

URBAN FLOODING IN THE REGION MERCOSUR



**10 th AIDA CCWP Meeting Copenhagen Th 11
June 2015**

MERCOSUR GROUP

María Kavanagh	Argentina
Pery Saraiva Neto	Brazil
Ana Rita Petraroli	Brazil
Ivy Cassa	Brazil
Ricardo Peralta Larrain	Chile
Miryam Aragón Espejo	Perú
Andrea Signorino Barbat	Uruguay
Roxana Corbran	Uruguay

General Coordination María Kavanagh

	Page
Summary	4/6
Introduction	7/8
Executive Summary	
Chapter I	
Urbanization in the World	9/13
Tackling the problem of urban flooding	13
Urbanization and urban flooding hydrological impact	13
Types of urban flooding	13
Chapter II	
Republic Argentina	
Urbanísticos aspects of the cities	14
General characteristics of the floods in Argentina	15
Urban flooding in Argentina	16
Land use and abuse	16/17
Pictures	18/19
Chapter III	
Federative Republic of Brazil	
Urbanísticos aspects of the cities of Brazil	20/21
General characteristics of urban flooding in Brazil	21
Urban flooding in Brazil	22
Pictures	23/24
Chapter IV	
Republic of Chile	
Urbanísticos aspects of the cities of Chile	25
Urban Flooding in Chile	26/27
Pictures	27/28
Chapter V	
Republic of Peru	
Spatial aspects of the cities of Peru	29
Urban flooding in Peru	29/30
Pictures	31/32
Chapter VI	
Oriental Republic of Uruguay	

Urbanísticos aspects of the cities of Uruguay	33
Urban flooding in Uruguay	33/35
Pictures	36/37
Conclusion	38
Acronyms	39
Bibliography	40

Summary

Urban environments with a high degree of waterproofing have problems with flooding due to rapid runoff of water. This paper presents the description of the most important aspects of the complex and its hydrological impact on cities. Moreover, the possibility of a sustainable architecture and adaptation to climate change and regarding flood insurance and financial risk transfer instruments mentioned.

Chapter I

Is the process of urbanization in the world, refers to the three historical phases, pre-industrialization, industrialization and the current or communications.

Population growth requiring more classes cadenced to settle on the banks of the rivers in the cities.

The lack of planning and regulation in most municipalities, with poor public power. The technical answer is to discipline the urban occupation through a compatible densification flood risks.

At the same time in the same chapter urbanization and hydrological impact and urban flooding, impacts on the water cycle is analyzed. Types of floods and urban drainage subsystems.

Chapter II

In this chapter the urban areas in the cities of Argentina, the general characteristics of urban flooding in the country, the use and abuse of the land question.

A large part of the cities of Argentina reflect a very close interaction between the process of urban settlement and hydrological networks. Unplanned urban expansion and a weak environmental awareness are triggers flooding in those areas. At the same time there is a kind of urban flood generated from strong disturbances rural environment for agriculture, as well as the development of road infrastructure. Mention in this section of the latest developments of more severe urban flooding is done.

Chapter III

In this section, the urban aspect of the cities in Brazil is. It is the fifth country in the world's largest, which is why we were forced to select a city for research. One of the urban models with ecological character is the city of Curitiba, a development model promoted by an interdisciplinary team. The model of the city is a developmental environmentalism.

In Brazil 82% of the population is located in towns, on the other hand is the most advanced in the analysis and treatment of the problem of urban drainage country of Latin America. Nevertheless, significant rainfall in San Pablo prodjeron causing serious damage.

Chapter IV

In Chile, the history of flooding and flooding in Chile more important is recorded in the communes of Valparaiso and Vina del Mar. To minimize these problems mitigation works related to the construction of canals and vaulted the streams were built, and then master plans for evacuation and rainwater drainage and communal and inter plans that regulate urban settlements, considering conservation areas and developed risk.

Mitigation works have developed but reduced the problem of waterlogging that was generated in the plain of the communes, have failed to prevent the transfer of problems to the upper parts of the cities, especially the occurrence of landslides and mudslides, caused by heavThe March 25, 2015, an unusual weather caused rainfall in northern Chile, with consequent flooding and overflowing of Copiapo and Salado rivers, causing damage in several towns and cities.

The most affected city was Copiapo, a small city in Chile, capital of the province and the region of Atacama, with mining tradition from its origins.

They reached 30,000 victims and damage to public and private property. In the sector of the insurance market, they reported more than 700 incidents were reported, forcing liquidators install an office of engineers and buildersy rainfall recorded in the Mediterranean climate.

Chapter V

In Peru there are still no large-scale experiences of urbanization and sustainable construction. Peru does not have a housing policy and construction that promotes holistic integration of the environmental dimension. The Ministry of Housing and Construction still

has a very weak in this regard policy. While there are a number of already developed instruments whose approval is still very slow, lacking specific rules and legislation promoting sustainable construction in itself.

Some district municipalities have advanced and have incorporated some requirements on licensing procedures, as San Isidro, asking Studies Urban Environmental Impact and Road, which although they are not regulated by the industry, are a step forward, but implementationIt can not be generalized.

Floods in Peru are a recurring problem each year due to the seasonality of rainfall in the Andean region, which has a dry season and a time of distinct rain, the latter from December to March.

