

Industrial losses caused by floods: is it worthwhile to stay in risk?

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What is this study about?

- **Economic effects of urban floods are under-researched within the Brazilian industrial sector, mainly at local scales.**
- This research has the **aim** to explain **how public, private and non-governmental representatives of Esteio, a small municipality, understand the concept of resilience to flood events.**

Why Esteio?

- It is a municipality of the Metropolitan Region of Porto Alegre, Rio Grande do Sul State, Brazil, rated in **18th place in terms of GDP among 497 State municipalities.**
- It presents **the highest demographic density of the State** - almost 3,000 inhabitants per square kilometer in 32.5 sq kilometers.
- It presents a **2nd highest demographic density of the whole South Brazil Region, only behind Curitiba.**
- It is **highly vulnerable to floods**: low topography, high impermeabilization levels, mainly in downtown.

The place of study



Source:
Brubacher (2016)

More reasons to focus on Esteio...

- Esteio has almost 63% of its urban area (27 sq kilometers) under threat of frequent flooding (César, 2015).
- It holds a variety of industrial firms.
- It is placed in the neighborhood of relevant federal (BR 116, BR 448) and State (RS 118) highways, that enable a privileged logistical situation.
- The main oil refinery of the Southern Brazilian region is on the edge of Esteio, influencing positively the local economy.

Research Gap

- Hydrological disasters are under-researched when it comes to the assessment of the losses for industrial sectors.
- A review in the main international academic data bases (Web of Knowledge, Science Direct, Emerald) regarding floods, supply chain disruption, and industrial losses, retrieved **2,797** references from 2010 to 2016. **Only 25 of these studies cover the issue of industrial losses.**
- In the Brazilian database of the main Industrial Engineering congress proceedings, there were found **17 studies in the same period of time, but none related to industrial losses.** Such studies cover the issue of humanitarian aid and logistics schemes that can be improved under Industrial Engineering tools and methods for making humanitarian aid more efficient.

A hideable problem...

- In the last decade, especially in 2013 and 2015, Esteio suffered due severe floods that caused losses to citizens and to the private sector.
- Nevertheless, firms' representatives avoid talking about losses, and prefer to focus on reactive measures, that they understand as resilience.

Floods

- Are events in which a watercourse breaches its banks, occupying meadows, that is a natural area of any hydrographic basin.
- **Studies on flood impacts are increasingly common in Europe** (Merz et al., 2010), mainly in Germany and the U.K., that have been recently affected by such phenomena.
- Besides general losses estimations, investigation about **supply chain disruption** due to floods are increasingly common (Kumar and Havey, 2013) in Europe and Asia.

Remarkable floods, remarkable damages

- **Thailand, 2011**

Toyota stopped its production for 42 days, and lost 240,000 automobile units;

Nissan stopped for 29 days, and did not deliver 33,000 units of production;

Honda had 174 days with no production, and lost 150,000 units of production (Haraguchi and Lall, 2015).

