

The background of the entire page is a dark green, semi-transparent aerial photograph of the Bogotá River Basin. A white grid is overlaid on the lower half of the image, representing a planning or zoning strategy. In the upper left quadrant, several birds are shown in flight against the sky. The overall aesthetic is clean and professional, with a focus on urban planning and environmental sustainability.

HYBRID CITY

a Planning strategy for the Sustainable Development of the Bogotá River Basin

REPORT P5

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Colophon

All images, maps and schemes in this graduation project were made by the author. Some of them were not and all of these sources can be found in the reference list in the bibliography with the description and origin.

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Section 1

Context

Introduction

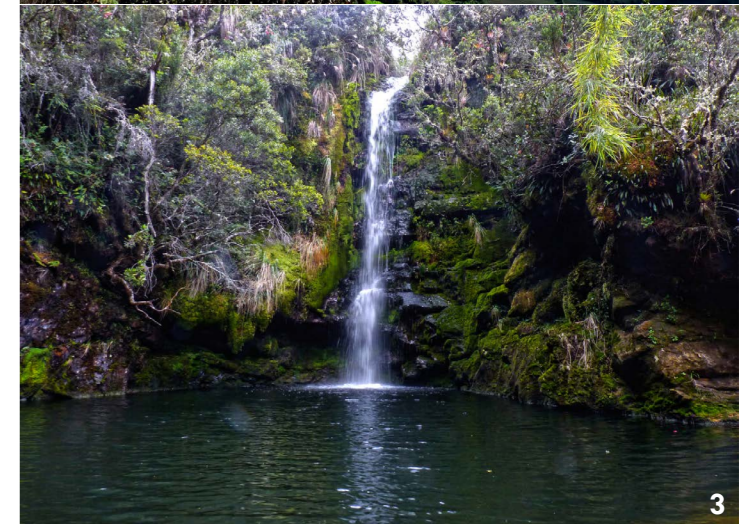
Colombia is recognized worldwide for its vast natural resources in forests, deserts, water and biodiversity. This heritage is one of its greatest strategic possessions; however it has not been considered in all its dimensions as the large added value for economic, social and environmental sustainability of the country.

The Bogotá River rises about 3.300 meters above sea level in the Guacheneque Paramo ecosystem and natural reserve. It flows 380 kilometers down to a height of 208 meters above sea level in the Magdalena River. It is the main water source of the Savannah of Bogotá. The river constitutes the essential axis of the capital city - Bogotá - and the general region's water structure.

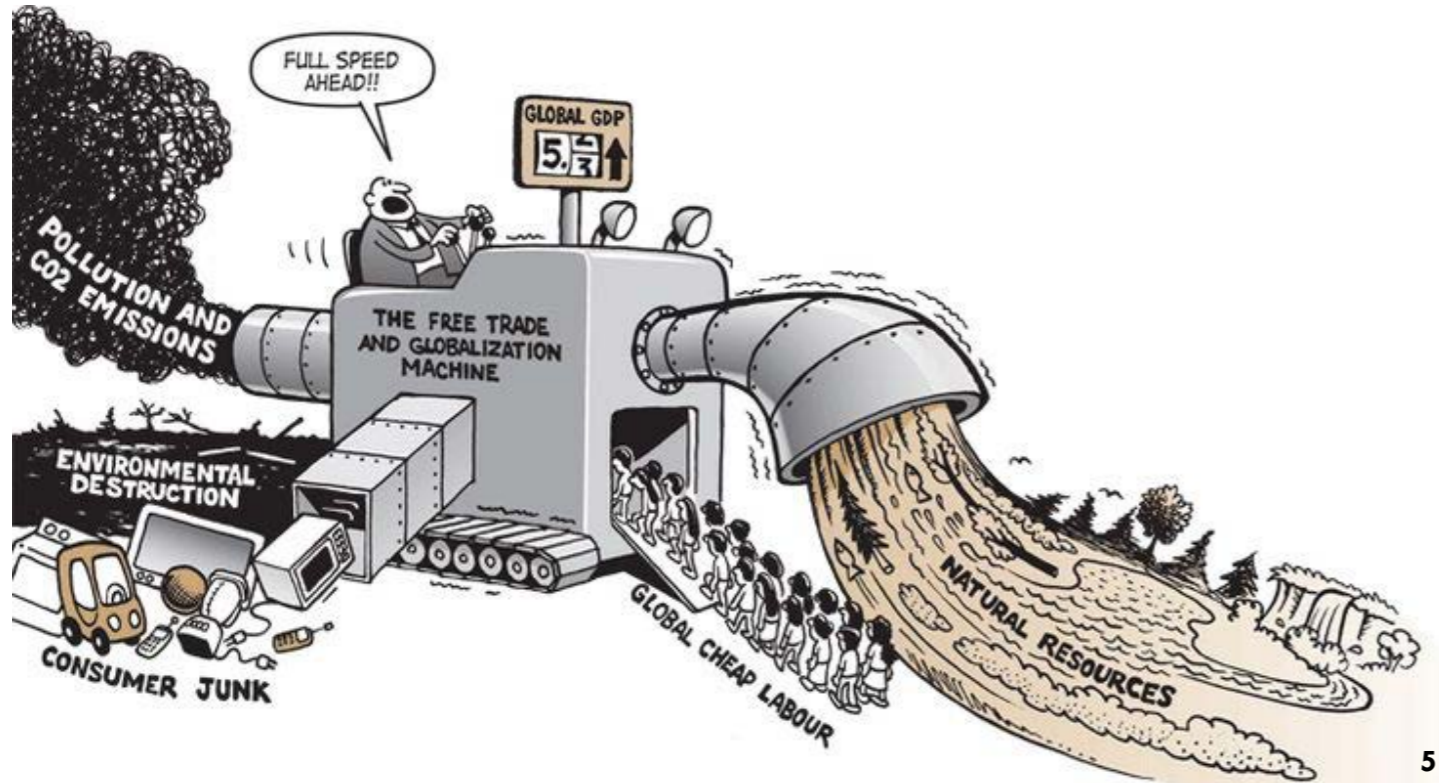
The Bogotá River Basin flows with an area of approximately 590,000 hectares, corresponding to about 32% of the region surface. In the basin, 75% of the population lives in urban areas and only 25% lives in rural areas.

The water accommodates according to the relief of the terrain, it can drain or infiltrate, accumulate in the mountains as snow or in depressions as lakes. Over the years it has not only generated the orography but also the political divisions: rivers and lakes provide natural boundaries between regions inside the country.

The interest in the Bogotá River involves as principal elements water and soil, and its relation with the excessive urban development occurred in the region. The natural elements have powerful properties of self-regulation and are highly used by human activities. Their deterioration causes the urgency of prioritizing them over human activities. They have higher relevance for the population over the economic factors. For this reason, the graduation project started with the analysis of the natural system structure.



Problem



The Bogotá River in Cundinamarca, Colombia, has had for some a forgotten and for others an unknown story through the years. In the 20th century the wood was extracted from the surrounding forests for energy input and in the 21st century the water is the protagonist for the hydroelectric power plants. Food is produced and drinking water comes from the longest fertile and varied river basin in the region. The natural structure became relevant in the past centuries due to the constant use of the resources that are provided for human activities and urban development. However, it was only a matter of time for us to realize, that the allegedly renewable resources were no longer renewable. Moreover, the consequences arisen over the water and the soil bring dramatic impacts for the population and the environment.

The picture above illustrates the irony in which human activities need more raw materials and consume the natural resources to produce additional outcomes that should supply the demands over the population growth. It exemplifies in one image the enormous problem that Colombia is struggling with, not only in the Bogotá River basin but in many other river basins throughout the country.

How is it happening? The crisis incurred by the deterioration of the natural system structure occurs together

with three significant and arising issues: contamination, sewages and waste amounts. These three matters bring vast concern in the future and durable life and stability of the natural resources.

The contamination is generated by several productive activities that bring economic inputs to the region. The sewers come primarily from housing and industrial areas. Finally the waste amounts are threatening the health and the ecological presence in the river basin.

It is a fact, that the most productive areas in the country host the highest amount of population. These fertile areas provide with ecological services the society. The current situation shows, there are substantial environmental threats over the Bogotá River basin. Therefore, it is essential to restore the ecological structure of the river basin into a sustainable environment.

I want to tackle in this project, and I will present in detail, the necessity of an improved urbanization model that includes both design and governance. That can accomplish the requirements for future developments while in balance and in a sustainable way with the environment contained in the area. For this reason, the main goal of this project is to generate a sustainable (liveable and renewable) system between water + soil + human activities along the Bogotá River and basin.

How? It is divided in ...



Contamination



Sewage



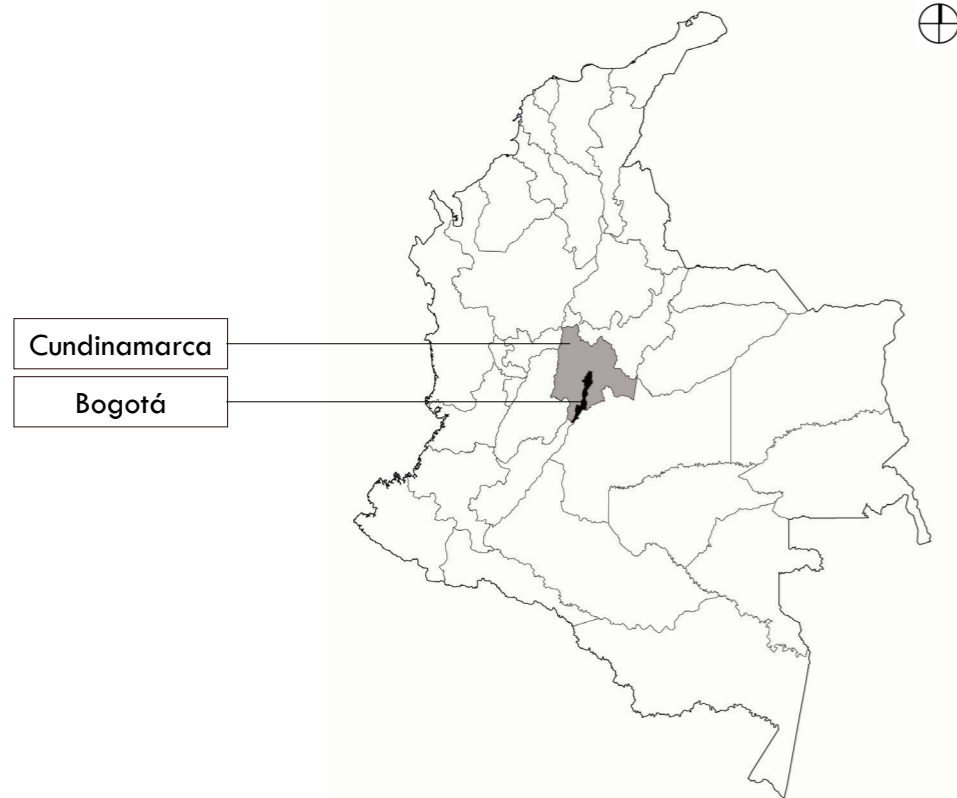
Waste amounts



The excessive and unquantifiable use of the resources have produced three principal issues shown above: contamination, sewers and waste amounts. In this research, the Bogotá River and basin will be the prin-

icipal area analyzed in the project. It is located in Colombia, in the department of Cundinamarca, where the capital city Bogotá is located too.

