

Participatory master plan, territory and floods in Rio do Sul/State of Santa Catarina

Plano Diretor Participativo, território e inundações em Rio do Sul/SC

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Abstract

The study was carried out with the objective of crossing information about urban planning and natural disaster management, having as object the municipality of Rio do Sul, State of Santa Catarina. Using GIS, vector layers of floods that occurred in the city were interpolated with the zoning of the Participatory Master Plan. With territory as the theoretical framework, we discussed the power relations involved and their effects on the local urban morphology. Our aim was to provide an academic contribution to the technical and critical analyses of urban planning and management that were conducted after the approval of the City Statute, necessary for cases of other Brazilian cities. We concluded that the technicians responsible for the master plan did not consider floods in the process of composition of this instrument, influencing the spatial agents' action and reinforcing the segregation processes that already occurred.

Keywords: urban planning; urban flooding; urban management; geographic information system; territory.

Resumo

O estudo deste artigo foi realizado com o objetivo de cruzar informações entre planejamento urbano e gestão de desastres naturais, tendo como objeto o município de Rio do Sul/SC. Foram interpoladas, utilizando SIG, camadas vetoriais de inundações ocorridas na cidade com o zoneamento do Plano Diretor Participativo. Tendo território como referencial teórico, discutiram-se as relações de poder envolvidas e os efeitos observados na morfologia urbana local. Buscou-se contribuir academicamente com análises técnicas e críticas de planejamento/gestão urbanas pós-Estatuto da Cidade, necessárias para casos de outras cidades da realidade brasileira. Concluiu-se que os técnicos responsáveis pelo Plano Diretor Participativo pouco consideraram as inundações no processo de composição desse instrumento, influenciando a atuação dos agentes espaciais e reforçando os processos de segregação que já ocorriam.

Palavras-chave: planejamento urbano; inundações urbanas; gestão urbana; sistema de informação geográfica; território.



Introduction: interests and disasters in a new national context

The urban occupation and natural dynamics relations (hydrological, climatological, geomorphological, etc.) has a trend to present conflicted processes, that have their own spatial dynamics and result in territorially delimited consequences. The urban production and reproduction of space encompass these tensions, changing cities morphologies where these subjects are relevant to their respective historical and spatial contexts of consolidation. In the Brazilian case, a semi-peripheral country with characteristics of an unequal capitalism, the spatial agents show huge heterogeneity, flirt and interact between them and compose a range of interests hard to count.

These characteristics are not confined only to the big national metropolis, but manifest spatially in different scales, hitting also the small and intermediate cities. In these environments, the relations of interests, and by consequence, power, can manifest itself in a more sharp way at the space comparing to the big centers, specially through the spatial agents acts, like, for example, industrial and real state market, the needs and objectives of social movements, State acting (in different government instances) and also the urbanism technicians.¹

In a moment that the national scale conditions advanced in a direction of the institutionalization expansion of the urban planning through the whole country, with the Estatuto da Cidade (Brasil, 2001)

consolidation and the Participatory Master Plans (PMP), the above-mentioned tensions surfaced and became a central subject at the scientific researches in Brazilian urban planning.² The necessity to zone, the wishes for a more efficient urban management and the challenge to articulate the interests game that compose the cities became marks of this new moment, manifesting it in a different way at the sundry territories through the country. The natural disasters management, another element of this "cauldron", looks to not have gained the proper importance by the planners and served even as a determinant factor to the spatialization of the real market profits, just like the case of study discussed here.

In September 2011, the Rio do Sul municipality, most populous city of the Alto Vale do Itajaí region, state of Santa Catarina, had one of the biggest natural disasters of its record, floods that reached 12,96 meters over the riverbed, the second highest of its history. Its consequences were huge economic and social damages, arising from a disorderly territorial occupation, susceptible to this kind of event.

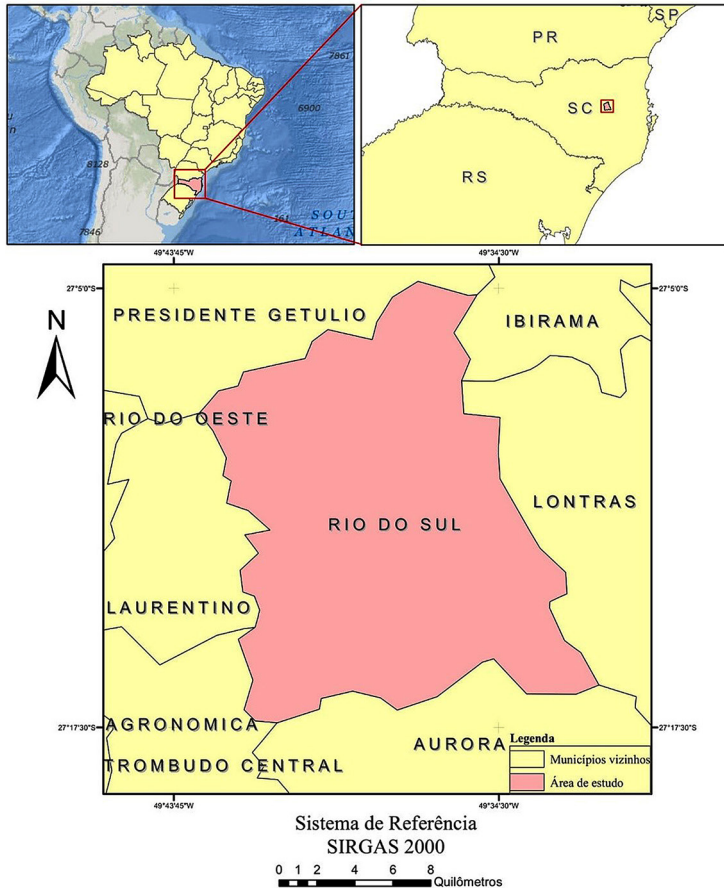
However, minor floods that also interfere in population's lives are becoming more frequent, especially because of the anthropization of non-suitable to urbanization spaces. And it is, on this context, that this case of study was formulated, with the objective to evaluate, using Geographic Information Systems, the Participatory Master Plan of 2006 zoning and its relations with the persistent floods in Rio do Sul, that cause various territorial consequences.

