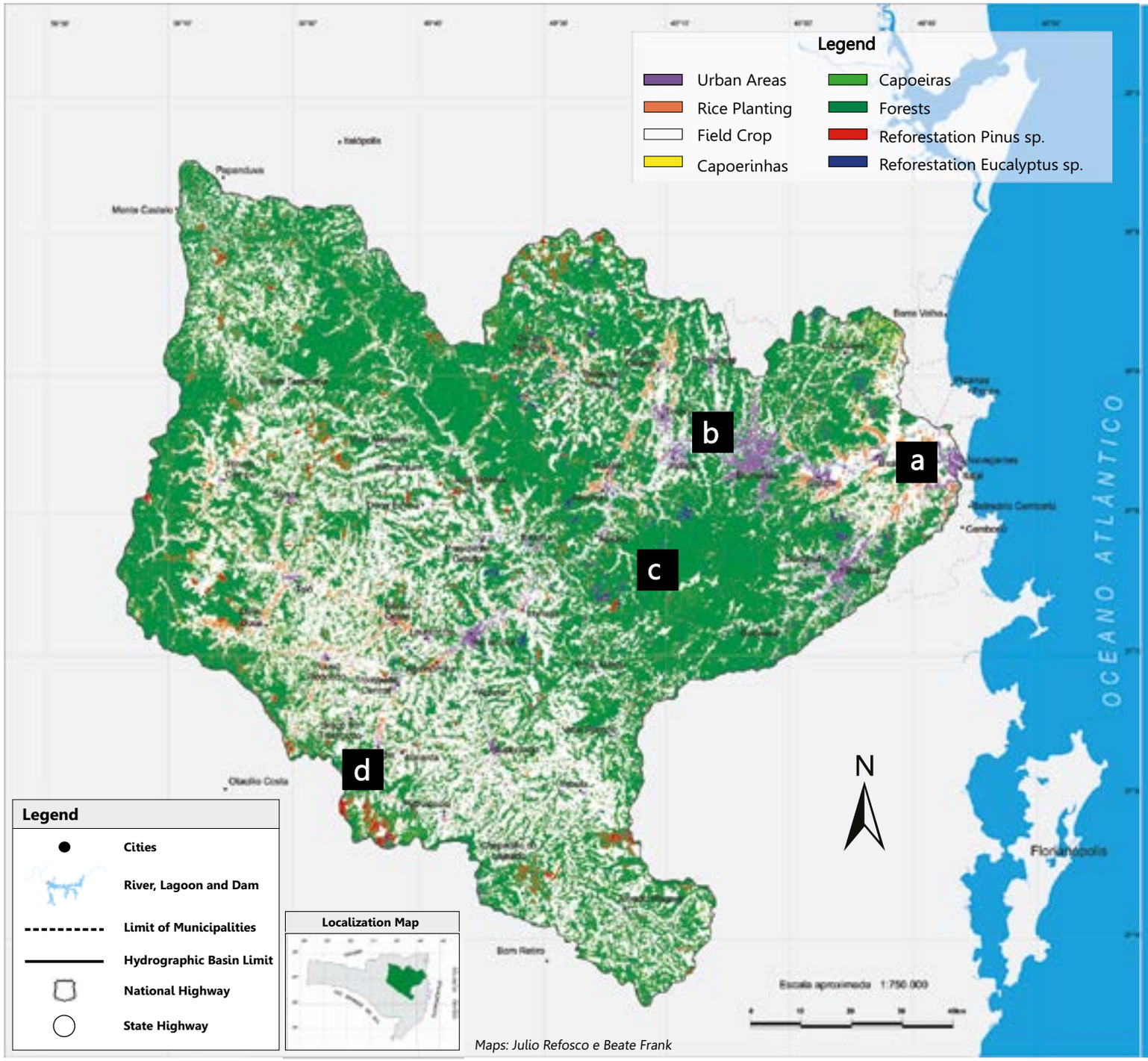
Image 10: Steel Bridge, Blumenau / Photo Maritima

Image 11: River in José Boiteux/ Photo: Ivo Kindel

Image 12: River in Itouporanga / Photo: Walter Antonio

Image 13: River in Rio do Oeste / Photo: Ivo Kindel

2.3. Land Use Map



Maps: Julio Refosco e Beate Frank

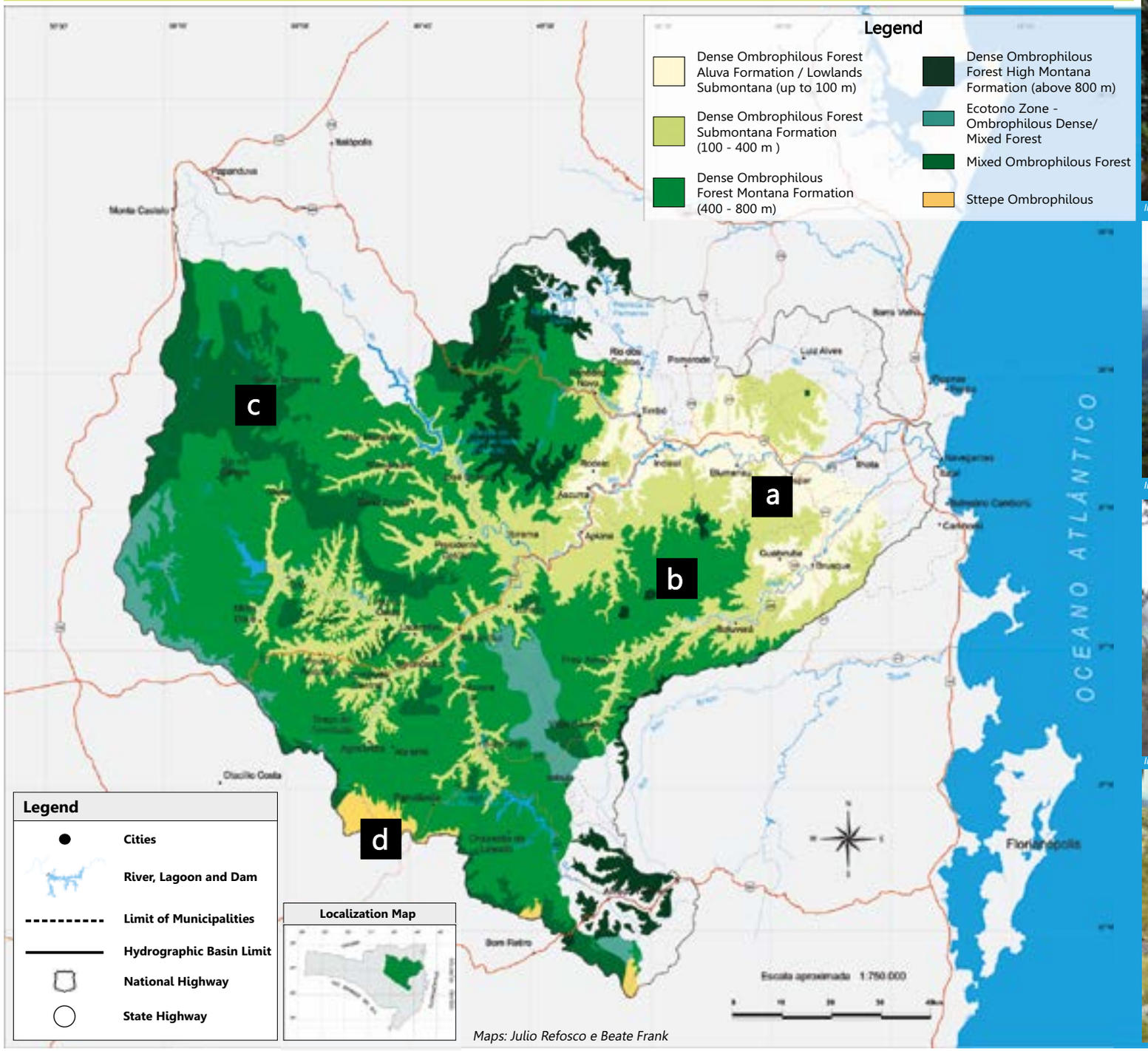
Image 14: Rice Planting in Ilhota / Photo: Epagri

Image 15: Center of Blumenau by drone / Photo: Patrick Rodrigues

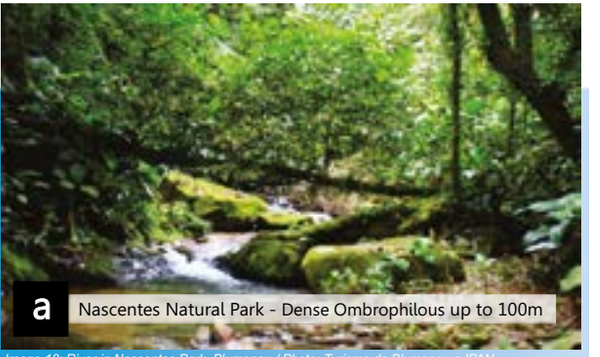
Image 16: Park in Blumenau / Photo: Sidnei Recco

Image 17: Pinus planting in Atalanta / Photo: Feriastur.com.br

2.4.Vegetation Map



Maps: Julio Refosco e Beate Frank



a Nascentes Natural Park - Dense Ombrophilous up to 100m

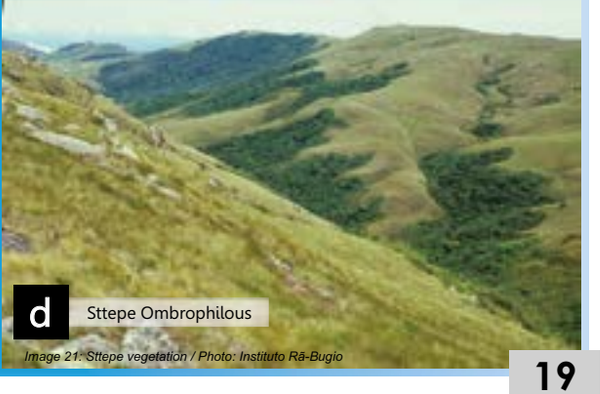
Image 18: River in Nascentes Park, Blumenau / Photo: Turismo de Blumenau e IPAN

b Dense Ombrophilous- Serra do Itajaí Natural Park

Image 19: Forest in Botuverá / Photo: J.P. Maçaneiro

c Mixed Ombrophilous Forest (Santa Terezinha)

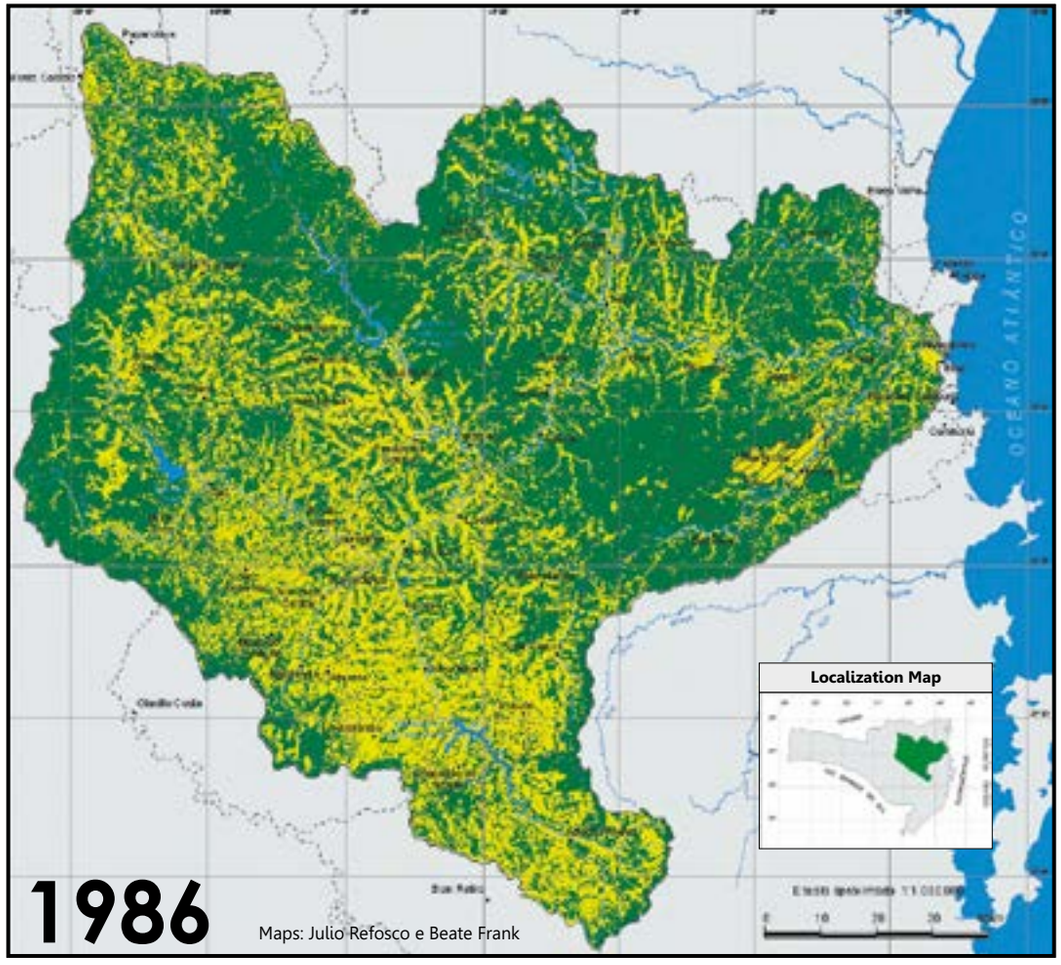
Image 20: Mixed Forest (Araucária) in Santa Terezinha / Photo: Eduardo Mussatto

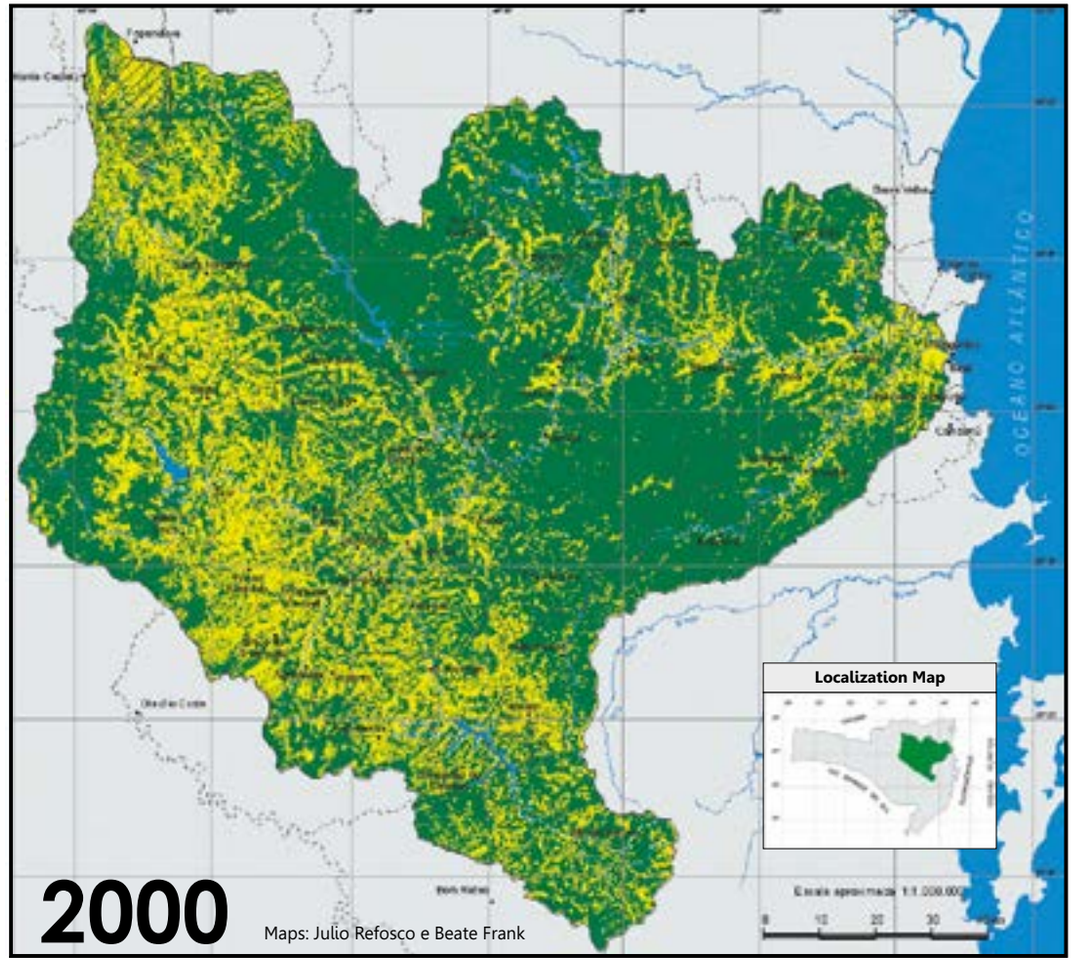


d Sttepe Ombrophilous

Image 21: Sttepe vegetation / Photo: Instituto Rã-Bugio

2.5. Vegetation Cover Map





Legend

- Cities
- River, Lagoon and Dam
- Limit of Municipalities
- Hydrographic Basin Limit
- Vegetal Cover (Natural and Reforestation)
- Occupied Areas (Field Crops and Urban Areas)
- Clound Cover

Deforestation Timeline


Image: Acervo Histórico PMB


Image: Acervo Histórico PMB


Photo: Indexgrupo


Photo: Acervo Histórico PMB

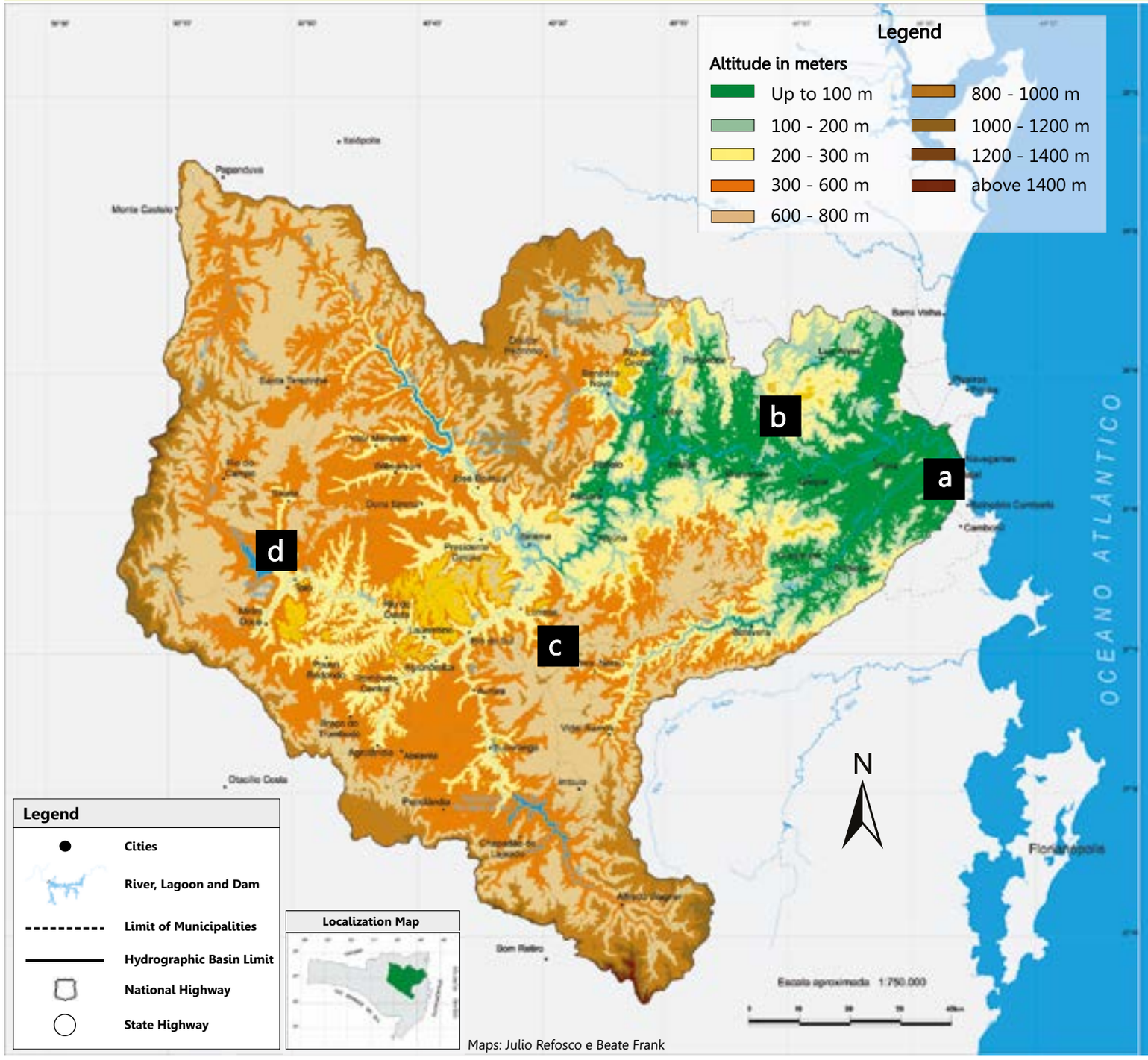
1860 Image 22: Deforestation for agriculture and livestock, Blumenau.

1900 Image 23: Wood Extraction in Blumenau.

1960/70 Image 24: Field crops and pinus planting.

1980 Image 25: Urban expansion. Blumenau.

2.6. Hypsometry Map



Maps: Julio Refosco e Beate Frank

a Itajaí - 2 m

Image 26:View of Itajai / Photo: Prefeitura de Itajaí

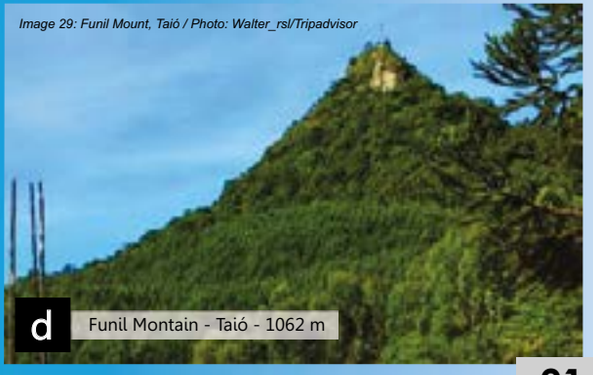
Image 27: View Bau Hill, Ilhota / Photo: Terra Média Trekking

b Bau Hill - Ilhota - 819 m

Image 28: Canions, Lontras / Photo: Dariusturismo

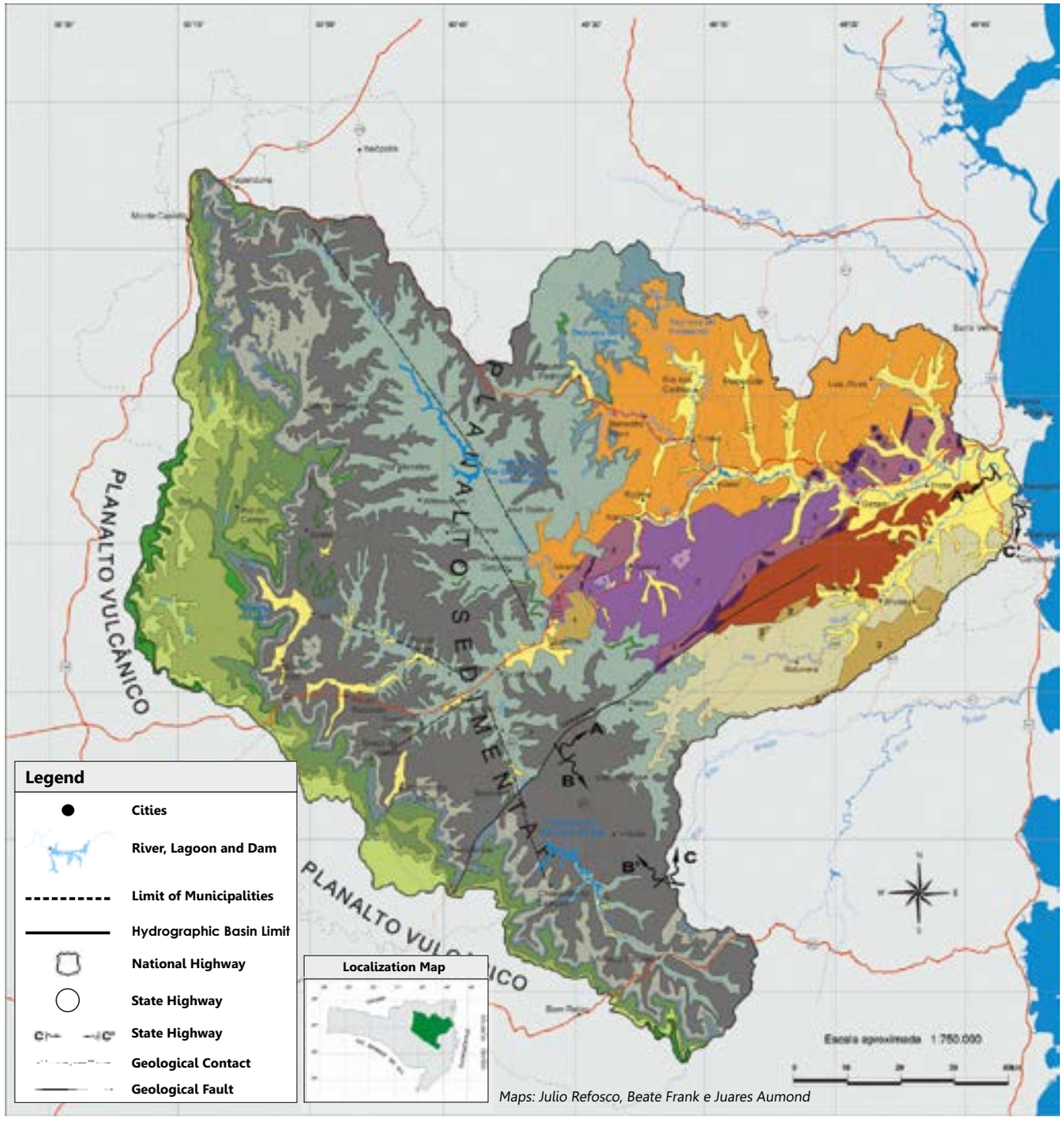
c Lontras Hills - 360 m

Image 29: Funil Mount, Taió / Photo: Walter_rsl/Tripadvisor



d Funil Montain - Taió - 1062 m

2.7. Geology Map

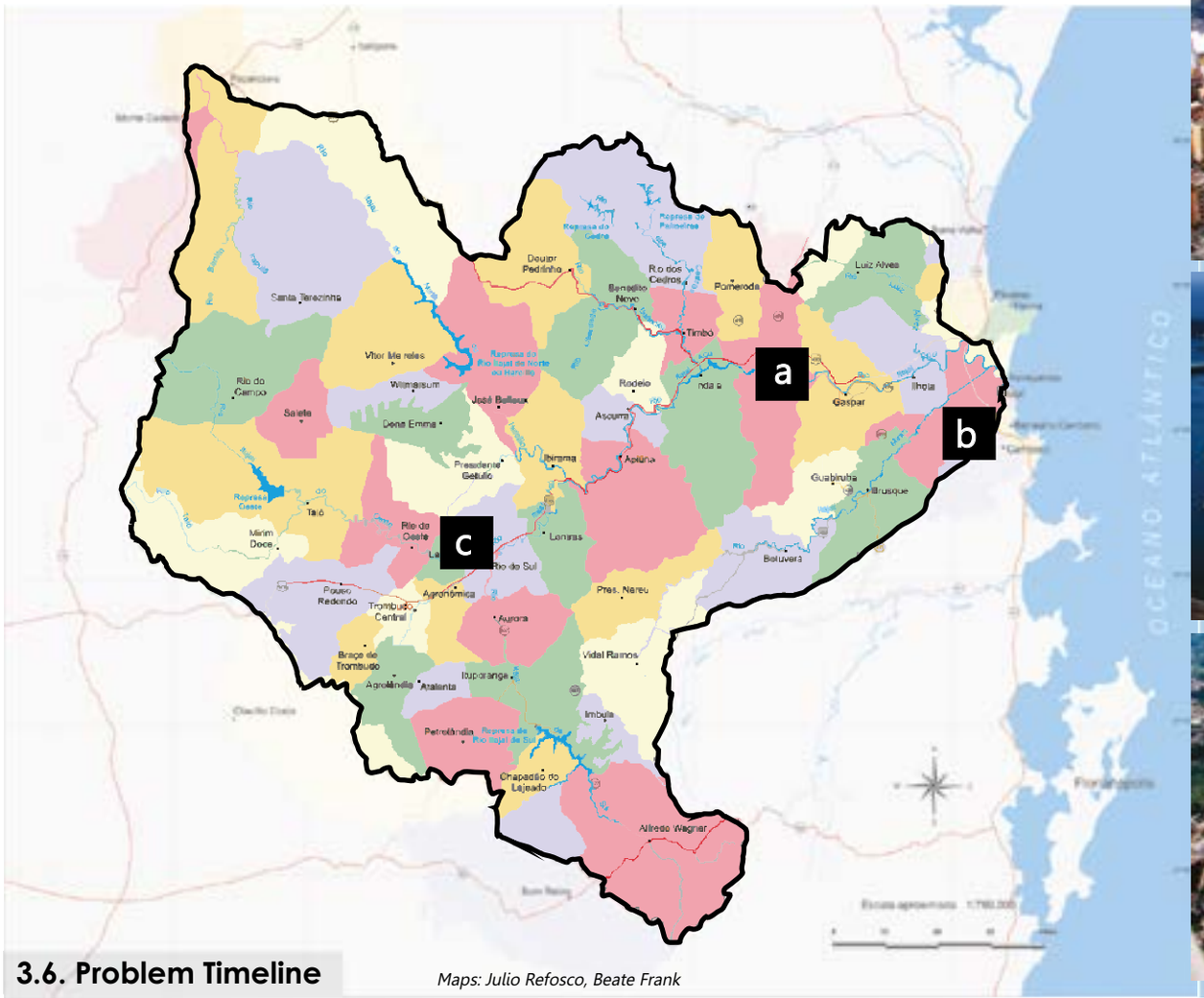


Maps: Julio Refosco, Beate Frank e Juares Aumond

Geological Column

Chrono Geological Units	Lithostratigraphics Units			
Cenozoic	Quaternary	Holocene	Recents Quaternary Sediments	
85 m.a		Pleistocene		
120 m.a Mosozoic	São Bento Group	Serra Geral Formation		
		Botucatu Formation		
225 m.a Palezoic	Passo Dois Group	Rio do Rastro Formation		
		Teresina Formation		
		Serra Alta Formation		
		Irati Formation		
	Tubarão Super Group / Guatá Gr.	Palermo Formation		
		Rio Bonito Formation		
435 m.a	Tubarão Super Group / Itararé Group	Rio do Sul Formation		
		Mafra Formation		
		Campo Tenente Formation		
540 m.a		Suíte Intrusiva Subida		1
Proterozoic 600 m.a	Itajaí Group	Campo Alegre Formation	Volcana Superior Seq.	1
			Sedimentar Intermediária Seq.	2
		Gaspar Formation	Arenitos Sílticos	3
			Arenitos Conglomerado	4
		Suíte Intrusiva Guabiruba		2
1900 m.a		Suíte Intrusiva Valsungana		3
	Brusque Complex	Epiclastica Superior Sequence		
		Volcano Sequence - Sedimentary		
Archean 2600 m.a		Tabuleiro Complex		
		Glanulíticos SC Complex		

2.8. Socio-Environmental Problems



Maps: Julio Refosco, Beate Frank

Image 30: Center of Blumenau / Photo: Adalberto Day

Image 31: Flood in the Center of Blumenau
Photo: Liza Campestrini / Adaberto Day

Image 32: Center of Itajaí / Photo: Eduardo Marquetti

Image 33: Flood in the Itajaí /
Photo: Filipe Araújo

Image 34: Center of Rio do Sul / Photo:AMAVI

Image 35: Flood in the Center of Rio do Sul
Photo: Dancuco.blogspot

3.6. Problem Timeline

Image: Acervo Histórico PMB

Image: Acervo Histórico PMB

Image: Felie Vieira Trijan

1850 Image 36: imigrants arrive in the itajai valley.

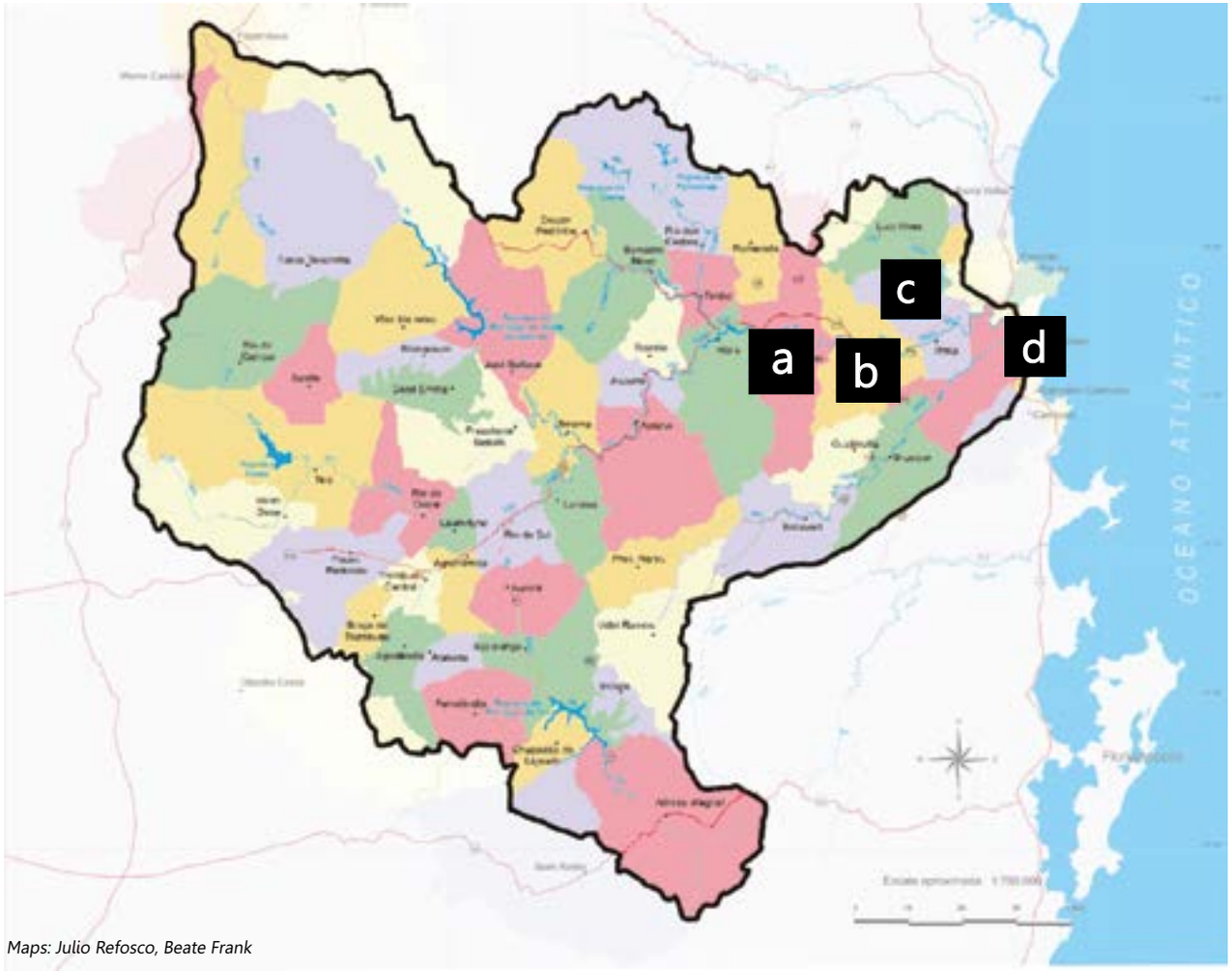
1880 The first great flood. 17 meters.
Image 37: XV st. Blumenau

1960 Urban and population expansion
of the region. Image 38: Center of Itajaí.

1983/84 Image 39: Large floods in Blumenau.

2008 Disasters of 2008.
Image 40: Landslides in Ilhota.

2.9. Itajai Valley - Disaster of 2008



Maps: Julio Refosco, Beate Frank

Numbers of 2008 Disasters

63	cities declare state of emergency in Santa Catarina.
494	millimeters of rain in Blumenau on november 21.
3.000	landslides recorded in the Itajai Valley.
11,52	meters of flood quota in Blumenau.
4,75	billion reais in losses and damages to the State.
67.000	people displaced and 15.000 people homeless.
89	people dead and 4637 people injured.

Desastre de 2008: Água, Gente e Política

Image 41:Landslide in Coripós, Blumenau / Photo: J. Aumond

Image 42: Landslide in Gaspar / Photo: Gazeta do Povo

Image 43: Landslide in Baú, Ilhota / Photo: Folha UOL

Image 44: Flood in Itajaí / Photo: Clickcamburiu

3. Blumenau

Blumenau is a municipality at the state of Santa Catarina, Southern Brazil. It is located at the homonymous microregion and at the Vale do Itajaí Meso-region. It was founded by the German philosopher and pharmacist Hermann Bruno Otto Blumenau, who arrived by boat at Itajaí-Açu river with seventeen people coming from Germany. They arrived at Ribeirão Garcia in 1850, September, 2nd.

Founded:
September 2nd, 1850

German
Colonization

Language:
Portuguese

Mayor:
Napoleão Bernardes

334.002 inhabitants

Area: 519 km²
(200.710 sq. mi)

Density: 594.83 hab.km²
(1,540.6/sq mi)

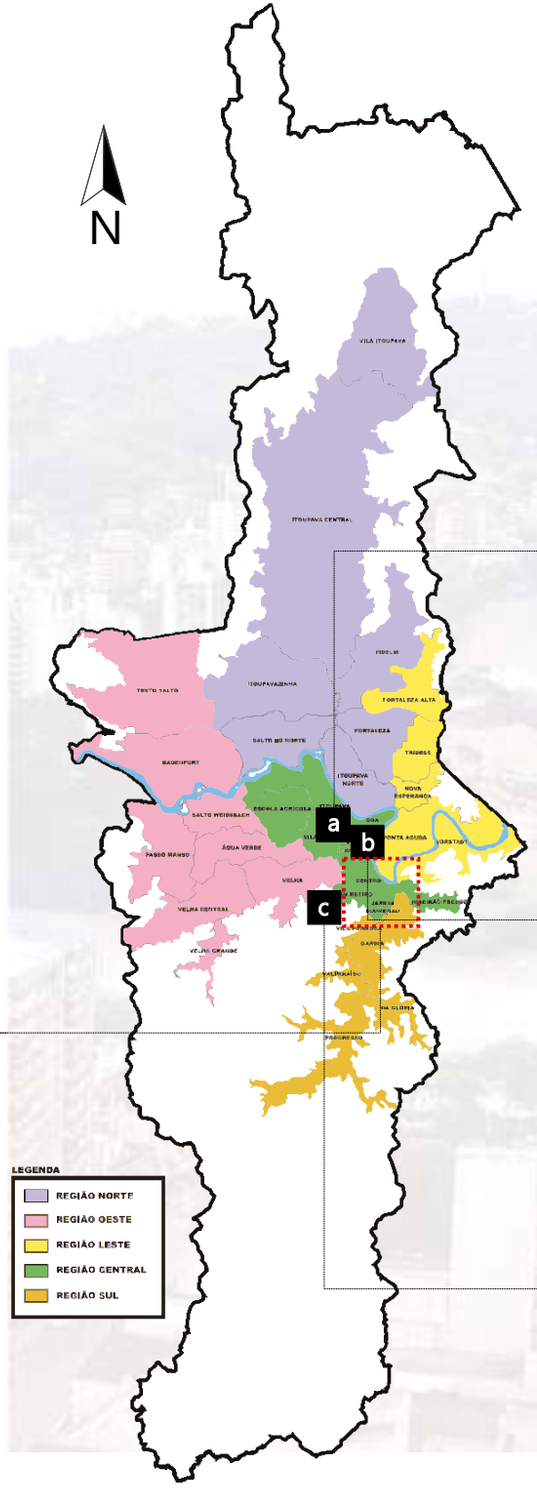
Elevation: 21 m

IDH 0,806 very high
PNUD/2010

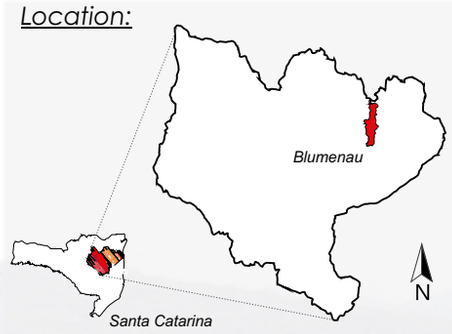
Image 45: View of the Center of Blumenau, 1860
Acervo Histório

Image 46: View of the Center of Blumenau, 1950
Acervo Histórico

Image 47: View of the Center of Blumenau, 2018

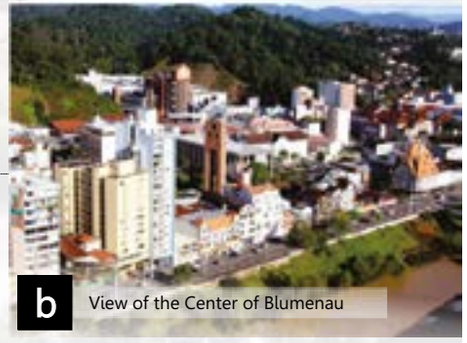


Location:



a Regional University of Blumenau - FURB

Image 48: FURB / Photo: www.furb.br



b View of the Center of Blumenau

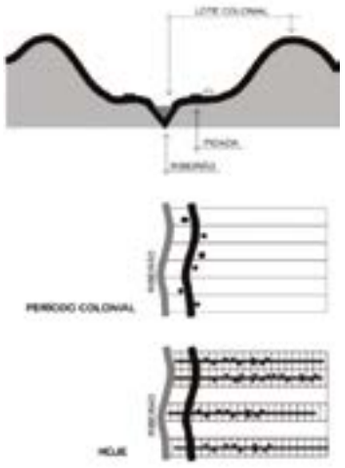
Image 49: Center of Blumenau / Photo: Francisco Fresard

c Hering Industry

Image 50:Hering / Photo: Divulgação/Hering

3.1 History of Blumenau

Founded in 1850 by German immigrants, Blumenau is often remembered for the historical floods that from the 1960s and 1970s, and because of population growth and limited flat area in the municipality, induced occupation of the city's slopes (Vieira, 2016).



