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Inovações e Soluções Sustentáveis em Engenharia Ambiental

Floods in the state of Acre in the Brazilian Amazon: 2015 events, impacts and challenges

Inundações no estado do Acre na Amazônia brasileira: eventos de 2015, impactos e desafios

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ABSTRACT

Floods are stressful processes that disrupt the environment in which they occur. The aim of this article is to analyze, from an impact perspective, the largest flood on record in the city of Rio Branco, capital of the state of Acre, in the south-western Brazilian Amazon. It also aims to propose measures to reduce risks and minimize impacts. In 2015, the level of the River Acre reached a historic high of 18.40m (4.40m above its overflow level). As a result, 32 days were spent submerging more than 4,500 hectares of the municipality's urban area, with more than 100,000 people affected and more than 10,000 left homeless. The damage (human and material) and losses (economic and social) exceeded five hundred million reais. For the proposed analysis, the research focused on a literature review of works on risk perception, resilience and governance, in order to take in theoretical contributions and case studies focused on these themes, analysis of reports, plans and official documents, as well as research into official databases. The results showed severe negative social and economic impacts on the affected population and require, in the subjective (individual and community), institutional and governance context, tools and mechanisms to reduce the risks of their occurrence and minimize their impacts. Prevention and preparation for coping with them involve aspects of adaptive capacity, social participation, strengthening institutions and risk governance.

Keywords: Risk perception; Resilience; Governance

RESUMO

Inundações são processos estressores e perturbadores do ambiente em que ocorrem. Este artigo tem o objetivo de analisar, sob a ótica dos impactos, a maior inundação que se tem registro na cidade de

cem mil afetados e uma quantidade superior a dez mil desabrigados. Os danos (humanos e materiais) e prejuízos (econômicos e sociais) superaram o montante de quinhentos milhões de reais. Para a análise proposta, a pesquisa centrou-se em uma revisão de literatura de trabalhos sobre percepção de riscos, resiliência e governança, no sentido de acolher contributos teóricos e estudos de caso voltados para estas temáticas, análises de relatórios, planos e documentos oficiais, bem como pesquisa em banco de dados oficiais. Os resultados mostraram impactos negativos severos de ordem social e econômica na população afetada e requerem, no contexto subjetivo (individual e comunidade), institucional e da governança, de ferramentas e mecanismos que conduzam à redução dos riscos de sua ocorrência e minimização de seus impactos. Prevenção e preparação para o seu enfrentamento perpassam pelos aspectos da capacidade adaptativa, participação social, fortalecimento das instituições e da governança dos riscos.

Keywords: Percepção de riscos; Resiliência; Governança

1 INTRODUCTION

Floods are stressful events that disrupt the environment in which they occur. Between 1900 and 2021, this type of disaster was the most impactful in global terms (EM-DAT, 2021). As a result of climate change, floods are becoming more frequent and more severe (Marengo et al., 2009). Extreme weather events related to the climate crisis only achieve political recognition when the social order is affected (Zangalli Júnior, 2024). Floods result from the interaction between physical-natural elements (rainfall, river dynamics) and social elements (occupation of susceptible areas). Threats (hydro-meteorological processes) and vulnerabilities (social exposure), in interaction, give rise to risks (Souza; Zanella, 2010). In turn, when risks materialize, they give rise to disasters and, due to their multidimensional characteristics, they are almost always configured as hybrid risks (Mendonça; Buffon, 2021). In the socio-spatial context, human beings take on the role of aggressor and victim of the environment they occupy (Veyret, 2007), as they impose transformations that end up making them vulnerable to the consequent negative effects of these changes.

Risk perception, resilience and governance are some of the ways that can contribute to reducing flood risks and minimizing negative impacts and effects. In this sense, risk perception might be understood as the set of subjective attributes