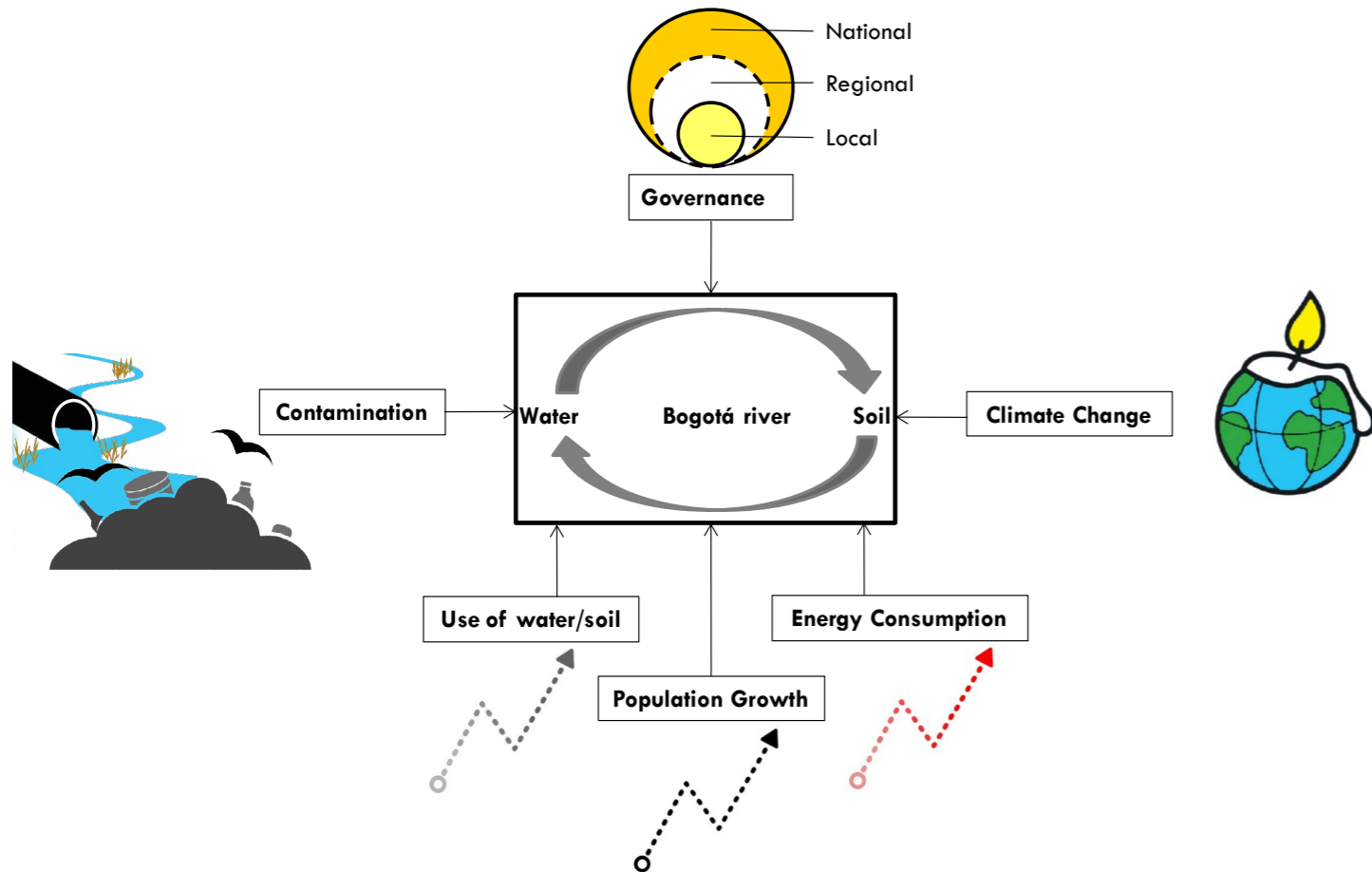
Where?



Why the Bogotá River basin is been pushed to an environmental threat? The answer is provided through six different factors that influence in the deterioration of the river basin. The problem produced by the behaviour of the population including use of the water/soil,

energy consumption, contamination and the model of governance (internal factors). On the other hand, climate change (external factor) weakens the already exploited ecosystem.

Why?



Problem Statement

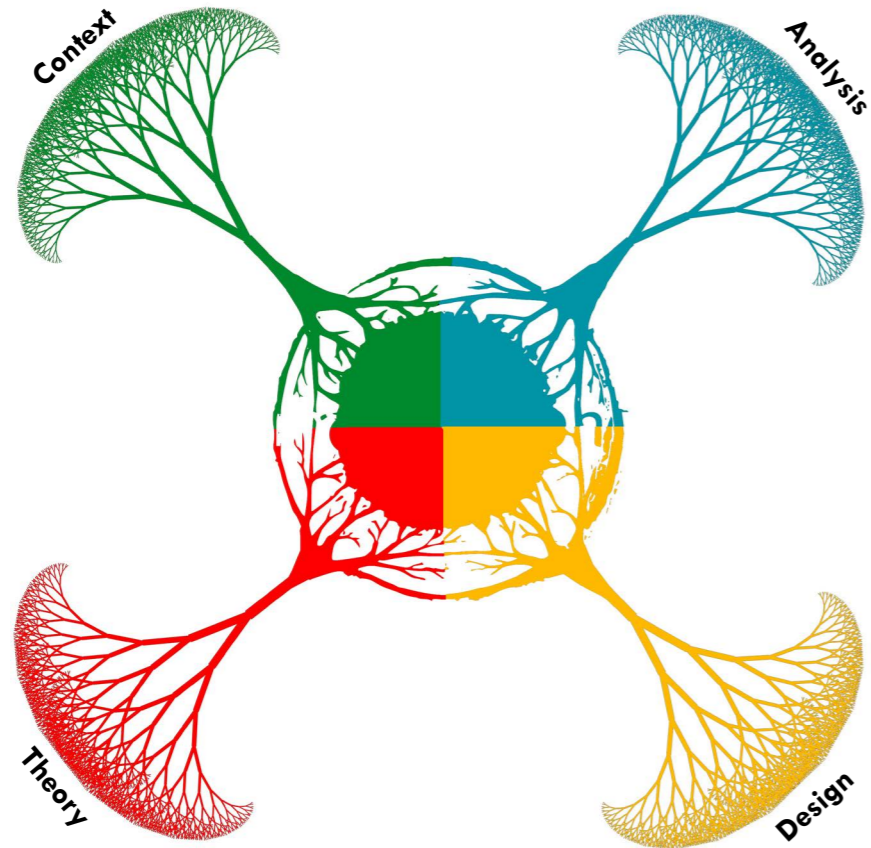
The analysis of the situation brings the following conclusion:

The Bogotá river has an extension of about 380 km; its basin surface has around 6.000 km² and passes through **different administrative boundaries**: 45 municipalities and the city of Bogotá. It is used as an **articulator between urban and rural areas**; and is the **main water source** of the Sabana de Bogotá.

However, there are **three principal factors that threaten the environmental system** of the river and its basin: contamination, urban development and rural activities such as agriculture and cattle.

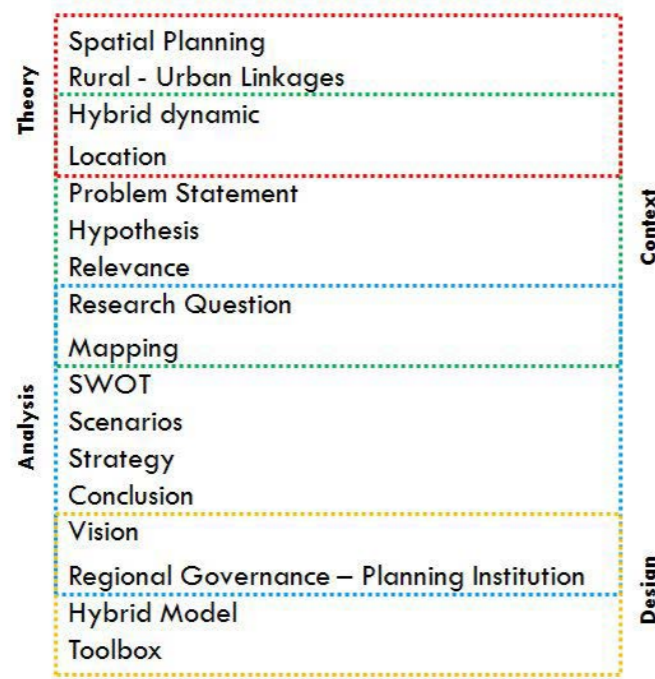
The **absence of a regional law**, the **constant lose of ecological biodiversity** as a consequence of the contamination of the water and the soil, and finally the **permanent pollution** received through discharges of tanneries, sewages and industry have provoked environmental **degradation** over the river and the basin.

Methodology



The **methodology** of the project is divided in four branches: theory, context, analysis and design. These branches are going to work together along each other to develop a balanced proposal, which not only involves the Colombian context but also it takes into

account the applied concepts and theories in other contexts analyzed before which could be relevant for the intervention. The four branches are identified with different colors to highlight every theme included in each one. They are explained below:



The overlapping of these four branches consequently, makes it possible to go from one theme to another taking into account its connections and backgrounds with one another. The result in the end will create the fusion of the four bases established into an innovative model of governance (planning institution) and acco-

modation of population growth, applied through the hybrid city model dynamic. This is going to upgrade some economic activities in the region in balance with the natural system structure for a sustainable system between water, soil and human activities.

Theory

The theory involves applied strategy concepts as:

Regional Planning

(MacLean Lewsi, Wiley, and sons, 1949: 116).

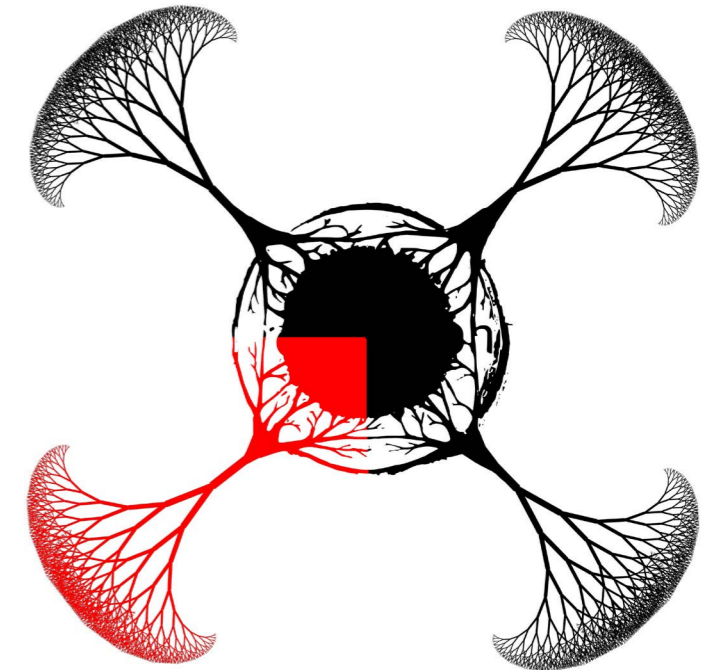
Spatial Strategies

(Albrechts, et al., 2003: 128).

Rural - Urban Linkages

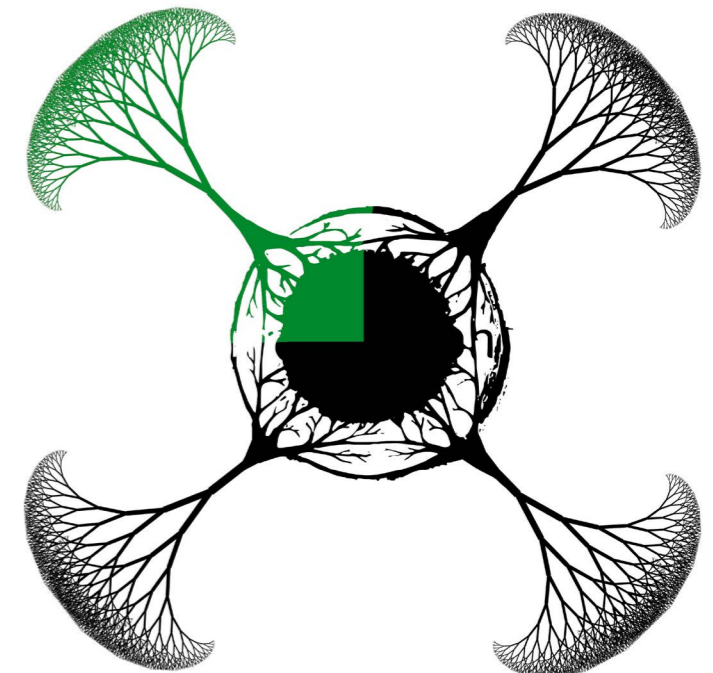
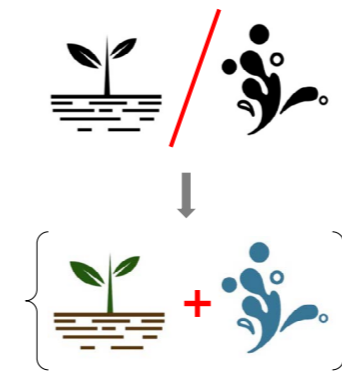
(Habitat III, et al., 2015: 1).

Hybrid Dynamic



Context

The **context** will not only involve knowledge about the location but also about the ecosystem. This is going to reinforce and highlight the importance of the elements such as water and soil and the future use of these resources.



Analysis

The **analysis** involves different methods such as SWOT, Scenarios, Vision and Strategy through mapping. Includes the goal in the environmental field and the objectives over human activities to achieve in the further development of the project.

