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Willingness to pay for Ecosystem Services provided by a Green Infrastructure project in Santiago de Cali

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Summary

The transformation human interaction has enforced on nature is primarily for the growth and development of cities with production and consumption activities that demand 75 percent of the world's energy and produce 80 percent of its greenhouse gasses. Consequently, the responsibility and the key for changing the current trajectory lies in cities, with an economic development that is less resource intensive. Cities can be very rich in biological diversity that provide ecosystem services. Green infrastructure planning can create frameworks for future development while ensuring the preservation of natural resources that provide ES. Urban Ecosystem services are a key component to building urban resilience and reduced vulnerability through mitigation and adaptation measurement. Cities need not only resilient ecosystem services, but to generate them as well.

This paper examined the value of urban ecosystem services provided by a green infrastructure project “Corredor Ambiental Urbano Río Cañaveralejo” in Santiago de Cali, by means of a contingent valuation method (CVM) applying a survey/questioner and damage cost avoided method (DCA) and emphasises in the need for context-specific classification of ecosystem services provided by project. Within this context, the project will provide the city among other benefits with **regulating services** and **cultural services** and the WTP for this services is **$35.00** per year with a medium range of $25.00 to $44.00.

The study also reveals citizens positive attitude towards nature and the environment and the importance of including natural solution in city planning.

Past events analysis applying damages cost avoided exposed that an average cumulative value of **$92,220.37** dollars (insurance value) per year could be utilized for alternative flood prevention methods. Which relates to the project's objective regarding adaptation and mitigation measures for flood events.

A broader and more generalizable result could be obtained if similar studies where performed in the other rivers that course thoroug Cali.

Valuation of ecosystem services serves an intrinsic purpose to guide city planner, decision and policy makers, with understanding comes change.

Keywords

Urban Ecosystem Services, Green Infrastructure, Willingness to Pay, Contingent Valuation Method, Damages Cost Avoided

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Abbreviations

IHS	Institute for Housing and Urban Development
ES	Ecosystem Services
UES	Urban Ecosystem Services
GI	Green Infrastructure
WTP	Willingness to Pay
DCA	Damages Cost Avoided
CVM	Contingent Valuation Method
CEM	Choice Experiment Method
UHI	Urban Heat Island
VIF	Variance Inflation Factor
TEEB	Economics of Ecosystems and Biodiversity

Table of Contents

List of Figures

List of Tables

List of Equation

Chapter 1: Introduction

1.1 Background

The world has entered a new anthropocentric stage. Humans activities have altered the Earth and started to have a significant global impact to the point that the Earth has entered a new geological time period. Carbon dioxide in the Earth's atmosphere has reached 400 parts per million for the first time. The build-up of carbon has disrupted the balance of the planet affecting the climate structure (By et al. 2013). With the overwhelming amount of evidence of accelerated climate change civilization has reached an epoch of climate consequences that requires to address vital climate imperatives.

One such vital imperative is not an entirely new concept; it has its roots in conservation and planning efforts that started over a century ago. The principles behind it have arisen from multiple disciplines including ecology and conservation biology, forestry, landscape architecture, planning and more recently transportation (By et al. 2013; Fallis 2013). The concept was used to identify all natural, semi-natural and artificial networks of wilderness, forests, parks, wetlands, greenbelts, rivers, lakes, gardens… within and around urban areas, that supports native species. Its origins are also connected to two ideas focused on linking parks and other green areas as well as conserving and linking natural systems to benefit biodiversity and the halting of habitat fragmentation. In the early nineteenth century, the work of the Olmsted brothers alleged that "no single park, no matter how large and how well designed, would provide the citizens with the beneficial influences of nature." But that parks need "to be linked to one another and to surrounding residential neighborhoods."

In more recent years' the term Green Infrastructure (GI) was first used in Florida in 1994 for a report on land conservation strategies that reflected the importance of natural systems as a part of city's infrastructure and it also pressed on the significance of planning to conserve and restore natural systems while impressing upon its citizens the importance of nature and community base planning.

In the past years, there has been a renewed attention in landscape-scale conservation and planning that focuses on making linkages between ecological systems and on the needs of the community that provide benefit for its people.

Ecologists and biologist have long-established that the idyllic way to preserve ecological systems and native animals and plants, is to create an interconnected natural system (Benedict and McMahon 2000). Restoring and protecting biological systems are key concept for the science of nature conservation and accepted practices for ecosystem services delivery and management. "A connected system of parks and parkways is manifestly far more complete and useful than a series of isolated parks" (Olmsted, John; Olmsted 1903).

Therefore "the concepts of ecosystem service (ES) and green infrastructure (GI) are born at the confluence of diverse environmental sciences" (Basnou et al. 2015).

The origins of the ecosystems concept can be found in literature ever since the mid-1960 and early 1970, although it emerged as 'environmental services' and it started with the framing of the ecosystem functions as services with social and ecological components and its benefits, in order to increase public interest in the conservation of biodiversity (The International Biological Program (1964–1974)), (Westman 1977; de Groot 1987). In the nineties the trendiness continued in the academic arena and on developing methods to assess an economic value and to formulate such values through the private and financial sectors in order to create economic incentives for preservation (Costanza et al. 1997). By the turn of the century The Millennium Ecosystem Assessment Reports generated a huge contribution by engraining (ES)

on the policy agendas and thereafter the concept has grown exponentially (Gómez-Baggethun et al. 2009).

One of the first urban ecosystem analysis made was in Brussels in the late 1970's and the efforts continued through the years in 1981, a comprehensive study was published on Hong Kong (Morren et al. 1984) and as research in the arena increased the interdependency of nature and human wellbeing is becoming further recognized (Rover and Persson 2014).

Cities with good quality urban green areas interconnected with green infrastructure, not only provide benefits but offers new context and opportunities for citizens to become stewards of multiple ecosystem services.

Green Infrastructure (GI) attributes an improvement in quality of life in different ways, through it's environmental, social and economic characteristics, based on the multipurpose and versatile use of natural capital. "Potentially a very valuable policy tool, GI's multifunctionality could contribute to the achievement of a number of policy aims and fulfill the needs of a variety of stakeholder groups" (Commission 2012).

This realization is taking place throughout the academy world and the political as well throughout develop and developing nations, the economics of taking a green infrastructure approach has gained cumulative recognition.

As more and more cities turned to more sustainable solutions, emerging government policy are growing through all nations, in Latin America Colombia has been at the forefront of sustainable urban planning, development and policy making. One recent effort is taking place in Santiago de Cali which in present years the city is aiming towards increasing its resilience and aims to tackle climate change impacts through various strategies. They plan to take measures against this deterioration of the urban rivers, recovering the Green Corridors with different facilities and high quality green public spaces improving citizen's wellbeing.

Santiago de Cali also called Sultana Del Valle, Sucursal Del Cielo, Capital de la Salsa, it was founded on July 25, 1536, and a municipality since 23 September 1863 by Law 131. It has an extension of 561 square kilometers and is situated 1003 Meters above sea level. It has a population of 2,110,571 approximately and the inhabitants are called Caleños.

Cali is the third largest city in Colombia, located in the Cauca River Valley and its limits to the north with Yumbo, on the West Dagua and Buenaventura, on the South Jamundi, by the East with Palmira, Candelaria and the Department of Cauca. Cali is considered Colombia's gate to the Pacific.

Cali has been a strategic Colombian transportation center for over four centuries and is connected by highway and railroad with the main cities of the Northeast and the Pacific littoral (Buenaventura) and it's bathed by Aguacatal, Cali, Jamundi, Cañaveralejo, Lili, Melendez, Pance and Cauca rivers.

Cali in the time it was founded it was not a very important site for the crown, so in its early years, a strong development is not experienced. But everything changes when the landowners begin to cultivate large areas of land, only possible because of Cali's specific hydrology (the city was surrounded by floodplains and lagoons) that offered some of the most fertile and productive lands in the country. The specific form of economic development in the region has largely been determined by the coffee industry, the sugar industry and also for the agricultural production of inputs for agribusiness (Vásquez Benítez, 1990).

Around these sectors, other complementary activities of significant importance were developed. These fundamental economic activities are located along the Cauca River valley

and caused a wave of consolidation and growth amongst urban centers were Cali plays a decisive role.

In the nineteenth century, Cali increases its connectivity, its river trade and grows into a city with in-betweenness properties, which enables rapid development of its economy and its infrastructure.

In the early twentieth century, it is formed officially and by direct order of the president, Cali in named the capital of the department of Valle del Cauca. Trading routes and markets expand, leading to the construction of the Pacific Railway by an investment from the elites of the city (Zuluaga, U., et al., , 2015).

Before its transition to industrialization and modernization in the late forties and fifties, the economy was based on the cheap labor for the collection of raw materials and a high level of manufacturing work. From the fifties and on the city starts flourishing industrially, though because of its large growth the city begins to experience more and more flood that inundate large tracts of land. The root of this problem, although not the only one, lies in the lack of control of the waters that irrigate the Valley with Cauca River and its branches (all seven of them) as the main sources. It was therefore with the creation of the (Corporación Autonoma Regional del Valle del Cauca) C.V.C. in 1954 as the solution to a dual problem that came seriously affecting regional development is addressed: control of the water which overflows rendered useless large areas for agricultural use, and the generation of electricity in a manner suitable to the industrial and economic growth of the region (Nayibe, 2005).

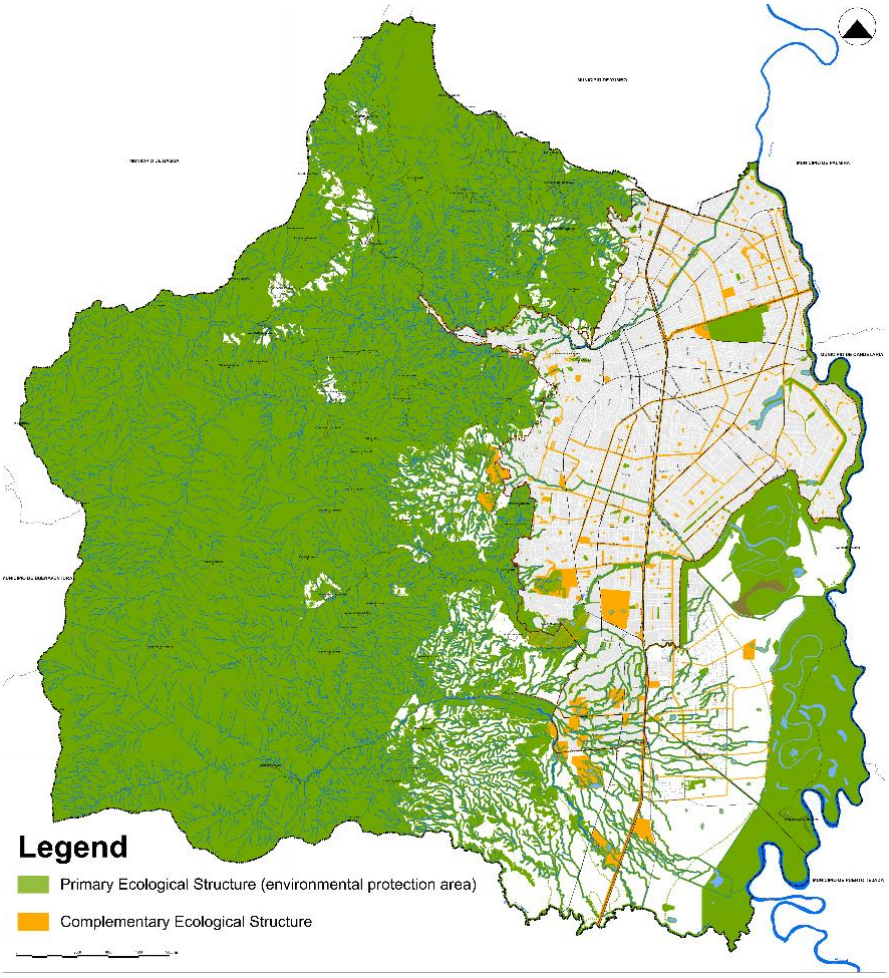
In 1970 a "revolution" overtakes the city, with globalization and the development of a culture as rich as it is that of Santiago de Cali, not much time passes before noticeable changes are being done, some subpar and other of colossal importance.

The disordered and uncontrolled growth of the city (through the overflows of capital) by land occupation processes in which they were leaving the most costly to develop sectors with fewer resources to do so. In middle and long term time frame generated disasters by floods and landslides in areas with strong environmental or technological constraints (Vásquez Benítez, 1990).

Overall, the spatial and temporal behavior of disasters matches this distribution of urban space. The sectors most affected historically been characterized belonging to the poorest people who had to occupy dangerous areas (hillsides with steep slopes or low ground exposed to overruns of channels or channels) this has been increased by the impacts of climate change (flash floods produced by heavy rains).

However, in present years the city is aiming towards increasing its resilience and aim to tackle climate change impacts through various strategies, approaches and disciplines of social sciences in order to deepen the study of the relationship of Society with Nature and the impact of deterioration of urban and peri-urban green space. Some of the strategic projects are the actualization of the master plan including the Cali's Land Use Plan 2014-2027 (POT) "greener" which contains goals to restore the 7 rivers, mountains protection, PNN Farallones (205,000 hec.) and the recovery of water bodies, within the city. The Transformational Green Corridor Program (TGCP) "CORREDOR VERDE Pograma Transformacional: Visión Cero Emisiones"; included in the Municipal Development Plan 2012-2015: "CaliDA, una Ciudad para todos". It aims to transform the lifestyle of the city engaging the local community and diversifying livelihoods (Del Valle del Cauca, Corporacion Autonoma Regional, 2015).

Figure 1 Municipal Ecological Structure



Source: Author compilation

1.2 Problem Statement

The rivers of the city of Cali and its drainage patterns were altered radically several decades ago with the aim of protecting the agricultural areas. This drastic change in a natural system altered and damaged the rivers dynamics and led to major environmental, economic conflicts and exposed the community to risk (Del Valle del Cauca, Corporacion Autonoma Regional, 2015).

Local government recognizes the missteps in the past and the potential of this areas. They plan to taken measures against this deterioration, recovering the Green Corridors with different facilities and high quality green public spaces improving citizen's wellbeing.

According to their updated Land Use Plan (POT) the municipality of Cali identifies that the Base of Ecosystems is made up of "the elements of the natural system that interrelate and

govern essential ecological processes like ecosystems, geology, geomorphology, climate, biodiversity and s water systems, and they define the strategic determinants that condition land use, location of human settlements and morphology ". (Concejo, 2014 p. 56).

This vision is adopted as a strategy to apply in the Urban Environmental Corridors projects, that are already incorporated into the Land Use Plan of the city, where the goal is to recover and interconnected green areas, for protection and for the enjoy of citizenship.

The Urban Environmental Corridors projects act as natural axes providing valuable ecosystem services and countless good environmental quality generators, which connect the natural national park headlands of Cali with the Cauca River, both key elements of regional and national environmental system.

As a part of the strategic planning, local government plans to utilize different methods to provide resilient infrastructure to be able to tackle increasing urbanization rates and climate change issues. One of the main strategies to enhance urban climate resilience is using Green Infrastructure (GI), promoting Urban Ecosystem Services (UES), improving biodiversity, economic growth of the city and at the same time deliver additional environmental benefits and fomenting green economy to ensure a healthy environment.

A quintessential process to take into account while thinking of implementing a green infrastructure projects and the benefits that it can provide a city is the allocation of funding for said infrastructure. Public agencies face complicated decisions regarding budget investments and in making such decisions governments need to consider environmental actions and the effects this may have in the city and its people. Public administration must justify their investment decisions regarding accountability while protecting and restoring natural environments thus, furthering public support. The ideal way is to demonstrate the benefits of the investment in economic terms. In economy, “how to allocate limited resources, relies on valuation to provide society with information about the relative level of resource scarcity.” (Pascual et al. 2010).

Ecosystem services valuation can be even more complex and controversial and has been often criticized in the economy world. Therefore, natural ecosystem services valuation can be extremely useful in prioritizing funds and presenting a justification to society and to the decision makers, regarding how nature's functions and services are scarce and precious commodities and ignoring them presents a higher price to society (King and Mazzotta 2000).

This study, therefore, intends to examine the valuation of Urban Ecosystem Services (UES) trough different mechanisms.

1.3 Research Objective

The objective of this study is to assess the some of the different ecosystem services provided by the green infrastructure project “Corredor Ambiental Urbano del Río Cañaveralejo” in Santiago de Cali and estimate the economic value of the urban ecosystem services provided by this project.

1.4 Provisional Research Question(s)

What is the **value of urban ecosystem services** (UES) of the green infrastructure (GI) project?

1.3.1 Assess what are the **categories of ecosystem services** (ES) and the benefits provided by the Urban Environmental Corridor of “Rio Cañaveralejo”?

1.3.2 Assess what is the **willingness to pay** (WTP) for particular regulating and cultural ecosystem services (ES) provided by the Urban Environmental Corridor of "Rio Cañaveralejo"?

1.3.3 Estimate what is the **cost avoided** of the green infrastructure project Urban Environmental Corridor of "Rio Cañaveralejo"?

1.5 Significance of the Study

Over the past decades, an overwhelming amount of literature on ecosystem services has been conducted some of the literature now focus on urban ecosystem services that represent a fundamental relevance since cities are in the forefront of the causes of the degradation of ecosystems. The studies also focus on the importance for human development and human wellbeing but this requires an understanding of the complex structure involved. With understanding comes institutional change in environmental governance and policy.

The results of the study can be used to develop cost benefit analysis which in terms means to assess economic benefits to policy and decision makers and the overall population. At the same time creating stewardship of ecosystem services provided by green infrastructure.

1.6 Scope and Limitations

The scope of this study covers some of the urban ecosystem services provided by a green infrastructure project in Santiago de Cali, Colombia; the Urban Environmental Corridor of "Rio Cañaveralejo" with emphasises in a context-specific categorization of ecosystem services provided by project. At the same time the study assess a value to the UES by means of contingent valuation method (CVM) and damage cost avoided method (DCA). The CVM will be conducted through a willingness to pay (WTP) survey while the DCA will be evaluated through insurance values (premiums paid and past events). The study is based in the valuation methodology employed by the TEEB.

The study is based on a single green infrastructure project and solely focus on some of the UES provided by the project which presents a challenge when generalizing the results. A broader and grater generalizable result could be obtained from similar studies performed in the other rivers that are part of the same overall project "CORREDOR VERDE Pograma Transformacional: Visión Cero Emisiones", as well as a more in-depth study covering all ecosystem services provided.

The availability of respondents could also present a problem in generalizing the results to the area that is engulphed by the study.

Another limitation is to overcome the information barrier with the insurance companies since the information regarding their practice, pricing and statistic in past events including monetary payments can be considered proprietary.

Urban ecosystem services valuation can be controversial because of the current economic system and its often scrutinize in the economy world.

Chapter 2: Literature Review / Theory

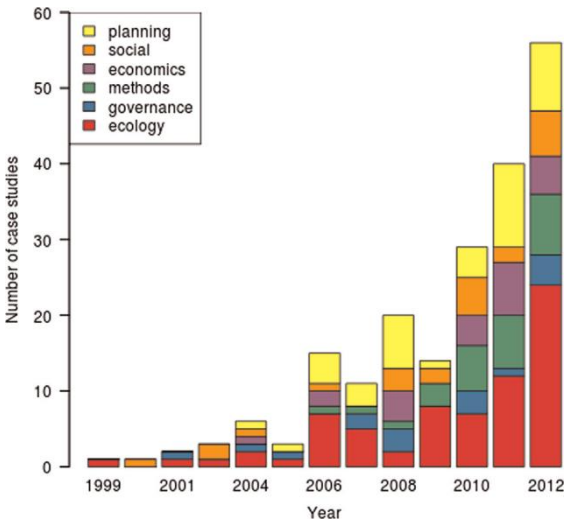
2.1 Ecosystem Services and Urban Ecosystem Services

The world has reached a new dawn where more than half of the population now lives in cities and by 2050 7 out of every 10 will be urban dwellers creating immense opportunities, but also challenges for human well-being, environmental impacts and transition towards sustainability. Most of the growth are expected to happen in Africa, Asia, and Latin America in small and medium-sized cities, not in developed cities. Most of the area needed for this growth has not been built and this massive urbanization can cradle a new environmentally sustainable oriented development and economic growth influencing directly on human well-being (Secretariat of the Convention on Biological Diversity 2012).

This accelerated land use transformations together with the increasing global population has created enormous pressures altering almost all ecosystems. Systems that everyone in the world depends on and ever since the mid-1960 and early 1970 references to this concept "ecosystem services" has been used, although it started in order to increase public interest in the conservation of biodiversity (Gómez-Baggethun et al. 2010). Ecosystem services are the benefits provided by components of nature (e.g., soil, water, species) that contribute to our health and wellbeing making human life both possible and worth living. In recent years, the theory has been developed as a way to understand and manage natural resources (Millennium Ecosystem Assessment 2004).

The concept of ecosystem service (ES) and green infrastructure (GI) and their utilization and implementation for urban environments has incised in the last decade (Luederitz et al. 2015). Studies are focusing on more specific issues as water (Mulatu et al. 2014; Karabulut et al. 2016; Lundy and Wade 2011), forest (Dobbs et al. 2010; Adekunle, M. F. 2012), parks (Muhumuza et al. 2013). Other recent studies have mapped the demand of (ES) (Maes, Joachim; Teller, Anne; Erhard 2013; Pulighe et al. 2016; Kroll et al. 2012), there have also been a number of reviews (Luederitz et al. 2015). But most important recent papers also are focusing in the importance of stakeholders (including citizens) inclusion and involvement (Burkhard et al. 2012).

Figure 2 Distribution of case studies and their main perspective over time.



Source: A review of urban ecosystem services (Luederitz et al. 2015)

The research perspectives in urban ecosystem service show that between 2000 and 2012, the objectives of the research have been vastly variable. Overall, most of the attention has been focused in ecology with 35% of all case studies, trailed by the planning 20% and were the least common focuses has been in governance.

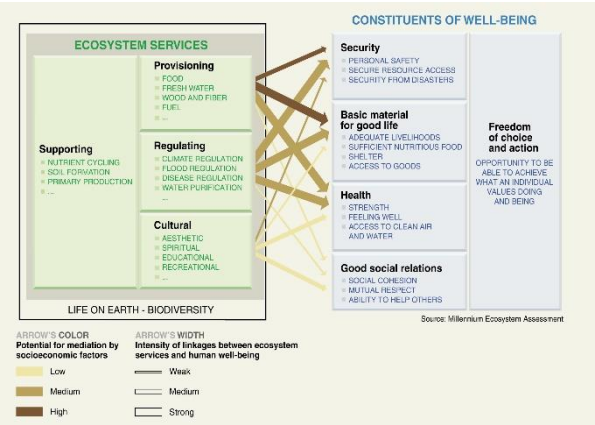
The large array of focuses and investigative lenses presents as much an advantage; in the growing interest in the subject and in the in-depth focus and as a challenge regarding numerous scales, inconsistency's in qualifications and methods. Highlighting the importance for a greater focus on the normative and control of the concept, which can help the development of robust economic, ecological and social values of ecosystem services and broader policy's regarding natural resource management and decision-making (Crossman et al. 2013).

Literature on ecosystem services, sometimes referred as "natural capital" provides a range of typologies of functions and goods that are attributed to ecosystems and the structures and processes that we take for granted. A well-accepted typology presented by The Economics of Ecosystems and Biodiversity (TEEB) divides ecosystem services into four basic categories (TEEB 2010):

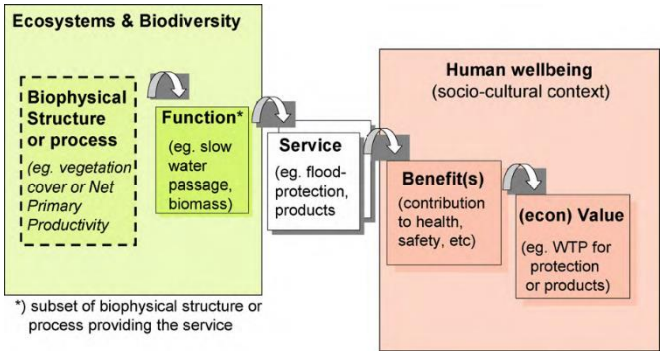
- **Habitat or Supporting services**: basic processes and functions that are necessary to produce all other ecosystem services like soil formation, nutrient cycling, photosynthesis, water cycling, required for the upcoming services.
- **Provisioning services**: The products obtained from ecosystems, including food, fiber, fuel, genetic resources, natural medicines, ornamental resources, fresh water; that ecosystems provide and humans consume or use.
- **Regulating services**: The benefits obtained from ecosystem processes such as flood reduction and water purification, air quality regulation, climate regulation, erosion regulation, pollination, that healthy natural systems can provide
- **Cultural services**: intangible benefits people obtain from ecosystems through spiritual enrichment, aesthetic enjoyment, reflection, recreation and religious inspiration provided by natural landscape

The categories are divided into subcategories depending on the conceptual framework been used.

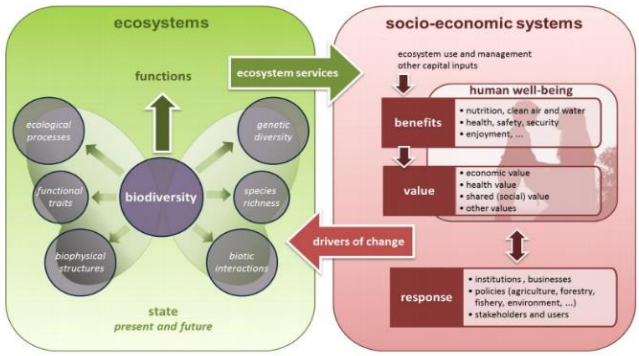
Figure 3 Theoretical frameworks in literature



Source: Millennium Ecosystems Assessment



Source: TEEB Foundations 2010, Chapter 1



Source: Conceptual framework for EU wide ecosystem assessments

"The theoretical framework for Ecosystem Services places human well-being as the central focus for assessment while recognizing that biodiversity and ecosystems also have intrinsic value and that people take decisions concerning ecosystems based on considerations of both well-being and intrinsic value" (Millennium Ecosystem, 2005).