Fonte: A influência da divisão da terras do período colonial na ocupação de encostas em Blumenau [SIEBERT, 1998]

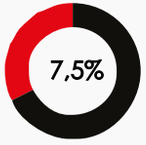
3.1.1. Since the Fundation

The region's economy, initially based on agriculture and logging, has evolved gradually to handicraft, small trade and industrialization, with a strong textile sector. Industrialization brought with it population growth, the recent and gradual urbanization of the territory. Progress, understood as an act of subjugating nature can also be observed, throughout the evolution of the city, in the construction of bridges and roads, the cutting of hills to open streets, the occupation of river banks and the channeling and rectification of its margins. The great floods led to the verticalization of the buildings in floodable areas. For the low-income population that cannot afford to pay for apartments, the option to escape the floods was to occupy hills in a self-built system. The growth of the illegal city followed the demographic growth of Blumenau. In the 70's, the accelerated urbanization caused by the migratory movements of the interior of the state, was not oversaw by competent bodies (SIEBERT, 2009).

3.1.2. After 1984 disaster

The formation of risk areas is enhanced by the morphology resulting from the occupation of Blumenau in its colonial period, beginning at fluvial plains, with the main streets parallel to the river, and extending towards the slopes. Since the 90s, the productive restructuring process of the companies in the region as a way of facing the globalized competition, resulted in strategies of automation and outsourcing, which in turn, resulted in unemployment and precariousness of labor relations. This furthered the irregular occupation on the slopes by the low-income population.

3.1.3. Social-environmental Paradigms



People in Blumenau live in poverty, in subnormal clusters

23.131 People

They live in clusters Subnormal

A community resident earns seven times less than a downtown resident.

3.1.4. Socio-Environmental Problems

Image 51:Landslide in Coripós, Blumenau 2008. Photo: Defesa Civil

Image 52: Landslides in Bairro Progresso. Blumenau, 2008.
Image: Eraldo Schnaider

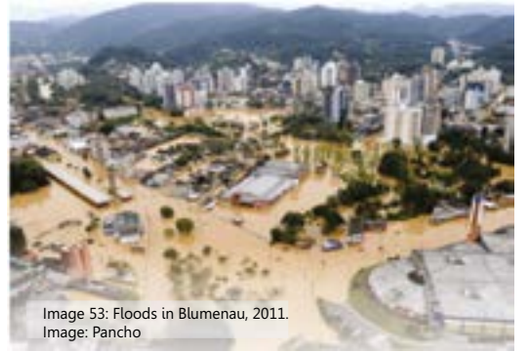


Image 53: Floods in Blumenau, 2011.
Image: Pancho

Image 54: Landslides in Garcia. Blumenau, 2008.
Image: CEPED UFSC

Image 55: Landslides in Bau Mount. Ilhota, 2011.
Image: CEPED UFSC

3.2. DISASTER TIMELINE IN BLUMENAU

DISASTER YEAR ↓

1852	1880	1911	1957	1984	2008
Dr. Hermann Blumenau, founded Blumenau in 1850.	Constituition of the Stadtplatz.	EFSC Railroad Foundation.	Diffusion of the textile industry.	Urban expansion.	Landslides affect the houses in the hills.
Flood Scale: 16,30 m Date: 10/29	Flood Scale: 17,10 m Date: 09/23	Flood Scale: 16,90 m Date: 10/02	Flood Scale: 13,07 m Date: 08/18	Flood Scale: 15,46 m Date: 08/07	Flood Scale: 11,52 m Date: 11/24

Urban Expansion

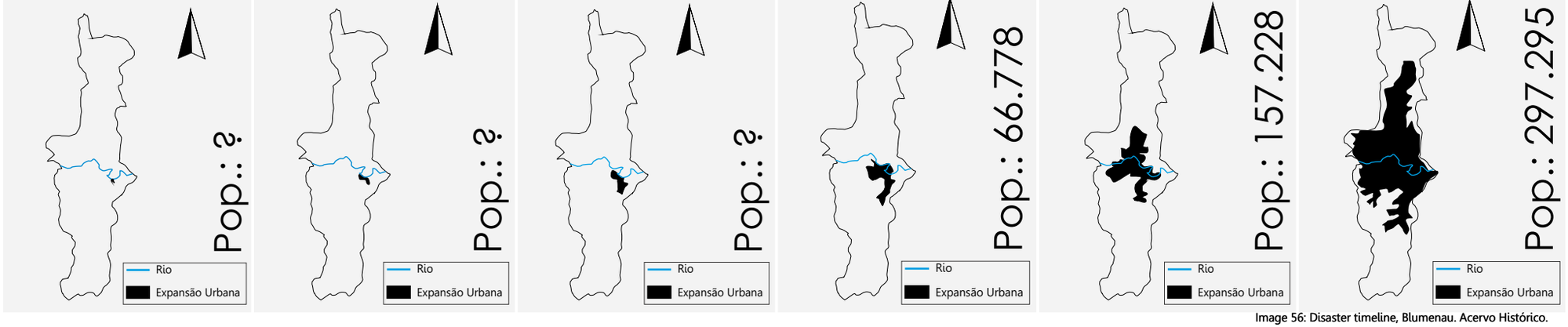
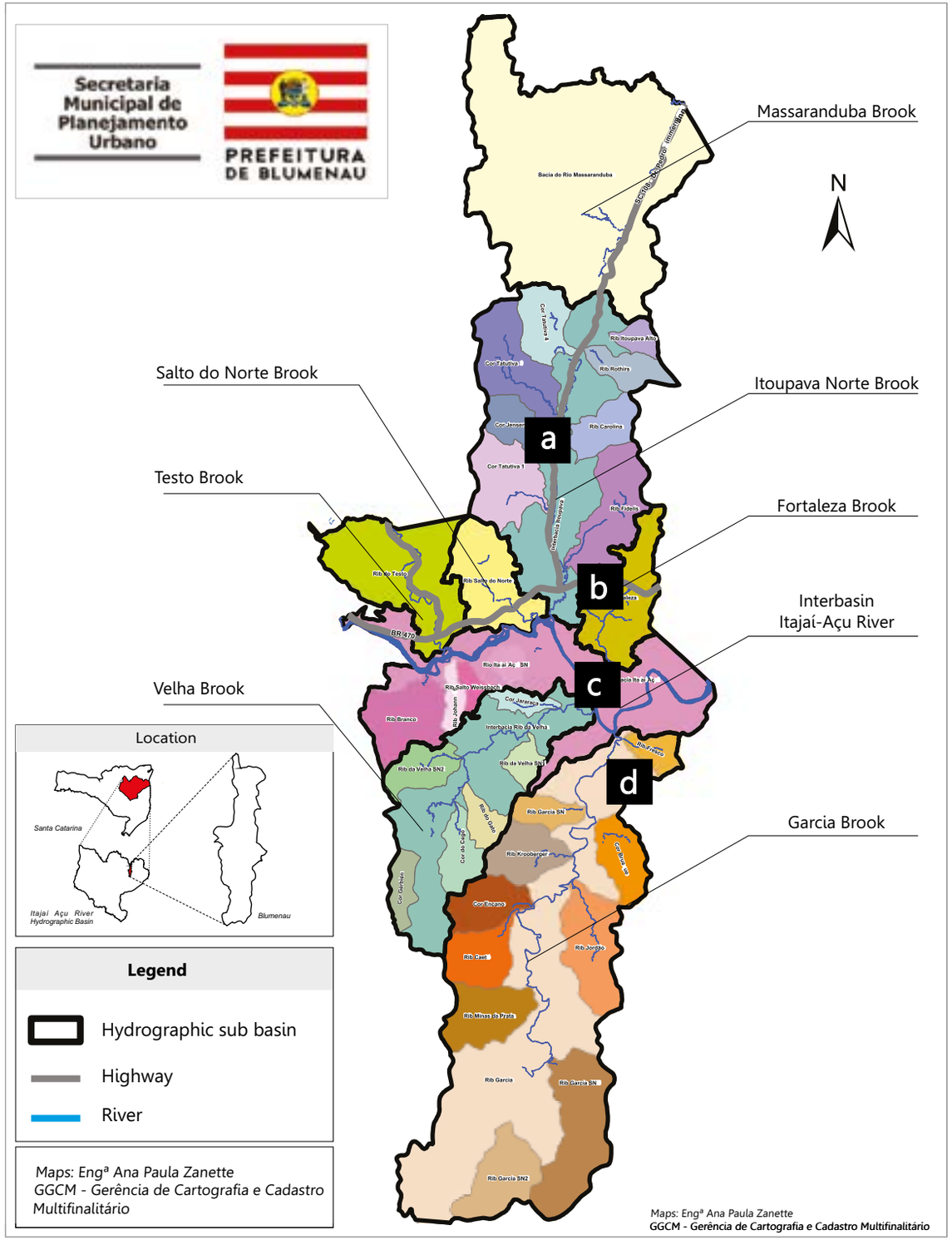


Image 56: Disaster timeline, Blumenau. Acervo Histórico.

3.3. Hydrographic and Sub Basin Map

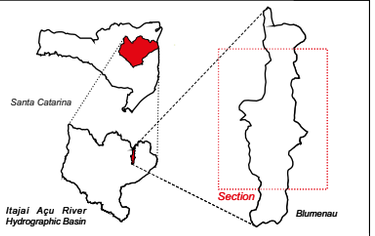


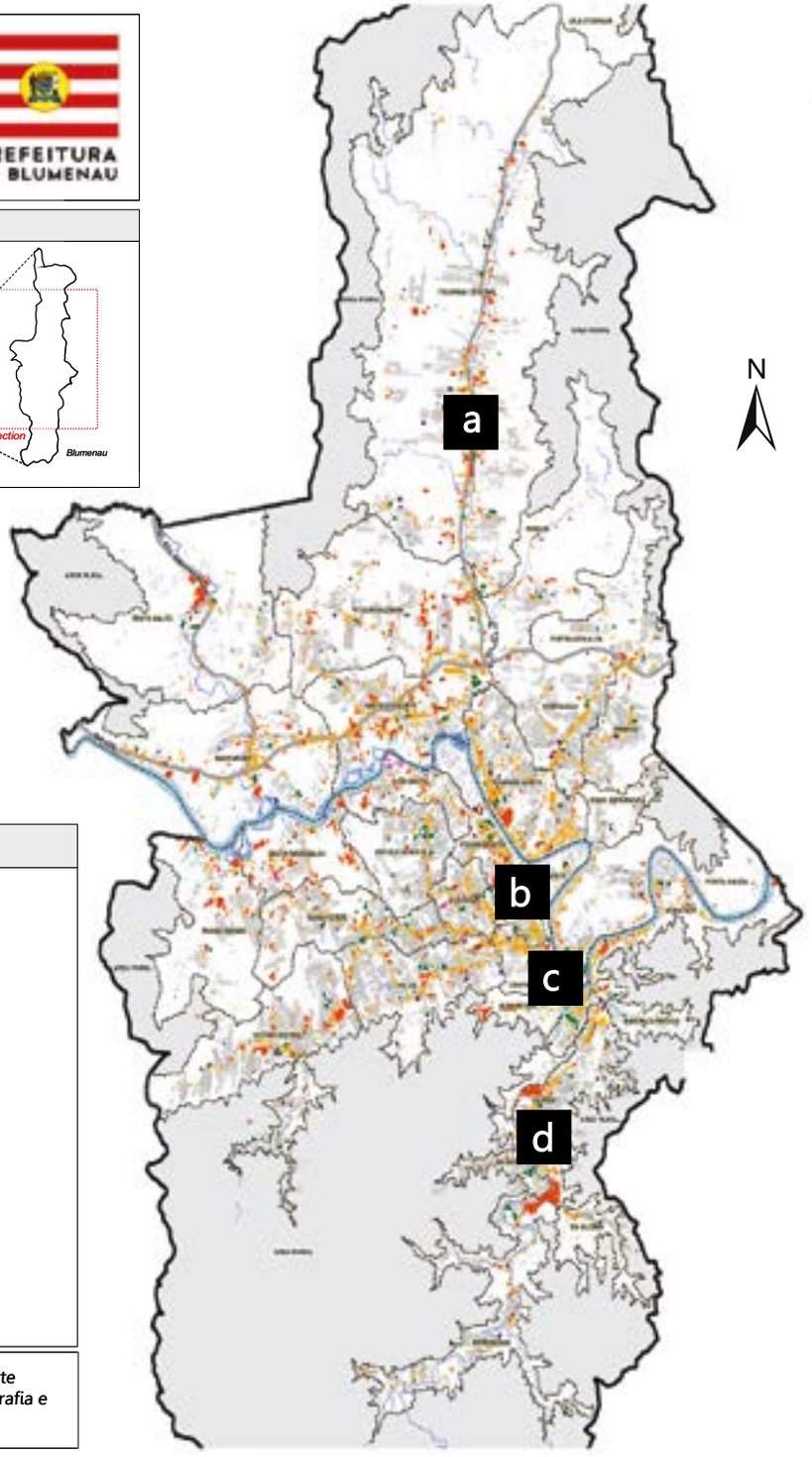
3.4. Land Use Map

Secretaria Municipal de Planejamento Urbano

PREFEITURA DE BLUMENAU

Location





Legend

- Division of Neighborhood
- Highway
- River
- Industrial use
- Commercial use
- Service use
- Service and Health use
- Education and Culture use
- Financial use
- Municipal government use
- State government use
- Federal government use
- Residential use
- Religious use

Maps: Engª Ana Paula Zanette
GGCM - Gerência de Cartografia e Cadastro Multifinalitário

Image 61: WEG industry / googlemaps

Image 62: FURB /Photo: Francisco Fresard

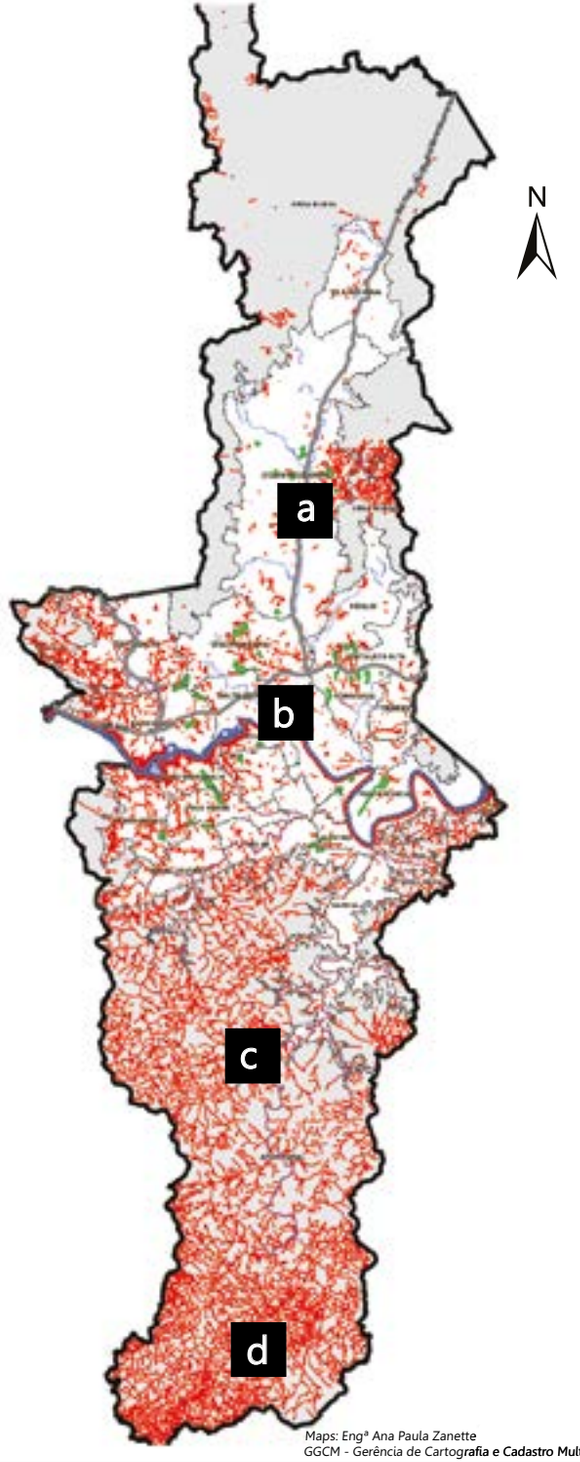
Image 63: Center of Blumenau / googlemaps

Image 64: Garcia / googlemaps

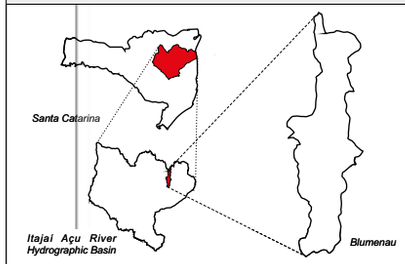
3.5. Ambiental Legislation Map

Secretaria Municipal de Planejamento Urbano

PREFEITURA DE BLUMENAU



Location



Legend

- Division of Neighborhood
- Highway
- River
- APP - Water Course - Forest Code
- APP - Mountain Top - Decree 9853/2012
- Rural use

Maps: Engª Ana Paula Zanette
GGCM - Gerência de Cartografia e Cadastro Multifinalitário

Maps: Engª Ana Paula Zanette
GGCM - Gerência de Cartografia e Cadastro Multifinalitário

Image 65: Itoupava Central / googlemaps

Image 66: Tamarindo Bridge. Itoupava Norte / googlemaps

Image 67:River in Nascentes Park / Photo: ecohopsedagens

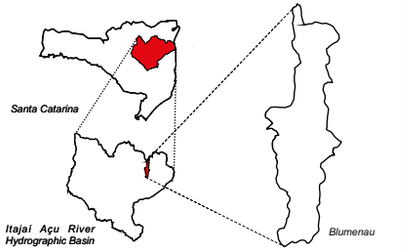
Image 68: View of Serra do Itajaí Park, Blumenau /brviarural.com

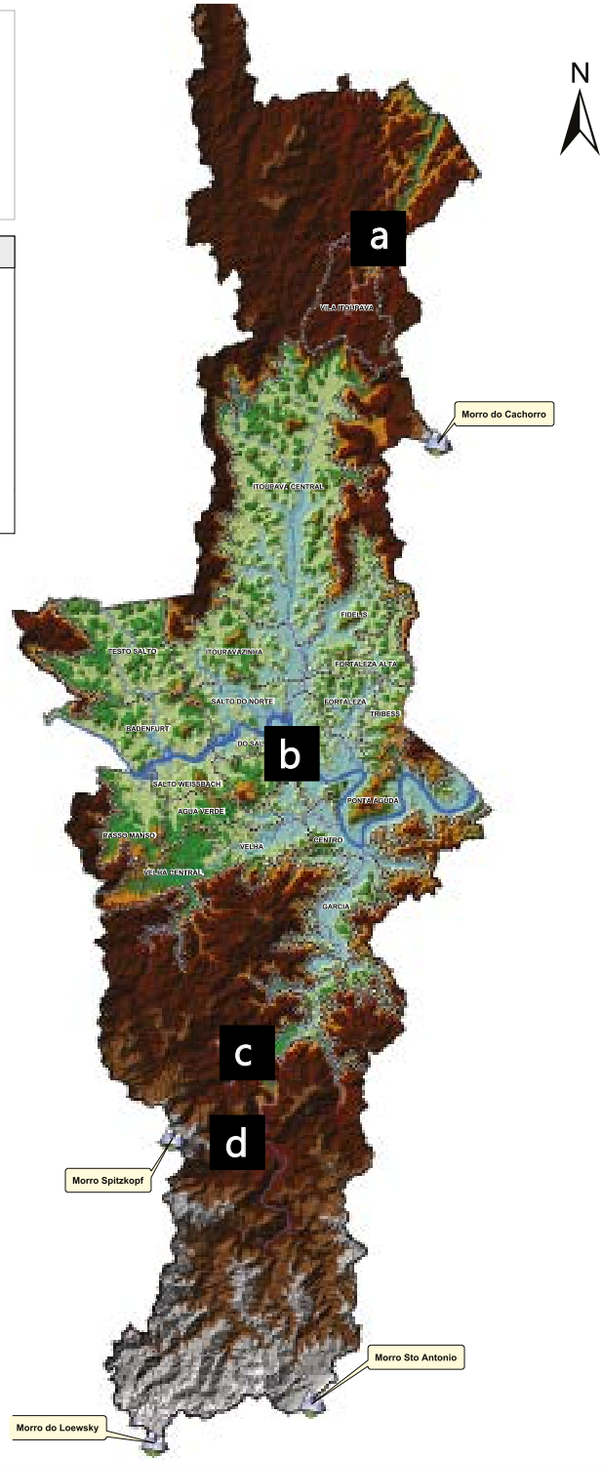
3.6. Hypsometric Map

Secretaria Municipal de Planejamento Urbano

PREFEITURA DE BLUMENAU

Location





Legend

- Highest Hills
- Division of neighborhoods
- River

Hipsometry

- 0 - 25m
- 25 - 50m
- 50 - 75m
- 75 - 100m
- 100 - 150m
- 150 - 200m
- 200 - 400m
- 400 - 600m
- 600 - 800m
- 800 - 960m

Maps: Engª Ana Paula Zanette
GGCM - Gerência de Cartografia e Cadastro Multifinalitário

a Vila Itoupava

Image 69: Road in Vila Itoupava / googlemaps

b View of Center - Itajaí Açu River

Image 70: Prainha / Photo: Lucaskallermann

c Region South of Blumenau

Image 71: Progresso / googlemaps

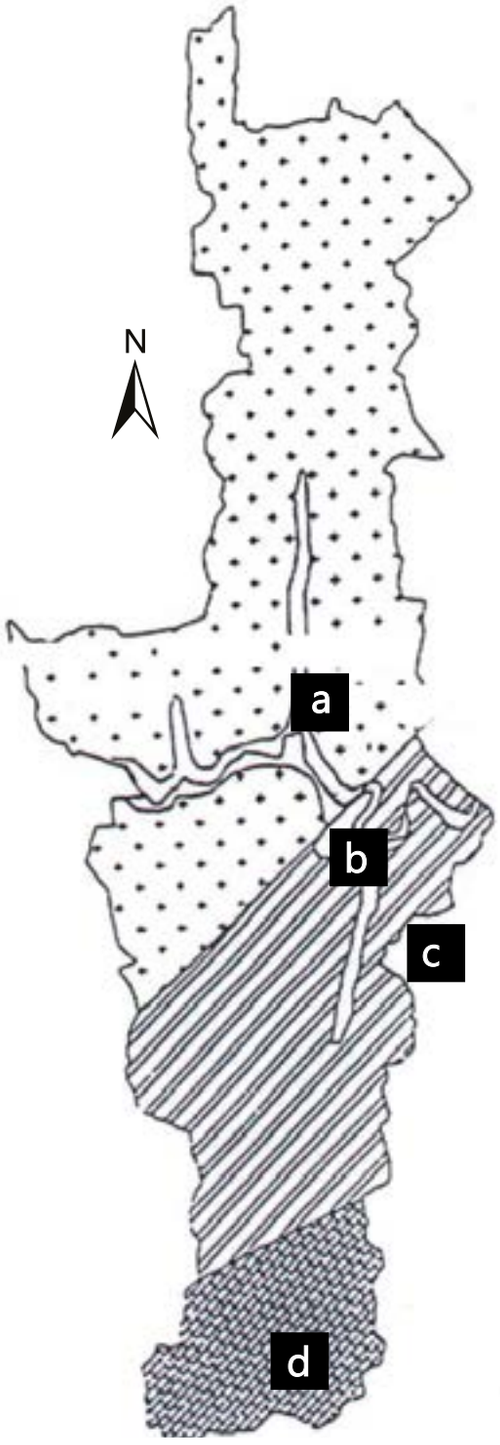
Image 72: Spitzkopf Mount / googlemaps

d Spitzkopf Mountain

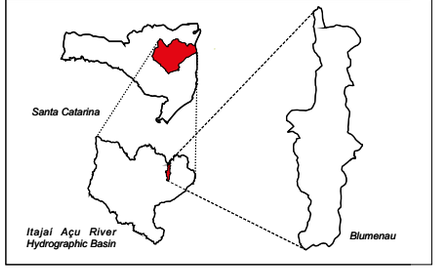
3.7. Geology Map

Secretaria Municipal de Planejamento Urbano

PREFEITURA DE BLUMENAU



Location



Legend

- Aluvionares Deposit
- Luiz Alves Complex
- Itajaí Group
- Granulitc Brusque Complex

Image 73: View of Blumenau / Photo: B.Mello

Image 74: Riverside in Center of Blumenau / Arthur Moser

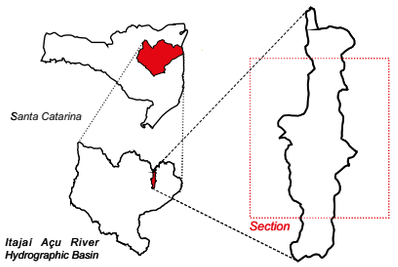
Image 75: Hillside in Ararangua / Photo: B.Mello

Image 76: View of South Blumenau / Photo: WWF

Secretaria Municipal de Planejamento Urbano

PREFEITURA DE BLUMENAU

Location



Legend

Flood quota

- 7 m
- 8 m
- 9 m
- 10 m
- 11 m
- 12 m
- 13 m
- 14 m
- 15 m

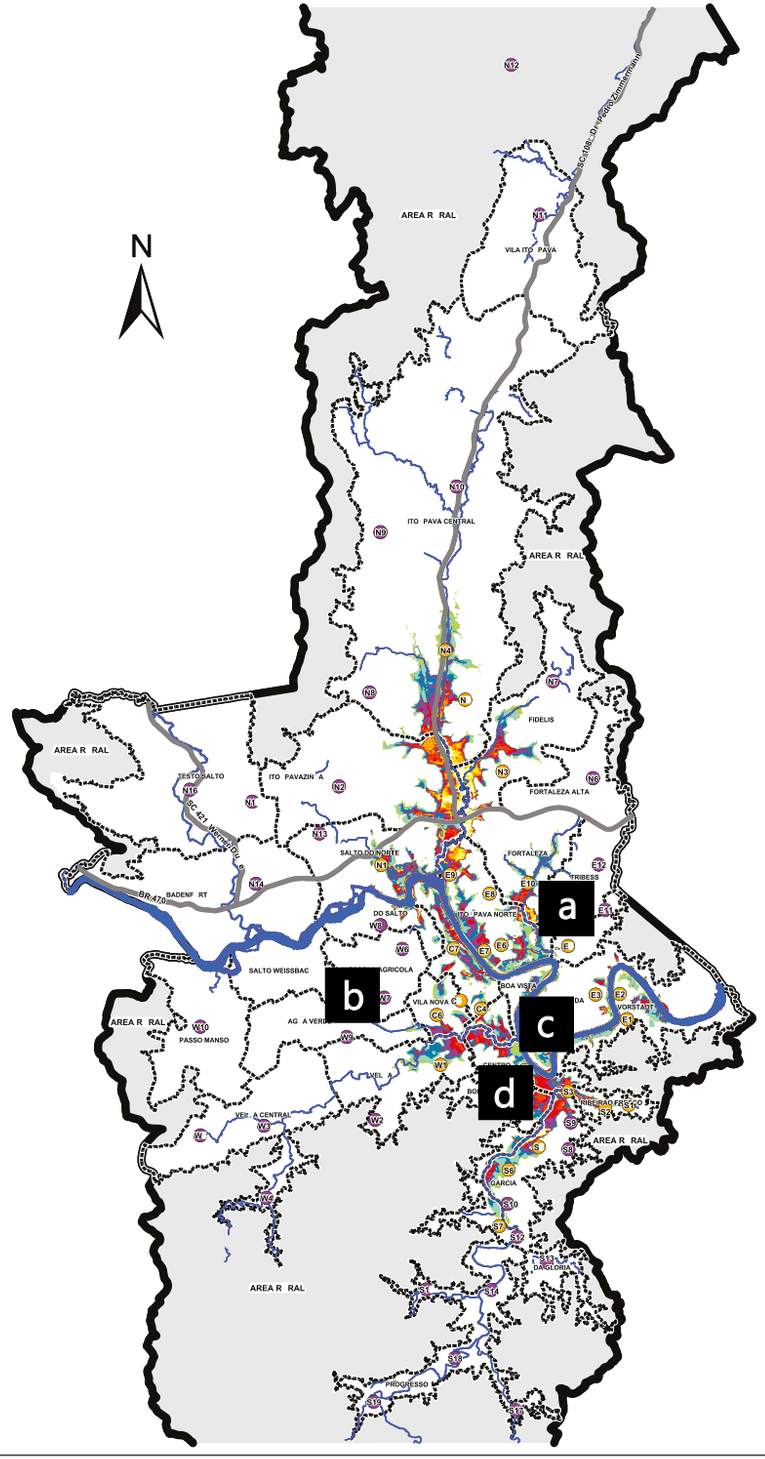
Civil defense shelters

- Landslides
- Floods

Legend

- Division of Neighborhood
- Highway
- River
- Rural Area

Maps: Engª Ana Paula Zanette
GGCM - Gerência de Cartografia e Cadastro
Multifinalitário



3.8. Flood Quota and Shelters

a Shelter E5 - E.B.M. Gustavo Richard

Image 76: School/ Shelter in Fortaleza, Blumenau / googlemaps

b Shelter W7 - E.B.M. Norma Dignart Huber

Image 77: School/ Shelter in Coripós, Blumenau / googlemaps

c City Center, 2011 Floods

Image 78: Flood in Blumenau, 2011. Photo: Patrick Rodrigues / Blog Adalberto Day

d Rio Branco Street, 2011 Floods

Image 79: Flood in Blumenau, 2011. Photo: D. Lima

3.9. Susceptibility Map and 2008 Disaster

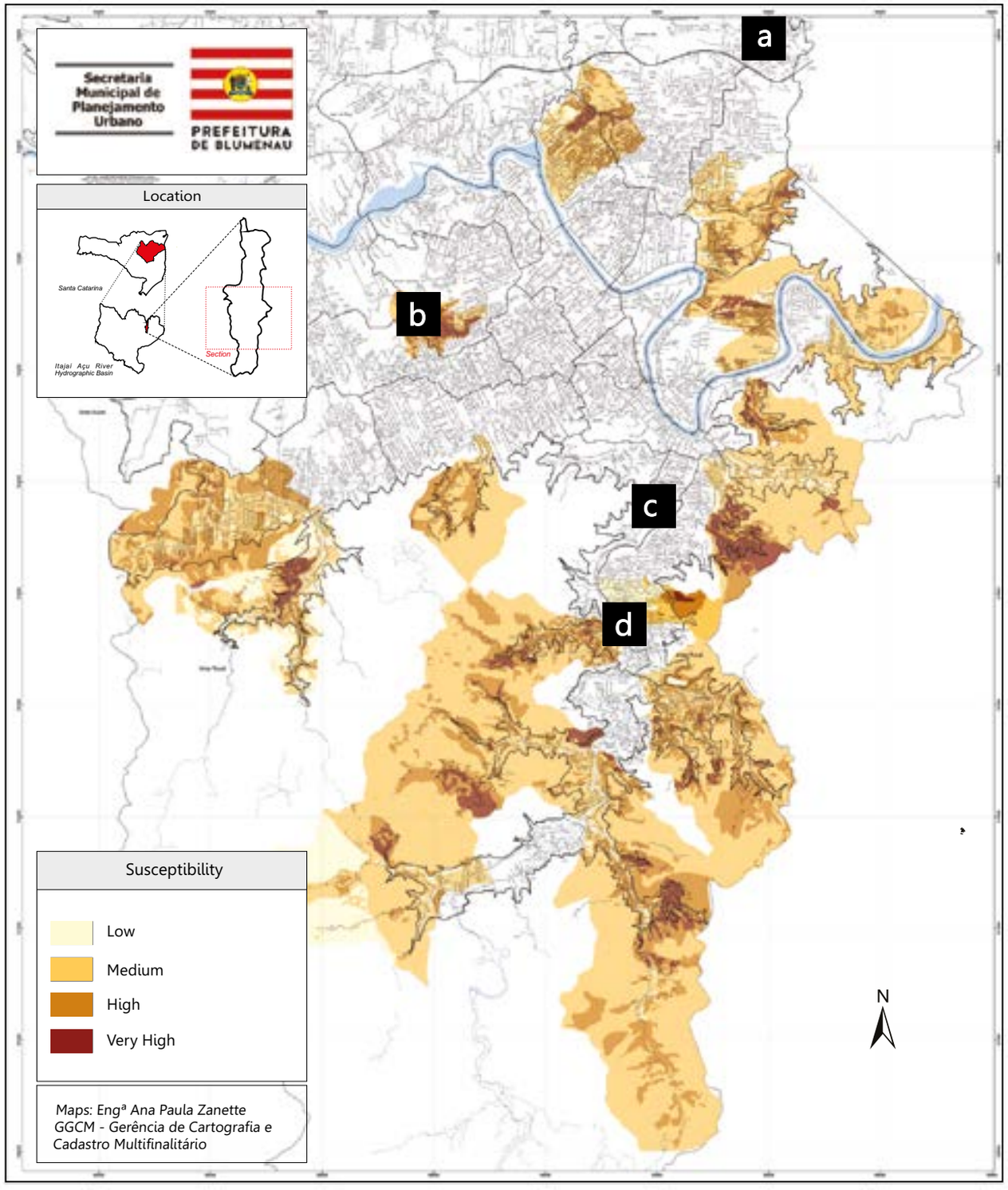


Image 80: Lanslides in Fortaleza, 2008 / Photo: J. Aumond

Image 81: Landslides in Coripós, 2008 / Photo: Defesa Civil

Image 82:Landslides in Hermann Huscher, Center, 2008 / Photo: Marina Andrade/Folha Online

Image 83: Landslides in Garcia / Photo: Notícias de Blumenau

4. Ribeirão Fresco

Neighborhood located along the right bank of the Itajaí-Açu River in the Southeast portion of the municipality, near the central area of Blumenau. The district occupies the area formed by the two banks of the narrow Ribeirão Fresco creek valley which displays exuberant vegetation in all its extension with stretches of marked slope. There were four colonial lots on the right bank of the creek and eight on the left bank. It is a narrow valley with a plain of 200 to 300 meters wide, with many springs that soften the temperature during the hot summers. The neighborhood is divided in the Valley section, the low section (subject to flooding at a ten meters quota) and the urban section, part of the former Stadtplatz (PMB, 2011)