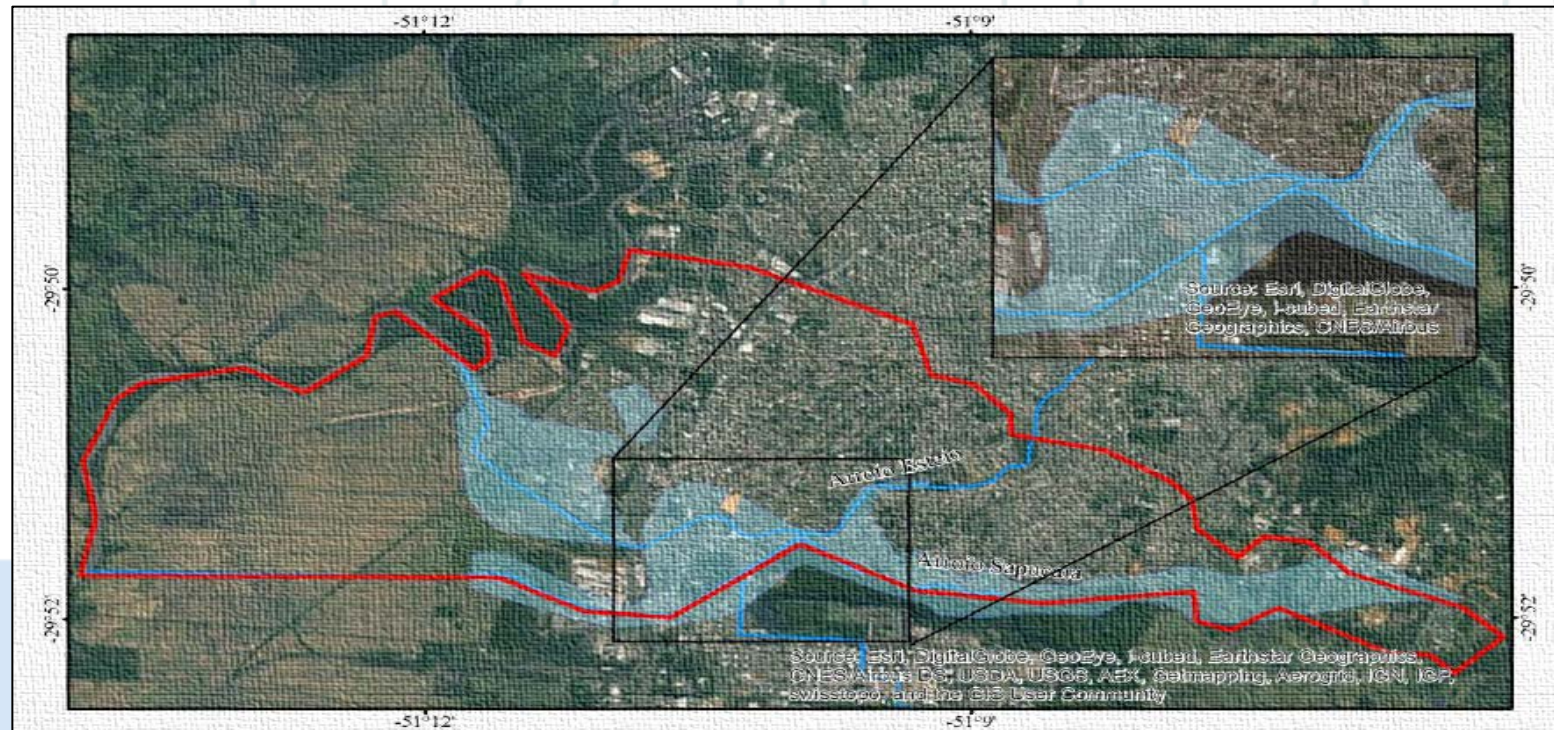
Seagate, Western Digital, and Toshiba recorded supply chain