(encompassing fear, concern, experiences, learning, uncertainties and behaviors) that support the individual in facing the adversities of a disaster (Motoki et al., 2014; S. Birkholz et al., 2014). In the literature on risk perception, there seems to be a lack of methodological standards, which might pose a challenge to comparing studies on this subject (Kellens et al., 2013). The frequency with which flood events occur can define the perception of an individual who has been affected (Lechowska, 2018) and imply their behavior in dealing with this type of stressor. The behavior of individuals, from the perspective of prevention, preparation and response, denotes the existence or not of adaptive capacity in the face of frequent events (Lopez-Marrero, 2010). Linked to risk perception, the necessary adjustments must be made based on the floods that have occurred and, in the event of future events, conduct must be improved with a view to minimizing the impacts (Calgaro; Villeneuve, 2020; Curtis et al., 2022). Along with adaptive capacity, risk communication plays an important role in risk perception. Additionally, generation and dissemination of information keeps people aware and up to date on the possibility of floods occurring and thus makes them more prepared (Kammerbauer & Minnery, 2019). Social norms that interfere with behaviors, psychological aspects and risk communication favor more effective attitudes towards floods (Lim et al., 2022; Santoro et al., 2022).

Also associated with risk perception, resilience emerges as an aggregating factor when it comes to response and recovery actions in a disaster scenario. Conceptually, it can be understood as a condition that allows us to strengthen capacities, flexibility for survival, learning and the adaptation needed to deal with unpredictable change (Buschbacher, 2014; Bachrach & Zautra, 1985). Community participation, adaptive capacity, risk communication and governance, in the field of resilience, are also mechanisms that play important roles in flood circumstances. Research into disaster resilience is still in its infancy in Latin America and the Caribbean. Studies aimed at incorporating technologies, more robust data, the role of natural systems and the

interactions of the effects on the affected watershed are some of the fields to be explored (Pinos; Quesada-Román, 2022). When it comes to resilience, planning systems need to be rethought in the face of climate change, natural risks and disasters (Birkmann et al., 2014). Risk governance, given the vulnerability of communities exposed to danger, must take into account traditional knowledge and the participation of local social structures in directing the actions to be taken in the event of climate threats (Iocca; Fidélis, 2018, 2021). The fact that resilience encompasses the field of multidisciplinarity means that socio-ecological aspects benefit from the effective participation of the community, institutions and experts (Zevenberger et al., 2020), along with the construction and continuous improvement of empirical resilience (Asadzadeh et al., 2015).

The state of Acre, located in the north of Brazil, in the westernmost part of the Brazilian Amazon, has been affected by frequent and intense flooding events over the last thirty years. In the case under study, the municipality of Rio Branco (the state capital) has experienced a severe breach of normality due to repeated events. The aim of this article is to analyze the floods that occurred in Rio Branco in 2015, and to propose measures to reduce the risks and minimize the impacts of these hydrological events, which affect the social, economic and environmental order of the local population. The research was based on a literature review on risk perception, resilience and governance, combined with exploratory research into flood contingency plans and institutional reports. Socio-demographic and hydro-meteorological information was also sought from official databases. These sources and procedures guided the research from a methodological point of view.

2 MATERIAL AND METHODS

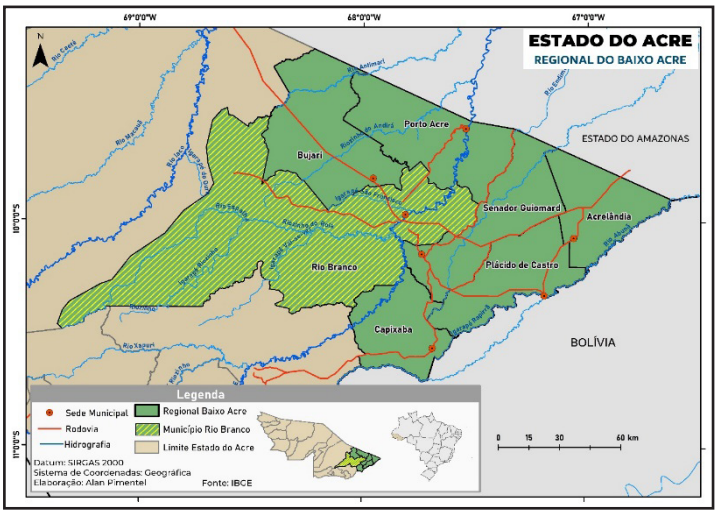
As explained above, this research was methodologically based on the following steps: (a) literature review; (b) exploration of institutional reports/documents and (c)