Colonization:
1864

German
Colonization

Area: 1,22 km²

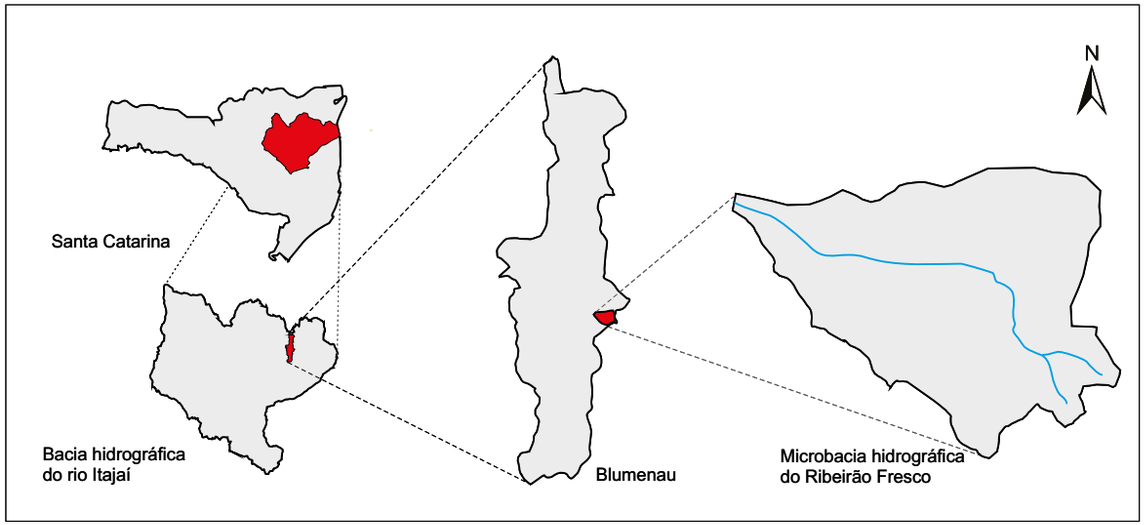
Elevation:
0 - 210 m

1.359 inhabitants

Residences:
535 houses

Streets:
25 streets

Floods:
20 streets - 80 % of the neighbourhood



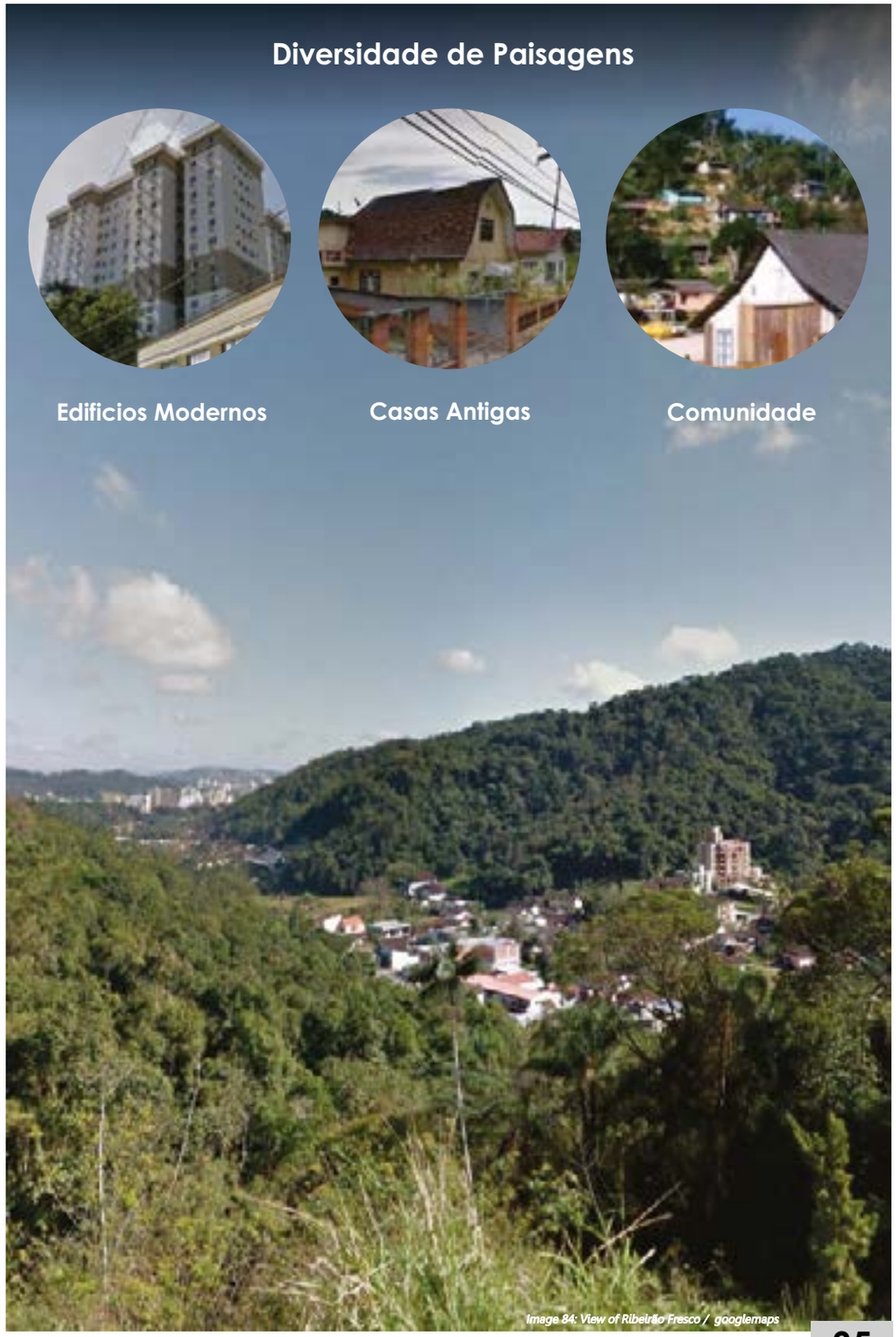


Image 84: View of Ribeirão Fresco / googlemaps

4.1. Landscape Units

Maps: Jéssica Teixeira e João Tomio

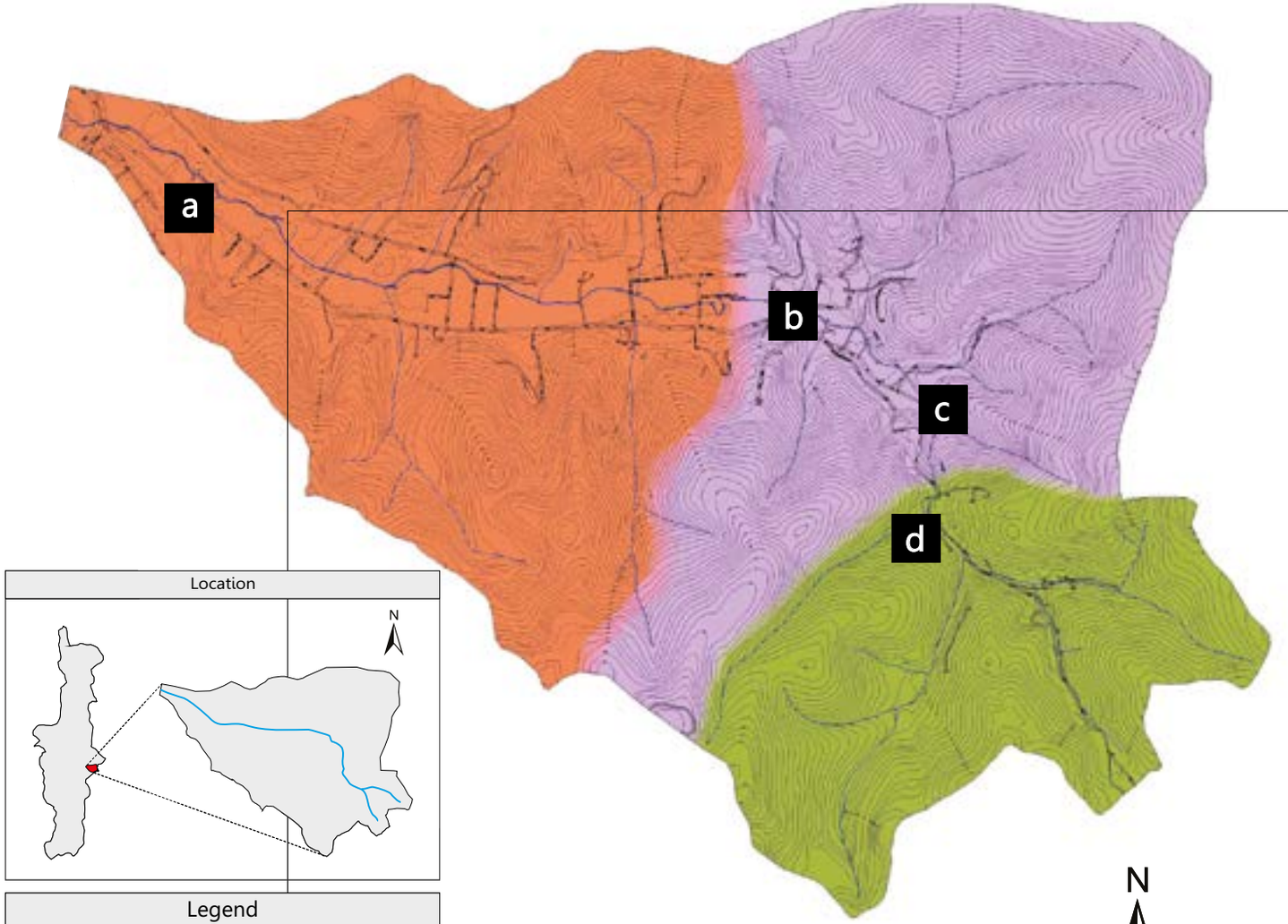


Image 85: Old House in Ribeirão Fresco / googlemaps

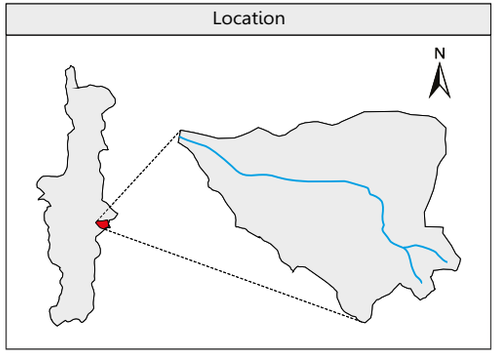
Image 86: New Buildings / googlemaps

Image 87: Housing made by homeless people
Plano de Habitação de Blumenau / PMB

Image 88: House in Garuva
Plano de Habitação de Blumenau / PMB

4.2. Hypsometric Map

Maps: Jéssica Teixeira e João Tomio



Legend	Legend: Meters	
Streets	0 - 40 m	120 - 160 m
Perennial Stream	40 - 80 m	160 - 200 m
Intermittent Stream	80 - 120 m	200 - 240 m

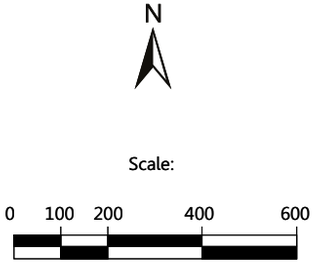


Image 89: Pastor Osvaldo Hesse st. / Photo: B. Mello

Image 90: View of Neighborhood / googlemaps

Image 91: Moacir st. / googlemaps

Image 92: View of the Mount / googlemaps

4.3. Ambiental Legislation Map

Maps: Jéssica Teixeira e João Tomio

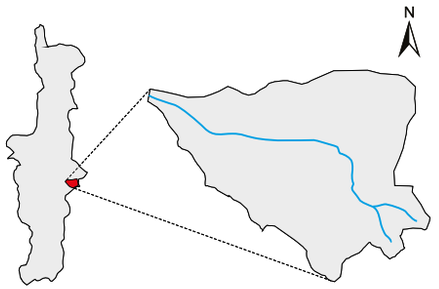
a

b

c

d

Location



Legend

Streets

Unpaved Streets

Edification

Perennial Stream

Intermittent Stream

75 Level curve

APP - Permanent Preservation Area

N

Scale:

0 100 200 400 600

Image 93: River / googlemaps

Image 94: Vegetation / googlemaps

Image 95: Vegetation and Affluent / Photo: B.Mello

Image 96: River / googlemaps

4.4. Hydrographic and Geology Map

Maps: Jéssica **Teixeira e João Tomio**

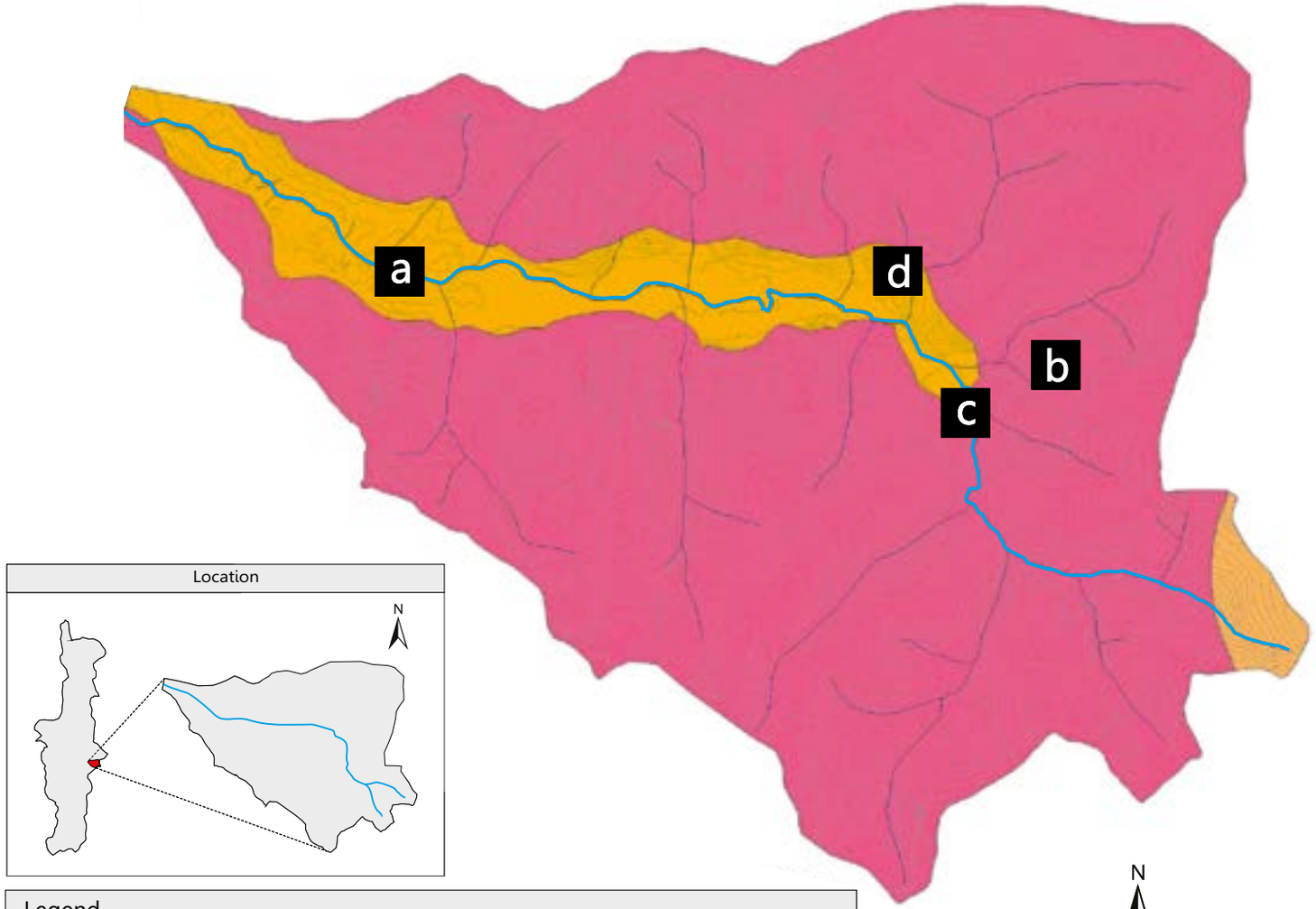


Image 97: River / Photo: B.Mello

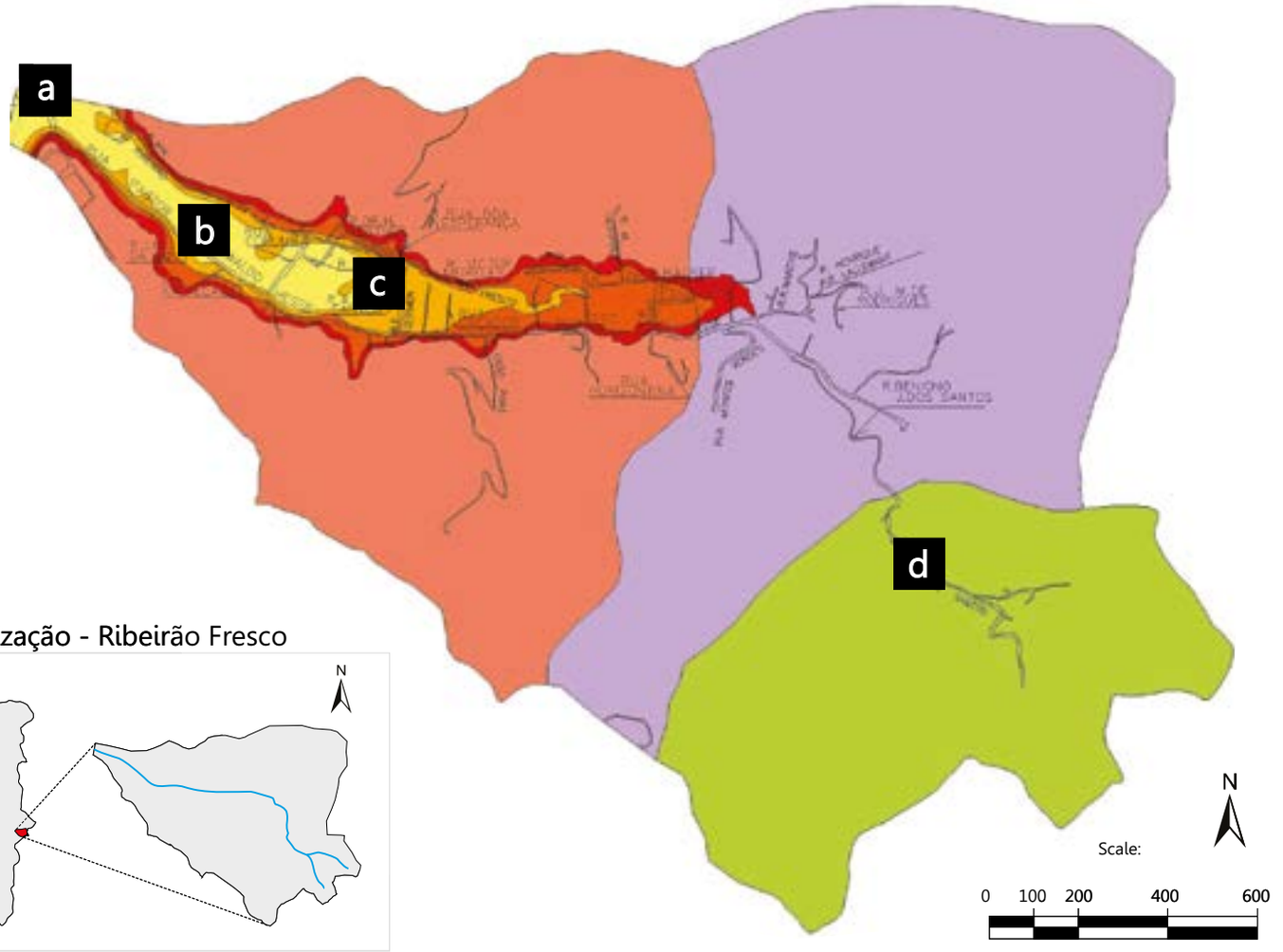
Image 98: River / Photo B.Mello

Image 99: Hillside / googlemaps

Image 100: Hillside / googlemaps

4.5. Socio environmental Problems - Floods and Landslides

Maps: Jéssica Teixeira e João Tomio

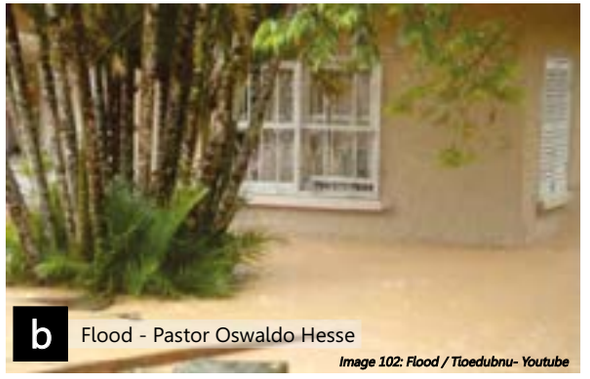


Localização - Ribeirão Fresco

Convenções Cartográficas	Legend: Flood Zones	Legend: Landscape Units
Streets	Flood Zone Until 10 meters	First Unit of Landscape
Perennial Stream	Flood Zone 10 m to 12 meters	Second Unit of Landscape
Intermittent Stream	Flood Zone 12 m to 15 meters	Third Unit of Landscape
	Flood Zone 15 m to 17 meters	

Image 101: Flood / Photo: Thedebora5- Youtube

a Flood - Pastor Oswaldo Hesse



b Flood - Pastor Oswaldo Hesse

Image 102: Flood / Tioedubnu- Youtube

c Flood - Pastor Oswaldo Hesse

Image 103: Flood / Tioedubnu- Youtube

d Landslides - Garuva

Image 104: Landslide / Photo: PMB

5. Itajaí

Itajaí is a municipality located in the state of Santa Catarina, in the Southern Region of Brazil. It is the sixth most populous municipality in the state. It is located on the northern central coast of Santa Catarina and is part of the Itajaí Valley region, on the right bank of the Itajaí-Açu river mouth. Itajaí was founded by Agostinho Alves Ramos in 1823 who came from the city of Rio de Janeiro. However, the municipality was officially founded only in 1858, after a local residents social movement.

Founded:
July 15th, 1860

German and Portuguese Colonization

Language:
Portuguese

Mayor:
Volnei Morastori

212.615 inhabitantes

Area: 304 km²

Density: 636 Hab/km²

Elevation: 1 m

IDH 0,785 Very High
PNUD/2010


Image 105: View of Itajaí, 1960
Acervo Histórico
Itajaí - 1960

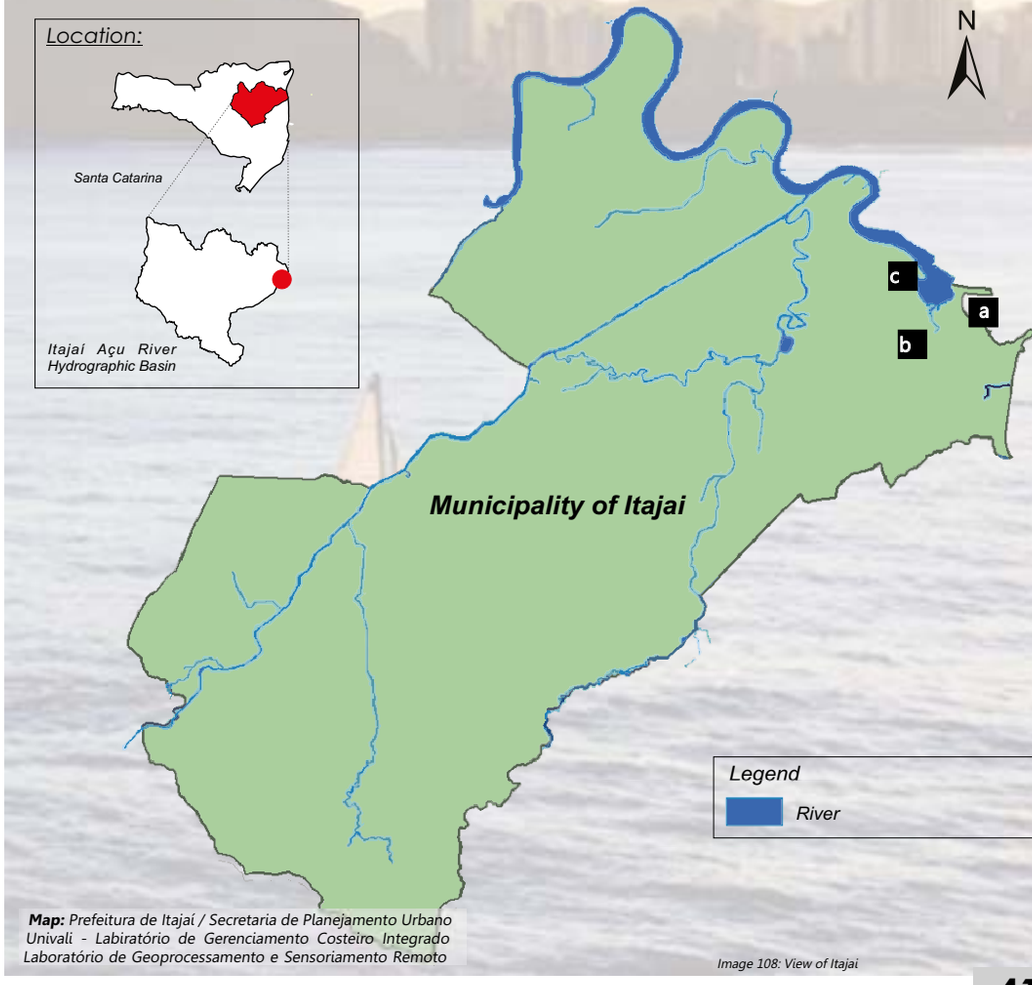

Image 106: View of Itajaí, 1960
Acervo Histórico
Itajaí - 1960


Image 107: View of Itajaí, 2018
Photo: Eduardo Marquetti
Itajaí - Today


a Estuary of the Itajai River


b Univali - University


c Port of Itajaí



Map: *Prefeitura de Itajaí / Secretaria de Planejamento Urbano*
Univali - Labiratório de Gerenciamento Costeiro Integrado
Laboratório de Geoprocessamento e Sensoriamento Remoto

Image 108: View of Itajaí

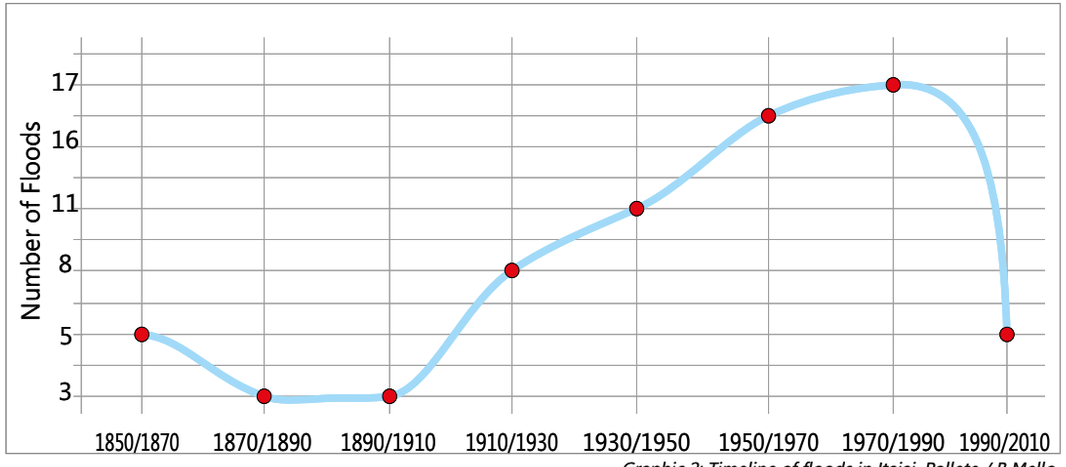
5.1 History of Itajaí

In the second half of the 19th century, the Itajaí Valley received tens of thousands of colonists of Italian, German, Austrian and Polish origin, who sought to populate the Brusque and Blumenau colonies. However, many preferred wage labor, commerce, or port activities than agriculture at the colonies. Therefore, there was a shift to the coast in search of better living conditions. Thus, some districts of Itajaí, such as São Roque, Espinheiros, Limoeiro, Itaipava, Quilômetro Doze, Arraial dos Cunhas and Campeche were created (Polette, et al., 2008).

5.1.1. Since the Fundation

The resources invested in the colonization of the Valley had direct repercussions on the commercial development of Itajaí, since the port was the gateway of people and goods to the Brusque and Blumenau settlements. Thus, its identity is marked by the close relationship with the sea, rivers and maritime activity. In the early 20th century, the urban perimeter of Itajaí stretched two kilometers to all sides, counting from the Mother Church. In the 1920s and 1950s, the urban perimeter grew and comprised the Itajaí-Mirim river (a strong urban element to this day) to the north, the Cruz hill to the south, Navegantes to the east and the Carvalho neighborhood to the west. In general, the early occupation of the urban space occurred mainly along the Itajaí - Florianópolis and Itajaí - Brusque roads. In a second stage, the largest occupation occurs to the west, from downtown up to the Itajaí-Mirim river and through the Itajaí-Blumenau roadways. The third stage extends across the main motorways crossings and along the left bank of the Itajaí-Mirim river. Its economy is marked by three main cycles: wood, fishing and seaport modernization. The economy is currently concentrated in the tertiary sector, trade and service provision (Polette et al., 2008), mostly related to the seaport and its large input for Itajaí's economy. The city sits at the Itajaí-Açu river estuary, and receives fluvial waters from the 58 municipalities that make up its hydrographic basin, so it is directly affected by urban growth, which is often characterized by an unplanned process that prioritizes the problem of flooding at upstream municipalities (Bertoni, 2004). Besides being a floodplain, the region has favorable conditions for the occurrence of intense rainfall, because of its hot and humid climatic conditions (Aumond et al., 2009).

5.1.2. Flood Timeline



Graphic 2: Timeline of floods in Itajai. Pollete / B Mello

5.1.3. Socio-Environmental Problems (Floods)

Image 109 :BR -101. Photo: TALLINI, R. (Nov., 2008).

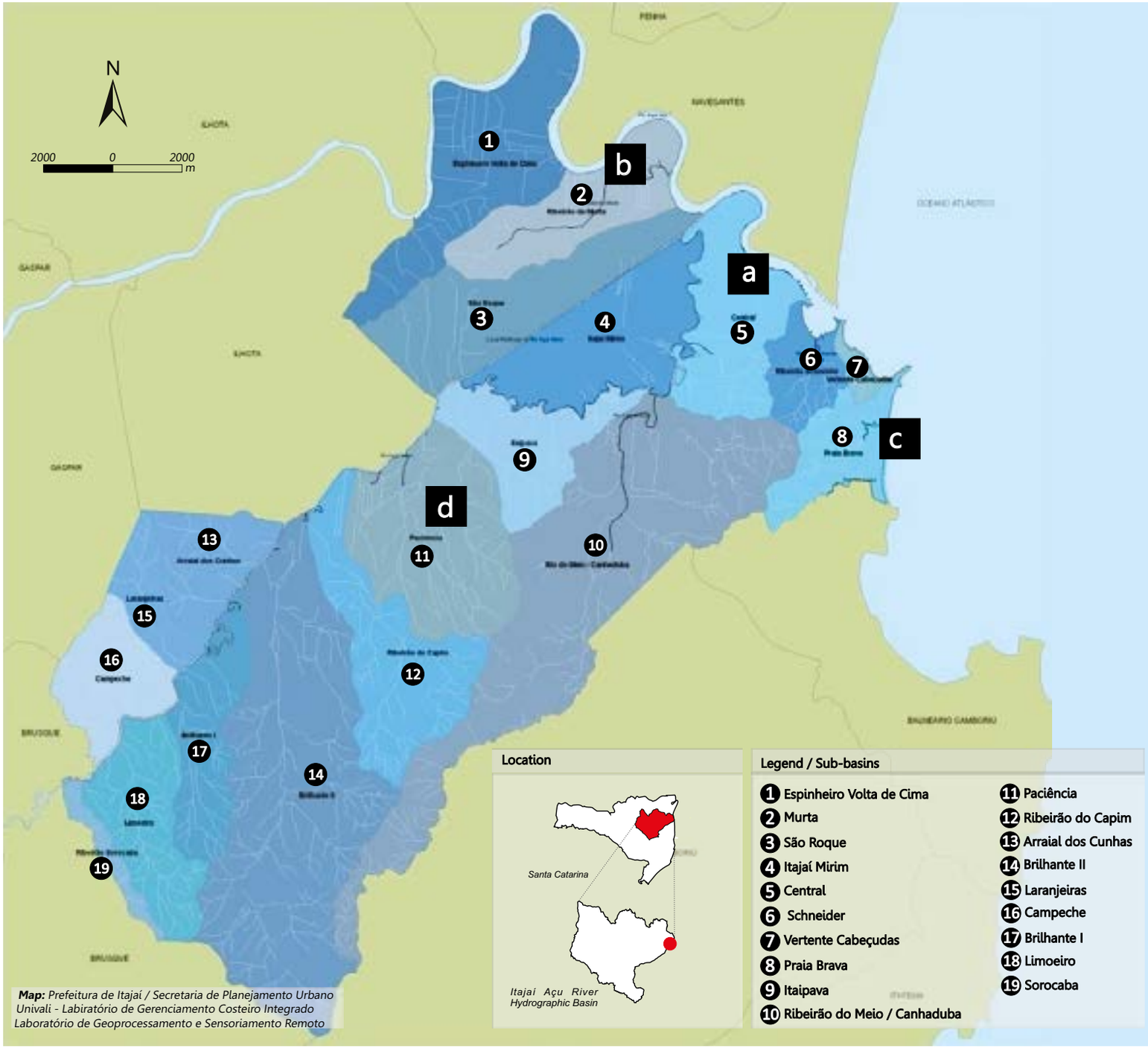
Image 110: Flood São Roque. Photo: Filipe Araújo/Agência Estado

Image 111: Port of Itajai. Photo: Amarildo Madeira

Image 112: Flood in Itajaí Mirim. Photo: João Thadeu de Menezes

Image 113: Flood in Center. Photo: Arca de Noé

5.2. Sub-Basins and Hidrographic Map



Map: *Prefeitura de Itajaí / Secretaria de Planejamento Urbano*
Univali - Labiratório de Gerenciamento Costeiro Integrado
Laboratório de Geoprocessamento e Sensoriamento Remoto

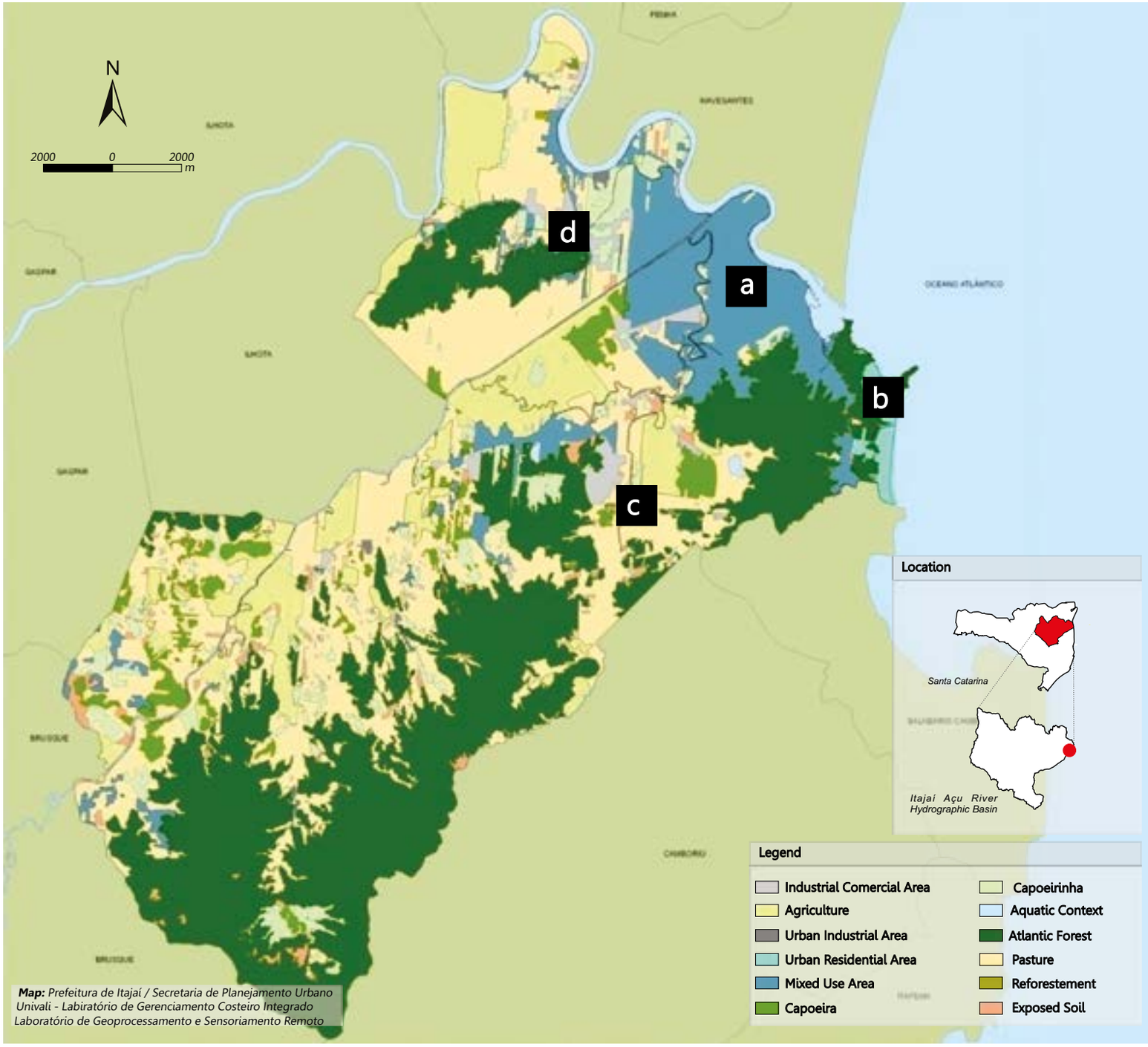
Image 114: View of Center / Photo: Cidades e Fotos

Image 115: Itajai Mirim River / Photo: Zé Rogério RIC TV

Image 116: Brava Beach / Photo: Casa do Turista

Image 117: Paciencia / / Photo: Vivareal

5.3. Land Use Map

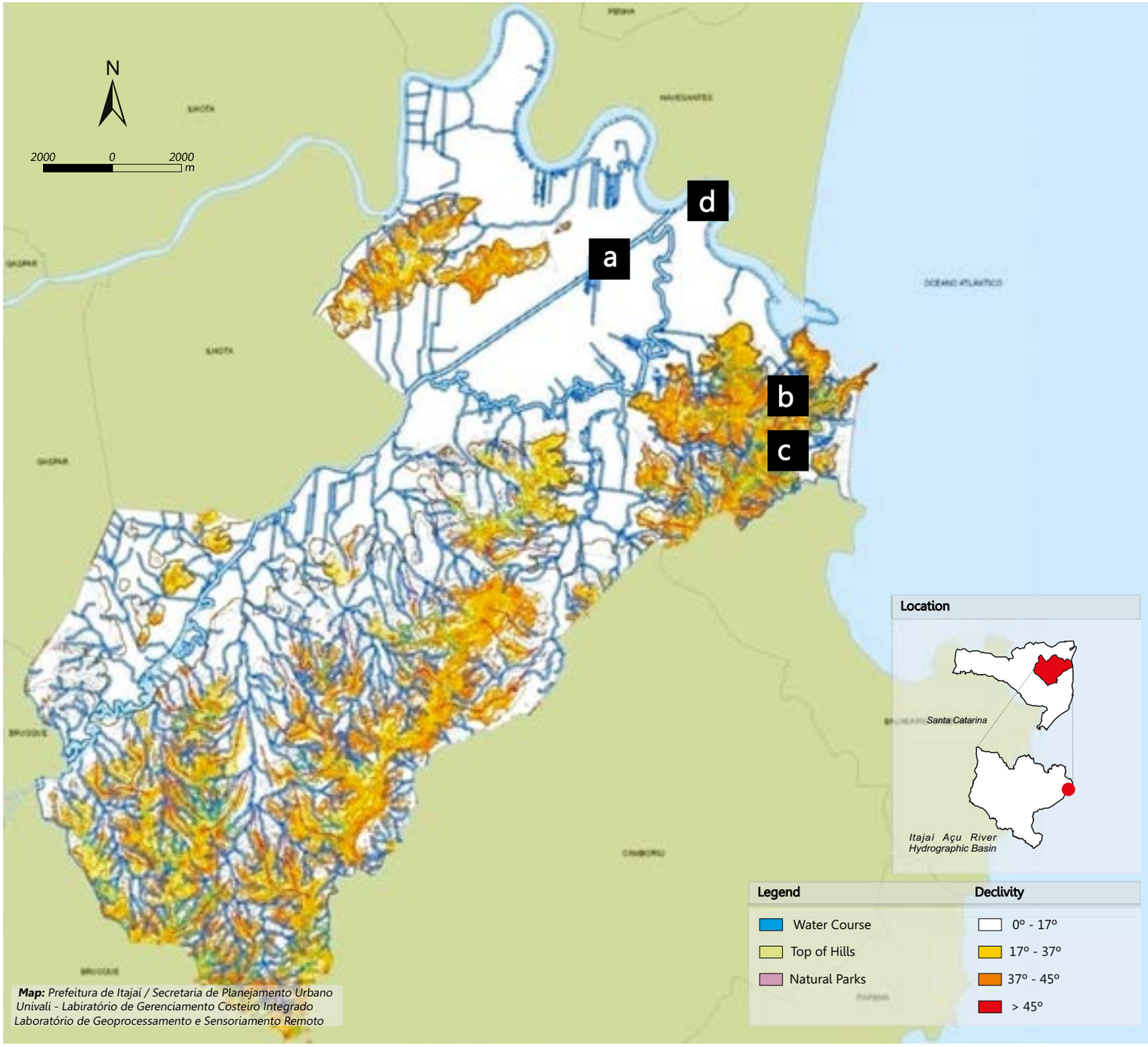


Map: *Prefeitura de Itajaí / Secretaria de Planejamento Urbano*
Univali - Labiratório de Gerenciamento Costeiro Integrado
Laboratório de Geoprocessamento e Sensoriamento Remoto

Image 119: Mount / Photo Google Maps - TMP

Image 121: Industries in Espinheiros/ Google Maps

5.4. Ambiental Legislation Map



Map: *Prefeitura de Itajaí / Secretaria de Planejamento Urbano*
Univali - Labiratório de Gerenciamento Costeiro Integrado
Laboratório de Geoprocessamento e Sensoriamento Remoto

a River Bank - Itajaí-Mirim River

Image 122: Itajaí Mirim River / Google Maps

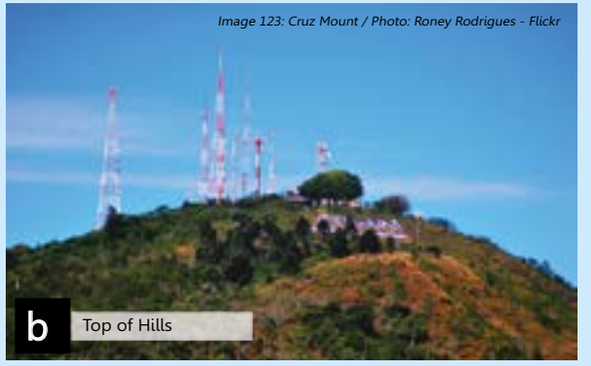


Image 123: Cruz Mount / Photo: Roney Rodrigues - Flickr

b Top of Hills

c Declivity

Image 124: Santa Clara / Google Maps

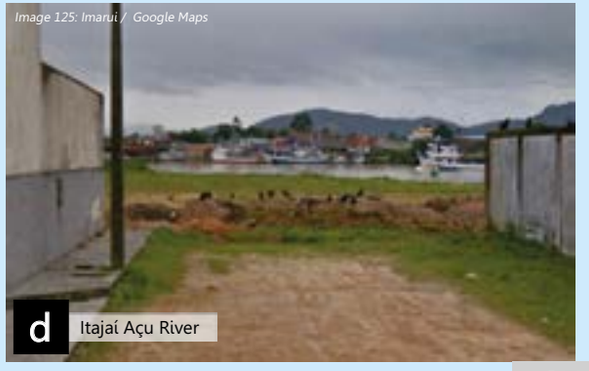
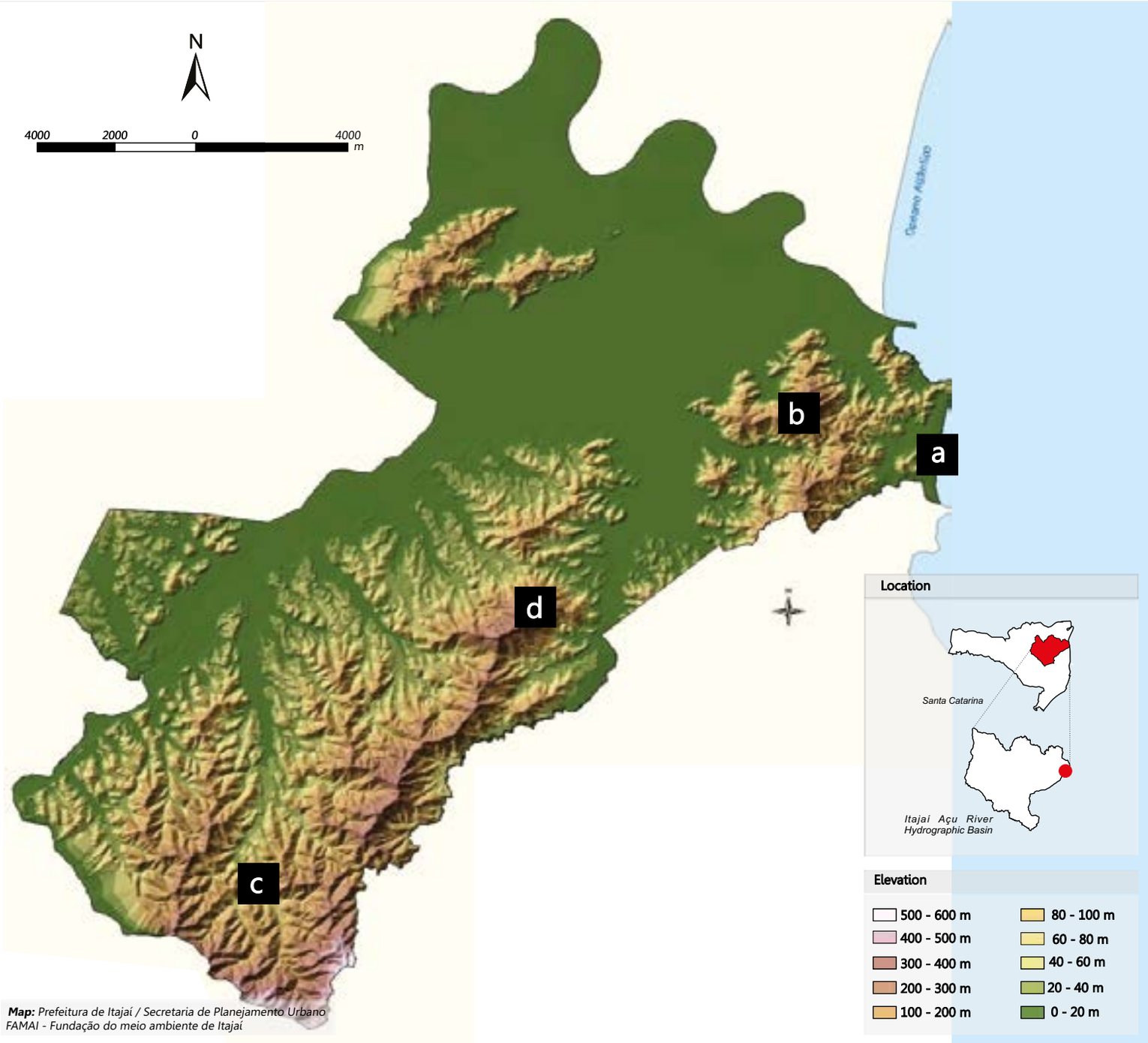