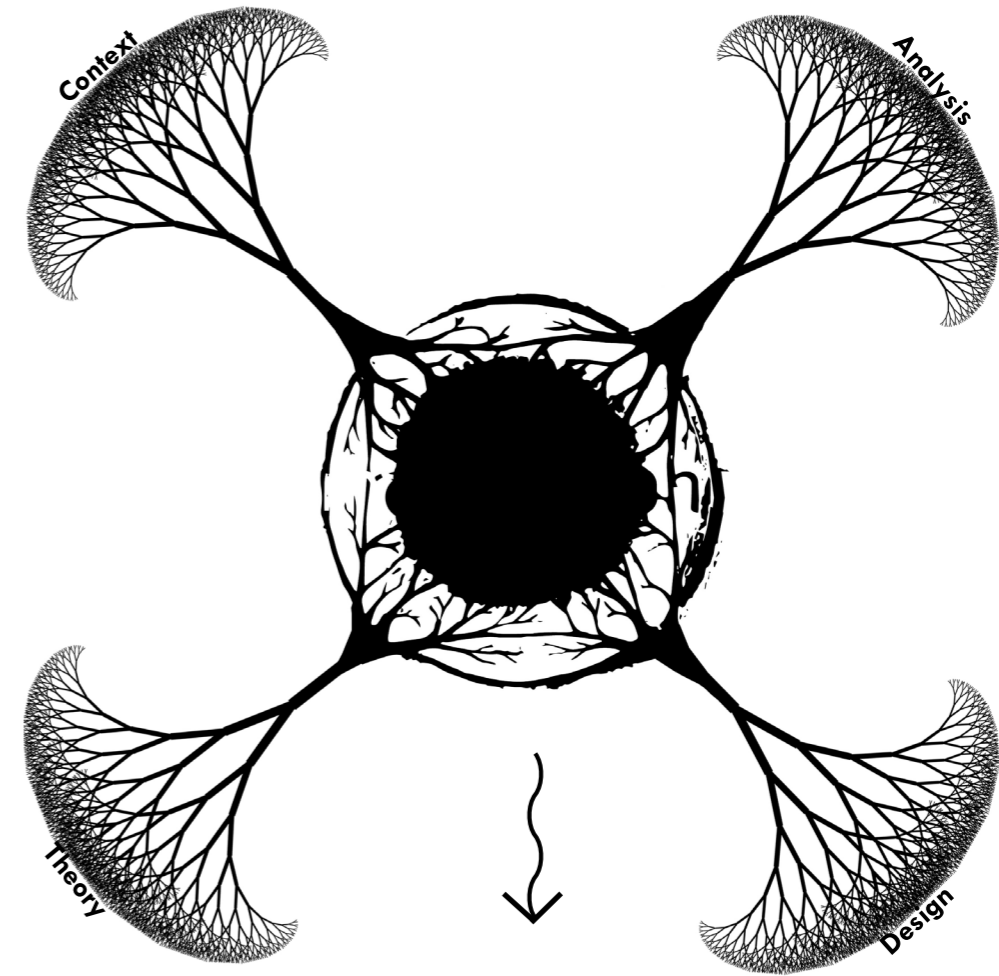
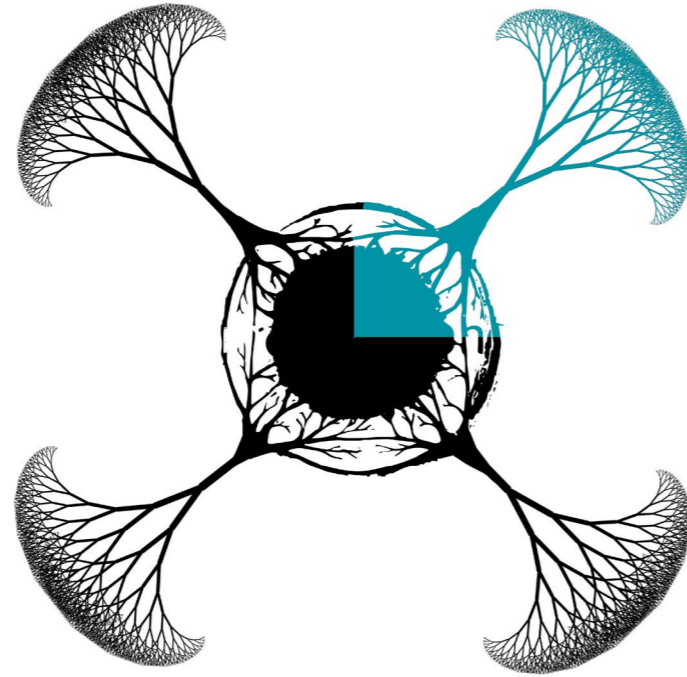
GOAL

Recover the natural system structure.



Objectives

- a)
- b)
- c)
- d)

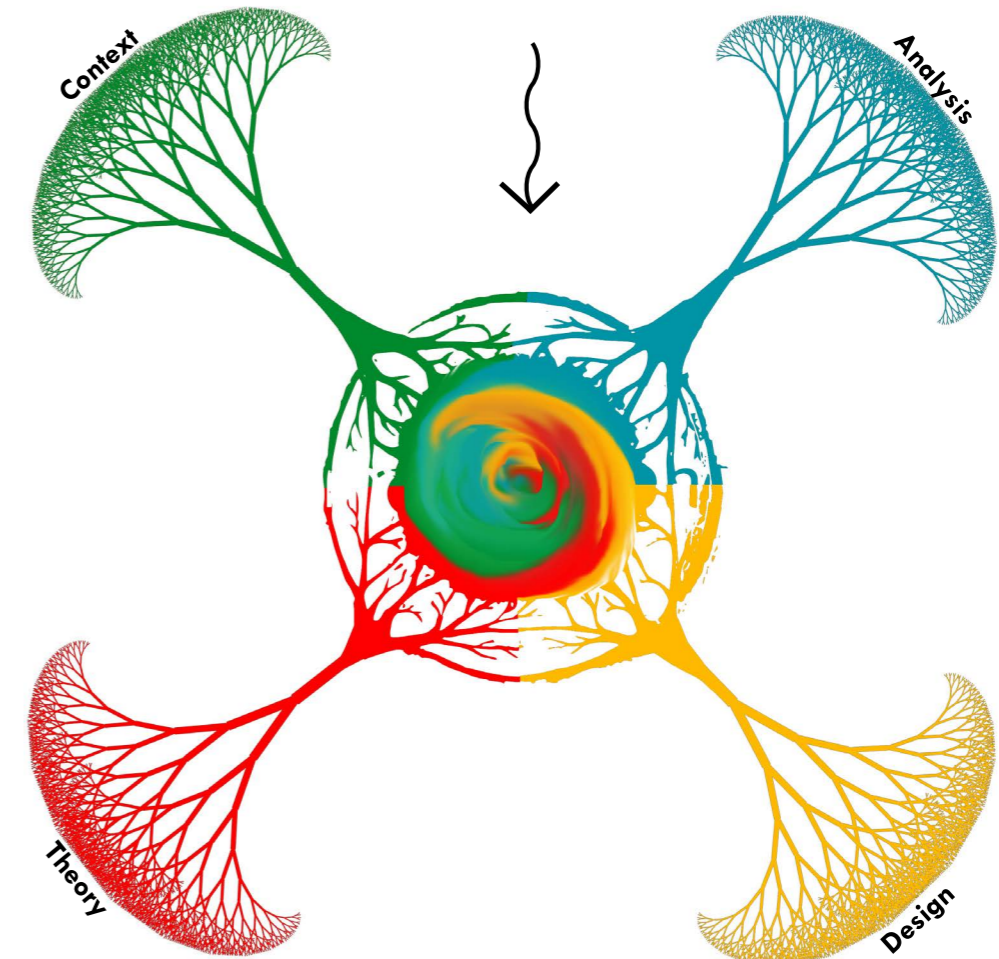
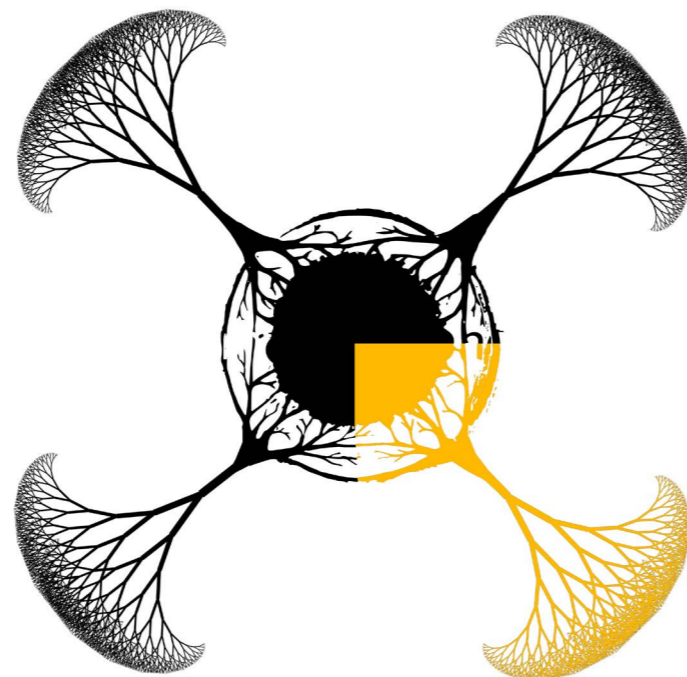
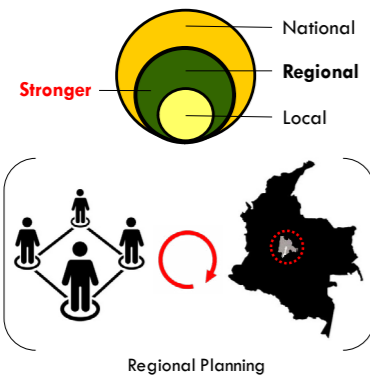


Strategy = Design = Governance

Design

Finally, the **design** is going to be concluded in a spatial regional strategy applied in a proposed model of governance. That way planning in this region will become stronger and more sustainable. The strategy will result in a working team between governance and sustainable design.

The development of a new model of governance (planning institution) and the implementation of **urban - rural linkages (hybrid dynamic)** strategies along the river basin for the improvement and protection of the ecosystem. A innovative way of governance that is going to attract a variety of stakeholders that would want to get involved.





Section 2

Research

Theoretical Framework

The theoretical framework involves concepts such as: Regional Planning, Spatial Strategies and Rural - Urban Linkages, highlighted in the previous section. Also the research made by Professor Thomas Elmqvist from the Stockholm Resilience Centre, addressed the conflicting role between ecosystems, human activity and the role of governance.

In his work *Cities and Biodiversity Outlook*, he talks about the world's first assessment of biodiversity in cities and highlights the importance of biodiversity contained in cities. He illustrates how innovation in the transition to sustainable processes is fundamental and essential in environments life expectation (Elmqvist, 2013: 635). All of them were taking into account in the spatial strategy in the Bogotá River Basin. Some of the most relevant references are:

Regional Planning

- The regional planning scale allows to focus in the ecosystem structure, taking care of the conservation of natural resources, flood control, and broad economic and governmental problems (MacLean Lewsi, Wiley, and sons, 1949: 116).

Spatial Strategies

- The shift in governance cultures is a long-term process. The implementation of the new planning institution, can achieve a transition to creative and flexible spatial strategies. The ambition is realising an open, innovative, and collaborative governance practice,

which will translate into a sustainable environment and an improved quality of life (Albrechts, et al., 2003: 128).