searches of official databases. For the literature review, we immersed ourselves in theoretical content and case studies on risk perception, resilience and risk governance in order to verify the contributions of the literature to the theme developed and the scope of the proposals made. This procedure sought out the scientific bases needed to support the work. As a result of the range of studies, those with the greatest alignment, convergence and suitability in the context of the research were selected. However, it is worth pointing out that, due to the breadth of existing work, the literature selected provides a theoretical overview and case studies on coping with flood disasters, which proved to be sufficient for the desired basis. In the field of institutional documents, a robust visualization of the disaster scenario was sought. We analyzed the contingency plans for flooding in Rio Branco, damage assessment reports and emergency decrees, with the aim of describing the floods that occurred in the state capital in 2015, as well as characterizing their occurrence, impacts and consequences for the affected population, from an economic, social and environmental perspective. Exploratory research in official databases (National Water Agency - ANA, Brazilian Institute of Geography and Statistics - IBGE and EM-DAT-Emergence Database) made it possible to analyze socio-demographic and hydro-meteorological aspects, draw up maps and check river dynamics during that year's floods. Finally, the information was consolidated and analyses carried out in order to identify possible measures for dealing with these events and minimizing their impacts.

3 THE CASE STUDY

As part of the Baixo Acre administrative region, the region with the largest number of municipalities, Rio Branco has an area of 8,835km^2 and 364,756 inhabitants (IBGE, 2022). The following image (Figure 1) shows the map of the Baixo Acre region, with Rio Branco in particular.

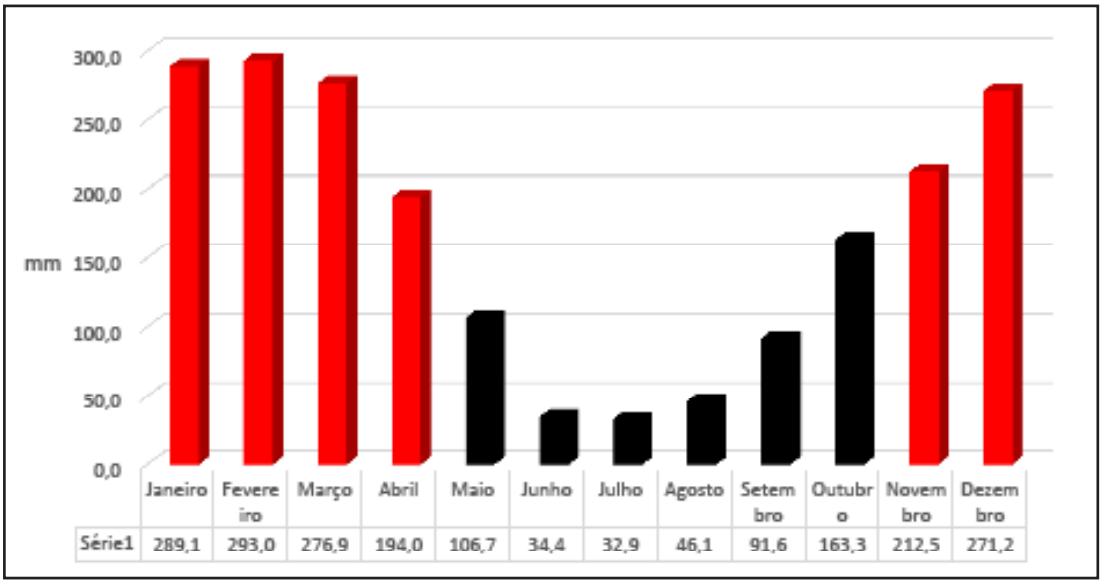
Figure 1 – Baixo Acre region (highlighting the municipality of Rio Branco)



Source: IBGE (2021)

A characteristic aspect of the South-Western Amazon is its seasonal climate, where there are two well-defined periods, one rainy (from November to April) and one dry (from May to October). This rainfall regime can be seen in Graph 1.

Graph 1– Average monthly rainfall in Rio Branco (AC) - 1970 to 2023 (mm)



Source: Designed by the author, based on the National Water Agency and the Municipal Civil Protection and Defense Coordination

Graph 1 shows monthly rainfall totals of more than 200mm between November

and April, indicating the rainy season, when 76% of the state's rainfall occurs. Flooding occurs especially between January and April (Rio Branco, 2019). In Rio Branco, the Acre River has an alert level (situation of attention) of 13.50, with 14.00m being the overflow level, when the Acre River exceeds its main channel and reaches the floodplain.