Chapter VI

In this section the work the Urban Water Risk Management team has been developing in recent years aimed at consolidating a comprehensive view of water management in the city, exploring and investigating disciplinary aspects in the development of planning instruments is and management of urban land in risk areas, which contribute to the development of public policies and the design of sustainable solutions in Uruguay.

Flooding in Uruguay are one of the key urban issues. They cause significant imbalances in the economy and the cultural development of the localities, exacerbating the isolation and fragmentation of important sectors of the population.

Introduction

In this research, and the impact on topic of Climate Change in the Mercosur region try floods in urban areas. In recent years there have been detected in the region, phenomena of excessive rainfall that caused serious flooding.

In addressing the issue, we have taken the urbanization as a causal factor in the process of flooding in river banks, in this context it should be mentioned that urbanization is one of the most significant manifestations of human activity throughout history process urbanization recognizes three stages: Pre-industrial, Industrial and Current or communications.

Today the world population is about 6,100 million and the urban population reaches 2.850 million, ie 46.7%. In a short time, for the first time in history the number of urban dwellers will overtake the rural areas.

As regards the geographical distribution of the urban population in the world, South America is leading this trend. In our continent, urban concentration in major cities has the highest rate of growth among regions of the world and the greatest of all time, with a marked tendency of concentration of socio-economic and administrative functions in a few major cities by country.

Urbanization is increasing in the world and particularly in South America. This trend, which is also recorded in the Mercosur region, generates continuous pressure to the occupation of urban space. The rapid expansion of the neediest sectors becomes difficult to control all aspects associated with growth.

Attention to the problems of urban drainage is usually performed only immediately after their occurrence, resulting in works whose life is ephemeral. The problem of urban flooding often is forgotten with the passage of time, particularly during periods of drought. Unfortunately, neither the growing awareness for the preservation of the environment has yet generated significant practical actions in relation to the urban drainage. In this sense it is hoped that the dissemination of concepts tied to the process of generation of urban flooding

help a greater degree of awareness of the general population and in particular the actions of environmental groups.

The objective is to minimize, and if possible prevent, the systematic increase hydrograph urban areas. This requires quantify the impact of different conditions of urbanization on runoff and establish a land use regulation.

Natural hazards policies should focus on establishing an effective response to natural disasters affecting human life, While the response of government administrations disaster is important, it does not address the causes of the losses caused this event. These causes originate in the complex interaction between human settlements and the natural environment. Repeated natural events become disasters because populations are in the path of the damage, improperly prepared structures to withstand the hazards posed by nature. In order to protect people and their property, the policies formulated to deal with natural disasters should cover a wide range of issues. In developing countries, these aspects are linked to a network of policies related to economic development. The best protection against the ravages of nature is an economically viable country with strong democratic institutions. In the same way that reducing poverty requires a wide variety of policies affecting various strata of society and government, reduce the frequency of natural disasters requires a comprehensive approach that reflects the causes of vulnerability of a society to such disasters. Not only must articulate a comprehensive strategy but must also build a political and economic will to support these new policies. A national system for responding to disasters is made by the interaction of institutions, financial mechanisms, standards and policies that make up how to address the disaster risk management in a country. In this context, flood insurance coverage is a risk transfer mechanism that allows the distribution of risk between the parties, reduces the differences in the risk of each person, can risk discrimination, promotes measures to reduce losses and provides a tool to monitor and control the behavior (Freeman and Kunreuther, 1997).

CHAPTER I

Urbanization in the world ¹

Urbanization is one of the most significant manifestations of human activity. Throughout history the process of urbanization recognizes three stages: Pre-industrial, Industrial and Current or communications.

In 1800 only 1% of the population lived in cities. Since the mid-eighteenth century, where as a partner to expand the industrial revolution effect, urbanization has increased globally at an ever faster pace.

According Guglielmo (1996), during the first half of the twentieth century the total world population increased by 49% and the urban population at 240%. In the second half of the century this trend accelerated: the urban population grew from 1,520 million in 1974-1970 million in 1982. Today the world population is about

6,100 million and the urban population reaches 2.850 million, ie 46.7%. In a short time, for the first time in history the number of urban dwellers will overtake the rural areas. As regards the geographical distribution of the urban population in the world, South America is leading this trend. In our continent, urban concentration in major cities has the highest rate of growth among regions of the world and the greatest of all time, with a marked tendency of concentration of socio-economic and administrative functions in a few major cities by country.

Moreover, population growth of cities is accompanied by a spatial extent. There is now a general trend of population decline in the inner cities. The industry is no longer the main factor of growth of cities, particularly in large cities. Worldwide, the primary cause of the decline in manufacturing employment over the whole of the cities is the policy of industrial decentralization, which concerns almost all metropolises of the world. By the early 90 large cities in Latin America have also adopted a policy of industrial decentralization. This is done at the expense of the development of the peripheral areas of these cities.

¹ Urban flooding in Argentina. Bertoni J.C.2004

Tackling the problem of urban flooding

Urbanization is increasing in the world and particularly in South America. This trend, which is also recorded in the Mercosur region, generates continuous pressure to the occupation of urban space. The rapid expansion of the neediest sectors becomes difficult to control all aspects associated with growth.

In this context, attention to the problems of urban drainage is usually performed only immediately after their occurrence, resulting in works whose life is ephemeral. The problem of urban flooding often is forgotten with the passage of time, particularly during periods of drought.