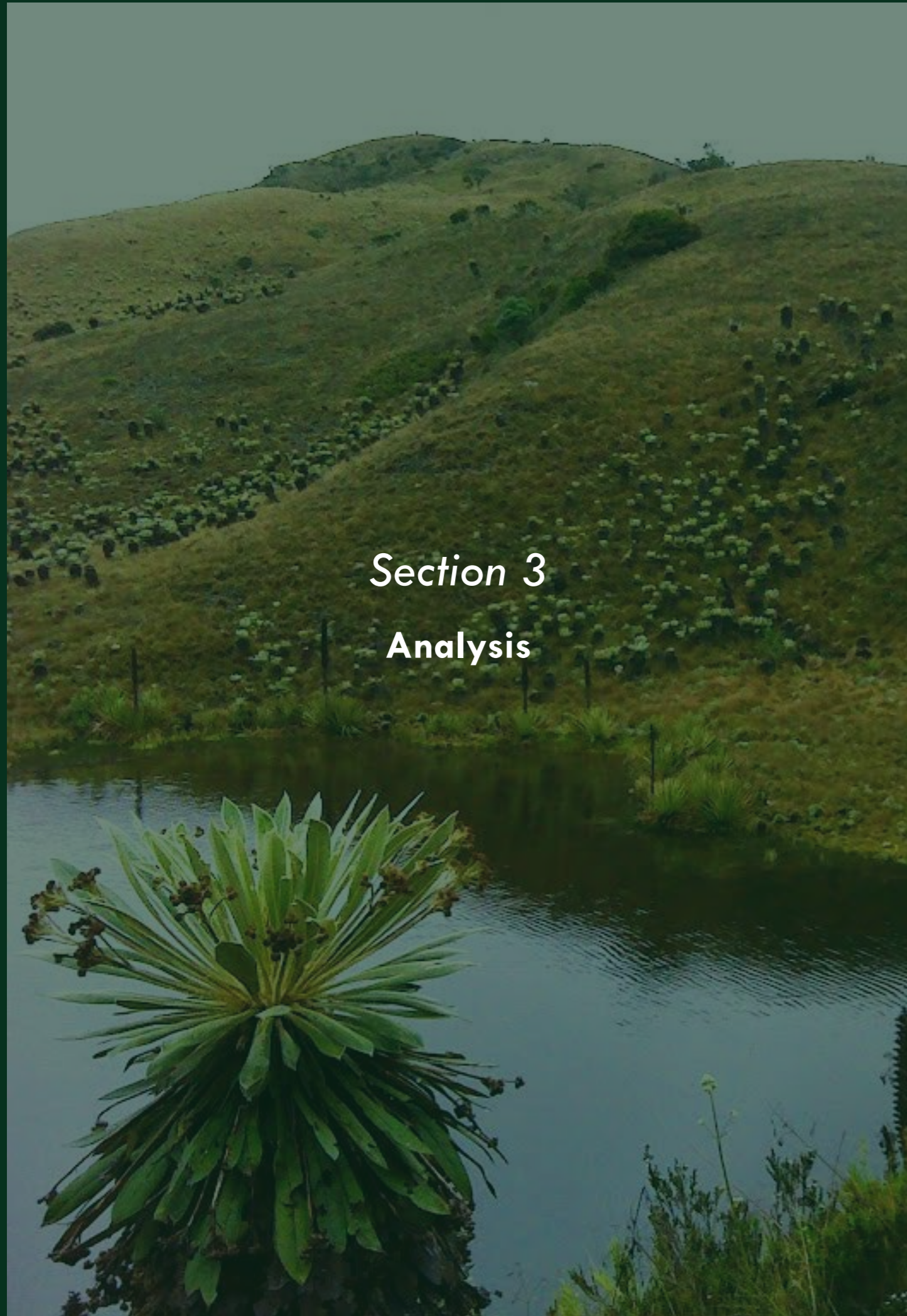
Rural - Urban Linkages

- This refers to complementary and cooperative functions in flows of people, natural resources, capital, goods, employment, ecosystem services, information and technology between rural and urban areas (Habitat III, et al., 2015: 1).

- Nolan and White (1984) suggest that the urban-rural relations should be structured to reflect one principle: "Urban-rural relationships should change from being exploitative to mutually beneficial" (Funnell, 1988: 270).

All of these concepts studied were an important element to conclude that the region needed an improved model of governance. It also leads for spatial creative and innovative programs, that can increase the stability and unity in the region.

In this case, the Bogotá River basin, the implementation of a sustainable model of development and governance, brings with it the opportunity for innovation, authority influence and support (see Appendix I for further development in these concepts and the relation and relevance in the project). As Thomas Elmqvist stated, the innovation lays 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 (Elmqvist. 2012).



Section 3 Analysis

Hypothesis

The interest in the river which involves as principal elements water and soil with the human activities and their interactions caught my attention given that, in my personal opinion, the physical factors in this specific case have urgent priority and are of higher relevance for the population over the economic factors. They have more influence on the daily life needs rather than the economic structure.

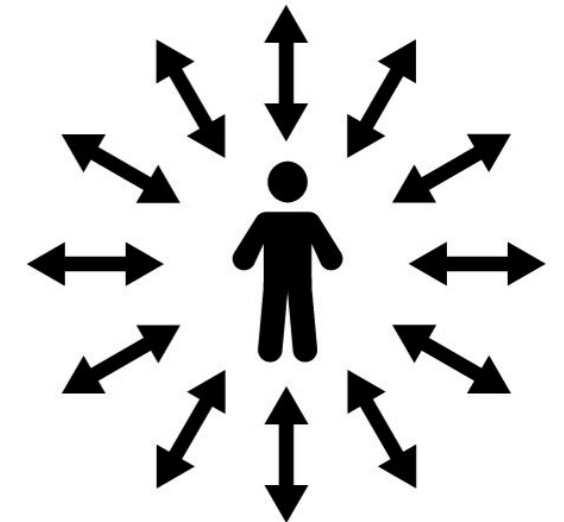
There are two ways for human activities to interact inside the natural system structure: the actual situation is the one represented in the model of the right (above), the irresponsible, selfish and short sighted approach; whilst the ideal model (right middle) the responsible, cooperative and foresighted.

For this reason, the research started with the analysis of the natural system structure where the hydrological cycle takes place and is relevant for the analysis and research. Although the interactions in the natural system are not rigid, in the sense that when it comes to the hydrological cycle the interactions create different associations and incorporate a variety of exchange processes. It is shown how it actually occurs in the scheme (right below).

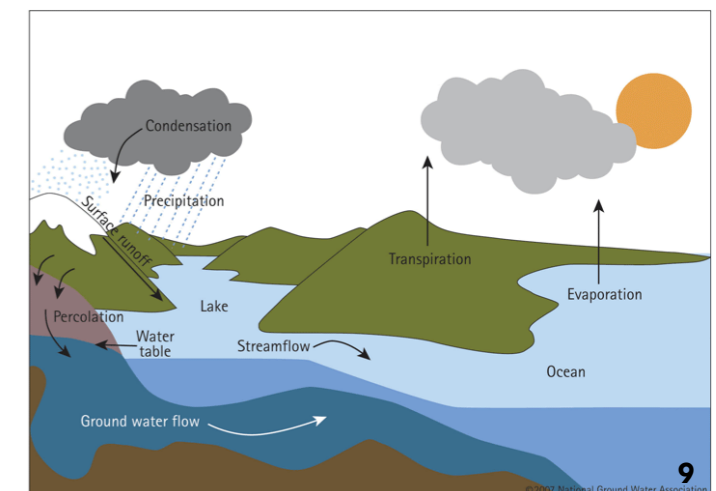
The image of the Hydrological Cycle (the natural system) has illustrated the system structure and its principal elements: water and soil. There is a constant interaction between them (condensation, evaporation, transpiration, etc). However a conflict exists when human activities become part of the system. Where they use natural resources without taking into account the consequences over them. This interaction between human activities + water + soil, is not helping because is not working as a sustainable system structure.



Irresponsible Consumption

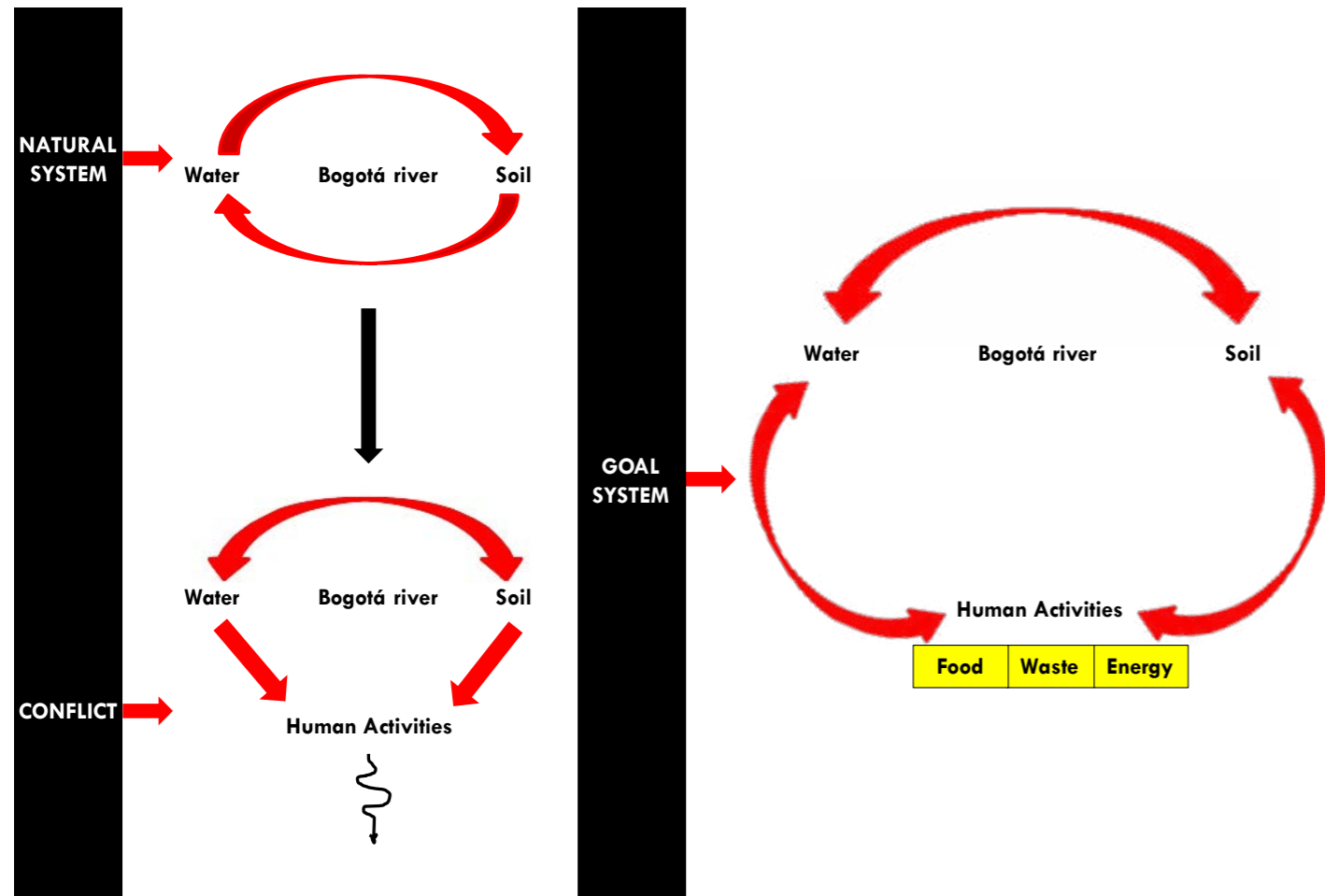


Responsible Consumption
Sustainable system



The model (interaction) has been working generating different kinds of problematic issues. Principally it has been influenced by human developments which include governance, food demands, energy generation and more specifically contamination of the Bogotá River. Then the hypothesis, ideal model and main goal for the future condition (goal system) of the river is shown in the image above.

This is the system in which it should work and is useful for the present and future conditions. It is a model in which water, soil and human activities interact with each other but also **work together in a sustainable way**: social, economic and environmental sustainability. It would be a self-regenerating system that fulfills needs of the population in the region.



Problem Field

The context of the territory in which the study area is located is shown below. The Colombian territory covers **1.7%** of the global surface, which hosts **14%** of the global biological heritage. It also has more than three hundred ecosystems in its characteristic geography.

On the other hand, the water structure of the country is large and bio-diverse, which is one of the most important qualities. It shelters the variety of ecosystems around the territory.

It is important to understand the natural structure of the country because few has been done to coexist with it in a sustainable manner.

The images aside show the water and soil landscape structures in the country. The department Cundinamarca is located in the most populated and economically productive region in the country called Andina region; it has **116 municipalities**.

The Bogotá River provides considerable input to the productivity and economy of the region and the country. In the west border of Cundinamarca, the Magdalena River becomes part of the Andina Region sharing the ecosystems involved in it.

In this context, the Magdalena River is relevant given that the Bogotá River in the end of its riverbed flows into and contaminates it.