- **Germany, 2013**

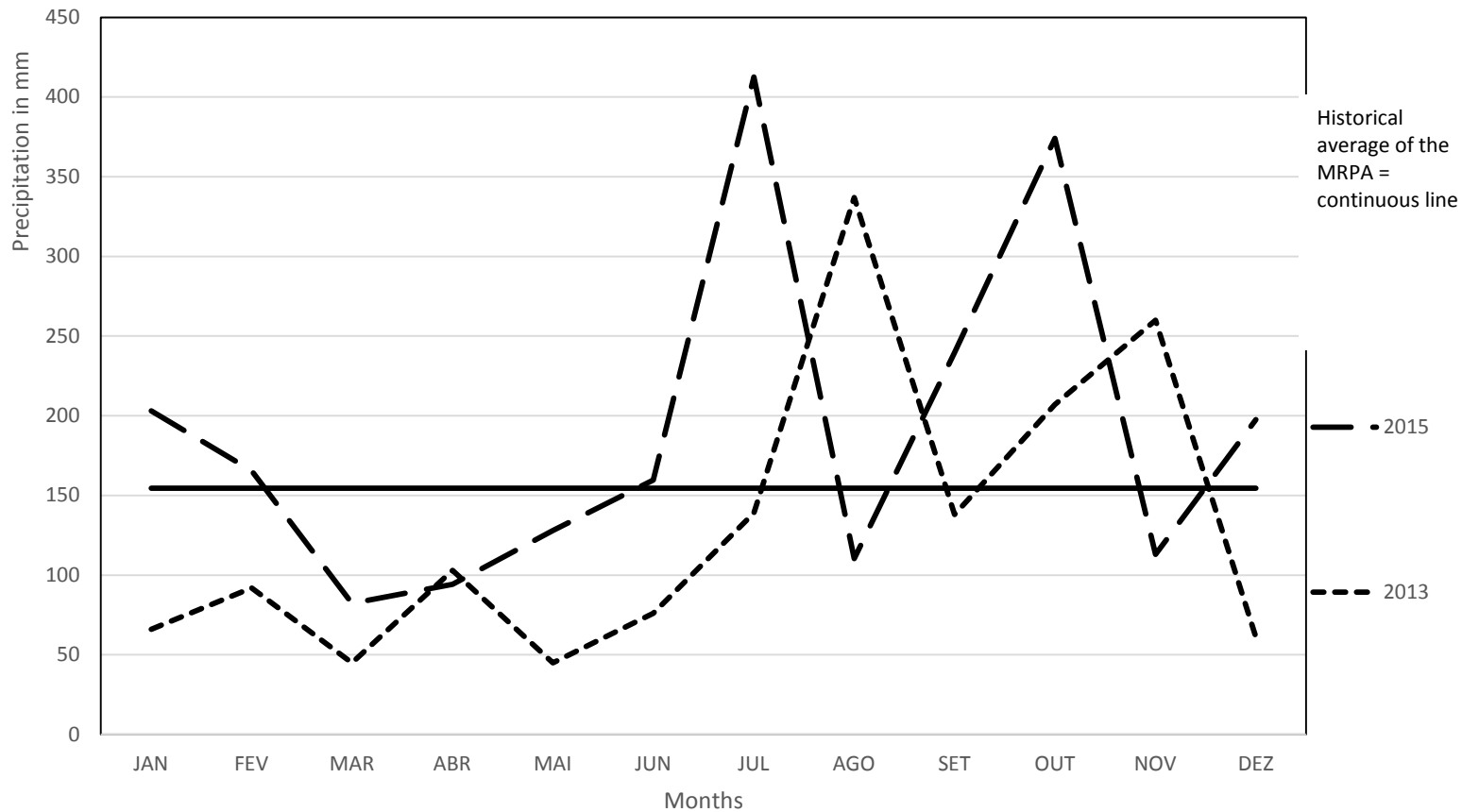
A flood in Westphalia resulted in export disruption, difficulties accessing raw materials, loss of production, with the main impacts in the automotive sector.

High density rain records

- In 2013, Esteio had **3,000 mm of precipitation**, while the Metropolitan Region of Porto Alegre had 1,500 mm.
- In 2015, such records were **4,100 mm** and 1,800 mm, respectively (Civil Defence of Esteio, 2016). The below figure shows flooded area (source: Brubacher, 2016).



Unusual patterns of precipitation



Source:
Civil
Defence
of
Esteio
(2016)

Resilience concept

- It is a mix of **robustness, flexibility, and adaptation capacity**. There are several dimensions in which resilience is employed – ecological, sociological, organizational, physics, materials science. In a broad sense, **resilience is the extent to which a system, organization, or individual is able to absorb changes, disturbances, and keep on functioning through adaptation**, generally at a different level from the initial state. In a broad sense, resilience is the ability of continuous rebuilding (Soni et al., 2014), or returning to a previous disruption situation (Matsuo, 2015).
- In **supply chain management** resilience is the ability to keep on the SC working despite disturbances.

Research field – Private agents

Bakery, small firm, 66 employees, 15 years in Esteio.

Plastic industry, big business, 2,500 employees, 20 years in Esteio.

Metallurgic industry, small firm, 45 employees, 20 years in Esteio.

Mechanic industry, small firm, 10 employees, 11 years in Esteio.

Service firm, small, 3 employees, 8 years in Esteio.

Rep. of Ind. and Com. Association, business leader, since 2013 in charge.