Image 125: Imaruí / Google Maps

d Itajaí Açu River

5.5. Hypsometric Map



Map: *Prefeitura de Itajaí / Secretaria de Planejamento Urbano*
FAMAI - Fundação do meio ambiente de Itajaí

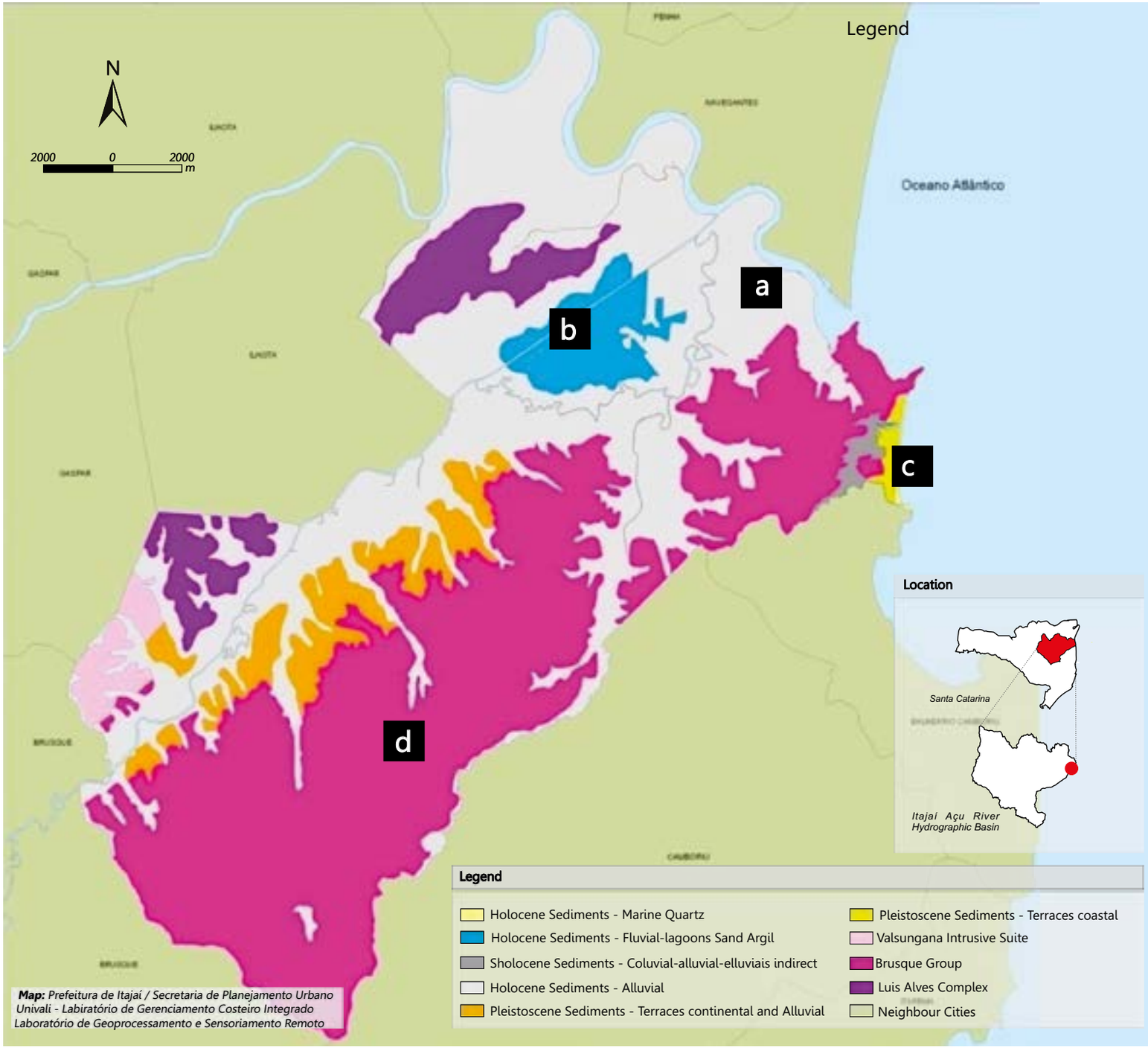
Image 126: Beach / Photo Moacir Montagna - Google Maps

Image 123: Cruz Mount / Photo: Roney Rodrigues - Flickr

Image 127: Brilhante II / Google Maps

Image 128: Rio do Meio / Google Maps

5.6. Geology Map



Map: *Prefeitura de Itajaí / Secretaria de Planejamento Urbano*
Univali - Labiratório de Gerenciamento Costeiro Integrado
Laboratório de Geoprocessamento e Sensoriamento Remoto

Image 129: Center of Itajaí / Photo: O Blumenauense

a Holocene Sediments - Alluvial - Center

Image 130: Itajai Mirim River / Google Maps

b Holocene Sediments - Fluvial-lagoons Sand Argil

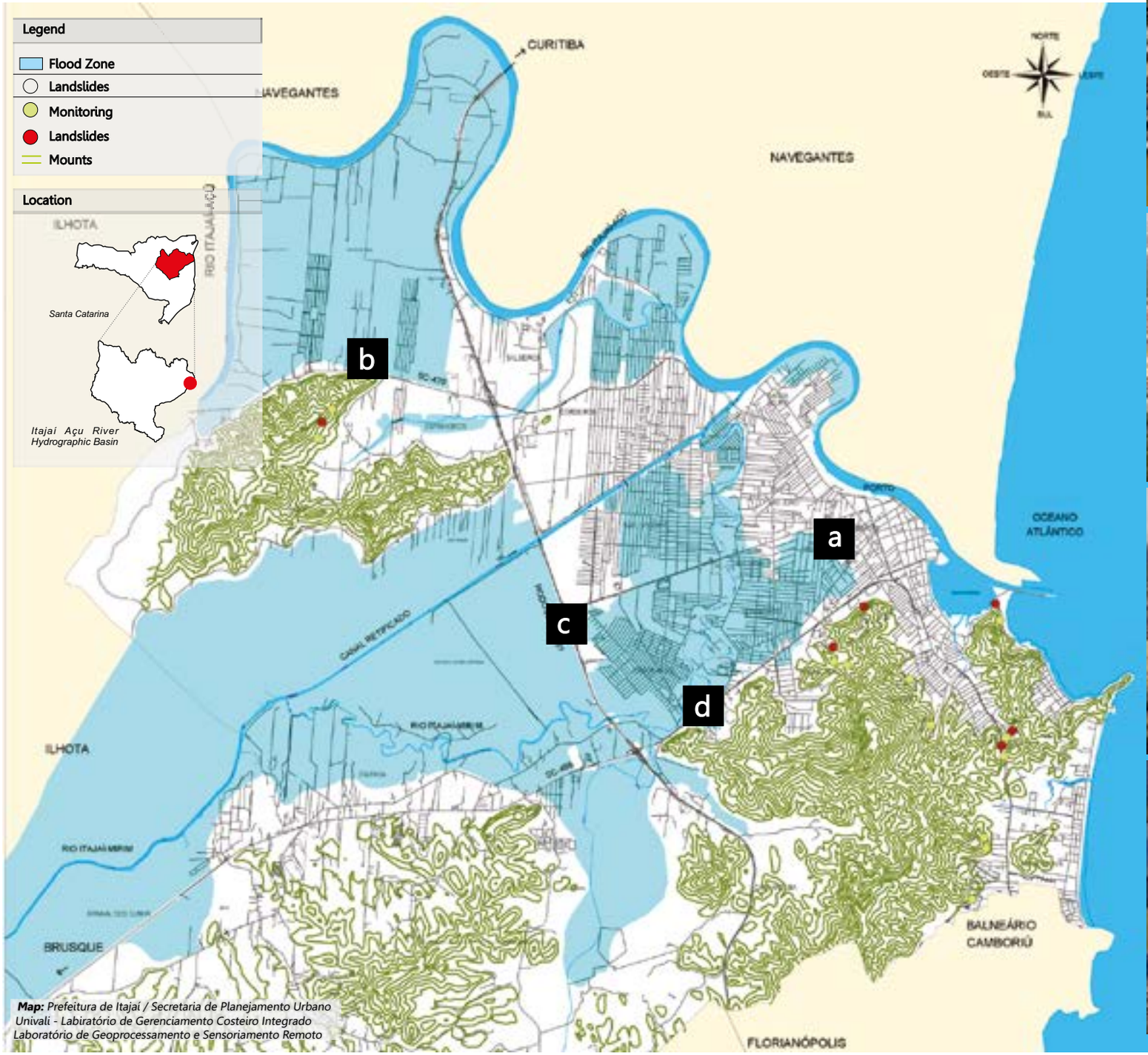
Image 131: Brava Beach / Google Maps

c Pleistoscene Sediments - Terraces coastal

Image 132: Paciencia / Googlemaps.com

d Brusque Group

5.7. Flood Zone and landslides Map



Map: *Prefeitura de Itajaí / Secretaria de Planejamento Urbano*
Univali - Labiratório de Gerenciamento Costeiro Integrado
Laboratório de Geoprocessamento e Sensoriamento Remoto

a Center

Image 133:Flood in Center / Photo: Blog do Coyote

Image 134: Flood in Itajaí / Photo: Click Camboriú

b Volta de Cima

Image 135: Flood in Itajaí / Alessandro Salvador - Youtube

c BR - 101

Image 136: Flood in Itajaí / João Thadeu de Menezes

d Cidade Nova

6. Volta do Rio (Imaruí)

The area was originally the runway of the Salgado Filho Airport, now transferred to the municipality of Navegantes, on the exact opposite side of the Itajaí-Açu river. The settlement begun with the abandonment of the airport runway. The abandoned area has become attractive to the low-income population that at the time faced housing shortages. Older residents claim it happened in 1975. Since 1994, this process accelerated by the expansion of support jobs that accompanied the growth of the port sector. Currently, the consolidation of the urban area around Imaruí is visible: there, as already mentioned, industries, ports and shipyards occupied the river banks, causing drastic environmental degradation over time (Schuch, 2005).

Founded:
1975

Brazilian
Colonization

Language:
Portuguese

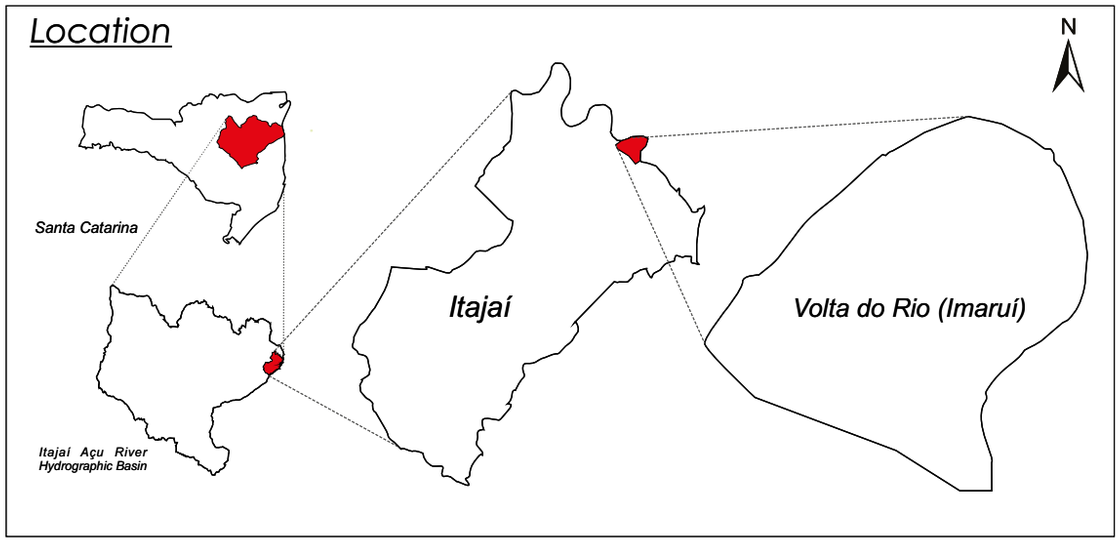
300 - 400 Families

Area: 4,8 ha

Elevation: 1 m

Streets:
15 streets

Floods:
20 % of the neighbourhood



Lanscapes Diversity

Industrial Area

Comunity

Comercial Area

Image 137: Imaruí / googlemaps.com

6.1. Land Use Map

Image 138: Alfredo Eick st. /googlemaps.com

Image 139: Constantino st. / googlemaps.com

Image 140: Alfredo Eicke Jr. st/ googlemaps.com

Image 141: Cambé st. / googlemaps.com

6.2. Ambiental Legislation and Flood Zone Map

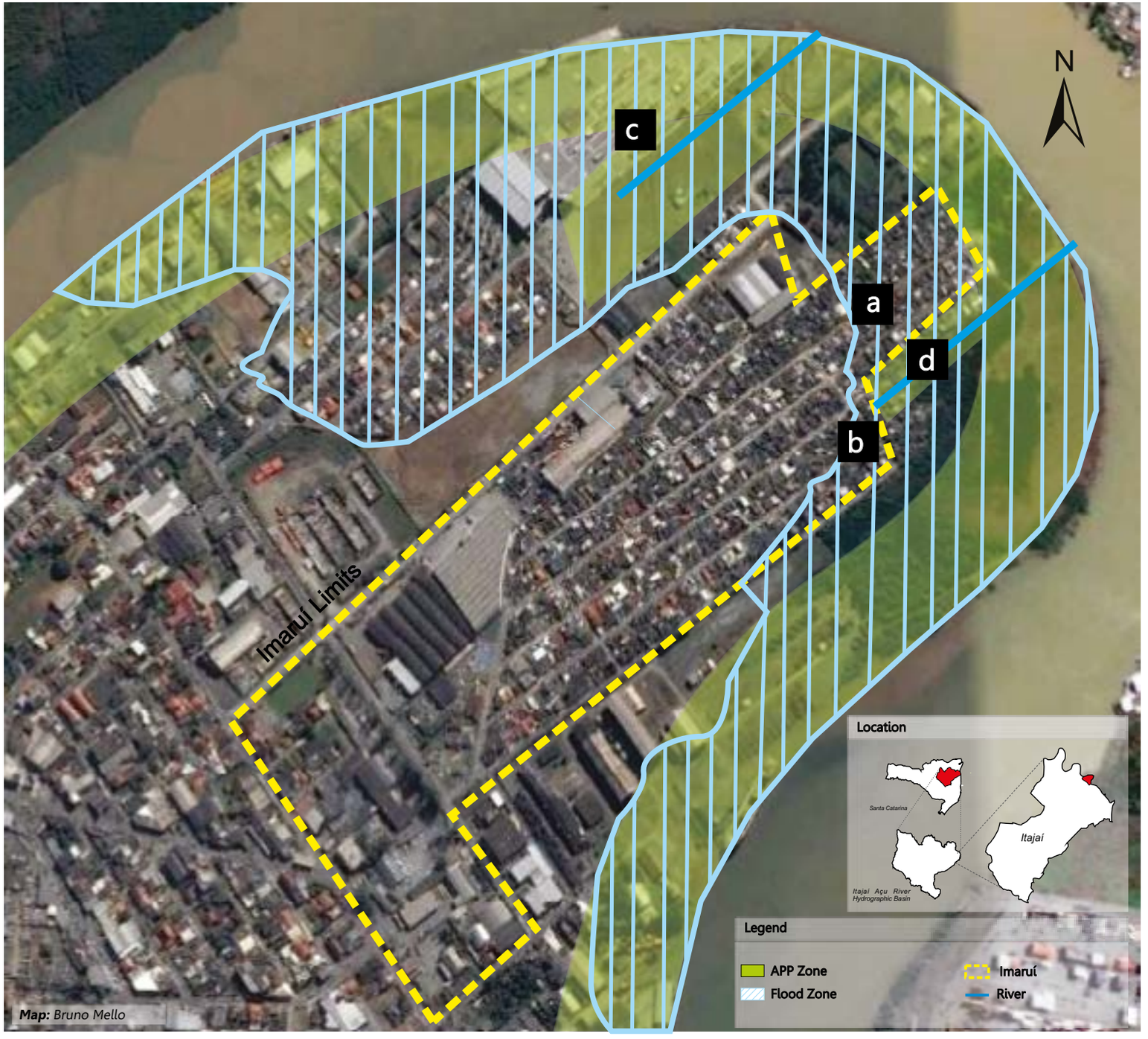


Image 141: Flood in Imaruí / Photo: Osvaldo Schuch

Image 142: Flood in Imaruí / Photo: Osvaldo Schuch

Image 143: Imaruí / Googlemaps.com

Image 144: Houses in Imaruí / Photo: Osvaldo Schuch

6.3. Geology and Hypsometric Map

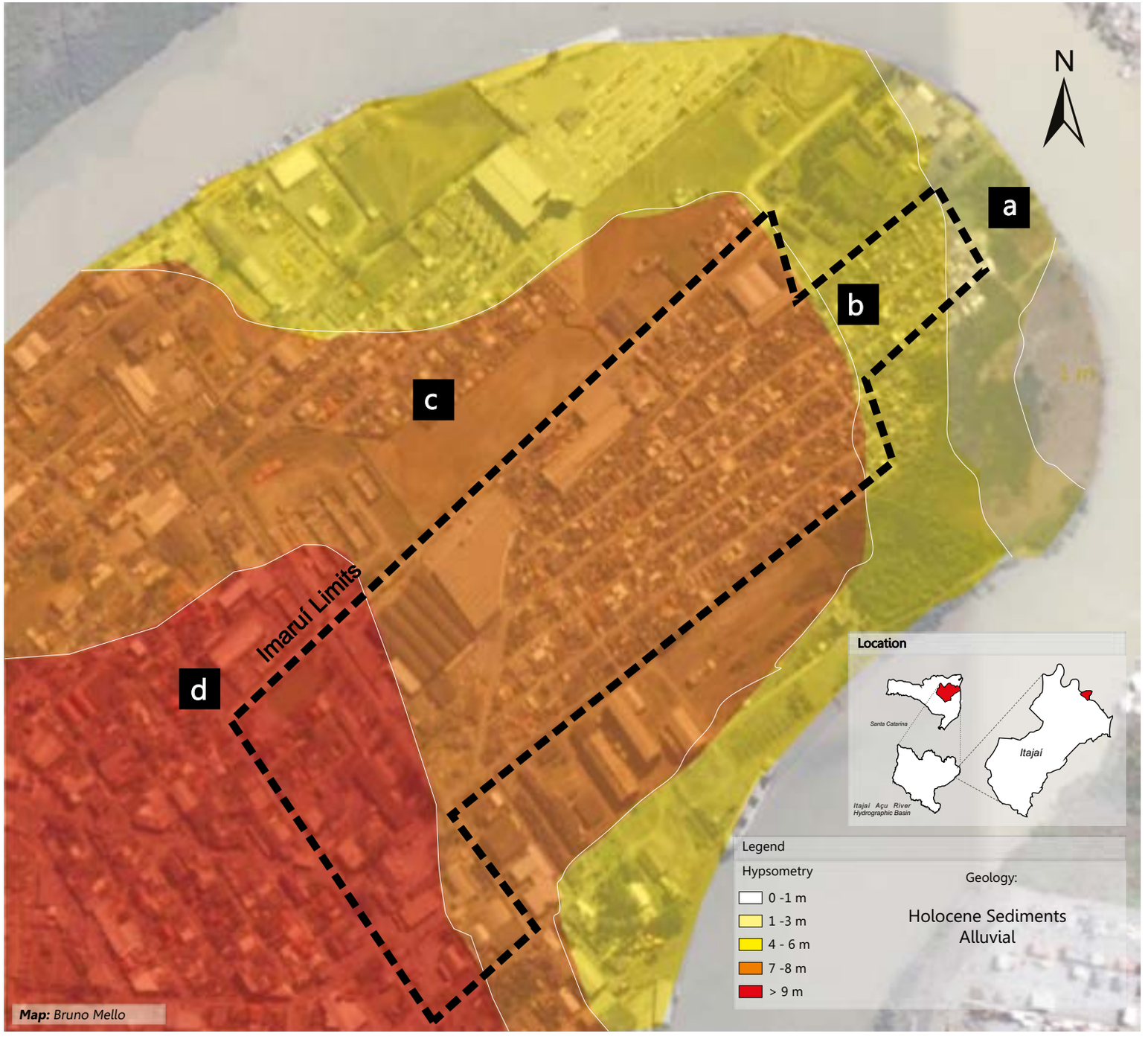


Image 145: Imaruí / googlemaps.com

Image 146: Cambé st. / googlemaps.com

Image 147: Blumenau St. / googlemaps.com

Image 148: João de Miranda St / googlemaps.com

7. Resilience

Resilience means returning to the normal state, a term derived from the Latin resiliens. Resilience has several meanings for psychology, administration, ecology and physics. Resilience is the ability to return to its natural state, especially after some critical and unusual situation. In the year 1807, the Englishman Thomas Young was one of the first to use the term. After their discovery and practical applications in the field of physics, other areas have borrowed the term due to the possibility of extending their meanings beyond physical materials, which may be related to the environment or even to a capacity of the human mind. In the context of ecology, resilience is the suitability of a given system that allows it to regain balance after a disturbance. This concept refers to the ability to restore a system. The notion of environmental resilience became known as of 1970, thanks to the work of the famous Canadian ecologist C. S. Holling.

7.1.Socio-Ecological Systems

A social-ecological system consists of 'a bio-geo-physical' unit and its associated social actors and institutions. Social-ecological systems are complex and adaptive and delimited by spatial or functional boundaries surrounding particular ecosystems and their problem context (Glaser, 2011).Elinor Ostrom and her many co-researchers have developed a comprehensive "Social-Ecological Systems (SES) framework", within which much of the still-evolving theory of common-pool resources and collective self-governance is now located. It also draws heavily on systems ecology and complexity theory. The studies of SES include some central societal concerns (e.g. equity and human wellbeing) that have traditionally received little attention in complex adaptive systems theory, and there are areas of complexity theory (e.g. quantum physics) that have little direct relevance for understanding SES (Cumming, 2011)

7.2.Socio-Ecological Resilience

In the context of ecology, resilience is the suitability of a particular system that balance after being disturbed. This concept refers for the ability to restore a system. The notion of environmental resilience known since 1970, thanks to the work of the famous Canadian ecologist C. S. Holling.Resilience is the capacity of a social-ecological system to absorb or withstand perturbations and other stressors such that the system remains within the same regime, essentially maintaining its structure and functions. It describes the degree to which the system is capable of self-organization, learning and adaptation (Holling 1973, Gunderson & Holling 2002, Walker et al. 2004).

1620 - Term

Was first used in the 1620s and was derived from ‘resiliens’, the present participle of Latin ‘resilire’, ‘ to recoil or rebound’.

1807 - Engineering

Thomas Young used the term after its discovery and practical applications in the field of physics.

1950-70 - Psicology

As psychology is the study of the human being in behaviors, attitudes, and in your mind, the resilience, in psychology, is a concept that respect to one's ability to cope with the mishaps of life.

1973 - Social-Ecological

The notion of environmental resilience has been from 1970, thanks to the work of the famous ecologist Canadian C. S. Holling.

Image 150: Resilience Timeline / B. Mello

ABSTRACTS

TOWARDS THE SUSTAINABILITY OF SOCIAL RECOVERY INITIATIVES: A MULTI-STAKEHOLDER APPROACH

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Introduction

Resilience can be described as the capacity or degree to which a socio-ecological system is capable of self-organization, learning and adaptation in the face of stressors to that system (Holling, 2001). Such stresses by may be brought about by conflicts, wars or natural hazard impacts like flooding or coastal erosion. Flooding is a fairly common phenomenon where up to 1 in 6 houses in the UK are at risk (Environment Agency, 2017). Some regions in emerging economies have similar flood risk patterns but rarely have the resources to plan for, mitigate or respond to such disasters to the same extent. Therefore, responses tend to be reactive to disasters rather than proactive measures of planning and mitigation.

Sustainability on the other hand refers to the development for today's population while protecting future generations (WCED 1987). While some academics see sustainability and resilience as related and interconnected, others perceive them as distinct considerations. A key attribute of resilience is the social recovery of a community after such a disaster (Mannakkara and Wilkinson, 2015). Evidence suggests that many disaster recovery programmes, especially in emerging economies have failed or are ineffective because they have been unable to achieve intended outcomes. This study seeks to develop a collaborative framework for sustainable social recovery of communities ravaged by flooding by integrating knowledge gained from sustainability and resilience literatures and disaster recovery practice in advanced economies.

The research would explore theories of urban planning (particularly participatory planning) to address gaps in accommodating right psycho-social support and capacity development of beneficiary communities as part of the recovery process. The study seeks to explore complementary case studies of flood prone areas in Brazil and the UK to develop new knowledge on how to manage social recovery more effectively from a bottom-up perspective. The expected outcomes of this research would be; co-production of knowledge across cross-cultural contexts; the adoption of long-term sustainability principles to social recovery initiatives and improved social recovery success in post disaster management in the Itajaí Valley region of Brazil and other similar areas.

Keywords: Disasters, Multi-stakeholder approach, Resilience, Social recovery and Sustainability.

Aim

The aim of this study is to explore how sustainable social recovery initiatives have been in the Itajaí Valley region of Brazil in order to reduce the vulnerabilities of communities in this region. There are historical incidences of natural hazard impacts such as flooding and landslides in this area, hence the need to consider long-term sustainable recovery actions in the interest of the population.

Objectives

The objectives of this study are:

- To explore the nature of social recovery initiatives in the Itajaí Valley region of Brazil in response to natural hazard impacts.
- To assess the sustainability of those recovery initiatives in comparison with other examples from the UK.
- To recommend actions that could improve the sustainability of social recovery initiatives in the Itajaí Valley region.

Literature Review

Resilience in the built environment is a concept that has been stretched in different directions. The underlying concept refers to the ability to withstand stresses. Hassler and Kohler (2014) explores this concept from its 19th century design principles, chronicling its evolution through to socio-ecological resilience. In the built environment, resilience is often associated with the ability of communities to cope with external stressors such as natural hazard impacts and man-made conflicts to that socio-ecological system (Bhamra et al., 2011). The DFID (2011)

developed a resilience framework with four main themes: context, disturbance, capacity and reaction. This research is concerned the 'reaction' aspect of this framework, whereby recovery from the disturbance is the main focus.

Amongst the natural hazards faced in many parts of the world, floods and landslides rank amongst the most common occurrences. These natural hazards have impacts which include damages to housing, assets and other property, loss of lives, means of livelihood and vulnerabilities to some health risks (Hillier and Nightingale, 2013). While the effects of the natural hazard impacts are unwanted, there is often an opportunity for the impacted community to 'bounce/build back better' (DFID, 2011, Mannakkara and Wilkinson, 2016).

The problems of post-disaster responses and recovery have been well documented in literature. Post-disaster activities are usually dominated by large scale housing reconstruction programmes. On the surface, this appears to be the rational thing to do. However, researches report that many of these post-disaster recovery efforts are not successful for a variety of reasons. For example, the need for large scale reconstruction puts pressure on construction materials and other resources which could in turn exert pressures on the socio-ecological system. Also, it is common for donor and relief agencies to propose solutions to affected communities without engaging with them to ascertain what their needs are, and the psycho support needed to bounce back socially (Mannakkara and Wilkinson, 2016).

In view of this problems, some researchers have explored for the interrelationships of resilience and sustainability concepts (Derissen et al., 2011, Achour et al., 2015, Ismail et al., 2017). The arguments differ from those who regard sustainability as part of resilience and vice versa, and those who consider them as separate entities that need to be integrated. The tensions between both contexts are exacerbated by the knowledge that many post-disaster recovery efforts have not been sustainable in the long run. This study explores this gap and the framework by Mannakkara and Wilkinson (2014) is adopted to study how post-disaster social recovery efforts are developed/implemented in the Itajaí Valley region of Brazil.

Methodology

The nature of the study lends itself to the use of a multi-case study approach (Eisenhardt and Graebner, 2007). From the review of literature, there is ample evidence to suggest that developed countries appear to suffer less consequences from natural hazard impacts and communities seem to bounce back more quickly than in emerging economies. This provides an opportunity to learn from places where social recovery initiatives have been deemed to be more effective.

The Itajaí Valley region has perennially suffered from flooding and landslides and anecdotal evidence of the patterns of these occurrences show that inhabitants of the informal settlements of Ribeirão Fresco and Imaruí suffer the worst of landslides and floods respectively. These regions are populated by low income families, meaning that they are more vulnerable than the rest of the population. This study would explore social recovery initiatives in both Ribeirão Fresco and Imaruí as case studies in comparison to what is obtainable in the UK. Data collection methods for this study would include non-participant observations, interviews and archival records (Bryman, 2016) from government institutions. As the data generated from this study is qualitative, thematic analysis would be carried out with the aid of NVivo software (Bazeley and Jackson, 2013).

Expected outcomes

The aim of this study is to develop transferable knowledge across two different contexts with regards to sustainable social recovery initiatives, post disaster. It is expected that from this study, relevant knowledge can be developed on how both the UK context and the Brazil context can learn from each other in developing and implementing social recovery initiatives that imbibe both sustainability and resilience principles, resulting in more resilient communities in the future.

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IMPACT OF CONSTRUCTION ACTIVITIES ON BIODIVERSITY AND ECOLOGICAL RESILIENCE

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Abstract

The built environment has been recognised as a major contributor to loss of biodiversity and should therefore play a major role in a sustainable world where ecological values are enhanced. There should be a smooth interaction between the built environment and the natural environment because humanity and nature are the usual victims of loss of biodiversity. The purpose of this paper is to examine the link between the Built Environment and Biodiversity. The paper explores the role of a sustainable built environment towards biodiversity conservation through critical review of literature. The results show that, even though the built environment has a negative impact on biodiversity, it also has the greatest opportunity to integrate biodiversity into all development projects. Reducing the impact of the built environment on biodiversity should be an integral part of policies and strategies towards a sustainable built environment.

Keywords: Biodiversity; Built environment; Construction industry; Sustainable development

1. Introduction

The United Nations Convention on Biological Diversity defines Biodiversity (Biological Diversity) as "*the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems*" (UN, 1992:3). The term Biodiversity describes all living things such as plants, animals, fungi, and micro-organisms and the variations within or between species and the ecosystems.

The Built Environment rarely considers the connection between the biodiversity and human wellbeing when delivering infrastructure and housing projects; little attention is paid to the integration of the relevant biodiversity strategies for sustainable urban development (Edwards, 2010). Despite the negative impact of the built environment on biodiversity, the delivery of new construction projects or the refurbishment of existing built assets have the opportunity to enhance the ecological value of most construction sites (UK Green Building Council, 2009). The preservation of biodiversity in a sustainable built environment with little or no natural habitat could help the drive to reduce loss of biodiversity without concentrating on unharmed natural habitats (Alvey, 2006). Preserving and enhancing biodiversity through the design and the management of sustainable urban environment requires the consideration of both the ecological and the human requirements and use (Aronson *et al*., 2017).

The built environment is described as a major contributor to biodiversity loss and climate change due to the large volume of resources consumed by the construction industry. It is therefore argued that, the built environment can significantly contribution to the solutions addressing the problem of biodiversity loss (Zari, 2012). The built environment presents a serious threat to the protection of biodiversity if an urgent action towards a more sustainable built environment across the globe is not implemented.

2. Understanding biodiversity and the built environment

The ecosystem and biodiversity are essential part of the urban environment contributing to environmental resilience against disaster resulting in an improved quality of life. It is argued that an integrated approach to sustainable built environment leads to a general quality of life (SIDA, 2016). Biodiversity offers social, economic and environmental benefits beyond the protection of habitat and species. In 2011, the United Nations declared a Decade on Biodiversity (2011-2020) with a global ten-year framework of action to be adopted by all countries and all stakeholders. The strategic plan was to understand the primary causes of loss of biodiversity and to ensure that governments and industry consider the impact of all decisions on biodiversity (UNEP, 2011). The destruction of valuable habitat during urban development process requires strategic management use of habitat replication techniques to ensure the achievement of the sustainable development goals (Donovan *et al*., 2005). The provision of urban green space for biodiversity conservation due to fragmented natural environment caused by global urban development is essential for sustainable development (Goddard *et al*., 2010).

2.2 Construction industry activities on biodiversity

The built environment impacts on wildlife and ecological networks negatively at both the construction and the in-use stages of the project lifecycle. The global problem of biodiversity loss is critical for the international community considering how biodiversity has featured in all the major global initiatives to combat environmental issues (Bastian *et al*., 2012). The international community's desire to end poverty and ensure prosperity for all cannot be achieved without the protection of the environment. Construction activities negatively impact on endangered species on construction sites and adjacent areas. For example transport infrastructure projects have the potential to destroy large areas of natural habitat since such projects form a large network of infrastructure affecting both local and national biodiversity.

The extinction of endangered species due to loss of biodiversity cannot be reversed and therefore every effort should be put in place to prevent it from happening (Zari, 2012).

The man-made systems of the environment, such as the buildings and infrastructure (transportation, telecommunications, energy, water and waste systems) affect biodiversity (Nolan *et al*., 2009). Environmental issues should be considered at the front-end of the project cycle to minimise the negative impact of construction activities on the environment. The demand for large volumes of natural resources such as timber and fossil fuels for construction activities is destroying large areas of habitat causing loss of biodiversity (Fahrig, 2001). Again mineral extraction for use in the construction industry affects biodiversity; the industry should carefully consider the source of all materials used in construction. Another approach is to conserve and rehabilitate existing built assets instead of demolishing and building new projects. Biodiversity considerations seem to be one of the least priorities when assessing new development project. Biodiversity as an integral part of the built environment is beneficial to individuals, businesses and communities since a healthy and functional natural environment

Discussions

An enhanced biodiversity in the built environment could be a critical driver for the construction industry. A built environment designed, constructed, managed and controlled by human interactions with biodiversity should be the new approach if loss of biodiversity is to be reduced. A well designed and constructed built asset create habitats in which wild species flourish. The impact of materials used on all construction projects on biodiversity should be assessed; the embodied carbon of specified materials should be evaluated. Construction materials sourced from unapproved forest can affects locally protected species.

A sustainably planned, designed and constructed built asset contribute to the quality of the built environment required for a positive human health and wellbeing. For example, ecological professionals could be used as trainers on biodiversity awareness to construction site workers. Noise from construction activities should be reduced as much as possible by programming high noise related activities at certain time of the year; avoiding such activities during birds breeding season. Urban development projects can be used to enhance the ecological value of construction sites instead of destroying them. For example, construction sites and surrounding areas could be protected by planting tree species and leaving naturally occurring plants uncut for the benefit of wildlife.

Conclusions

The study explores the adoption of sustainable construction practices that enhance the preservation and the promotion of biodiversity as an integral part of the built environment. A built environment with incorporated biodiversity improves the planets ability to adapt to climate change, improves the quality of air, flood mitigation and the overall health and wellbeing of people in society. Biodiversity policies and strategies should consider the best approaches on harnessing the interaction of the natural and the built environment for the benefits of human needs and existing wildlife. The study clearly shows that the built environment has an important role to play in reducing loss of biodiversity through the design, construction and the maintenance of built assets. Adopting sustainable procurement practices that only source timber that has been certified by the Forest Stewardship Council (FSC) for construction activities could contribute towards the protection of biodiversity.

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THE DOCE RIVER LARGE SCALE ENVIRONMENTAL CATASTROPHE: DECISION AND POLICY-MAKING OUTCOMES

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Abstract

A tailing dam failed on the 5th of November 2015, flooding the Doce River, Brazil, with 34 million m^3 of tailings and killing 19 people, together with massive aquatic life annihilation (14 ton of deceased fauna). A total of 663.2 km of river channel were directly affected, leaving over 600 people homeless and an impacted coastline, including protected areas with threatened marine species. Following the disaster, a series of political and management decisions were taken impairing the progress of ecosystem recovery, even 2 years post disaster. In this study, we discuss governmental actions after the Fundão tailing dam rupture and its environmental impacts in the Doce River watershed. The creation of a new governance structure that would theoretically deal with river basin reclamation is here evaluated according to each stakeholder decision-making power. Results show that there is a bias towards funds management, diminishing effective institutional diversity in the decision-making process. Furthermore, a vulnerability analysis that combines dam stability and socioeconomic data regarding indigenous people representation, GDP, administration improbity, shows that the latter aspect increases substantially basin vulnerability. We conclude that despite the new efforts in creating new environmental governance systems to address post-disaster ruptures, Brazil has a greater threshold to surpass: the implementation of regulations. The lack of equanimity in the governance structure, as well as frail law enforcement, maybe the main overall impairment in developing economies.

The new Doce River Governance Framework

The *Framework Agreement* has the goal to provide restoration of environmental damage to the communities affected, including indigenous. A fund of up to US$6.3 billion (20 billion BRL) was made available for clean-up costs and damages recover related to the Samarco dam failure, contrary to the US$1.1-billion mentioned previously (Nazareno and Vitule, 2016). The *Framework agreement* establishes then a public-private governance system to rehabilitate the Doce River Basin with environment-related incentives, constituting the first hybrid governance system in Brazil. According to Muradian & Rival (2012), hybrid regimes are indeed more suitable to deal with the governance challenges derived from the characteristics of ecosystem services. The major challenge is the integration of 'regulatory processes, mechanisms and organizations through which political actors influence environmental actions and outcomes' (Lemos and Agrawal, 2006). To evaluate stakeholders' role in the new framework agreement setup, a stakeholder analysis was carried out aiming at identifying weakness and loss of opportunities to improve governance. The stakeholder analysis was based on Brown (2006), whose approach considers relative levels of influence and importance to classify stakeholders according to their power, values, and interests.