The urban floods in Rio do Sul

Just before discussing objectively the flood, it is necessary to understand, at least superficially, what is Rio do Sul's location and positions in its urban network, as a regional center of small size for the Brazilian patterns, but with a significant regional importance. With a population measured by the census as 61.198

inhabitants and estimated today as 71.061 (IBGE, 2019), the city is the most populous of the microrregion of the same name, composed by 20 municipalities. The region is colloquially known as Alto Vale do Itajaí, name of the local municipalities association (Associação dos Municípios do Alto Vale do Itajaí). Its location is relatively central in the Santa Catarina state, what can be seen at Map 1.

Map 1 – Localization of Rio do Sul/SC municipality



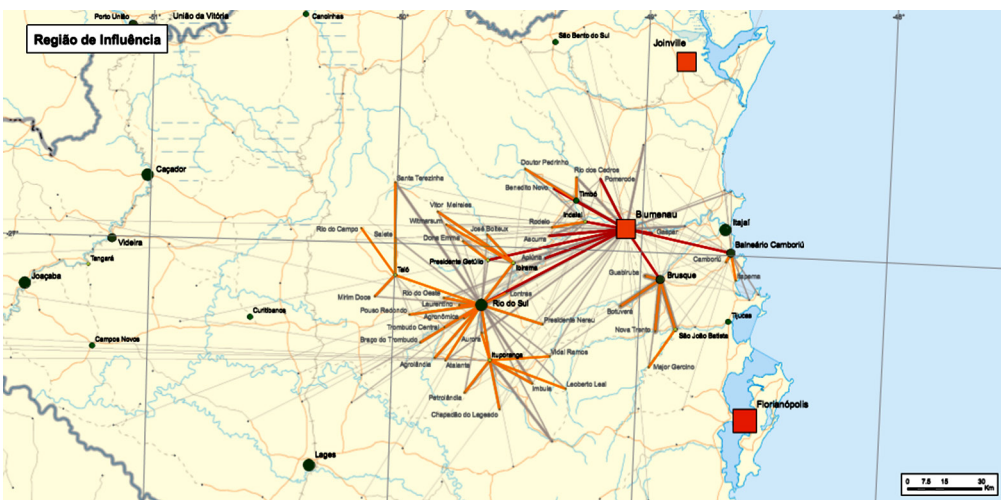
Source: labored by the author.

In terms of urban space, Rio do Sul presents intense conurbations with Lontras and Angraonômica municipalities and, in a more mild way, with Aurora and Laurentino. According to IBGE (2007), the city can be classified as a sub-regional center A,³ influencing directly ten local centers and three B zone centers (Ibirama, Ituporanga and Taió, which on with, respectively, three, six and four municipalities of "local center" levels on its spheres), being a subordinate of bigger centers as Blumenau and Florianópolis, what is possible to see at Figure 1. In economic and social terms, this municipality presents relevant significance in the state, having a gross domestic product of about R\$2,5 billion, Santa Catarina's 21^o place (IBGE, 2019), and with a Human Development Index of 0,802, very high, being the 9^o best in the state and 36^o in the country (PNUD, 2013).

Understanding its regional position, it is possible to focus in how the urban floods are an essential factor to comprehend the urban reality of Rio do Sul, being an intrinsic part of its history as a city and municipality. For that reason, it is a memorable theme for the media and local popular imagination that, respectively, notice and live these phenomena.

In historical and spatial terms, these floods are present in the local reality since the colonization and urbanization beginnings. Cardoso (1984) describes massive events in 1880 and 1911, for example, that, even being measured only in the central region of Blumenau at the time, presented reports that treat about its impacts in what is today the municipality of Rio do Sul (a Blumenau district at the time). To understand this dynamic, it is needed to look at the situation's two main aspects: the physical environment in which the

Figure 1 – Rio do Sul’s position in the urban network, at Blumenau’s influence area



Source: IBGE (2007).

city is involved; and the space anthropization resulted from the demographical growing and the subsequent urbanization (Bogo, 2016).

About the first aspect, it is needed to comprehend Rio do Sul's presence in the Itajaí-Açu river hydrological basin that, according the Santa Catarina Atlas (1986), is the biggest basin entirely in the Santa Catarina state. However, it is not only this characteristic the floods cause, as in the riosulense case there is a complex relation of factors that favor these events. First, the classifications presented by Pandolfo et al. (2002) insert Rio do Sul in a subtropical weather (Koppen-Geiger method) or mild mesothermic type 2A (Braga & Ghellere method); for this analysis purposes, however, the most important of these findings is the rainfall index, which ranges among 1300 and 1500 mm yearly, showing the considerable amount of rain that hits the municipality through the year.

The Santa Catarina Atlas (1986) and the Geological Map of Santa Catarina (1986) also add the substrate factors that intensify the flood occurrence. These publications establish that the local geology is composed mostly by siltites, claystone and varvites, what Machado (n/d) argues as being sealant rocks, making it difficult the water absorption. The soils, in its turn, are classified as old and humid, something that influence the floods maintenance for a longer period, as according to Oliveira, Oliveira & Soares (2010), this kind of soil presents, in general, low permeability.

There is, therefore, a relation among high rainfall indexes, a high capacity hydrological basin, including geology and pedology that difficult the water absorption, aspects that influence floods occurring.

However, would be too simple to consider just the natural dynamics as this municipality floods cause. The human activities influence is strong in this case of study, beginning since the colonization period until the municipality emancipation and the Rio do Sul urban center densification, between the 30 and 40 decades of the 20th century.

This thesis is sustained by Colaço & Klanovicz (1999), as the authors assign that most part of Rio do Sul's occupation happened as a "random" effect of following its main river, without creating a city center at the time. This just happened during the 1930 decade, with the timber industry growing, specially the Odebrecht family enterprises, as described by Cardoso (1984). As a consequence, the city center, as known today, came to be established during the 1940 and 1950 decades, being close of the Itajaí do Sul and Oeste rivers, what Colaço & Klanovicz (ibid.) call a "urban structuring node", in line with the local economic and demographic growing of the period.

The relation between the urban morphology and the floods was already observed at the time, progressively beginning the effects seen today in Rio do Sul: the urban rental market depreciation in floodable areas, a growing migration to higher areas by the wealthiest classes and a consequential pushing of the poor to regions with the lowest flood quotas, as analyzed by Bogo (2016). This is a clear evidence, even with a hard empirical accounting, of a strong relation between natural and anthropic aspects of urban space production and the real estate market appropriation of this dynamic.