Ecosystem frameworks as any other framework are working structures that change over time and at some point, are scrutinize and criticize, as it happened to the paper by Robert Costanza in 1997 “The Value of the World’s Ecosystem Services and Natural Capital” one of the best-known example of ecosystem service valuation. In which it is suggested that a “minimum estimate” of the natural capital value was US $33 trillion (Costanza, d’Arge, et al., 1997). This study set off a wide controversy and criticism, particularly but not exclusively from economists. However, it is still used and referenced today.

The TEEB conceptual frameworks implies an overview of the systems biological, chemical, and physical interactions between components on a global scale but the transformation human interaction has enforced on this natural processes are primarily for the growth and development of cities and current statistic show that the world is heading towards 70% urbanization this urban expansion will heavily draw on natural resources, with immense effects on biodiversity and ecosystem services throughout the planet. "Production and consumption activities heavily concentrated in cities have contributed to consume 75 percent of the world's energy and produce 80 percent of its greenhouse gasses" (Satterthwaite 2008). Therefore, cities have the potential and responsibility to improve global sustainability and to mitigate climate change by promoting resource efficient development, by demonstrating strong incentives for local governments, the private sector, and all stakeholder involved, to invest in natural solutions and to maintain vital ecosystem healthy and rich in biodiversity.

The importance of assessing the role of ecosystem biodiversity in urban areas is because cities can be very rich in biological diversity and cities need to learn how to cope, maintain and enhance the rich biodiversity in and around them. The role of cities is critical as they are consuming most of the resources and human behaviour impacts greatly in sustainability, so it is in cities that the responsibility and the key for changing the current trajectory lies, with economic development that is less resource intensive.

Biodiversity assessments can be used by decision maker to shape urban development as new guidelines and ideas are presented trying to endow knowledge and inspire governments on how to address climate change even though this issue largely neglected is one of the most important that could help and complement cities respond to some of the major ongoing urban problems.

According to the CBO assessment that highlights initiatives and typologies (Secretariat of the Convention on Biological Diversity 2012), what is important is to develop and incorporate already existing green spaces into the existing infrastructure of a city.

"The innovation lies not so much in developing new infrastructural technologies but to work with what we already have. The results are often far cheaper and more sustainable as well," (UN Convention 2012).

The Cities and Biodiversity Outlook typologies highlight a varied range of initiatives for local governments in both developed and developing countries. Some of the key recommendations of the CBO are:

Nature-based solution entails not only relying on global ecosystems but should start in cities with urban ecosystems to address challenges related to climate change, exploring deeper dimensions of how characteristics of ecosystems, that may be applied and used to introduce resilience in the urban landscape. This entails redefining the role of cities so that they gradually turn into sources of ecosystem services. However every city is unique with its own social-

economical, and biodiversity system and structure and there are no global solutions to urban ecosystem management and sustainability though there is knowledge to be gained from current innovation in decision making, policies, governance, and development, producing better insights into possible solutions. Sharing information and experiences between cities around the world is essential to integrate urban development with ecosystem services and the conservation of biodiversity (Haase et al. 2014). Facing such complex challenges as climate change will need a social-ecological approach (Secretariat of the Convention on Biological Diversity 2012).

The frameworks mention are not meant to be static documents; ecosystem services is an evolving concept. Doing this requires the scientific community to stay up to date on new research and innovations check the validity of early formulated concepts and their evolution and how these new ideas can be utilized by all the stakeholders including politicians, scientists, economists, policymakers, land managers and environmental educators (Fisher et al. 2009).

This exchanges of information among and between the stakeholders including society created innovations that contribute to solving the problems that threaten social-ecological development.

Furthermore, even though there is considerable skepticism in ecosystem and biodiversity frameworks new frames of governance and innovative practices throughout cities are closing the breach to implement this practices proving that the supply of a healthy biodiversity in the urban areas can generate economic benefits and reduce city expenditures (De Groot et al. 2002).

Table 1 Definitions of Ecosystem Services / Urban Ecosystem Services

Source	Ecosystem Services / Urban Ecosystem Services
(Daily 1997)	ES; The conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life
(Luederitz et al. 2015)	UES; Those services that are either directly produced by ecological structures within urban areas, or peri-urban regions.
(Bolund and Hunhammar 1999)	UES; All natural green and blue areas in the city, including in this definition street trees and ponds. In reality, street trees are too small to be considered ecosystems in their own right, and should rather be regarded as elements of a larger system.
(Costanza et al. 1997)	We identify seven different urban ecosystems which we call natural, even if almost all areas in cities are manipulated and managed by man. The ecosystems are street trees, lawns/parks, urban forests, cultivated land, wetlands, lakes/sea, and streams. ES; Consist of flows of materials, energy, and information from natural capital stocks which combine with manufactured and human capital services to produce human welfare. The benefits human populations derive, directly or indirectly, from ecosystem functions
(Luederitz et al. 2015)	UES; Services that are either directly produced by ecological structures within urban areas, or peri-urban regions. For example, rural food production can be 'delivered' to either rural or urban dwellers and therefore does not, in our definition, constitute an urban ecosystem service.

Source: Researcher's own adaptation of principles and concepts from authors mention.

2.2 Green Infrastructure and Ecosystem Services

The concept of Green Infrastructure (GI) was used to identify forests parks, wetlands, greenbelts. Recently it is used to identify sustainability and resilience development achieved by a mixture of strategic planning instrument and natural solutions. The Conservation Fund defines green infrastructure as "strategically planned and managed networks of natural lands, working landscapes, and other open spaces that conserve ecosystem values and functions and provide associated benefits to human populations" (Benedict and McMahon 2006). According to (Andersson et al. 2014) GI "can be considered to comprise of all natural, semi-natural and artificial networks of multifunctional ecological systems within, around and between urban areas, at all spatial scales".

Kopperoinen (2014) describes it as "the network of natural and semi-natural areas, features and green spaces in rural and urban, terrestrial, freshwater, coastal and marine areas, which together enhance ecosystem health and resilience, contribute to biodiversity conservation and benefit human populations through the maintenance and enhancement of ES".

Green infrastructure in cities offers new context and opportunities, integrating urban development, natural sustainability, protecting the biodiversity and landscape diversity thus enhancing the provision of ecosystem services with-in the city and promoting public health.

However when analyzing GI concepts and benefits is important to emphasize the quality as well as quantity and to consider not only surrounding hinterlands but also urban green spaces. These urban landscapes have evolved through complex and ever-changing land use reforms and diverse government policies, and we are beginning to understand their importance in generating urban ecosystem services and the linkage to human well-being. The most commonly known and used UES is cultural services (Andersson et al. 2014)

Urban green infrastructure can contribute directly to ecosystem health in many ways by increasing vegetation coverage, offering a safe haven for biodiversity, maintaining the integrity and creating habitats, creating ecological networks which support the alleviation of ecological impacts and habitat disintegration and instigating overall sustainable landscapes and ecological resilience (Tzoulas et al. 2007; Opdam et al. 2006).

Therefore, the provision of ecosystem services in an urban context can by delivered through green infrastructure which contributes to ecosystem health and to public health providing physical and psychological benefits to the citizens.

Table 2 Definitions of Green Infrastructure

Source	Green Infrastructure
(Benedict and McMahon 2006)	strategically planned and managed networks of natural lands, working landscapes, and other open spaces that conserve ecosystem values and functions and provide associated benefits to human populations
(Andersson et al. 2014)	considered to comprise of all natural, semi-natural and artificial networks of multifunctional ecological systems within, around and between urban areas, at all spatial scales

(GVaNI 2013)	A collection of natural assets which provide multiple functions and services to people, the economy and the environment. These natural assets span spatial scales and types of land use. For example, they include: ▪ § woodland ▪ § water courses ▪ § coastal habitats ▪ § highway verges ▪ § parks ▪ § urban trees ▪ § private gardens ▪ § the grounds of hospitals, schools and business parks.
(Tzoulas et al. 2007)	It can be considered to comprise of all natural, semi-natural and artificial networks of multifunctional ecological systems within, around and between urban areas, at all spatial scales. The concept of Green Infrastructure has been introduced to upgrade urban green space systems as a coherent planning entity.
(Lovell and Taylor 2013)	A strategically planned and managed network of natural lands, working landscapes, and open spaces that provide a range of diverse benefits

Source: Researcher's own adaptation of principles and concepts from authors mention.

Table 3 Definitions of Grey Infrastructure

Source	Grey Infrastructure
(Foster et al. 2011)	Conventional storage structures (reservoirs, detention ponds) and conveyances (pipes, canals) used to manage drinking, sewer, or storm water usually constructed of concrete or metal; also including streets, roads, bridges, and buildings that do no incorporate technologies intended to achieve environmental goals.

Source: Researcher's own adaptation of principles and concepts from authors mention.

2.3 Valuation of Ecosystem Services

The damage to urban ecosystem services at one time or another involves an economic cost in different scales. Some cases may include economic costs arise from health problems related to loss of ecosystem services like air purification, loss of water regulation services from land-use change may result in the need for a costly water purification plants, carbon sequestration by urban trees, buffering of climate extremes by vegetation barriers, noise reduction by vegetation walls among others (Gómez-Baggethun and Barton 2013).

Thus, far as business as usual practices, ecosystem services can be replaced by built infrastructure and services and because the traditional economic structure does not consider the price of replacing the ecosystem services once they are gone, it's usually thought of as the best option in local government planning.

There is a diverse and increasing range of information, valuation methods and criterias on the ecological and socio-economic values of functions and services that are provided by natural and semi-natural ecosystems. However, much of this literature is unpublished scattered across the different academic and governmental agencies throughout the World (Wallace 2007). In addition, "data on ecosystem goods and services often appears at incompatible scales of analysis and is classified differently by different authors" (De Groot et al. 2002).

Nevertheless, resilient ecosystem services are fostered by assessing its value and by combining the concept with urban planning and management. And so, this inherently requires an understanding of social and ecological drivers of ecosystem services so that local governments and communities can be engaged creating stewardship. Cities need not only resilient ecosystem services but the generation of itself to be resilient (McPhearson et al. 2014).

For assessing ecosystem values a combination of methods are utilize depending on the service been analyzed and in an urban context a typology of different scales could be applied.

Table 4 Valuation Methods

Valuation Methods	Description
Direct market	(goods provided by nature)
Market alternatives or indirect markets	(no clear markets available)
▪ Replacement cost	Manmade solution
▪ Damage costs avoided	The cost of the protection
▪ Production function	value added by nature, change in land use
Surrogate markets	(revealed preference)
▪ Hedonic price method	Extra amount paid for environmental quality
▪ Travel cost method	Cost of visiting a place
Stated preference	(people's preferences and choices)
▪ Contingent valuation method (CVM)	WTP or WTA for ecosystem services
▪ Choice Modelling (CM) / Choice Experiments (CE)	preferences from different scenarios
Participatory valuation	(group deliberation and valuation)
Benefits transfer	(transferring or borrowing of valuation)

Source: Researcher's own adaptation of principles and concepts from authors mention (TEEB 2010).

Nevertheless, even if the valuation of ecosystem services is controversial because of the potential importance that such values can have over the current economic system and in policy making. Although the innate value of ecosystems services is obvious, failure to qualify and quantify ecosystem services can result in an implied value of zero, "rather than being 'priceless', it is 'worthless.'" (TEEB 2010), as the business as usual scheme has done over the past decades proving to be inefficient and detrimental to our existence (Loomis 2000), leading to an over-exploitation and overall degradation of ecosystems.

Valuation of ecosystem services serves different purposes including raising awareness, to determine the consequences of alternative courses of action, assess the impacts that they have on human well-being, to understand and help decision making regarding the management of ecosystems and overall to establish a value to nature's capital that has been taken for granted. This requires to determining the services provided by ecosystem (quantifying biophysical relations of the flow of benefits) and the impact on human wellbeing, so a value can be established (Millennium Ecosystem Assessment 2003).

The methodologies for valuation are usually offered in typologies or groups so that there is a better assortment where all services can be valued but not all method work for all services (TEEB 2010).

As discussed before many methods exist and to be able to make a comprehensible ecological and economic assessment of the benefits and services a standardized framework is needed. The upcoming analysis is based on the typology and valuation methods by The Economics of Ecosystems and Biodiversity (TEEB) for valuating function and services in a clear and consistent manner.

The TEEB categories the valuation methods as follows (TEEB 2010);

2.3.1 Direct market

The market value for a service provided by nature primarily related to goods; timber and fish (provisioning functions) and also applied to some regulating functions. But most ecosystem services don't have a direct market price (TEEB 2010).

2.3.2 Market alternatives or indirect markets

Valuation based on market alternatives or indirect market prices "by 'mimicking' what would happen if there were a market" (TEEB 2010). No clear markets available.

Indirect markets can be categorized in three methods:

1. Replacement cost: What does the alternative cost? (Manmade solution; retaining wall or a levee replacing a wetland);

2. Damage costs avoided (DCA): the cost of damages incurred if the protection of ecosystem services were absent (property damages avoided). The cost of the protection;

3. Production function: value added by nature, what are the monetary effects of changing the quality and quantity of ecosystem inputs to production (change in land use).

2.3.3 Surrogate markets

Are also known as revealed preference methods. People's preferences and actions in environmental non-marketed goods (surrogate).

Two main methods are:

1. Hedonic price method: The price of a marketed good (real estate) related or influenced by its characteristics or services. Extra amount paid for environmental quality;

2. Travel cost method: Cost of visiting a place related to the ecosystem services provided. (park, lake) can be used as a reflects of how much the ecosystem service is worth.

2.3.4 Stated preference

A complex analysis of people's preferences and choices to make trade-offs among different alternatives, regarding monetary values for environmental resource and services.

There are two broad methods:

1. Contingent valuation method (CVM): Willingness to pay (WTP) or Willingness to accept (WTA) on hypothetical environmental scenarios using a description of alternatives in a social survey or questionnaire. WTP or WTA for ecosystem services.

2. Choice Modelling (CM) / Choice Experiments (CE): preferences from different environmental scenarios (include ecosystem services and varied costs).

2.3.5 Participatory valuation

Involves group deliberation and valuation, it is often carried out through a focus group exercise where stakeholders voice their concerns and present issues to deduce indirect values. It is based on the idea that public decision-making should not be the combination of individual preferences but from open public debate.

2.3.6 Benefits transfer

Benefits transfer is not a methodology in itself and it includes several variations. It is the transferring or borrowing of valuation made of a similar study to provide an estimate and informed decision making.

2.4 Stated preference (Contingent Valuation)

Contingent valuation method is currently a widely used nonmarket valuation and stated preference method especially for valuing environmental assets and cost-benefit analysis (Venkatachalam n.d.).

There are two main approaches to estimating stated preferences techniques; contingent valuation method (CVM) and choice experiment method (CE). Both are known methods capable of measuring passive use values of ecosystem services. CVM uses surveys, questionnaires or interview to represent people's preferences indicating their willingness to pay (WTP) for a good of service portraying social welfare estimates in economic terms (Mitchell and Carson 1989).

Alternatively, CE is the technique where all services and goods are described by their characteristic and qualities and where individuals are asked to choose their preferred option from a set of alternatives, later asked a sequential question for such a choice (Latinopoulos et al. 2016).

While using CVM in principle, either willingness to pay (WTP) techniques or willingness to accept (WTA) techniques could be used transposable to acquire individual's preferences in a change in the amount of environmental services and goods (Venkatachalam n.d.).

By the method of WTP using a survey of questioner the individual is asked what he would be willing to pay for a service, good or a feeling (D'Acci 2014). In the first part of the questioner, a detailed description of the area is conveyed as the new conditions after the project is implemented if the individual pays. Subsequently, the interviewees are told the manner in which the payment will be made; fee, taxes, donations among other (Loomis 2000).

Table 5 Definitions of Willingness to Pay (WTP)

Source	Willingness to Pay (WTP)
(Mitchell and Carson 1989)	Questionnaires or interview to represent people's preferences for a good of service portraying social welfare estimates in economic terms

Source: Researcher's own adaptation of principles and concepts from authors mention.

A concern among different author regarding this method is the validity (accuracy) and reliability (consistency) of the responses.

Nevertheless, this method has been used with great success, in the context of river improvement projects all over the world for measuring the benefits of implementing green infrastructure projects. Some studies that utilizes this method are analyzed and discussed.

Table 6 Willingness to Pay (WTP) for cases of river restauration / protection

Study	Reference	Country	Benefits considered in the analysis	Method	Valuation techniqu	Monetary value
Measuring the total economic value of restoring ecosystem services in an impaired river basin: results from a contingent valuation survey	(Loomis et al. 2000)	Nebraska, USA	Dilution of wastewater, natural purification of water, erosion control, habitat for fish and wildlife and recreation.	Contingent Valuation Method (CVM)	Willingness to Pay (WTP)	$21 per month or $252 annually for the additional ecosystem services.
Estimating the economic value of improvements in river ecology using choice experiments: an application to the water framework directive	(Hanley et al. 2006)	Durham, England	Improvements in these three indicators: River Ecology, Aesthetics, Banksides	Contingent Valuation Method (CVM) / Choice Experiments (CE)	Willingness to Pay (WTP)	Improvement in River Ecology £18.19, Aesthetics £15.68 and Banksides £19.57
Farm households' preferences for collective and individual actions to improve water-related ecosystem services: The Lake Naivasha basin, Kenya	(Mulatu et al. 2014)	Kenya	Improvements in one collective attribute (reforestation) and two individual attributes (environment-friendly agricultural practices and restoration of riparian land).	Choice Experiments (CE)	Willingness to Accept (WTA)	Riparian Land $2.44, Environment-friendly $135.37 and Reforestation $7.70
The rehabilitation of a Finnish river affects recreational ecosystem services	(Polizzi et al. 2015)	Finland	Improve conditions for fish spawning and increase the recreational attractiveness of natural areas along the river.	Contingent Valuation Method (CVM)	Willingness to Pay (WTP)	The estimated increase in recreational ESS value was 40.0–144.7 €/person/year.
Valuing ecosystem services across water bodies: Results from a discrete choice experiment	(Doherty et al. 2014)	Ireland	Ecosystem services provided by Irish water body types (sea, river and lake).	Contingent Valuation Method (CVM)	Willingness to Pay (WTP)	Health of ecosystems, €16.50 Water clarity and smell €40.54 Access to Recreational activities €15.00 and Conditions of banks or shoreline €19.00 .
Assessing Local Communities' Willingness to Pay for River Network Protection: A Contingent Valuation Study of Shanghai, China	(Shang et al. 2012)	Shanghai, China	River network protection.	Contingent Valuation Method (CVM)	Willingness to Pay (WTP)	The mean WTP was 226.44 RMB per household per year. (33.08 US Dollar)
Willingness To Pay for Flood Risk Reduction and Its Determinants in Japan	(Zhai et al. 2006)	Toki City and Nagoya City, Japan	Flood risk reduction.	Contingent Valuation Method (CVM)	Willingness to Pay (WTP)	The WTP levels for different measures range from ¥2,887 to ¥4,861 for the mean (27.16 to 45.73 US Dollar) and from ¥1,000 to ¥2,000 for the median. (9.41 to 18.82 US Dollar)
Scenario realism and welfare estimates in choice experiments e A non-market valuation study on the European water framework directive	(Kataria et al. 2012)	Denmark	Preferences for improvements to the Odense river in Denmark.	Contingent Valuation Method (CVM) / Choice Experiments (CE)	Willingness to Pay (WTP)	€59 for a good quality of river, €20 for good access for recreational activities.
Estimating the Value of Achieving "Good Ecological Status" in the Boyne River Catchment in Ireland Using Choice Experiments	(Stithou et al. 2012)	Ireland	Improvements in River Life: Fish, insects, plants, Water Appearance, Recreational Activities and Condition of River Banks.	Contingent valuation (CV) and choice experiment (CE)	Willingness to Pay (WTP)	€36 for good water clarity and appearance, €28 for good river life and €23 for access for all recreational activities (walking, boating, swimming, fishing. Overall average of €47.25.
Estimating the benefits of water quality improvements under the Water Framework Directive: are benefits transferable?	(Hanley, Hanley, et al. 2006)	Scotland	Water quality improvements for two small catchments where agricultural-source non-point pollution and irrigation water abstraction are the main threats to ecological status.	Choice Experiments (CE) / Benefit Estimates (BE)	Willingness to Pay (WTP)	WTP is £24–28 per annum over and £23–36 in the correlated attributes version.
Economic valuation as a tool to support decision-making in strategic green infrastructure planning	(Wilker and Rusche 2014)	Esslingen, Germany	Green infrastructure investment categories. Path improvements, City greening, River renaturation and Rest and sit possibilities.	Contingent Valuation Method (CVM)	Willingness to Pay (WTP)	The absolute WTP averaged among all respondents was €11.85. Path improvements €14.43, City greening €13.27, River renaturation €12.16 and Rest and sit possibilities €15.16
Going Green? Economic Valuation of a Multipurpose Water Infrastructure in Northern Italy	(Reynaud et al. n.d.)	Italy	Multipurpose infrastructures (grey or green) for managing flood risk and water pollution.	Contingent Valuation Method (CVM)	Willingness to Pay (WTP)	WTP for a green infrastructure varies from €6.3 to €7.1 per household and per year (for a twenty year time horizon).
Contingent valuation, net marginal benefits, and the scale of riparian ecosystem restoration	(Holmes et al. 2004)	North Carolina, USA	Abundance of game fish, water clarity, wildlife habitat, allowable water uses, and ecosystem naturalness.	Contingent Valuation Method (CVM)	Willingness to Pay (WTP)	WTP survey results, the present value of public benefits of full restoration was estimated at $2,835,373, or $4.54 per household per mile

Source: Researcher's own adaptation of principles and concepts from authors mention.

Loomis (2000) in a project designated to improved river quality uses CVM survey method to estimate household WTP to increase ecosystem services such as (dilution of wastewater, natural purification of water, erosion control, habitat for fish and wildlife and recreation) in the Platte River in Nebraska. Results propose households are willing to pay $21 per month or $252 annually for the added ES. In general households living along the river yields a value of approximately $19 million.

Hanley, N., Wright, R.E. and Alvarez-Farizo, B. (2006) estimated the economic value for the ecological improvements of the River Wear and Clyde in the United Kingdom, using CE and CVM. The study focused in three indicators, and thus on the non-market economic benefits towards a good ecological status utilizing water rates as payment mechanism. The results of the WTP questioner showed that individuals are willing-to-pay £18.19 ($23.03) for improvements on River Ecology, £15.68 ($19.85) for Aesthetics and £19.57 ($24.77) for Banksides.

In the study conducted in the River Pajakkajoki in Finland, Polizzi, C. (2015) through a CVM, set out to find the WTP for improve conditions for fish spawning and increase the recreational attractiveness of natural areas along the river. Based on a survey administered to locals and non-locals the estimated increment in the value for recreation was €40.00 ($42.86) to €144.70 ($155.03) per person/year, with minor differences between residents and non-residents.

In China a study by Shang, Z. (2012) considered the degradation because of rapid urbanization and population growth. In his analysis, he promoted river network protection projects and creating awareness of the value of the river network. Through a contingent valuation method (CVM) a status quo and future scenario where compared. Findings showed that the mean WTP

was 226.44 RMB ($33.27) per household per year and that "residents in Shanghai had a high degree of recognition of river network value but a low degree of satisfaction with the government's actions and the current situation" (Shang et al. 2012). Additionally, the questioner showed that respondents selected "voluntary labor" as the leading activity for contributing to river network protection projects.

The study of Zhai, G. (2006) aimed to clarify citizens preferences regarding flood control measures in Japan, by applying the contingent valuation method (CVM) with willingness to pay (WTP). Participants were asked for internal and external flood measures that relate to infrastructure modification and they were also ask for early warning systems that relate to nonstructural measures. Results showed that most of the respondents expected a change in river management and some flood control measures to reduce risk. The willing to pay mean levels for different flood control projects range from ¥2,887 ($27.16) to ¥4,861 ($45.73) per year. The projects presented were scenarios comprise in 10-year flood, 20-year flood, 500-year flood and 1,000-year flood.

Some studies also address how the economic valuation from the implementation of green infrastructure and the ecological benefits can support decision-making strategies as in the study by Wilker, J. and Rusche, K. (2014) in Esslingen, Germany. Residents that participated in the WTP survey stated their preferences of investment for different green infrastructure types (Path improvements, City greening, River renaturation and Rest and sit possibilities). Findings showed that absolute WTP averaged among all respondents was €11.85 per year and depending on the infrastructure types considered respondents will pay €14.43 for Path improvements, €13.27 for City greening, €12.16 for River renaturation and €15.16 for Rest and sit possibilities.

Finally, the study conducted in Italy regarding water infrastructure in Gorla water park located in Milan. Reynaud, A. (2016) analyzed a multipurpose water infrastructure using a contingent valuation approach (CVM) to estimate how households value the different infrastructure (grey or green) for managing water pollution and flood risk reduction. Based on the survey the estimated in the WTP for a green infrastructure varies from €6.3 ($6.75) to €7.1 ($7.61) per household and per year (for a twenty-year time period).

In general contingency valuation method, CVM has been widely uses in different cases, particularly in developing countries. It even exceeded other environmental valuation methods. It can accurately estimate willingness to pay for environmental goods (Gaglias et al. 2016).

2.5 Market alternatives (Damages Cost Avoided) Insurance Value

Worldwide an increasing frequency of climate change and environmental events occurrences is having an impact on urban areas (Mcphearson et al. 2013). Ecosystem services are key component to building urban resilience and reduced vulnerability through mitigation and adaptation measurement. The contribution of ecosystem services to generate more flexible cities regarding shocks is known as "insurance value". Insurance value reflects "the maintenance of ecosystem service benefits despite variability, disturbance and management uncertainty" (McPhearson et al. 2014).

Ecosystem services promotes resilience responding to a particular disruption including urban vegetation that provides urban temperature regulation, reduces surface runoff and binds soil, thus reducing the probability of damages by flooding and landslides as well as buffering health impacts.

Insurance values produce an intrinsic economic value to ecosystem services as the changes caused by shock are costly to reverse if possible at all (Walker et al. 2010).

The valuation method based on market alternatives more specifically damage costs avoided can be applied using two approaches. The first approach uses information regarding flood protection and the potential damages that properties could incurred if there was no restoration to a natural barrier. It could also be approached in the opposite way, looking at the economic cost of past events (flooding). The second approach is to determine the economic value that people spent in flood protection, for example insurance premiums paid for extreme natural phenomena (i.e. flooding), insurance as a proxy for the value of risk reduction projects. (King and Mazzotta 2000).