The analysis of stakeholders involved in the new *Framework Agreement* generates 29 stakeholders, with different degrees of decision-making power (Figure 1). Brown (Brown, 2006) defines the importance of these stakeholder groups as for how their livelihoods were (i) impacted by the outcome of decision-making and their (ii) influence over the decision-making process. Stakeholders were categorized into primary and secondary, depending on the level of decision-making power. The upper left square of Figure 1 describes a type of stakeholder that is defined as *Demanding* by Mitchell et al. (1997), a group that has no power nor competences but is highly impacted by the decision-making process (Figure 1). In the current case, local communities (1 in Figure 1) are considered the highest impacted stakeholder, only to be matched by the local professional fisherman (3). Local communities are considered here as the local population living in the river vicinity, but also the indigenous people that live and worship the river. For these people, the Doce constituted water, food, shelter

and a belief system. The most impacted and influenced by the disaster, Local communities (1) have the lowest influence over the new governance system. The local professional fishermen (3) have higher influence than (1) since they form official associations that represent their well-being and interests. Both land-developers (7) and industries (8) are considered here as small local businesses, like farmers and dairy farms. Both (7) and (8) are currently facing economic and environmental scarcity, in terms of degraded land and river, since they lack the Natural resources that sustained their business. AGERH (10), ANEEL (11) and IDAF (12) (Discretionary stakeholder) are Federal and State institutions that possess both expertise and legislative power but are neither greatly impacted by the disaster nor have great influence over the decision process. These are institutions that have none to little representation at the CIF and are not currently included in the watershed recovery, but have legislative power at the State level (Figure S5, Section S3). Therefore, we consider them as *Discretionary* stakeholders (Mitchell et al., 1997). Samarco (15), Vale (16) and BHP (17) are defined as powerful stakeholders (*Dormant*). The three mining companies are involved in the prosecution process and responsible for providing funds to finance the Doce river recovery. They are constituted powerful in this analysis due to its financial influence, however lack urgency and legitimacy in its effective recovery. Another type of stakeholder are the *Dangerous* type, where regularly NGOs take this role. However, Brazil does not host NGOs with sufficient power to influence the decision process as it is. Therefore, we leave this category blank. The Fundação Renova (14) is the sole stakeholder defined as *Dominant*, since it has power with legitimacy to manage the funds that were allocated to the Doce river recovery. It is worth noting that the DNPM, the institute supervising tailing dams in Brazil, is indicated as neutral in terms of impact and influence (Figure 1). The DNPM has all the legitimacy to sanction and stop mining exploitation prior to disaster. Once the tailing dam was ruptured, the DNPM has no competencies relative to ecosystem and environmental restoration. The *Definitive* stakeholder is a stakeholder that has all three driving attributes for effective decision-making (Mitchell et al., 1997). Here, we define CIF as the sole *Definitive* stakeholder in the decision process of the Doce recovery. Empirically, the MPF has all the three main attributes as well, but it removed itself from the Framework agreement early in the process.

Legend:

Primary stakeholders		Secondary Stakeholders	
1	Local communities	12	IDAF
2	Local recreation users	13	Municípios
3	Tourists	14	Fundação Renova
4	Recreation fishermen	15	Samarco
5	Professional Fishermen	16	Vale
6	Hotel owners	17	BHP Billiton
7	Land developers	18	MMA
8	Industries	19	Ibama
9	Watershed committee	20	ICMbio
10	AGERH	21	ANA
11	ANEEL	22	IGAM
		23	IEF
		24	FEAM
		25	IEMA
		26	DNPM
		27	CPRM
		28	CIF
		29	Technical groups

Figure 1 – Stakeholders levels of importance (Brown, 2006) in relation to being impacted by the disaster and level of influence on decision-making on the post-disaster actions following the new Framework agreement

Samarco (15), Vale (16) and BHP (17) are considered as powerful stakeholders because they have financial capacity and they provide the funds that will be used to recover the ecosystem. As the authors analize here, they are still the *Dormant* stakeholders because they lack the urgency to recover the environment. However, this urgency should increase in a post-disaster scenario, mainly by main authority imposition – the MPF. Since the MPF has removed itself from the Framework Agreement, the powerful dormant stakeholders will remain as such. The stakeholder analysis suggests that the new *Framework agreement* continues to underrepresent the most impacted stakeholders (Figure 1). Being the CIF the definitive stakeholder, and the Renova Foundation the dominant one,

measures should be taken to assure that decision-making is not mainly affected by economic interests but mainly based on the technical and scientific advice provided by the Technical boards.

Some Considerations

The jurisdictions of environmental management systems and water resources management systems in Brazil are separate and the Framework Agreement addresses this divide. Efforts to decentralize decision-making from the CIF and to reduce the industrial ruling should be made. Instead, the watershed ecosystem recovery should be prioritized and concepts of ecological engineering and ecohydrology should be adopted (McClain and International Association of Hydrological Sciences., 2002; Millenium Ecosystem Assessment, 2005). For this to take place, a basin approach should be considered and for that, the watershed committee (9) should take central role as *Definitive* stakeholder. This way, environment, energy production, population, sewage treatment, agriculture irrigation, wetland preservation, to mention a few, will be incorporated in decision-making. An instrumental aspect would also to engage indigenous people and make them more representative in the process. The recovery of wetlands along the Doce river is instrumental in the support of indigenous people, the Krenak, who support themselves from the Doce river. In addition, as the Krenak perceive the Doce river as a deity, working proactively in its recovery would reassure and engage them in its recovery. As an example we have the Kagera project, a transboundary watershed between Burundi, Rwanda, Tanzania, and Uganda supported by FAO, can serve as an imprint for the Doce River recovery. Actions portfolio consist of protection of wetlands for water and food supply carried out by local communities in tandem with the technical support. This decentralized approach involves field work and teaching local communities.

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THE SEA LEVEL RISEN DESIGNED BY THE INTERGOVERNMENTAL PANEL OF CLIMATE CHANGE AND ITS IMPACTS ON THE DEVELOPMENT OF THE CENTRAL NORTH COAST OF SANTA CATARINA

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The sea level rising represents one of the strongest evidences that the phenomenon of climate change is real and eminent. Global warming, a cyclical and natural phenomenon on the planet, is catalyzed by anthropic activities, especially after the industrial revolution. The thermal expansion of the water bodies, together with the melting of the poles and in the mountains glaciers, presents a worrying scenario for the populations located in the coast. The Intergovernmental Panel on Climate Change, an institution represented by experts from around the world, warns of an alert and disaster scenario. Their projections bring a disturbing situation to the coastal regions, which will have substantial losses of their areas, either by regional floods, coastal erosion and other events like rip tides. Scientific studies indicate that climate change are cyclical and natural phenomena of our planet and that it has undergone these transformations several times in its 4.5 billion years. However, due to the anthropic action, through the urban densification, the burning of fossil fuels and deforestation, the concentration of greenhouse gases in the atmosphere has increased the temperature of the planet. In this sense, there is a combination of scientific and political discussions on the theme, making international actors able to take mitigating and adaptive actions of climate problems. The section explored in this work is the sea level rising, caused by the melting of the glaciers and the heating of the water in the oceans. It is proposed that the area analyzed to this phenomenon is the region North-Central Costal Sector in Santa Catarina. There is a growing urban density, driven by real estate speculation and also because it is a strong import and export route to the state. The region include the municipalities Navegantes, Itajaí, Balneário Camboriú and Itapema. The guiding question represented by the main objective is: How can the eustasy designed by the Intergovernmental Panel on Climate Change impact on the development of the SLCN region from a multidimensional perspective? It is justified because it is a theme that represents one of the greatest challenges of humanity in the near future. Reflections of sea level rise and coastal erosion are present all over the world and are fully visible on the coast of Santa Catarina. The proposed methodology is exploratory and descriptive regarding the objective: to analyze how the eustasy projected by the Intergovernmental Panel on Climate Change can impact on the development of the North-Central Coastal Region in Santa Catarina from a multidimensional perspective. Regarding the data collection process, this is qualitative-qualitative. Qualitative in the sense of working with the subjective impressions of key actors (academia, public and community) and quantitative indicators of development, socioeconomic, environmental and IPCC projections. For this, it is proposed a triangulation of information from four techniques (bibliographic / documentary research, semi-structured interviews, transects / geo-environmental incursions and mapping / geoprocessing) and three groups of informants (academia, public power and community / population). Bibliographic research was based on the concept of development through the provision of basic needs and the achievement of a higher quality of life. This development is linked to the idea of sustainability and the maintenance of ecosystem services in a socioecological systems (SSE) approach (OSTROM, 2009). Through the resilience of SSE the maintenance of the ecosystem services and quality of life of the population is maintained. This is done by adapting SSE to disasters or disruptions while maintaining other ecosystem services. Still in the bibliographical research one has the investigation of the neoinstitucionalista theory of the International Relations, represented by the importance of the international bureaucratic institutions. Emphasis is given to debates and institutions dealing with climate change and the international meetings that have emerged with them. Geobiological and geo-environmental incursions are obtained by geobiophysical-natural aspects, such as relief, geology, climate, vegetation and socioeconomic and infrastructure aspects (SEIXAS, 2005). The transects were carried out in the most vulnerable areas affected by the marine transgression (Navegantes: Gravatá, Centro-Porto and São Pedro; Itajaí: Historic Center and Community of the Imaruí; Balneário Camboriú: central beaches, and Itapema: Canto da Praia, Restinga and Meia Praia). This information on the most affected areas was achieved and flagged through interviews with key actors. In the same way, the incursions must happen with the presence of a multidisciplinary team and with an actor who knows the locality, its conditioners, fragilities and

potentialities. Data collection through geoprocessing is done by the use of software for processing and manipulation of collected cartographic data. Through Geographic Information Systems (GIS) or GIS you have the storage, manipulation and analysis of geographic data. In the GIS, it is still allowed the management of information inherent to the geographical positioning, functioning as tools of urban planning. Overlay mapping gives the possibility to create and simulate models of interference in the territory (MOURA 2005). Thus, projections about sea level rise can be viewed with map overlay in current dimensions. The scenarios analyzed refer to the projections signaled by the Intergovernmental Panel on Climate Change on four perspectives for sea level rise: a scenario that converges the eustasy forecasts for 2030 (RCP 2.6, RCP 6.0 and RCP 8.5) to 0.13 at 0.25m. And the predictions for 2100: an optimistic RCP 2.6 (0.26m to 0.55m), an intermediate RCP 6.0 (0.33m to 0.63m) and a pessimistic RCP 8.5 (0.45m to 0.85m) (IPCC, 2014). The cross-referencing of this information provides an overview of the multidimensional aspects of the region's development, encompassing the concept of sustainable development. It advocates a better quality of life by meeting the needs of humankind without calling into question the resource reserves for future generations. The analysis will be based on a multidimensional perspective of the development, evaluating its possible transformations against the event of eustasy prospected by the IPCC (AR5, 2014). In summary, it was concluded that although they have similar problems regarding marine transgression and the fragility of coastal and riverine areas, responses to these problems are given in an isolated manner in each municipality. It was also concluded that there is a distance between the key actors within the municipality itself, and that the academic information does not reach the community or even the public agencies. Public agencies, in turn, do not demand such information from the university and work disassociated with representatives of the community. However, an important point conquered in this part of the work was the signaling of the observation areas for the realization of the transects and the application of the projections through the tools of Geoprocessing. In case the eustasy phenomenon is realized, some prospects were pointed out: Although it is believed that the region will continue to be one of the highest population and urban densities of the state, it is believed that a reconfiguration of the social dynamics. The quality of life factors should stagnate or fall at first, having a great impact on those with lower income. Nevertheless, after the period of collapse and reorganization of the SSE, there is a great possibility of resumption of the current development condition. The issue of socioecological injustice should become more evident with eustasy, making the opportunities for improving the quality of life less egalitarian. It is necessary to increase the capacity to satisfy the basic needs of this population, especially those of understanding, participation and identity. We must consider a technological adaptation that allows the continuity or improvement of the facilities of container yards, shipyards, fish industries, guaranteeing the conditions of employability in the municipalities. The construction industry is likely to continue an expanding sector in Itapema and Balneário Camboriú, targeting areas with higher elevation levels. This dynamic can mean the continuous flow of investments and employability in the region, even after the process of eustasy. Tourism tends to continue as an expansion factor of employability in the region, even if it is curbed at first, the service delivery chain tends to expand and reorganize in the face of changes in the local landscape. The productive sectors in the municipalities of the SLCN region should continue to have the service sector as the main and leverage of the local economy. Nevertheless, the range of services should be widened due to the threat that rising sea levels may undermine some jobs at an early stage. Diversification of production would imply alternatives to move the economy of the region. Investments in the primary sector represent an alternative for reducing dependence on food supply in the region, as well as being a necessary productive and income-generating source. Diversification in the industry in the region is relevant to bring in new investment opportunities and allow better resilience of the SSE. This represents an alternative to the shortage of service-linked jobs, which may occur momentarily in the collapse phase of the resilience cycle. The environmental responses to the devastation caused by the productive structures and by the settlements of the population must be even more tragic. The absence of the restinga and dunes brings a complication in the restructuring of the environmental cycles in the promotion of the ecosystem services of supply, protection and regulation in all the municipalities of the SLCN. With eustasy and the entry of a new regime in the resilience cycle, it is believed that the process of demographic deconcentration in the studied municipalities of the SLCN region should increase. The transformation of space that occurs through the center-

periphery, inland-coast expansion must inevitably follow this direction. The reorganization of the territory affected by eustasy will require an urban reconfiguration. One should think of an urban planning that reallocates the housing units, the urban equipment and the productive units to higher levels and out of the waterways. Investments in water containment barriers will not do much better than the environmental events of marine transgression. The process of erosion of the shoreline should be even more intense. In this sense, one must think of a long-term process of transposition of the populations that are in the lower areas (border and near the water courses) to the terraced areas of the Pleistocene, less susceptible to flooding. It was noticed that the traditional communities linked to the fishing dynamics (craft) have disappeared over the years. The replacement of artisanal fishing activities by productive sectors reveals a transformation in the way of life of the population and its identity with the local. There are still remnants of fishing communities in the municipalities, but there was a migration not only of activities, but also of their identity in the face of obstacles to exercise their way of life. There is a difficulty of cultural resilience in the face of changes in the environment, which is being lost to the point of no longer recovering. From this, can be concluded that the climate change issue combined with development topics is a rich field for academic research. Eustasy already represents an imminent problem that demands rapid actions of urban and environmental planning in coastal municipalities. There is a great need for mobilization in the various social extracts so that the subject can be disseminated, not only in the academic environment, but also reaches the understanding of the public power and the community in general. Still, eustasy is surely an event that will bring great transformations, not only in the landscape, but also in the socioeconomic dynamics in the SLCN region. Transposing the problems generated by this event means finding ways to continue promoting regional development.

Keywords: Sea-level Rise. Intergovernmental Panel on Climate Change. Climate changes. Central-Northern Coast of Santa Catarina. Regional development.

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THE ROLE OF KNOWLEDGE SHARING CULTURE IN BUILDING COMMUNITY DISASTER RESILIENCE AWARENESS TO ADAPT TO FLOODS AND ASSOCIATED RISKS

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Abstract

Governments' movements and initiatives towards managing risks as a result of floods and associated risks would not be fulfilled or blossom without communities being aware of the possible risks and how to manage them. Indeed, Brazil, compared to the UK, could be facing an increasing demand caused by hazard impacts on larger populations and critical economic difficulties. Therefore, engaging and educating the local communities in managing disasters and building resilience could have better chances when the culture of knowledge sharing is embedded. knowledge Sharing culture can help with identifying hazards and risks, acting to build safety and resilience, and reducing future hazard impacts. Communities and individuals usually can – and want to – become partners with governments in this. Public awareness and public education for disaster risk reduction can empower normal people everywhere to participate in reducing future suffering. This type of culture can be even more effective in countries where economic development is critical. This is because the culture of knowledge sharing helps in the spending the government would need to do on awareness and training programmes. This poster will be addressing the possible role in which the culture of knowledge sharing would play in building community disaster resilience awareness to adapt to floods and associated risks. The benefits governments can gain from embedding such culture and the obstacles that can hinder building such culture in communities will be also addressed. Additionally, different examples on how the culture of sharing knowledge has played a significant role in building awareness among the public in different areas will be provided. Finally, recommendations on how the culture of knowledge sharing can be built among local public communities to enhance disaster resilience awareness to adapt to floods and associated risks will be suggested.

Keywords: knowledge Sharing culture, community, disaster resilience awareness, floods.

Introduction

The importance of sharing knowledge and information across people, governmental and local communities' charities and agencies during flood crisis is a key to reduce the possible risks and to increase the potential for saving more lives (Zhang, Zhou and Nunamaker, 2009). Yates and Paquette, (2011) argued that during flood people will not be only physically impacted but also emotionally traumatised by the crisis that took their beloved lives and destroyed their financial resources. A large number of people- during or after the floods' crisis- would lose their ability to manage and effectively use information to make the right decision. Additionally, they would lose their ability to communicate information and share knowledge that help them recover from the crisis. In such situations, the importance role of the government appears as fundamental agent to bridge the gap- result from the crisis - in accessing, communicating and sharing knowledge.

In the current literature, there have been suggestions that the governments should establish different information points or channels for people to share knowledge and information during crisis (Chatfield, et.al., 2012). The effectiveness of such channels will be gauged by the channels' capabilities to respond to the knowledge's needs of the local communities. For that, in-advance knowledge sharing platform should be created to link between the governmental agencies and local communities. The role of such channels mainly is to serve the immediate knowledge sharing needs of the local people during the crisis. Indeed, knowledge sharing projects must be supported by the accurate policies to support building up the culture of sharing knowledge (Ahmad Dahla et al.,2013). Alongside the policies, the government is requested to offer training, education and awareness programmes to public communities (Yates and Paquette, 2011).

Although, the literature of disaster management has paid some attention to the topic of knowledge and information sharing across crisis and flood's victims (Altay et al., 2006; Manoj and Baker, 2007), a paucity of research studies that focus on the role of knowledge sharing culture- educated by the government - in building community disaster resilience awareness. Therefore, there is an urgency

to work in reducing disaster risks by understanding the role of the government in educating the community to establish the culture of knowledge sharing. A theoretical point of view, this study contributes to the body of knowledge by investigating how educating for knowledge sharing culture will help in building community disaster resilience awareness?

The context of the study

Brazil is one of the countries that has experienced regular devastating natural crisis mainly floods (Merz et al., 2010). Rivers and flash floods killed in Brazil between 2000 and 2011 over 1300 people. Connectively, the Brazilian's economic loses around 2.8 Billion USD in the last 10 years as a result of regular floods (Sibaja, 2011). The current reports about the crisis related to flood, demonstrate increasing demand caused by hazard impacts on larger populations and critical economic difficulties. The local government in Brazil set a prevention measures to address the possible emergency needs and expenses. The government also established strategies the government to manage the risks for all-natural crisis including the floods' crisis (Abertas, 2011). But, there is no evidence that the local government initiatives towards managing risks included any sharing knowledge initiatives. The current literature suggests a lack of evidences regrading whether the local government of Brazil is aware to the possibilities of sharing knowledge in building the communities' resilience. The importance of this project is to address the potential of knowledge sharing culture in enhancing the local communities in Brazil in achieve community resilience.

Nuwayhid et al., (2006) defined community resilience as the sustained ability of a community to withstand and recover from different types of disasters including flood disaster. Rivera et al., (2011) argued that engaging and educating the local communities in managing disasters and building resilience could have better chances when the culture of knowledge sharing is embedded. Educating on the culture of knowledge sharing can help with identifying hazards and risks, acting to build safety and resilience, and reducing future hazard impacts. Communities and individuals usually can – and want to – become partners with governments in building the communities resilience. Public awareness and public education for disaster risk reduction can empower normal people everywhere to participate in reducing future suffering. This type of culture can be even more effective in countries where economic development is critical. The fact, that the culture of knowledge sharing helps in the decision makers in understanding and gauging the local communities' urgent needs. Hence, the decision makers will be better in prioritizing the spending and in making better plans for their education and training programmes.

Conclusion

This research focus on addressing the role in which the culture of knowledge sharing would play in building community disaster resilience awareness to adapt to floods and associated risks. In order to achieve this aim, there is a need to understand what role the Brazilians' government can perform to assure that the required channels and culture to share knowledge are established. The benefits governments can gain from embedding such culture and the obstacles that can hinder building such culture in communities will be addressed. Additionally, different examples on how the culture of sharing knowledge has played a significant role in building awareness among the public in different countries in the world will be highlighted. Finally, recommendations on how the culture of knowledge sharing can be built among local public communities to enhance disaster resilience awareness to adapt to floods and associated risks will be suggested. An important expected contribution of this project is : to create a framework that helps the local government agencies in educating the local communities in Brazil to embed the culture of knowledge sharing. The project outcomes will be useful to different stakeholders including the governments agencies, academics, civil and charity organisations, of course, for local people of Brazil.

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IS THE MODERN FLYING FACTORY (MFFS) THE QUICK FIX FOR DISASTER MANAGEMENT?

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Abstract

The world is often criticised for its shortcomings in managing disaster either due to inadequate preparations (checks and control), for such occurrences; before happening or post disaster. And very often when disaster occurs, there are minimal preparations for re-housing those affected and displaced. In the light of this development, this paper will seek to explore the possibility of re-housing those affected within the quickest possible time either, whilst disaster is being anticipated or slightly after its occurrence.

Whilst considering options and solutions, will the modern flying factory (MFF) therefore be a solution? The modern flying factory (MFF), is a concept that involves the manufacture of specific components or modules in temporary off- or near- site locations, using relatively simple and quick to set up and dismantle technologies and processes, with an aim to produce short batches, hence achieve some of the benefits of off-site manufacture on a much smaller scale than in dedicated factory environments (Young et al., 2015). The modern flying factory (MFF) is an improved prefabrication method that entails much improvement on the existing prefabrication principles of producing homes in the UK. It involves quick fix of prefabricated structures and moving the machinery and equipment on a moving trailer eliminating the complications of involving capital-intensive prefabricated production factories, which has been identified as one of the major setbacks for setting up prefabrication factories. Prefabrication could add the additional potential of increasing efficiency, quality improvements and cost savings whilst simultaneously reducing the risks and increasing the benefits of close supplier-builder relationships and also reducing the negative user perceptions towards prefabricated houses (Steinhardt et al., 2013).Hence, with more research, investment and awareness, could MFF be the most appropriate idea for manufacturing homes for people affected with disasters as a quick fix solution for manufacturing permanent residences?

Keywords: Disaster, Modern Flying Factory (MFF), Prefabrication, Management

COASTAL VULNERABILITY TO CLIMATE CHANGE IN THE NORTHERN COAST OF SÃO PAULO STATE, BRAZIL

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Abstract

Due to the complex interaction between terrestrial and marine habitats, the coastal zone is very susceptible to environmental variables variations. In this work, we use quantitative data linked to geomorphology, natural habitats, tidal rates, winds, continental depth profile and population coverage to analyze the coastal vulnerability in the Northern Coast of São Paulo State. The Coastal Vulnerability module of the InVEST (Natural Capital Project) model was executed, obtaining a quantitative map of the climatic vulnerability factors. It shows Exposure Index (EI) for flooding and erosion to the coastal segments, distinguishing high (EI = 5) from low (EI = -1) exposure areas to these threats. The results point EI between -1 and 3. Thus, coastal segments with values higher than 1.5 were identified as the most vulnerable to flooding and erosion, reaching about 127 km of the 456 km of the Northern Coast (approximately 28%). The most vulnerable geomorphological areas, such as the coastal and fluvial lowlands, have achieved the highest IE. Attention should be focused on the population living in these segments, due to the high risk that they are subject to in the incidence of storms. In the context of climate change, increasing the amount and the intensity of storms may complicate the situation of these people, even more serious when considering the increase in the population density in coastal areas. Conversely, the higher altitude zones presented less vulnerability. The population benefit from the protection services offered by the nature conserved in these regions, demonstrating the importance of ecosystem to avoid socioeconomic threats and losses. The modeling tools of ecosystem services should help stakeholders to identify preferred locations for housing, activities and infrastructure. Therefore, the development strategies must be implemented in order to balance economic and conservation interests, enhancing human well-being without blocking the flow of ecosystem services.

Keywords: erosion, flood, coastal vulnerability, climate change, InVEST.

FISHERMEN'S ENGAGEMENT IN OIL SPILL RESPONSE PLANS: A BRAZILIAN EXPERIENCE

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Extend Abstract

The growth of brazilian offshore oil production has brought new challenges for coastal management. Due to the overlapping of distinct productive activities in the marine space, such as fishing, oil production and shipping, some conflicts and disputes have emerged. In addition, the environmental impacts and social risks of these activities have accumulated in recent decades, turning becoming management increasingly challenging.

integration of and tools

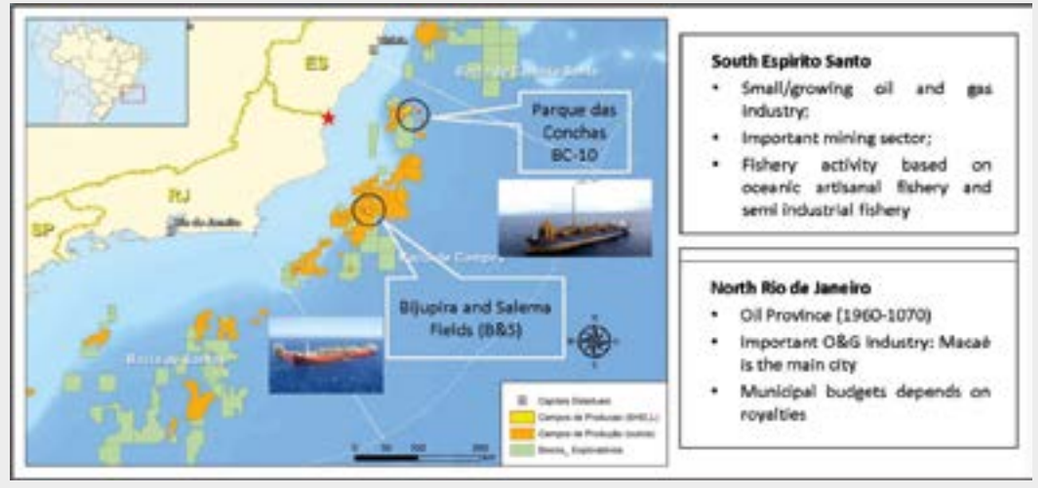

Figure 1: Study Area – North Coast of Rio de Janeiro and South Coast of Espirito Santo.

However, recent experiences have broadened the perspectives of conflict management and resolution through the integration of approaches such as stakeholder engagement, social impact analysis, social license to operate, participatory management [1] and shared value [2]. Based on the application of these concepts and tools, a pilot project was undertaken to enable artisanal fishermen to assist in oil spill events along the coast of Rio de Janeiro and Espírito Santo, Brazil.

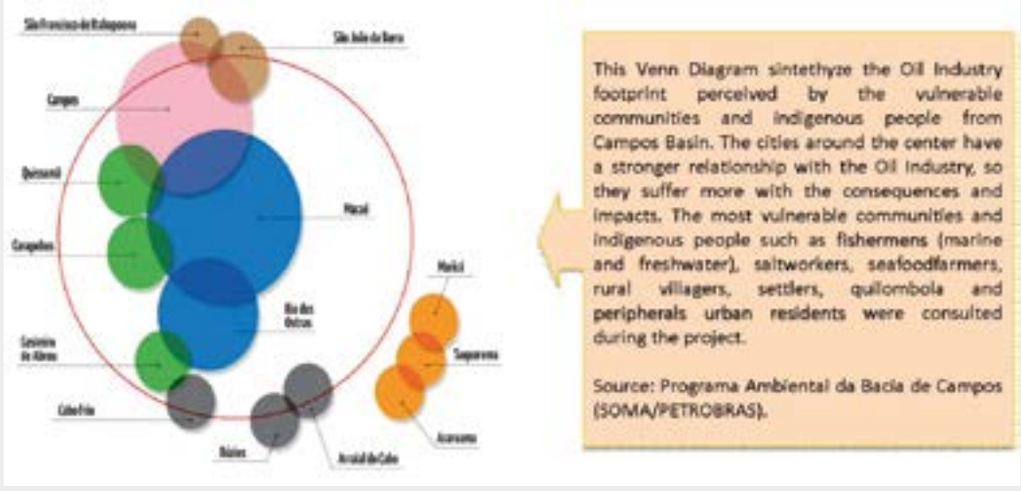

Figure 2: Venn diagram of Oil Industry perceived footprint in Lagos region at Rio de Janeiro, Brazil.

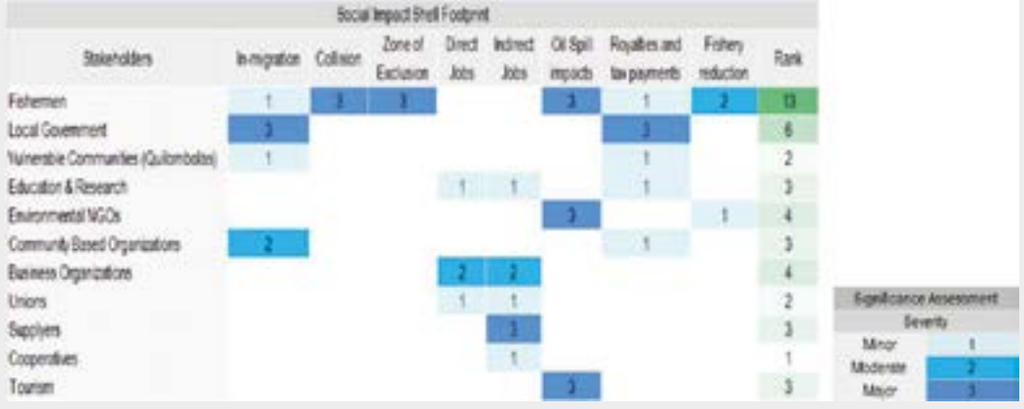

Figure 3: Social Impacts and Stakeholders Groups.

A previous participatory diagnosis identifying the main fishermen communities issues supported a robust and adequate engagement and communication plan. Based on this, a customized work of communication and engagement was carried out in July 2014 with the Fishermen through 23 institutional presentations, elaboration of printed materials, dissemination in the local media (radio, blogs and websites) and direct communication (door knocks and stands).

Figure 4: a) Colour Lines represent the areas of training and b) engagement team.

The project trained 142 artisanal fishermen and their families, making them able to protect the coast and their livelihoods in case of a real emergency. The project was very well received and evaluated by the community, generating results beyond expectations, such as a motion of applause from the City Council of São Francisco de Itabapoana/RJ, establishment of a prolific relationship between the Navy, Environmental Agencies, NGOs and fishermen, and promotion of new partnerships between local stakeholders. Transparency and inclusive participation ensured adequate conflict management.

Figure 5: Training exercises at the beach and at the mangroves.

The initiative qualified the company's social license to operate in the region by proactively identifying opportunities and impacts, mitigating environmental and social risks [4], and creating benefits for local communities.

Keywords: Fishermen´s, Conflict Management, Shared Value, Oil Spill Response, Social License to Operate.

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WHEN DISASTER TURNS TO INJUSTICE: FLOODS AND SOCIOENVIRONMENTAL JUSTICE IN THE ITAJAÍ VALLEY (BRAZIL)

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Since the 1960s studies in the fields of political ecology and environmental justice have shown how environmental resources and impacts are unevenly distributed among distinct social groups, especially because of their ethnic or class membership. Nevertheless, not so often are studies on the ecopolitical dimension of environmental disasters and on the prevention or containment of these disasters.

Considering the case of indigenous people in the Itajaí Valley region (Santa Catarina, Brazil), our objective with this essay is to critically reflect on how environmental disasters, such as floods, as well as prevention and containment actions affect (unfairly) different social groups. In addition, it is proposed that, as a matter of socioecological justice, nature should be included as a moral patient in the formulation of public policies and actions related to environmental disasters.

Our theoretical framework is based on the synthesis between the perspectives of political ecology (Porto-Gonçalves; Leff, 2015), environmental justice (Herculano, 2002; Bullard, 2010) and environmental ethics (Palmer, 2003; Light, 2005), culminating in the discussion around the notion of socioenvironmental justice. We begin with the recognition that: 1. political ecology and environmental justice privilege the issue of human equity in the discussions of the distribution of resources and environmental impacts, preserving to some degree an anthropocentrism in its proposals; 2. environmental ethics offers, above all, normative answers on the relationship between humans and non-humans that are difficult to incorporate into the solution of concrete conflicts. Because of that, we propose, through the idea of socioenvironmental justice, a perspective that seeks to reconcile social equity and moral consideration of nature.

Although Brazilian environmentalism is marked by environmental criticism with the incorporation of social issues (Acselrad, 2010), there are few approaches that seek to associate the theses of environmental justice with environmental ethics or ecological justice (Rammê, 2012; Gudynas, 2015; Florit, 2016). Gudynas (2015) points out that in Latin American debates, ideas of ecological justice and environmental justice rarely interpenetrate, prevailing the perspective of this last one.

We think that the idea of social and environmental justice must necessarily add the thesis of environmental justice and environmental ethics. Human activity has caused significant environmental damage and social conflicts that must be seriously discussed and evaluated in their complexity. This scenario requires the consideration of different approaches, respecting the diverse cultures and the visions of nature of the diverse actors that compose the socio-cultural mosaic – even more heterogeneous in the Brazilian case. In addition, it is necessary to incorporate the ecological environment and all its components as subjects of rights or at least as moral patients. Consequently, one must recognize the intrinsic value of the natural world.

Disaster discussions, including their social and environmental components, can be enriched with the inclusion of socioenvironmental justice principles. Particularly in real situations, such as those involving the implementation and impacts of large projects in territories of traditional peoples and communities, a principle of socioenvironmental justice would imply not only that affected populations should be heard and have their legitimate rights and interests guaranteed (that sustains their ways of life and the environmental preservation of their territories), but also the environmental impact must be considered.

To show how different populations are affected by disasters and prevention and containment actions, we use a qualitative approach, carrying out a bibliographic review of academic texts, newspapers and technical works. The subjects of the analysis are indigenous populations of the Duque de Caxias Reserve, in José Boiteux, Santa Catarina state (Brazil).

Such as many traditional peoples and communities, the indigenous population in Santa Catarina faces cases of environmental conflicts. The first record of invasion of indigenous lands in the state was in 1728, with the opening of the troop road. The occupation began to intensify in the nineteenth century, with the declaration of war to the Xokleng community by Dom João VI, through the Royal Charter (*Carta Régia*) of November 5th, 1808, and with the creation of various

mechanisms for the occupation of the indigenous territory, as the attraction of European immigrants (Florit, et al, 2016: 24-25).

One of the most emblematic cases of environmental conflicts in the present time, because it brings together all three ethnicities (Xokleng-Laklãnõ, Guarani, Kaingang) and because of its temporal dimension, refers to the Ibirama Indigenous Land (*Reserva Duque de Caxias*). Covering the municipalities of José Boiteux, Doutor Pedrinho, Vitor Meireles and Itaiópolis, the reserve was formalized in 1926 through the State Decree nº. 15 of April 3rd, 1926. However, the promised area was reduced from the original demarcation. In addition, the construction of a dam to contain floods, the North Dam, caused the reserve to lose about 900 hectares (out of 14,000), flooding approximately 95% of the fertile lands (Florit, et al, 2017: 35). Today, indigenous peoples living in the area are in legal dispute to expand the area to 37 thousand hectares, as proposed by Funai (National Indian Foundation) in 1994 (Camargo, 2015). Even after a series of protests and conflicts, the expansion has not yet been carried out. Therefore, the case shows that even disaster prevention actions can lead to cases of socioenvironmental injustice. In this case, an action to avoid floods affecting a predominantly white, urban and European-origin population led to a problem for an indigenous community that had its interests and territory sacrificed without proper compensation.

With the analysis, it is possible to conclude that in the Itajaí Valley the floods as well as prevention and solution actions, affect unequally different social groups. The North Dam (part of a complex of three dams built in the Itajaí Valley) was conceived as part of the "preventive" actions and "solution" to the floods. However, on the one hand, the dam mainly served the interests of the urban population (such as Blumenau's), composed of a white majority of European origin people. On the other hand, the territory of indigenous peoples began to suffer from floods and despite the dams, part of the urban population is still affected by them. This population is precisely the poorest and lives in risk areas. In addition, little attention is paid to the recomposition of the natural environment and non-human animals affected by the floods. Thus, it is necessary to discuss and implement principles of socio-ecological justice in the formulation of public policies and actions related to disasters in the Itajaí Valley.

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TRANSFER TECHNOLOGY FOR MONITORING WATER RESOURCES AND SOLID WASTE MANAGEMENT IN POMERODE, SC, BRAZIL.

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Professional studies are one of the pillars of a higher education institution, both from conceptual and legal points of view. Their accomplishment is a complement to the scopes of teaching and scientific research, providing an approximation between university institutions and the communities where they are inserted (Nogueira, 2000). Thus, on the one hand, professional studies go back to social actions and service provisions as a form of mitigation of social problems; on the other, they are presented as a mechanism for transferring knowledge produced at university contexts to society, often towards productive sectors and governments. Among different possible modalities of professional studies, knowledge and technology transfer is of crucial importance for local insertion of universities and their contribution to regional development. They enable the dynamization of different economic sectors and training local actors (Bagchi-Sen & Smith, 2012). However, there are very few references, indications or guidelines about this modality of university professional studies in diagnostics, balance sheets and technology transfer in Brazil. In a report produced in 2007 by the Provost forum for professional studies at Brazilian public universities (FORPROEX, in the Brazilian Portuguese abbreviation, 2007: 24), it was found that classified professional studies actions related to the area of "technology and production" represented only 10.7% of professional studies projects at public universities.

There is also a gap in relation to the percentage of projects effectively devoted to technology or knowledge transfer. In the Latin American and Brazilian contexts, the notion of university knowledge transfer is critically analyzed: a) from an epistemological point of view, because it presupposes greater legitimacy of university knowledge; b) from a political point of view, for supposedly privileging dominant elites' interests. Together, these practical and political barriers seem to prevent the increase of this type of professional studies.

One technology that has been widely used today is unmanned aerial vehicles (UAVs) in several areas such as research, sports, rescuing, communication, war and commerce, among others (Borne, 2014). The use of UAVs for environmental analysis, diagnosis and monitoring can provide an innovative tool for improving environmental management processes whether in a municipality, a river basin or even in wider regions. This may reflect, among other aspects, collection of data with greater accuracy and autonomy by UAVs projected.

It is in this context that we seek to overcome these obstacles and gaps by establishing a protocol for transmission of technology and practical application of registered patents. Thus, it aims to implement the transfer of expertise related to the patent application "A Method for Monitoring Floods in Real Time by means of Unmanned Aerial Vehicle" (registration BR1020170152685 filed on July 17, 2017), produced in the scope of the Center of Technoscience Studies (NET, in the Brazilian Portuguese abbreviation) (Postgraduate Program in Regional Development, PPGDR, in the Brazilian Portuguese abbreviation) at Brazilian university *Universidade Regional de Blumenau* (FURB, in the Brazilian Portuguese abbreviation), in a partnership with *Instituto Federal Catarinense* (Federal Institute of the Brazilian state of Santa Catarina, IFC, in the Brazilian Portuguese abbreviation).

Materials and Methods

The area studied comprised the territories of the 14 municipalities participating in a consortium in the so-called Middle Valley of the Brazilian city of Itajaí, in the state of Santa Catarina. Initially, areas were selected in the Brazilian cities of Timbó and Pomerode, in the state of Santa Catarina, to carry out the pilot project.

Studies began with searching partners represented by public and private institutions for development of activities and consequent transfer of the resulting technology. These meetings made it possible to indicate the areas of interest of the pilot project as well as the schools.

A multirotor UAV was developed with a built-in RGB sensor for imaging and diagnostics of controlled landfills of natural and anthropized areas. These images were obtained by means of an autonomous flight programmed on Mission Planner software and by means of this software it was possible to delimit the route that the UAV would have to realize to obtain the necessary images for construction of an orthomosaic one. Finally, images obtained were processed with the Pix4D program, on which they were compiled in a single orthomosaic. In addition, the software generated a three-dimensional point cloud, which makes it possible to generate a 3D model of the area analyzed. Both the orthomosaic and the three-dimensional models allow not only to record the area current scenario but also to increase the perception of the situation, which provides support for multidimensional approaches.

As a vehicle for dissemination of the project actions, a website is being developed which shall use the programming languages PHP 7.2 and JavaScript 1.8.5, in addition to the AngularJS 1.6.4 framework. Design development has taken place from HTML5 and CSS3, with Bootstrap 3.3.7 and W3CSS 4 libraries. In addition, an educational booklet is being developed with open source program GIMP 2.10.4 to develop assemblies and creation of illustrations.

Results and discussion

Partnerships have been carried out with the municipal government of Pomerode, represented by the municipal Department of Education, SAMAE Pomerode, SC, AGIR, UFSC, FURB (Blumenau, SC) and Consórcio Intermunicipal do Médio Vale do Itajaí (CIMVI) in Timbó, SC.

Partnership with SAMAE has enabled the selection of a rural area with a history of deforestation and soil slippage, which has a water course that is a tributary of the Domingos Stream, which in turn flows into the Testo River, the latter being the city's main river and one of the rivers of capture of water for treatment and supply of 60% of the population. This slippage has occurred in 2008 due to heavy rains in the region (Fig. 1).