It is, in this spatial-temporal context, that also Colaço & Klanovicz (1999) and Poleza (2003) treat directly of the spatial

disorganization that happened in Rio do Sul urbanization, where there was not a territorial ordinated land occupation. The non-planned street layout is a result of this process, for example. It happened also the emergence of an environmental crises, as the lack of control about the environmental legislation and also the hydrological basin uses to ravel out any kind of wastes and effluents, like domestic or industrial ones. There was attempts of a master plan implementation for the municipality in the 1960 and 1970 decades, mostly because of the federal developmentalism propaganda. However, none was effectively implemented, what Poleza (ibid.) sees as an aggravating factor for the city environmental problems, allowing non controlled urbanization.⁴

Considering this brief historical remembering, it is possible to understand the conditions that took to the environmental

disasters of 1983 and 1984, when the river water elevation reached, respectively, the 13,58 and 12,80 meters quotas. These are the biggest and third biggest (Chart 1) of all the historical flood record of the municipality, that surpass a hundred years (Camargo, 2015).

Concerning to the 1983 event, Poleza (2003) lists a series of urban problems that allowed the phenomenon to be even more impactful. First, the urban concentration that occurred from the 1970 decade⁵ influenced the urban population to be already 92% of the municipality total at the time (IBGE, 2011), resulting in a stronger occupation of the zones close to the river. Second, the non-occurring of floods that affected the central area (just the lowest quotas, striking only the poor) since the 1950 decade made the own public power to diminish the urbanization control, including in the occupation of floodable territories.

Chart 1 – Five biggest flood quotas of the Rio do Sul historical record (from 1983 to 2017)

Year	Flood quota (meters)
1983	13.58
2011	12.98
1984	12.80
1911	12.20
2017	10.89

Source: PMRS (2019) – labored by the author.

The event lasted for 13 days, and all the Vale do Itajaí suffered with it, leaving homeless around 250 thousand people. Just in Rio do Sul were 25 thousand, 70% of the municipality's population at the time, according to IBGE (*ibid.*) data. The author adds the fact that this flood surpassed by far the 1954 flood, since all the urban and social classes were affected, and not only the less wealthy that used to live in the lower parts. The factory sector was also damaged, since from the 125 industries present in the city, 120 had some kind of prejudice (Poleza, 2003).

In 1984 another strong flood happened, what Mattedi (1999) classified as an event that hit an already weakened population that was trying to recover from the last year's disaster. The author also describes that, not only the climate aspects interfered, but also the Vale do Itajaí population's socio-economical and geographical vulnerability, what reflected in Rio do Sul.

After 25 years of amenities about big floods (with some small ones happening during this period), Rio do Sul developed economically with its industry, specially textile, in line with the Vale do Itajaí reality (Siebert, 1997). This resulted in a better quality of life, showed (even in a superficial way) the already mentioned municipal HDI, a very high one (PNUD, 2013), and also changes in the urban morphology, like the verticalization rise. In reference of the urban planning, two master plans succeeded through the period, the 1995 and 2006 ones, but they almost did not modify the city's relation with the floods (Bogo, 2016).

The 2011 phenomenon, by its own, registered the second biggest quota of Rio do Sul's history (Chart 1), and the impacts were also huge, as by the fact that, according to Espíndola & Nodari (2013), the city was not prepared, in structure, management and disasters planning terms to deal properly with this event.

The damages summary can be seen at the Lapolli (2013) reports, that 15 thousand people were displaced and 3 thousand turned homeless. Being this the second biggest flood in the city's history, the socio-economic damages were highly significant, reaching a R\$283 million in prejudice, with 80% of the municipality affected, and 20% of the streets impassable. This high stakes flood, added to the others listed before, have the power to call media's and population attention around the environmental and planning problems that the Rio do Sul inhabitants have to deal in a daily basis. The debate tends to intensify, since the recent events of considerable size, like the 2013 (10,39 meters), 2015 (10,71 meters) and 2017 (10,89 meters) ones (PMRS, 2019).

However, it is needed to discuss about the frequent floods of minor size and less spatial range, but which hit directly mostly the houses of low income populations, what shows, by consequence, the economic and politic power relations that territorialize themselves on the urban space. Recent examples of this reality can be seen in the last flood events that happened in 2018 (7,34 meters) and 2019 (7,55 meters) (*ibid.*, 2019).

Territorialities and floods: which are the possible relations?

The concept of territory is complex, being, as argued by Souza (2006), of huge scientific richness. The diverse amount of authors (Gottman, 2012; Raffestin, 1993; Sack, 2011; among others) work on its applications on variable spectra, being it economic, social, natural or even the articulations of them all.

It is possible to analyze the territory as "spatially delimited power relations that operate over a subtract of reference" (Souza, 2013, p. 97). And, for every interaction to happen and also for the application of power, it is needed the presence of territorial agents, being them individuals, groups or classes. Correa (1986) describes the urban space agents as modifiers of its morphology through complex relations that compose them. It is possible to extend this concept also to the territorial dynamics, as these agents exercise power in relation to the land use according to its interests. However, we should not mistake the concepts of space and territory. As approached by Raffestin, "Space is the "original prison", and territory is the prison that men build for themselves" (1993, p. 2). So, the main aspect about territory concept are the power relations on space and where they happen.

From the concept of territory, others are born, like territoriality, and territorialization/deterritorialization. To Sack (2011), territoriality is "[...] the attempt, by a group or individual, to affect, influence or control people, phenomena and relations, by delimitating and securing control over

certain geographic area" (ibid., p. 76). That is, the author describes what happens as a power developed at the territory, as the different spatial agents create territorialities with objectives that in a lot of situations are connected to the certain location of certain territory and that will have articulations of economic interests to the agent that executes power and, by consequence, becomes a space producer, being in a material way or in a symbolic perspective. So, Sack (ibid.) realizes territoriality as a strategy applied by human beings in the most variable scales, evidencing how spatial relations are not neutral.