The value of extreme events is already study and capture in a way by insurance companies. According to MacDonald, D., Murdoch, J. and White, H. (1987; 2016) in some urban areas exposed to flooding, people have two option: "pay higher insurance premiums in areas with a greater likelihood of flooding or pay higher housing costs in areas with lower probabilities of flooding."

"The link between biodiversity, ecosystem resilience and insurance should now be transparent. Other things being equal, the greater the mix of species in terrestrial systems, the greater the resilience of those systems implying the greater the perturbation they can withstand without losing their self-organization. Biodiversity underpins the ability of far from equilibrium ecological systems to function under stress, and in so doing it underpins the predictability of those systems. Greater levels of biodiversity protect the system from the frequently unpredictable and irreversible effects of the change in self-organization associated with change in attractor or equilibrium state. It follows that the value of biodiversity conservation lies in the value of that protection: the insurance it offers against catastrophic change." (Perrings 1995)

Previous studies have focused on the valuation of ecosystem services in general when it comes to disturbances, change, and economic resilience. But literature neglects studies in urban areas which are highly vulnerable (Green et al. 2016). In the upcoming section an analysis of the applicability of insurance valuation towards green infrastructure within urban areas is presented.

Green infrastructure projects help to attain sustainability and resilience directives as well as reducing vulnerability, enhancing insurance values and the cost of climate change adaptation. "The value of green infrastructure is calculated by comparing the costs of green practices to "hard" infrastructure alternatives, the value of avoided damages, or market preferences that enhance value (e.g. property value)" (Foster et al. 2011).

Table 7 Cases of damages cost avoided

Study	Reference	Country	Benefits considered in the analysis	Method	Valuation techniqu	Monetary value
Chicago Green Alley Handbook	(City of Chicago 2010)	Chicago USA	Flood control. Permiable materials that allow water to soak back into the ground rather than running over it and into other stormwarter management systems. Flood control. 30 green alleys with permeable pavement and reflective concrete had been installed, along with over 200 catch-basins across the city. Landscape ordinances encouraged tree planting and installation in alleys of natural landscaping, rain-gardens (i.e., vegetation in artificial depressions) and bio-swales (i.e., artificially contained vegetation).	Damages Cost Avoided (DCA)	Insurance Value (IV)	The average national insurance claim for flooded basements is $3,000 to $5,000 per basement. Cities can accrue a rate of return on each tree of approximately $1.50 to $3.00 for every dollar invested.
Submerged Resources in the Face of a Changing Climate: Living Shorelines as an Adaptation Strategy	(Baldwin 2010)	Pensacola Bay, FL, USA	conservation of 15 acres of coastal wetland and rivers	Damages Cost Avoided (DCA)	Insurance Value (IV)	Cumulative value for hurricane and storm protection of $1.3 million through avoided damage.
The Value of Green Infrastructure for Urban Climate Adaptation	(Foster et al. 2011)	USA	Storm protection services	Damages Cost Avoided (DCA)	Insurance Value (IV)	Wetlands in the US overall are estimated to provide $23.2 billion in storm protection services.
The Charles River, Eastern Massachusetts: Scientific Information in Support of Environmental Restoration	(Weiskel 2007)	Massachusetts, USA	The protected wetlands provide a wide range of other water quality, recreational and economic benefits	Damages Cost Avoided (DCA)	Insurance Value (IV)	An estimated $19 million in flood damages, neighboring communities with out natural protection. Additionally tourists contribute over $4.5 million to the local economy. Properties adjacent to the protected wetlands have shown direct benefits to local residents through increased property values.
The Value of Green Infrastructure for Urban Climate Adaptation	(Foster et al. 2011)	USA	Carbon and Pollution Storage	Damages Cost Avoided (DCA)	Insurance Value (IV)	$24,731,400 of savings from Carbon and Pollution Storage and Monetary Value from Urban Forestry in Chicago, New York City, Philadelphia, San Francisco and Washington, DC

Source: Researcher's own adaptation of principles and concepts from authors mention.

Some of the cases engaging in the multifunctionality of GI seen in (Table 7 Cases of damages cost avoided) present different scenarios but with surmountable benefits. The city of Chicago became a pioneer of green alleys and streets implementing 30 green alleys with permeable pavement and over 200 catch-basins throughout the city. The project also included landscape planning with tree planting, natural landscaping, rain-gardens and bioswales. The objective of these measures was to slow the rate of storm-water runoff, allowing urban surfaces to have natural absorption thus preventing flooding and therefore increasing the urban infrastructure capacity to handle extreme precipitation events. This measures allowed 760,000 gallons of storm-water per year, to be naturally absolve. The results of the cost benefit analysis showed that because energy is needed to pump water in the sewage system to distribute and treat this measures help to decrease the 190,266 MWh of electricity city consumes annually therefore reducing GHG emissions which translate into less money spend. It also showed that avoiding the flooding of just 3 homes justifies this investment. Additionally the trees planted are also estimated to have a returned of approximately $1.50 to $3.00 per tree for every dollar invested (City of Chicago 2010).

In the river Charles in Massachusetts a wetland under protection not only provide a range of water quality, recreational and economic benefit but also protection to communities of Boston and Cambridge estimated $19 million in flood damages avoided. Additionally, tourists contribute over $4.5 million to the local economy and properties adjacent have showed an increase in value (Weiskel 2007).

A quintessential green infrastructure practice is urban forestry; trees provide multiple benefits for resilience cities including adaptation and mitigation goals. These vital entities can range from private gardens to urban parks creating a network that provide wildlife habitats and ES like urban heat island (UHI) and storm-water benefits to communities and cities as a whole. Trees also absorb and decrease air pollutants which presents great benefit for cities and its citizens especially in health-related issues (Foster et al. 2011).

All this data was put together in a five-city study conducted to obtain the monetary Value from Urban Forestry in Chicago, New York City, Philadelphia, San Francisco and Washington, DC, (Foster et al. 2011). The study showed that "the net economic benefits of mature urban trees range from $30 to $90 per year for each tree, accounting for all of the benefits listed above." (Foster et al. 2011). Estimated in a $24,731,400 in cost avoided.

Table 8 Carbon and Pollution Storage and Monetary Value from Urban Forestry

	Data Year	# Trees	Carbon Stored (MT)	Gross C Seq/yr (MT)	Energy Use Avoided (mBTU)	Energy Use Avoided (MWH)	Polln./yr Removed (T)	$/yr Polln. Removed
Chicago	2007	3,585,203	649,336	22,831	127,185	2,988	889	$6,398,200
New York City	1996	5,211,839	1,225,228	38,358	630,615	23,579	1,997	$10,594,900
Philadelphia	1996	2,112,619	481,034	14,619	144,695	10,943	727	$3,934,100
San Francisco	2004	669,343	178,250	4,693	No Data	No Data	235	$1,280,000
Washington, DC	2004	1,927,846	474,417	14,649	194,133	7,924	489	$2,524,200

Source: (Foster et al. 2011)

As discussed above communities, cities and countries can gain higher benefits and co-benefits when using green infrastructure alternatives. Some of this benefits are directly connected to insurance premiums because while implementing the measures communities and house owners reduce the risk of negative impacts from extreme events and the premiums for insurance go down. As shown earlier in the study by MacDonald, D., Murdoch, J. and White, H. (1987; 2016) people are looked in a choice of higher land values with no risk of events or lower land values with high risk of events. Therefore by reducing the risk and capturing this extra revenue in higher risk areas, land values go up providing an increase of tax revenue, produce by multifunctional green infrastructure.

Cities as a whole also enjoy the benefits of becoming more competitive due to the economic development and growth behind the new set of knowledge and skill required from building GI. Adding to that the savings from disaster impacts, public health and a more sustainable and resilient economy (Foster et al. 2011; Commission 2012).

Table 9 Definitions of Insurance Value

Source	Insurance Value
(Mcphearson et al. 2013)	The contribution of ecosystem services to generate more flexible cities regarding shocks
(McPhearson et al. 2014)	The maintenance of ecosystem service benefits despite variability, disturbance and management uncertainty

Source: Researcher's own adaptation of principles and concepts from authors mention.

2.6 Conceptual framework

2.6.1 Research objective and research question

Research Objective

The objective of this study is to assess the some of the different ecosystem services provided by the green infrastructure project "Corredor Ambiental Urbano del Río Cañaveralejo" in Santiago de Cali and estimate the economic value of the urban ecosystem services provided by this project.

Provisional Research Question(s)

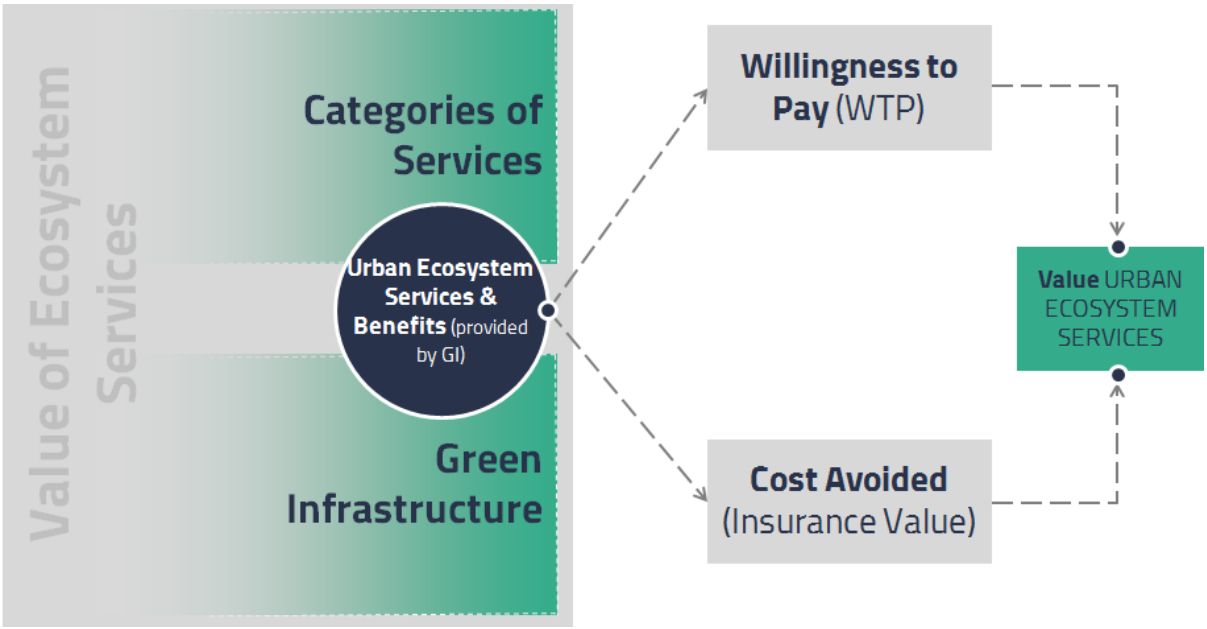
What is the **value of urban ecosystem services** (UES) of the green infrastructure (GI) project?

1.3.1 Assess what are the **categories of ecosystem services** (ES) and the benefits provided by the Urban Environmental Corridor of "Rio Cañaveralejo"?

1.3.2 Assess what is the **willingness to pay** (WTP) for particular regulating and cultural ecosystem services (ES) provided by the Urban Environmental Corridor of "Rio Cañaveralejo"?

1.3.3 Estimate what is the **cost avoided** of the green infrastructure project Urban Environmental Corridor of "Rio Cañaveralejo"?

Figure 4 Conceptual framework



Source: Researcher's own adaption of principles and concepts

Chapter 3: Research Design and Methods

3.1 Operationalization: Variables & Indicators

To be able to make the main concepts presented in Chapter 2 into components that can be observed and measurable a transition from theory to empirical research is necessary. The concepts that form the conceptual framework are translated into analytical entities. Furthermore, the concepts are defined and unbundle into variables and indicators that can be measured.

Independent Variable	Green infrastructure (GI)
Dependent Variable	Value of urban ecosystem services (UES), (regulating and cultural services)

Source: Researcher's own adaptation of principles and concepts

The following tables summarize the concepts and definitions regarding the value of urban ecosystem services derived from green infrastructure project in Cañaveralejo River Cali Colombia.

3.1.1 Operational definitions

Urban Ecosystem Services: The benefits provided by components of nature (e.g., soil, water, species) that provide provisioning, regulating, supporting and cultural services thus contributing to our health and wellbeing making human life both possible and worth living.

Green Infrastructure: Sustainability and resilience development achieved by a mixture of strategic planning instrument and natural solutions.

3.2 Variables and indicators

The main concept derives from chapter 2 are broken down into variables and indicators.

Table 10 Variables and indicators

Concept	Variable	Sub-Variables	Method and technics	Indicators
Green Infrastructure providing Urban Ecosystem Services	Regulating Services	Moderation of extreme events	Insurance Value Damages avoided	Cost of insurance
				Cost of damages incurred in past events
	Cultural Services	Mobility, Recreation and mental and physical health	Willingness to Pay (WTP)	**M2** upgraded and accessible green area (parks and plazas).
		Mobility, Walking & Bicycle paths		**Km** of additional bike lanes.
				M of additional pedestrian paths and areas.
(TEEB 2010)		Aesthetic		**Number** of additional trees.
(Gómez-Baggethun and Barton 2013)		Sense of place		**Number** of new parks and plazas in a 253,615 M2 upgraded and accessible green area.

Source: Researcher's own adaptation of principles and concepts from authors mention.

3.3 Research Strategy

The study aims to collect data related to an urban green infrastructure project in Cali Colombia more specifically the project based throughout Cañaveralejo River "Corredor Ambiental Urbano Río Cañaveralejo" which directly affects about 4,946 plots and indirectly has an overall impact on the entire city.

Cali is the third largest city in Colombia (it has a population of 2,110,571 approximately) and is known as the "Sucursal del Cielo" because of its specific and rich hydrology it has also been a strategic transportation center for over four centuries which has contributed to its rapid growth. This has taken its toll in the management of river basins and integrated green public space.

However, in present years the city is aiming towards increasing its resilience and aim to tackle climate change impacts through various strategies as the actualization of the master plan including the Cali's Land Use Plan 2014-2027 (POT)," aiming to transform the lifestyle of the city engaging the local community and diversifying livelihoods (Autónoma et al. 2015).

The research strategy for this thesis is based on a case study because the study is built on an empirical inquiry that in this case looks into alternatives of valuating non-market goods in a real-life context where the assessing of people's preferences regarding specific contemporary phenomenon is not clear. This relates directly to the characteristics of a case study since only

a small number of research units is been analyzed (Morimoto et al. 2015). Thereby, because an understanding of the environmental context is important to get a deep comprehension of the subject being studied (Baxter and Jack 2008), a case study is the approach more suitable. Taking into account the specific characteristic of this project a single case study has been chosen for the analysis.

The analysis will be elaborated using qualitative and quantitative data of a primary and secondary nature acquired by different means and sources (Yin 2009). The methods mostly use will be theoretical, observation, stated preference specifically contingent valuation method (CVM) with willingness to pay (WTP) and structured interviews and lastly market alternatives or indirect markets specifically damage costs avoided (DCA) considering insurance values. A theoretical outlook will be applied to examine the characteristic of the green infrastructure project "Corredor Ambiental Urbano Río Cañaveralejo" and what specific ES they provide. As the specific services are identify, diverse methodologies can be applied; as regulating services are mostly seen through cost avoided and cultural services through willingness to pay. Thus, survey and structured interviews will be conducted to gain an overall view of the status quo, including insurance status, followed by a preference of typologies of infrastructures and finishing with a willingness to pay with different methods of payment regarding the infrastructure preferred.

In the case of this study realizing the survey proved more difficult than initially assumed, some of the main challenge encountered were the lack of respondents since the questionnaire was originally designed to be answered via mail and the participant who received the e-mail were reluctant to answer through this method and other measures to obtain respondents had to be taken. While implementing the alternative measures the second challenge encountered was the change of the Comuna leaders and administration.

To overcome these difficulties the questioner was conducted in different manners to try to cover more ground including email, telephone interviews, house to house sampling, attending Comuna meetings where community leaders and members helped with the task of conducting the survey and finally some public and social gathering places close to the river or the canal where people were enjoying urban life where targeted.

The Questionnaire was designed with some open-ended questions and the majority were close structured question as this seemed more suitable for the aims of the research approach. This type of questionnaire can be seen in the other CVM applying WTP as is (Wilker and Rusche 2014; Reynaud et al. 2016) that opted for more open-ended WTP question. In the case of (Shang et al. 2012; Polizzi et al. 2015) opted for more structured questions.

The questionnaire was constructed of the following five sections: a. introduction, b. personal information and socioeconomic background, c. risk perception and protective behavior, d. infrastructure, e. infrastructure preferences, f. proposal corredor ambiental urbano and willingness to pay. Sections e. and f. are basically Contingent valuation inquiries which emphasized in two aspects the status quo of the infrastructure and the proposed improved infrastructure.

Interviews were conducted with the head of the household, community leaders, business owner among other and lasted 10-15 minutes. Subsequently, the data was cleaning and thru ready for analysis.

An important consideration in the elaboration of the questionnaire was the economic situation of Colombia as a developing country, because it has a lower world salary average as seen on

(Figure 9 Salary Statistics), the price range was set more moderate and reachable for Colombian citizens, with a range from $10.00 to $120.00 per year.

This data will be compared with previous secondary data conducted via surveys by Universidad Del Valle and from insurance companies on events occurred in the past in the predetermined area. The database of email and the existing data set (both from Universidad Del Valle) poses some limitation as can be with data from insurance companies regarding past events and monetary payments to their clients. Other conflicts can be also encountered in the previous questioners conducted by Universidad Del Valle in the sense that the sample was made considering different parameters and their focus was broader than the one intended for this study. The data gathered from this sources will be triangulated with new data gathered in the interviews and surveys to corroborate the findings and to improve validity and reliability.

The combination of methods and of sources adds to the validity and the depth of the study (Morimoto et al. 2015). Furthermore, because treating with a small number of cases in a specific project and surrounding areas a stratified sampling will be used, where the population is divided into subpopulations (stratum). The stratum is controlled with specific characteristic (in this case social economical) than a random sampling is drawn. This presents a more representative of the population (Neuman 2011).

The project of "Corredor Ambiental Urbano Río Cañaveralejo" has an extension of 3.6 km where a specific area will be analyzed because of its specific characteristic regarding socio-economic status.

In Colombia, the social-economic stratification is the classification of the property that receives public services. The main purpose of this differentiation is to be able to charge public services by Stratum to be able to allocate subsidies and collect taxes. In this way, those who have higher economic capacity pay more for public services and contribute to pay what the lower stratum cannot pay. Although for social-economic stratification the income per person is not taken into account but it is done by stratifying residential properties and not households.

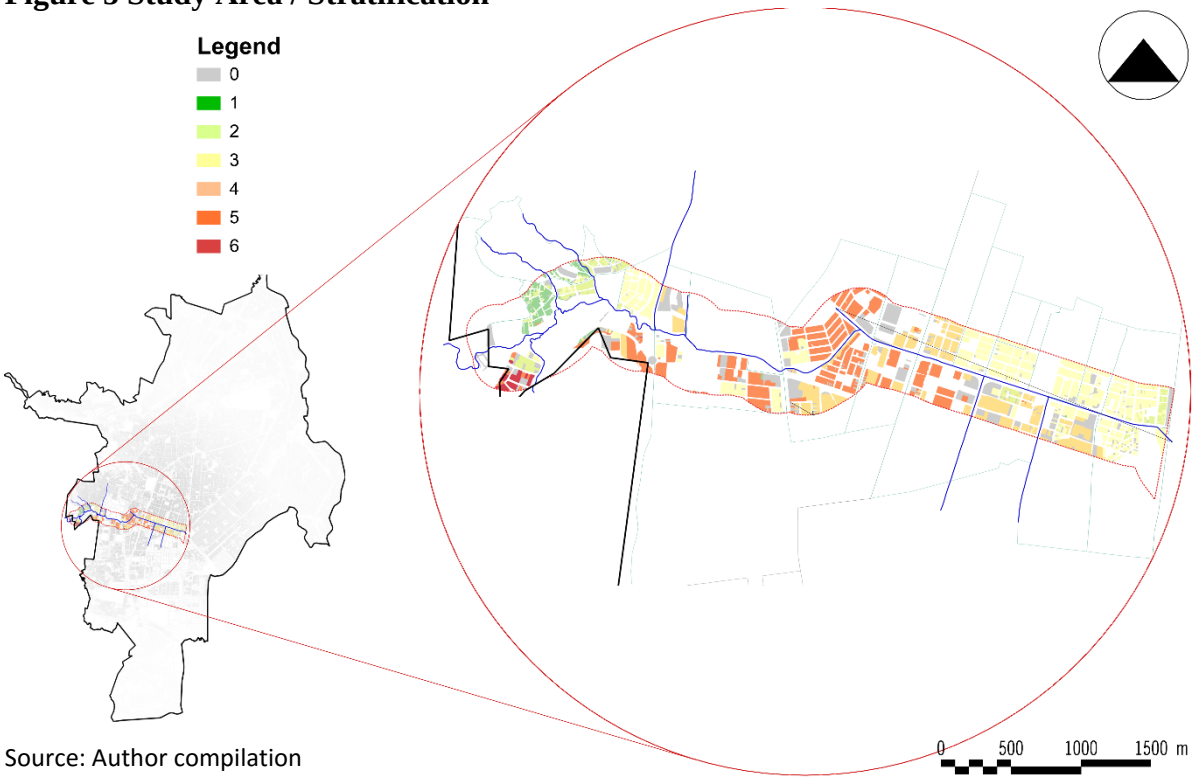
The socio-economic groups in Colombia are 6 and range as followed:

1 Low-low, 2 Low, 3 Medium-Low, 4 Medium, 5 Medium-High and 6 High

For the analysis conducted in this study the area selected considers stratum from a higher level, since the ideology of the Colombian law already determines that higher stratum can pay more

to cover lower stratum which has less to no economic capacity to cover all the taxation or fees. The area selected takes into account the area where the river enters the urban area with a distance of 6.0 Km where the GI project will be implemented in the first 3.6 Km. This section of the project is located in the Comunas 10, 19,17 and 20 including 26 Barrios Cañaverales - Los Samanes, Belisario Caicedo, Brisas de Mayo, Camino Real - Joaquin Borrero Sinisterra, Camino Real - Los Fundadores, Cañaveral, Cementerio – Carabineros, Cuarto de Legua – Guadalupe, Departamental, El Cortijo, El Limonar, Jorge Zawadsky, La Selva, Las Granjas,

Figure 5 Study Area / Stratification



Source: Author compilation

Nueva Tequendama, Panamericano, Primero de Mayo, Pueblo Joven, San Judas Tadeo I, Santa Anita - La selva, Santo Domingo, Sect. Cañaveralejo Guadalupe Antigua, U. D. A. Galindo Pl. Toros, Unid. Residencial El Coliseo, Urb. Militar, Venezuela - Urb. Cañaveralejo. In this barrios a higher social-economic stratum if found with a 6% of stratum 1, 10% of stratum 2, 47% of stratum 3, 10% of stratum 4, 19% of stratum 5, 1% of stratum 6 and 6% of other that include municipal land or non-classified land.

The sum of the barrios includes a total of 11,123 plots (according to the GIS from the municipality). However, using a buffer from the centre of the river of 200 meters[1] direct impact of the project affects around 4,946 plots which have an immediate enjoyment of the project but also have had a higher threat of the mismanagement of the river basins as is today and will have in the future if any further infrastructure malpractice is incurred.

[1] According to the previous report of flooding in the area, related in the GIS map and according to the Plan de ordenamiento territorial de Santiago de Cali. (Alcaldia de Santiago de Cali 2014). Also Matazu, M.B. and Chioma, M. (2014) "Buildings within 30 meters buffer distance from the river banks and flood plains are classified as highly vulnerable, 50 meters buffer distance is moderately vulnerable and 70 meters above as safe zones."

To calculate the sample size two methods were applied starting with the rule of thumb where the indicator concluded in the operationalization regarding willingness to pay and cost avoided where taken into account (stated preferences for infrastructure typology's, willingness to pay for infrastructure preferences, cost for insurance and cost of damages of past events) where each indicator represents a cell. Every cell needs a minimum of 30, thus having an overall of 120, this only represents 30% of 400 which is 100%. This represents an 8% of the selected plots (4946).

Using an alternative method with the following data:

Population Size:	4946	
Confidence Level (%):		95%
Confidence interval (%):		5%
Calculate Sample Size		357

Equation 1 Sample Size

$$Sample\ Size = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1+(\frac{z^2 \times p(1-p)}{e^2 N})}$$

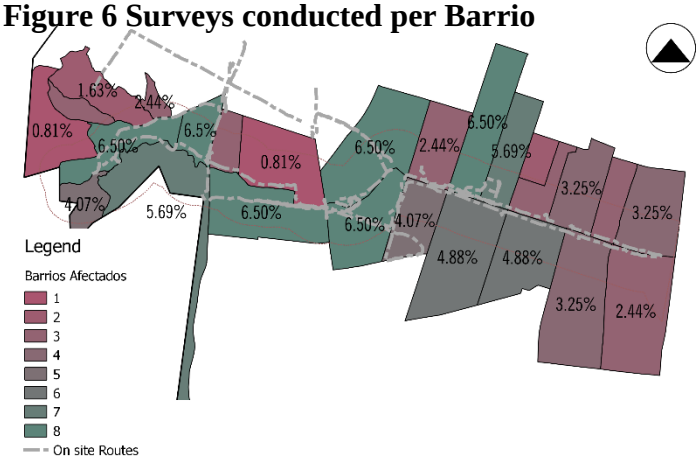
Where population Size = N / Margin of error = e / z-score = z (1.96) / e = percentage.

Confidence interval: the percentage that defines how closely the answer is to the "true value", the smaller the closer it is.

Confidence level: a measure of certainty that your sample reflects (Source http://www.surveysystem.com/sscalc.htm).

Where 30% of 357 is equal to 107 as a minimum for the sample. Both methods result in similar sample size.