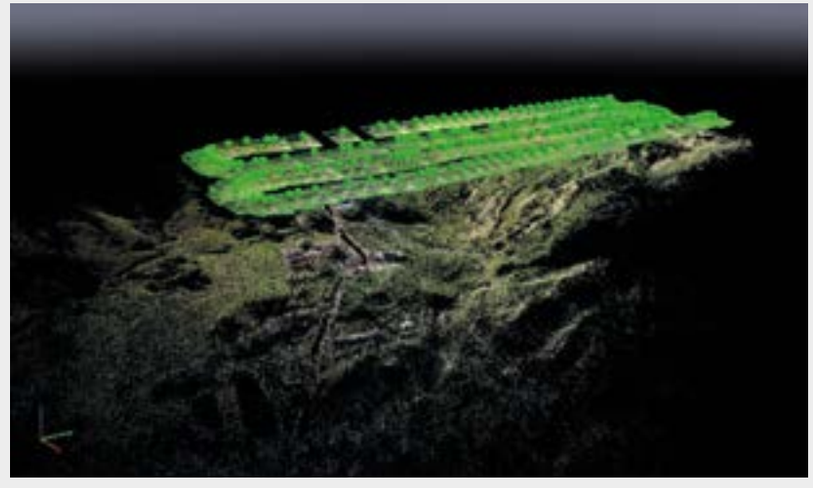
Figure 1: Current photo of an area where slippage has occurred

Source: Projeto Tat

Since 10 years ago, SAMAE Pomerode has been having problems with water treatment, because on days when rainfall exceeds xx mm water becomes very cloudy due to sediment load increase caused by the site mischaracterization.

Tests performed with the UAV in an anthropic area have demonstrated operation in an autonomous mission, that is, how the UAV operates in the field to capture images preestablished on a specific software (mission planner) (Fig. 2).

Figure 2: Points Cloud



Source:

Figure 3: Photo generated from drone photo record

Source:

Actions developed and some results have been initially used in environmental education activities through two communication tools in development: a website (www.tat.blumenau.ifc.edu.br) and an environmental education booklet that shall be used as a support material in basic education schools of the municipality of Pomerode.

Topics defined to make up the booklet were: History of land use and occupation; environment; deforestation; water resources; dynamic activities. We are currently developing the content. This pedagogical product shall be distributed after thematic lectures relating to conservation (water and deforestation) and the UAV.

With this action, technology transfer to AGIR and SAMAE Pomerode shall be disclosed, as well as information on environmental education. These steps shall allow the practical implementation of premises of sustainable development and ensure the presence of social, economic and environmental aspects intrinsic to professional studies projects.

Final thoughts

Based on researching pertinent legislation and analyzing soil use and occupation, a protocol of use of drones shall be created to diagnose the use of sources for capture of water resources and operation of landfills. This protocol shall be the result of an outline of the regulation of uses of springs and landfills through the implementation of aerial monitoring. Consequently, this product shall be transferred to AGIR at zero cost at the end of activities, focusing improvement of environmental management services carried out by the body.

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INDUSTRIAL PRODUCTION WATER AND ITS POTENTIAL FOR THE ENVIRONMENT SUSTAINABILITY OF METAL-MECHANICAL AND TEXTILE SECTOR OF SANTA CATARINA (BRAZIL)

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Abstract

The Brazilian economic model is punctuated by criticism, since it does not respond to the environmental anxieties of the society. In line with this demand, on September 20, 2017, the Federal Senate approved a provisional measure authorizing the IBGE (Brazilian Institute of Geography and Statistics) to calculate the Green GDP. The Green GDP is an indicator made to monitor the ways of introducing the losses generated by the degradation or depletion of the natural resources, resulting from the industrial activity. Therefore, green GDP appears as a way of equalizing the problems that involve the use of natural resources in industry. In this context, the objective is to analyze the efficiency of the calculation of the green GDP, to define the environmental sustainability of the metallurgical and textile sectors in Santa Catarina. The selection of these sectors occurred because they are two activities of great representativeness in the Santa Catarina economy. The theoretical justification fits the effort of interdisciplinary integration among regional development, territorial planning and resilience of socioecological systems theories in the Green GDP calculation perpective. Thus, to demonstrate how Green GDP can be used to measure the sustainability potential of the industrial product, it is intended to develop the Green GDP calculation. This calculation, in the Brazilian case, will be based on the consumption of water during the production (the largest indicator of comparison will be used the Industrial GDP). For the calculation of the Green GDP, the formula is proposed by the document “Handbook of National Accounting - Integrated Economic and Environmental Accounting - Final Draft Circulated for Information Prior to Official Editing”, published by the UN in 2003, as follows:

GDP Green = Industrial GDP - (Depletion of mineral resources + Cost of controlling environmental degradation)

To implement the formula, Young and Lustosa (2000)[1] point out that it is necessary to identify in a given productive activity or productive segment: (i) the conventional GDP, which is the total result of a certain production. (ii) depletion of water resources involving (a) water tariff for industry and (b) water consumption. (iii) the cost of the environmental degradation that is obtained through (a) production (thousand tons) and (b) the Gross Value of Production (industrial GDP) in R$, and finally c) Emission coefficient and industrial toxicity (%). The result obtained in the formula defines that if Green GDP equals Industrial GDP, there will be no loss of sustainability. If the Green GDP is lower than the Industrial GDP, it ignites an alert in the sense that the studied productive activity is losing the sustainability. Reducing sustainability compromises future possibilities for growth. Comparing the sectors, listed in table 1, it is verified that the metallurgical industry consumes a greater amount of water in its productive process than the textile sector. In both sectors it is observed that, year after year, consumption increases.

Table 1: Comparison of depletion of the water resources of the metalworking and textile sectors of Santa Catarina in R $

Year	Metalworking industry Total Value Water Consumption	Metalworking Tariff	Textile Sector Total Value Water Consumption	Textile Tariff
2015	5.891.620,05	3,69	1.922.591,40	9,48
2014	6.251.575,50	3,33	1.796.743,35	8,57
2013	5.582.559,08	3,22	1.620.398,99	8,27
2012	4.822.217,75	3,05	1.364.442,24	7,84
2011	4.218.502,71	2,83	1.162.632,94	7,27
2010	3.367.700,16	2,64	1.065.707,68	6,92
2009	2.286.188,70	2,46	805.921,38	6,21
2008	2.409.482,68	2,42	708.383,52	6,32
2007	1.778.865,90	2,10	584.458,75	5,75

Source: prepared by the authors

Although the metal-mechanic sector presents higher water consumption than the textile sector, it is observed that, considering the value of the tariff, the textile sector pays a higher value for the water consumption in the production (TABLE 1).

Table 2: Comparison of the environmental degradation costs of metalworking and textile from Santa Catarina in (R $)

Year	Metal-mechanic sector	Textile sector
2015	10.780.921.100,00	15.184.224.720,00
2014	12.676.301.880,00	15.697.049.760,00
2013	11.706.439.720,00	14.669.959.920,00
2012	10.675.653.320,00	13.030.242.960,00
2011	10.065.129.360,00	11.973.480.960,00
2010	8.613.444.340,00	11.530.441.440,00
2009	6.275.155.780,00	9.716.588.280,00
2008	6.722.888.960,00	8.391.967.080,00
2007	5.719.676.340,00	7.610.251.320,00

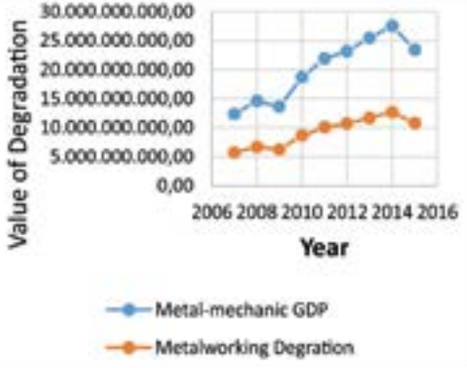
Source: prepared by the authors

The industrial toxicity coefficient for the metalworking sector is 0.46 and the coefficient of the textile sector is 0.84. That is, the toxicity coefficient of the textile sector is 82.61% higher than that of the metalworking sector. This result contributes to the fact that the cost of the environmental degradation of the textile sector is consequently higher than that of the metal-mechanic sector. This implies that, financially, the industry pays a larger account for the damages caused, due to the consumption of water in the production. The following charts

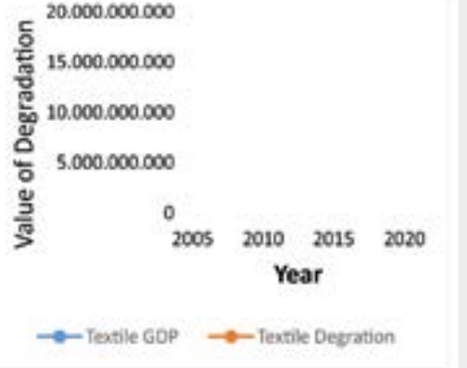
[1] YOUNG, C. E. F.; LUSTOSA, M.C.J. **Meio ambiente e competitividade na indústria brasileira.** Rio de Janeiro: IE-UFRJ, 2000.

compare the cost of the degradation with the volume of production in these sectors.

Graph 1: Comparison between the cost of degradation and the vol ume of production of the Metal -mechanic sector.



Graph 2: Comparison between the cost of degradation and the volume of production of the textile sector.



Source: prepared by the authors

What is perceived in graphs 1 and 2 is that there is a proportionality between the volume produced and the cost of degradation, which indicates that the larger the quantity produced, the greater the cost of environmental degradation. It is important to remember that in this case, the cost of environmental degradation refers only to the consumption of water in the production process. Regarding the comparison of the degradation costs, the textile sector (GRAPH 2) presents a degradation cost closer to the value of its Industrial GDP. Recalling that the rate of water consumption practiced by SAMAE is higher than the rate stipulated by the water company of Joinville, this also ends up affecting a higher cost of degradation.

Table 3: Comparison between the Industrial GDP and the Green GDP of the metalworking and textile sectors of Santa Catarina in (R $)

Year	Industrial GDP of the Metallurgical Sector	Green GDP of the Metallurgical Sector	Industrial GDP of the Textile Sector	Green GDP of the Textile Sector
2015	23.436.785.000,00	12.649.972.279,95	18.076.458.000,00	2.892.041.020,77
2014	27.557.178.000,00	14.874.624.544,50	18.686.964.000,00	2.989.734.566,01
2013	25.448.782.000,00	13.736.759.720,92	17.464.238.000,00	2.794.116.040,51
2012	23.207.942.000,00	12.527.466.462,25	15.512.194.000,00	2.481.814.595,85
2011	21.880.716.000,00	11.811.368.137,29	14.254.144.000,00	2.280.546.777,07
2010	18.724.879.000,00	10.108.066.959,84	13.726.716.000,00	2.196.167.989,16
2009	13.641.643.000,00	7.364.201.031,30	11.567.367.000,00	1.850.698.128,05
2008	14.614.976.000,00	7.889.677.557,32	9.990.437.000,00	1.598.399.081,84
2007	12.434.079.000,00	6.712.623.794,10	9.059.823.000,00	1.449.513.234,24

Source: Prepared by the authors

Although the textile sector has a higher cost of degradation than the metalworking sector, the GDP of the textile sector is more distant from its industrial GDP than that of the metalworking sector. This implies that the loss of sustainability of the textile sector is greater than that of the metal-mechanic sector (TABLE 3).

Graph 3: Comparison between the Industrial GDP and the Green GDP of the metal-mechanic sector.	Graph 4: Comparison between the Industrial GDP and the Green GDP of the textile sector.

Source: Prepared by the authors

As a result, in the state of Santa Catarina, the textile sector has a lower sustainability potential than the metalworking sector. However, since the Green GDP of both sectors are lower than Industrial GDP, both presented a loss of sustainability.

Keywords: Environmental degradation, Regional development, Land use planning, Socioecological System Resilience, Corporate sustainability, Economic viability

SUSCEPTIBILITY TO LANDSLIDES IN THE MICRO BASIN OF MÁXIMO RIVER, LUIS ALVES MUNICIPALITY, ITAJAÍ VALLEY, SANTA CATARINA, BRAZIL.

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Abstract

The landslides are processes of earth's natural dynamics and work on sculpturing and evolution the relief, through the detachment and transport of soil and/or rock material downward hillslope, by gravity action. However, the attention to these processes takes place due to the increase of disasters as a result of fast and unplanned urbanization, population growth and climate change, with great social, ecological and economic losses. In this scenario, the susceptibility mapping appears as an important tool for urban planning that can help to identify the more susceptible areas to occur these processes in an urgent necessity to avoid these losses. The present study analyzed and mapped the landslide susceptibility in the micro basin of Máximo river, located at the southwest of Luis Alves municipality, in the low Itajaí Valley, northeastern Santa Catarina State, Brazil, with coordinates 26°43'23.22" and 26°47'17.83" S and 48°53'16.02" and 48°57'27.96" W. The micro basin of Máximo river is tributary on the right bank of the Luis Alves river basin, which flows into the Itajaí-Açu River, the most important basin of the Atlantic coast of Santa Catarina State, as the figure 1 shows below.

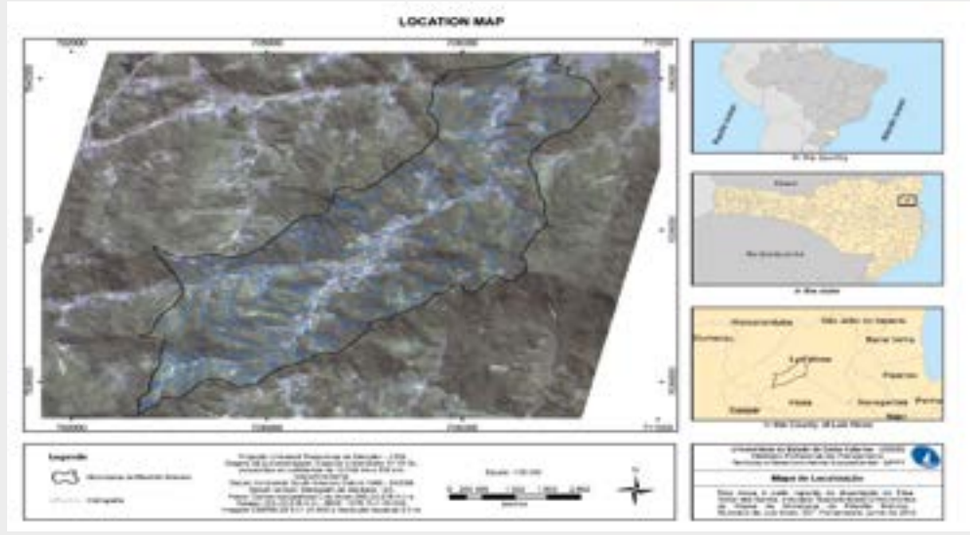

Figure 1: Location map

This study intended to meet a demand from the municipality of Luis Alves, in face of the damages and losses caused by the social ecological catastrophe that occurred in 2008, when heavy rains resulted in floods and landslides in many municipalities of Santa Catarina, leaving thousands homeless and displaced, as well as dead and injured. Data from the Civil Defense of Santa Catarina State (2008) indicate 77 municipalities affected, 135 fatal human victims, 2 missing persons, 2,637 homeless and 9,390 displaced. Most of the landslides occurred on 22 and 23 November of 2008, during which intense and concentrated precipitation occurred, totaling more than 400 mm, according to meteorological data. This maximum rainfall peak was preceded by a period of about three months of continuous precipitation that caused soil saturation and culminated in floods and numerous landslides, mainly in the municipalities of lower Itajaí valley. The World Meteorological Organization (WMO) pointed the rainfall of the last months of 2008 in Santa Catarina as the worst in a century in the region, highlighting the climatic event in the country as one of the most serious of that year in the world. This disaster has joined forces of the scientific community in the search for understanding these phenomena that have caused so much damage and losses around the world. In the context of this disaster, Luis Alves

municipality was one of the most affected, having decreed a state of public calamity. Only in the micro basin of Maximo river were mapped 18 landslide scars resulting from this period of intense precipitation. The work method was based on the systemic analysis, adopting the watershed as the unit of analysis. The analysis of these landslide scars together with the environmental specificities: as geology, geomorphology, pedology, and land use, allowed to raise the main conditioning factors involved in the occurrence of landslides in the area. These factors are slope, structural lineaments, geomorphological features and land use. These themes were mapped and the landslide susceptibility map was produced by the integration in SIG environment of these thematic maps, by the attribution of weights to each map and the classes of each map, as the frames below.

Frame 1: Weights attributed to the maps.

Map	Weight
Slope	5
Structural lineaments	4
Geomorphologic features	3
Land use	2

Frame 2: Weights attributed to the slope classes.

Slope classes	Weight
0-6º	1
6°-12º	2
12°-20º	3
20°-30º	4
30°- 45º	5
45°- 90º	5

Frame 3: Weights attributed to the structural lineaments classes.

Structural lineaments classes	Weight
1 structural lineament	4
Crossing of 2 or more structural lineaments	5

Frame 4: Weights attributed to the geomorphologic features classes.

Geomorphologic features classes	Weight
River plain	1
Erosional deep valley	2
Dissection in hills	2
Colluvium ramp	3
Dissection in mount	3
Dissection in mountain	4
Drainage headboards in amphitheater	4
Top depressions	5

Frame 5: Weights attributed to the land use classes.

Land use classes	Weight
Forest	1
Annual crops: vegetables and rice	2
Semi-perennial crops: sugar cane	3
Semi-perennial crops: forestry – pine and eucalyptus	3
Pasture	3
Semi-perennial crops: banana and palm	4
Built area	4
Mining	5

The landslide susceptibility was obtained by crossing these themes use using the Raster Calculator tool of ArcGIS 10 software, through the following calculation:

Susceptibility = (weight of slope classes*5) + (weight of structural lineaments classes*4) + (weight of geomorphological features classes *3) + (weight of land use classes*2)

The results obtained were distributed in the susceptibility classes from 1 to 5: 1 - very low, 2 - low, 3 - medium, 4 - high and 5 - very high, as the figure shows below.

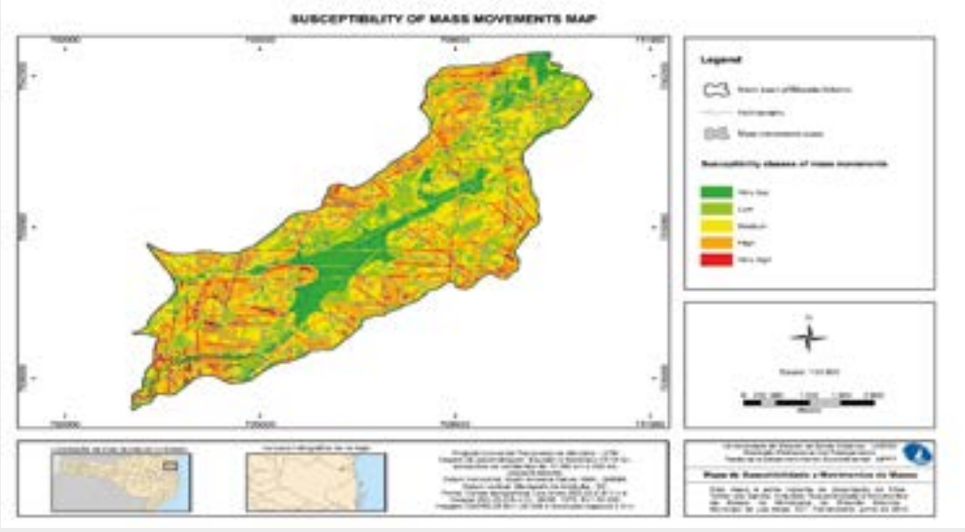

Figure 2: Landslide susceptibility map

The table below shows the area occupied by each landslide susceptibility class and quantity of landslide scars in each class.

Table 1: Landslide susceptibility classes and the quantity of scars in each of them

Susceptibility classes	Area (Km²)	Area (%)	Landslide scars
Very low	2.29	11.77	-
Low	4.53	23.34	1
Medium	5.25	27.05	2
High	6.39	32.94	5
Very high	0.96	4.90	10
Total	19.44	100.00	18

The very low landslide susceptibility areas occupy 2.29 km², representing 11.77% of the micro basin. These areas are located mainly in null or low slopes, between 0º and 6º, without structural lineaments, in flood plains, with annual crops: rice and vegetables. Its characteristics do not predispose the occurrence of landslides. The low landslide susceptibility areas occupy 4.53 km², representing 23.34% of the micro basin. These areas are mainly concentrated in slopes of 6º to 12º, with up to a structural line, in colluvial ramps, occupied by forests in the different stages of regeneration. The medium landslide susceptibility areas occupy 5.25 km², which corresponds to 27.05% of the area of the micro basin. These areas are located mainly in slopes of 12º to 20º, with up to a structural line, in areas of dissection in mount and mountain, occupied by forests in the different stages of regeneration and forestry – pine and eucalyptus. The high landslide susceptibility areas are predominant in the study area. They occupy 6.39 km², which corresponds to 32.94% of the area of micro basin. These areas are mainly concentrated in slopes of 20º to 30º, with up to a structural line, in areas of dissection in mountain, occupied by forest areas in the different stages of regeneration, forestry of pine and eucalyptus, and semi-perennial crops: banana and palm. The very high landslide susceptibility areas occupy 0.96 km², which corresponds to 4.90% of the area of the micro basin. These areas are located mainly in slopes of 30º to 90º, with crossings of structural lineaments, in mountain dissection, amphitheaters and top depressions, occupied by forest areas in the different stages of regeneration, forestry: pine and eucalyptus and semi-perennial crops: banana and palm. These results show the predominance of scars on the very high susceptibility areas, indicating that these areas are the most susceptible to new landslide occurrences.

Keywords: landslides, susceptibility, Luis Alves municipality, Itajaí Valley, Brazil.

HOW DO SOCIO-ECONOMIC FACTORS AFFECT POST-DISASTER RECONSTRUCTION SUSTAINABILITY? A CASE STUDY FROM THE ROAD SECTOR

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Abstract

In major disaster, road infrastructure sector frequently suffers the greatest losses and damages. Damaged road infrastructure significantly affects the recovery of the affected areas, as disrupted access may cause project delays and increased material prices. Many studies have shown that improvement in road transport infrastructure may provide positive impacts to the community due to improved speed, flexibility and accessibility, which support economic and social growth as well as increased international competitiveness. As a result, reconstruction of road infrastructure is among the top priorities following a disaster.

The implementation of the 'build back better' principle in a post-disaster reconstruction could result in improved road surfaces and extended road network coverage. However, in the long run, such improvement will be followed by a significant surge in maintenance needs.

Based on case studies in Aceh province, Indonesia, the socio-economic factors affecting the road maintenance performance is discussed. The findings suggest that the pressure to distribute projects locations regardless of priorities have resulted in reduced effectiveness of the budget expenses. Community's lack of sense of ownership towards the reconstructed road infrastructure, is argued to have been contributing to the rapid deterioration of the road assets. The immediate income provided by the industries, have also been obstructing the achievement of long-term objectives of road infrastructure investment. Lastly, the corruption problems, as experienced in the traffic loading control and execution of road maintenance works have also accelerate the road deterioration rate.

Keywords: road infrastructure, sustainability, post-disaster reconstruction, local government, capacity building

PALEOVEGETATION CHANGES DURING THE LAST 10,000 YEARS ON RIO DOCE VALLEY - PARQUE ESTADUAL DO RIO DOCE (PERD-MG)

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Abstract

In order to reconstruct the vegetation history of the last 10,000 years, palynological analyses were carried out using 17 sedimentary samples of a core drilled in the Parque Estadual do rio Doce (PERD-MG). In addition, the analyses focused on the reconstruction of depositional environments using the distribution of palynomorphs (e.g. pollen grains, spores, algae). Twenty-one species of fern spores, 52 species of pollen grains and 06 species of fungus were identified. Also, one genus of freshwater algae *Spirogyra* and one the Incertae sedis (*Pseudoschizaea rubina*) were recorded. The samples are clearly dominated by the pollen of angiosperms. The stratigraphic distribution of palynomorphs allowed the subdivision of section into 4 phases. Phase 1 (10,375 - 9,350 cal. years BP) is characterized by low concentration and diversity of pollen grains and organic matter measured by Total Organic Carbon (TOC), therefore interpreted by as fluvial system with presence of coarse-grained sediments. The second Phase (9,062 - 8,195 cal. Years BP) is interpreted as a transition from the fluvial to lacustrine environment, based on the increase in diversity index and presence of the taxa typical of water-logged forest, e.g. *Mauritia flexuosa*, *Ludwigia* sp., *Heteropterys* sp., *Tetrapterys* sp., *Microlicia* sp., *Psychotria* sp., *Polygonum* sp., *Sapindus* sp., *Gleichenia* sp., *Lycopodiella alopecuroides*. Phase 3 (7,905 - 4,785 cal years BP)is characterized the increase in trend of palynomorph concentration, highlighting the high abundance and diversity of ferns spores, such as *Anemia* sp., *Cheilanthes* sp., *Lophosoria* sp., *Dicksonia* sp., *Lycopodiella alopecuroides*, *Lycopodiella caroliniana*, *Lycopodiella cernua* and *Pityrogramma* sp. The presence of these taxa indicates a more humid condition. Morover, in

this phase the deposition is characterized by fine-grained sediments (mud), and high TOC values indicating a permanently closed environment with lacustrine water. In the uppermost phase, Phase 4 (4,785 - 50 cal. Years AP) recorded the lower abundance of herbaceous flora that is replaced by other vegetation groups (e.g. marsh, *cerrado*, Atlantic Forest). The uppermost sample represents the current environment (~50 years), which is characterized by seasonally-flooded condition.

Key words: Paleovegetation, pollen analysis, Holocene, South America, Parque Estadual do Rio Doce (PERD).

ANALYSIS OF THE GOVERNANCE OF DISASTER RISK MANAGEMENT: THE CASE OF ITAJAÍ RIVER BASIN

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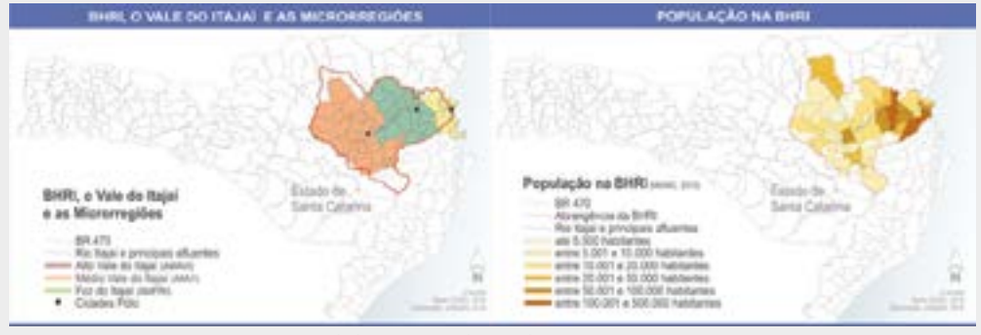
Keywords: disaster risks, disasters risks management, networks of governance.

The losses and damages increase created by natural disasters are reflected at disaster risk coping strategies formulation in different territorial levels in the last decades. The institution of 90's as the Reduction Risk International Decade by the United Nations, and the discussions promoted by the Intergovernmental Panel on Climate Change (IPCC), culminated in the frameworks of Hyogo (2005) and Sendai (2015). In Brazil, the recurrent natural disasters records and the international pressure, lead to the institution of the National Policy on Protection and Civil Defense (NPPCD). The Itajaí river basin, in Santa Catarina, South Region of Brazil, is located in the center-east portion of the state of Santa Catarina, with 1,369,425 inhabitants (IBGE, 2014) and is historically related to floods and mass gravitational movements records, highlighting 2008's disaster. The Itajaí River crosses the basin in an east-west direction; with three dams in its tributaries, and is composed of 50 municipalities (Image 1). The municipalities of the pole, more populous, also present great losses and occurrences.

Image 1 – Itajaí River Basin, the regions of Valley and de populational distribuction.



Own elaboration, based in CIASC, 2016.

The DRM is process and must be continuous in time and space. The management is not reflected in a project with a specific product, but rather on the continuation of the application of management principles and actions and on the sustainability of the processes. Sustainability means moving from a specific project to an continuos process.

The development of these DRM processes involve different stakeholders in a complex network of interrelationships. Understand the role that each stakeholder occupies in the public policy network, its hierarchical position, type of relationship, financial transfers, exchange relations, etc .; contributes to the analysis of DRM.

Objectives

The study's objective is to analyse the disaster risk management's governance, using the Itajaí river basin as case study. There are specific objectives:

- Identify and analyze the organizational-institutional structure of the Civil Defense organs of the municipalities that make up the Itajaí River Basin - SC;
- To identify and analyze the construction of public policies for the governance of Natural Disaster Management and Risk in the Itajaí-SC River Basin;
- Identify, spatialize and analyze the structure of the GRD governance network in the BHRI-SC (sociometric analysis), understanding the degree of implementation of the DRM key processes, the instances of legitimization of the DRM by the population and the continuity of the macroprocess of GRD. Spatialization and analysis.

Methodology

The research has a systemic approach and is structured in the steps surveying, systematization and analysis and synthesis. It's a fundamental research; quali-quantitative; explanatory; uses bibliographic and documental research, quiz survey and assistematic observation to collect data; content analyses and univariate descriptive statistics, generating tringulation in data collection and analysis. The data survey and analysis uses the risk disaster management construct proposed by Narváez, Lavell and Ortega (2009), in wich are considered: relation with sectoral policies; process continuity; legitimation and belonging mechanisms that generate the appropriation process; existing organizational-institutional structure, their representativeness and consolidation; networking agents and relationships at different territorial levels; and key processes development in a transversal and integral way.

Considering the systemic approach, the research use the hypothetical deductive method, in which the specific objectives establish direct relationship with the DRM construct (NARVÁEZ et al.; 2009) and a variables groups (Image 2).

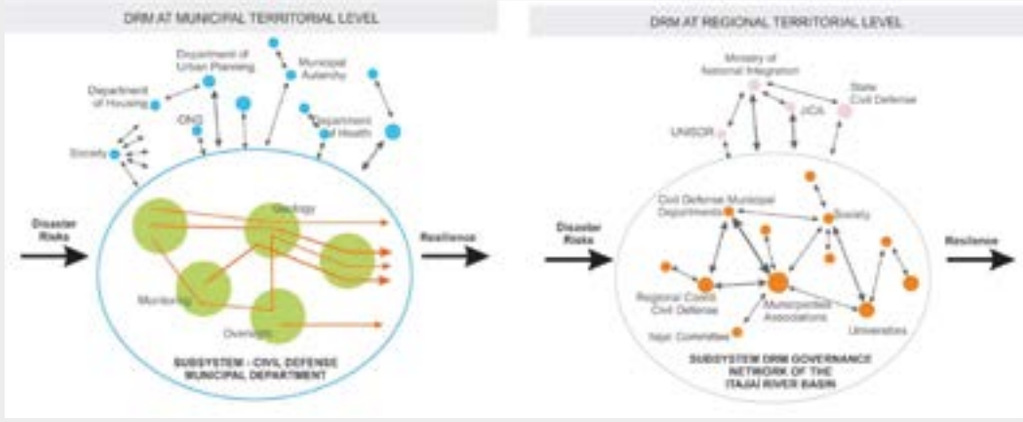
Image 2 - The specific objectives of the study, the relationship with the DRM construct and the groups of variables used.

Own elaboration, based in NARVÁEZ et al, (2009).

Expected results

As a result, it is expected to Generate the Indicator of Organizational Structuring - Institutional for GRD in the municipalities of Itajaí river basin; to understand the alignment of municipal policies and actions with NPPCD and the Disaster Risk prevention Plan for Itajaí river basin; and identify, spatialize and analyze the structure of the GRD governance network in the BHRI-SC (sociometric analysis), understanding the degree of implementation of the DRM key processes, the instances of legitimization of the DRM by the population and the continuity of the DRM macroprocess (Image 3).

Image 3 – Spacialization of DRM networks in Municipal and Regional levels.



Own elaboration, based in NAVÁEZ et al. (2009).

The study will develop an methodology for analysing the disaster risks management's governance in municipal and regional territorials levels, besides starting the municipal and regional database formation for disaster risk management in Itajaí river basin, which will allow in the future to investigate the governance network changes along the years.

NATURAL DISASTERS IN THE STATE OF RIO DE JANEIRO BASED ON CLIMATE DATA AND ORBITAL PRODUCTS: A STATISTICAL APPROACH

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1. INTRODUCTION

The natural catastrophe is an event, occurring in limited space and time, by which society or part of it suffers with its magnitude. From the economic point of view, a catastrophe implies, in a drastic reduction of investment, consumption, production and generation of employment. There are few studies on natural disasters (droughts, floods and desertification) in Brazil, which use an applicable methodology. Few studies were based on the areas of Physical and Statistical Climatology applied to the state of Rio de Janeiro (ERJ), focused on natural disasters (droughts, floods and desertification) based on climatic data and orbital products.

2. METHODOLOGY

The time series used were 47 years (1967 to 2013) and 71 years (1943 to 2013). Both series come from 100 existing stations (**Figure 1**) belonging to ANA, CPRM, INMET, SERLA and LIGHT. The temporal series (raw data) were faulty and were filled with TRMM satellite 3B43 product (1998 to 2013) and INMET climatological norm (1947 to 1997). The series were submitted to descriptive, exploratory, parametric (Shapiro-Wilks-SW and Barlett-B), non-parametric tests (Mann-Kendall-MK, Sen-Se, Pettitt and SOCUM), Box Cox transformation and Clusters Analysis (CA). In addition, monthly data from the Enhanced Vegetation Index (EVI2) between 2001-2012 with the objective of verifying the trend of increase and decrease of vegetation in the ERJ by non-parametric tests and future scenarios by the Markov Chain. It was used in the estimates of the Standardized Precipitation Index (SPI) at the 1 and 12 month scales.

Figure 1. Geographical location of the eight ERJ Government regions and distribution of 100 meteorological stations and together with elevation (m).

3. RESULTS AND DISCUSS

Descriptive analysis of the consistency of the raw data showed a probability of occurency above 75% (high temporal variability). Box Cox transformation was effective in stabilizing the normality of the residuals and homogeneity of variance of the monthly rainfall time series from the five regions of the SRJ. By CA technique was defined two homogeneous rainfall groups (G_1 and G_2). Groups G_1 and G_2 represent, respectively, 77.01% and 22.99% of the rainfall that occurs in the regions of SRJ (Figure 2). The groups were defined from the influence of weather systems of various scales and by climate variability modes, followed by the Atlantic Ocean proximity and complex topography (Oliveira Júnior et al., 2014). Data from TRMM satellite together with INMET are efficient on gap filling and construction of a consistent time series (Almeida et al., 2015; Brito et al., 2016). Statistical methods used in the study were effective in understanding the rainfall regime and on changes that affect water availability in the SRJ.

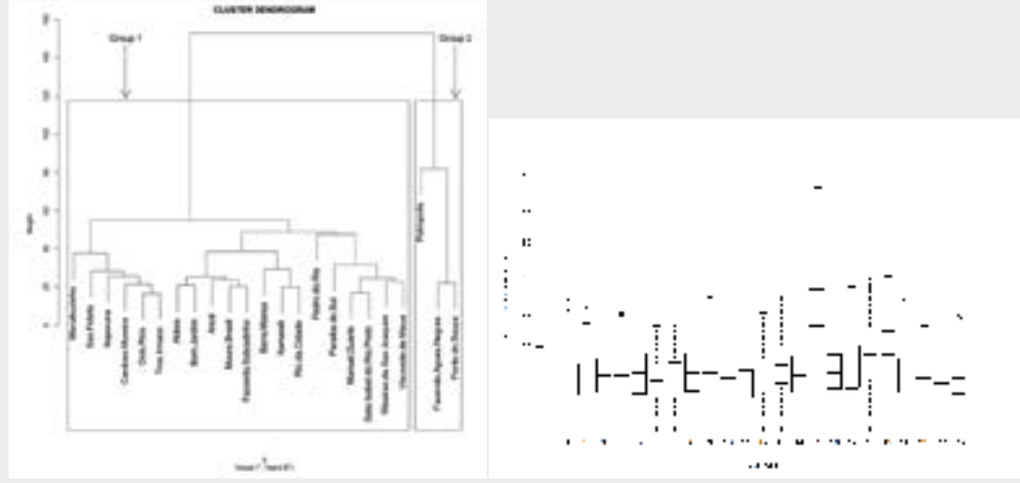

Figure 2. Dendogram of the cluster analysis of the monthly rainfall series of transformed data (**left side**) and Boxplot of the Rainfall Series Monthly of the data Transformed by the Box Cox (**right side**).

SW and B tests rejected the assumptions of normality and homogeneity of variance at all stations and, therefore, we verified the non-stability of the data variance. Box Cox transformation stabilized the variance of the time series at some stations belonging to the regions of Government, especially Médio Paraiba and Serrana, except the Noroeste Fluminense. The high variability of λ (0.326 to 0.565) is owing to most stations be on the slope of the Serra of Mar facing the continent, where the rainfall regime is influenced by the interaction of the topography with local and synoptic systems, only one station on the slope of the Serra of Mar facing the Atlantic Ocean with influence of the coastal environment and mesoscale and synoptic systems (Figure 3).

The SOCUM test identified 39 ENSO events with their respective categories in the time series. The highest percentages were in the Neutral events (48.72%), followed by the smaller percentages in the events of moderate El Niño and La Niña categorized as weak and strong (5.13%). The statistical tools used in the study can be applied in hydrometeorology studies and state public policies.

Overall, there is an insignificant trend in vegetation growth in 75%, followed by a significant trend of decreasing in 25% of the regions. Pettitt's test showed that there is not significant (NS) abrupt changes, both growth and decreasing

vegetation, and significant (S) abrupt changes of decreasing vegetation in the others Government regions. Spatial analysis from EVI2 in the regions Médio Paraíba amd Serrana showed the occurrence of NS abrupt change in the vegetation in November 2007 and 2003. Norte Fluminense and Metropolitana showed a NS vegetation increase in October 2003 and 2005. Noroeste Fluminense and Centro Sul Fluminense revealed an NS and S abrupt change of decreasing vegetation in April 2006. In Costa Verde and Baixadas Litorâneas NS and S abrupt changes in decreasing vegetation were observed in May 2004 (Gois et al., 2016).

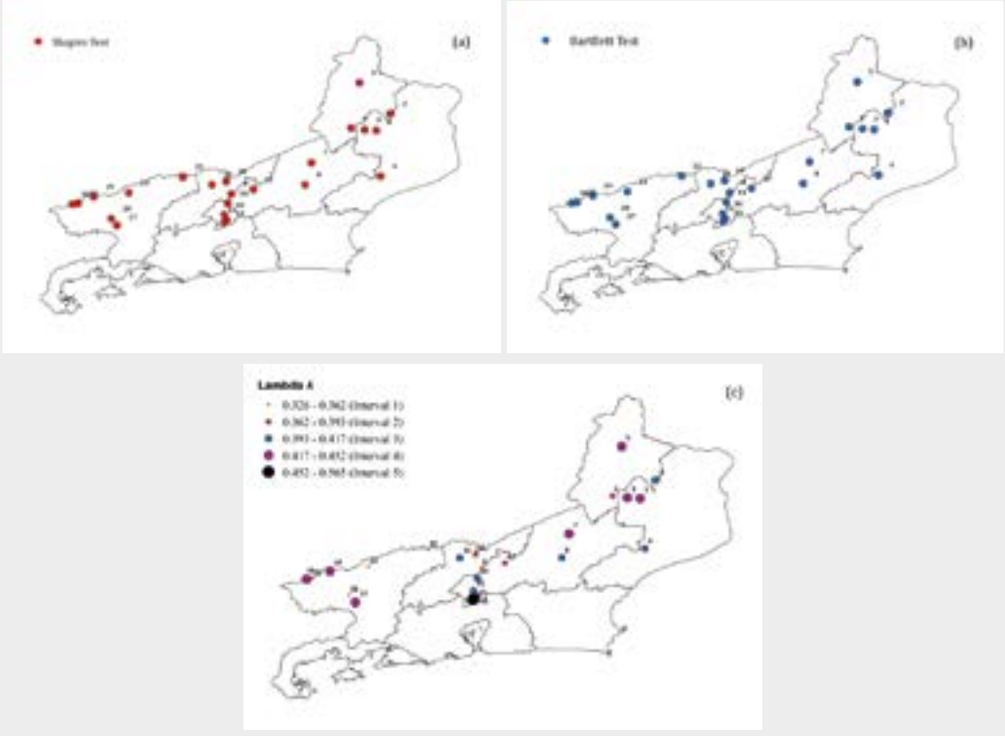

Figure 3. Shapiro (**a**), Bartlett (**b**) Test and lâmbda values (Box Cox transformation) (**c**) for the rainfall data of the state of Rio de Janeiro, with their respective ranges (1 to 5).

Moderate performance of SPI methods with untreated and Box Cox versus SPI-transformed data with reduced-box data transformed by Box Cox is evident in SPI-1, which shows the presence of significant variations of statistical parameters in the Norte, Costa Verde, Baixada Litorânea e Metropolitana shortage, followed by low performance of the r^2 coefficient in the ERJ regions. SPI-12 shows a significant high dispersion of the coefficient r, followed by a low to very low performance, and a low coefficient r^2. This indicates poor accuracy of SPI index estimates in both methods. The EPE and RMSE errors do not present significant variations, in the durations of 1 and 12 months. A high variation of the rec coefficients with the index d in the SPI-1 month is verified, a poor performance of the methods with data without treatment and with transformed by Box Cox versus SPI with data of the reduced variable transformed by Box Cox, for the SPI-12 Was verified in the ERJ regions.