Questions for private agents

- 1 What was the main flood episode in Esteio and how do you managed to endure it?
- 2 How do you understand resilience?
- 3 Do you think your firm is resilient to floods? (Explain.)
- 4 What were the losses, caused by floods, you firm have had regarding to production, days of work, client, suppliers, logistics, infrastructure, and others? (Specify quantities.)
- 5 Why do firms stay in Esteio even suffering losses ?

Research field – NGO agents and questions

- **Community center** - Informal organization, leaders have not sure when they started to collaborate.
- **Neighborhood association A** - Formal organization, since 2014.
- **Neighborhood association B** - Formal organization, since 2011.
- **Environmental organization** - Formal organization, since 1988.

QUESTIONS

- 1 What was the main flood episode in Esteio?
- 2 Do you think that firms placed in Esteio, and general community, are resilient to floods? (Explain.)

Research field – public agents and questions

- **Civil Defence of Esteio** - representative, in charge since 2011.
- **Environmental Local Authority** - representative, in charge since 2013.

QUESTIONS

- 1 What was the main flood episode in Esteio?
- 2 Do you think that firms placed in Esteio, and general community, are resilient to floods? (Explain.)

Data triangulation, results, discussion

Private agents: all but one mentioned that the main flood has happened in 2015.

They understand **resilience as capacity to adopt mitigation measures**, mainly regarding improvements in facilities and equipment acquisition.

Measures: buying draining pumps, bulding walls, closing windows, hiring cleaning service, moving to the second floor ... all palliative measures.

“After the last flood, we spent R\$ 300,000 for water draining, and R\$ 23,000 for fixing power generators. We also hired a service to clean the sewers after the floods”. (Bakery firm representative)

Data triangulation, results, discussion

Private agents: Firms were reluctant to talk about their losses.

Lost days of work: more significant for metalurgic and metal-mechanic sectors .

Metallurgic stopped working for 30 days in 2013, and seven days in 2015, when the whole factory was submerged. Contracts with customers were not honored, and communication was cut off.

Metal mechanic firm had 30 days of work lost in 2015, and had to renegotiate its contracts. Delays in deliveries of finished goods were the main problem.

Bakery was the only one that opened information on monetary losses, estimated at R\$ 1.5 million

Data triangulation, results, discussion

NGO organisations: All but one representative of non-governmental organizations consider the 2015 flood the most damaging they have known.

“3,000 persons were affected by the flood in 2015, a number higher than observed in previous floods”. (Communtary leader 1)

NGOs are unanimous regarding the current lack of resilience from communities, private, and public agents.

“Usually, everyone keeps the same careless behaviour with streets and buildings, and it is easy to forget the pain of the last flood”.

(Communtary leader 2)

Lack of social cohesion was observed by all NGOs representatives.

Data triangulation, results, discussion

Public agents: Civil Defence Representative: *“The community keeps on putting garbage in manholes and streams, and this type of behaviour makes resilience just a matter of mitigation rather than prevention.”*

Environmental local authority: There is no possibility to fully compare the 2013 and the 2015 floods, because the situation of the municipality regarding occupied places was different, and the municipal authorities have taken some measures to prevent flash floods in recent years, as: *cleaning sewers, draining flooded spaces, resettling people currently in irregular housing.*

Concluding remarks, future research directions

Private agents are inclined to see resilience as a material resistance to adverse phenomena. The perception of resilience by firms is disguised or shallow, focused on palliative measures. Business owners feel safe with physical barriers and pumps to drain rainwater after several floods have affected their buildings.

Many of them have strong bonds with the municipality, and accept the risks in order to maintain their businesses in that place.

Privileged logistics and closeness with refinery oil helps to keep them in the mode “business as usual”.

Private agents avoid talking about losses, and show concern with the possibility of noncompliance with contracts that can lead to the loss of suppliers and customers.

Concluding remarks, future research directions

Non-governmental leaders recognize the efforts of firms to maintain their business, but they see resilience with a deeper meaning.

Local authorities argue that firms prefer to accept risks in order to preserve their space in the business scenery.

Further research is necessary to better classify and quantify industrial losses caused by floods.

Such data would enable business owners to become better prepared for future natural disasters.

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