The municipal body, with areas dedicated to planning, it's not obtente urban floods are not always related to the policy of occupation of urban space, it determines difficulties in formulating effective measures.

When municipalities do not control the development or increase the capacity of the drainage system the occurrence of urban flooding increases, social and economic loss for the entire community.

One aspect that it should be mentioned, is the rainwater flow gravity. The consequences of the changes on the drainage system only appreciate later, during the occurrence of severe storms. In some cases the combination of effects resulting in flash floods on urbanized areas, even under not very heavy rains.

Unfortunately, neither the growing awareness for the preservation of the environment has yet generated significant practical actions in relation to the urban drainage. In this sense it is hoped that the dissemination of concepts tied to the process of generation of urban flooding help a greater degree of awareness of the general population and in particular the actions of environmental groups.

From the above, we can say that with increasing the carrying of the cities the consequences of the lack of planning and regulation are compounded. After that space is fully occupied, the solutions available are extremely expensive and technically complex. The public power passes to invest a significant portion of its budget to protect some sectors of the city suffering because of the lack of foresight on the land use. These funds are, ultimately, the entire population of the municipality, provincial or national state (depending on the

importance of the city and the seriousness of the situation), so the question of who should really pay arises.

The technical answer to the problem is to discipline the urban occupation through densification compatible with flood risks.

The objective is to minimize, and if possible prevent, the systematic increase hydrograph urban areas. This requires quantify the impact of different conditions of urbanization on runoff and establish a land use regulation.

Urbanization and urban flooding hydrological impact

The extension of the boundaries of cities is a natural occurrence associated with urban development, it makes possible the ordering, the ordering of the socio-cultural, economic and legal relations.

The impacts of urbanization on the water cycle are numerous:

- the land sealing,

- the acceleration of the runoff,

- the construction of obstacles to runoff,-the "artificiality" of the ditches, streams and rivers in urban areas

- the receiver means contamination.

Soil sealing, runoff acceleration and construction of obstacles to runoff, three impacts on the preponderance of magnitude increase in the frequency of flooding in urban areas.

Urban development, paving, with a shrinking green spaces in relation to the built environment dimension, results in a considerable increase in stormwater runoff in cities smaller with few paved roads, vacant land interspersed with houses generally funds include land or gardens, rain is a large proportion of infiltration areas (land, gardens) relative to the impervious areas (roofs, floors). Water runoff resulting from rain intensity over an area determined under these conditions is much lower than that which occurs on a heavily urbanized city where virtually 100% of its surface is impermeable in urban centers.

The development in a watershed tends to fill low areas (which previously They provided storage) and permeable paving areas (that provided infiltration). The sum of a storm sewer system with laces and more runoff collection ditches and directs it to riverbeds, lakes or wetlands.

Small runoff are those who collect and scatter most of the pollutants in urban water course.

These pollutants include sediments, metals, oils, which are washed from the impervious areas to the sewer system and directed toward the runway. Capturing these small events and detaining runoff for a period of time you can stop any of the pollutants settled before they download on the runway.

According to UNESCO, there are certain situations mean that exemplify the impact that urbanization occurs in urbanized areas.

Rural area has become urban per capita of population increase

-A Increased impermeability of 40% produces a 50% decrease in the time distribution of runoff and an increase of 90% of the maximum flow of floods;
When the population density goes from 0.4 hab / ha to 50 hab / ha-time distribution of runoff are reduced to one tenth and runoff volumes increased tenfold
-The Evapotranspiration is reduced by 38%

-The Surface runoff increases by 88%

We have identified the following impacts to waterways caused by the increase of the community:

-Caudales Maximum increase of 2 to 5 times on the preurbanización

-the Frequency of flood events may increase from one every two years to 3-5 times each year. A channel that through the years has adapted its floodplain will now be renovated due to the increase in the quantity and speed of water. There will be slides margins and extensions of bed, bed erosion and fallen trees.

-The Runoff will reach the receiving stream much faster (up to 50%).
He reduced base flow due to less infiltration.

- The increased sedimentation caused by erosion fill sections of backwater channels, directly impacting aquatic life and the number and types of organisms found.

-The Amount of pollutants entering the river system during and after the development is increased by an order of magnitude.

- The temperature of an urban channel can be increased 0.08°C per 1% increase in impermeability.

- The temperature of an urban river bed may be increased by 0.83°C 30 m when flowing through areas without sombran.

Types of floods and urban subsystems

Type of floods and recurrences

There are two types of urban flooding:

River flooding, usually associated with improper urbanization of surrounding waterways to flood areas.

Floods from the traditional urban growth.

They observed in several episodes of flooding, combinations of the two types statements. Most critical river flooding associated with severe events.

The floodwaters are classified as Ordinary if your return period not exceeding 10 years, Extraordinary when it is between this value and 100 years, Exceptional for more recurrences. Moreover the name Episodic, applies to those grown usually associated with times of more than 100 years, of which there are features in the landscape, advertibles through geological and geomorphological analysis return.

Urban drainage subsystems

Differentiation in the aforementioned type of floods corresponds to the basic subsystems that make up the urban stormwater drainage system of a city. Planning, design and operation of an urban drainage system distinguishes two levels: macro and micro drainage.