With this discussion it possible to understand how elucidative are these concepts for the Rio do Sul case of study, considering that the urban floods are a significant part of the territorial relations among human agents. An argument in favor of this thesis is the report by Colaço & Klanovicz about how the floods influence, specially the big ones, had in the real estate market of Rio do Sul, which the authors call as "social relocation", when "[...] the wealthier from the lower parts of the city look up for land uphill, considered until that moment as occupied mostly by the poor" (1999, p. 143).

The effects got deepened and generated internal transformations that clearly modified the city's urban morphology, through phenomena like real estate speculation, eviction of low income populations from certain areas and housing expansion non followed by infrastructure, since

The lots had their market values changed after 1984: the non-floodable regions, specially the hills where low income residents used to live at the time, got rapidly valued. However, the

hills had their own problems: lack of infrastructure, streets with no previous layout, lack of street lightning and almost nonexistent basic sanitation. Beyond that, the already installed houses did not have a construction pattern as good as the ones from the lower regions or the city center. It turns out then a restructuring and displacement of a significant part of the population, in other words, the hills inhabitants started to buy houses in the lower areas for a cheaper price, while families with higher incomes bought land or houses from the previous dwellers, reforming houses or building new ones. (Ibid., p. 144)

The phenomenon repeated itself in the following years after the 2011 flood and intensified after the more recent ones of 2013, 2015 and 2017, devaluating progressively the land price in floodable areas. Is at this moment that it can be seen, at practice, the territoriality concept as worked by Sack (2011). Since that, according to the author, it is a powerful geographical strategy to control people and things through area control, it turns clear that this is about power relations on space and the exercise of this power, in many times realized by the State, private sector or the articulation between them. The floods, characteristically from this local space, serve as another determinant in power application by these spatial agents, using it to delimitate specific areas in favor of certain interests or valuating others in favor of a bigger profit, respectively.

In the case of studied analyzed here, it is clear that exists an territoriality by the local government (in other words, the municipal chamber) that, when elaborating the master plan⁶ and conditioning the land use, allows

the construction on certain areas of the municipality and deny it on others. The law, in this case, is the tool for exercising a certain form of territoriality. And is noticeable how the public power position itself as a space agent (or territorial, in this case), according to the terms of Correa (1986). Law and zoning are not interests free, in a way that the land use delimitation by the PMRS tends to answer the needs from a narrow group, at the expense of most part of the citizens.

In a scientific analysis, as the one made here, to research which are the interests and power projects involved in this sociospatial would demand a qualitative research that escapes from the focus of this paper.⁷ However, it is possible to identify superficially which are the spatial agents involved in this plot, as the of institutional character as other actors that are "outside" of the process.

Based on Correa (ibid.) it is possible to put the group of spatial (or territorial) agents in a triad, which its relations cross and overlap each other, being them: society, State, and market/capital. In the case studied, the population is represented mostly by its relation with the market sphere in the realty buying and selling process, which suffers direct impact by the disasters, as shown previously by Colaço & Klanovicz (1999). The popular insertion in participation channels and the social movements acts with agendas about housing problems⁸ or with counter-hegemonic purposes are really small, something discusses by Lapolli (2013) as a unchanged scenario, even with the highly often occurrence of floods in the 2010 decade.

The State present in its institutional diversity and with is characteristic heterogeneity, which the focuses and

objectives of policies (and also the actors, individuals or interests involved in it) are not the same. In the riosulense case, there is a special spotlight to the planning secretary acts, responsible for the PMP discussed here (and also the later, from 2014); the Civil Defense that, after the 2011 floods, improved its apparatus and monitoring about the possibilities of floods occurring and also landslides;⁹ and the National Agency of Waters, in which the Rio Itajaí basin committee, composed by 50 municipalities, have as function to elaborate integrated plans and deliberate about environmental matters involving water use. With these agents identified, what is noticeable is that these relations are rowdy and not integrated about urban aspects. In a city with a history of flooding and inside a valley directly influenced by its hydrological basin, the local planning should be more articulated with Civil Defense and NAW, being more restricted to flooding and landslide areas. The existent territorial relation is that the PMRS, through its master plan, do not restrict enough the private capital's acts and do not changes the current processes that prejudice the population's quality of life, specially the low income classes. The civil defense is closed basically to a monitoring role, not the purposeful one needed for a high quality urban and disasters management.

And the market is marked specially by two agents with huge importance in the city: real estate market (construction and building companies and the renting/buying process that happens next to it) and industries. The private sector in the real estate market in Rio do Sul deal directly with the floods conditioning. Being it the high impact ones, rarer, or even the

smallest, almost yearly, that generates different land use values. Is at this point that the concept must be understandable and applied, since according to Sack "We have to know not only what territoriality is, but what it does. And it is specially there that lands the value of a definition: helping to indicate the important effects of a phenomenon" (2011, p. 75). In other words, the territoriality effect was the rise of land prices in uphill areas, attached to the spatial power application by the real estate market. The industries are also propellants of this effect, using their economic and political force to obtain municipality areas that allow production outflow, mostly relating itselfs with the BR-470 road; there is a new evidence of the correlation between private sector and public power. Knowing about the position close to a road makes sense in urban planning point of view, it is worth mentioning that these same industrial zones are not hit by small floods, that happen often, with its majority suffering damages only in the huge events.

And are precisely these smaller events, when the river hits up to the 8 meters quota, equivalent to about 37% of the events. If we consider until 9 meters, the percentage rises to 63%, according to PMRS (2019) data. So, it is possible to understand that this smaller floods, that receive less media and part of the population attention, are precisely the most commons pivots of *deteritorialization*.

This sub concept is presented by Souza (2013) as processes of social and spatial exclusion, which the inhabitants of certain territory are displaced and uncharacterized from it, interfering directly on individuals' quality of life and also creating an effect of "uprooting" in relation to the spatial identities of these localities.

The deterritorialization phenomenon is recurrent in Rio do Sul, either by State power application and, by consequence, the private sector, when there is residents displacement for the real estate market interests, either by socioenvironmental matters, just like the urban floods. As warned by Souza (ibid.), these effects generate identity and economic impacts to residents that suffer deterritorialization, what is recurring in a municipality that deals with economic interests attached to the floods consequences. The technical-political urban planning, in Rio do Sul case, shows ineffectiveness on trying to raise the coexistence of different socio-spatial stratum in the city, being needed to contest to which point if this is not from the dominant classes interest, normally related to the public power in the urban territories game of interests.