Figure 6 Surveys conducted per Barrio



Source: Author compilation

Chapter 4: Research Findings and Analysis

4.1 Description of the case

In this chapter the research main findings based on the data collected from theoretical observation and analysis of the basis of the project while taking into account that ecological services are best differentiates as goods with reference to a location and quality variances, meaning that the weight assigned to them should be spatially in reference (Boyd and Banzhaf 2007). Furthermore, data collected from the sample through surveys and structured interviews conducted in Santiago de Cali, Colombia along the buffers zone of the green infrastructure project and finally compared with previous secondary data conducted via surveys by Universidad Del Valle and climate events database. It is important to note that although the study by Universidad del Valle was conducted in the same boundary of this study only 73% of the "Barrios" were surveyed in their sampling.

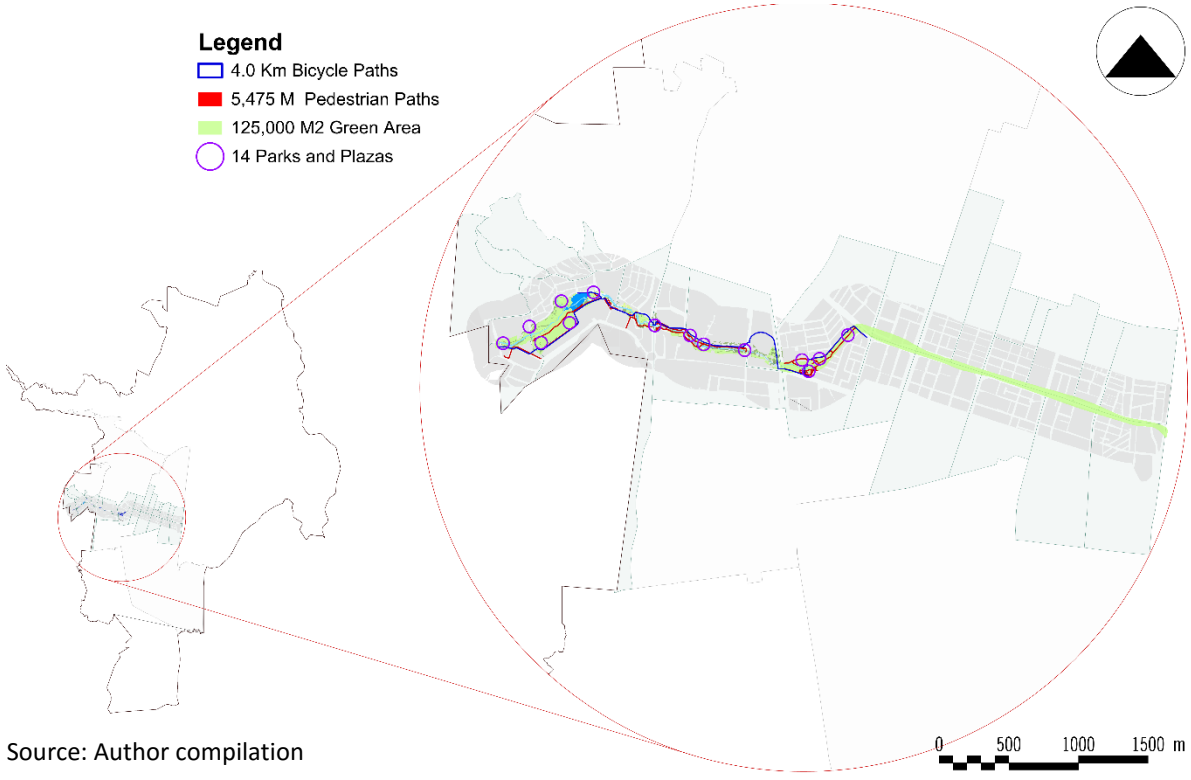
Table 11 Additional services provided by the Project

Green Infrastructure	Measurement	Units
Upgraded and accessible green area	**253,615**	**M2**
Bike paths	**4**	**Km**
Pedestrian paths.	**5,475**	**M2**
Planted trees	**207**	**Units**
Parks and plazas	**14**	**Units**

Based on the theoretical analysis of the green infrastructure project "Corredor Ambiental Urbano Río Cañaveralejo" several aspects were considered including a revision of the architectural and GIS plans, the description, mission and vision of the project, and the terms of reference.

The observed information found within all the documents mention above is that the project is based on several aspects that match and follow ecosystems services principals' mostly

Figure 7 Additional services provided by the Project "Corredor Ambiental Urbano Río Cañaveralejo"



Source: Author compilation

regulating and cultural services by trying to recover Cañaveralejo's river basin, creating and strengthening the natural and biodiversity network by making a link with the urban built environment, while generating stewardship of existing and new public spaces like parks, facilities with recreational and educational purposes emphasizing in the environment, in addition to mobility systems with low impact as bike paths and walking trails.

This environmental project has a multifunctional purpose generating ecosystems and natural landscapes that provide ecological services, quality of life, well-being and economic development also creating buffers against natural disasters. It is also important to mention that the interventions of the project when it comes to restoring the river basins and implementing the majority of infrastructure relates to the 3.6 km of the northwest part of the river route. The remaining 2.4 km receive sub sequential benefits trickle down stream.

In the literature review some similar cases where analyzed that used comparable indicator related to the nature of the GI project. For instance river ecology, aesthetics and banksides (Hanley et al. 2006), in the study of Doherty (2014) he applied health of ecosystems, access to recreational activities and conditions of banks or shoreline. The same in the case of Stithou (2012) for access for all recreational activities (walking, boating, swimming, fishing). Also Wilker and Rusche (2014) with path improvements, city greening, river renaturation and rest and sit possibilities.

The examination of the architectural and GIS plans accordingly revealed similar indicators as the studies mention and that the quantification of the services included in the project and thus in the study and survey were 253,615 M2 of upgraded and accessible green area (parks and plazas) which falls under *recreation mental and physical health with*, 4 Km of additional bike lanes and 5,475 M of additional pedestrian paths and areas under *mobility, walking and bicycle paths*, 207 additional trees that covers *aesthetic* and 14 new parks and plazas in 253,615 M2 of upgraded and accessible green area which foments sense of place, (Table 11 Additional services provided by the Project, Figure 7 Additional services provided by the Project "Corredor Ambiental Urbano Río Cañaveralejo").

Table 12 Demographic information

Variable		Count	% of Total
Gender	Female	56	46%
	Male	67	54%
Age Range	25 - 35 years	44	36%
	36 - 50 years	54	44%
	More than 50 years	25	20%
Level of Education	Primary	6	5%
	High school	36	29%
	Technical	34	28%
	Professional	47	38%
Salary range	1SM	33	27%
	1-2SM	31	25%
	2-3SM	36	29%
	3-4SM	11	9%
	4-5SM	6	5%
	Over 5SM	6	5%
Socioeconomic Stratum	1	13	11%
	2	19	15%
	3	31	25%
	4	26	21%
	5	31	25%
	6	3	2%

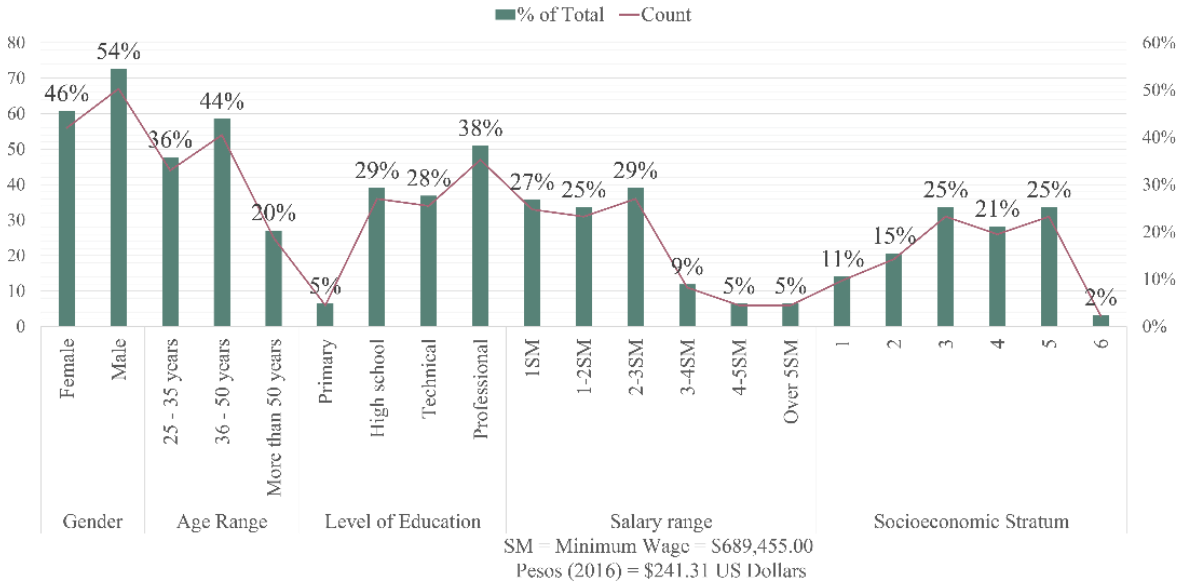
Source: Author compilation

4.2 Descriptive statistics

The findings of this study are based on the sample data collected from Santiago de Cali, Colombia bearing in mind the buffer zone (200 meters from the axis of the river) around the green infrastructure project. Usually, some main factors that affect WTP are gender, income level, education, past events, preferences and information about the service attained via a survey.

In this study a total of 123 households and businesses were surveyed. The respondents were almost evenly divided regarding gender with 56 (46%) female and men 67 (54%) being interviewed. An important distribution of the sampling was made when it came to the social-economic stratum (regarding the land taxation qualification) where all levels were represented, surveying 13 (Stratum 1), 19 (Stratum 2), 31 (stratum 3), 26 (stratum 4), 31 (stratum 5) and 3 (stratum 6). The complete demographic information is showed in Table 12 Demographic informationand Figure 8.

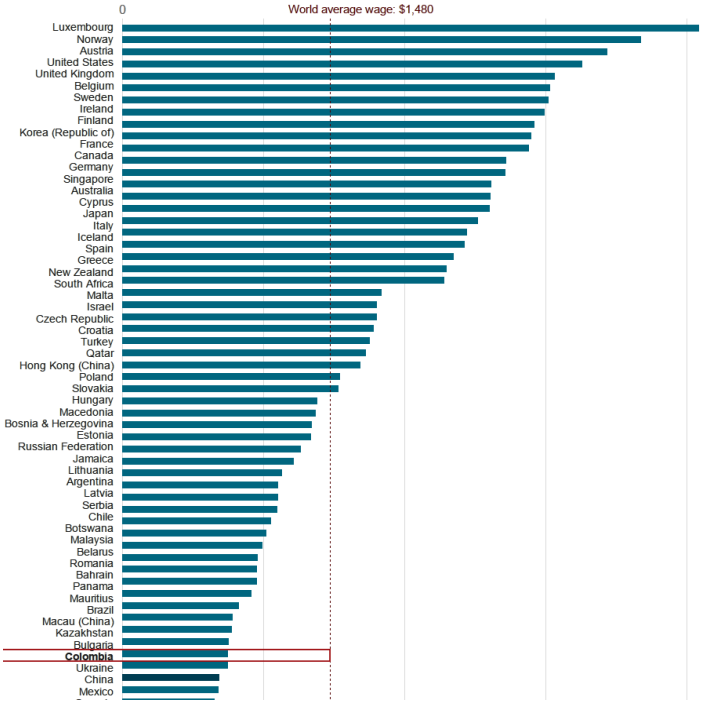
Figure 8 Demographic Information



Source: Author compilation

As seen on Figure 9, salary ranges in the sample are at an average of 1-3 SM (minimum wage) and have a mode of $723.93 US dollars. According to figures from the International Labour Organization (2014), "Colombia's monthly average salary is less than half the global average of $1,480. Colombia, with an average monthly salary of $692 (47% of the worldwide average) ranked 54 out of 72 countries on the global pay scale"

Figure 9 Salary Statistics



Source: (International Labor Organization 2014)

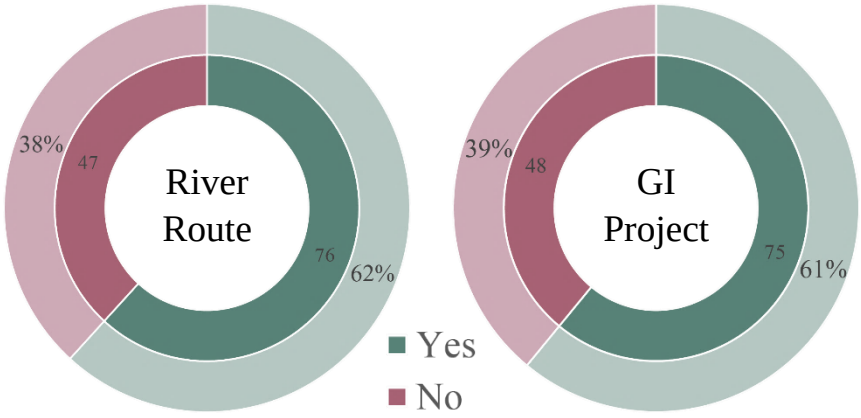
Table 13 Salary Statistics

Salary range			SM	US$
N	Valid	123		
	Missing	0		
Mean		1.54		$614.06
Median		1.00	1-2SM	$482.62
Mode		2	2-3SM	$723.93
Minimum		0	1SM	$241.31
Maximum		5	Over 5SM	$1,447.86

Source: Author compilation

Regarding the knowledge of the complete route of the river, citizens are mostly aware of the path of the river throughout the city with a 76 (62%) positive response and 47 (38%) of no familiarity of the rivers route. Correlating this information to the knowledge about the upcoming improvements with green infrastructure projects, 51 (41.5%) of the citizens who knew of the river route also knew of the green infrastructure projects although 24 (19.5%) of the citizens who did not know about the river's route did know about the green infrastructure projects taking place, (Figure 10). Overall citizens are familiar and well informed about the Cañaveralejo River and the upcoming improvements with the green infrastructure project.

Figure 10 Knowledge of the Population



Source: Author compilation

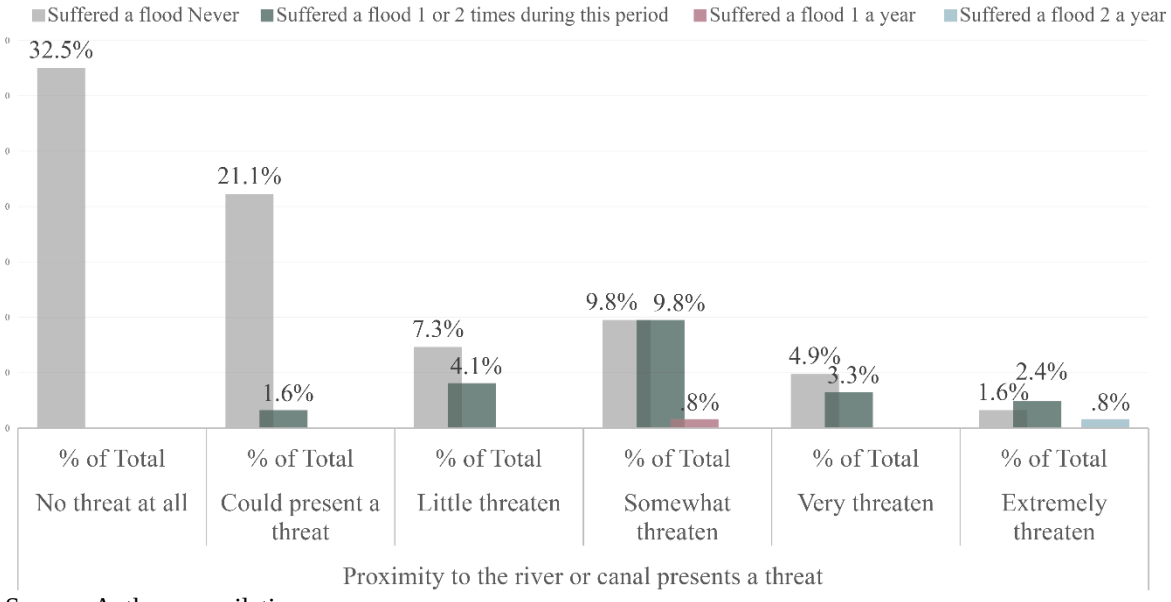
Table 14 Proximity to the river or canal presents a threat * Suffered a flood Crosstabulation

			Suffered a flood				
			Never	1 or 2 times during this period	1 a year	2 a year	Total
Proximity to the river or canal presents a threat	No threat at all	Count	40	0	0	0	40
		% of Total	32.5%	0.0%	0.0%	0.0%	32.5%
	Could present a threat	Count	26	2	0	0	28
		% of Total	21.1%	1.6%	0.0%	0.0%	22.8%
	Little threaten	Count	9	5	0	0	14
		% of Total	7.3%	4.1%	0.0%	0.0%	11.4%
	Somewhat threaten	Count	12	12	1	0	25
		% of Total	9.8%	9.8%	.8%	0.0%	20.3%
	Very threaten	Count	6	4	0	0	10
		% of Total	4.9%	3.3%	0.0%	0.0%	8.1%
	Extremely threaten	Count	2	3	0	1	6
		% of Total	1.6%	2.4%	0.0%	.8%	4.9%
Total		Count	95	26	1	1	123
		% of Total	77.2%	21.1%	.8%	.8%	100.0%

Source: Author compilation

In relation to the threat perceived if situated within a proximity to river, it was found that more than half of the sample perceives no threat to the proximity of the river 68 (55.3%), this correlates with the study done by Universidad del Valle early 2016 with a response of (72.65%) (Valle 2016). This study is followed by 39 respondents (31.7%) perceives some too little threat and 16 (13.0%) perceives extremely threaten to the river's closeness. Cross-referring the threat appraisal with past flooding events, all of the citizens that have suffered a flooding 28 (22.8%) also recognize the proximity of the river as a future threat, which is something expected. Although most resident of the area have never experienced a flood event 95 (77.2%) two-fifths still feel that the river could represent a threat 55 (44.7%).

Figure 11 Proximity to the river or canal presents a threat * Suffered a flood Crosstabulation



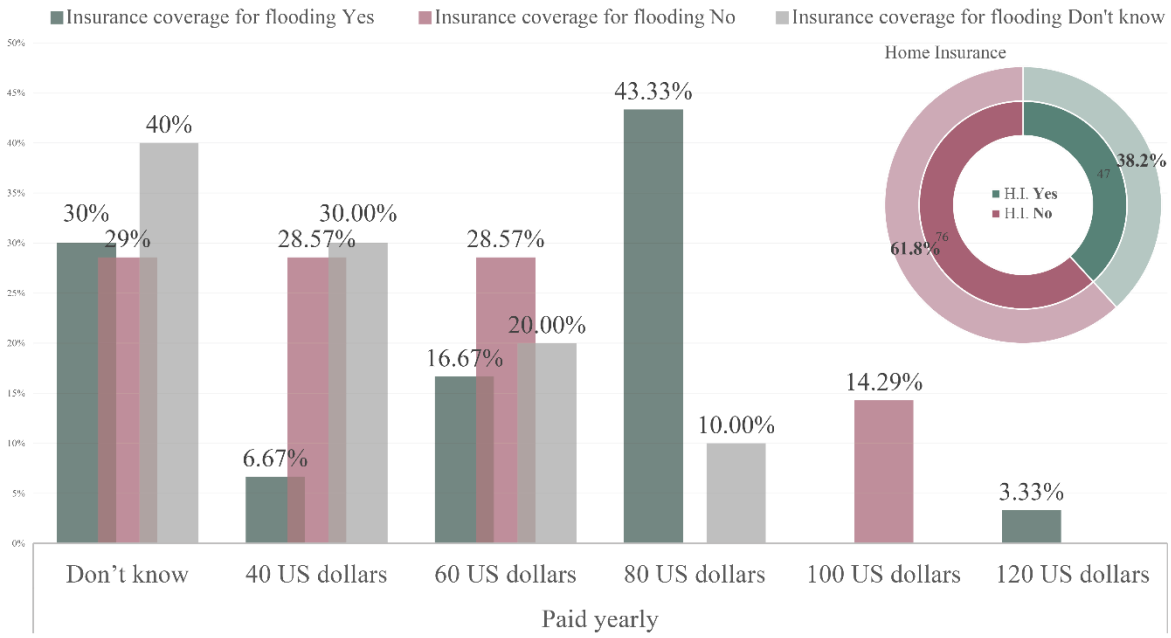
Source: Author compilation

Table 15 Insurance Flood Coverage * Paid yearly Crosstabulation

			Paid yearly							
			Don't know	40 US dollars	60 US dollars	80 US dollars	100 US dollars	120 US dollars	N/A	Total
Insurance Flood Coverage	Yes	Count	9	2	5	13	0	1	0	30
		% of Total	7.3%	1.6%	4.1%	10.6%	0.0%	.8%	0.0%	24.4%
	No	Count	2	2	2	0	1	0	0	7
		% of Total	1.6%	1.6%	1.6%	0.0%	.8%	0.0%	0.0%	5.7%
	Don't know	Count	4	3	2	1	0	0	0	10
		% of Total	3.3%	2.4%	1.6%	.8%	0.0%	0.0%	0.0%	8.1%
	No Insurance	Count	0	0	0	0	0	0	76	76
		% of Total	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	61.8%	61.8%
Total		Count	15	7	9	14	1	1	76	123
		% of Total	12.2%	5.7%	7.3%	11.4%	.8%	.8%	61.8%	100.0%

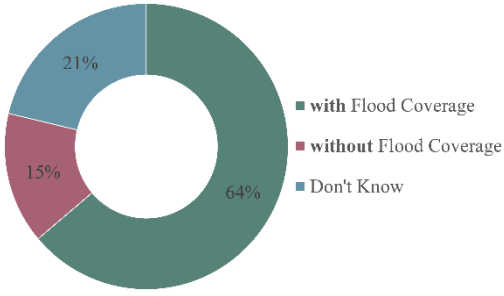
Source: Author compilation

Figure 12 Flood Coverage of the (38%) with Insurance * Paid yearly



Source: Author compilation

Figure 13 Insurance



Source: Author compilation

Table 16 Insurance _ Paid yearly

Paid yearly			
N	Valid	47	38.21%
	Missing	76	
Mean		1.62	
Median		2.00	60 US dollars
Range		5	
Minimum		0	Don't know
Maximum		5	120 US dollars

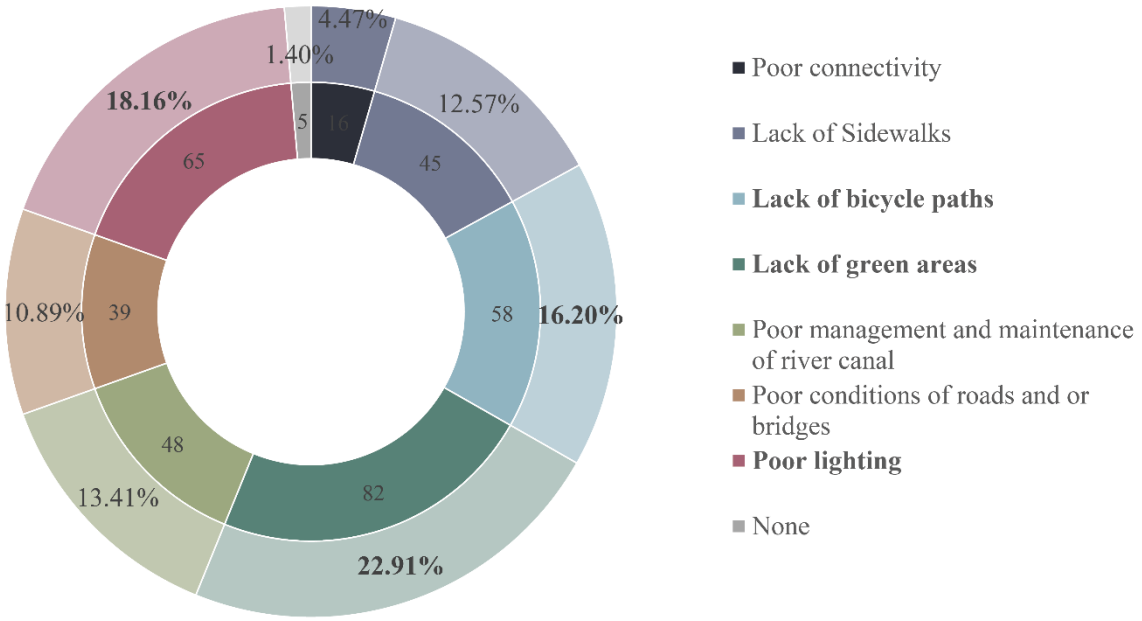
Source: Author compilation

For the results for insurance coverage it was found that more than three-fifths of the sample do not have insurance 76 (62%) and of the remaining 47 (38%) that have insurance the majority (64%); (i.e. 24.4% of the whole sample) are covered for flooding with only (15%); (i.e. 5.7% of the whole sample) are not covered for flooding (Figure 13 Insurance). The study from Universidad del Valle found a higher percentage of households without insurance (92.56%), but at the same time reported availability of the respondents to acquire insurance (29.75%).

Cross-referencing this results with the cost of insurance, as it is expected the ones that pay more have coverage for flooding, paying an average of **$8.50** per year more for flood coverage.

Regarding the infrastructure problems mentioned in the sample a focus on the lack of green areas been mention 82 (22.9%), followed by poor lighting 65 (18.16%) and lack of bicycle paths 58 (16.20%), among other, (Figure 14 Infrastructure Problems).

Figure 14 Infrastructure Problems



Source: Author compilation

The survey was conducted using help from digital renderings (digital generated photograph of possible outcome of the implementation of the GI project) the of the ecosystem services (mentioned above) provided by the green infrastructure project and citizens stated their preference regarding the current scenario or actual state of the infrastructure and the scenario or state of the infrastructure provided by the project.