12

Caño Cristales River



13

Amazon River



14

Magdalena River



15

River born



16

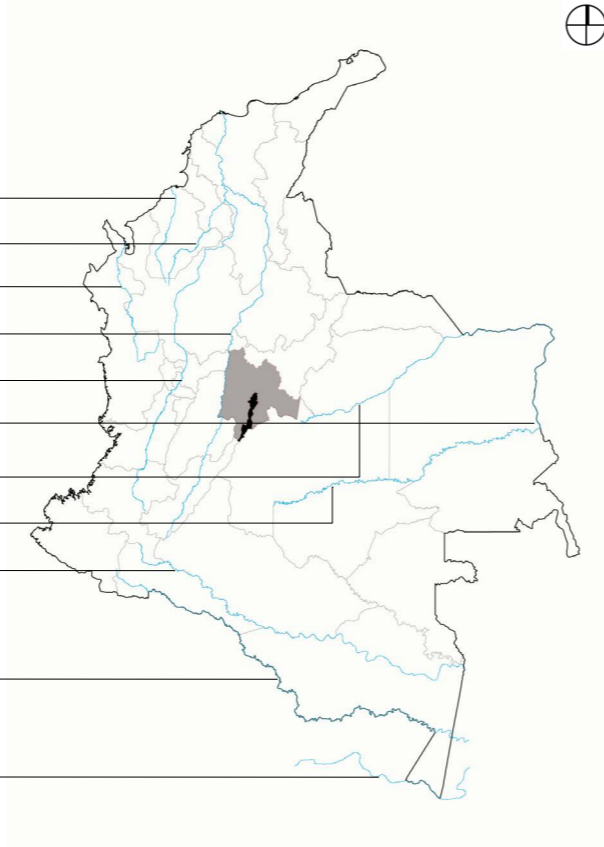
River basin



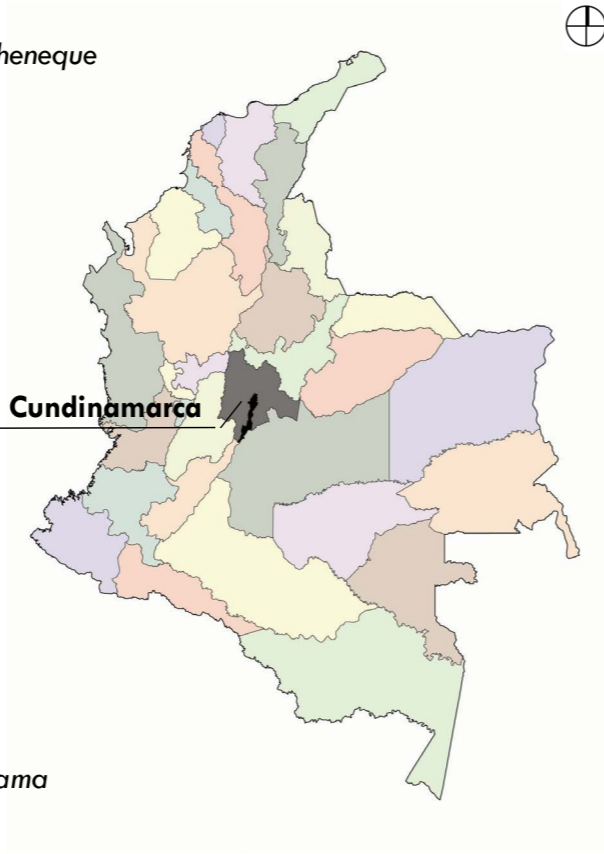
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Change of topography

- Sinú River
- San Jorge River
- Atrato River
- Magdalena River
- Cauca River
- Orinoco River
- Meta River
- Guaviare River
- Caquetá River
- Putumayo River
- Amazonas River



Páramo de Guacheneque



Landscape

Crops

Salto del Tequendama

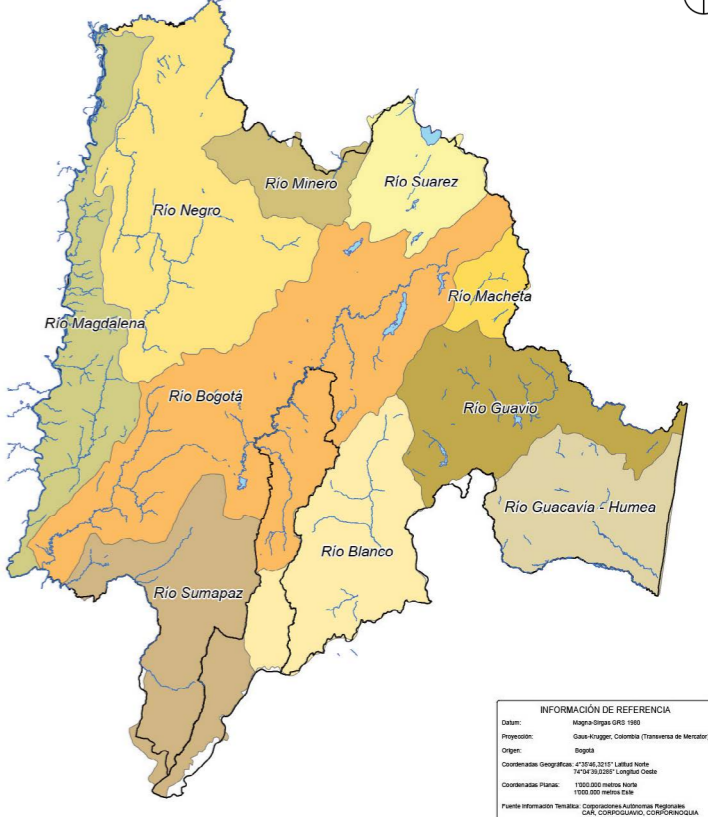
Cundinamarca

The map in the right shows the River Basins Administrative Division:

Given by administrative boundaries of the different municipalities in the department and also topographic and geographic features.

The Bogotá River basin is the orange area. It has **46 municipalities** which correspond to **1/3 of the department**.

The Basin has an area approximately of around **590,000 Ha.** Which is **33% of territory**.



INFORMACIÓN DE REFERENCIA:
 Escala: Mapa Original (1:500 000)
 Proyección: Gauss-Krüger, Colombia (Transversal de Meridiano)
 Origen: Bogotá
 Coordenadas Geográficas: 4° 38' 00" N, 74° 04' 00" W
 Coordenadas Planas: 1100 000 metros Norte, 1100 000 metros Este
 Fuente: Información: Topografía, Cartografía, Aeronáutica, Geografía, SAG, COPROVIA, COPROFERROVIA.

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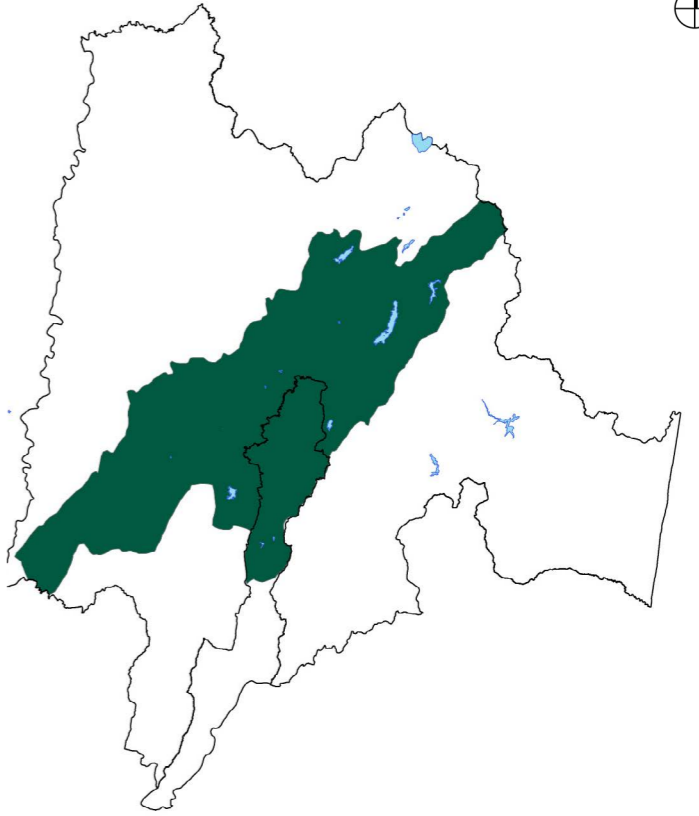
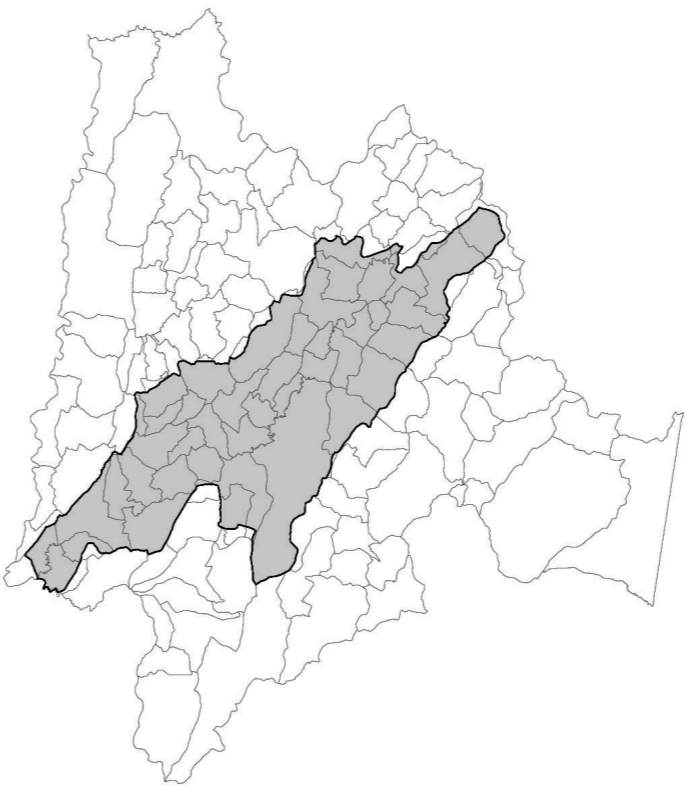
Some of the principal qualities of the region are shown in the next pictures. Flower fields, livestock and agriculture are the activities with the main incomes in the GDP.

All these values together shape the prosperous and abundant river basin that the country has. The rich natural resources that are present show

the majestic landscape of the surroundings.

The largest areas in the river basin are covered with nature; on top of that the agriculture, cattle and flower fields also benefit from the river basin.

In terms of numbers, the structure of the population has the following dimension:







Flower fields

19



Livestock

20



Natural Resources

21



Agriculture

22



23

Population Department: **10.600.000 people** approx.

Bogotá: **7.800.000 people** approx.

115 municipalities: **2.800.000 people** approx.

Then, in the river basin the proportions are the following:

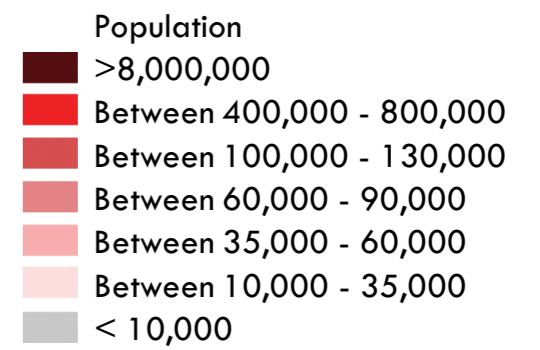
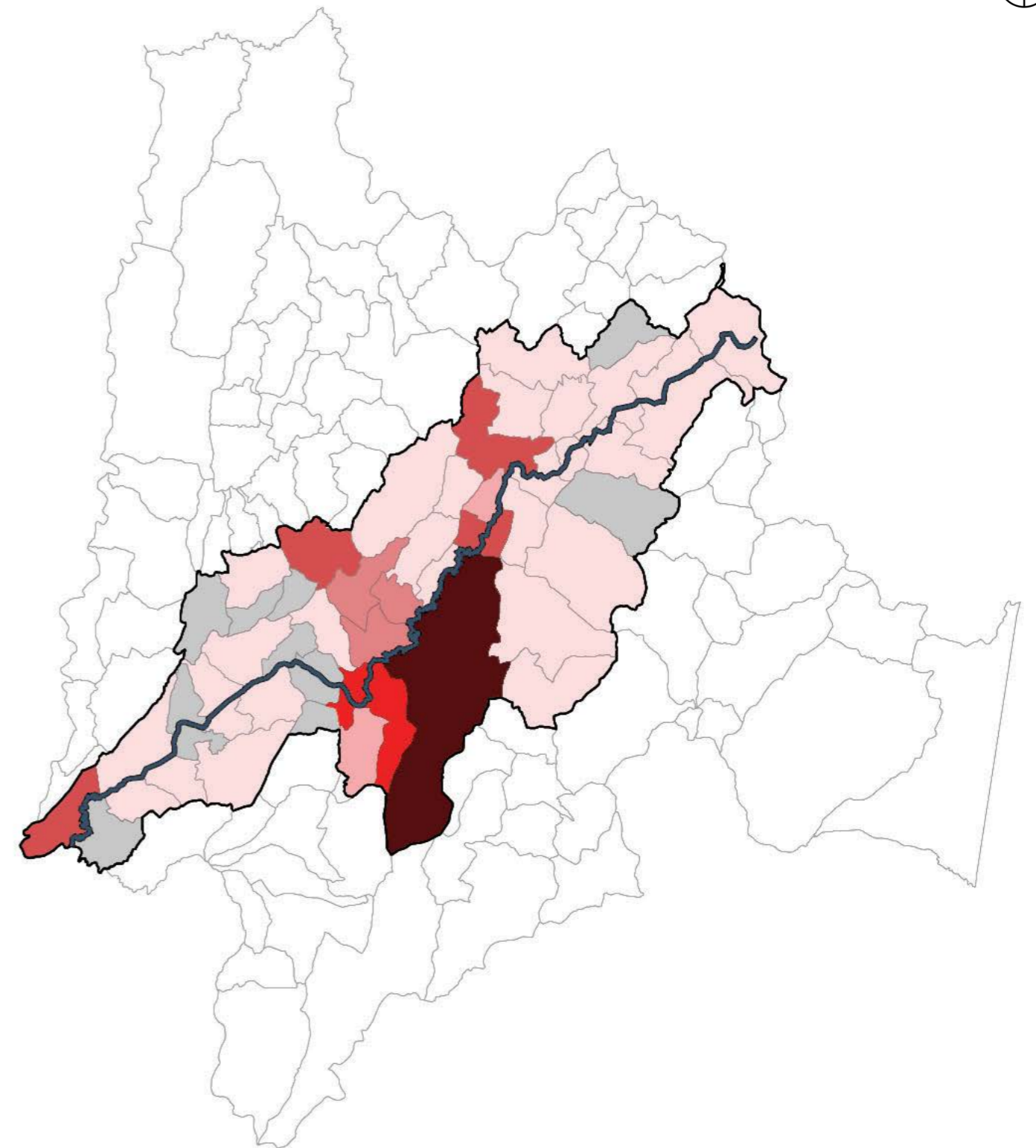
Population Bogotá River Basin:
9.650.000 people = 92% of the department

Bogotá: **7.800.000 people** approx.