Rio Branco has 43% of the state population (IBGE, 2022) and was formed on the banks of the River Acre. The urban agglomerations that started the creation of the city are located on the banks of this watercourse or on its floodplain. In this context, the threats, characterized by the physical-natural elements (rainfall patterns and river dynamics), associated with the social vulnerabilities and susceptibilities of the exposed population, generate the risks of flooding or its occurrence. Between 1970 and 2024, the Acre River in Rio Branco did not exceed the warning level in only 11 years, in 16 years there were small floods (between 14.00m and 15.00m), in 12 years medium floods (between 15.01m and 16.00m), in 9 years large floods (between 16.01m and 17.00m) and 6 years there were extraordinary floods (above 17.00m). These major events occurred in 1988, 1997, 2012, 2015, 2023 and 2024.

4 RESULTS AND DISCUSSION

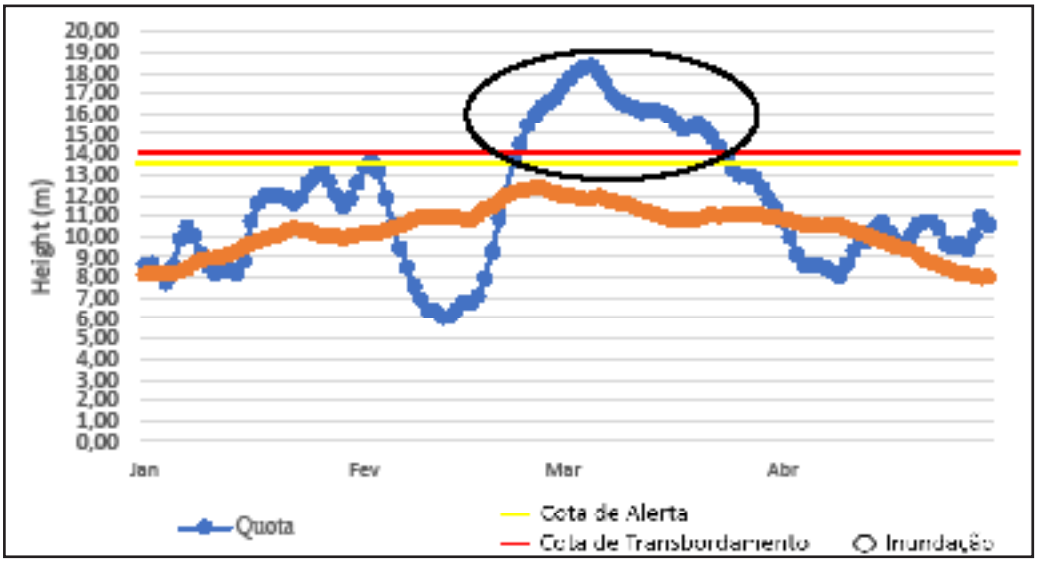
The records indicate a situation in which, over the years, the intervals between floods have become closer together. Historically, the city of Rio Branco has seen floods of great magnitude, with considerable damage and losses to the population affected. The years 1988 and 1997 saw extraordinary floods, albeit over a nine-year period. Sequential events occurred between 2009 and 2015, with varying magnitudes, with the 2015 floods being the largest ever recorded (Dolman et al., 2018). In a shorter period of time, the floods of 2012 and 2015 reached proportions considered extraordinary (Rio Branco, 2019). It is worth noting that the process of formation of Rio Branco's urban space took place on the banks of the Acre River (Souza, 1995), in the area that comprises the floodplain of this watercourse, where a considerable portion of the municipality's population lives. This condition of environmental vulnerability is

associated with unfavorable socio-economic conditions, which makes exposure to the danger of flooding a preponderant factor in the occurrence of damage and losses of great magnitude.

Since 1970, the Acre River in Rio Branco has been monitored daily in two ways: by visual observation of the water level ruler and by telemetry (started in 2012), the latter from a station that transmits fluviometric (river level) and pluviometric (rainfall) data. This monitoring is maintained by the joint work of the National Water Agency (ANA), the Geological Survey of Brazil (CPRM), the State Secretariat for the Environment and Indigenous Policies (SEMAPI) and the Acre State Civil Defense and Protection Coordination (CEDEC-AC).

The flood of 2015 was the biggest ever recorded and brought with it severe negative effects, making it a historic milestone for the city of Rio Branco and its population. To begin the analysis of this disaster, Graph 2 shows the level of the Acre River in Rio Branco between January and April of that year.