Table 17 Public Preferences of Ecosystem Services

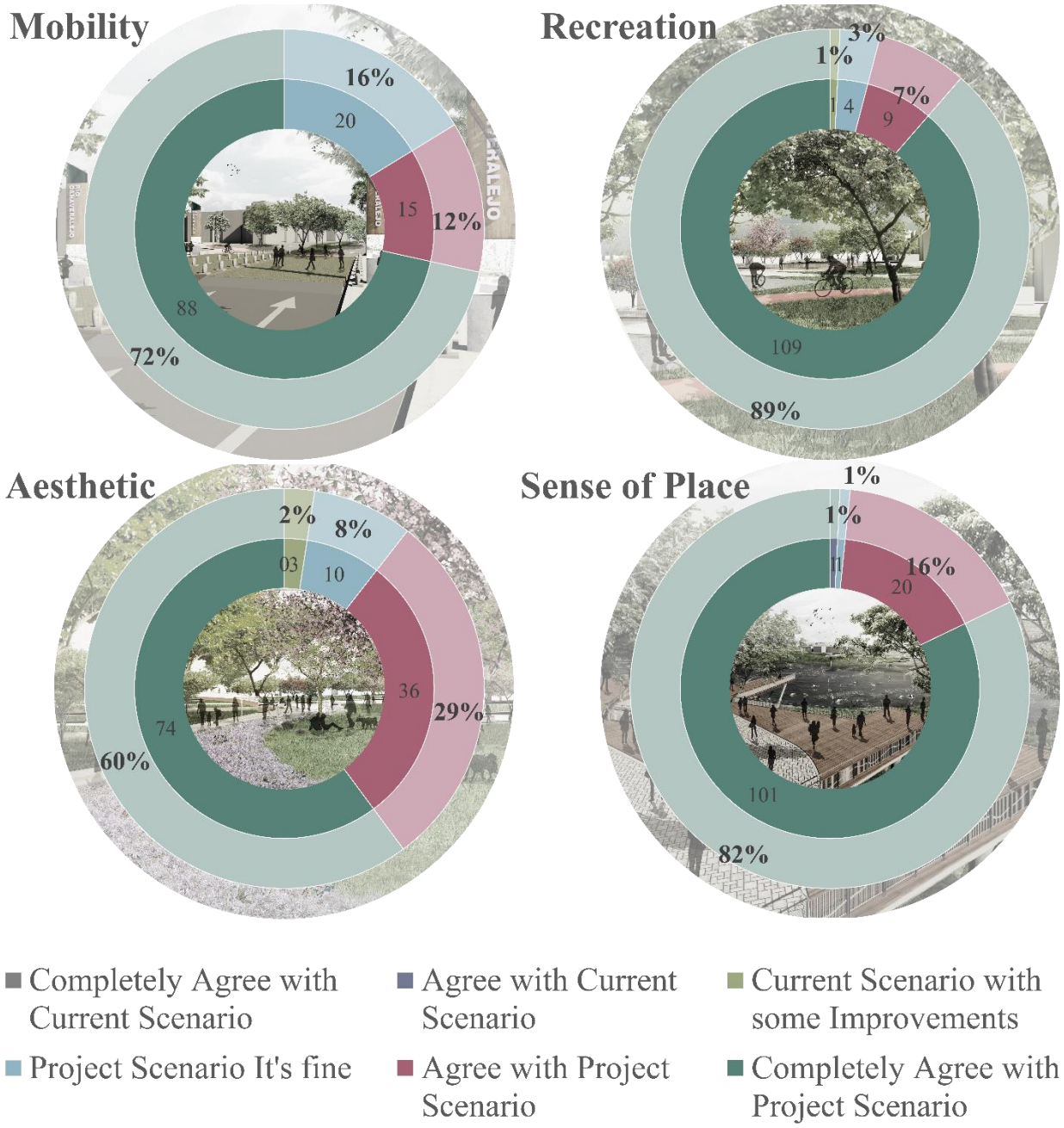
Stated Preference		Completely Agree with Current Scenario	Agree with Current Scenario	Current Scenario with some Improvements	Project Scenario It's fine	Agree with Project Scenario	Completely Agree with Project Scenario	Total
Public preferences on Mobility service	Count	0	0	0	20	15	88	123
	% of Tota	0%	0%	0%	16%	12%	72%	100%
Public preferences on Recreation service	Count	0	0	1	4	9	109	123
	% of Tota	0%	0%	1%	3%	7%	89%	100%
Public preferences on Aesthetic service	Count	0	0	3	10	36	74	123
	% of Tota	0%	0%	2%	8%	29%	60%	100%
Public preferences on Sense_Place service	Count	0	1	0	1	20	101	123
	% of Tota	0%	1%	0%	1%	16%	82%	100%

Source: Author compilation

The information was not only visual in nature but also included the increments in units (i.e. km, meters, and amounts) that the project will implement. The results of the sampling regarding the ecosystem services provided shows that the ecosystem service that citizens are more inclined to is **Recreation** with (89%) of complete approval followed by **Sense** of **Place** with (82%) then **Mobility** (72%) and finally **Aesthetic** (60%) of complete agreement with the project scenario. Furthermore, the rest of the responses of the sample were also inclined to a positive acceptance in the majority, representing an “agreement with the project scenario” and “the project scenario been fine”.

The information acquired using a Likert scale representing different compliances or percentage of mixtures of current scenarios and scenarios with the green infrastructure project.

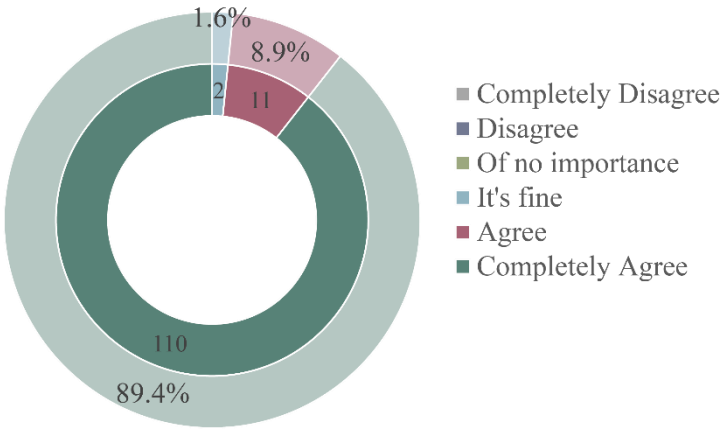
Figure 15 Public Preferences of Ecosystem Services



Source: Author compilation

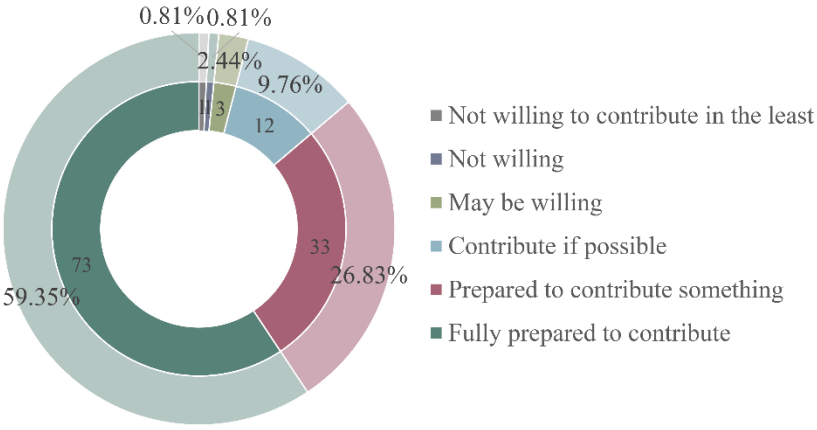
The overall acceptance of the green infrastructure project "Corredor ambiental urbano del río Cañaveralejo" including ecosystem services and further benefit is highly positive obtaining a 100% of approval and more than four-fifths of the sample complete agrees with the project (89.4%). Expectedly this also is represented in citizen's willingness to contribute for the project to be implemented. Within the sample 73 (59.35%) are fully prepared to contribute and 33 (26.83%) are prepared to contribute something, totalizing in an overall compliance to contribute of 106 (86.18 %) to participate in community consultations and meetings to discuss the best scheme for the community, Graph 7. The correlation to the study done by Universidad del Valle early 2016 is similar where they determined that willingness to intervene for the benefit of the city is (70%).

Figure 17 Public preferences on Green Infrastructure



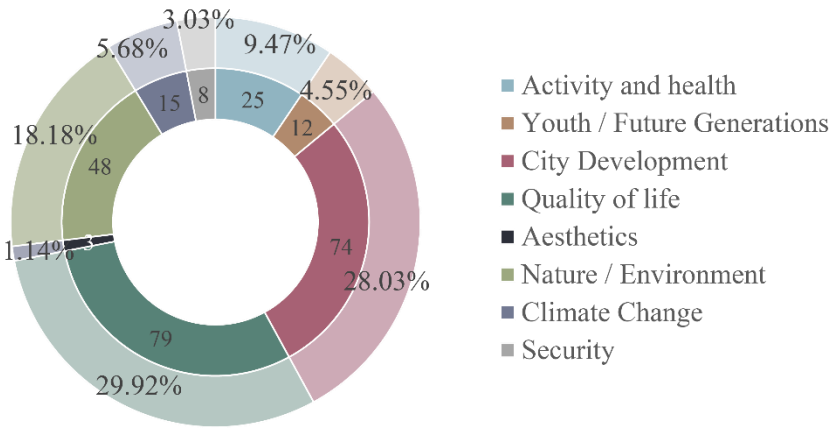
Source: Author compilation

Figure 16 Willing to contribute for this green infrastructure project to be implemented



Source: Author compilation

Figure 18 KEY concepts why people agree with Green Infrastructure Project



Source: Author compilation

Within the sampling it was ascertained citizen's perspective on the high acceptance rate and some of the key concepts that were mention repeatedly were as follow; because of quality of life (29.9%), city development (28%) and nature / environment (18%). The information gathered provides an insight on the predisposition of the citizens in this area and perhaps the city. It also engulfed a reflection on the earlier results regarding the infrastructure problems and how the green infrastructure project "Corredor ambiental urbano del río Cañaveralejo" and the benefits provided are expected and needed for the city and its citizen's well-being.

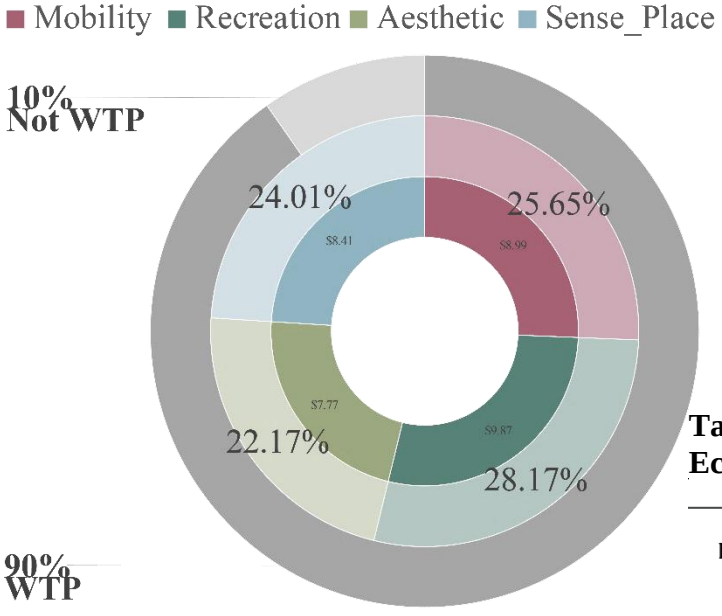
The results from the descriptive analysis up till now indicates that the respondents have positive attitudes towards nature and the environment in general and its inclusiveness in the city's development.

The data also demonstrates a pronounced degree of willingness to pay indicating that 111 (90%) of the respondents are willing to pay. The results are exceptionally high compared to other studies where a positive response rate for willingness to pay oscillates around 30 to 60 percent (Loomis 2000; Zhai et al. 2006; Hanley et al. 2005; Wilker and Rusche 2014) with the highest reaching 60 percent (Stithou et al. 2012). This can be clarified by taking into consideration the economic situation of Colombia as a developing country and with a lower world salary average as seen on (Figure 9 Salary Statistics). Considering the previous statement and as stated in the methodology a lower range in the WTP questionnaire was presented. While making the range more accessible the response rate for willingness to pay raised significantly around (30%) taken into account the highest response rate of the cases analyzed.

According to Wedgwood, A. and Sansom, K. (2003) another common inaccuracy in surveying can be that respondents may also adopt a behavior supporting a good cause and only answer in a positive and helpful manner to satisfy the interviewer and appear sympathetic to the cause with disregard to the impact and capacity of their budget.

The amount that the respondents are willing to pay also differ with some of the studies with the highest amount per household per year reaching $252.00 in the case of (Loomis 2000). Although some of the result from other cases where similar (Shang et al. 2012; Zhai et al. 2006; Hanley et al. 2006), where the willingness to pay ranges from $33.08 to $45.73 per household per year (Table 18). Whereas in this study the absolute WTP averaged for all services and among all respondents was **$35.03** per household per year (Table 18 Willingness to Pay per Ecosystem Service).

Figure 19 Willingness to Pay * Payment per Ecosystem Service



Source: Author compilation

Some cases also coincided in analysing the same specific services as with Hanley et al. (2006), that looked into aesthetics values arriving at £15.68, Doherty et al. (2014) assessed the value for recreational activities with €15.00, Stithou et al. (2012) allocated €23 for access for all recreational activities and Wilker and Rusche (2014) with Path improvements (400 meter- long new bicycle and pedestrian path along the river) €14.43 and City greening €13.27 among others. All this studies comes close to doubling the amount allocated for each service compared to the result in this case but they also took place in developed countries England,

Table 18 Willingness to Pay per Ecosystem Service

		%	$Pcr/Y
Ecosystem Services	Mobility	25.65%	$8.99
	Recreation	28.17%	$9.87
	Aesthetic	22.17%	$7.77
	Sense_Place	24.01%	$8.41
	Total	**100.00%**	**$35.03**

Source: Author compilation

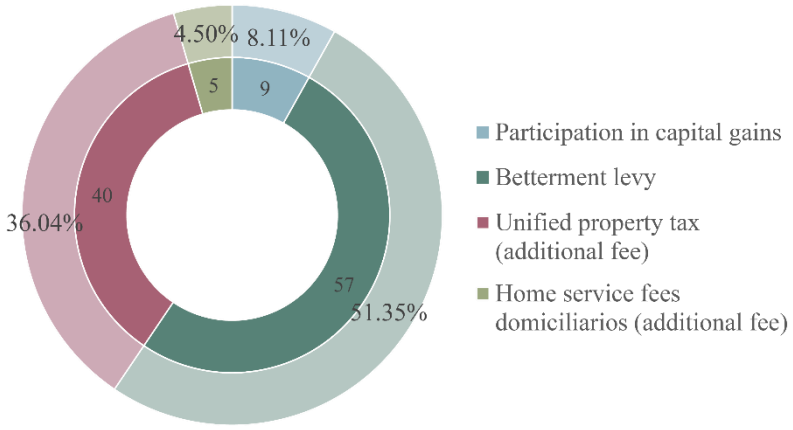
Ireland, Germany respectively, whereas mentioned before the ranges of WTP are higher than the ones used for this case.

Specific economic allocation for the different ecosystem services were determined in the study with a minimum difference but a slight inclination toward *recreation services* (28.17%) which included 253,615 M2 of upgraded and accessible green area (parks and plazas) and a WTP of **$9.87**, followed by the *mobility services* (25.65%) and **$8.99**, comprise by 4 Km of additional bike lanes and 5,475 M of additional pedestrian paths and areas, *sense of place* includes 14 new parks and plazas in a 253,615 M2 upgraded and accessible green area and was preferred (24.01%) with an amount of **$8.41** and coming very close to the rest *aesthetics* with (22.17%) implementing 207 additional trees, allocated **$7.77**. The results have a similar parallel connection with the respondent's preferences on ecosystem services with a difference in the choosing of mobility and sense of place services were in the preference sense of place came before mobility. Perceptually speaking the difference in the preference was bigger that in the distribution of capital where is less than (2%). In general, the preferences and distribution of economic support per ecosystem services are equitable in both analyses.

Secondary benefits can also be quantity to sum to the total amount gained by a green infrastructure project as the case of Foster J. (2011) were trees were estimated to have a value of $30 to $90 per year for each tree, accounting for benefits like decreased air pollutants, urban heat island and storm-water. But this benefits are outside the focus of this study.

Colombia has a land taxation system that recognizes different modalities to tax land and city's development, the study reflected upon the most common ones to acquire the payment of the respondent's wiliness to pay. The methods of taxation given as options are Participation in capital gains (Participación en plusvalías), this tax is liable for the owners or possessors of properties for which there has been an increase in the price of land as a result of urban actions that modify their use or increase their use. Betterment levy (Contribución por valorización), this is not a tax but a contribution that an owner of the property should do as compensation for the value that is generated or incremented to the property because of an infrastructure work built by the state. Unified property tax (Impuesto predial unificado), this tax is paid by all owners, holders or beneficial owners of property that are located within the municipal jurisdiction. Its tax base is the property valuation assigned by the cadastral authorities. Lastly Home service fees (Tasas por servicios domiciliarios), these fees are for the services that are inherent in the social purposes of the State (water, sanitation, maintenance, among other) which can be summarized into general welfare and improve the quality of life of the population, (CALI 2014; Super Servicios-SSPD 2012; Restrepo 2010). Having analyzed this the most suitable for the green infrastructure project "Corredor ambiental urbano del río Cañaveralejo" appears to be Betterment levy and more than half of the respondents seem to concur 57

Figure 20 Manner of Payment

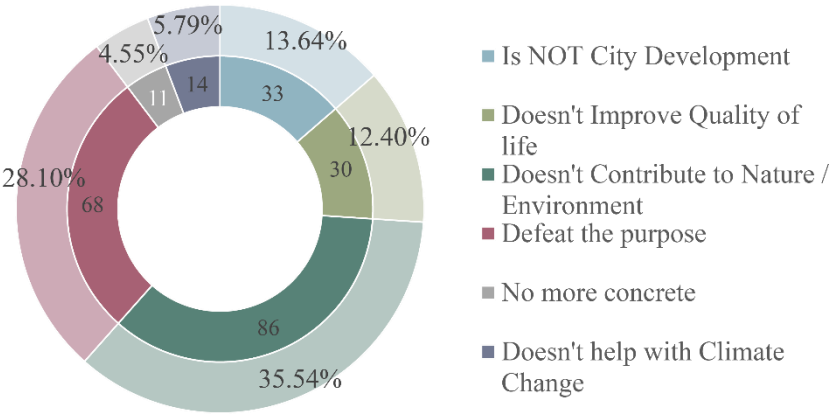


Source: Author compilation

(51.35%), followed by an extra fee to the unified property tax 40 (36.04%) and with little representation from the other methods mention.

Another significant indication of the attitude and disposition of the respondents towards the needs of infrastructure within the area of the project and Santiago de Cali in general and the willingness to pay for ecosystem services provided by such projects was determined inquiring if there was willingness to pay for infrastructure projects that did not include natural ecosystem rehabilitation and conservation. Some of the key concepts repeatedly mention representing an understanding of the importance of green infrastructure projects and a positive attitude towards the environment. The most mention were "does not contribute to nature and the environment" 86 (35.54%). Followed by "Defeat the purpose" 69 (28.10%) with regards towards the nature of the project and the needs of the city, which correlates with the next key concept "It's not city development" 33 (13.64%) and also "does not improve quality of life" 30 (12.40%). Leaving the final two with significantly less representation but still shows that they echoes in the citizen's mindset, "does not help climates change" and "the city does not need more concrete".

Figure 21 KEY concepts why people agree with Green Infrastructure Project



Source: Author compilation

4.3 Regression Results

The Willingness to pay equation was estimated using SPSS Version 20.0 to determine the relationship between WTP and different factor that may affect it.

A multiple linear regression analysis was used to develop a model for willingness to pay WTP based on Level of Education, Socioeconomic Stratum, Salary range, threat appraisal and preferences on GI.

The arrangement of the equation showed is primarily motivated by theory and relevant literature. In this model, willingness to pay is endogenously defined and is a function of the following independent variables: Level of Education, Socioeconomic Stratum, Salary range, Proximity to the river and preferences on GI.

Thus, $WTP = \beta 0 + \beta_1 LE + \beta_2 SES + \beta_3 SR + \beta_4 PR + \beta_5 PGI$

A significant regression equation was found ($F(\mathbf{5, 117}) = \mathbf{10.924}$, $p < .\mathbf{000}$), with an R2 of **0.318**.

The coefficient of determination of the model shows that **32 percent** of variations in WTP is attributed to the explanatory variables and the remaining 68 percent is unexplained. In other words, 32% of the correlation of the dependent variable is explained by the independent variables.

Participants' predicted **Willingness to Pay** is equal to **-2.764** + **0.385** (**Level of Education**) + **0.096** (**Socioeconomic Stratum**) + **0.159** (**Salary range**) - **0.123** (**Proximity to the river**) + **0.745** (**preferences on GI**), where ***Level of Education*** is coded as (0 = Primary, 1 = High school, 2 = Technical, 3 = Professional), ***Socioeconomic Stratum*** is coded as (1 = Stratum One Low-Low, 2 = Stratum Two Low, 3 = Stratum Three Medium-Low, 4 = Stratum Four Medium, 5 = Stratum Five Medium-High, 6 = Stratum Six High), ***Salary range*** is coded as (0 = $250.00, 1 = $500.00, 2 = $750.00, 3 = $1,000.00, 4 = $1,250.00, 5 = $2,000.00), ***Proximity to the river*** is coded as (0 = No threat at all, 1 = Could present a threat, 2 = Little threaten, 3 = Somewhat threaten, 4 = Very threaten, 5 = Extremely threaten) and ***Preferences on GI*** is coded as (0 = Completely Disagree, 1 = Disagree, 2 = Of no importance, 3 = It's fine, 4 = Agree, 5 = Completely Agree).

While other conditions remain the same (Table 19);

Respondents Willingness to Pay increased **0.385** per each increase of unit of Level of education

Respondents Willingness to Pay increased **0.096** per each increase of unit of Social stratum

Respondents Willingness to Pay increased **0.159** per each increase of unit of Salary range

Respondents Willingness to Pay decreases **0.123** per each increase of unit of Threat appraisal and

Respondents Willingness to Pay increased **0.745** per each increase of unit of Preferences on GI.

The beta coefficients can be negative or positive representing the magnitude of the slope of the line. A significance coefficient is measured if there is a meaningfully different from the line the X-axis.

The triplicity of **Level of education (0.005)** and **Preferences on GI (0.006)** are significant predictors of Willingness to Pay and with a slight significance **Threat appraisal (0.061)**. Because as the P-value measure of the strength of the evidence against the null hypothesis H_0 and the smaller the P-value is, the more evidence we have that the H_0 is wrong. Put in another way, to prove the alternative hypothesis H_1 (the effect the predictor variables have on WTP) a significance level is $\leq$ **0.05.**

However, **Social stratum (0.347)** and **Salary range (0.144)** do not represent any significance to predict Willingness to Pay.

To eliminate complications related with multicollinearity, a variance inflation factor (VIF) value tests were run among the variables in a regression model and a high correlation of the of all predictor variables was checked in the correlation matrix. The correlation coefficients found in the study were smaller than 0.6 (Table 20) and according to Unwin (2013) " a way of identifying multicollinearity is to see if any correlation is very highly (correlations of above .80 or .90)."

There is no official VIF value for defining the presence of multicollinearity, but generally speaking, in literature, if the value is between 1-10, then there is no multicollinearity and if it's < 1 or> 10, there is cause for concern.

Therefore, based in the Collinearity Statistics obtained the highest VIF value 2.267 (Table 19), which is between 1 – 10, consequently it can be concluded that there is no multicollinearity symptoms.

Table 19 Multiple Linear Regression

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.564 [a]	.318	.289	1.082

a. Predictors: (Constant), Public preferences on GI Cañaveralejo_P service, Level of Education, Proximity to the river or canal presents a threat, Socioeconomic Stratum , Salary range

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	63.969	5	12.794	10.924	.000 [b]
	Residual	137.023	117	1.171		
	Total	200.992	122			

a. Dependent Variable: Willingness to Pay

a. Predictors: (Constant), Public preferences on GI Cañaveralejo_P service, Level of Education, Proximity to the river or canal presents a threat, Socioeconomic Stratum , Salary range

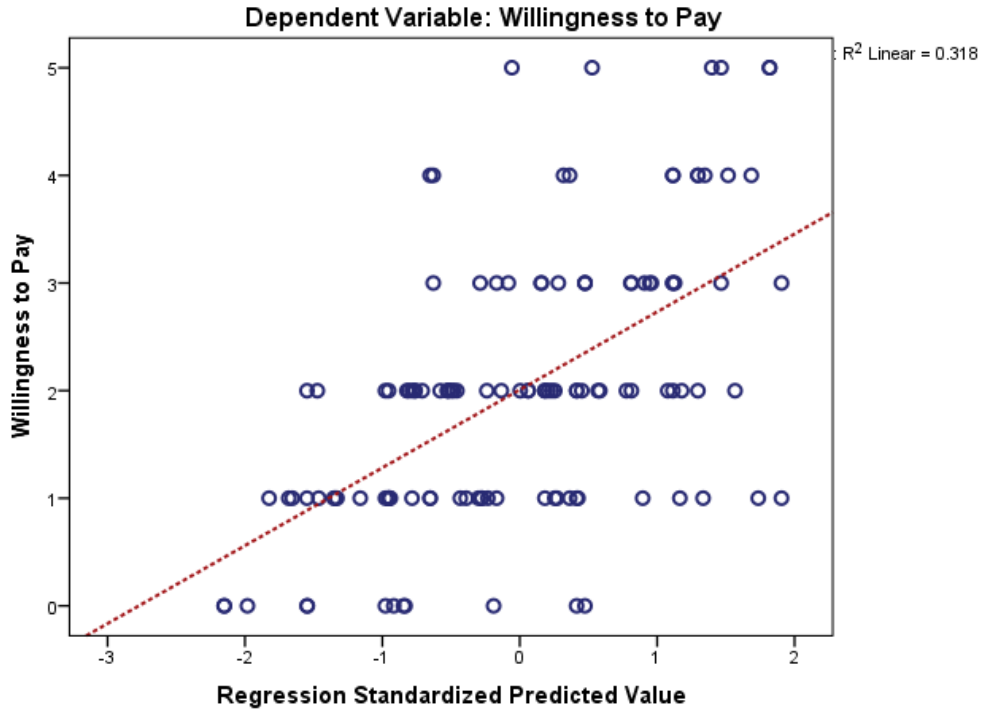
Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	-2.764	1.349		-2.049	.043		
	Socioeconomic Stratum	.096	.101	.101	.943	.348	.503	1.987
	Level of Education	.385	.135	.281	2.846	.005	.598	1.672
	Salary range	.159	.108	.169	1.468	.145	.441	2.267
	Proximity to the river or canal presents a threat	-.123	.065	-.147	-1.888	.062	.955	1.047
	Public preferences on GI Cañaveralejo_P service	.745	.268	.218	2.782	.006	.952	1.051

a. Dependent Variable: Willingness to Pay

Source: Author compilation

Figure 22 Scatterplot



Source: Author compilation

Table 20 Pearson Correlation

		Willingness to Pay	Socioeconomic Stratum	Level of Education	Salary range	Proximity to the river or canal presents a threat	Public preferences on GI Cañaveralejo_P service
Willingness to Pay	Pearson Correlation	1					
	Sig. (2-tailed)						
	N	123					
Socioeconomic Stratum	Pearson Correlation	.397 **	1				
	Sig. (2-tailed)	.000					
	N	123	123				
Level of Education	Pearson Correlation	.450 **	.536 **	1			
	Sig. (2-tailed)	.000	.000				
	N	123	123	123			
Salary range	Pearson Correlation	.452 **	.679 **	.607 **	1		
	Sig. (2-tailed)	.000	.000	.000			
	N	123	123	123	123		
Proximity to the river or canal presents a threat	Pearson Correlation	-.181 *	-.172	-.087	-.103	1	
	Sig. (2-tailed)	.046	.058	.338	.256		
	N	123	123	123	123	123	
Public preferences on GI Cañaveralejo_P service	Pearson Correlation	.223 *	.022	-.003	.131	.121	1
	Sig. (2-tailed)	.013	.813	.975	.149	.184	
	N	123	123	123	123	123	123

**. Correlation is significant at the 0.01 level (2-tailed).

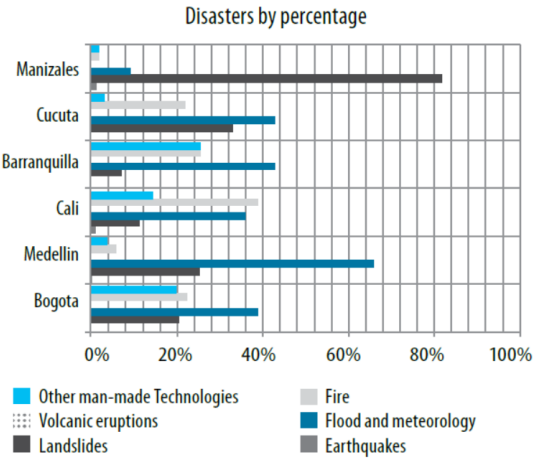
*. Correlation is significant at the 0.05 level (2-tailed).