The subsystem includes all the macro drainage runoff courses defined by natural topographic depressions of the basin, even though ephemeral. This level higher areas drains a 5 km², depending on the size of the city and relief of the region. A Fundamental characteristic of this component is always there, even when no specific drainage works are executed. For the purposes of this sub-project should be able to eliminate or reduce the damage caused by exceptional rainfall, conveniently between 25 and 100 years recurrence time.

Micro drainage subsystem covers all drainage works carried out in areas where natural drainage is often not well defined, being determined by the land use. In an urban area micro drainage subsystem typically includes the layout of the streets, the cord-gutter systems and / or sewers, hydrants storms and groundwater systems driving up the macro drainage. This subsystem must be designed to operate seamlessly from storms with return periods between 2 and 25 years depending on the type of employment in the sector.

CHAPTER II

REPUBLIC ARGENTINA ²

Spatial aspects of the Argentine cities

There are characteristics that typify the main urban areas of cities. Three items are essential:

- 1) The geographic picture of the city, outlined by the notions of .situación. and .sitio. (Ideas associated with the regional and local levels respectively).
- 2) The distribution plan (or plane) of the city
- 3) The relief (or cityscape) created by the same city

The situation and the sites of a large part of the Argentine cities reflect a very close interaction between the process of urban settlement and river networks in the country. The waterways are often the key to the location of the cities on its banks nexus, mainly those created during European colonization.

Consequently watercourses are often the key to the location of the link cities along its banks, mainly those created during European colonization.

Consequently, unplanned urban expansion and weak environmental awareness concept .ciudades taking place on the banks of the waterways "is

He transformed into that of "waterways that cross the cities ..

This explains the installation of neighborhoods in naturally flooded areas, typically made of various Argentine cities and neighborhoods regards different socio-economic, fundamentally humble strata.

As for the "relief" or urban "landscape", there are two basic tendencies depending on the size of cities in Argentina: for commercial and central areas of large and medium cities urban scheme has a strong vertical development.

² Urban flooding in Argentina. Bertoni. J. C. 2004

General characterization of urban flooding in Argentina

In 2000, the World Bank issued a report, the Argentina within the global context, it is among the 14 countries most affected by flood disasters in rural and / or urban, reaching higher losses to 1.1% of GDP.

The frequency of occurrence of major flood damages of any kind is high, exceeding an important event every ten years. Since 1957, 12 severe episodes (one every four years) have occurred, causing deaths and significant losses in infrastructure, agricultural production, private property and economic activities

The World Bank (2000) classified flooding occurring in the Argentine territory according to four basic types:

In the valleys of the great rivers (or river flooding)

in the Andean foothills (by rapid melting of snow and / or concentrated rain);

Flash floods (floods .flash.) Occurred in cities and rural areas (generated from heavy storms)

Flood plains areas, generated by strong storms and originated from inadequate drainage and rural land management, including the treatment it's network vial of rural feeder roads.

Its duration and degree of involvement at national level the central region (South of the provinces of Cordoba and Santa Fe, northwest and southwest of the province of Buenos Aires and north of the province of La Pampa). These have reached extraordinary levels during recent wet years, being the reflection of inadequate land use in rural areas for agriculture, highlighting the river flooding linked to the valleys of the great rivers of the Plata, since in that region is generated over 76% of GDP and 70% of the population is located.

It also highlights nationwide floods in the drastic change of culture, of course, the occupation of flooded areas and the development of road infrastructure is not always compatible with the characteristics of surface runoff.

Urban flooding in Argentina ³

Argentina has about 90% of its population located in urban areas, a fact which places it among the countries that hold the highest urban concentration in South America. Urban flooding often cause increasing damage that increase systematically. riparian and caused by the traditional urban development: two basic types of urban flooding were identified.

In Argentina it can distinguish a third type: the so-called urban floods generated from strong disturbances rural environment for agriculture, as well as by the development of secondary and primary road infrastructure. Such floods affect urban centers of medium and small and are typical of the central agricultural region. As previously mentioned, they were evident during the last period of wet years.

Team members of Land Management of the Institute of Environmental Studies (ISEA) of the National University of Cordoba (UNC) completed a report on the causes of the flooding occurred in the Sierras Chicas after heavy rains in February 2015.

The report had two instances: one of analysis based on GIS and the other field sampling. A satellite image of the basin of Rio Ceballos was used in the first analyzing forest type and extent of urban development. In the second instance, they evaluated a set of variables: slope, distance to rivers and streams, levels of altitude in relation to sea and how the sub part to the exit of the basin of Rio Ceballos-Saldán

A record of the damage in the week of 20 to 23 February in Villa Allende, Mendiolaza, Unquillo, Saldán and Rio Ceballos through images, interviews with residents and 102 points samples was also performed. These studies were reflected in a risk map of the basin, with which they were defined areas of low and high risk of flooding to persistent rain.

Land use and abuse

The developments Sierras Chicas, both ancient and current, are located in areas of increased risk of flooding. This was re clearing of native forest that was two thousand hectares in just seven years.

³ ISEA-UNC report

The biggest flood risks fall on the cities, because the water has few obstacles in his path. And the opposite happens in the greater vegetation cover.

Villa Allende, the water outlet. According to the geography of the place the "door" leaving water throughout the basin is the town of Villa Allende, so during peak hours of the flood of February 15, the central streets of the town became rivers.