Graph 2 – Acre River level in Rio Branco - 2015 (Jan to Apr)



Source: Prepared by the authors, based on the National Water Agency and the Municipal Coordination of Protection and Civil Defense

The behavior of the level of the Acre River in the first four months of 2015 is shown in Graph 2 (blue line) and shows a calm situation until the end of February (the 23rd), when it exceeded the overflow level, reaching 14.54m. Eleven days later, it reached 18.40m, characterizing the 2015 event as an extraordinary flood and the biggest ever recorded in the state capital. In all, there were 32 days in an overflow situation (indicative circle in Graph 2), from February 22 to March 24, with seven days above 17.00m (the lower limit for an extraordinary flood) and four days above 18.00m, according to monitoring by the Rio Branco Municipal Protection and Civil Defense Coordination (Rio Branco, 2019). Table 1 shows the evolution of the 2015 flood, according to the dynamics of the rise of the River Acre and the number of people affected (homeless).

Table 1 – Evolutionary pattern of the 2015 flood in Rio Branco - AC

Date	Level (m)	Homeless	Condition Decreed	Shelters
23/Feb	14,74	107	SE	1
27/Feb	16,60	2.511	SE (extended)	1
01/mar	17,44	5.162	ECP	3

Source: Prepared by the first author, based on Rio Branco (2015a), (2015b) and (2015c)

According to Table 1, with the Acre River at a level of 14.74m (February 23rd), the mayor of Rio Branco decreed a Situation of Emergency (SE). On that date, more than a hundred people had to leave their homes and were taken into the first shelter (Parque de Exposição) set up to receive the homeless (Rio Branco, 2015a). The evolutionary pattern of the disaster aggravated the abnormality scenario (the Acre River reached 16.60m on February 27), making it necessary to publish a new decree incorporating new areas and people affected, since more than 2,500 people had already been housed in the shelter (Rio Branco, 2015b). Following a progressive rise, the Acre River reached

a level of 17.44m (March 1st), forcing the municipal government to declare a State of Public Calamity (ECP). In three public shelters, more than 5,100 people were already homeless. On March 5, the River Acre reached the historic mark of 18.40m.

With regard to the negative effects, Tables 2 to 7 show the damage and losses resulting from the 2015 flood, based on the information contained in the Disaster Information Form - FIDE (Rio Branco, 2015d), completed by a multidisciplinary team involving members of various agencies and secretariats. It is worth noting that this instrument does not reflect the scenario reached by the peak of the flood, since it was carried out with the Acre River at a level of 17.44m (on March 1) and, by March 5, the situation had worsened even more, reaching 18.40m.

Table 2 – Human damage from the 2015 flood* in Rio Branco - AC

Human Damage **Number of people**	**Total**
Dead	1
Injured	—
Sick	1.799
Homeless	5.160
Displaced persons	14.500
Missing	—
Others	50.106
Total affected	71.566

Source: Prepared by the first author, based on Rio Branco (2015d) *up to 01 Mar 2015

The situation in Table 2 shows a significant amount of human damage. With more than 70,000 people affected, of which 5,160 were homeless and 14,500 displaced, the 2015 event had considerable negative effects on the affected population. There was also one death caused by an electric shock. Table 3 describes the environmental damage caused by the 2015 event.

Table 3 – Environmental damage caused by the 2015 flood in Rio Branco-AC

Discrimination	Yes	No	Population affected in the municipality
Water pollution or contamination	X		More than 20% of the population affected
Air pollution or contamination		X	
Soil pollution or contamination	X		More than 20% of the population affected
Water shortage or depletion		X	

Source: Prepared by the first author, based on Rio Branco (2015d)

The environmental damage is described in the FIDE (Rio Branco, 2015d) and shown in Table 3, basically defining its extent in percentage terms for water (more than 20% of the population affected), air (10% to 20% of the population affected) and soil (more than 20% of the population affected). Negative effects on the environment include the accumulation of garbage (solid waste and debris) carried by the water during the uplift process, affecting streets, houses and land. The contamination of tube wells and the drainage network increases the potential for the proliferation of water-borne diseases. The environmental damage was estimated at more than R$ 7,000,000.00 (seven million reais) which, when monetized, amounted to almost R$ 15,000,000.00 (fifteen million reais). Table 4 describes the material damage caused by the 2015 flood.