Source: Author compilation

4.4 Insurance

In the past years, there has been an increase in extreme events caused by rainfall, as reported in the Fourth IPCC Report. Showing that risk conditions are materializing in a greater number of damages. Which reinforces the need for disaster risk management in planning and municipal investments (The World Bank 2013).

Figure 23 Percentage of disaster events in cities under study, 1970-2011



Source: based on information provided by OSSO-EAFIT Corporation, 2011. (The World Bank 2013)

To ascertain more information regarding past events and insurance values a second survey was conducted targeting the insurance companies of Santiago de Cali especially the ones that provide services to household along Cañaveralejo River. According to Colombian Federation of Insurers; Fasecolda (Federación de aseguradores colombianos), Colombian Association of Insurance Brokers; Acoas (Asociación Colombiana de Corredores de Seguros) and the Insurance Information Institute, there are around twenty prestigious home insurance companies that provide service in Santiago de Cali. The top ten for the past years were among the targeted companies (Table 21).

Table 21 General Insurance Companies

	Companies
1	Suramericana de Seguros
2	Seguros del Estado
3	Mapfre
4	Seguros Bolívar
5	Allianz Seguros SA
6	Liberty Seguros
7	Previsora
8	AXA Colpatria Seguros S.A.
9	QBE Seguros
10	La Occidental

Source: Author compilation

As with the previous survey, this questionnaire also proved to be more difficult that initially expected, the response rate was lower than anticipated because the neglectance to respond questioner via mail and insurance companies are not willing to part with the information enquired due to confidentiality issues and internal bureaucracy. This challenge was surpassed by conducting the survey via telephone and contacting insurance brokers, banks and insurance associations. Although the response rate only reached 30%.

Multi-risk home insurance is a fairly complex tool because of the large amount of coverage offered which can complicate acquiring a policy. A home insurance policy may be different from another, depending on the company which issues it or the needs of the insured. In any case, the insured may find a suitable policy for their needs and economic capacity. Additionally, citizens are able to create a package custom-built that includes individual preferences.

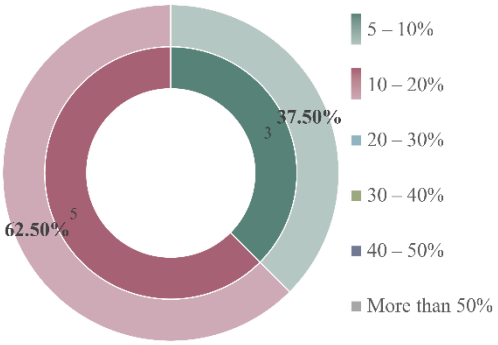
According to the questionnaire conducted, although individual home insurance is becoming more popular in Santiago de Cali the percentage of the population with home insurance is low barely reaching a range between 7 to 15 percent (Table 22).

Table 22 Percentage of the population of Cali with home insurance

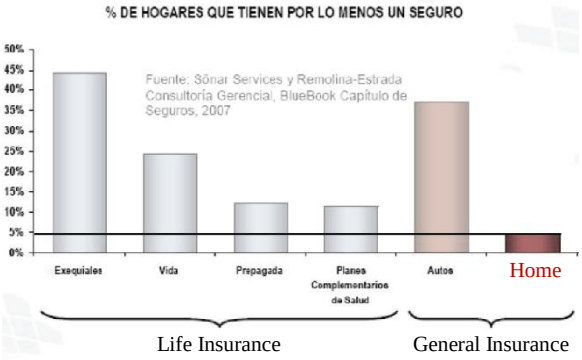
		Count	% of Total
Home Insurance	5 – 10%	3	37.50%
	10 – 20%	5	62.50%
	20 – 30%	0	0.00%
	30 – 40%	0	0.00%
	40 – 50%	0	0.00%
	More than 50%	0	0.00%
	Total	8	100.00%

Source: Author compilation

Figure 24 Percentage of the population of Cali with home insurance



Source: Author compilation

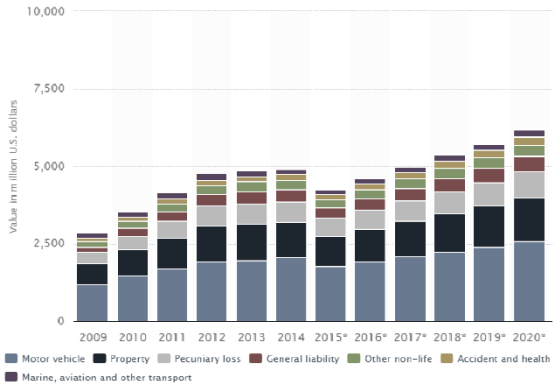


Source: fasecolda.com

This can be corroborated with the statistics information gathered in a study conducted by Fasecolda which shows the percentage of households with home insurance in Colombian (including flood risk) is less than 5%. Although this study was conducted in 2007. Using the statistical study led by Statista (http://www.statista.com/) an increment of up to (25%) of households would be insured in Colombia forecast for 2020,(Figure 25). The survey from Universidad del Valle also contribute to these findings as their study only found (7%) of the sample to have insurance.

Regarding insurance coverage according to the type of house and the social stratum the result were positive, reaching (100%) of respondents, were all types of houses are insurable but it depends on the condition of the fiscal structure of the house, furthermore all types of social stratum are also cover according to (75%) of the sample the other (25%) were from the largest insurance company Sura which can cover hoses from all stratum but avoid the lower stratum because of the complication of constructing a made to fit policy for lower stratum (Figure 26 Coverage Type of House * Stratum Crosstabulation).

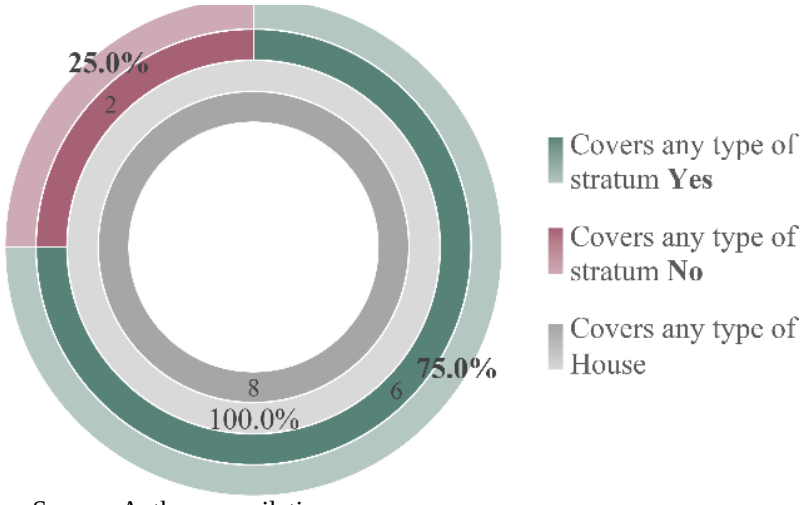
Figure 25 Growth of non-life insurance premiums projected to 2020



Source: Statista http://www.statista.com/

The sample in the study directly covered several insurance companies and insurance brokers which represent an array of companies, the insurance represented in the study are, (Table 23 Insurance in study sample).

Figure 26 Coverage Type of House * Stratum Crosstabulation



Source: Author compilation

According to the Law 2/1981 of 25 March, of Mortgage Market Regulation provided in Article 8 says that "Properties with mortgaged/loans must be insured against damage for the pricing value of the property, under the conditions prescribed by the regulation". Furthermore, Co-ownership or neighborhood community, according to Law 675 of 2001 are required to ensure the commons, at the least against the risks of fire and earthquake. This policy covers the settlement of the typical damage that may occur within the community: damage to common elements, water leakage, etc. However home insurance acquired by the community has limits,

and a careful analysis is required regarding coverage and distinctions of the cost of repair included. Expectedly this is reflected in the sample.

As mention above Multi-risk home insurance is a fairly complex tool and premiums largely depend on several aspects regarding the characteristic of the property, in the sample the most important mention are location, the commercial value of the property, cost of reconstruction of the building and cost of inventory.

Table 23 Insurance in study sample

	Insurance Companies
1	Sura
2	La Occidental
3	Generali
4	Mapfre
5	Equidad
6	Previsora
7	Seguros del Estado
8	BBVA Seguros
9	Liberty Seguros
10	AXA Colpatria
11	Seguros Bolívar

Source: Author compilation

General coverage for multi-risk home insurance will include earthquakes, flooding, theft and fires. Some insurers include services such as electric, plumbing, resetting locks and keys and Garden Grove and replanting for all-inclusive premiums, but minor damages are not always insurable. However, this type of coverage may not be included in some of the packages offered, especially the ones that cover neighborhood community and standard home coverage (offered as a base package in some mortgages). In this regard, individual home insurance has become more popular covering both the continent and the content, i.e., all the belongings found inside the house.

The study reflects that all insurance companies (100%) in the sample cover against flooding and in almost all cases flooding is included in the standard plan (88%), although as mention before there could be various differences in a standard home insurance and all-inclusive premiums.

Home policies offer several different coverages for owners or tenants of housing.

- Fire and / or lightning: covers damages resulting from the occurrence of a fire inside the house and / or a lightning strike on it.
- Earthquake: cover damage resulting in housing and / or its contents, because of an earthquake, earthquake or volcanic eruption.
- Larceny: gives the secured an injunction against losses caused by shoplifting at home.
- Explosion: is coverage that protects you from damage resulting in housing and / or its contents because of an explosion occurring within the housing. (Eg heater, pressure cooker, gas systems, etc.).
- Hail, *flooding* and water damage: cover damage resulting in housing and / or its contents, because of events hail, rain and accidents in the pipes located inside.
- Strong winds: it is protection against damage resulting in housing and / or its contents, following strong winds. Especially, it is an important coverage on the coast and in times of strong winds in the country.

Within this coverage, some of the internal aspects could be modified to accommodate a lower price for the premiums a thus include all the general aspects but with limited extent. And as expected this is reflected in the price.

Table 24 Cost of insurance depending on flood coverage

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
cost of a home insurance that **cover** flood damage	8	2	5	4.00	1.195
		$60.00	$120.00	$100.00	
cost of a home insurance that **DO NOT cover** flood damage	8	1	5	2.63	1.506
		$40.00	$120.00	$78.27	
Valid N (listwise)	8				

Source: Author compilation

From the data collected regarding price range of all-inclusive premiums, the results show that an overall average of **$29.75** is paid extra per year for extreme events coverage in comparison to what is paid for a standard home insurance plan. Although this all-inclusive coverage includes a wide range of items and advantages, not only flood coverage. This is generally because the percentage of the premium allocated to flood events is not unbundle but composed or integrated as (50%) of the sample responded. The other (50%) responded as information covered by confidentiality issues or not available.

The study also ascertains the frequency of extreme events in the area and how much was the damages incurred (monetary terms) in the event, as well as the insurance company responsible for payment. As not all insurance companies were surveyed directly but some were through insurance broker some information could not be acquired but out of the sample (88%) recall an event regarding flooding as for the rest they recalled past events but were not involved directly.

Table 25 Cost of damages from past flooding events along the buffers zone of the green infrastructure project.

Damages Past Events					
	Isurance Companies Responsible				
Year	Sura	La Occidental	Mapfre	Other	Total
2007				$9,800.00	$9,800.00
2010	$297,500.00				$297,500.00
2013		N/A	$8,750.00		$8,750.00
Total	$297,500.00	$0.00	$8,750.00	$9,800.00	$316,050.00

Source: Author compilation

From this data and taking into account the range of years from (2007-2016 – 9y) a yearly amount of **$35,116.67** dollars could be utilized and if the range of year is adjusted to the one reported in the survey (2007-2013 – 6y) a yearly amount of **$52,675.00** could be utilized for alternative flood prevention methods.

Substantiating with secondary data acquired from DesInventar (Colombia 2014) which is a Disaster Information Management System which holds a database of past events, a total of 15 flood events were found from (2000-2013 - 13y) which is the year of the last update of the database and it is important to note that not all the events had an input of cost of damages.

Regardless, similarly to the data from the sample in this statistical database it is reported a total of **$253,510.31** of damages losses, and that comes into a yearly quota of **$21,125.86** (Colombia 2014) (Table 26 DesInventar: Inventory system statistical database of disasters).

As mention before, acquiring the records of past events was challenging and the records found did not have all the information regarding the monetary expenditures per event. When compared to other studies that have used GI as means to provide natural protection to citizens (among other benefits) the cost-benefit analysis is insignificant. Baldwin (2010) showed a cumulative value for storm and flooding protection of $1.3 million through avoided damage. In the study of Weiskel (2007) $19 million was saved through damages avoided in flood control and in Foster J. (2011) a range from $1,280,000 to $10,594,900 was saved in a five-city study conducted to obtain the monetary value from urban forestry project in Chicago, New York City, Philadelphia, San Francisco and Washington, DC. Estimating a total savings of $24,731,400 in cost avoided including all cities.

This supports the need for more strict records regarding past events in Santiago de Cali and the impact they have in the city.

Compounding an average of the values mention above regarding past events in Santiago de Cali (Damages avoided), a value of **$36,305.84** could be utilized for alternative flood prevention methods. Adding to this a percentage of the extra amount paid per year for extreme events coverage (Insurance Value) and considering the number of people that acquire this service, and amount of **$55,914.53** per year can be exploited. Coming up to a total of $**92,220.37** minimum per year that could potentially go towards green infrastructure projects. As mention before the project has strong ties and characteristic to the adaptation and mitigation of flood events in which such amount could be used (Gutiérrez, Julián; Alarcón 2015).

While examining insurance premiums fluctuation in the course of the last year's many causes arouse but as most things they are tangled to the global economy in general, were home insurance rates are tied to the stock market and bond market to give some examples. For this reason, the rates for home insurance can fluctuate sometimes per day. Furthermore, insurance companies can also manipulate home insurance rates making them more accessible to attract more clients.

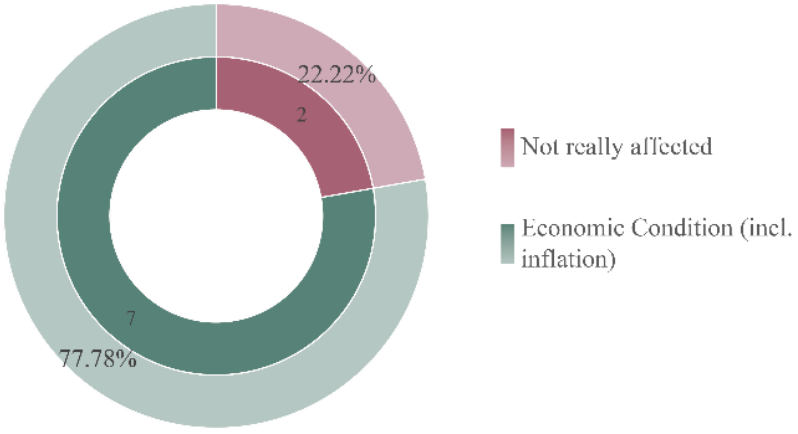
According to (Swiss Re Group n.d.) “Inflation is the economic phenomenon of increasing prices for goods and services. It impacts insurers’ claims and general expenses, the value of liabilities and, less directly, the value of assets. Growth in insurers' claims costs has historically exceeded inflation due to additional factors, referred to as "social cost escalations". These social cost escalations, which are in addition to inflation costs, include the effects of increased litigation, changes in social norms, and rising expenses for medical treatment”. Although inflation does not have a direct impact on insurance premiums, because it’s already integrated into the structure of insurance premiums calculations.

Regarding the sample acknowledging the fluctuation of insurance premiums (77.78%) agrees that economic conditions are mostly responsible for the price of insurance premiums.

According to NASA and National Oceanic and Atmospheric Administration (NOAA), (Stevens and Carlowicz 2016), 2015 was officially the hottest year on Earth since records began. Thou some events as cyclones are decreasing in frequency but increasing in intensity.

This amplified intensity of natural phenomena's places floods prone areas at an augmented risk of damage.

Figure 27 Fluctuation of Insurance Premiums



Source: Author compilation

While home insurance in Colombia is increasing, this dynamic is not matched by the level of risk that the country is facing, not only for issues regarding rains and floods but also including drought, windstorms and earthquakes, according to the insurance carrier and industry.

In areas with high frequency of natural disasters home insurances rates can be influenced by the number and damages reported on the claims. If the claims are large and sizable enough, future premiums will reflect this. Although usually, the first element of a home insurance that can be affected by an event are the deductibles.

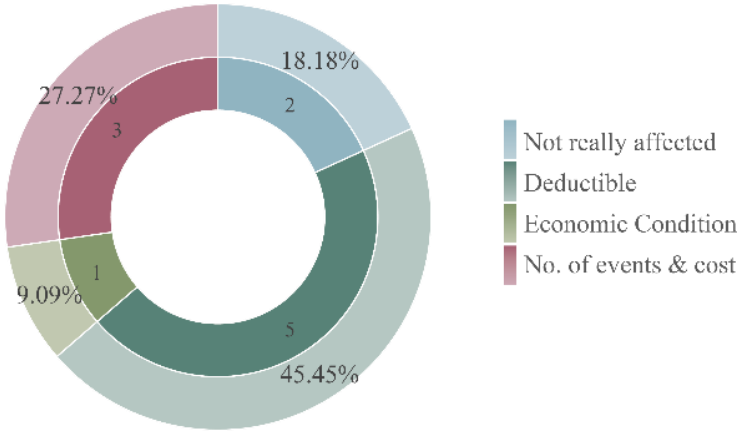
Basically, the deductible is the part that is "subtracted", the payment made by the insurer for the loss suffered by the insured.

Traditionally, the contract of insurance, deductibles have the function to spread the risk among the insured (customer) and insurers. Thus, when a loss occurs, the insured pays a portion of this out of their pocket, being that portion the one that is known as a deductible.

The deductible may be a specific amount, i.e., a dollar figure, or may be a percentage of the total amount of insurance contracted in the policy. Generally, the higher the premium, the lower the deductible will be.

Deductibles expressed in percentages are calculated based on the total amount insured.

Figure 28 Premiums Affected after a Flood Event



Source: Author compilation

The deductible on a property insurance policy works differently than other insurance deductibles: it applies to each claim filed.

The results of the sampling among insurance companies concur that the deductible (45.45%) are mostly affected by a flooding event and could also have a representative impact on premiums depending on the number and cost of the damages of the event (27.27%) and the economic conditions in the time of the event.

Chapter 5: Conclusions and recommendations

With the world reaching a new dawn where more than half of the population now lives in cities and is estimated that by 2050 7 billion peoples will be urban dwellers and where most of the area needed for this growth has not been built, enormous pressures on the environment has already and will continue altering almost all ecosystems.

The transformation human interaction has enforced on this natural processes are primarily for the growth and development of cities with production and consumption activities that consume 75 percent of the world's energy and produce 80 percent of its greenhouse gasses.

Therefore, it is in cities that the responsibility and the key for changing the current trajectory lies, with economic development that is less resource intensive. Cities can be very rich in biological diversity that provide ecosystem services and cities need to learn how to cope, maintain and enhance the rich biodiversity in and around them.

Ecosystem services are a key component to building urban resilience and reduced vulnerability through mitigation and adaptation measurement.

“Ecosystem Services places human well-being as the central focus for assessment while recognizing that biodiversity and ecosystems also have intrinsic value and that people take decisions concerning ecosystems based on considerations of both well-being and intrinsic value” (Millennium Ecosystem, 2005).

Valuation of ecosystem services serves different purposes including raising awareness, determine the consequences of alternative courses of action, assessing the impacts that they have on human well-being, to understand and help decision making regarding the management of ecosystems and overall to establish a value to nature's capital that has been taken for granted. And even though there is considerable skepticism in ecosystem and biodiversity frameworks new frames of governance and innovative practices throughout cities are closing the breach to implement this practices proving that the supply of a healthy biodiversity in the urban areas can generate economic benefits and reduce city expenditures.

This study contributes to the increasing empirical literature regarding valuation of urban ecosystem services and brings an understanding of UES approaches to the decision-making process.

This paper examined the value of urban ecosystem services provided by a green infrastructure project “Corredor Ambiental Urbano Río Cañaveralejo” in Santiago de Cali, by means of a contingent valuation method (CVM) utilizing a survey/questioner and damage cost avoided method (DCA) were qualitative and quantitative information was ascertained, which can offer insight into future implementation in urban policy and planning.

Santiago de Cali is the third largest city in Colombia, located in the Cauca River valley and after a fast track development through 1970 to 2000 were drastic changes to the natural system altered and damaged the rivers dynamics which led to major environmental, economic conflicts and exposed the community to risk. However, in present years local government recognizes the missteps in the past and the potential of this areas, the city is aiming towards increasing its resilience and aims to tackle climate change impacts through various strategies and disciplines in order to deepen the study regarding the relationship of society with nature and the impact of deterioration of urban and peri-urban green space.

One of the main strategies to enhance urban climate resilience is using Green Infrastructure (GI), promoting Urban Ecosystem Services (UES), improving biodiversity, economic growth

of the city and at the same time deliver additional environmental benefits and fomenting green economy to ensure a healthy environment.

Green infrastructure planning can create frameworks for future development while ensuring the preservation of natural resources for future generations.

The study emphasizes the need for context-specific classification of ecosystem services for the project "Corredor Ambiental Urbano Río Cañaveralejo". The categorization of UES shows significant differences in literature but the most commonly use are the Millennium Ecosystem Assessment and The Economics of Ecosystems and Biodiversity TEEB which this study relied on with and adaptation from ecosystem services for urban planning by Gómez-Baggethun and Barton

After analysing the spatial characteristic of the green infrastructure project "Corredor Ambiental Urbano Río Cañaveralejo", it can be concluded that the project will provide the city among other benefits with **regulating services** and **cultural services** that include **253,615M^2** of upgraded and accessible green area, **4 Km** of new bike paths, **5,475 M^2** of new pedestrian paths, **207** of newly planted trees and **14** new parks and plazas.

The study's findings can be summarized as follows. First, overall citizens in the surrounding areas are familiar and inform about the Cañaveralejo River and the upcoming improvements with the green infrastructure project "Corredor Ambiental Urbano Río Cañaveralejo".

Second, although individual home insurance is becoming more popular in Santiago de Cali the percentage of the population with home insurance is between 7 to 15 percent. However, 29 percent of households without insurance reported availability to acquire insurance.

The household with all-inclusive insurance premiums pays an average of **$8.50** more per year for the extra coverage including damages from flood events.

The overall acceptance of the green infrastructure project "Corredor ambiental urbano del río Cañaveralejo" including ecosystem services and further benefit is highly positive obtaining a 100 percent of approval and more than four-fifths of the sample complete agrees with the project (89.4%). Expectedly this also is represented in citizen's disposition to contribute for the project to be implemented. Within the sample 73 (59.35%) are fully prepared to contribute and 33 (26.83%) are prepared to contribute something, totalizing in an overall compliance to contribute of 106 (86.18 %). The high acceptance of the project as relayed by the citizens include improved quality of life, city development and betterment of nature and the environment within the city which reflects on how the green infrastructure project "Corredor ambiental urbano del río Cañaveralejo" and the benefits provided are expected and needed for the city and its citizen's well-being.

In accordance with previous CVM literature, this study reveals a positive attitude towards nature and the environment in general, the importance for the local population and its inclusiveness in the city's development. The data also demonstrates a pronounced degree of willingness to pay indicating that 90 percent of the respondents are willing to pay. The WTP levels ranges from $25.00 to $44.00 and with a mean of **$35.00** per year. In general, the preferences and distribution of economic support per ecosystem services are equitable in both analysis. The willingness to pay (WTP) for the particular services provided by the GI relays as follows:

For *recreation services,* which included 253,615 M2 of upgraded and accessible green area (parks and plazas) an allocation of **$9.87**.