A slide

The basin studied is a region of high slope, which refers to the decline of land measured in percent (a decline of 10% means that the ground 10 meters rises 100). In the area of risk thousands of hectares are identified with slope levels ranging between 18% and 60%. Thus, the area of Sierras Chicas becomes a "slide" through which the rain water slides, which is enhanced by the low forest cover and the large presence of stones and surface urbanized facilitating water runoff. In areas of low slope, located mostly in the cities, the water tends to stagnate.

Height

In the highlands compared to sea level, low water quickly by the gravitational effect itself. And in low areas the opposite occurs and is likely to stagnate. The highest regions have much less risk of flooding to the lowest. Altitude limits that the phenomenon occurred were between 500 meters (Villa Allende) and 800 meters (Rio Ceballos).

Too close

It is one of the most important causes and has to do with the constructions near the banks of rivers and major streams.

The highest density of developments following the path of the water. Then, under intense as registered flood, it was verified that the water reached up to 300 meters from the banks of the waterways. The impact of water decreases as the developments away from the rivers.

The flood map

The five variables studied form a map of the watershed that clearly defines which areas with different levels of flood risk are. There are 12,052 hectares "no risk" of flooding, mainly the areas where the forest is conserved, pastures and rocky areas, and where the greatest height above sea level and high slope is recorded. Then, there are 4,804 hectares of

"low risk" and 1,968 other h The aspect that stands out in the report are the 859 hectares of "high" risk and 330 hectares with "extremely high" risk of flooding: it is primarily here that unfolds the urban layout. In these more than a thousand hectares it is where homes, businesses and institutions are located.

- "The most influential factor in the flooding was the steep slopes of the area, which facilitated the rapid flow of water downhill. "This large amount of turbulent water in the stream dragged everything in its path, facilitated by the large built-up area".

- "The results suggest that urban areas and elbows river banks and streams were the most affected," says the team. And underline: "Excessive urbanization, until even the banks and into streambeds and Rio Ceballos was the determinant of human and material loss occurred on February 15, 2015 lives".

- "To prevent this happen again is essential to prevent developments in areas of high and very high risk of flooding and recover, in these areas, vegetation cover. We must implement a new land use planned strategically, which already contemplation we also like-although the provincial law 9,814 (Forest Act). And this depends on the commitment of the whole society and the actions of management of municipal and provincial authorities. "



girls-saws overflowing river



girls-saws overflowing river



CHAPTER III

FEDERAL REPUBLIC OF BRAZIL ⁴

Urbanísticos aspects of the cities of Brazil

Brazil is the world's fifth largest country, occupying 47% of the South American continent, with an estimated population of over 8.5 million km².

The territorial extension requires us to select a city for this research, the Brazilian city of Curitiba, capital of Parana state, became the nineties in ecological city emblem. In the contemporary context of crisis of urban models, the example of Curitiba provides a new reference: the city that takes aim at being green. Curitiba consolidation model was made possible thanks to more than thirty years of development of a new urban project promoted by a large multidisciplinary team of architects, engineers, geographers, economists, lawyers, sociologists, historians and other experts. The continuation of this process by stages constitute a precedent magnificent in a Latin America that has too often revealed as the laboratory in which the most common is to start again, abandoning the projects and the results above, without accumulating certainties.

The key is their model Curitiba developed public transport system, interpreted as the backbone of the operation of the city. This system has been perfected down to the red bi-articulated buses that circulate in its own lane and have tube stations. The proper functioning of the system is based on the busway with synchronized traffic lights and stops tube which is arranged in advance of the ticket and embark at the height of the bus immediately with small gateways that are deployed between the vehicle and the platforms. Curitiba model is a developmental ecology defender sustainable development or ecological modernization. The environmental arguments are used to justify the development, growth and enrichment. In Curitiba there ruralista model garden city or nostalgic; On the contrary, there is a decided option for urban and metropolis. After the most emblematic operations there are economic reasons. Thus, the development of the great avenues of bus lines the

⁴ Gaddi Architect

urbanization of the great avenues of bus lines and the proposed buildings and staggered vertical used to obtain high gains with solar urbanized for high-rise buildings, reversing gains in promoting the city.

The second major feature of Curitiba is the vast system of parks, which have the function of providing drainage of the entire territory. The policy of creating green areas has been so intense that happened in 20 years of 0.5 m² of green area per 50 m². Curitiba to become ecological capital, it was necessary to revitalize its old center is full, restoring historic buildings, constructing new public facilities, strengthening parks, squares and pedestrian streets.

A complementary element to the public transport system, the introduction of parks and pedestrian and regeneration of the historic city was, from 1978, the creation of the network of bike paths or bike lanes. The bike paths also serve to protect areas of possible environmental degradation, creating parallel railway lines, rivers and streams stretches. Citizens environmental education has enabled its inhabitants are considered jointly responsible for the functioning of the city. With few resources and little imagination has ensured that 90% of waste is recycled, for example, converting old buses in classrooms and mobile offices, mobile places for learning.