Table 4 – Material damage (2015 flood)* in Rio Branco - AC

Type	Quantities Destroyed	Damaged quantities	Value (R$)
Public Health Facilities	__	13	5.200.000,00
Public Education Facilities	__	20	12.000.000,00
Public Institutions Provision of Other Services	—	—	—
Public Facilities for Community Use	—	—	—
Housing units	__	29.000	14.000.000,00
Public Infrastructure Works		15	25.000.000,00
Total			52.600.000,00
Monetary update			108.339.515,28

Source: Prepared by the first author, based on Rio Branco (2015d) *until 01 Mar 2015

The material damage shown in Table 4 (with information up to March 1) describes the impairment of various segments of public service provision (health, education, infrastructure and housing). In the health segment, thirteen Basic Health Units were partially or totally affected, jeopardizing care for the population whose vulnerability was increased by the flooding. The impacts on health facilities were valued at R$5,200,000.00 (five million, two hundred thousand reais). A total of twenty public education facilities were affected in some way and totaled R$12,000,000.00 (twelve million reais) in material damage. At the time of writing, a total of 4,000 housing units had been damaged, amounting to R$14,000,000.00 (fourteen million reais). Damage to public infrastructure (streets, works of art and other public facilities) totaled 15 units and reached R$25,000,000.00 (twenty-five million reais). The total material damage was R$52,000,600.00, which, monetarily restated, amounts to more than R$108,000,000.00 (one hundred and eight million reais). Table 5 below details the economic damage.

Table 5 – Economic damage caused by the 2015 flood* in Rio Branco - AC

Essential services affected	**Restoration Value (R$)**
Medical Assistance, Public Health and Emergency Medical Care	5,450,000.00
Drinking Water Supply	8,600,000.00
Storm Water Drainage and Sanitary Sewerage System	2,850,000.00
Urban Cleaning and Waste Collection and Disposal System	4,300,000.00
Disinfestation/Habitat Disinfection/Pest and Vector Control System	3,000,000.00
Electricity Generation and Distribution	505,000.00
Telecommunications	563,000.00
Local, regional and long-distance transport	32,000,000.00
Distribution of fuels, especially those for domestic use	—
Public Security	942,000.00
Teaching	720,000.00
Total Value of Public Losses	58,930,000.00
Monetary update	121,705,050.26

Source: Designed by the first author, based on Rio Branco (2015d) *until Mar 1st, 2015

Essential services, as shown in Table 5, suffered losses in various sectors, with emphasis on medical care, public health and emergency medical care, which

significantly compromised meeting the demands of the population in the municipal health network units, totaling more than R$5,000,000.00 (five million reais) in losses. As for the drinking water supply, the losses amounted to R$8,600,000.00 (eight million, six hundred thousand reais), affecting the collection, treatment and distribution processes, with some neighborhoods having their supply interrupted. As for the urban cleaning system, solid waste and garbage accumulated in the flooded areas, due to the fact that access for collection was impaired, totaling more than R$ 4,000,000.00 (four million reais) in damages. The generation of electricity suffered an impact of R$505,000.00 (five hundred and five thousand reais) due to the interruption of supply to the affected areas, as there were submerged consumer units, causing risks of electrical discharge. The total damage amounted to almost R$59,000,000.00 (fifty-nine million reais). After monetary restatement, the amount came to close to R$122,000,000.00 (one hundred and twenty-two million reais). Table 6 below describes the losses in the sectors of the economy that were affected by the 2015 event.

Table 6 – Damages from the 2015 flood (sectors of the economy)* in Rio Branco - AC

Economic sectors	**Value (R$)**
Agriculture	59,000,000.00
Livestock	34,226,000.00
Industry	—
Services	65,400,000.00
Total Value of Private Losses	158,626,000.00
Monetary update	327,601,990.55

Source: Designed by the first author, based on Rio Branco (2015d) *up to Mar 1st, 2015