Understating this matter's importance to the city's urban planning and its influence on territorial terms and, by consequence, on the land use, a spatial impact evaluation can bring distinguished findings about the discussions of this research.

Spatial relation between flood and the 2006 Participatory Master Plan zoning

Before discussing the relations that narrow this topic, a brief introduction is needed about the Rio do Sul's 2006 Participatory Master Plan, created upon the complementary law number 163, from December 12th, 2006. The plan's elaboration was the answer for the PMPs national demand, that urged with the *Estatuto*

da Cidade (law nº 10.257), from 2001, and intensified after the Cities Ministry creation, in 2003. The law, by itself, established a five year term for elaboration and revision of master plans in all cities that composed metropolitan regions, areas of strategic interest or with over 20 thousand inhabitants (Santos Júnior, Silva & Sant'Ana, 2011), category which Rio do Sul was a part of.

One of the *Estatuto* main focus was raising popular participation in master plans formulation, to combat the fully technocratic land use planning and to generate a stronger interaction between public power and communities, a social movements demand that resulted in the 182 and 183 articles of the 1988 Federal Constitution, with most notorious groups being the *Movimento Nacional da Reforma Urbana* (National Movement for Urban Reform) and the *Fórum Nacional da Reforma Urbana* (National Forum for Urban Reform).¹⁰ However, scientific research identified through a series of case studies, various difficulties (or lack of interest) in intensifying popular participation and also achieve high technical quality according to PMP's needs, in big and medium size cities (Avritzer, 2008; Fontes, 2010; Oliveira & Sant'Ana, 2011; Vieira et al. 2013; Silva, 2014; Pereira, 2015).

And, based upon Lapolli's (2013) description, the Rio do Sul case was not different. The author described low participation levels (even with communication made by parts of the municipal chamber), and also a significant technical limitation of the Planning Secretary during the plan elaboration, with just three employees working intensely on the PMP. These facts resulted on problems presented more

detailed by Bogo (2016), being: using of base quotas that were not really according to the municipality's real topography (factor adjusted in 2014's PMP); superficial description of *non aedificanti* areas limits; small detailing about matters that interfered in valleys regions anthropization; the non-implementation of measures discusses over the own plan; and inappropriate planning in many city's places.

The last one above, in line with the September 2011 event, was a correlation of factors that encouraged this research making, using specific methodology for Rio do Sul's urban planning evaluation, crossing local zoning information from that time with empirical data obtained via geographic information systems. The resulting maps were elaborated using the 1:70000 scale, permitting to show the impacts that happened in the whole municipality's urban perimeter. So, the spatialization was evaluated together with interpolations among the different flood quotas discussed, the 2006 PMD zoning, the urban expansion areas and transversally of these spatial information.

It is worth mentioning, too, the elaboration method of some layers applied in this study, specially the flood sprawls. For the 12,96 meters case, referring to the 2011 event analyzed here, the information was obtained and described by Dolzan & Laudares (2015), being provided by them. However, the 7 and 9 meter sprawls were elaborated following the municipality's topographical contour lines, obtained by a Digital Terrain Model in 1:5000 scale. Following the riverbed quotas, the flood sprawls were made based upon the measures conceded by Rio do Sul's Civil Defense.

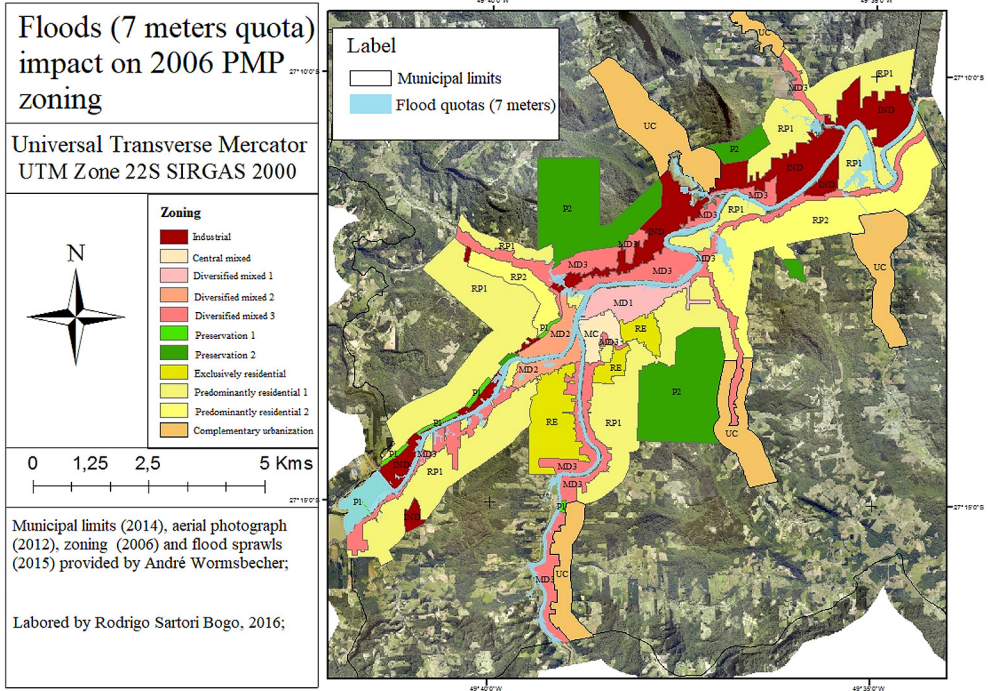
Talking about the urban features layers from the municipality and civil register, their last update are from 2014. The area covered by these features is limited by the restitution area established, including the whole urban perimeter, being applied to lots, streets and even topographical contour lines. The crossing method among different spatial information, with the objective to identify the disasters and zoning overlap can be seen in the study made by Rego Neto & Teixeira (2015), for the city of Florianópolis.

For the case of study here conceived three maps were made: one to show the relation between the 2006 PMP zoning and the 7 meters flood quotas (Map 2), a second one to show this relation about 9 meters quotas (Map 3) and the third one with the same information, but now showing the 2011 event, with the 12,96 meters quota (Map 4).

In Map 2, it can be seen that the 7 meters floods impact could be considered low, in comparison to another flooding events, to be described later. However, some points need considerations about this quota, like the territorial consequences of these events, mostly the resulting relations of these relatively frequent floods.