General characteristics of urban flooding in Brazil ⁵

Brazil's total population now exceeds 170 million people. Brazilian cities housed within a century ago 10% of the population; currently 82% of the population is gathered in cities, several of which are of great size. Among them a variety of observed cases associated drainage and urban flooding. In turn, the country is one of the most advanced in Latin America in the analysis and treatment of urban drainage problems. The Ministry of the cities of Brazil is developing a national program of rainwater. The proposed Program Stormwater aims to reduce the vulnerability of the population to coastal floods, which occur in urban drainage, minimization of environmental impacts through an institutional, economic and technical policy and action plan management of stormwater in

⁵ Flood Management Course Urbanas- Morelli Tucci EC -2006

conjunction with the other elements of urban development in Brazilian cities.

The program presented is based on the following elements:

Institutional: address legal elements, management, training, science and technology and data;

Technology: the highlight of the elements of quantity and quality, is the technical elements necessary for the development of sustainable management.

Financial Officer: is the elements of economic and financial viability of stormwater management.

Public participation: is the potential mechanisms for greater public participation in program development

Action Plan: using the basis proposed in other plans, develops an action plan for the Ministry of Cities providing program implementation.

Urban flooding in Brazil

In February 2015, heavy rains have caused flooding in several parts of Sao Paulo. The slum suburb of Eavy suffered damage to some of its possible construction. Civil defense officials reported that the floods and landslides forced thousands of people to flee their homes in the state of Sao Paulo.

The heavy rain that fell in Sao Paulo raised the level of the main reservoirs supplying the metropolitan area of the city slightly. Their situation remains worrying. The storm caused much damage.

The rains caused the overflowing of the Tiete river, water invaded at least 250 homes. Statistics indicate that in five hours rained scheduled for six days. The climate phenomenon also brought down trees in Greater São Paulo, about 1,765 have fallen since November 2013 until now, causing severe damage.



Sao Paulo in February 2015 Flood





Sao Paulo in February 2015 Flood

CHAPTER IV

REPUBLIC OF CHILE⁶

Urban areas of the cities of Chile

The complex represents the maximum human interference in the hydrological cycle, hydrological creates a new environment, where the asphalt and concrete replace the soil and drains and rain-water conduits replace the natural channels and basins. So that its influence is seen in different ranges of precipitation, infiltration, evapotranspiration, that occur in urban areas. The environmental effects of urbanization vary urban use being analyzed, associated with land cover features, density of buildings, percentage of impervious surfaces and type of activity taking place. The urbanization of watersheds disturbs and significantly alter the balance of energy, matter and information about natural systems.

The history of flooding and flooding of Chile more important is recorded in the communes of Valparaiso and Vina del Mar. To minimize these problems mitigation works related to the construction of canals and the vaulting of the streams were built, and later developed master plans for evacuation and rainwater drainage and communal and inter plans that regulate urban settlements, considering conservation areas and risk. Mitigation works have developed but reduced the problem of waterlogging that was generated in the plain of the communes, have failed to prevent the transfer of problems to the upper parts of the cities, especially the occurrence of landslides and mudslides, caused by heavy rainfall recorded in the Mediterranean climate.

Knowledge of the influence d the types of urbanization on surface runoff, can not propose structural measures, such as environmental management of watersheds, communal integrated master plans, to maintain or improve infiltration each use or cover, to try to balance the greater waterproofing certain areas more other infiltration capacity. The cities of Vina del Mar and Valparaiso are part of the Greater Metropolitan Area of

⁶ Relationship between the socioeconomic composition of the population, urbanization and the risk of flooding in two communes of the Great Valparaiso. University of Chile Faculty of Forestry and Nature Conservation. M. L. Cadima Revollo 2010

Valparaiso and is located 100 kilometers northwest of the Metropolitan Region of Santiago. In the area a warm-temperate climate with winter rains and prolonged dry season comes. 80% of rainfall is generated in the winter months between May and August, reaching an average annual sum of over 350 mm.

The metropolitan area of Greater Valparaiso is the second most populous urban settlement Chile after Santiago, accounts for 50% of the regional population. This metropolitan area is the result of a process that was first produced conurbation between Valparaiso and Vina del Mar, and later took over the communes of Concón, Quilpué and German Villa. The cities of Viña del Mar and Valparaiso were built on terraces of marine abrasion, forming a succession of slopes and terraces, reaching heights of 450 meters, with slopes ranging from soft to very steep. Valparaiso has 42 hills and ravines that serve 17 delimitation of the first and evacuation of rainwater.

The urban area of Valparaiso is formed on an ancient beach covered by artificial fill and has spread considerably towards the streams and adjacent terraces, which are deep in the vicinity of its mouth and arranged radially in the flat part of Valparaiso. The city of Vina del Mar was built on a natural drainage system formed by the estuary of Vina del Mar or a Marga Marga and its main tributaries.

Because urbanization that occurred in these communes, from the plains to the slopes, generating a natural replacement coverage for artificial flooding problems occur in the center of these cities, which are trying to solve with embovedado of the streams action while controlling these problems in flat areas of the city, does not help to lower the flooding rains on the slopes, mainly in the municipality of Valparaiso, in which these areas were occupied by groups low socioeconomic income. In the town of Vina del Mar, socioeconomic groups high income and upper middle are located mainly in the lower part of the commune and lower income groups on the slopes.

Urban flooding in Chile

The March 25, 2015, an unusual weather caused rainfall in northern Chile, with consequent flooding and overflowing of Copiapo and Salado rivers, causing damage in several towns and cities.

The most affected city was Copiapo, a small city in Chile, capital of the province and the region of Atacama, with mining tradition from its origins.