With regard to agriculture, especially family farming, the flooding of 2015 severely affected production. In order to preserve what had been planted, it was necessary to bring forward the harvest, many of which had already been compromised by the rise of the River Acre, affecting the following products: cassava, bananas, sweet potatoes, papaya, rice, annatto, among others (Acre, 2015a). In this sector, losses amounted to R$59,000,000.00. The impairment of pastures due to prolonged submergence, as well

as the loss of fences, were some of the impacts on livestock, which accounted for more than R$34,000,000.00 (thirty-four million reais). Services were affected in terms of the interruption of the activities provided, due to the breakdown of normality, preventing this segment from functioning, with the losses being valued at around 64,000,000.00 (sixty-four million reais). The overall total of the damage caused to sectors of the economy was more than R$ 158,000,000.00 (one hundred and fifty-eight million reais). Monetary restatement brings this figure to around R$327,000,000.00 (three hundred and twenty-seven million reais). Table 7 describes all the damage and losses resulting from the 2015 flood, consolidating the damage (material and environmental) and the economic losses (essential services and sectors of the economy).

Table 7 – Damage (material and environmental) and losses (economic and social) - Flood of 2015

Order	Damages	Total R$
01	Material Damage - Buildings	52,600,000.00
02	Environmental damage - Natural resources	7,230,000.00
03	Economic Losses - Essential Services	58,930,000.00
04	Economic Losses - Economic Sectors	158,626,000.00
Total		277,386,000.00
Monetary update		572,870,814.06

Source: Designed by the first author, based on Rio Branco (2015d) *until Mar 1st, 2015

For material damage to buildings (damaged or destroyed), the amount was more than 52,000,000.00 (fifty-two million reais). With a value of over R$7,000,000.00 (seven million reais), environmental damage was the lowest among the impacts and consequences assessed. The economic damage (essential services and sectors of the economy) amounted to over 217,000,000.00 (two hundred and seventeen million reais). The overall total of damages, including monetary restatement, was almost R$573,000,000.00 (five hundred and seventy-three million reais).

On March 5, 2015, the date on which the level of the Acre River reached its maximum level (18.40m), the disaster scenario widened considerably. Table 8

illustrates the figures regarding some aspects of the biggest flood on record in the city of Rio Branco.

Table 8 – Flood situation (March 5, 2015) in Rio Branco-AC

FLOOD SCENARIO (as of March 5, 2015)	
Neighborhoods	53
Buildings	29,300
Streets and length (km)	700 (154)
Affected (people)	102,000
Rural areas (communities)	32
Affected urban area (ha)	4,500
Interdicted bridges	3
Public shelters	29
Homeless (people)	10.600

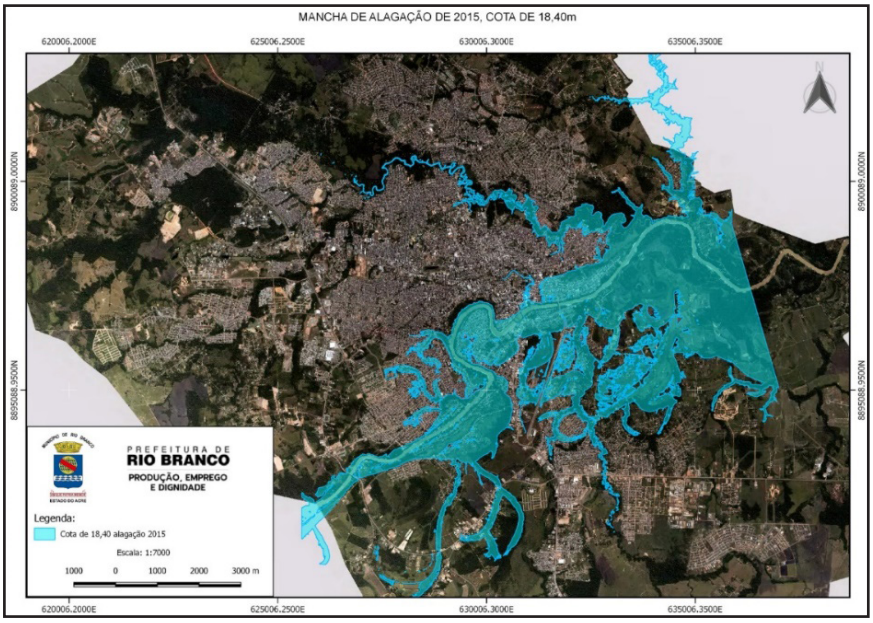
Source: Designed by the first author, based on Rio Branco (2015e)

The flood scenario on the last day of the rise in the level of the River Acre, shown in Table 8, shows the consequences of the intensity of the event. Fifty-three neighborhoods were affected (Rio Branco had a total of 212 at the time), the Rio Branco City Hall georeferencing system counted more than 700 streets, totaling 154 km in partial or total submergence, preventing vehicle traffic and hindering relief and assistance actions in the affected areas. Some of those affected remained in their homes, fearing looting and theft of their property, because at night, with the suspension of the electricity supply, the affected neighborhoods were left in the dark. This system also quantified 29,300 buildings affected, with more than 102,000 people affected. In rural areas, 32 communities suffered damage as a result of the flooding.