First, it is known that these quotas are hit more often, with some events happening more than one time in the same year in certain occasions, being the most recent the ones in 2011, 2014 and 2017 (PMRS, 2019). This makes the already established residences in these regions to be more affected and, by consequence, to have a lower market value, being occupied by lower income individuals. This phenomenon is related by Colaço & Klanovicz (1999).

Map 2 – Floods (7 meters quota) impact on 2006 PMP zoning

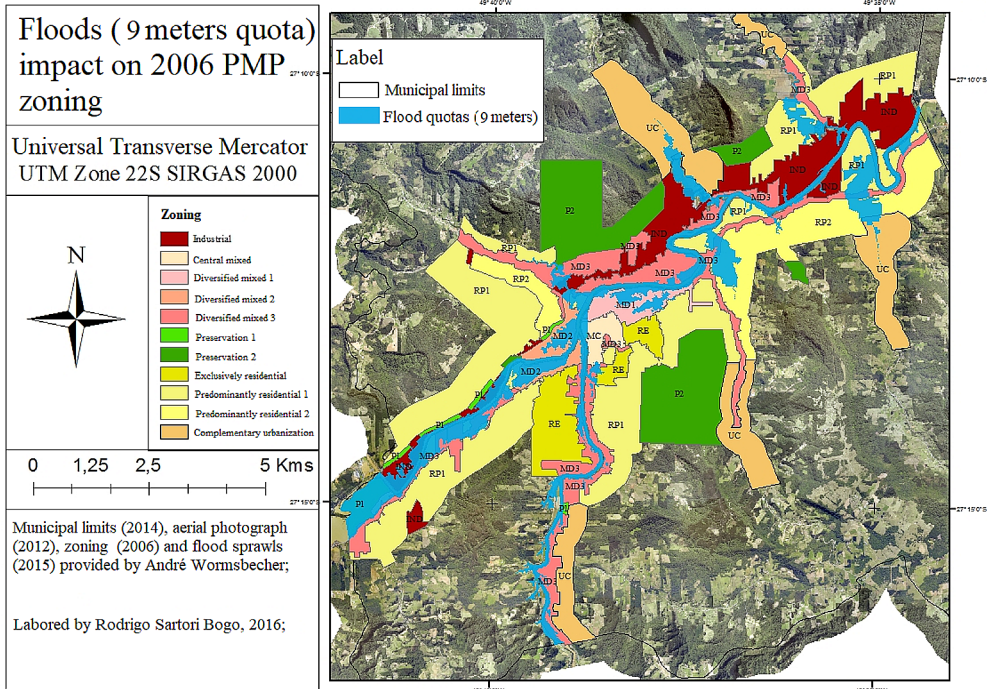


Source: labored by the author.

It is noticeable also that, even with the high frequency floods, almost the whole sprawl hits zoning areas classified as allowed for residences. The mixed diversified zones (ZMD 1, 2 and 3) and the predominant residential (RP 1 and 2) are damaged in different spots of the urban perimeter, with stronger impacts at the zoning east portion. Some areas classified as industrial also suffer impacts, but in a smaller scale. The permanent preservation areas (P1) are almost not hit, with the exception of a large area on the municipality's extreme southwest. The zoning classes could be used, for example, to prevent construction in lower quotas and to weak the floods effects, a possibility almost non applied on this PMP.

This shows, in a first sight, little use of the knowledge about the floods natural dynamics to local urban planning, since legal instrument attached to it was not restrictive to the urbanization in areas with clear environmental risks. The people that live there, of low income in most cases, suffer with aspects that are seen in the informal city, from the conceptualization of Maricato (2000). Even if they are under the law's watch, are ignored by the public power, losing the right to housing and quality of life. Even if the socio-spatial segregation matter is less marked in comparison to the 9 meters floods (Map 3), the debate stills relevant.

Map 3 – Floods (9 meters quota) impact on 2006 PMP zoning



Source: labored by the author.

On Map 3, with the flood quotas between 9 and 9.5 meters, the impact spatialization is much more present in other zones, with spotlight to ZMDs of all classes, but specially for type 2. This reflects a bigger impact on areas with more inclination to commerce and that cover huge people's circulation, what influence directly on the floods socio-economical prejudice. Areas delimited as RPs 1 and 2 are vastly damaged on the zoning east portion, showing local fragility and conditioning the residents' life quality.

In the west side of the map it is possible to identify that the industrial areas are vastly hit, just like the of ZMD 3 type. Even with the bigger industrial need for them to be close to river for waste purposes and also to the BR-470 road for production outflow, industrial areas being damaged at relatively low quotas (and with more frequent flood occurring recently, as seen earlier) is worrisome, especially because of the possible economic impacts.

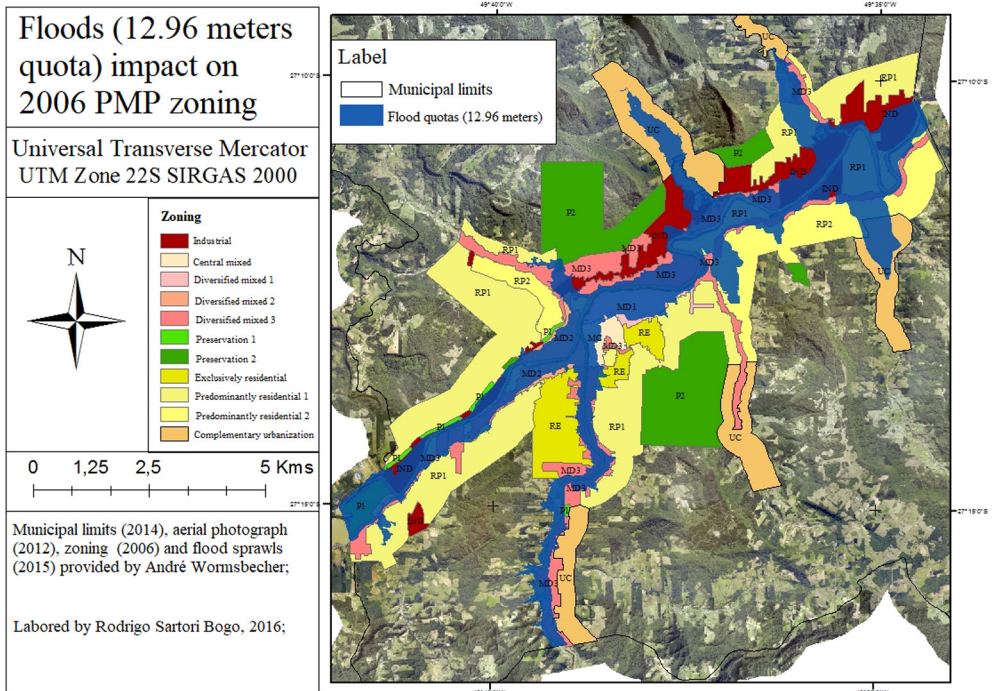
As a positive point, it is clear in the map that none controlled urbanization (UC) area, in other words, zones where the PMRS pretend