The temporal/annual analyzes of SPI-1 and 12 in the regions show a high variability and greater intensity of SPI-1, unlike SPI-12. SPI-1 and SPI-12 in the regions show similarity in the behavior of SPI-1 and SPI-12, where the highest and lowest frequencies of droughts categorized as moderately, extremely and extremely dry were recorded in the 70, 80, 90, 2000 and in the period 2010/2013, except for the 60 (Oliveira Júnior et al., 2018). Events of ENOS were observed in the study period. The Pettitt test identified the years of changes in the SPI-12 index, in 1977 (El Niño weak), 1984 (La Niña weak), 1989 (Neutral), 1992 (Neutral) and 2002 (Moderate El Niño). The prevailing category was close to normal in the Norte Fluminense, Baixadas Litorâneas and Costa Verde regions, followed in the other regions of Government in some parts (SW), (SSW) (SE) and (NE) (Sobral et al., 2018). The moderately dry category occurred in the regions, Metropolitana, Centro Sul Fluminense, Médio Paraíba, Serrana and Noroeste Fluminense, and the other parts in the (SW), (NW) and (NNE) portions of the ERJ. In short, the application of statistical, parametric and non-parametric tests, chain of Markov, multivariate analysis are efficient tools in the evaluation of natural disasters in the ERJ.

4. CONCLUSIONS

By CA technique was defined two homogeneous rainfall groups (G_1 and G_2). Groups G_1 and G_2 represent, respectively, 77.01% and 22.99% of the rainfall that occurs in the regions of SRJ. The groups were defined from the influence of weather systems of various scales and by climate variability modes, followed by the Atlantic Ocean proximity and complex topography. Data from TRMM satellite together with INMET are efficient on gap filling and construction of a consistent time series. Statistical methods used in the study were effective in

understanding the rainfall regime and on changes that affect water availability in the SRJ. Future scenarios showed changes in vegetation trend in SRJ with indication of decreasing. Predictions of changes in future scenarios ranging from 1 to 2 years in constant intervals (3 to 10 years) were observed in all future scenarios analyzed in the SRJ.

In sum, the application of the parametric and non-parametric tests to the monthly rainfall series without treatment (gross) and to the reduced variable in the Government regions is efficient in detecting the hypotheses of normality and homogeneity of variance of the monthly rainfall series and Identifying the years of abrupt changes in the time series of the SPI-12 index in the State of Rio de Janeiro. In sum, the application of SPI in the 1 and 12-month scales in the eight regions of Rio de Janeiro State Government may point to possible water deficit trends in smaller scales (SPI-1) and its aggravation with the gradual increase of the scale, SPI being an essential tool in the specific identification of regions in emergency situations caused by the drought phenomenon.

The results of this work consider the methodology created and applied efficient in assessing natural disasters in any region of the world.

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OPPORTUNITIES FROM THE DISASTERS IN URBAN AREAS

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Cities, beyond awakening the interest of researchers in diverse areas of knowledge such as demographics; means of production; segregation and appropriation of space (especially in urban agglomerations); and occupation in risk areas (such as river margins and hillsides); also encompass more specific issues, such as their own vulnerability. Moser [1] and authors Marandola and Hogan [2] understand that the term vulnerability cannot analyzed without considering the concept of risk. In addition, social and environmental complexities and inequalities highlight a situation in which is generalized the risk, which may yield definitive consequences such as those described by Beck in his industrial city [3].

When a catastrophe occurs, many decisions must be taken: emergency ones, which are quicker; and those following the accident, often slower, as for instance, emerging social damage that takes longer to recover. Some catastrophes are notable for their duration as a media spectacle. Others acquire an enormous intensity at the onset as they receive special attention from the media; however, it diminishes rapidly, often lasting only up until the duration of the victims' funerals. Natural disasters are sometimes difficult to deal with because they may lack points of reference to identify their causes and the exact timeframe in which the crisis occurred. A rainfall, for example, over several cumulative days, imperceptible at first, but which over time accumulates and ends up causing a flood or surge. Which moment the cause of the adverse and undesirable impact happened? What was the cause of this? Thus, are addressed other variables beyond the traditionally known impacts of natural disasters, which are treated mainly with emergency actions.

To this end, are adjusted some concepts such as "hazard", by authors Mattedi; Butzke [4] for better understanding the phenomenon under analysis. Therefore, "hazard" is here understood as a phenomenology happening now of the accident, but also comprising the conditions that lead to the assessment of a risk, the accident itself, and an eventual reconstruction.

Starting from the premise that are intimately interlocked the past, present and future within the city. This interlocking becomes more evident in moments of crisis, above all those arising from natural disasters, an analytical-methodological instrument here termed is used the "expanded moment of disaster" in order to understand the many scenarios leading to action in the face of these same phenomena. This moment is here understood as the one that comprises the conditions which lead to the ascertainment of a risk, analyzed within a triple timeframe: the past; the "core" instant in which the accident occurs, in other words, the present; and the future, here understood as the moment in which the danger is over and the eventual reconstruction starts.

Thus, when adverse events happen, such as a natural disaster, or an action that alters a more predictable process from the past—a phenomenology that alters the present situation—there is a so-called "urban inflexion". The term "inflexion", which according to Ultramari and Duarte [5] was defined as a clear moment on the timeline, that of construction and appropriation of the cities, here is understood as an expanded moment, reaching beyond the phenomenology most clearly and concretely observed, in the case of disasters. This moment is therefore expanded to include events prior to and after the disaster, always highlighting the diversity of the agents involved in the formatting of its variables.

Some cities succumb to these changes while others adapt to seek a positive outcome from the transformations. According to Lerner [6], in urban design sometimes it is necessary to act upon an area so it can help in the healing, in making things better, creating a positive chain reaction, a true urban acupuncture. Are analyzed these alterations with the objective of working the temporal dimension simultaneously as a process of construction as well as historical reinforcement and explanatory element of the phenomenon. It is in these moments that the relationship between past, present and future becomes more compacted. This discussion analyzes whether the past, which forms the receptive base of an accident explains the present, or, in the case of the temporal dimension being concurrent, if it is possible or even valid to deal with emergencies with this temporal differentiation.

This analysis addresses how and by whom are appropriated the phenomena, in other words, whom are the agents participating in the action towards the phenomenon. There is the understanding that while humans may trigger the

accident, they will also seek solutions to benefit from the potential outcome of the accident.

There is recognition on the part of researchers and empirical verification that in post-disaster situations are articulated social networks towards supporting the population most directly affected. Are explored the media acts as an important vehicle for transmission of values, promotion of action in the organization, as well as in the reinforcement and dismantling of the network, as it mobilizes the feeling of solidarity.

The same disaster typology may yield different impacts; according to Mattedi [7] social conditions of vulnerability determine the level of impact. Cutter [8], when linking vulnerability to harmful events and disasters, points out that vulnerability has a spatial dimension, is defined varies over time and as both material and psychological potential losses. This author believes that are linked potential losses in response to dangerous situations and disasters to how society adapts to change which itself affects the people's level of psychological resilience.

The same typology of disaster can have different impacts depending on the level of vulnerability of the area in which it occurred. It can be as examples the earthquakes in Haiti, on January 12, 2010, and in Chile, on February 27 of the same year of a same typology phenomenon, however with very distinct impacts. The earthquake in Chile reached 8.8 degrees on the Richter scale[1]; On the other hand, the one in Haiti was 7 degrees on the same scale, however they were both in urban areas of similar demographic volumes. The impact of the disaster in Haiti resulted in 220,000 deaths; the one in Chile resulted in 795. Explain these two distinct and antagonistic situations in large part by the different levels of vulnerability of the settings in which they occurred and by the performance of the existing governmental institutions, in other words, by the level of organization of the State in responding with appropriate timeliness and capacity.

> The Chileans were also without water and electricity, but re-established the supply was beginning by the end of last week. In Haiti, the majority of the population never had access to these basic services. Chile is a country used to tremors. In 2008, the firefighters of Concepción took a course with rescuers from Houston, Texas, United States, specialized in natural disasters. They have adequate equipment for this type of occurrence. Because of this, retrieved many of the injured from the ruins still alive. In Haiti, people collected the debris by hand. [...] Because it is a seismic country, Chile has rigorous civil construction norms to avoid damage by tremors. In Port-au-Prince, where the government never worried about this, almost everything came down [9].

Such examples, if coincidental in terms of event, are opposites in terms of the local conditions to face a crisis. Both are amenable to mitigation; however, they differ not only on the level of humanitarian reaction, but also equally on the critical level of existent conditions prior to the adverse event. Addressed important elements in the discussion of urban management, such as the organization of society, solidarity, the application of inclusive initiatives, and considered the priorities established within what adequate public policy, besides the diverse interests on equally diverse outcomes from such situations.

Another aspect, especially in cities with low urban consolidation or reduced socioeconomic levels, is the fragility of the State in the capacity to internalize resources during the occurrence of natural disasters, that is, there are many resources available for post-disaster actions, when the correct focus should have been in its prevention.

Beyond the State, responsible for local actions, in parallel and perhaps in the same proportion to the gravity of the adverse phenomenon, international aid is multiplied mainly through financial assets, without, however, any exact determination on how these resources will be utilized, under which conditions as well as timeframe. In this manner, according to the present discussion, that the occurrence of an accident could reveal many situations:

1. A myriad of interconnected interests, competing or associated only by momentary consortia of proposals;
2. an excessive valuing of facts by the media which may not represent the exact level of destruction caused by an adverse phenomenon, but which may awaken solidarity and the concept of rights;

[1] The Richter scale, created in 1935 by the American seismologist Charles Richter, classifies earthquakes by points, according to their levels of magnitude and damage intensity. Between 0 -2,9: the earthquake is not felt, only registered by seismographers; between 3,0-3,9: shaking is perceived but it causes no damages; between 4,0-4,9: it shakes walls and shatters windows; between 4,9-5,0: it cracks walls and moves large pieces of furniture; between 6,0-6,9: it topples flimsy buildings; above 7,0: it topples buildings and bridges. Source: Professor Paul Mann - University of Texas 2009.

3. An ephemeral nature to the stances of solidarity observed in some moments.

The historians Carretero, Rosa and Gonzalez [10] state that, when explaining changes over time, they employ techniques that allow them to explain present events and prepare for the future based on the past. Bizzo [11], following the same reasoning as the historians mentioned above, states that the past significantly aids the comprehension of the present. In addition, assumes the existence of a link of continuity between past and present.

The form in which described natural disasters throughout history also allows the re-evaluation of the multiple dimensions of the process of construction of the risk, such as environmental degradation and the increase of poverty, and demonstrates that the worsening of the problems of the disaster is intimately related to the processes of socioeconomic development. According to Mairal [12], the opportunity of narrating catastrophes offers a window into how perceived the current day in terms of the environment.

The difficulties in acting upon the disaster could be:

1. in the form of characterization and interpretation of the phenomenon when considering the environment as a subject of risk and study;
2. The scarcity of studies on how to deal with disasters and their potentialities;
3. In the prioritization of the political, economic, and social agendas of each community, which highlights the institutions and their performance
4. in the difficulty of capturing potentialities brought on by catastrophes when debating public policies;
5. In considering the political culture of solidarity and concept of rights in the affected regions.

The present article has the intent to contribute to a possible optimization in the actions of prevention, rescue and reconstruction of cities, which have suffered situations of natural disasters.

Selected three cities, which have suffered an environmental disaster, as Case Studies. Port-au-Prince, Haiti (due to the number of victims, volume of resulting analysis material, and international publicizing); Curitiba, Brazil (due to the greater availability of data for research and specific characteristics in terms of potentialities); and Concepción, Chile (the same characteristics found in Port-au-Prince, however with significantly smaller impact). The two international cities are similar in terms of the typology of the disaster, but they differ in the way in which local conditions confront the adversity. Curitiba – in the area occupied by Vila Audi, subject to recurring inundations - presents the issue of local government actions, which are very timely, influencing the temporal dimension of the accident. The choice of these cities is also justified by the different events, understood as different “core” moments: an earthquake has a shorter “core”, but at the same time, it is more visible in the media; an inundation has a longer period of duration, a wider spatial distribution, has a more expanded “core” and, therefore, presents different expanded moments.

Interviewed people knowledgeable about the history of the city. Who lived through or participated in some form in the discussion of the city when the catastrophe occurred.

Sought social, political and economic variables in the expanded moment of disaster as evidence through testimony of those interviewed from the three cities, as they influenced to greater or lesser degree the participation of the agents.

The questions sought to unveil possible potentialities in the past, present and post-accident timeframe in order to obtain greater richness of details while analyzing natural disasters as they occurred.

The structure of the analysis of the cities considered the following variables: social; geographical/environmental; public policy and political culture; solidarity policy; and the conception of rights in the expanded moment of the disaster. Analyzed these variables according to three moments.

CLIMAX PROJECT - CLIMATE SERVICE THROUGH KNOWLEDGE CO-PRODUCTION: THE BRAZILIAN CASE OF ENERGY SECTOR

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Keywords: Knowledge Co-production; Climate Services; Extreme Climate Events; Trans-disciplinary; Social Studies of Science

Introduction and Objectives

Climax is an inter- and trans-disciplinary framework based on a European-South American research cooperation is proposed to underpin climate services in South America. Climate variability patterns linking the South American Monsoon region, including Amazonia, with southeaster South America (SA), influence climate extremes and impact several societal sectors. More than 200 million people live in the region that is one of the world largest agricultural producing region and where the second largest hydroelectric power plant on earth is situated.

Besides recent progress, further efforts are needed to better understand and predict regional climate variability. The project will be implemented to achieve five general objectives.

The first project objective is "to better understand the combined role of remote and local drivers on SA climate variability from sub-seasonal to decadal timescales, and its impact on the occurrence and intensity of extreme events" (e.g. floods in Argentina, droughts in southeastern Brazil) using historical data and model simulations. A special focus will be made on the effects of land cover changes in tropical South America from the Amazon to southern SA and their impact on climate extremes.

The second project objective is "to assess the predictability levels associated with the climate features identified in the first objective from sub-seasonal to decadal timescales". Being a very large continent, there are evidences that some of SA´s regions exhibit large (e.g. northeastern Brazil) or moderate (e.g. southeastern SA) levels of climate predictability on seasonal times scales, while climate variability is hardly predictable.

The third project objective is "to develop innovative regional prediction tools not only of climate variability but also of climate impact on agriculture and hydrology in SA on subseasonal and seasonal time scales".

Methods

The project is developing an interdisciplinary and trans-disciplinary approach by using a multidimensional climate approach to address the fourth project objective, which proposes "to map and analyse:

a) The process and its feedbacks, from generation of climate information until the stakeholders use it to make decisions;

b) Goals, expectations, values and practices of all agents involved, to understand how the salience, relevance, and legitimacy of the information is constructed along the generation-distribution process of climate information". Climate services, the products and implementation of climate research, has hitherto been created too often in the 'uni-directional' way of supply-driven instead of demand-driven, defined in a co-production process with stakeholders and science from the start of the production process. CLIMAX aims to break with this practice to identify variables and factors affecting the usefulness of the climate information, including understanding when, where and how scientists and stakeholders meet, collaborate and communicate, and which factors increase (and decrease) the productivity of this interaction. The latter implies that researchers will engage with the stakeholders in the research process.

The project is implemented in the context of the southern South America Regional Climate Centre, and include actors from the national meteorological services, agriculture and energy stakeholders/ organizations. Three fundamental concepts form the project's fundamental basis:

i) strong disciplinary teams on both climate and social sciences are integrated in an inter-disciplinary framework;

ii) trans-disciplinary work is the backbone of the project organization streamlining the fulfilment of the project objectives under a co-design and co-production framework;

iii) the combined inter-disciplinary and trans-sectoral arrangement allows the transformation of knowledge throughout the process.

The CLIMAX project tries to co-design specific climate service products with stakeholders, scientific-academic and experts. A "case study" approach is central, and they will frame the knowledge coproduction process. Thus, the knowledge co-production in CLIMAX is based on two case studies of highly important socio-economic sectors, the hydropower sector in Brazil and the agriculture sector in Argentina.

After a first prototype is created productive sector actors will test it in practice, and based on their results, periodic working sessions are held among all actors involved to share experiences and challenges. This way, not only the experimental phase, technological development phase and climate products modeling phase will dialogue, but a common language will be consolidated as well as a working practice with institutional roots in the sectors will be involved. The project is implemented in the context of the southern South America Regional Climate Centre, and includes actors from the national meteorological services, agriculture and energy stakeholders/ organizations.

The case study in Brazil

In Brazil, the case study is about the use of climate information in the electric sector decision-making. The energy sector significantly depends on weather and climate variability, which impacts both demand and supply, at all timescales. Despite the energy sector being one of the most advanced users of weather and climate information, its rapid evolution constantly creates new needs, which require a new paradigm for a more effective exchange of information between meteorologists and energy sector users. Scientific progress on its own is indeed not sufficient to increase the value of weather forecasts. Indeed, improving decision-making processes, and hence the value of meteorology, also demands improved communication and mutual understanding between energy and meteorology people.

Climatological knowledge is considered by professionals of the atmospheric sciences and by scholars of the energy sector in Brazil an important resource for the optimization of the generation, transmission and distribution of electric energy. Experts consider that weather forecasting allows reducing risks in hydropower operation reducing maintenance costs of transmission lines and distribution networks and adding security in new projects. It is stated that more reliable meteorological forecasts are crucial in the daily operations of the electric system and in the planning of the emergency actions of this sector. In addition, studies have discussed the impacts of climate change on the Brazilian energy sector, alerting to the possible fall in productivity in the hydroelectric sector and other sources of energy due to the reduction of rainfall volume and long-term temperature change, recommending adaptation strategies. Thus, through the production of weather forecasts and climate studies, scientists have sought to inform decision makers in the planning of their actions, assuming that techno-scientific knowledge and tools can bring greater rationality to the discussions and decisions and help in the organization and planning of the energy sector.

Nevertheless, many of the influential studies on the use of knowledge-based information in policy and decision-making have focused on the dichotomy between science produced for policy (''applied'' or ''decision-driven'') and science grounded in research alone (''basic'' or ''knowledge-driven''). The sociology of science has criticized the so-called "mode 1" of science production whose problems are settled and solved in contexts under the domain of the academic interests of a given scientific community. Therefore, scholars have become increasingly interested in approaches in which the division between science and policy is blurred and ''usable'' knowledge is co-produced in the context of everyday interaction between scientists, policy-makers, and the public.

Preliminary results

One of the activities of the Brazilian team of CLIMAX was related 10 interviews with people from the energy sector. These interviews were conducted with different actors of the energy system in Brazil, among them: professionals from the Operator of the National Electricity System (ONS), Electric Energy Trading Chamber (CCEE), Consulting Companies and Traders of the free Energy Market, professionals from the Eletrobrás Electric Energy Research Center (CEPEL) and professionals of energy-generating companies like Hydroelectric Company of São Francisco (CHESF) and Energy Company of Minas Gerais (CEMIG).

With these interviews it was possible to perceive that there have always been important links between energy and meteorology in Brazil but these interactions

need to be stepped up to a new level of inter-connectedness to facilitate an efficient transformation of the energy sector and underpin the associated capital investment. Climate variability across the full range of temporal and spatial scales is also a critical consideration for governments in setting advantageous policy parameters to ensure an optimum future energy system.

Further, we can perceive with these interviews the information gaps relating to the type, level of accuracy and frequency of delivery of specific weather and climate information, and what extra information is required by the energy sector in the coming years. The agents of the electric sector in general consider the meteorological information for Brazil far below their expectations. They do not consider the seasonal climatic forecasts produced for Brazil reliable for their decision making. They demand a process of "tropicalization" of models, tools and climatic information.

COASTAL LANDSLIDE HAZARDS AND RISK MANAGEMENT: A SYSTEMATIC ASSESSMENT

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Abstract

The impact of coastal landslide hazards on infrastructure depends on geography, population, coastal infrastructure and diverse environmental conditions. Geological, environmental and, socio-economic conditions significantly affect coastal landslide vulnerability; therefore efficient management and control of landslides is necessary where coastal landslides are in an active state. Reliable evidence and data on the prediction of coastal landslides remain scarce even in developed nations. This information gap is an obstacle to the identification and prediction of coastal landslides in various geographical areas. In order to overcome these difficulties, as well as for a better management of landslides in the United Kingdom (UK) particularly in the coastal regions, a robust framework is necessary to aid identification and prediction of landslides. The present study systematically analysed UK landslides management procedures through a 2 Path Analysis. Results reveal that 966 landslides have been recorded in the UK for the above mentioned period, and of those, 748 of landslides were recorded at coastal regions. Most experts considered that coastal landslide prediction is difficult, particularly in the UK because of the nature of UK landscapes; however experts considered that prediction is possible to some extent. 57% of the experts adjudged the England coastline to be vulnerable to coastal landslides, but only 29% of experts judged that the Welsh coast is more vulnerable than the English coastline. Analysis of landslides events in-between 2010-2016 should be used as a tool for planners and policy makers for developing management strategies to improve coastal resilience. Experts' views help to fill the existing knowledge gaps for coastal landslides; this reduces the level of uncertainty for future identification and prediction of landslides, not just for the UK but also at a global level.

Keywords: Coastal landslides; GIS Maps; Expert judgements; United Kingdom; Disaster management

Abbreviations

Abbreviation	Full form
BGS	British Geological Survey
EM-DAT	The Emergency Events Database
Defra	Department for Environment Food & Rural Affairs
GIS	Geographical Information Systems
IUCN-UNEP-WCMC	International Union for the Conservation of Nature- United Nations Environment Program- World Conservation Monitoring Centre
ONS	Office of National Statistics
UNISDR	United Nations International Strategy for Disaster Reduction
UK	United Kingdom
USGS	United States Geological Survey
2PA	2 Path Analysis or Two Path Analysis

1. Introduction

Natural disasters such as landslides, floods, cyclones and storms are dangerous, destructive phenomena and these events effect communities, economies and coastal environments (Cavallo and Noy 2009; Gasper et al. 2011; Blaikie et al. 2014; Obraczka et al. 2017; Kantamaneni et al. 2018; Sahoo and Bhaskaran 2018). However, the intensity of destruction, loss of life and damage costs varies according to the geographical area. There is currently very limited protection for coastal environments available against the growing threat of natural hazards and disaster risks (McInnes 2006). There is currently inadequate understanding of landslide distribution and vulnerability in the UK, because an understanding of landslide distribution and vulnerability is inadequate and incompatible in the UK. Proper planning and management can improve the socio-economic losses and reduce the number of fatalities as a consequence of landslides. The present study aimed to systematically analyse the landslides and hazard management procedures via 2 Path Analysis. Landslide events have been investigated and generated GIS maps in Path One (P1); expert survey was (experts judgement) undertaken from global coastal landslide experts in Path Two (P2).

2. Methodology and materials

Kantamaneni et al's (2017) methodological approach, i.e., Two Path Analysis (2PA) has been adopted for the current study.

This method consists two vital paths as follows:

2.1 Path One (P1): This step deals with the analysis of the UK landslides for the period of 2000-2016 as well as the development of landslide GIS maps. British Geological Survey (BGS) data has been used for the identification of recorded landslide events across the country for the above mentioned time period. The 22nd version of ArcGIS software was used to generate a GIS landslides map.

2.2 Path Two (P2): This step gathers and analyses the expert judgements on the prediction of coastal landslides.

3. Results and discussion

3.1 Pat One
Landslide trends

Landslide events were recorded across the United Kingdom for the period of 2000-2016. The majority (68.4%) of landslides (661) were recorded in England followed by Scotland (20.6%); the lowest number of landslide events were reported in Wales (11%) and none in Northern Ireland.

3.2 Coastal landslides and trend analysis

For the current study, a 25 km radius from the coastline was used for the estimation of coastal landslide events in the UK for the period of 2000-2016. Previous studies have shown that, (from the long historical perspective) people have preferred to live within 100 kilometres from the coastline (Small & Nicholls 2003; McGranahan et al. 2007). Consequently, we defined 25 km inwards from the coastline as the study area. Based on the analysis, 748 coastal landslides

were recorded in the UK for the above mentioned period; 501 coastal landslides were recorded in England and 158 in Scotland and 89 in Wales . However, high coastal vulnerability exists in certain coastal areas of Wales such as Aberystwyth, Port Talbot and Llanelli, though coastal landslides number was very low when compared with England and Scotland regions.

4.2 Path Two (P2)

Expert opinions were analysed based on the following four questions:

Question 1: Can we predict landslides, particularly coastal landslides?

Question 2: If so, how far ahead can we predict the landslides?

Question 3: Can we control landslides, particularly in coastal regions?

Question 4: Where are the coastal landslide hotspots in the UK

4. Conclusion

Assessment of coastal landslide identification and prediction needs multi-aspect approaches that integrate physical, environmental, urban and socio-economic factors. Accordingly, the current study systematically analysed UK coastal landslides and also carried out a survey of experts' judgements by implementing a 2 Path Analysis procedure. On average 56.8 landslides were recorded per year in a 17 year period revealing that there has been a rapid upsurge in the frequency of landslides. The results of the survey of experts demonstrates that England is considered to have the highest prevalence of landslides, including coastal landslides, with the Scottish and Welsh regions deemed to have a lower rate. Based on statistical pooling of expert judgements, the current study also found that the majority of the experts considered that prediction of coastal landslides is possible, but it depends on the landscape and geographical area. 57% of the experts deemed the England coastline to be most vulnerable for coastal landslides, but 29% judged the Welsh coast as the most vulnerable. Based on the systematic analysis of landslides and pooling of expert judgements, the current study results and GIS maps should be critically important to coastal planners, policy and decision makers to devise new pre- and post-landslide disaster management strategies, particularly under climate change scenarios. Experts' views help to fill the existing information gap regarding coastal landslides prediction in distinct coastal areas not just for the regional scale but also on the global scale.

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SOCIAL ECOLOGICAL RESILIENCE IN THE CAMBORIÚ RIVER BASIN

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> "It is necessary to build a new water culture, based on ethical, ecological and cultural values that guarantee inclusion and social environmental justice, by promoting transparency and broad representative popular participation in the different sectors of society."
>
> Alternative World Water Forum (2018)

Keywords: Camboriú River, water management, social ecological resilience.

Introduction

The Camboriú River Basin (Fig.1) is the main drainage and water catchment area for one of the main touristic centers in the State of Santa Catarina, composed by the municipalities of Camboriú and Balneário Camboriú. This basin has an extension of 40 km and drains an total area of 220.04 km^2, with 54.80% of its area covered by forest remnants, 22.35% covered by pastures, approximately 12% covered by urbanized area and 4.49% covered with agriculture.

Fig.1. Localization of the Camboriú River Basin.

Although vegetation covers most of the soil in the watershed of the Camboriú river and contiguous, the largest volume is associated with hillsides and hills. In addition, approximately 30% of the area of the basin is composed of Permanent Preservation Areas marginal to the water courses, springs and areas above 45º. Despite the river water quality, the behavior of the physico-chemical parameters revealed a higher degree of water deterioration at the downstream, mainly due to the influence of the disorderly advance of urbanization in this area. The high concentration of nutrients and turbidity, as well as the color, indicate a deficit of sanitation in the basin, probably associated to the lack of treatment of sewage in the city of Camboriú and lack of control of the use of agrochemicals and basic sanitation in rural areas. The results of the Water Quality Index for the Camboriú River indicate that its waters can be classified as of average quality in rural areas, bad in urban areas and very bad in one of the points in the urban area. Socioeconomic data from the basin show that its population growth in the last 50 years was quite high (Fig. 2). This growth in a short time, together with the lack of sewage treatment in Camboriú, is directly related to the poor quality of the water resources of the basin, as well as its scarcity in certain periods.

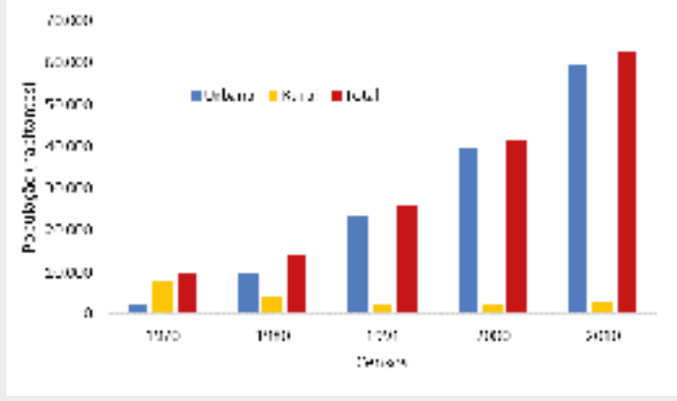

Fig. 2. Urban and rural population growth in the basin.

Although environmental conflicts and problems are similar to those found in other basins in the state of Santa Catarina, the watershed of the Camboriú river is the smallest basin in the state with an implanted committee. This fact establishes the possibility of using this basin in studies of institutional arrangements for integrated management and, in this way, serve as an example for the establishment of management strategies for other larger basins.

Basin resilience

Due to the anthropic activities, this basin suffers several risks of disasters associated with erosion processes, silting, floods, droughts, water supply collapse, irregular occupations on slopes and riverbanks and also risks of coastal disasters. The objective of this study was to develop participatory management of the Camboriú River Basin (SC), in order to be resilient to river floods and other disasters, based on institutional arrangements and transparency in water management. The environmental degradation of the basin occurs from the 1980s and that the worsening of water quality is a reality of the last ten years. The strong population growth over the last fifty years has had consequences for the environmental quality of the region. Land use in the basin has shown that it is composed of a large vegetated area and has a thirty percent area composed of Permanent Preservation Area, but these must be respected according to the legislation so that the environmental integrity of the basin is maintained over time. Also, in order to reduce river floods and to have water supply in the dry season it was suggested that an artificial multipurpose flooded park should be made (Fig. 3).

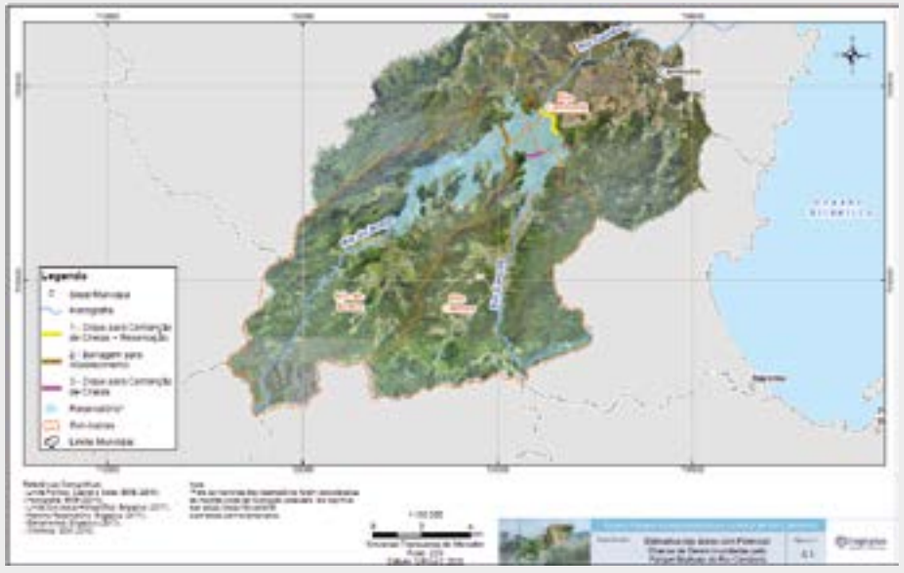

Fig. 3. Multipurpose flooded park.

The purpose of the park is to function as: (a) holding basin to amortize flows flooding and flooding downstream; (b) retention basin for reserving water in the dry season to supply the demand; (c) recover and preserve the areas of riparian forest and dispose of the rest of the area as environmental conservation with less restrictive use; and (d) provide the public use to be explored as an area of contemplation, recreation, sports, leisure and tourism, always in a manner compatible with its capacity to support. The entire area of the park will be in an area that is currently occupied by irrigated irrigation, which uses the floodplain areas. The park will control flooding capacity to meet the demands of flood containment and increase water availability. The basin committee requests that the project area will be decreed as a public utility (707 ha), so it was created by the municipality of Camboriú the public utility decree number 3324/18.

Conclusions

The results of the institutional analysis reveal problems related to social participation in the management of water resources in the Camboriú river basin, showing that efforts to improve aspects related to the themes raised can improve the management of water resources, increasing the efficiency of the basin committee, with social participation and transparency. In addition to the technical elements evaluated, for participatory and democratic management of the water resources and the disasters occurred in the basin, it was important to be aware of the historical environmental degradation process affecting the basin, as well as a continuous institutional evaluation and participation of the actors involved. Institutionally, water management in the basin needs to move forward and it is necessary to invest in transparency and social participation for the democratic management of water resources to have social ecological resilience in the basin. This study was also based reports of memories obtained from interviews with residents of the basin in the period 1950-2010. Reported uses, lost uses and characteristics of the basin were identified during this period in the upper, middle and lower courses of the Camboriú river. Several experiences have shown that it is possible to create democratic and plural public spaces of articulation and participation that leads to the necessity of the basin population. However, social participation and transparency are weak pillars for the full development of democracy in the management basin problems and conflicts, as the decisions taken in the basin committees are often not fully respected by the government.

IMPROVING SOCIAL AND ENVIRONMENTAL RESILIENCE THROUGH THE DEVELOPMENT OF HEALTHIER URBAN AND RURAL ENVIRONMENTS.

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Extended Abstract

The research locates *health* at the heart of socio-ecological resilience. The combined pressures of global population growth, large-scale urbanisation and climate change are increasing the need for resilience from disasters, particularly in coastal and fluvial areas. In order to improve resilience from these pressures, more sustainable forms of development are needed to help reduce, or counter, harmful effects on the environment, economy and society. Simultaneous to a shift towards sustainability, is the need to improve human health and wellbeing. There are severe inequalities in health and wellbeing. Much of the world's population suffer health problems and the majority of these illnesses are associated with unhealthy lifestyles; the built environment is linked to many determinants of health. Public health promotion, disaster risk reduction and sustainable development are all interlinked. There are already many overlaps and healthy symbioses between the three different fields: however there are many gaps in knowledge to be addressed. It is vital for ecosystem health and human health to be integrated and understood holistically. This research develops a *conceptual framework* that enables the integration of these three fields in order to make urban and rural settlements, particularly in coastal and fluvial locations, more resilient, sustainable, and healthier. The conceptual framework is conceived as a mechanism for the evaluation and realization of development to ensure improved social, environmental, economic and human health outcomes. Any conceptual framework must be contextualized in each individual location through participation with local residents, stakeholders and users. Researchers and practitioners need to look to indigenous, traditional solutions to disaster resilience, but as the effects of climate change are being felt at the local level, we also need to develop new approaches to resilience that can deal with hitherto unprecedented weather scenarios.

The world's population is increasing rapidly; there are over seven billion people on the planet and that figure is set to reach nearly ten billion by the middle of the century (UN, 2017). The majority of this population already inhabits urban areas and by 2050, over two-thirds will be urban dwellers (ibid). Much of this urbanisation occurs, or will occur, in coastal or fluvial locations. Unfortunately the risk of disaster due to flooding is set to increase in many of these locations (Hirabayashi et al, 2013; Hinkel et al 2014). Coastal areas have the combined challenge of sea level rises as well as greater meteorological risks due to climate change (Neuman et al, 2015). Fluvial areas are anticipated to suffer greater vulnerability to flooding due to higher levels of development, reduction of permeable areas and changes to land usage (Kriebich et al, 2015). Climate change is linked to many flood risk events, particular sea level rise and changes to meteorological patterns (Wahl et al, 2015). Towns, cities and societies located in these areas will be increasingly unable to cope with flood events.

There are acute health challenges facing society (Bloom et al, 2011; Brown Cueto and Fee, 2006). The financial consequences of poor health is predicted to be approximately thirty trillion dollars over the next twenty years; equivalent to half of Global Gross Domestic Product in 2010 (Bloom et al, 2011). Poor health affects all sectors of society; however there are severe health inequalities within society. Highly deprived communities are liable to experience worse health outcomes than less deprived communities (Wilkinson & Marmot, 2003; Donkin, Goldblatt & Lynch, 2002). Within a single city, life expectancy may differ by ten years from the most to the least deprived areas (Buck & Maguire, 2015). Health promotion is a key aspect of improving health outcomes and can play a role in disaster resiliency; however it is important to have fully integrated strategies for health promotion (Rice & Sara, 2018). The design of urban areas, including water features, can greatly affect health outcomes. Blue infrastructure can be a beneficial asset for urban areas; careful design and integration of coastal and river features can positively impact human health. Blue infrastructure can reduce the risk of flood disasters and mitigate against the consequences. Water features can be used to both improve health and, when appropriately located and managed, reduce inequalities. However water in urban areas, when in a state of flood, can cause myriad long-term and short-term negative health outcomes.

Correct design, location and governance of urban areas can ameliorate many of the harmful effects of flood events. Accordingly, the United Nations (UN,

2015) has established Sustainable Development Goals to promote, among other ambitions, the implementation of urban development that reduces flood risk. It is worth noting that the United Nations's Sustainable Development Goals replaced their Millennium Development Goals with more of a focus on health. Notably one of the new Sustainable Development Goals deals directly with health issues (Goal three: 'good health and wellbeing') but more generally, as the World Health Organisation (2015) note, "*health has a central place as a major contributor to and beneficiary of sustainable development policies*". Health and wellbeing are important factors to consider as part of sustainable and resilient urban developments.

There is a need for greater integration between Disaster Risk Reduction, Sustainable Development Goals and improving public health. Three key policy frameworks relating to this are the: Sendai Framework, UN Sustainable Development Goals and the World Health Organisation's 'Healthy City'. The (UN) 2015 Sendai Framework for Disaster Risk Reduction, adopted by the UN, aims to reduce disaster risk and subsequent harm to lives and livelihoods. More specifically for urban contexts are the *'Ten Essentials for Making Cities Resilient'* which enable urban areas to evaluate their level of resiliency; particularly in order to plan, mitigate, respond, recover and adapt to disasters. The Sustainable Development Goals cover a range of issues, but for urban areas the key principles that must be addressed are: social, environmental and economic. These are particularly required in order to combat the drivers of climate change. Of the seventeen principal Sustainable Development Goals, Goal eleven specifically targets *'sustainable cities and communities'* which relate to urban development and flood risk. Thirdly, the World Health Organisation has developed the '*Healthy Cities'* strategy (WHO, 2018b). Healthy Cities reveal "*how the built environment··· affects the health of our citizens and the importance of integrating health and sustainable development considerations in how we plan, design, maintain, improve and manage our cities and neighbourhoods"* (WHO, 2008; 3]. The Healthy City strategy reflects the important role that *'place-based'* environments play in determining human health outcomes. As the world's population urbanises, the role of *'place-based'* determinants of health will be increasingly relevant. However there is a need for greater integration across each of these three strands of development: Disaster Risk Reduction, Sustainable Development Goals and Healthy Cities. Strategies developed that consider only one of these policy programmes risks missing key areas of action from other important social, economic and environmental realms. A more co-ordinated effort across all of these strategies would be more effective in delivering healthier, more resilient, sustainable urban environments. An integrated framework can help to reinforce the positive effects of each domain across all three fields; equally it can ensure that there are no contradictory approaches from different organisations.

New and existing urban environments need to look for innovative *design* solutions for dealing with flood events. *Research and design* need to be combined together in order to develop these alternative solutions. Design alternatives for retrofitting an urban area, or developing new urban areas, can be developed and assessed that aim to maximize the synergies across the three fields of sustainable development, disaster risk reduction and improved health. The framework is developed to be applicable in a variety of different cultural, social, climatic and economic situations; nonetheless each analysis must also be flexible and responsive to local context. Involvement with local stakeholders: communities, residents, workers and neighbours of all ages and backgrounds is needed to ensure that analysis is appropriate for the local conditions. Participatory design research is a frequently used approach for ensuring local stakeholder involvement (Robertson and Simonsen 2012). In participatory design research, non-experts become part of the design research team and contribute to the development of local solutions that are appropriate, not just technically, but culturally, economically and socially (Rice, 2017). This approach to research is particularly focused on working collaboratively and inter-disciplinarily, particularly for complex socio-natural issues. It is accepted that there is no perfect solution to such 'wicked problems'; instead any solutions are not 'right or wrong' but can only be deemed 'better or worse' by stakeholders. Furthermore, as each context differs, each design solution is necessarily unique, novel and contingent. This research is particularly relevant in Brazil as it faces profound health inequalities and will require radical approaches to develop appropriate local strategies for improving disaster resilience in coastal and river areas. The aim of participatory design research, in this scenario, is to co-design knowledge to promote liveable, safe and vibrant communities using an integrated framework across sustainability, resilience and health.