They reached 30,000 victims and damage to public and private property. In the sector of the insurance market, they reported more than 700 incidents were reported, forcing liquidators install an office of engineers and builders.



Flood Copiapo City in March 2015





Flood Copiapo City in March 2015

CHAPTER V⁷

REPUBLIC OF PERU

Spacial aspects of the cities of Perú⁸ 7

In Peru there are still no large-scale experiences of urbanization and sustainable construction. Peru does not have a housing policy and construction that promotes holistic integration of the environmental dimension. The Ministry of Housing and Construction still has a very weak in this regard policy. While there are a number of already developed instruments whose approval is still very slow, lacking specific rules and legislation promoting sustainable construction in itself. The FCPV is working with the Office of the Ministry of Environment to cover these gaps, but these proposals need to be approved and implemented.

Some district municipalities have advanced and have incorporated some requirements on licensing procedures, as San Isidro, asking Studies Urban Environmental Impact and Road, which although they are not regulated by the industry, are a step forward, but implementation It can not be generalized.

Peru has a high concentration of population in the city or in the two most populous cities. " At the same time there has been a gradual population settlement in areas that were historically sparsely populated and are at the center of the region, particularly around the basins of the Amazon and Orinoco rivers. These changes pose new priorities for governments in the region.

Urban flooding in Peru 8

Floods in Peru are a recurring problem each year due to the seasonality of rainfall in the

7- Building Cities for life. Contributions to sustainable construction in Peru. Forum cities for life .Miranda Sara L. Lima Peru 2008

8 - www.rimd.org

Andean region, which has a dry season and a time of distinct rain, the latter from December to March, coupled with years of presence of the phenomenon of child make the flow of the rivers flowing from the Andes to the coast increase several times its size, overflowing and causing damage to coastal cities specifically in the northern region of the country, such as: Tumbes, Piura, and Lambayeque. Sometimes these floods have come to Lima with the excesses of Chillón and Rímac rivers. Equally important floods have occurred in the southern coast, in cities such as Ica, and Pisco which have left extensive damage.

In the case of the Amazon, by the characteristics of its relief features such as a low slope, fluvial dynamics of the rivers have a higher annual rate of migration to 200 m rivers like the Ucayali and Marañón, these courses usually change each recovering previous year flood plains, this is not a problem when the presence of population is zero, the opposite occurs when there are towns located close to the channel, such as the city of Pucallpa. Floods also affect the summer months by heavy rains in Amazonas department, Junín, Loreto and Ucayali.

On the side of Titicaca, floods occur most mind by the excesses of Coata, Ramis rivers, this combined with the lack of drainage in urban areas and the topography of the area, makes collapse the drainage system. The cities most affected are Puno and Juliaca, also in the summer, which coincides with the rainy season, accentuating the child witnessed the phenomenon.

In the month of January 2015, over 600 families were affected by the overflowing of the rivers Huallaga and Huayabamba in the San Martín region, the authorities asked the central government declared the emergency

The water invaded districts and population centers not only caused the collapse of 69 houses and the total loss of the goods of the people. 70 hectares of in the district of Pachiza in the province of Mariscal Cáceres, were razed.

The districts of the provinces of Bellavista and Juanjuí, located on the banks of the Huallaga River are the most affected, with homes, churches and schools severely damaged.

On February 5, 2015, in the town of Ayacucho, heavy rains caused dozens of homes are affected. In addition, a health center and a school.

A wounded and left 78 families homeless flood, caused by heavy rains accompanied by hail, in the district of Coracora located in Parinacochas, Ayacucho region in Peru are a recurring problem each year

The February 19, 2015 at 01:20 hours, a result of heavy rainfall, increasing the flow of rivers Acre and Yaverija recorded; then the overflowing of the two rivers flooded homes, public buildings, roads and cultivation areas in the district of Iñapari province of Tahuamanu.



Acre river overflow



Acre river overflow



CHAPTER VI

REPUBLIC OF URUGUAY⁹

Urbanísticos aspects of the cities of Uruguay

The condition of the water in the city is one of the major determinants of the quality of urban life. The water-city relationship has varied over time, according to the needs, uses and demands of man. In recent decades, major advances in scientific knowledge have contributed new elements to the understanding of the relationship between the water system and its associated ecosystems and urban system.

The work that the Urban Water Risk Management team has been developing in recent years aimed at consolidating a comprehensive view of water management in the city, exploring and investigating disciplinary aspects in the development of instruments for planning and management of urban land in risk areas, which contribute to the development of public policies and the design of sustainable solutions.

Flooding in Uruguay are one of the key urban issues. They cause significant imbalances in the economy and the cultural development of the localities, exacerbating the isolation and fragmentation of important sectors of the population. Also they affect public spaces concerning community identity.

Among the changes observed in recent years in water regimes in our country, the increased precipitation is highlighted, but in particular the concentration thereof in specific events of strong features. The analysis of daily rainfall can conclude that "increase the number of rainy days and the same are more intense, despite the increase in daily rainfall intensities is more important than the number of days .

Urban flooding in Uruguay¹⁰

⁹ University of the Republic, Faculty of Architecture. Institute of Theory and Planning

¹⁰ Flooding in Uruguay. Contributions from the territorial order. A. Piperno, Sierra P, Institute of Theory of Architecture and Urbanism. Faculty of Architecture. University of the Republic.