to expand the city sprawling, is hit. This demonstrates that, at least for the planned extension areas for the urban structure, there was some kind of consideration with the flood quotas, even if the smaller ones, what does not apply for the larger events (Map 4). Even so it's relevant to cite, again, that the higher areas suffer from strong real estate speculation, what is not properly controlled by the local public power. It is noticeable, in this case, a strong correlation between different agents in urban space production, as described by Correa (1986), exercising their territoriality through law or the private sector. However, returning to the zoning aspect, the impact

by the 9/9,5 meters floods in other areas considered for residential and commercial purposes, just like the UC zones, is evident.

Now, the discusses object is Map 4, that shows the 2011 floods. In a first sight, it is clear its range, in terms of spatial coverage, of floodable areas, being highly superior to the others seen in earlier maps. With the flood quota hitting almost 13 meters, the social and economic impacts are huge, as presented before. In zoning terms, various different areas were hit, but in a heterogeneous way. The spotlights are ZMD of all kinds, but specially type 3 ones. The fact that all zoned areas were damaged, some almost

Map 4 – Floods (12.96 meters quota) impact on 2006 PMP zoning



Source: labored by the author.

entirely, show virtually a pattern in the zoning configuration. The commercial areas, most of them flow centers, suffered in a more aggressive way with the disaster.

However, these floods impacted other areas in a more embracing way, like the center mixed (MC) and the RPs, strongly damaged. The last ones, specially type 1, had impacts all over the municipal territory, with spotlights to the effects seen on the east side, where one of the RP 1 zones is almost completely submerged. But, the areas of exclusive residence (RE) are less hit.

This is an evidence of a pattern among zoning and disasters, in which the social life, commerce and population housing are the most affected. This tends to create the deterritorializations mentioned by Souza (2006), as the residents are progressively pushed away, in a correlation between natural and anthropic phenomena, from its territory and from commercial relations.

But there aren't only the areas indicated for commerce and housing that are damaged; industrial zones suffer equally a really significant impact in this occasion, what reflected on the numbers showed before about the economic losses suffered by the municipality. Even that most part of the zoning for industries is not hit, the waters range is relevant on the smaller industrial areas located on the extreme west of the map and also in the biggest portion on the east side, were there is a bigger flood sprawling.

Discussing about the urban expansion attached to the UCs, this event hit 4 out of 5 of these classified areas, with a large impact on two. This is an evidence that, even with the effort by the public power, to decentralize urban features and cause a migration to higher

areas, some of the zoning areas keep suitable to disasters, what shows an inappropriate use (or not enough, at minimum) of urban planning instruments, including the ones introduced by Estatuto da Cidade.

Even being comprehensible that the 2011 event is considered exceptional, since is the second biggest flood occurring registered of a more than hundred years' record (PMRS, 2019). This kind of dynamic is directly attached to the municipality reality, of its population, of its urban space, and by consequence, of its urban planning and management. The reach and impact of the 2011 floods were inferior than 1983, which reached 13.56 meters. Owing this information, presented in a spatial form, it is demonstrated that the elaboration of the 2006 Participatory Master Plan did not consider the 1983 floods, in terms of zoning. In other words, the negligence about intrinsic aspects of Rio do Sul's territory – the power relations on city occupying and its connections to environmental matters – shows an insufficient use of legal instruments for urban planning and management.

Even that the PMP text mention, as seen before, parts about the necessity to reach a planning that is suitable with the city's floods reality, just a few can be seen in practice. The urban phenomena arising from the 1983 floods were not considered, being these cited by Colaço & Klanovicz (1999) and Poleza (2003) and discussed earlier.

Even if treating about an extreme event and considering the history of urban occupation just by the side of the river, retrospect of a combination between regional characteristics and the Brazilian reality showed by Tucci (2007), the land use instruments should be used in a more efficient

way. The results of an among between space anthropization, real estate speculation and not active public power is the reality of more frequent floods, plus large events that hit strongly almost all the population, like 2011, described by Lapolli (2013) and showed in Map 4. The last analysis can be seen in Chart 2, turning possible to identify the relation between damaged areas and zoning.

The chart shows, first, the impact caused by floods already at the 7 meters mark, hitting more than 8% of construction enabled areas, showing the flaws on conditioning the occupation of low areas by the zoning law.

The chart also describes how the 2011 and 1983 floods impact is extremely large, surpassing more than 30% of 2006 PMP zoning areas with construction permission. Without considering P1 and P2 zones, that should not be occupied, the index turns to be almost 40%. Beyond showing, by the numbers, the level of the above-mentioned disasters, also clear the needs for the urban tissue to be displaced to non-floodable areas. The master plan must

be used as a tool to this goal, even that it is hard to it, alone, to contain the private sector mobility and also the political arrangements, that are part of the urban reality and from the power relations in capitalist cities space production, among metropolis, intermediate and small cities.

And by this case of study, reasoned on empirical data, it is possible to identify the strong relation between State acts and its urban management and planning with the territorialities in result. The municipal territory is not limited by its administrative limits, but shows a lot of others variables that involve intentions with certain portions of space and that manifest itself through certain mechanisms that permit (or limit) power application. The cities production and reproduction is a central mark in capitalism and from the existent interests in urban areas, which the focus tend to be in profits or territorial control (or both). The disasters management, which should be seen under a humanized perspective and focused in life

Chart 2 - Zoning area damaged by floods in km²

Date	Flood	Damaged area	Damaged zoning area	Zoning area damaged without P1 and P2
*	7 meters	4,37 km ²	7,2%	8,43%
*	9 meters	8,95 km ²	14,75%	17,27%
2015	10.71 meters	11,97 km ²	19,73%	23,09%
2011	12.96 meters	19,17 km ²	31,60%	36,99%
1983	13.56 meters	20,02 km ²	33%	38,63%

* Occurrences unrelated to a specific case.