Keywords: Healthy cities, disaster, risk reduction, resilience, codesign

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THE ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTS) FOR DISASTER RESILIENCE: FLOODS IN THE ITAJAÍ VALLEY, BRAZIL

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Abstract

The chapter addresses the role of information and communication technologies (ICTs) for disaster resilience. It describes the case of flooding events in the Itajaí Valley, Brazil, the evolution of ICTs and their employment by the local population as means of preparing for, recover from, and reorganizing in response to these disasters. It focuses particularly on new technologies such as mobile phones, Internet, and social media and their role for improving disaster management and resilience at a local level. First, it presents a brief outline of the evolution of technology use for communication and disaster resilience in the region of Blumenau. Then, it analyses and discusses online interactions during the 2008 and 2011 floods in the city of Blumenau and its impacts for disaster response and resilience. Finally, it suggest possible features for an improved management of disaster based on ICTs.

The Itajaí Valley and the city of Blumenau are historically affected by flooding events. The first recorded flood happened in 1852 – only two years after the foundation of the settlement that later became the city. Throughout the 20th century, recurring events shaped a culture for disaster response and the region's resilience. Impact and number of affected residents have been increasing while governmental response strategies have become more complex. However, the changing dynamics of disasters (particularly the 2008 and 2011 floods and landslides) have highlighted the limits of local and regional resilience mechanisms. More precisely, these recent disasters mark an important turn in the way technologies are employed for disaster communication and management in the Itajaí Valley. At first, disasters were faced with support from centralized and slow communication methods (e.g. newspaper) or centralized and fast methods (telegraph, radio, TV). Recently, however, disaster communication has changed to decentralized and fast methods, namely Internet and social media. This paradigm shift brought a series of challenges for the affected population and public officials. The widespread dissemination of information from various sources – official and unofficial, false or true – complicates risk assessment, disaster response, and overall resilience. As a response for the possible "information overload" and misinformation, Blumenau city officials commissioned and launched in 2015 the mobile app and webpage "AlertaBLU" (Ludwig et al., 2012). This platform includes centralized weather forecast information, river levels updates, and a disaster alert system.

In this sense, on the one hand, the chapter explores the risks and downsides of fast and decentralized information mechanisms (such as Internet hoaxes or "information overflow") for resilience before, during and after disaster events (Takayasu et al., 2015). It addresses the issue of misinformation as reducing potential resilience. On the other hand, it questions the relevance of centralized solutions in the current stage of technological development and the use of Internet and social media in helping local populations to prepare for and reorganize after disasters (Lindsay, 2011). In this regard, it presents some sociological and cognitive remarks on the pitfalls of ICTs, especially considering communication during emergencies and disasters. Thus, the chapter aims at evaluating the pros and cons of ICTs for disaster resilience, considering the case of floods in the Itajaí Valley.

Finally, it discusses sociotechnical tools for improving the use of ICTs for disaster resilience, such as an open and interactive platform for evaluating images, video, and news. More precisely it touches on the subjects of Artificial Intelligence image recognition, text classification, and geotagging as ways of improving technological management of disasters communication. Therefore, it proposes a platform for integrating official, centralized information and user-generated content, including georeferenced data, to be applied for flooding and related disaster events in the Itajaí Valley.

Keywords: floods, ICTs, Itajaí Valley, resilience, collaborative platforms

DISASTER AND TERRITORY: THE CIVIL DEFENSE AS A VECTOR OF LOCAL RESILIENCE[1]

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Disasters are phenomena that occur in the relationship between society and nature. They are understood as the "Result of natural or man-made adverse effects on a vulnerable ecosystem, causing human, material and / or environmental damage and consequent economic and social harm" (Pinheiro, 2015, p.50). Disasters go beyond the capacity of a system or community to coexist or resist the impact and evidence the weaknesses, the potentialities and the degree of resilience of that territory. The process of building resilience, the way the population acts and organizes itself to minimize and mitigate the consequences of disaster, requires the development of strategies to address existing deficiencies. Worldwide there is a significant increase in the number of occurrences of disasters. The Em-Dat (The international disaster database) database with more than 22,000 major disasters in the world since 1900, averaged 80 disasters / year in the 1970s and its significant increase to 400 events / year in 2008 (Em-Dat, 2018). Also in Brazil the expressive increase of occurrences is visible, as well as the damages and losses resulting from the events. Data from the same University Center for Studies and Research on Disasters (UCSRD) indicate the occurrence of 22,810 disaster situations in the country between 1995 and 2014. The regions of Brazil that suffer most from the occurrence of events and from the resulting damages and losses are the Northeast, Southeast and South (Ceped, 2016). The poor are the most vulnerable people. According to Warner (2018, p.12), "a disaster occurs in the encounter between forces of nature and social vulnerabilities, when a landslide, a flood, an earthquake, a drought, a tsunami ... surpasses the human capacity to resist ". The way we conceive them results in how we will face them. For a long time the disasters were considered only from their geological and physical characteristics. According to White (1973), for this reason, the measures used as a solution were always structural. Through the years of study, they have come to be understood as social phenomena and studied from their social dimension. With the change of paradigms, the emphasis was on the social dimension and the impact of the event on the territory and its population. Thus, the importance is on the impact of the event on the territory and on the population (social variable) and the triggering agent of disaster (natural variable). The multidimensionality of the character of the disasters (natural and social dimension, with emphasis on the social) and the capacity of the system or territory to resist the impact and to organize itself to overcome its deficiencies and weaknesses are evidenced.

In this sense, the relevance of studies on socioecological resilience to disasters is explained, and this work, based on bibliographical data - preliminary product of the author's doctoral thesis - which addresses the Civil Defense as a vector of resilience to disasters in the territory (at the local level) is justified.

Conceptually, resilience to disasters is the ability of a system or community to, in a state of danger (extreme disaster), adapt, resist and change to continue functioning at desirable levels. This process involves recognition of deficiencies and potentialities, learning from past experiences, and ability to organize with the goal of improving or building actions and strategies for protection and reduction of disaster risk for the future (ISDR, 2004). The impacted population needs to be clarified about the dynamics of the threat and endowed with a risk concept with objectives of reducing vulnerability and increasing resilience (Valêncio, 2010). The Hyogo Framework defines vulnerability as "Conditions determined by physical, social, economic and environmental factors or processes that increase the susceptibility of a community to the impact of hazards ..." (UN, 2015, p.4). The risk or danger is defined in the Sendai Framework as a "potentially damaging human phenomenon or activity that can cause loss of human life or injury, property damage, social and economic disruption, or environmental degradation" (UN, 2015, p.3). These hazards may be natural or human-induced and represent future threats to a system or territory. There is evidence of the need to reduce risk and vulnerability and increase the resilience of the population or territory. In this sense, the Civil Defense, as an organ present in the municipalities and that acts directly in the management of disaster risk, plays a fundamental role, as much by its location in the territory, as by its capacity to act as an institution

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that promotes local resilience. Conceptually, according to Pinheiro (2015, p. 42), the Civil Defense is a "set of preventive, relief, assistance, rehabilitation and reconstructive actions aimed at avoiding or minimizing disasters, preserving the morale of the population and establishing social normality." According to the author, the institution is formed by "all organs, public and private institutions and the society itself as a whole" (Pinheiro, 2015, p.42) with diverse responsibilities and functions. Among these, the formation of the Community Protection and Civil Defense Corps (CPCDC), whose purpose is "to develop a process of permanent orientation to the population" and its objective is "the prevention and minimization of risks and disasters in the areas of greater vulnerability in the municipalities "(Lucena, 2005, online). The formation of these nuclei is extremely relevant because it aims to involve the population in planning and managing risk. When this happens, a more positive response of this population occurs in all phases of risk management: prevention, emergency preparedness and reconstruction of the areas affected by events (Lucena, 2005). The presence of these Civil Defense nuclei in the municipality establishes a formal link between the Municipal Councils for Protection and Civil Defense (MCPCD) - responsible for Civil Defense actions in the municipality - and the population. The CPCDCs favor "co-management in the planning and execution of actions" and disseminate "the principle of prevention in relation to risk areas" (Lucena, 2005, online). One of the expected results is increased resilience to disasters. The operationalization of Civil Defense to promote community participation and the strengthening of the resilience to disasters in the territory are evident. However, the reality in Brazil shows that Civil Defense has difficulties in implanting the NUPDEC's. In a lecture held at the Social Ecology Resilience to River Floods and Coastal Disasters Workshop, which occurred in Blumenau, Santa Catarina, Brazil, from July 16 to 20, 2018, members of the Civil Defense reported difficulties in moving forward in the creation and implementation of these local nuclei. Several researches by the author, together with the Nucleus of Studies of Technoscience (PPGDR / FURB) between 2013 and 2015, found that the greatest difficulty for the implantation of these nuclei is that the proposal appears in the community "from top to bottom", that is, it does not come from the local population, but comes ready, determined by the Civil Defense.

In view of this, we have developed a proposal of a Community Civil Defense, with a decisive character (figure below), created by the community itself and coupled or inserted in the Civil Defense system of the municipalities.

Source: Prepared by the author (2018).

The proposal would result in disaster risk management with a democratic and participatory nature, as provided by the National Policy on Protection and Civil Defense (NPPCD). For its effectiveness, partnerships between Extension Programs of local and regional universities, other institutions and the Civil Defenses of each municipality. The institution would act as a vector of local socioecological resilience and the Community Civil Defense as a tool of capillarization of the actions of disaster risk management in the municipality.

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THE POINT OF FAILURE OR WAY FORWARD TO RESILIENCE: WHERE DO WE STAND?

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Background and research objectives:

Specific perspectives around understanding theories of hazard and risk are developed over the years often presented by disciplines reflecting their own spectrum of boundaries. This resulted in general lack of interdisciplinarity in the field of understanding and reflecting on the complex phenomena of hazard and its different causalities holistically over space and time. In 1999 Corson first brought in the term 'hazardscape' which focussed on technological hazards (Corson, 1999). In disaster research the concept was identified as the mosaic between natural and anthropogenic hazards at a given point of time (Shabana Khan & M. J. Crozier, 2009). The concept captures the interaction between processes, people and place- the three key aspects of disaster cycle (involving hazard, vulnerability and risk).

With potentially escalating losses, and more population and assets exposed to risk, it is evident that difficult choices need to be made by affected individuals or communities regarding the necessary adjustments in social, economic, cultural and environmental contexts. These choices are framed within the vulnerability of socioecological systems constituted by both the human and natural environment (Bhattacharya-Mis &Lamond, 2014). The importance of the concept of hazards cape lies in its ability to incorporate both physical and social (behaviour, perception, awareness, experience and cultural effects) and political (institutions, non-government agencies) of disaster response and resilience. This concept fits well with the focus of this research which investigates the fragile environmental conditions and human choices to enhance resilience in the context of a holistic system (Khan et al, 2012).

In case of a repeat flood event, where the focus of this research lies, the overall impact of the disaster event is the reflects in level of vulnerability over time. Patterns and feedbacks from the repeat shocks can either have an adverse effect on

building resilience against disaster or can act as a motivating factor for developing capacity to respond in an effective manner and 'build back better' in the long term. Therefore, looking at the temporal dimension of hazardscape within the critical window of response and recovery is one of the key factors that assisted disaster management cycle to thrive. The system creates its own memoryscape with time which store information from the past to provide evidence for anticipated changes in the future. Vulnerability being multidimensional, the incorporation of temporal variation through memoryscape, throughout the disaster management cycle (pre, during and post disaster situation) and understanding the ability of the system to absorb dynamic changes was often under researched. Therefore, the question that the research aims to answer based on the identified gaps was how the temporal dimension of system memory interacts with the changing socio-ecological system to have an impact on the total vulnerability and future resilience building.

Methodology selection and steps:

To understand the concept of hazards cape and memorycape in-depth, it was essential to have a structured review of available literature in this field of research. For this, an enquiry based qualitative approach through structured review of literature was found suitable to answer the research question. Wider range of literature from different fields of research (geography, ecology, psychology, economics and disaster management) were reviewed to develop a conceptual framework for forthcoming stage of research. The literature found were fragmented and scattered with no major reviews in the field presenting the two aspects together. Academic literature was given priority over non-academic keyword searches which were complemented by searches from various disciplines due to nature of enquiry. The main themes around the literature search were various vulnerabilities in socio-ecological system followed by identification of weaknesses within different integral systems constituting the identified vulnerabilities that causes the system to fail. After reviewing the existing complexities factors were identified which constituted the conceptual framework that lead the way forward for data collection from field.

Based on the conceptual framework the research used a postal survey method of data collection from different frequently flooded locations in England. Due to the nature of the study using a postal questionnaire was identified to be the most appropriate data collection instrument. This method of data collection helped in gathering large sample of data from spatially diverse geographical locations with high risk of flooding in the last 15 years. The data was collected from a range of people with different socio-economic background, occupation and livelihood to capture different sectors of the economy. Different questionnaires with overlapping sets of questions were prepared and send to different types of property owners (residential and commercial). The major themes surrounding both questionnaire sets were: details of the flood affected property, the respondents' flood experience, their action and response for damage and future reduction, availability and affordability of flood insurance with target population of multiple flood experience. Although the respondents who had experienced flooding once also showed interest in responding to the questionnaire and the data was preserved to have a comparative understanding of memory cape. A dataset layer of different base layers was generated within the GIS platform at a postcode level using the Ordnance survey datasets overlaying historical flood maps from the Environment Agency. The data was then cleaned and analysed to answer the research questions of temporal dimension of system memory and its impact on fragility of the system.

Outcome/result

The outcome from the structured literature review indicated that authors have called for further understanding the system memory adjusted through physical, environmental, social and economic memory in making progress towards resilience against disaster. Although it was argued that in spite of the importance of the other indicated memory factors in hazardscape, majority of the research focussed on economic memory in disaster research. This is because of the easier accessibility and comparability of financial and economic information and the difficulty in representation of subjective factors in the measurement framework. For instance in understanding of social memory and its clear link between stress from external changes to build resilience association such as individual, community, and institutional levels play an important role in identifying existing practices, knowledge, values and world view (Adger, 2005, 2016). However factors such as resource dependency, unreliability of human memory and inconsistency in

method of measurement causes considerable effect on the implementation of the knowledge outputs. Similar problems are also seen within the spectrum of associated uncertainties in physical and environmental memory which considers factors such as changing climate, weather patterns and its integrated relationship with frequency, magnitude and susceptibility of hazard.

The output from the structured review also suggested that the direct and indirect links that exists between the different memory systems work in a pattern of interconnected loops, and the vulnerability within them vary spatially and temporally from one system to another (Rashed & Weeks, 2003). Therefore there is a potential for incorporating subjectivity in the system. Therefore the best performance of this model can be obtained if different scenarios are chosen to contribute towards understanding of holistic system memory for enhanced resilience.

The results obtained from the survey of the residents and business property holders at risk of flooding therefore was targeted towards understanding of system memory by incorporating individual feedbacks based on their experiences and knowledge in specific memory systems to contribute towards the holistic system memory. The outputs showed differences in behavioural patterns for the two different sample sets, for example in the strategies undertaken by them for improved mitigation and risk reduction for the future. Feedbacks showed differences in pattern of reliance or resource dependency in the two sectors (residential and business) for example in case of reliability on insurance, residential property holders were far more reliant on insurance sector than businesses. In terms of actions taken, it emerged that business property holders are keener on taking up protection measures to reduce risk and keep their businesses open soon after disaster occurs to avoid impact on turnover. this observation cannot however be generalised as happening in all sectors of businesses or residential properties, as the level of acceptable risk is often determined by the balance between cost and benefit aspects, social and institutional support , financial capacity and the rate of change in the magnitude of risk.

Implications of the study:

By aligning the concepts of different forms of memory this study argues that there are functional interdependencies between different systems and the complexities posed by such dependencies are needed to be studied in a holistic manner if the point of failure in a system is to be identified. The disaster management policies often are based on feedback from one system of the other, therefore the actions from those policies often does not solve the problem. The possibility of aggravating the situation as a result if also visible in different case studies from literature. The study highlights the need for a shift towards more 'proactive' stance rather than the usual 'reactive' way disaster management policies and actions have been formed.

Understanding and relying calibrated knowledge from the past in the form of antecedent system memory can help in making appropriate choices for a resilient future for individuals and society as a whole. However, it is important that both spatial and temporal dimensions are taken into account as a result of with changes in a multifaceted structure with multiple levels of complexities altering resilience. Consideration of the effect of time on the window of opportunity to build resilience is essential as it reflects the equilibrium that the system can achieve before getting affected by another disruptive event. The concept of memoryscape within the hazrdscape stands an important factor in identifying a way forward in resilience building therefore needs highlighting and incorporation in research.

Keywords: 'memory, socio-ecological system, temporal, spatial, repeat flooding'

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CAUSES AND EFFECTS OF DAM DISASTERS IN INDIA: A CASE STUDY

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Abstract

Indian subcontinent is prone to various natural disasters such as floods, earthquakes, cyclones, tsunami, landslides, etc. Previous study found that the construction of dam projects affects the free flow of environment due to which natural calamities take place. In India, the dams are funded by the government for providing drinking water, creating hydroelectric renewable energy, flood control, agriculture, etc. to facilitate better environment for people. However, there are various threats from dams due to the failure in disaster risk management. Thousands of people are relocated from their ancestral lands every monsoon by the Indian government due to flooding, or due to new dam construction. Since large amount of water is held in dam, it can prove to be very dangerous in an event of a disaster. Therefore, it is very critical to maintain the dams in optimum condition and reduce the negative impact of the dam on the surroundings to endure its safety.

The increase in water and energy demand has risen the need for new construction of dams. However, due to natural calamities, structural failure and less consideration towards environment, many dams have created disastrous situations. Hence, there is a need to explore the status of dams and the steps taken by the Indian government to reduce the dam disaster risk. The safety of a dam is a subject of national importance to safeguard national investments and their benefits. In this context, the study aims to investigate the causes and effects of dam disasters in India. The study adopted the case study approach and used interviews as its data collection methods. The data was analysed using content analysis. It is believed that this research will provide insight into a dam disaster for the government to take remedies to minimise future disasters.

Keywords: Causes, Dam, Disasters, Effects, India

MEASURING SOCIAL ECOLOGICAL RESILIENCE: LEARNING LESSONS FROM GREATER MANCHESTER, U.K.

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Keywords: action-plan, assessment, resilience, social-ecological, stakeholders

Extended Abstract

Disaster Resilience toolkits claim supporting risk management decision making process, by providing a step-by-step guidance to develop resilience action plans, yet the lack of context and scope leave DRR key stakeholders challenged with the need for managing the 'underlying political relationships between state and society', while holding the responsibility of forming institutional governance for building resilience at the national and sub-national levels, 'this involves learning and innovation, self-regulation, accountability, shared knowledge and decision-making by all parties' (ODI, 2017). In understanding the association between governance of disaster risk management and measuring social ecological resilience, it is important to consider the interactions between people, communities, economies, societies, cultures and the biosphere surrounding them.

The Sendai Framework for Disaster Risk Reduction (SFDRR) Priority 2 calls for 'Strengthening disaster risk governance to manage disaster risk, at the national, regional and global levels is very important for prevention, mitigation, preparedness, response, recovery, and rehabilitation' (UNISDR, 2015). As a 15-year, voluntary, non-binding agreement, the passion and commitment of DRR Key Stakeholders play a significant role in fostering collaboration and partnership, to embed resilience into DRR policy, and insure the sustainability of leadership and accountability of risk governance, beyond the limits of time-bounded city officials' authoraitive powers, to the city-wide actors' and implementers of legislative frameworks and national DRR strategies. As a role model city within the United Nations Office for Disaster Risk Reduction (UNISDR) 'Making Cities Resilient Campaign' and taking part in the 100 Resilient Cities (100 RC); an initiative pioneered by the Rockefeller Foundation, this papers address the following research question of how can we develop a resilience action plan in the context of Greater Manchester, and investigate the factors affecting the process of DRR key stakeholders' engagement in risk governance, to measures social-ecological resilience.

Defined as 'the capacity to adapt or transform in the face of change in social-ecological systems, particularly unexpected change, in ways that continue to support human well-being' (Chapin et al. 2010, Biggs et al. 2015), this study aims to investigate the impact of adopting the disaster resilience assessment tools as mechanisms to embed learning from multi-level and multi-actor dialogues, and the role of national legislative policies and formal resilience partnerships in building accountability, autonomy and flexibility in forming Urban Resilience Action Plans.

Shaping the means to carry out the research actions, study objectives are defined: 1) To map and analyse the Greater Manchester (GM) city region urban risk profile in general, with focus on understanding the interrelationship between the local and national United Kingdom DRR platforms, targeting the underlying drivers of risk and monitoring the historical evolution of civil contingency. 2) To identify DRR Key stakeholders at the (GM) city region constitutional districts structure, and the impact of forming Resilience Forum in strengthening disaster risk governance.3) To investigate and document the city region's DRR stakeholders experience and role in joining the UNISDR's Making Cities Resilience Campaign (MCR) in comparison to the 100 Resilient Cities initiative pioneered by the Rockefeller Foundation, and the impact of both tools in strengthening risk resilience governance and developing the city's region Urban Resilience Action Plan.

To fulfil the research aim and objectives, a semi-structured interview with key informants from the Association of Greater Manchester Authorities (AGMA) Civil Contingencies & Resilience Unit was conducted, to gain insights into disaster risk governance, and the role of key stakeholders in developing an Urban Resilience Action Plan. Derived from the World Bank (2012) Workbook on Planning for Urban Resilience in the Face of Disasters, 'Steps in Local Resilience Action Planning' the interview questions are formed around the constructs of 'Sensitization', 'Technical

analysis', 'Stocktaking and needs assessment', 'Option identification and program prioritization' and 'Plan creation'. Reflecting on GM Resilience Forum experience, the study results showcase how local and national disaster risk profiles drive the indicators for measuring resilience, and help identify the factors, commonalities and differences between resilience assessment models, while measuring the impact on strengthening disaster risk governance and framing GM Resilience Action Plan.

The study qualitative primary data collection started with investigating the GM city authority understanding of resilience as a concept. Where 'Public health' was raised as the main driver of risk, GM brought here a new component for assessing resilience beyond the UNISDR Disaster Resilience Scorecard 'Ten Essentials' for measuring resilience, which focus more on the economic, environmental, urban, institutional, societal and physical components of critical infrastructure and building back better. Here it is important to indicate that 'GM is yet to agree what 'resilience' means for the city region. Arguably, as the governance structures have evolved, so has the understanding of a number of related concepts, with attention moving from civil contingencies to DRR through to a broader concept of resilience' (Oldham K. & Astbury K., 2018).

Taking into account that global DRR Frameworks are legally-non binding agreements, the legistlative nature of the 2004 Civil Contingencies Act helped establish the grounds for GM city's region Local Resilience Forum (LRF), aligned with the adoption of the Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters, and building the statuary requirements to integrate resilience into emergency planning and response. Tracing their roots back to 2004, Anderson B. and Adey P. indicates that this legislation was designed to address 'a need to improve anticipation of threats; a requirement to engage more actors in planning for emergencies given the interconnectivity and complexity of emergencies; an emphasis on inter-organisational coordination and cooperation; and a need to ensure command and control mechanisms were flexible enough to address emergencies requiring swift action across different spatial geographies' (Cited in Oldham K. & Astbury K., 2018).

Learning from the implementation of the UK DRR national policy, GM city's region first Resilience Action Plan was formed in 2008, with broader understanding of the UNISDR approach of building cross-sector communication and professional integrity, advanced by joining the (HFA) Making Cities Resilient Campaign. The 'Making Cities Resilient Campaign' was developed by UNISDR and its partners to assist local governments in assessing their progress in building resilience to disaster. It is part of a series of tools for measuring the progress of nations and communities towards meeting the objectives of the Hyogo Framework for Action (HFA) to 'increase understanding and encourage commitment by local and national governments to make disaster risk reduction and resilience a policy priority and to bring the global Hyogo Framework closer to local need' (HFA, 2005-2015). This was followed with the launch of the Local Government Self-Assessment tool (LGSAT) in April 2012, in support to the global Making Cities Resilient Campaign, to enrich understanding of disaster risk, identify gaps in planning policies and financial risk investments. This is an online tool that identify main Ten Essentials.

Answering the question 'How can resilience assessment results help translating numerical indicators and metric indices into Urban Resilience Action Plan?', Greater Manchester Chief Resilience Officer replied "Gathering and analysing data for resilience metrics has been helpful in developing multi-stakeholder conversations and engagement but the quantitative outcomes have less directly influenced our action plans". Key words such as 'Leadership', 'Passionate' and 'Senior' were quoted consistently, highlighting the role of DRR Key stakeholders in "sustaining strategic interest and the engagement of city leaders". On the other hand, the benefits 100 RC approach for developing GM Resilience Action Plan were acknowledged, in demonstrating an added value for the identification of the city's shocks and stresses, helping to reshape the existing action plan to accommodate the new strategy and 5 years' implementation framework, while providing a clear approach for developing the 2030 city region's resilience strategy, aligned with the SFDRR 2015-2030 timeframe, with focus on three main components 'people, economy and places'.

The finding of this study will offer better understanding of the role of DRR stakeholders and institutional agencies in measuring urban resilience at the local level, and identifying the means of translating disaster resilience indicators generated indexes, into operational policy guidelines that shall have an impact at the National level, to implement sustainable resilience action plans. Learning

lessons from the UK, the implications of this study will contribute to the Researcher Links Workshop 'Social Ecological Resilience to River Floods and Coastal Disasters' knowledge sharing outcomes, and best practice transfers between UK and Brazil to improve social ecological resilience. A joint proposal for collaboration is now formed between research students from London South Bank University (London, UK) and Regional University of Blumenau (Antônio da Veiga, Brazil), to replicate the study methodology and develop comparative analysis between the two city regions Civil Contingency Institutional structures, to understand the constructs for stakeholders engagement in measuring resilience in both cities, and measure the impact on developing disaster resilience action plans to improve social ecological resilience assessment and urban risk governance.

FLOODS AND THE CASE OF TERESÓPOLIS/RJ 2011: PERSPECTIVES SIX YEARS AFTER THE BRAZILIAN FOREST CODE (LAW 12.651/2012)

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Expanded Abstract

The tragedy of State of Rio de Janeiro's mountainous region in 2011, one of the worst and recent episodes concerning floods and landslides in Brazil, was not an isolated incident. It displayed clearly the results of scarce urban planning, social vulnerabilities and not enforced environmental law along with extreme weather events. This terrible event resulted in nearly 1.000 deaths, 388 of those in the City of Teresopolis. It also produced around 45.000 displaced and homeless people, of which, 6.700 located in Teresopolis. Yet, after 6 years, 6,7 thousand people were still living in risk areas (data from 2017). Second most affected city in the 2011 catastrophe, only behind Nova Friburgo, Teresopolis was founded in the late 1890's. It has around 770 square kilometres and 170 thousand residents, 90% living in urban areas. The main economic activities are: tourism, industries, commerce and agriculture. Land use and occupation are characterized by many vacation properties (of medium and high income levels), irregular building in risk areas (predominantly low income dwellings) and wrong housing policies. The rains of the 10th, the 11th and 12th of January 2011 were greatly above the average expected. Damages were calamitous: The World Bank (after a special report on economic losses), estimated that the housing sector alone, suffered a 2.6 billion reais estimated loss, mostly affecting low income houses (Worl Bank: 2012). Still, in Teresopolis, 6 years later, 1600 people were waiting for new homes (data from 2017). At the time, official (Brazilian Minister for the Environment: 2011) and independent (see, for instance, the Architects Bar Association: 2011) reports claimed that the compliance with the forest code (then Law 4.771/1965), specially the respect of the so called permanent protected areas (APPs) would have saved lives and reduced the damages attributed to the heavy rains of January 2011. On May of the following year, Brazil approved a new forest code (Law 12.651/2012) with considerable setbacks on the forest protection concerning APPs. Created by

the Second Forest Code (1965), APPs were only granted a general definition in the 90's by a provisional measure (MP). Such definition was roughly maintained by the Federal Law 12.651 as laid down on article 3, II: "protected area, covered or not with native vegetation, having as environmental functions to preserve water sources, landscapes, geological stability and biodiversity, facilitating the fauna and flora's genetic flow, to protect the soil and to assure the well-being of human populations" (BRASIL, 2012, our translation). Some characteristics of APPs are: a) should remain with original flora and or geological features, unless in the three legal exceptions: public utility, social interest, low impact – all defined on the code; b) can be identified directly by the law (most ordinary and known case) or declared in concrete opportunities by the Executive's Chief there when there is a need for additional APPs to protect or favor an environmental functions. One of the critical points of the current Forest Code (Federal Law 12.651/2012) is that it brings two different legal regimes to the APPs: the permanent regime applies to the ordinary, present and future cases; the special transitory regime is granted to those who suppressed APP's vegetation or occupied it before July 22nd of 2008. Among the setbacks brought by the current code's permanent regime, we underline: new minimum height of 100 meters for hill tops and mountains to host legally-defined APPs. The restriction of riparian APP's to the considered natural rivers. As to reservoirs, they should be natural and have a surface equal or bigger than 1 hectare in order to be protected. With regard to the called special/temporary, it brings softer requirements concerning forest recovery in both rural and urban areas, allowing partial and; sometimes, even no restoration in the case of the considered small rural properties - that could reach over 400 hectares, according to the fiscal module rules. The fiscal modules were created to measure rural proprieties and implement a federal tax. The Brazilian Agency for Land Reform (INCRA) establishes the fiscal module for each local district (municipality), ranging each unit from 5 to 110 hectares. Following the approval of the Federal Law 12.651, some reports and studies point out an alarming tendency of deforestation growing rates. Recently this law has been considered constitutional by the Brazilian Supreme Court (STF), except for a few dispositions that were declared not compatible with the Brazilian 1988´s constitutional charter. It seems that this decision has, by ending the debates concerning the current Forest Code, may also influence the deforestation rates' trend. This expanded abstract aimed to provide some important relations between floods and forest protection in Brazil, bringing to light the case of Teresópolis/RJ, one of the most affected cities in the 2011´s episode, and the rules validated in 2018 by the STF. To do so, it based itself on various specific articles and reports concerning the tragedy of 2011, the 2012´s Forest Code, as well as recent reports on those issues and their developments. The conclusions show that, in the scenario of growing extreme weather events, the approval of the Law 12.651/2012 and its validation by the Brazilian Supreme Court pose higher risks in areas that were before 2012 protected as APPs and that are now available to land use changes due to the new Forest Code permanent and special regimes.

Keywords: Floods – Brazilian Forest Code – Permanent Protection Areas – Teresópolis

IMPACT OF SUSTAINABLE PROCUREMENT ON POST DISASTER RECONSTRUCTION

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Overview

Implanting sustainability within post disaster reconstruction supply chains is very important in achieving sustainable development. Encouraging transparency in supply chain and improving procurement strategies in relation to sustainable factors (environmental, social and economic) if the issues created by natural or artificial disaster is not addressed through sustainable reconstruction process or policy. This will have a much greater impact on the supply chain which may present main economic and environmental risks to the community and the nation at large, with the right procurement approach in place, important sustainable development will emerge. Sustainable procurement is an evolutionary thing that required introducing new innovative ideas into the way we procure our building and services. Many ideas and initiatives have come to play Dexter et al (2009). For example the LEEDS in US and BREEM in UK for measuring and standardising operational carbon emission.

Despite all the research work put in place by academia and industrial professionals in achieving sustainable procurement of goods and services in post reconstruction, it does not have the necessary impact on the community social situation but only reinvigorate other sustainable issues such as land degradation (Nazara & Resosudarmo, 2007), environmental conservation (O'Brien et al., 2008, Roseberry, 2008) and economic dislocation (Jayasuriya & McCawley, 2008). In quest of completing reconstruction on time and rescue the community back to their normal life, this will affect other element of iron triangle (time, cost & quality) as a result of competition for scarce construction material and resources including but not limited to timber (Zuo, Potangaroa, Wilkinson, & Rotimi, 2009), bricks (UNDP, 2006), cement (ADB, 2007) and labour (Pathiraja & Tombesi, 2009), which will inevitably affect cost (Nazara and Resosudarmo, 2007, Steinberg, 2007) and quality (Jayasuriya et al., 2005, Kennedy et al., 2008) including time in sorting out alternative supply (Dercon, 2007, Zuo et al., 2009). All this together with poor workmanship and inadequate quality control measure in place will result in defects and eventual project failure, to huge extent damage the significant of attaining a sustainable procurement measure in post disaster reconstruction.

Lyons, (2009) conclude that Post disaster reconstruction often fails in its stated objectives, 50% at the World Bank rate and worse off in reconstruction project in Africa, was over 50% (Ika et al. 2012). With the increase in natural disasters around the globe, it is crucial that all stakeholders and international communities involved in disaster reconstruction can learn all the intricacy enshrine in the various project they have involved with in the past (Karunasena & Rameezdeen 2010; Kumaran & Negi 2006).

The increasing in world population, urbanisation and migration will increase the population density in the city making more people vulnerable to disasters due to the effect of climate change resulting in high impact on natural disaster (Mainka and McNeely, 2011). The rate and severity of disasters will continue unabated and the demand for post-disaster reconstruction will need to be intensified. Recovery is the least studied among the stages of a disaster Management and few research into impact of incorporating sustainable procurement into post disaster reconstruction (Dash and Zhang, 2007). Many stakeholders do not consider sustainable procurement of goods and services during recovery and reconstruction, where been consider they always run into logical, organisational and structural issues (Daniel, 2014). Researcher has spent their time researching on sustainability, supply chain and procurement to develop a strategy or process in achieving sustainable procurement best practice, which is important in any post disaster reconstruction. All this effort has been implode, making it difficult to achieve a meaningful approach during this period, what the community and other stakeholder will be looking at, is a quick fix method or cost cutting measure without any consideration for the environment. Hence, this paper will consider the impact of sustainable procurement will have on post disaster reconstruction, bringing out the effect for all the stakeholder to understand the significant of implementing a sustainable procurement policy during any post disaster reconstruction.

Sustainable Procurement Impact

The urgency of post disaster reconstruction is an inherent challenge for the community in term of the need and desire to rebuild speedily, safely and equitably (Kates et al., 2007; Nelson, Ehrenfeucht and Laska, 2007; Olshansky, 2006). Time is of the essence to drive the economic recovery by creating opportunity for the community (Olshansky, 2006), and the resettlement must be timely otherwise the community might take it upon themselves to start building in protected or unsafe area (Permanent Preservation Area APP) which can inbreed vulnerabilities of the community on same situation as before (Nelson, Ehrenfeucht and Laska, 2007; Olshansky, 2006). The logistic behind post disaster reconstruction is convoluted (Zuo et al., 2008). This in conjunction with lack of adequate supply chain for materials and labours with quick demand for reconstruction will affect cost and jeopardised the application of sustainable procurement resulting in vulnerability to future disaster.

Adopting sustainable procurement in post disaster reconstruction will embolden sustainable development and disaster resilience of the concerns community. Any post disaster reconstruction that does not complied with sustainable procurement strategy will exacerbate future disaster and reducing sustainable benefit, using sustainable procurement method will help to achieved the goals associated with 'building back better' and 'building back safer' (Berke and Beatley, 1997; Kennedy et al., 2008; Smith and Wenger, 2007). Natural disaster is described as a triggering factor build on existing social, economic and environmental issues which increases sustainable trends. In many part of the world, sustainability issues has left many community highly vulnerable to nature disaster (Aquilino, 2011; O'Brien et al., 2006; van Breda and Laprade, 2008; Roseberry, 2008). The loss associated with this are greater in developing world compare to developed countries. Hence, the need to concentrate on sustainable procurement process during post disaster reconstruction since it emphasis on continuing community resilience, in order to "build back better and safer", and promote a culture of prevention' (Guarnacci, 2012).

Method

The current research builds on past definitions of sustainable development and applies an adjusted definition of sustainable procurement created specifically for the post-disaster context: *Sustainable Procurement during post-disaster activities is a process where services/resources are acquired/ provided through best value for money for the affected citizens whilst generating economic and social benefit without undue disadvantages to natural environment.*

This research, however, did not ponder on the analogy of sustainability; but base on the principles of Sustainable procurement, such as minimising total wastage and environmental degradation.

This study aims to address gaps in the existing knowledge of sustainable procurement on post-disaster reconstruction by examine the impact in a post-disaster setting. The research is focused on using an unsustainable procurement means on post disaster reconstruction that can impede long term recovery, create new risks or exacerbate old ones, such as increased vulnerability to flood and coastal disaster. The research examined London 2012 Olympic Games and Paralympic Games sustainable procurement practice and how it can be a best practice for post disaster reconstruction. They have employed sustainable procurement process as an important tools in delivering the Games throughout the major stages in the development of the project, which stage from planning and construction, staging the Games and realising the legacy with the overall aims of achieving healthy living, inclusion, waste management, climate change and biodiversity and ecology. The primary data collection consisted of semi-structured interviews with informal stakeholders and direct observation during field visits to disaster affected areas in Brazil in July 2018.

Findings

This analysis is based on a case study of London 2012 Olympic Games and Paralympic Games, which will provide us the practical basis of sustainable procurement. Interview with informal stakeholders during site visits to Brazil with community affected with flood and coastal disaster will be used in analysis to fashion out the benefit or impact of sustainable procurement will have in redeveloping the community.

The adoption or acceptance of sustainable procurement on post disaster reconstruction over the conventional process will depend on impetus and ability of both formal and informal stakeholders in dealing with issues surrounding awareness and priority during this volatile period when the community concern

were shelters for temporary housing and security against health and safety of all and sundries, instead of combing sustainable procurement of goods and services with programming. Some of the barriers deduces from the research include but not limited to: Alleged trade-off between iron triangle (cost, time, quality) and sustainable factors (social, economic, environment), also more unsustainable ideology are more acceptable during planning because the stakeholder wanted to recover their community on time with limited resources without paying attention to quality guarantee.

Conclusion

Sustainable procurement comes with an inherent benefit which the supply chain must manage together with other procurement and sustainability legislation without infringing on stakeholders requirement while maintaining a balance legislation and client pressure in quick redevelopment. The UK has an established legislation and regulatory framework in place for sustainable development which deal with energy and climate change, act as drivers for sustainable procurement process. In Brazil or any other country prone to disasters should be encouraged to implement sustainable procurement strategy during post disaster reconstruction and where no tangible legislation in place to act as a guide in the implementation process and this should be enacted by the government for the full benefit to be reap.

It is necessary to shift focus from responses and recovery to sustainable procurement. In order for this to happen, this paper suggests sustainable procurement on post disaster reconstruction over the conventional process. This approach must be supported by necessary legislation and framework.

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APPLICATION OF DIGITAL TECHNOLOGIES IN RESILIENT PERFORMANCE OF CIVIL INFRASTRUCTURE AND BUILT FACILITIES

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Abstract

Infrastructure performance is of great importance for a nation's economy and its people's quality of life. Inadequate infrastructure is estimated to cost the UK £2 million a day, in terms of maintenance and management. The fast development in digital technologies, including sensing technologies, smart materials, advanced artificial intelligence techniques, etc, enables the digital transformation of civil infrastructure. Nowadays new types of monitoring sensors and systems have been developed, such as optical fibre sensors, ultrasonic guided wave sensors, and wireless sensing technologies. The popularisation of smartphones provides a cheap and easy-to-use sensing system (through their GPS receivers and vibration sensors) for monitoring purposes. This can not only enhance the quality of built asset management and to lower the whole-life costs, but also provide early warnings in extreme events, such as earthquake, tsunami, landslide, etc, to safeguard critical civil infrastructure. Currently, a large volume of real-time sensing data, affected by operational, structural and environmental conditions, can be collected. They are expected to provide more detailed information regarding the actual conditions of a structural/mechanical system compared to traditional inspection techniques. However, compared with the advancement of sensing technologies, the interpretation of the sensing data with different formats, specifications, and measured properties, remains a challenge. Following the identified gaps, there research questions are proposed: 1) what are the innovative sensors for the monitoring system in emerging scenarios (offsite construction)? 2) according to

different sensing paradigms and different monitoring parameters, what are the state-of-the-art data interpretation technologies? 3) How to use the sensing data to guide disaster prevention in extreme events?

Keywords: Civil Infrastructure; sensing technology; artificial intelligence; data interpretation; disaster prevention.

AN INVESTIGATION INTO THE DOMESTIC ELECTRICITY SUPPLY AND DEMAND SECURITY OF FLOOD-PRONE AREAS. CASE STUDY OF THE SOUTH-EAST OF ENGLAND

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Abstract

In the UK, domestic electricity demand and supply security has attracted considerable research attention in recent times. Several research-policy directions have been proposed such as modelling demand characteristics, demand balancing, demand-side management and projecting demand flexibility. These have largely been driven by cost reduction for the stakeholders (suppliers, consumers, regulators and in recent times, aggregators). Despite these, limited attention has been paid to policies that can enhance supply and demand security at times of natural disasters especially in the South East. Some gaps such as restructuring the centralised grid system, investigating the demand attributes of flood-prone areas and a specific policy framework to restore supply and demand when floods occur persist. Currently, there is limited data on the specific demand needs during and after floods occur. This study examines the current and future trends of domestic electricity demand with focus on residential demand in the South East and how this data can be derived to ensure energy security. Survey and energy data from national studies are proposed to achieve this. Intended outcomes include demand variability policy recommendations from electricity use timing and rhythms.

Keywords: Domestic electricity demand, energy demand and supply security

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