For mobility services comprise by 4 Km of additional bike lanes and 5,475 M of additional pedestrian paths and areas an allocation of **$8.99**.

For *sense of place,* which includes 14 new parks and plazas in a 253,615 M2 upgraded and accessible green area an amount of **$8.41**.

For *aesthetics* with the planting of 207 additional trees an allocation of **$7.77**

The study has shown that with suitable economic methods and tools, monetary values can be attributed to non-market services. There is also a need to engage with urban planner and policy makers and urban residents with regards green infrastructure and its implementation to benefit themselves, as well as ecosystem functions.

Colombia has a land taxation system that recognizes different modalities to tax land and city's development, the most suitable for the green infrastructure project "Corredor ambiental urbano río Cañaveralejo" is Betterment levy and more than half of the respondents seem to concur.

Citizens conveyed an understanding of the importance of green infrastructure projects and its positive attitudes towards the environment vs. projects without environmental inclusion. The perception included ideas as "does not contribute to nature and the environment", "Defeat the purpose" with regards towards the nature of the project and the needs of the city, which correlates with the next concept "It's not city development" and also "does not improve quality of life".

The main findings obtained using multilinear regression and covariance structure analysis within this framework are summarized as follows. After an econometric analysis of stated and accurate willingness to pay, from the survey data, the stated value of willingness to pay was positively affected by the respondents Level of education, Salary range and Preferences on GI. Amounting to 32 percent of the correlation of the dependent variable is explained by the independent variables.

Colombian's market on individual household insurance is growing promoted by insurance companies trying to manage an output product that covers all types of houses , although it depends on the condition of the fiscal structure of the house, furthermore almost all insurance companies try to accommodate all types of social stratum, according to 75 percent of the sample.

The study reflects that all insurance companies included in the sample cover against flooding and in almost all cases flooding is included in the standard plan (88%), although there could be various difference in a standard home insurance and an all-inclusive premium within the internal and external aspects covered.

All-inclusive premiums paying an overall average of **$29.75** per year more for extreme events coverage. Although this all-inclusive coverage includes a wide range of items and advantages, not only flood coverage.

Past events analysis applying damages cost avoided exposed that an average of **$92,220.37** dollars (insurance value) per year could be utilized for alternative flood prevention methods. This amount is limited by the information gathered in surveys and secondary data where only 47 percent of the events reported had economic figures.

Fluctuation of insurance premiums are mostly affected by economic conditions and are often manipulated by insurance companies to attack more clients and while home insurance in Colombia is increasing, this dynamic is not matched by the level of risk that the country is facing.

In areas with high frequency of natural phenomena's home insurances rates can be influenced by the number and damages reported on the claims. If the claims are large and sizable enough, future premiums will reflect this. Although usually, the first component of a home insurance that is affected by an event are the deductibles.

As the climate change issues are becoming more and more evident, policy makers and urban planners can turn to alternative methods of financing green infrastructure which include social perception and participation and overall are more socioecological oriented. This study can also prove to be valuable to inform urban planners to plan and implement tangible measures that enhance the provision of particular urban ecosystem services.

The study also highlights the importance of inclusion of green spaces within the city as well as peri-urban to maintain healthy ecosystems and ensure and abundant supply of ecosystem services. As well as contributing to overcome the division between urban and natural. Underlining the multifunctionality and multi-beneficial connection to nature within and urban environment, underpinning humans as an integral component of ecosystems.

5.1 Recommendations

Although these findings provide valuable insights for the policy makers and urban planner in Santiago de Cali, this study had some limitations. The sample covers 123 of the plots around the delimited area along the canal or river basins. Therefore, similar studies can be performed in other rivers that are part of the same overall project "CORREDOR VERDE Pograma Transformacional: Visión Cero Emisiones" to provide more robust knowledge so that the results can be more generalize in the context of Santiago de Cali, so that the concept can be more useful for urban planning and competitive in the emerging economies

To encourage a broader discussion on the sustainability of urban ecosystem services and alternative means of implementation including social participation. Green space management or environmental governance are of extreme importance to generate stewardship of green areas and natural networks provided by green infrastructure that at the same time deliver urban ecosystem services.

Further research should stress both the importance of the potential of urban ecosystem services as a multifunctional concept acquiring relevance's in different fields and levels in urban governance and although specific context is important it should aim to research the field of ES as a whole, covering all phases of production and interactions within the city, its soundings, all stakeholders involved and pthe values to the human condition.

Retrofit of existing frameworks regarding the city's policies and urban infrastructure planning and implementation specifically aim to reduce environmental impacts.

Bibliography

Adekunle, M. F. (2012). Public willingness to pay for ecosystem service functions of a peri-urban forest near Abeokuta, Ogun State, Nigeria. *Journal of Development and Agricultural Economics*, 4(2), pp.45–50. [online]. Available from: http://www.academicjournals.org/jdae/abstracts/abstracts/abstracts2012/Jan/26 Jan/Adekunle and Agbaje.htm.

Alcaldia de Santiago de Cali. (2014). Plan de ordenamiento territorial de Santiago de Cali. Documento técnico de soporte. , p.1170.

Andersson, E. et al. (2014). Reconnecting cities to the biosphere: Stewardship of green infrastructure and urban ecosystem services. *Ambio*, 43(4), pp.445–453.

Anon. Sample Size Calculator. [online]. Available from: https://www.surveymonkey.com/mp/sample-size-calculator/.

Autónoma, C. et al. (2015). VOLUMEN V.

Baldwin, A. (2010). Submerged Resources in the Face of a Changing Climate: Living Shorelines as an Adaptation Strategy. [online]. Available from: http://www.dep.state.fl.us/northwest/Ecosys/section/greenshores.htm [Accessed November 17, 2016].

Basnou, C., Pino, J. and Terradas, J. (2015). Ecosystem services provided by green infrastructure in the urban environment. *CAB Reviews*, 10(4), pp.1–11.

Baxter, P. and Jack, S. (2008). Baxter, P., & Jack, S. (2008). Qualitative case study methodology. Study design and implementation for novice researchers. The qualitative report, 13(4), 544-559. , 13(2), pp.12–1. [online]. Available from: http://nsuworks.nova.edu/tqr [Accessed May 20, 2016].

Benedict, M.A. and McMahon, E.T. (2000). Green Infrastructure. *Recreation*, May(37), pp.4–7. [online]. Available from: http://ec.europa.eu/environment/nature/info/pubs/docs/greeninfrastructure.pdf [Accessed November 1, 2016].

Benedict, M.A. and McMahon, E.T. (2006). Green Infrastructure: Linking Landscapes and Communities. *Urban Land*, June, p.299. [online]. Available from: http://www.conservationfund.org/.

Boyd, J. and Banzhaf, S. (2007). What are ecosystem services? The need for standardized environmental accounting units. *Ecological Economics*, 63(2–3), pp.616–626.

Burkhard, B. et al. (2012). Solutions for sustaining natural capital and ecosystem services. *Ecological Indicators*, 21, pp.1–6.

By, E. et al. (2013). Natural infrastructure. *World Resources Institute*, 56(4), p.18.

CALI, C.D.S. DE. (2014). *POR MEDIO DEL CUAL SE ADOPTA PLAN DE ORDENAMIENTO*.

City of Chicago. (2010). The Chicago Green Alley Handbook. , pp.1–35. [online]. Available from: http://www.cityofchicago.org/city/en/depts/cdot/provdrs/alley/svcs/green_alleys.htm [Accessed November 17, 2016].

Colombia, C.O.-. (2014). DesInventar Online Edition 2013. [online]. Available from: https://online.desinventar.org/.

Commission, E. (2012). The Multifunctionality of Green Infrastructure. *Science for Environment Policy*, (March), pp.1–36.

Costanza, R. et al. (1997). The value of the world ' s ecosystem services and natural capital. *Nature*, 387(May), pp.253–260.

Crossman, N.D. et al. (2013). A blueprint for mapping and modelling ecosystem services. *Ecosystem Services*, 4, pp.4–14.

D'Acci, L. (2014). Monetary, subjective and quantitative approaches to assess urban quality of life and pleasantness in cities (Hedonic Price, Willingness-to-pay, Positional Value, life satisfaction, Isobenefit lines). *Social Indicators Research*, 115(2), pp.531–559. [online]. Available from: http://link.springer.com [Accessed April 17, 2016].

Dobbs, C., Escobedo, F.J. and Zipperer, W.C. (2010). A framework for developing urban forest ecosystem services and goods indicators. *Landscape and Urban Planning*, 99(3–4), pp.196–206. [online]. Available from: http://dx.doi.org/10.1016/j.landurbplan.2010.11.004 [Accessed April 15, 2016].

Doherty, E. et al. (2014). Valuing ecosystem services across water bodies: Results from a discrete choice experiment. *Ecosystem Services*, 7, pp.89–97.

Fallis, A.. (2013). A Short History of the Term Green Infrastructure and Selected Literature. *Journal of Chemical Information and Modeling*, 53(9), pp.1689–1699.

Fisher, B., Turner, R.K. and Morling, P. (2009). Defining and classifying ecosystem services for decision making. *Ecological Economics*, 68(3), pp.643–653. [online]. Available from: http://dx.doi.org/10.1016/j.ecolecon.2008.09.014.

Foster, J., Lowe, A. and Winkelman, S. (2011). The Center for Clean Air Policy. The Value of Green Infrastructure for Urban Adaptation. , (February), p.February 2011.

Gaglias, A. et al. (2016). Implementing the Contingent Valuation Method for supporting decision making in the waste management sector. *Waste Management*. [online]. Available from: http://linkinghub.elsevier.com/retrieve/pii/S0956053X16301751 [Accessed May 10, 2016].

Gómez-Baggethun, E. et al. (2009). The history of ecosystem services in economic theory and practice: From early notions to markets and payment schemes.

Gómez-Baggethun, E. et al. (2010). The history of ecosystem services in economic theory and practice: From early notions to markets and payment schemes. *Ecological Economics*, 69(6), pp.1209–1218. [online]. Available from: http://dx.doi.org/10.1016/j.ecolecon.2009.11.007.

Gómez-Baggethun, E. and Barton, D.N. (2013). Classifying and valuing ecosystem services for urban planning. *Ecological Economics*, 86, pp.235–245.

Green, T.L. et al. (2016). Insurance Value of Green Infrastructure in and Around Cities. *Ecosystems*, accepted. [online]. Available from: http://link.springer.com/10.1007/s10021-016-9986-x [Accessed May 24, 2016].

de Groot, R.S. (1987). Environmental functions as a unifying concept for ecology and

economics. *Environmentalist*, 7(2), pp.105–109. [online]. Available from: http://link.springer.com/10.1007/BF02240292 [Accessed November 8, 2016].

De Groot, R.S., Wilson, M.A. and Boumans, R.M.J. (2002). A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics*, 41(3), pp.393–408.

Gutiérrez, Julián; Alarcón, M.T. (2015). DISEÑO ARQUITECTÓNICO, PAISAJÍSTICO Y DE CONECTIVIDAD ECOLÓGICA DE CORREDORES AMBIENTALES URBANOS PARA LOS RÍOS MELÉNDEZ Y CAÑAVERALEJO EN SANTIAGO DE CALI. , pp.1–544.

Haase, D., Frantzeskaki, N. and Elmqvist, T. (2014). Ecosystem services in urban landscapes: practical applications and governance implications. *Ambio*, 43(4), pp.407–12. [online]. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24740613 [Accessed May 5, 2016].

Hanley, N., Wright, R.E. and Alvarez-Farizo, B. (2006). Estimating the economic value of improvements in river ecology using choice experiments: an application to the water framework directive. *Journal of Environmental Management*, 78(2), pp.183–193.

Hanley, N., Wright, R.E. and Alvarez-Farizo, B. (2005). Estimating the economic value of improvements in river ecology using choice experiments: an application to the water framework directive.

International Labor Organization. (2014). Global Wage Report 2014/15.

Karabulut, A. et al. (2016). Mapping water provisioning services to support the ecosystem–water–food–energy nexus in the Danube river basin. *Ecosystem Services*, 17, pp.278–292.

King, D.M. and Mazzotta, M.J. (2000). Ecosystem Valuation. , pp.1–63.

Kopperoinen, L., Itkonen, P. and Niemel??, J. (2014). Using expert knowledge in combining green infrastructure and ecosystem services in land use planning: An insight into a new place-based methodology. *Landscape Ecology*, 29(8), pp.1361–1375.

Kroll, F., Nedkov, S. and Müller, F. (2012). Mapping ecosystem service supply, demand and budgets. *Ecological Indicators*, 21, pp.17–29.

Latinopoulos, D., Mallios, Z. and Latinopoulos, P. (2016). Valuing the benefits of an urban park project: A contingent valuation study in Thessaloniki, Greece. *Land Use Policy*, 55, pp.130–141. [online]. Available from: http://www.sciencedirect.com/science/article/pii/S0264837715300107.

Loomis, J. et al. (2000). Measuring the total economic value of restoring ecosystem services in an impaired river basin: results from a contingent valuation survey. *Ecological Economics*, 33(1), pp.103–117.

Loomis, J.B. (2000). Measuring the Total Economic Value of Restoring Ecosystem Services in an Impaired River Basin: Results from a Contingent Valuation Survey. *Ecological Economics*, 33(1), pp.103–117. [online]. Available from: http://catalog2.nmsu.edu:2048/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=ecn&AN=0528147&site=ehost-live&scope=site.

Luederitz, C. et al. (2015). A review of urban ecosystem services: Six key challenges for future research. *Ecosystem Services*, 14, pp.98–112. [online]. Available from: http://www.scopus.com/inward/record.url?eid=2-s2.0-

84937913591&partnerID=40&md5=7999a9b7b505aac915f49f87a49bf595\nhttp://ac.els-cdn.com/S2212041615300024/1-s2.0-S2212041615300024-main.pdf?_tid=85a0f600-56fa-11e5-b09d-00000aab0f6c&acdnat=1441807148_8fa3750 [Accessed April 6, 2016].

Lundy, L. and Wade, R. (2011). Integrating sciences to sustain urban ecosystem services. *Progress in Physical Geography*, 35(5), pp.653–669. [online]. Available from: http://ppg.sagepub.com/cgi/doi/10.1177/0309133311422464 [Accessed November 10, 2016].

MacDonald, D., Murdoch, J. and White, H. (1987). Uncertain hazards, insurance, and consumer choice: Evidence from housing markets. *Land Economics*, 63(4), pp.361–371. [online]. Available from: http://www.jstor.org/stable/3146293.

MacDonald, D.N. et al. (2016). Flood Hazard Pricing and Insurance Premium Differentials : Evidence from the Housing Market. , 57(4), pp.654–663.

Maes, Joachim; Teller, Anne; Erhard, M. (2013). Mapping and Assessment of Ecosystems and their Services. *European Commission*.

Matazu, M.B. and Chioma, M. (2014). The Application of Geospatial Techniques in Flood Risk and Vulnerability Mapping for Disaster Management at Lokoja , Kogi State , Nigeria. , 4(5), pp.54–61.

McPhearson, T. et al. (2014). Resilience of and through urban ecosystem services. *Ecosystem Services*, 12, pp.152–156.

Mcphearson, T., Auch, R. and Alberti, M. (2013). *Urbanization , Biodiversity and Ecosystem Services : Challenges and Opportunities*. [online]. Available from: http://link.springer.com/10.1007/978-94-007-7088-1.

Millennium Ecosystem Assessment. (2003). Ecosystems and human well-being: A framework for assessment. , pp.1–25.

Millennium Ecosystem Assessment. (2004). Living Beyond Our Means: Natural Assets and Human Well-being. *Annual Report*, p.24. [online]. Available from: http://ideas.repec.org/a/fip/fedbar/y2004p6-25.html.

Mitchell, R.C. and Carson, R.T. (1989). USING SURVEYS TO VALUE PUBLIC GOODS : THE CONTINGENT VALUATION METHOD. , 54(2), pp.0–2.

Morimoto, Y. et al. (2015). Heat treatment inhibits skeletal muscle atrophy of glucocorticoid-induced myopathy in rats. *Physiological Research*, 64(6), pp.897–905.

Morren, G. et al. (1984). The Ecology of a City and its People: The Case of Hong Kong. [online]. Available from: http://www.jstor.org/stable/41463583 [Accessed November 9, 2016].

Muhumuza, M., Sanders, M. and Balkwill, K. (2013). A theoretical framework for investigating ecological problems associated with biodiversity conservation in national parks: A case of the Rwenzori Mountains National Park, Uganda. *Open Journal of Ecology*, 3(2), pp.196–204. [online]. Available from: http://www.scirp.org/journal/PaperDownload.aspx?DOI=10.4236/oje.2013.32023.

Mulatu, D.W., van der Veen, A. and van Oel, P.R. (2014). Farm households' preferences for collective and individual actions to improve water-related ecosystem services: The Lake Naivasha basin, Kenya. *Ecosystem Services*, 7, pp.22–33.

Neuman, W.L. (2011). *Social research methods : qualitative and quantitative approaches*. Allyn & Bacon.

Olmsted, John; Olmsted, F. (1903). REPORT OF THE PARK BOARD.

Opdam, P., Steingröver, E. and Van Rooij, S. (2006). Ecological networks: A spatial concept for multi-actor planning of sustainable landscapes. *Landscape and Urban Planning*, 75, pp.322–332.

Organization, I.L. (2014). Global Wage Report 2014/15.

Pascual, U. et al. (2010). Chapter 5 The economics of valuing ecosystem services and biodiversity. *The Economics of Ecosystems and Biodiversity. Ecological and economic foundations*, (March), pp.183–255.

Perrings, C. (1995). Biodiversity conservation as insurance. *The economics and ecology of biodiversity decline:* [online]. Available from: https://books.google.nl/books?hl=en&lr=&id=8zSavItcId8C&oi=fnd&pg=PA69&dq=%22The+link+between+biodiversity,+ecosystem+resilience+and+insurance+should+now+be+transparent%22&ots=QrfLyLfDaC&sig=WUc-h6QyJBnvD2n0pl3hyR299Nk [Accessed November 16, 2016].

Polizzi, C. et al. (2015). Is ecosystem restoration worth the effort? The rehabilitation of a Finnish river affects recreational ecosystem services. *Ecosystem Services*, 14, pp.158–169.

Pulighe, G., Fava, F. and Lupia, F. (2016). Insights and opportunities from mapping ecosystem services of urban green spaces and potentials in planning. *Ecosystem Services*, 22, pp.1–10.

Restrepo, P.A. (2010). Instrumentos de financiación deldesarrollo urbano en colombia: la contribución por valorización y la participación en plusvalías. Lecciones y reflexiones. *Desafíos*, 22(1), pp.13–54.

Reynaud, A. et al. (2016). Going Green? Economic Valuation of a Multipurpose Water Infrastructure in Northern Italy *. , (308428), pp.1–24.

Rover, T. De and Persson, T. (2014). *The Concept of Ecosystem Services: Integrating the concept of ecosystem services on the environmental impact assessment of the Bunge Quarry*. [online]. Available from: http://www.diva-portal.org/smash/record.jsf?pid=diva2:751735 [Accessed November 9, 2016].

Satterthwaite, D. (2008). Cities' contribution to global warming: notes on the allocation of greenhouse gas emissions. *Environment and Urbanization*, 20(2), pp.539–549. [online]. Available from: www.sagepublications.com [Accessed May 5, 2016].

Secretariat of the Convention on Biological Diversity. (2012). Cities and Biodiversity Outlook. *Executive Summary*, p.16. [online]. Available from: http://www.cbd.int/authorities/doc/cbo-1/cbd-cbo1-summary-en-f-web.pdf.

Shang, Z. et al. (2012). Assessing local communities' willingness to pay for river network protection: A contingent valuation study of Shanghai, China. *International Journal of Environmental Research and Public Health*, 9(11), pp.3866–3882.

Stevens, J. and Carlowicz, M. (2016). 2015 Was the Hottest Record: Image of the Day. *NASA Earth Observatory*. [online]. Available from: http://earthobservatory.nasa.gov/IOTD/view.php?id=87359 [Accessed September 5, 2016].

Stithou, M. et al. (2012). Estimating the value of achieving 'Good Ecological Status' in the Boyne river catchment in Ireland using Choice Experiments. *Economic and Social Review*, 43(3).

Super Servicios-SSPD. (2012). *CARTILLA DE SERVICIOS PÚBLICOS PARA ENTIDADES TERRITORIALES*.

Swiss Re Group. New Swiss Re sigma study examines how inflation impacts insurers | Swiss Re - Leading Global Reinsurer. [online]. Available from: http://www.swissre.com/media/news_releases/New_Swiss_Re_sigma_study_examines_how_inflation_impacts_insurers.html.

TEEB. (2010). Teeb - The Economics of Ecosystem and Biodiversity for local and regional policy makers. *Report*, p.207. [online]. Available from: http://www.teebweb.org/wp-content/uploads/Study and Reports/Reports/Local and Regional Policy Makers/D2 Report/TEEB_Local_Policy-Makers_Report.pdf [Accessed April 21, 2016].

The World Bank. (2013). Disaster Risk Management in Armenia. , (June 2013), pp.1–13.

Tzoulas, K. et al. (2007). Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review. *Landscape and Urban Planning*, 81(3), pp.167–178.

UN Convention, on B.D. (2012). Biodiversity Conservation can Improve Human Health in World's Growing Cities.

Unwin, A. (2013). *Discovering Statistics Using R by Andy Field, Jeremy Miles, Zoë Field*. [online]. Available from: http://sro.sussex.ac.uk/38823/\nhttp://doi.wiley.com/10.1111/insr.12011_21.

Valle, U. del. (2016). ENCUESTA SOBRE VULNERABILIDAD SOCIAL DEL RIESGO LILP. RÍO CAÑAVERALEJO, CALI, 2016.

Venkatachalam, L. The contingent valuation method: a review.

Walker, B. et al. (2010). Incorporating Resilience in the Assessment of Inclusive Wealth: An Example from South East Australia. *Environ Resource Econ*, 45, pp.183–202.

Wallace, K.J. (2007). Classification of ecosystem services: Problems and solutions.

Wedgwood, A. and Sansom, K. (2003). Willingness-to-pay surveys - a streamlined approach: Guidance notes for small town water services. [online]. Available from: http://www.wsp.org/Hygiene-Sanitation-Water-Toolkit/Resources/Readings/Willingness to Pay.pdf.

Weiskel, P. (2007). The Charles River, Eastern Massachusetts: Scientific Information in Support of Environmental Restoration. [online]. Available from: http://doczine.com/bigdata/2/1367071809_356a96aefb/gip-47.pdf.

Westman, W.E. (1977). How Much Are Nature's Services Worth? *Science*, 197(4307), pp.960–964. [online]. Available from: http://www.sciencemag.org/cgi/doi/10.1126/science.197.4307.960 [Accessed November 8, 2016].

Wilker, J. and Rusche, K. (2014). Economic valuation as a tool to support decision-making in strategic green infrastructure planning. *Local Environment*, 19(6), pp.702–713. [online]. Available from: http://www.tandfonline.com/doi/abs/10.1080/13549839.2013.855181.

Yin, R.K. (2009). *CASE STUDY RESEARCH : DESIGN AND METHODS*.

Zhai, G. et al. (2006). Willingness To Pay for Flood Risk Reduction and Its Determinants in Japan1. *Journal of the American Water Resources Association*, 42(4), pp.927-936-940. [online]. Available from: http://search.proquest.com/docview/201308976?accountid=25704.

Annex 1:

Institute for Housing and Urban Development Studies
Erasmus University Rotterdam, The Netherlands

Universidad del Valle
Cali Colombia

Encuesta

SERVICIOS ECO-SISTÉMICOS; CORREDOR AMBIENTAL URBANO RÍO CAÑAVERALEJO, CALI 2016

Survey

ECOSYSTEM SERVICES; CORREDOR AMBIENTAL URBANO RÍO CAÑAVERALEJO, CALI 2016

Este cuestionario es parte de un estudio de tesis para un programa de maestría que busca la valuación de los servicios eco sistémicos del proyecto de infraestructura verde "Corredor ambiental urbano río Cañaveralejo". La información recaudada tiene fines estrictamente académicos y las respuestas son voluntarias y **confidenciales**. Se solicita de manera más respetuosa su participación.

El proyecto "Corredor ambiental urbano río Cañaveralejo" ofrece una recuperación de la cuenca del rio Cañaveralejo, generando y fortaleciendo la red natural y de biodiversidad creando una articulación con el sistema urbano, al mismo tiempo genera nuevos espacios de apropiación para los ciudadanos, como plazas, equipamientos de uso recreativo y educativo con énfasis ambiental, además de sistemas de movilidad de bajo impacto como las ciclorutas y senderos peatonales.

Este proyecto ambiental tiene un propósito multifuncional generando ecosistemas y paisajes naturales que brindan servicios ecológicos, calidad de vida, bienestar y desarrollo socioeconómico además que crean amortiguadores contra los desastres naturales.

https://docs.google.com/forms/d/1dJnR4A4vRAbJXwLIJXuvr6dqpvPx7aCkusRkUu0oXPk/viewform

This questionnaire is part of a thesis study for a master's program that seeks the valuation of ecosystem services of a green infrastructure project "Corredor ambiental urbano río Cañaveralejo". The information collected is strictly for academic purposes and the responses are voluntary and **confidential**. We respectfully requested your participation.

The project "Corredor ambiental urbano río Cañaveralejo" offers a recovery of Cañaveralejo river basin, creating and strengthening the natural and biodiversity network by making a link with the urban system, while generating stewardship of public spaces like parks, facilities with recreational and educational use with an emphasis the environment, in addition to mobility systems with low impact as bike paths and walking trails.

This environmental project has a multifunctional purpose generating ecosystems and natural landscapes that provide ecological services, quality of life, well-being and economic development also creating buffers against natural disasters.

https://docs.google.com/forms/d/1kCLzuLj4PZLGqza7x1LSobqVYWMtDdRZeFQ8Sai8VLE/viewform

INFORMACIÓN PERSONAL Y ORIGEN SOCIOECONÓMICO

1. Genero

Femenino
Masculino

2. ¿Rango de edad?

25 – 35
36 – 50
Más de 50 años

3. El estrato de la vivienda que usted habita según el recibo de servicios públicos, es:

1
2
3
4
5
6
No sabe

4. ¿Barrio donde reside?