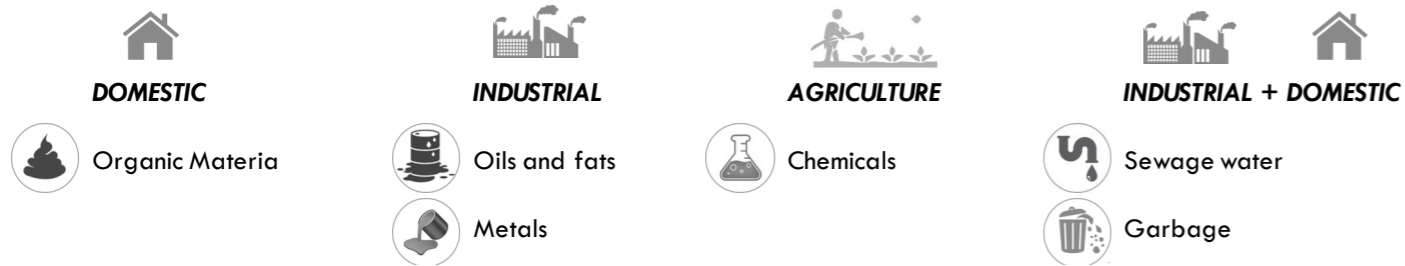
45 municipalities: **1.850.000 people** approx.

In the majority of the cases, the most populated and developed urban areas settled closer to the water structure are the ones that contaminate the river the most. In other words, the amount of people mentioned before that live in the river basin are not the only ones that contaminate the area, also the ones in the surroundings. The river receives waste from about 9,410,000 inhabitants. This includes Bogotá (capital city) and the surrounding municipalities of the Bogotá River basin.

The map with the total population shows, the larger amount of people that live in the river basin are located in the middle part of the Bogotá River. It includes municipalities such as Zipaquirá, Chía, Cajicá, Soacha, Girardot, Madrid, Mosquera, Funza and the capital city Bogotá.

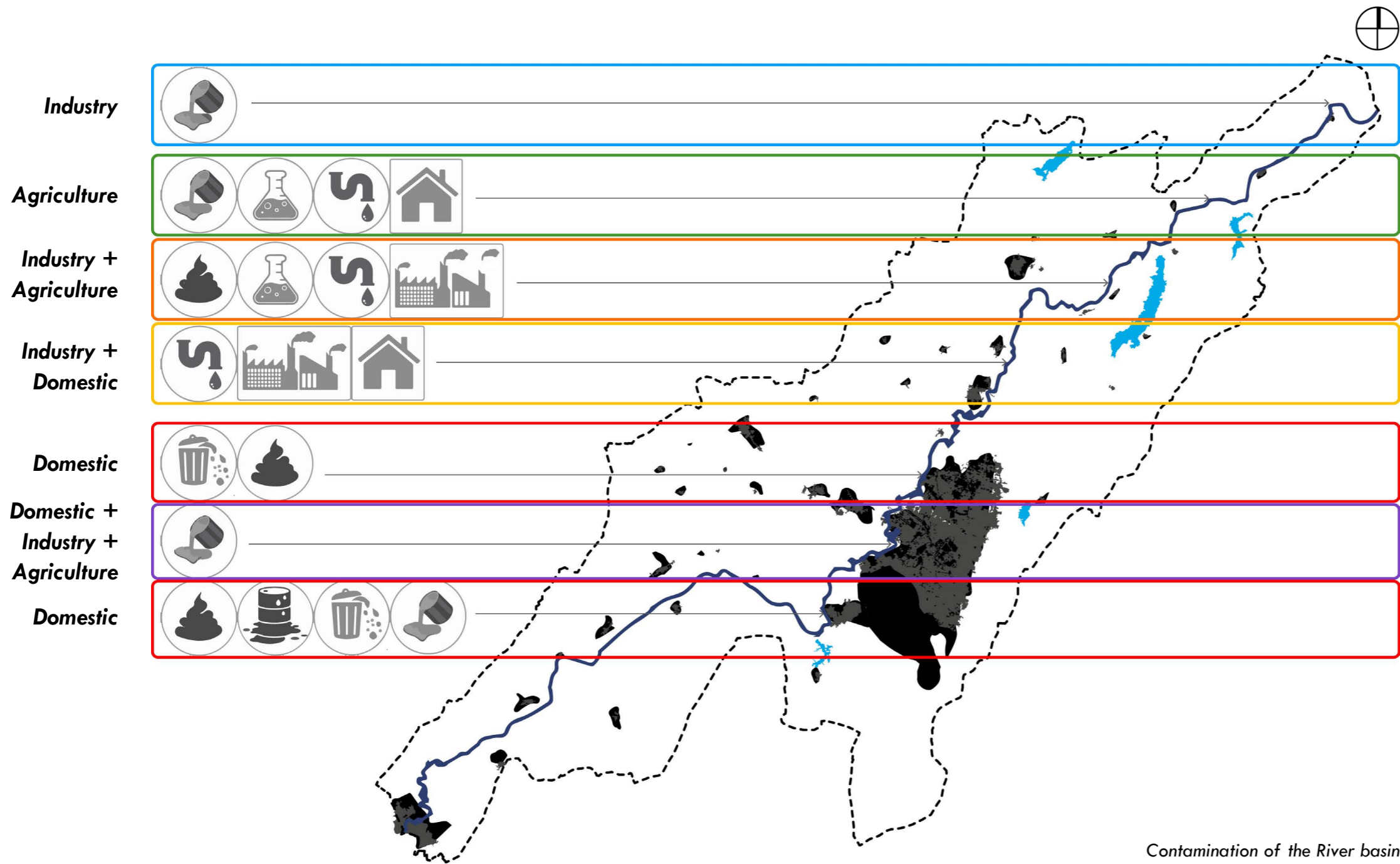






For a more illustrative example of the problem studied in the river basin area, the map below shows the interpretation on the data from the Bogotá basin, made by the public entity CAR (Regional Autonomous Corporation) about the contamination in the water structure, overlapped with the urban growth of the municipalities along the basin territory.

It compares the urban development, understood as human activity, with the quality and the water status. This concludes that: on one hand, the river presents high amounts of contamination along the whole natural structure; and on the other hand, the urban developments keep growing near the water structure.



The contamination is given by four principal sources: domestic, industrial, agriculture and the mixture between industrial and domestic. All of them have threatened the purity and usefulness of the water structure. All of them are located near the territory that surrounds the river. It is really important to highlight the organization of territorial, social and economic issues because it is going to be explained further in one of the strategies that involve waste management.

As a conclusion, there are seven areas delimited with different kinds of contamination. The most harmful areas are the ones near the capital city that are defined as domestic, domestic + industry + agriculture and domestic. With huge amounts of garbage, metals, oils and organic materials.

Contamination of the River basin



Incertidumbre por río Bogotá

Atraso en obras y recursos ponen en duda la recuperación. **Los datos** 1. Punto crítico Contaminación se vuelve crítica cuando el afluente entra en contacto con el río Fucha y el Tunjuelo. 2. Otra duda Falta claridad en las competencias que tiene cada una de las entidades y su trabajo articulado. Entre los aspectos más preocupantes está la financiación de las obras, para lo cual se requieren 2 billones de pesos; la construcción del interceptor Tunjuelo Comas, que sigue retrasada y las máquinas que se han comprado pero que no se han podido utilizar. Entre los aspectos más preocupantes está la financiación de las obras, para lo cual se requieren 2 billones de pesos; la construcción del interceptor Tunjuelo Comas, que sigue retrasada y las máquinas que se han comprado pero que no se han podido utilizar.



Diseño: Esther Ramos / foto: Google Maps. El río que pasa de forma marginal por la ciudad de Bogotá y que sus principales afluentes son el río Tunjuelo, el río Fucha y el río Salitre. Después de cruzar el Distrito Capital, el Río Bogotá pasa por los municipios de San Antonio del Tequendama, Tena, La Mesa, El Colegio, Anapoima, Tocaima, Agua de Dios, Ricaurte y Girardot. Luego de bajar 380 kilómetros su recorrido finaliza en el río Magdalena a 280 metros sobre el nivel del mar, en el municipio de Girardot.