Urban flooding in Uruguay are one of its main problems, caused major disruptions in the economies and socio-cultural development of the localities, exacerbating the isolation and fragmentation of large sections of the population and affecting public spaces concerning community identity.

From "Historical Records of Adverse Event Record" shows that:

Most of the actions of the same correspond to floods

The 19 departments of the country have suffered in recent years some kind of flooding event, the most affected Artigas, Tacuarembó, Cerro Largo, Durazno, Mercedes, Thirty-Three and Paysandu.

The roadblocks caused by the floods is a factor that alters the relationship between accessibility and cities. An example of this is the rise of the Yi River, causing the city of Sarandí del Yi is "away" 100 km. Montevideo to cut over No. 6 Road.

The response to situations of flooding in urban edges escapes reflection on contemporary construction processes of territories and therefore require a change of approach, looking for the traditional paradigms of planning and in particular the relationship city - river.

It is necessary to re-understand and re-formulate the problem, betting on the transformation of the modes of action, rescuing the strengths and potential of the different local situations, it being understood that a proactive look positive responses territory drives that work with prevention and mitigation of the impact of flooding. Thus, "the river threatens the opportunity river" is assumed as the main slogan

In the course of the investigation "Urban Flooding in Uruguay" an "toolbox" that enables those responsible for making decisions design programs, projects and instruments tailored to the different situations of action and management scale proposed appropriate (local, micro-regional - basin or national).

These programs must fit into a planning system where the general policy of land use and integrated management of water resources integrated flood as one of its components. Planning instruments should be designed as open, to allow coordination with other

instruments, and flexible, to enable constant adaptation of these figures to particular cases and disciplinary transformations that occur.

The land use plans at different scales should integrate these problems through recognition of vocations of the territory, defining in principle as undeveloped land flooded areas of high recurrence, establishing specific regulations for these areas and in particular to those already They have reached an important level of consolidation. These regulations should consider among other things, the "danger zones", the characteristics of the population and its activities, the existence of high-value areas, urban drainage and fractionation, building and land use.

In the national legal framework Land Management Law and Sustainable Development highlights, with average parliamentary sanction to date, recognizing the Land Management as "the set of cross-state actions that aim to maintain and improve the quality of life population, social integration in the territory and use and environmentally sustainable and democratic development of natural and cultural resources (Article 3). Among the subjects of Land Management raises "the risk areas identified by the existence of natural phenomena or hazardous installations and vulnerable human settlements" (Article 4), excluding the land urbanization process "with natural hazards or impairment of technological risks of major accidents to goods and persons "(Article 49). Furthermore, Article 50 makes explicit reference risk prevention.

The December 26, 2014, in Montevideo, capital of the country, there was the worst storm in 50 years, leaving the city under water. In an hour they fell 60 millimeters. The phenomenon affected several vehicles, electric light lines and rescued many people. In Montevideo there are several areas where drainage systems reached the end of its life, because they were built 80 years ago and have design problems



Flood City Montevideo





Flood City Montevideo

Conclusion

In this research, an overview of the knowledge of urban flooding in Mercosur countries, and measures designed and implemented institutional responses are developed. Emphasis was placed on the role of urbanization and urban development in the construction of flood risk and the interaction between the dynamics of the watershed and the causality of flooding in cities was highlighted. Knowledge analyzed indicates that although floods are a serious socio-economic problem in cities of the region, the flood risk management is just being incorporated in planning and public policy. In this regard, it states that urban policies should be integrated in the context of the basin, water and water management and risk management in the planning of urban space.

The analysis of the relationship between urbanization and flood exposed the need considering various features and socio-economic and political that generate differential vulnerability in cities, including poverty and environmental insecurity conditions in informal settlements, urban marginality as a contributing factor in employment in areas subject to flooding, and weak urban governance in some areas, among others.

Planning is one of the measures of flood risk management practices applied urban planning, policy and management. Integrate measures to create solutions with other benefits for the environment, health and economy.

Each flood risk scenario is different: there is no single procedure for flood management designs for flood management must be able to cope with variable and uncertain future. Rapid urbanization requires flood risk management is integrated into planning and governance. A comprehensive strategy requires the use of structural and non-structural measures, along with good indicators to "get the right balance is impossible to completely eliminate the risk of flooding".

It is important to consider the social and ecological consequences of spending on flood management in this context flood insurance and financial risk transfer instruments are essential to repair the damage of flood phenomena.

Acronyms

FCPV Cities for Life Forum

ISEA Institute of Environment Studies

UNC National University of Cordoba

Bibliography

Bertoni J.C. 2006 Urban Flooding in Argentine

Cadima M.L. Revollo 2010 Relationship between the socioeconomic composition of the population, urbanization and the risk of flooding in two communes of the Great Valparaiso. University of Chile Faculty of Forestry and Nature Conservation

Gaddi- Architect

ISEA –UNC report

Miranda Sara L. Lima Peru 2008 Building Cities for life. Contributions to sustainable construction in Peru. Forum cities for life

Morelli-Tucci EC 2006 Floog Management Course Urbanas

**University of the Republic, Faculty of Architecture. Institute of Theory and Planning
Flooding in Uruguay. Contributions from the territorial order. A. Piperno, Sierra P,
Institute of Theory of Architecture and Urbanism. Faculty of Architecture. University
of the Republic**