Departamental
Brisas de Mayo
Cementerio - Carabineros
El Cortijo
Pueblo Joven
Nueva Tequendama
Panamericano
Belisario Caicedo
Urb. Militar
Unid. Residencial El Coliseo
Venezuela - Urb. Cañaveralejo
U. D. A. Galindo Pl. Toros
Santo Domingo
La Selva
Sect. Cañaveralejo Guadalupe Antigua
Jorge Zawadsky
Las Granjas
San Judas Tadeo I
Camino Real - Joaquin Borrero Sinisterra
Cuarto de Legua - Guadalupe
Cañaveral
Camino Real - Los Fundadores
Santa Anita - La selva
Primero de Mayo
El Limonar
Cañaverales - Los Samanes

5. ¿Nivel de Educación?

Primaria
Secundaria
Técnico
Profesional

PERSONAL INFORMATION AND SOCIOECONOMIC BACKGROUND

1. Gender

Female
Male

2. Age range?

25 - 35
36 - 50
More than 50 years

3. According to the receipt of service. What is the stratum of your house?

1
2
3
4
5
6
You don't know

4. In what Neighborhood do you live?

Departamental
Brisas de Mayo
Cementerio - Carabineros
El Cortijo
Pueblo Joven
Nueva Tequendama
Panamericano
Belisario Caicedo
Urb. Militar
Unid. Residencial El Coliseo
Venezuela - Urb. Cañaveralejo
U. D. A. Galindo Pl. Toros
Santo Domingo
La Selva
Sect. Cañaveralejo Guadalupe Antigua
Jorge Zawadsky
Las Granjas
San Judas Tadeo I
Camino Real - Joaquin Borrero Sinisterra
Cuarto de Legua - Guadalupe
Cañaveral
Camino Real - Los Fundadores
Santa Anita - La selva
Primero de Mayo
El Limonar
Cañaverales - Los Samanes

5. Level of Education?

Primary
High school
Technical
Professional

6. ¿Rango salarial?

-1SM
1-2SM
2-3SM
3-4SM
4-5SM
Mas de 5SM
SM = Salario Mínimo = $689,455.00 Pesos (2016)

7. ¿La vivienda donde vive actualmente es?

Propia
Alquilada
Otra

6. Salary range?

-1SM
1-2SM
2-3SM
3-4SM
4-5SM
Over 5SM
SM = Minimum Wage = $ 689,455.00 Pesos (2016)

7. State of property ownership?

Own
Rent
Other

PERCEPCIÓN DEL RIESGO Y COMPORTAMIENTO DE PROTECCIÓN

8. ¿Conoce el recorrido del Río o Canal Cañaveralejo?

Si
No

9. ¿Conoce sobre el proyecto de infraestructura verde "Corredor ambiental urbano del río Cañaveralejo"?

Si
No

10. ¿Estaría dispuesto a contribuir para que este proyecto se ejecute?

0 No estoy dispuesto a contribuir en lo más mínimo
1 No estoy dispuesto
2 Puede ser que esté dispuesto
3 Contribuiría si es posible
4 Preparados para aportar algo
5 Totalmente dispuesto a contribuir

11. ¿Siente que la cercanía al Río o Canal presenta una amenaza?

0 No hay peligro en absoluto
1 Podría presentar una amenaza
2 Poco amenazado
3 Algo amenazado
4 Muy amenazado
5 Extremadamente amenazado

RISK PERCEPTION AND PROTECTIVE BEHAVIOR

8. Do you know the route of the river or canal Cañaveralejo?

Yes
No

9. Do you know about the green infrastructure project "Corredor ambiental urbano del río Cañaveralejo"?

Yes
No

10. Would you be willing to contribute for this project to be implemented?

0 Not willing to contribute in the least
1 Not willing
2 May be willing
3 Contribute if possible
4 Prepared to contribute something
5 Fully prepared to contribute

11. Do you feel that the proximity to the river or canal presents a threat?

0 No threat at all
1 Could present a threat
2 Little threaten
3 Somewhat threaten
4 Very threaten
5 Extremely threaten

12. ¿Ha sufrido una inundación desde el 2005?

Nunca
1 a 2 veces en este periodo
1 vez al año
2 vez al año
Más de 2 veces al año

12.1 ¿Qué tipo de daños ha sufrido?

Pérdida de vida
Salud
Interrupción de las actividades diarias
Pérdidas o daños a la propiedad
Daños a la infraestructura (alrededor de su casa)
Daños a los servicios proporcionados a usted

12.2 ¿Cuánto ha sido el costo de la inundación más dañina que sufrió?

-1SM
1-2SM
2-3SM
3-4SM
4-5SM
Mas de 5SM
No sabe
SM = Salario Mínimo = $689,455.00 Pesos (2016)

13. ¿Cuenta con seguro de hogar?

Si

13.1 ¿Lo cubre contra inundaciones?

Si
No
No sabe

13.2 ¿Cuánto paga anualmente?

101-150 mil
151-200 mil
201-250 mil
251-300 mil
Más de 300 mil
No sabe

No

12. Have you suffered a flood since 2005?

Never
1 or 2 times in this period
1 a year
2 a year
More than 2 times per year

12.1 What kind of damage did you suffered?

Loss of life
Health
Disruption of daily activities
Damage to property
Damage to infrastructure (around your house)
Damages to services provided to you

12.2 How much was the cost of the most harmful flood endured?

-1SM
1-2SM
2-3SM
3-4SM
4-5SM
Over 5SM
Don't know
SM = Minimum Wage = $ 689,455.00 Pesos (2016)

13. Do you have house insurance?

Yes

13.1 Does it cover floods? Yes/No

Yes
No
Don't know

13.2 How much do you paid yearly?

101-150 thousand
151-200 thousand
201-250 thousand
251-300 thousand
Over 300 thousand
You don't know

No

INFRAESTRUCTURA

14. ¿Según usted qué problemas de infraestructura existen alrededor de su propiedad?

Falta de conectividad vial
Falta de aceras
Falta de ciclovias / ciclorutas
Falta de áreas verdes / parques
Mala administración y mantenimiento del rio canal
Las malas condiciones de las calles o puentes
Falta de iluminación
Ninguna

INFRASTRUCTURE

14. According to you what infrastructure problems exist around your property?

Poor connectivity
Lack of Sidewalks
Lack of bicycle paths
Lack of green areas
Poor management and maintenance of river canal
Poor conditions of roads and or bridges
Poor lighting
None

PREFERENCIA DE INFRAESTRUCTURA

En una escala de 0 a 5 seleccionar cualquiera de los extremos si está completamente acuerdo con la infraestructura descrita, o si lo prefiere mezcla intermedia.

15. ¿Qué preferiré?

INFRAESTRUCTURA ACTUAL
INFRAESTRUCTURA CON EL PROYECTO

— MOVILIDAD PEATONAL Y CICLÍSTICA —

4 Km de carriles bici adicionales.
5.475 M adicionales de caminos peatonales y áreas.

¿Por qué prefiere esta infraestructura?

INFRASTRUCTURE PREFERENCES

In a scales from 0 to 5 select either end if you agree completely with the infrastructure describe or if you prefer a mixture in the middle.

15. Which would you prefer?

CURRENT SCENARIO
SCENARIO WITH PROJECT

— PEDESTRIAN AND CYCLING MOBILITY —

4 Km of additional bike lanes.
5,475 M of additional pedestrian paths and areas.

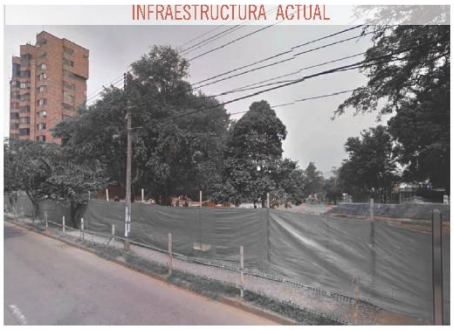
Why do you prefer this type of infrastructure?

16.¿Qué preferiré?

INFRAESTRUCTURA ACTUAL
INFRAESTRUCTURA CON EL PROYECTO

RECREACIÓN, SALUD MENTAL Y FÍSICA

253.615 M2 de área verde mejorada y accesible (parques y plazas).



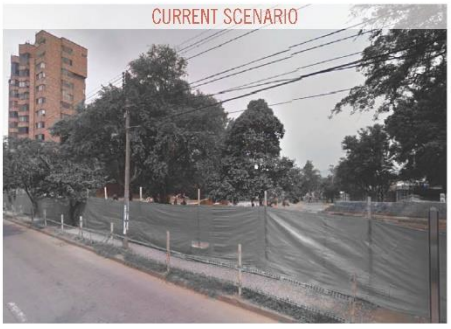
¿Por qué prefiere esta infraestructura?

16.Which would you prefer?

CURRENT SCENARIO
SCENARIO WITH PROJECT

RECREATION, MENTAL AND PHYSICAL HEALTH

253,615 M2 upgraded and accessible green area (parks and plazas).



Why do you prefer this type of infrastructure?

17.¿Qué preferiré?

INFRAESTRUCTURA ACTUAL
INFRAESTRUCTURA CON EL PROYECTO

ESTÉTICA

207 Árboles adicionales.

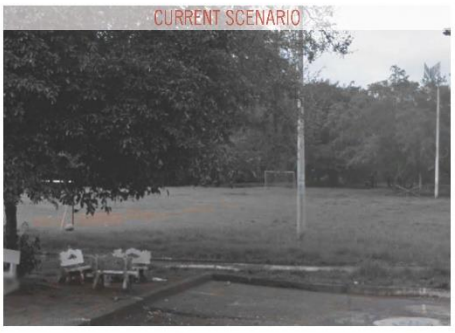
¿Por qué prefiere esta infraestructura?

17.Which would you prefer?

CURRENT SCENARIO
SCENARIO WITH PROJECT

AESTHETIC

207 Additional trees.



Why do you prefer this type of infrastructure?

18.¿Qué preferiré?

INFRAESTRUCTURA ACTUAL
INFRAESTRUCTURA CON EL PROYECTO

SENTIDO DE LUGAR

14 Nuevos parques y plazas en una superficie verde mejorada y accesible de 253.615 M2

¿Por qué prefiere esta infraestructura?

18.Which would you prefer?

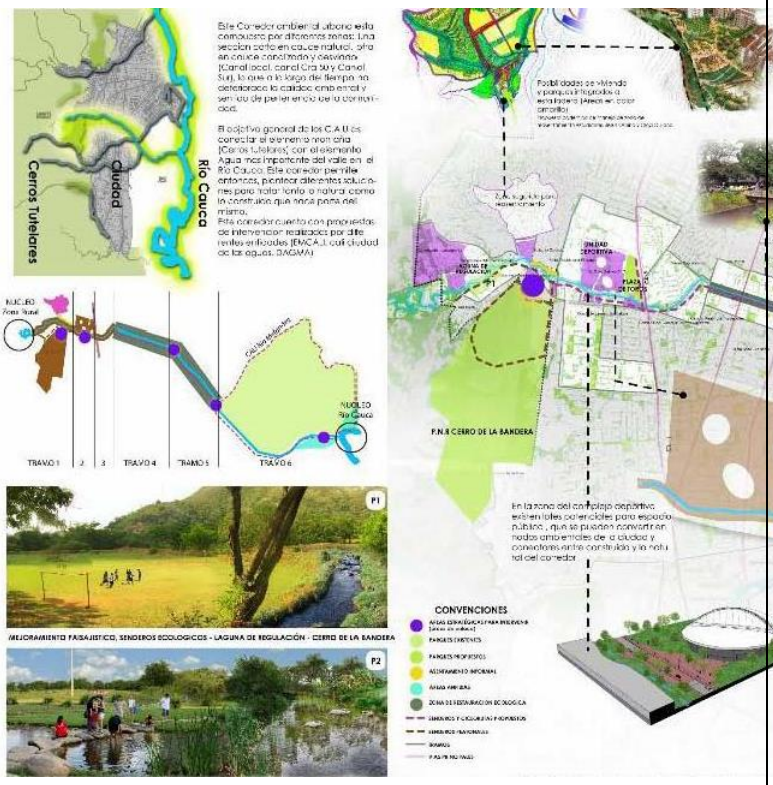
CURRENT SCENARIO
SCENARIO WITH PROJECT

SENSE OF PLACE

14 New parks and plazas in a 253,615 M2 upgraded and accessible green area.

Why do you prefer this type of infrastructure?

PROPUESTA CORREDOR AMBIENTAL URBANO
Rio Cañaveralejo



19. ¿Está de acuerdo con este proyecto de infraestructura verde?

0 Totalmente en desacuerdo
1 En desacuerdo
2 No tiene importancia
3 Está bien
4 De acuerdo
5 Totalmente de acuerdo

19.1 ¿Porque está o no está de acuerdo con este proyecto?

20. ¿Estaría dispuesto a contribuir para que este proyecto de infraestructura verde se ejecute?

0 No estoy dispuesto a contribuir en lo más mínimo
1 No estoy dispuesto
2 Puede ser que esté dispuesto
3 Contribuiría si es posible
4 Preparados para aportar algo
5 Totalmente dispuesto a contribuir

PROPOSAL CORREDOR AMBIENTAL URBANO
Rio Cañaveralejo

19. Do you agree with this green infrastructure project?

0 Completely Disagree
1 Disagree
2 Of no importance
3 It's fine
4 Agree
5 Completely Agree

19.1 Why do you agree or disagree with this Project?

20. Would you be willing to contribute for this green infrastructure project to be implemented?

0 Not willing to contribute in the least
1 Not willing
2 May be willing
3 Contribute if possible
4 Prepared to contribute something
5 Fully prepared to contribute

21. **¿Cuánto estaría dispuesto a pagar?**

10-50 mil
50-100 mil
101-150 mil
151-200 mil
Más de 200 mil
Nada (No es mi responsabilidad)

22. **¿Qué porcentaje le alocaría a cada servicio visto?**

% Movilidad Peatonal y Ciclística
% Movilidad, recreación, Salud Mental y Física
% Estética
% Sentido del Lugar

23. **¿De qué manera estaría dispuesto a pagar esta cantidad?**

Participación en plusvalías
Contribución por valorización
Impuesto predial unificado (tarifa adicional)
Tasas por servicios domiciliarios (tarifa adicional)

24. **¿Pagaría lo mismo si el proyecto NO incluyera la conservación y rehabilitación de los ecosistemas naturales?**

Si
No

23.1 ¿Porque?

21. How much would be you be willing to pay?

10-20 US dollars
20-35 US dollars
35-50 US dollars
50-70 US dollars
More than 100 US dollars
Nothing (not my responsibility)

22. What percentage would you allocate to each service?

% Pedestrian and Cycling Mobility
% Mobility, recreation, Physical and Mental Health
% Aesthetics
% Sense of Place

1. In what manner would you be willing to pay this amount?

Participación en plusvalías
Contribución por valorización
Impuesto predial unificado (additional fee)
Tasas por servicios domiciliarios (additional fee)

2. Would you pay the same if the project DID NOT includes natural ecosystem rehabilitation and conservation?

Yes
No

23.1 Why?

Annex 2:

Institute for Housing and Urban Development Studies
Erasmus University Rotterdam, The Netherlands

Universidad del Valle
Cali Colombia

June 14, 2016

Allianz
Santiago de Cali, Colombia

Dear Allianz

My name is Diego Giron Estrada and I am a student doing a master program in the **Institute for Housing and Urban Development Studies** (IHS), Erasmus University Rotterdam, the Netherlands.
At the moment I am conducting my thesis project which seeks the valuation of ecosystem services of a green infrastructure project "Corredor ambiental urbano río Cañaveralejo", in Santiago de Cali, Colombia. This environmental project has a multifunctional purpose generating ecosystems and natural landscapes that provide ecological services, quality of life, well-being and economic development and also creating buffers against natural disasters. My research is been conducted with the cooperation of **Universidad del Valle**, Cali Colombia.

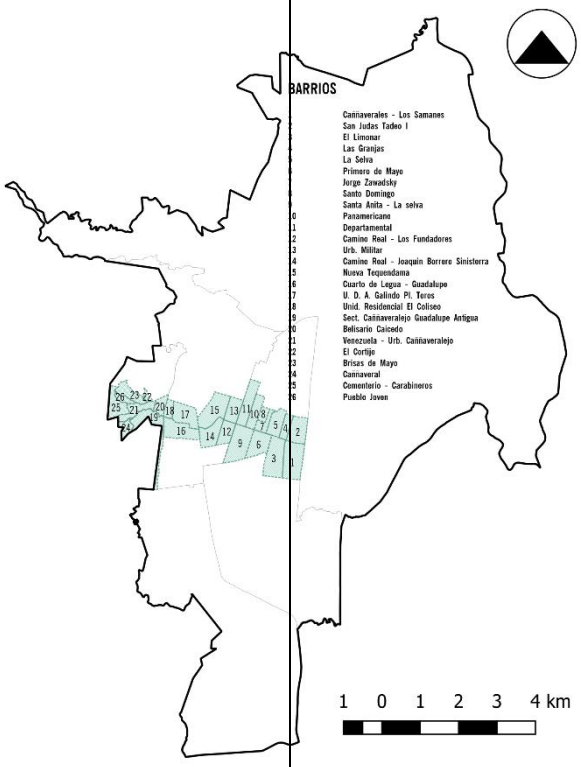
I am contacting your company because part of the study if focused in the impacts that climate change have in the city, specifically focusing in flooding events that may have occurred along Cañaveralejo River, where this project will be implemented.
My interest then lies on your knowledge on insurance premiums, coverage regarding flooding and a history on past event that may have come to pass along the river.

I would appreciate your collaboration with this breaf survey related to the matters mentioned above. The information collected is strictly for academic purposes and the responses **confidential**

I sincerely hope that you will consider participating in this important effort to document the history of project and my thesis process. I will be contacting you via telephone or email in the near future to confirm your interest in participating in this survey. Please feel free to contact me with any questions.

Sincerely,

Aseguradoras



1. ¿Qué porcentaje de la población de Cali cuenta con seguro de hogar?

5 – 10%
10 – 20%
20 – 30%
30 – 40%
40 – 50%
Más del 50%

2. ¿La aseguradora cubre cualquier tipo de vivienda?

Si
No

3. ¿La aseguradora cubre cualquier tipo de estrato?

3.1 ¿Nombre de las aseguradora/s?

4. ¿Las viviendas con hipoteca o préstamo deben de tener seguro?

Si
No

5. ¿Qué factores toma en consideración para el cálculo de las primas de seguro de hogar?

Insurance Companies

1. What percentage of the population of Cali has home insurance?

5 – 10%
10 – 20%
20 – 30%
30 – 40%
40 – 50%
More than 50%

2. Does this insurance company cover any type of households?

Yes
No

1.1 ¿ Name of insurance companies?

3. Insurance company covers any type of stratum?
4. Do households with mortgage need to have insurance?

Yes
No

5. What factor do you take into consideration to calculate the insurance premiums?

6. ¿Cuál ha sido la fluctuación de las primas de seguros en los últimos 5 años?
7. ¿Las primas han sido afectadas después de un evento de inundación?
8. ¿Ofrecen seguro contra inundaciones?

Si
No

COBERTURA

9. ¿La cobertura contra inundaciones está incluida en el plan de hogar estándar?

Si
No

9.1 **¿Nombre de las aseguradora/s?**

10. ¿Cuánto es el costo promedio de un seguro para el hogar que cubra inundación? (costo anual)

101-150 mil
151-200 mil
201-250 mil
251-300 mil
Más de 300 mil

11. ¿Qué porcentaje de la prima esta designada a eventos de inundación?

12. ¿Cuánto es el costo promedio de un seguro para el hogar sin cobertura contra inundación? (costo anual)

101-150 mil
151-200 mil
201-250 mil
251-300 mil
Más de 300 mil

EVENTOS

13. ¿Sabe si han habido eventos de inundación a lo largo del rio Cañaveralejo en los últimos 10 años?

Nunca
1 a 2 veces en este periodo

6. What has been the fluctuation of insurance premiums in the last 5 years?
7. Have premiums been affected after a flood event?
8. Does this insurance company offer flood insurance?

Yes
No

COVERAGE

9. Is it included in the standard plan for homes?

Yes
No

9.1 **¿ Name of insurance companies?**

10. How much is the average cost of a home insurance that cover flood damage (annual cost)?

101-150 thousand
151-200 thousand
201-250 thousand
251-300 thousand
Over 300 thousand

11. What percentage of the premium is allocated to flood events?

12. How much is the average cost of a home insurance that cover does not cover flood damage (annual cost)?

101-150 thousand
151-200 thousand
201-250 thousand
251-300 thousand
Over 300 thousand

EVENTS

13. Do you know if there have been flooding events along the river Cañaveralejo in the last 10 years?

Never
1 or 2 times in this period

1 vez al año 2 vez al año Más de 2 veces al año **14. ¿En qué año sucedió/eron los evento/s?** **15. ¿Cuál ha sido el costo del evento más dañino? (un promedio)** **15.1 ¿Quién lo pago?**	1 a year 2 a year More than 2 times per year **14. What year did the event occurred?** **15. What has been the cost most harmful event? (average)** **15.1 Who payed?**

Table 26 DesInventar: Inventory system statistical database of disasters

Observations about the effects	Affected	Homes de	Homes af	Houses aff	Education	Health cen	Loss value	Loss value US$	Other	Duration	Start date	Type of ev	Place	Geography Name	Victims	[illegible]	Other losses	Transport	Type of cause	Observations about the cause
Se inundó el sector de la avenida Roosevelt y la	0	0	0	0	0	0	0	$0.00	0	0	5/4/2000	Inundación		Urbano/Comuna 19/U. D. A. Galindo Plaza de Toros	0	YES		0	Lluvias	
Inundados 30 barrios del sur y oriente de la ciud	YES	0	YES	0	0	0	0	$9,118,717.50	0	0	5/4/2000	Inundación		Urbano/Comuna 20/Belisario Caicedo	0	3		0	Desbordamiento	Río Cañaveralejo
Inundados 30 barrios del sur y oriente de la ciud	47	0	YES	0	0	0	0	$63,312,800.00	0	0	5/4/2000	Inundación		Urbano/Comuna 20/Venezuela - Urbanización Cañaveralejo	0	47		0	Desbordamiento	Río Cañaveralejo
20 viviendas inundadas dejaron las fuertes lluv.	74	0	20	0	0	0	0	$0.00	0	0	5/24/2006	Inundación		Urbano/Comuna 20/Venezuela - Urbanización Cañaveralejo	0	0		0	Desbordamiento	Se rebosó el canal de aguas lluvias
Las fuertes lluvias hicieron que el canal de agua:	YES	0	YES	0	0	0	0	$0.00	0	0	4/1/2006	Inundació	Carrera 84A con c	Urbano/Comuna 17/El Limonar	0	0		0	Desbordamiento	Las fuertes lluvias hicieron que el canal de aguas lluvias de Nueva Palmas se colmatara
Las fuertes lluvias hicieron que los sistemas de d	0	0	0	0	0	0	0	$0.00	0	0	11/7/2006	Inundació	Simón Bolívar con	Urbano/Comuna 10/San Judas Tadeo I	0	0		YES	Diseño	Las fuertes lluvias hicieron que los sistemas de desagüe colapsaran
El nivel del agua llegaba hasta las ventanas de la	YES	0	YES	0	0	0	0	$0.00	0	0	12/12/2006	Inundación		Urbano/Comuna 10/Las Granjas	0	0		0	Lluvias	
100 milímetros de agua en menos de dos horas	YES	0	YES	0	0	0	0	$0.00	0	0	12/12/2006	Inundació	[illegible]	Urbano/Comuna 10/San Judas Tadeo I	0	0		0	Desbordamiento	Las lluvias provocaron el desbordamiento de el caño de Santa Elena, el de la 50 y el Cañaveralejo
El caño San Judas se desbordó e inundó varias c	0	0	YES	0	0	0	0	$0.00	0	0	7/5/2008	Inundació	Calle 14 con carre	Urbano/Comuna 10/La Selva	0	0		YES	Desbordamiento	Por lluvias se desbordó el caño San Judas se desbordó
El periódico menciona que la inundación afectó	YES	0	0	0	0	0	0	$0.00	0	0	4/6/2011	Inundación		Urbano/Comuna 17/El Limonar	0	0		YES	Diseño	Un fuerte aguacero se presentó en horas de la tarde. Sin embargo, el ingeniero José Cerón, gerente de agua residuales de Emcali, precisó que la emergencia se originó porque los canales instalados en estas zonas no tienen la capacidad para transportar grandes cantidades de agua.
El desborde del canal ubicado en la calle 14 con	YES	0	0	0	0	0	0	$0.00	0	0	4/6/2011	Inundació	Calle 14 con Carre	Urbano/Comuna 17/Primero de Mayo	0	0		YES	Diseño	El ingeniero José Cerón, gerente de agua residuales de Emcali, precisó que la emergencia se originó porque los canales instalados en estas zonas no tienen la capacidad para transportar grandes cantidades de agua.
El periódico menciona que la inundación afectó	YES	0	YES	0	0	0	0	$0.00	0	0	4/22/2011	Inundació	avenida Guadalu	Urbano/Comuna 17/Primero de Mayo	0	0		0	Otra causa	Se menciona que el agua se devolvió por los sumideros
Se informa que el río dejó averiada 1 vivienda y	7	0	1	0	0	0	0	$0.00	0	0	4/22/2011	Inundación		Urbano/Comuna 20/Belisario Caicedo	0	0		0	Lluvias	Se menciona la ola invernal como causa de la ola invernal
La inundación afectó a viviendas y personas en	YES	0	YES	0	0	0	0	$0.00	0	0	2/9/2012	Inundación		Urbano/Comuna 10/San Judas Tadeo I	0	0		0	Desbordamiento	
Se informa que la inundación dejó personas y vi	YES	0	YES	0	0	0	0	$0.00	0	0	5/26/2012	Inundación		Urbano/Comuna 19/Cuarto de Legua - Guadalupe	0	0		0	Desbordamiento	
								$72,431,517.50												

Source: http://www.desinventar.org/

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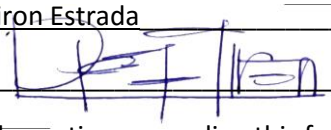
Your Signature(s) : 

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