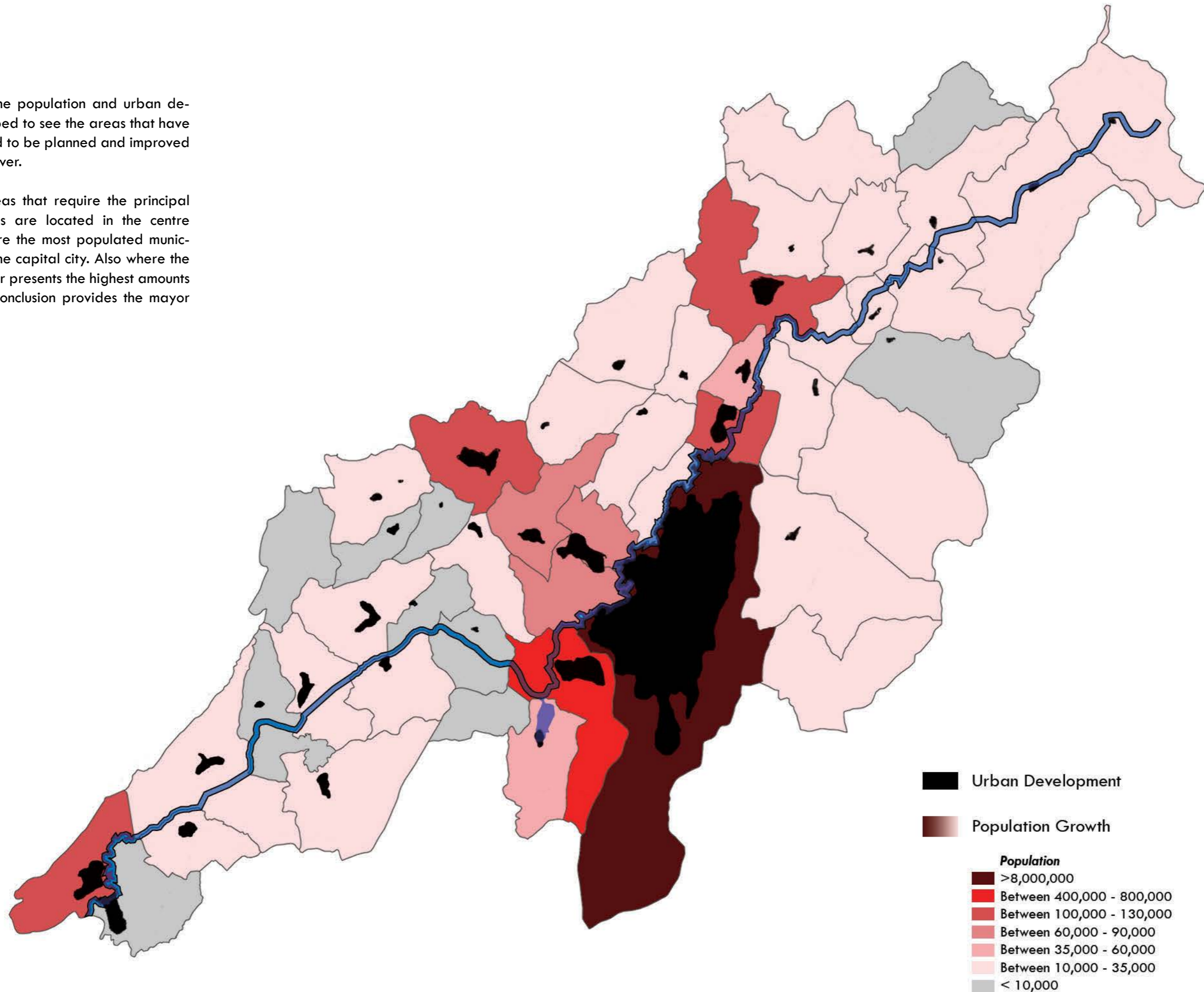


Diseño: Esther Ramos / foto: Google Mas



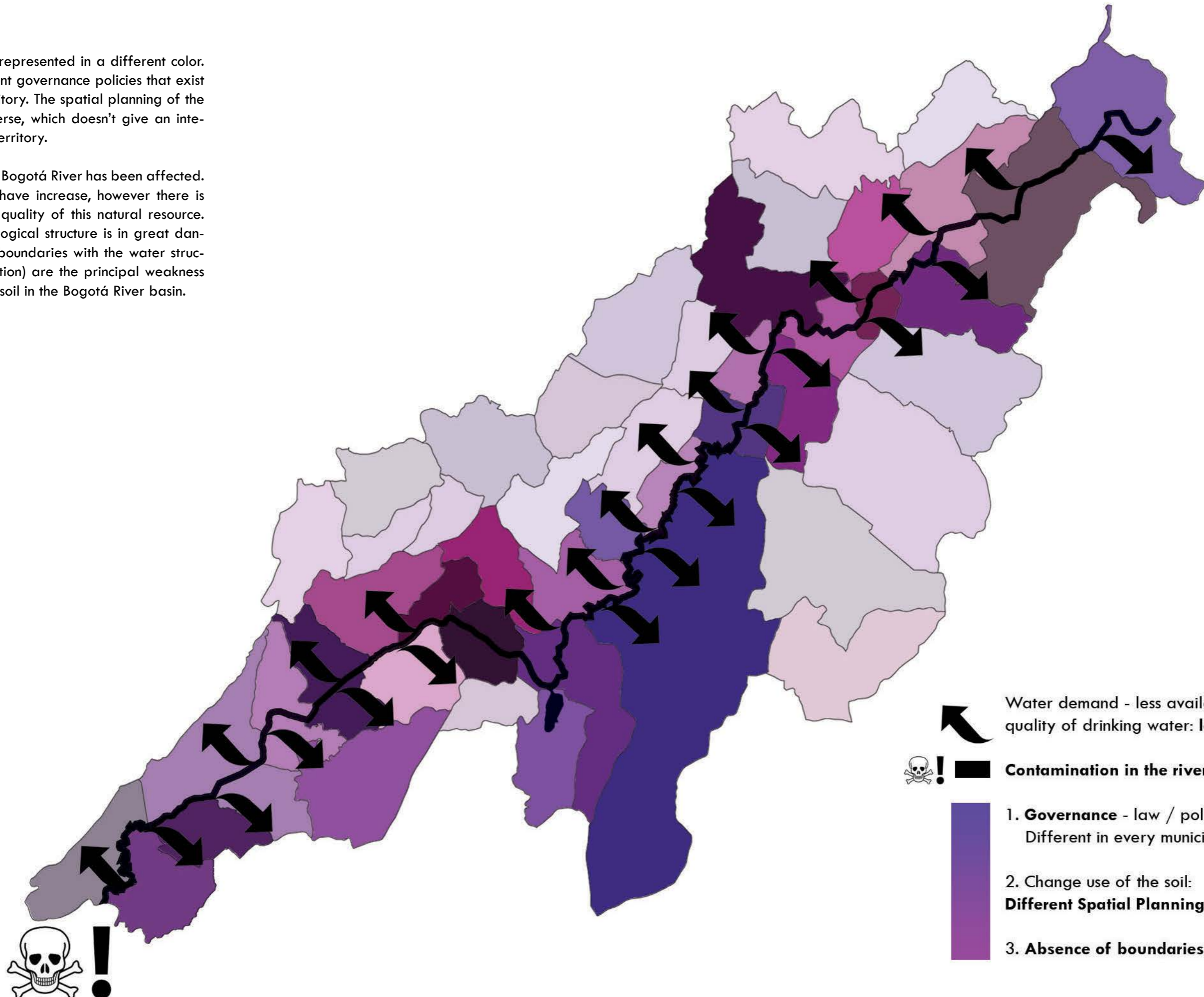
In the following map, the population and urban development are overlapped to see the areas that have priority and urgent need to be planned and improved to protect the Bogotá River.

The most important areas that require the principal sustainable interventions are located in the centre of the river basin; where the most populated municipalities are, including the capital city. Also where the area of the Bogotá River presents the highest amounts of contamination. This conclusion provides the mayor threat of the territory.

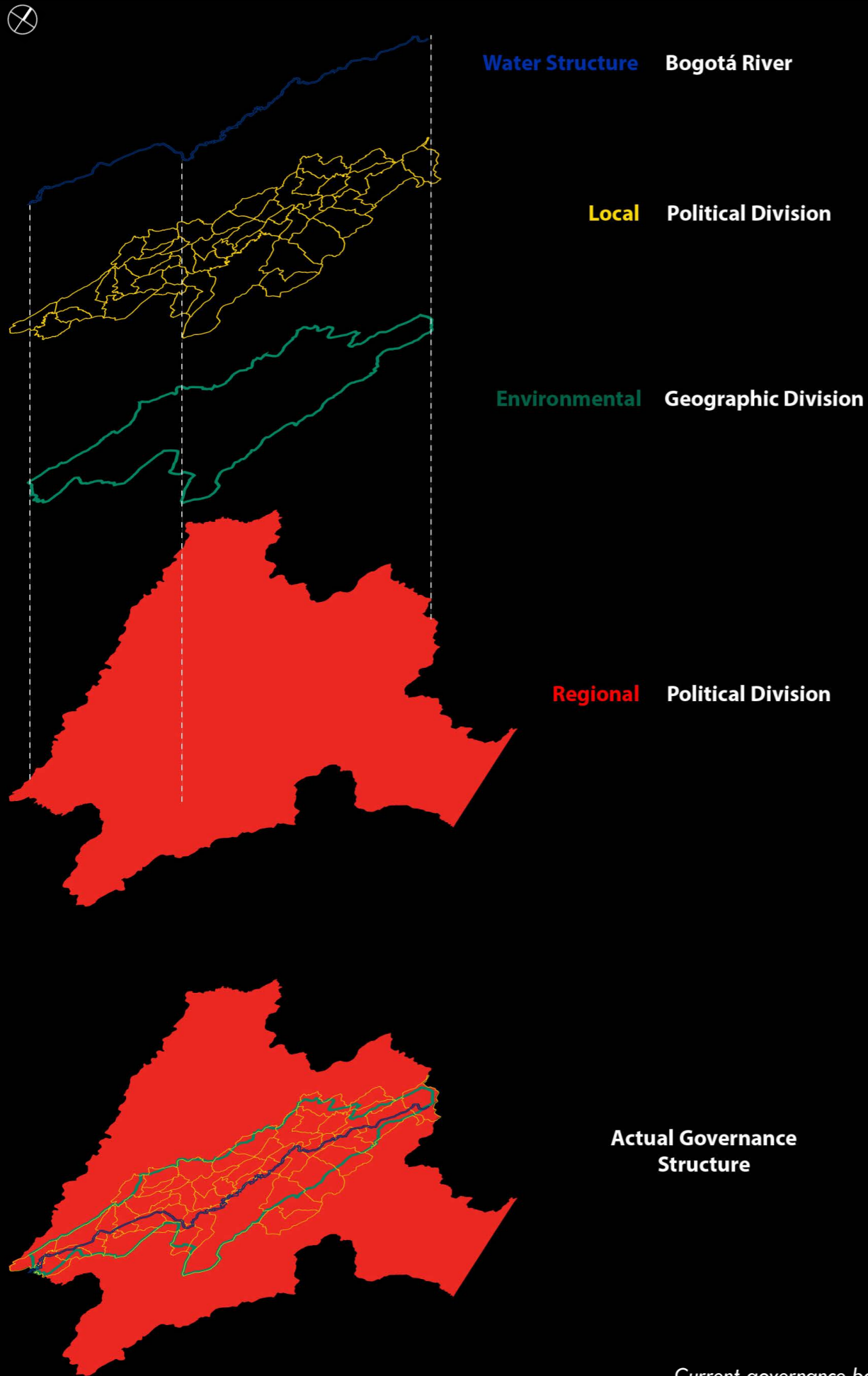


Every municipality is represented in a different color. This shows the different governance policies that exist in the river basin territory. The spatial planning of the use of the soil is diverse, which doesn't give an integrated vision of the territory.

As a consequence the Bogotá River has been affected. The water demands have increase, however there is less availability and quality of this natural resource. The river and its ecological structure is in great danger. The absense of boundaries with the water structure (limits for protection) are the principal weakness of the water and the soil in the Bogotá River basin.



Governance Structure



Current governance boundaries

The current governance boundaries map (left) and the governance political figures (right), have the government structure of the department of Cundinamarca, alined and overlapped. The water structure is the Bogotá River, the local and regional governance is represented by the political division (governor + mayors). Finally, the environmental structure is the geographic division defined by the Autonomous Regional Corporation that is the first regional environmental authority.

The conceptual vision scheme (bottom) illustrates the result in the overlap of all these layers. Conclusion: even though the Bogotá River is inside a regional delimitation, the local (municipalities) delimitation disperses the actual responsibility over the Bogotá River. The environmental or political division don't plan and protect in an integrated way the territory as it should be done. (See Appendix II for further analysis about the current governance structure of the region).

The schemes in the right, represent the conceptual vision of what is happening and what could be done.

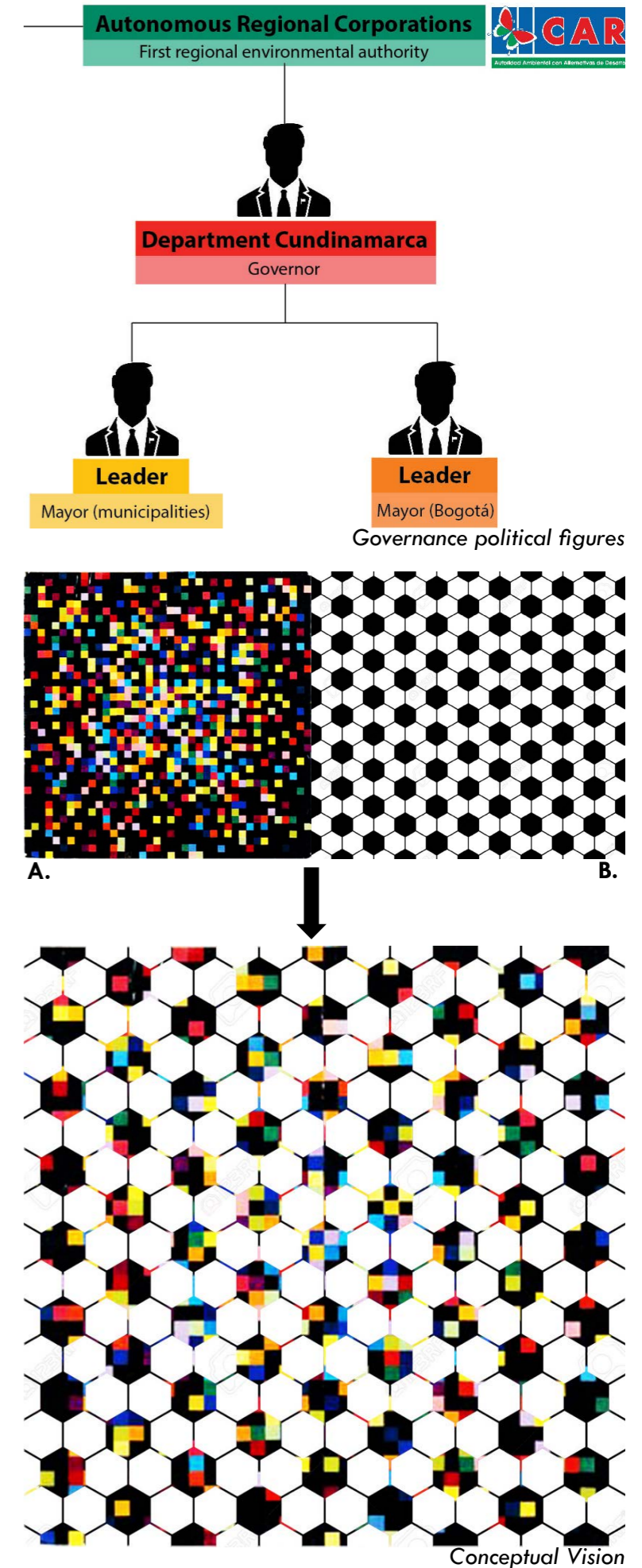
A. Current planning = Sprawl

B. Ideal planning = Integrated Network



Fusion

In the next section, it will be explained how to structure this ideal scheme into a realistic one.