Table 8 also shows that the number of displaced people reached 10,600, forcing the installation of 29 public shelters (Parque de Exposição, SEST/SENAT, SESC, SESI gymnasium, SESINHO, COMARA, headquarters of the Regional da Baixada [one of Rio Branco's regional administrative headquarters]) and 22 state and municipal schools). For the sake of comparison, the total number of people made homeless (10,600)

by the 2015 flood in the city of Rio Branco was greater than the population of four municipalities in Acre, according to the IBGE (2022): Assis Brasil (8,100) from the Alto Acre regional, Capixaba (10,392) from the Baixo Acre regional and Santa Rosa do Purus (6,723), all from the Purus regional, as well as Jordão (9,222), from the Tarauacá/Envira regional. Figure 2 shows the 2015 flood scenario in the city of Rio Branco, with the Acre River at a level of 18.40m (reached on March 5 of that year).

Figure 2 – Flood spot in the city of Rio Branco in the 2015 event (Acre River elevation 18.40m)



Source: Rio Branco (2023a)

The entire area colored blue shows the advance of the water. According to calculations carried out by the Rio Branco City Hall Geotechnology Center (Rio Branco, 2023a), an area of 4,500 hectares in the urban part of the municipality has been submerged. A considerable part of Rio Branco's urban area was affected by the waters of the Acre River and its tributaries. As previously reported, it took 32 days from February 23rd, when the Acre River exceeded its overflow level (14.00m), until it returned to a level below that level, with negative consequences of great magnitude for the affected population.

Extreme flooding events have occurred frequently and with severe intensity in the state of Acre, especially in its capital Rio Branco. According to records, the 2015 episode was considered the biggest in history, causing severe economic and social damage. The scientific literature referenced in this paper indicates that broadening the perception of risk (as a subjective attribute), resilience (a mechanism that strengthens recovery from these stressors) and governance (the involvement of institutions through public Civil Protection and Defense policies) can lead to a positive and integrated agenda of behaviors to reduce risks and minimize their impacts. The lessons learned from previous events suggest greater social protagonism, institutional strengthening, risk communication strategies and adaptive capacity. The success or failure of preparedness depends on the integrated effort of these three elements as an action strategy. The overall safety of the population in the event of a disaster must be linked to other public policies aimed at the sustainability of cities and communities, especially those most vulnerable and exposed to the risks of these stressful events, as these are the most challenging scenarios.

5 CONCLUSIONS

In a socio-environmental context, floods are disruptive elements, negatively impacting the exposed population, when established in a susceptible environment, where physical-natural threats are associated with social vulnerabilities, generating risks and materializing disasters. In 2015, the city of Rio Branco, capital of the state of Acre and the most populous municipality, was hit by the biggest flood ever recorded, in which the level of the Acre River reached 18.40m and, for thirty-two days, submerged an area of more than four thousand five hundred hectares. The consolidated damages (human and material) and losses (social economic) exceeded five hundred and fifty million reais. The number of people affected exceeded one hundred thousand, and more than ten thousand people were forced to leave their homes and stay in public

shelters. As described, flooding events occurred prior to 2015, and in 2023 and 2024 new episodes of flooding hit the state capital. Risk perception, resilience and governance are some of the elements that can contribute to reducing disaster risks and minimizing their impacts and consequences. From this challenging perspective, community participation, adaptive capacity, risk communication strategies and the development of institutions in the direction of risk governance are guiding instruments for the public policies that are necessary and appropriate to achieve the necessary success in the face of flood disasters. Targeted research, in the context of these three pillars (risk perception, resilience and governance), based on the mechanisms mentioned above and, in a specific way, carried out in vulnerable communities, can add to the efforts in this intense battle towards establishing safer communities and more sustainable cities, in the light of the Sustainable Development Goals (SDG 11 - Sustainable cities and communities).

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