Source: labored by the author.

quality, is relegated to a monitoring role, what turns into spatial and power relations consequences. The public power, using centralized planning, allowing and validating construction and manipulation from the private sector in floodable areas, position itself as an agent holder and provider of spatial power, opening ways for the real estate market holder can reproduce and territorialize themselves. The instruments available in Estatuto da Cidade to diminish speculation and to distribute onus in more equally way at urban space are underestimated and, by consequence, turn into forming intense territorial marks. To be exempt or to be absent are also being present, and it is in the territory that we can see this clearly.

Final remarks

As conclusions, it was possible to identify with this research that relations between territorialities and floods exist, since the last are determinants for spatialization of power relations in Rio do Sul's urban areas. As well as the floods interfere in the residents' lives and its everyday routine, the space agents shape urban morphology and create new territories, being them from low income classes, real estate market, industrial sector or even the public power, which order, plans and crosses its interests with the other agents. Based on the statements by David Harvey (Valença, 2008), in a semiperipheral and capitalist country as Brazil, where the neoliberal logic is strong in spatial relations, the financialization, mercantilization, and state market capital

reproduction phenomena occur according to interests between capital and State in cities of different scales.

These considerations are one of the results obtained in the research, turning possible to conclude that the 1983 and 1984 floods were little considered for the 2006 PMP elaboration, what permitted the occupation of floodable areas. This, added to the large event of 2011, made the disaster and economic impacts suffered worst, changing again the understanding from the population about their own city. Beyond that, the 7 and 9 meters floods reach also shows the smaller floods impact, what should be put under discussion on the local urban planning.

The analysis was made possible by the collecting of empirical data and its manipulation in SIG, in a way that the floods and zoning interactions became clear in spatial terms. So, the study objectives were achieved, as the data are evidence of the hypothesis and the social dynamics discussed by the author in this research. And this is a way of identifying the concept of territory as a fundamental category to understand urban relations, observing that the empirical data support the theoretical foundations and are evidence of spatially distributed power relations, as discussed before.

Concluding, in terms of practical actions that could begin from the data obtained by this research, it is considered that two fronts are needed: first, urban planning. Second, urban management. Both focused in Rio do Sul reality. In terms of planning, agreeing with the deeper study carried by Bogo (2016), the most recent PMP advanced in some problems that involved what is discussed here, but

still insufficient in stopping urbanization in dangerous areas, specially the floodable ones. By law, the master plans must be renewed every 10 years (Brasil, 2001), something that is coming by to the most recent document, from 2014. It is considered that this occasion should be a suitable moment for the realization of a participatory process of higher quality, that effectively debates the city's problems with its residents, the most interested in an urban planning closer to Rio do Sul's space needs. It is needed to regulate and restrict occupation in lower areas and also seek for the river bank recovery, focusing in both urban and environmental matters.

Finishing, urban management is the second point that should be worked hardy and better so it could change the processes and phenomena reported here. Natural disasters, that have significant impact in

Rio do Sul's population reality, should be seen no only under the perspective of its direct material effects, but also about its influence on space organization. In terms of management, the civil defense, the State Environmental Institute, the local section of ANA and the municipal chamber (with its subdivisions, like the environmental and planning areas) should be related and focusing on urban matters. Another needed aspect is an upper scale vision that considers the other municipalities around and the impacts caused by their own local management on the Itajaí river hydrological basin dynamics. Rio do Sul, as a central municipality and biggest in the region, should take the lead of planning regionally and being focused on the direct relation between cities and its rivers, that historically shaped the Alto Vale do Itajaí urbanization.

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Translate: the article was translated by Rodrigo Sartori Bogo.

Notes

- (1) This can be considered the main empirical finding of the clustered researches in Pereira (2015).
- (2) The Santos Júnior & Montandon (2011) research it is a significant mark of this academic production.
- (3) A sub-regional center is characterized as: "169 centers with less complex management integrate this level, specially among the levels 4 and 5 of territorial management; they have a reduced occupation area, and its relationships with outside centers to its own network occur, in general, only with the three national metropolis. With a more dense presence in strongly occupied areas in Northeast and Center-South regions, and more sparse in less dense populated spaces of North and Center-West regions, they are also subdivided in groups, being: a) Sub-regional center A – composed by 85 cities, with medians among 95 thousand inhabitants and 112 relationships; and b) Sub-regional center B – composed by 17 cities, with medians of 71 thousand inhabitants and 71 relationships." (IBGE, 2007, p. 10).
- (4) In spite of agreeing with Villaça (1999) critical commentaries to the historical "fetish" or the Brazilian urban planners with the master plan idea, which tend to assign to it an overdone optimism as a balanced urbanization vector, the total absence of an institutional urbanistic ballast was harmful for the studied city, agreeing with Poleza (2003).
- (5) This intense urbanization process, of national feature, is described and analyzed deeply by Santos (2013).
- (6) Bogo (2016) does a brief critical analysis about the popular participation on the 2006 and 2014 Participatory Master Plans of Rio do Sul, which were possible to identify a technocratic trending in both, misaligned with the Estatuto da Cidade principles (Brasil, 2001).
- (7) Some examples of researches in this matter and focused in urban planning on Santa Catarina context can be seen at Pereira (2015).
- (8) The same cannot be said about social groups that have the floods impact as their agenda. An example is a movement that requests the construction of an overflow channel on Salto Pilão power plant, in Rio do Sul's downstream. This debate was already institutionalized after a motion approved by Lontras Councilors Chamber, a neighboring municipality (Rádio Educadora, 2018).
- (9) What is evidenced in its official site (<https://defesacivil.riodosul.sc.gov.br/index.php>).
- (10) Souza (2010) argues that both above-mentioned articles of the 1988 federal constitution, as well as the Estatuto da Cidade, were "strategic defeats" for the MNRU/FNRU, even with the clear advances in comparison with the previous historical periods.

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