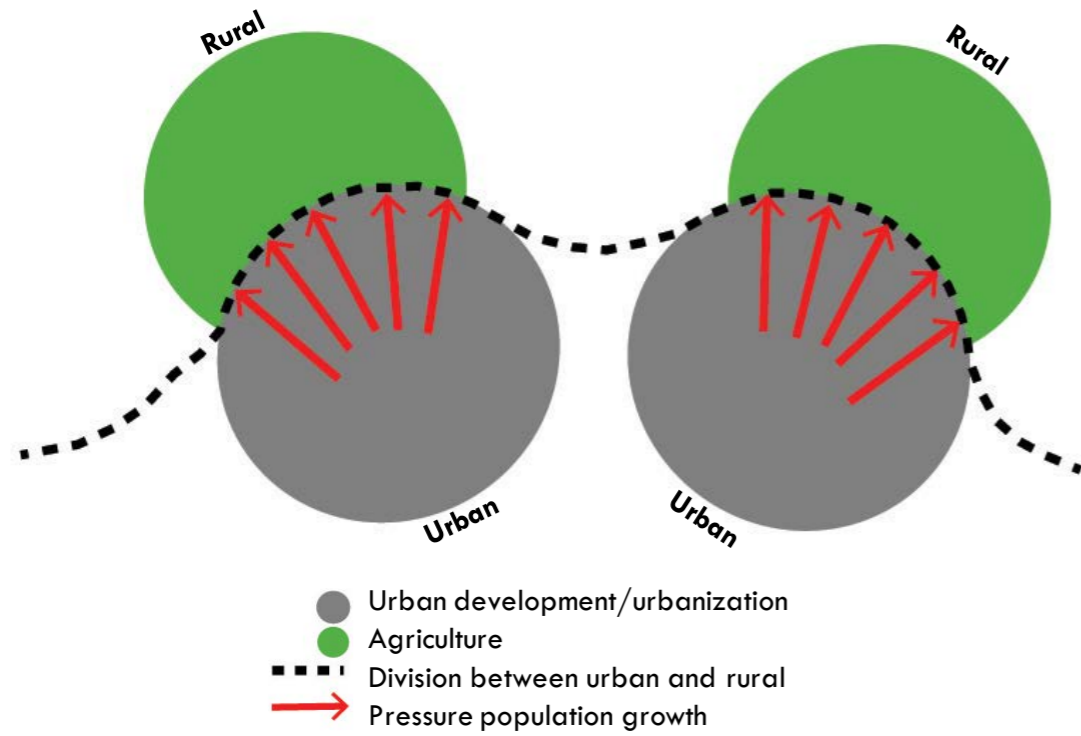


Dynamic

The actual dynamic in the region is given by the scheme below. The urban development has absorbed the rural areas along time and the pressure is increasing. The existing boundaries between rural and urban areas have changed dramatically during the last 20 years. Without any territorial planning rural areas

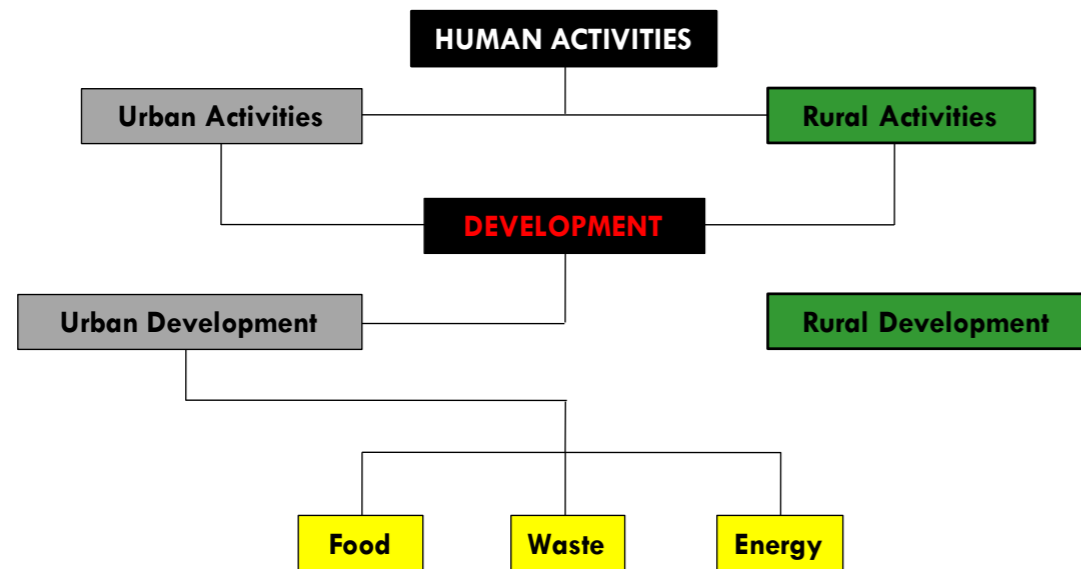
become urban areas given to population growth, as it can be seen in the images in the next page. Any improvement in infrastructure or services has been done producing impressive expansion of urbanized areas. This dynamic generates fragmentation, which is a driving force that is enlarging along the department.

Driving forces = Economic + population growth



The result is an unbalanced and unsustainable dynamic between the human activities in rural and urban areas. There is a failure in the structure of the system and it is really necessary to intervene. The scheme below points out the themes that are going to become part of the research, analysis and finally the strategy

and design of the regional plan. The development is the main theme because is the main issue involved with the planning and governance of the region. The other three (food, energy and waste) are complementary themes that are going to become part of the possible strategic projects.



Dynamic = unbalanced = non sustainable



Research Question / Specific Research Questions

The research questions are defined based on the consequences given over the natural system structure, named: water and soil and on the description of the problem statement. The principal factors provoking a change are human activities divided in rural and urban activities. Development generates certain flows that are applicable and significant to highlight in de-

termined areas along the river basin. These three flows are: food, energy and waste.

Therefore the general research question covers these themes previously mentioned and specifically emphasized on the creation of a sustainable system structure in the region.

GENERAL

How to generate an **integrated system** between **urban development, food production and waste management and energy generation**, due to the increasing pressure of urbanization and the **need to protect the environment** contained in the Bogotá River and its basin?



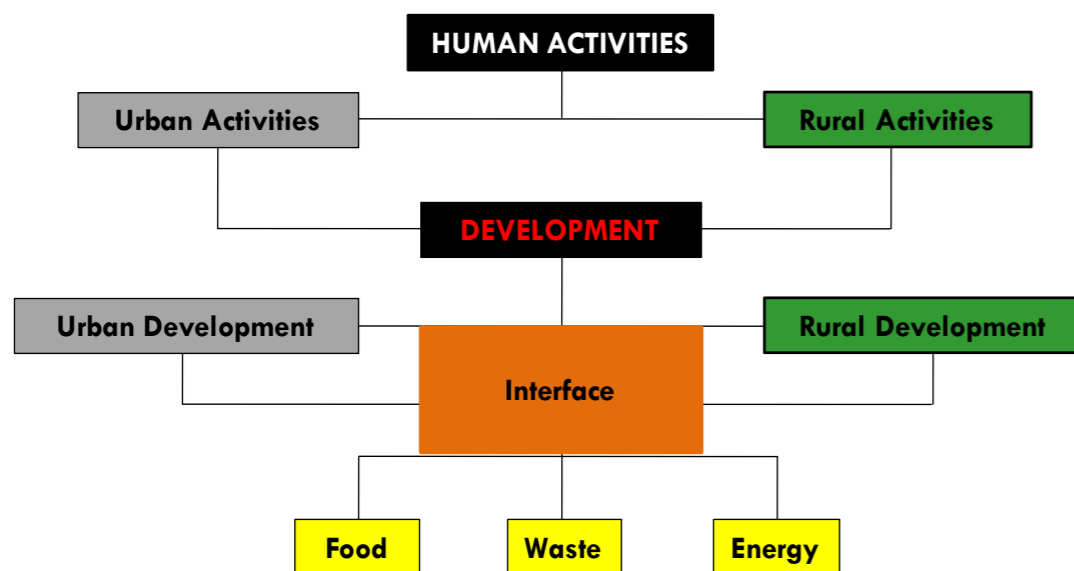
The specific research questions will work with the central human activities and its three respective flows:

SPECIFIC

- 1. DEVELOPMENT** - How to generate land for urban development without harming the river system?
- 2. FOOD** - How to create a balance between the natural structure and food production in cattle and agriculture activities?
- 3. ENERGY** - How to improve water and soil utilization for energy generation?
- 4. WASTE** - How to adequate areas for waste management and treatment along the Bogotá river and basin?

To resolve the breakdown in the system, the idea is to generate an interface as part of a strategy based on the guiding principle "decentralization" to improve the structure of the regional system.

Dynamic = balanced = sustainable



	PROBLEM		STRATEGY
FOOD			
ENERGY			
WASTE			

The analysis of three flows: food, waste and energy that are part of the proposed interface in the hybrid model, helped me identify the key elements highlight-

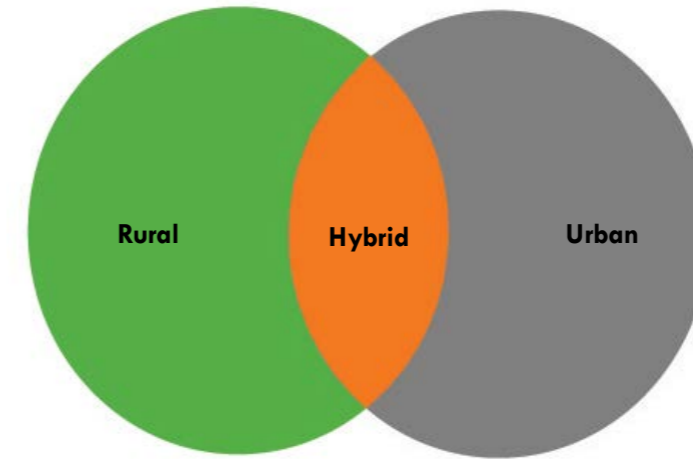
ed in this toolbox. They are important in the development of the regional strategy. From transport, production, sources, between others. (See Appendix III and IV).

Section 4 Strategy

Strategy



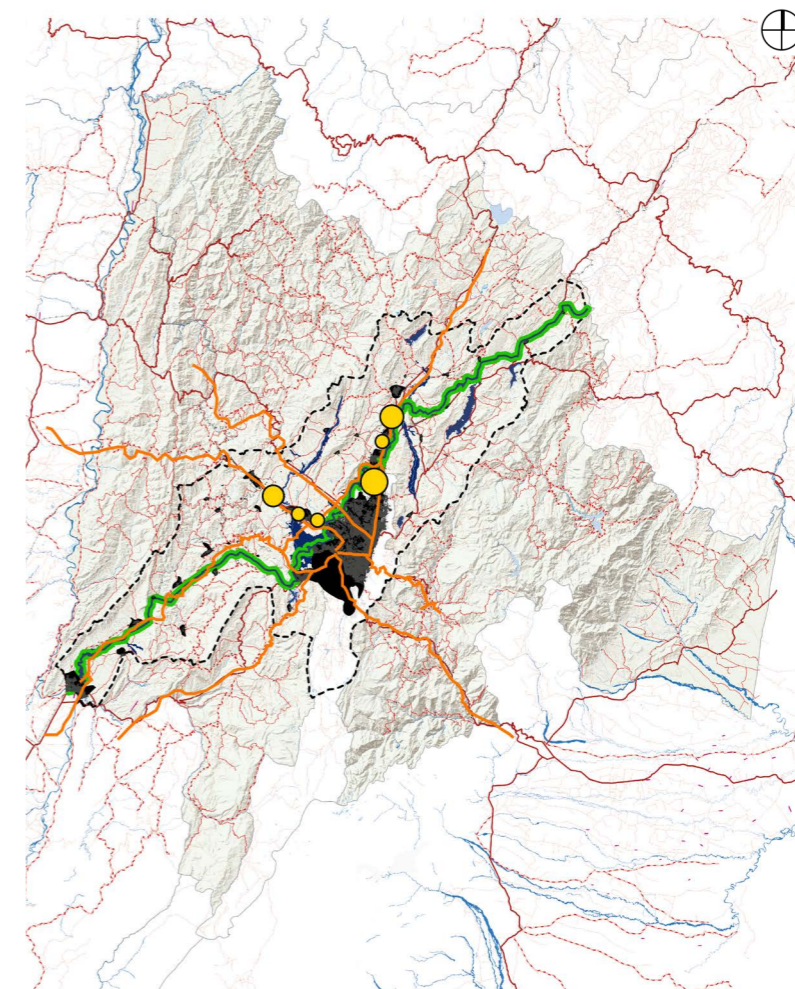
Driving force = Overlap union → Interface



- Urban development/urbanization
- Agriculture
- Hybrid spatial structure: Mixed components

The challenge of the country and the regions is: Colombia's 75% of the population live in urban areas. It has been projected that in 2050 its population will increase to 85% in urban areas. Cities around the world consume around 67% of the energy produced

and are responsible of almost 80% of the greenhouse gases. The increasingly demographic growth in urban areas and specifically in Colombia has put more demand and pressure over the natural resources.



Development of Hybrid Area

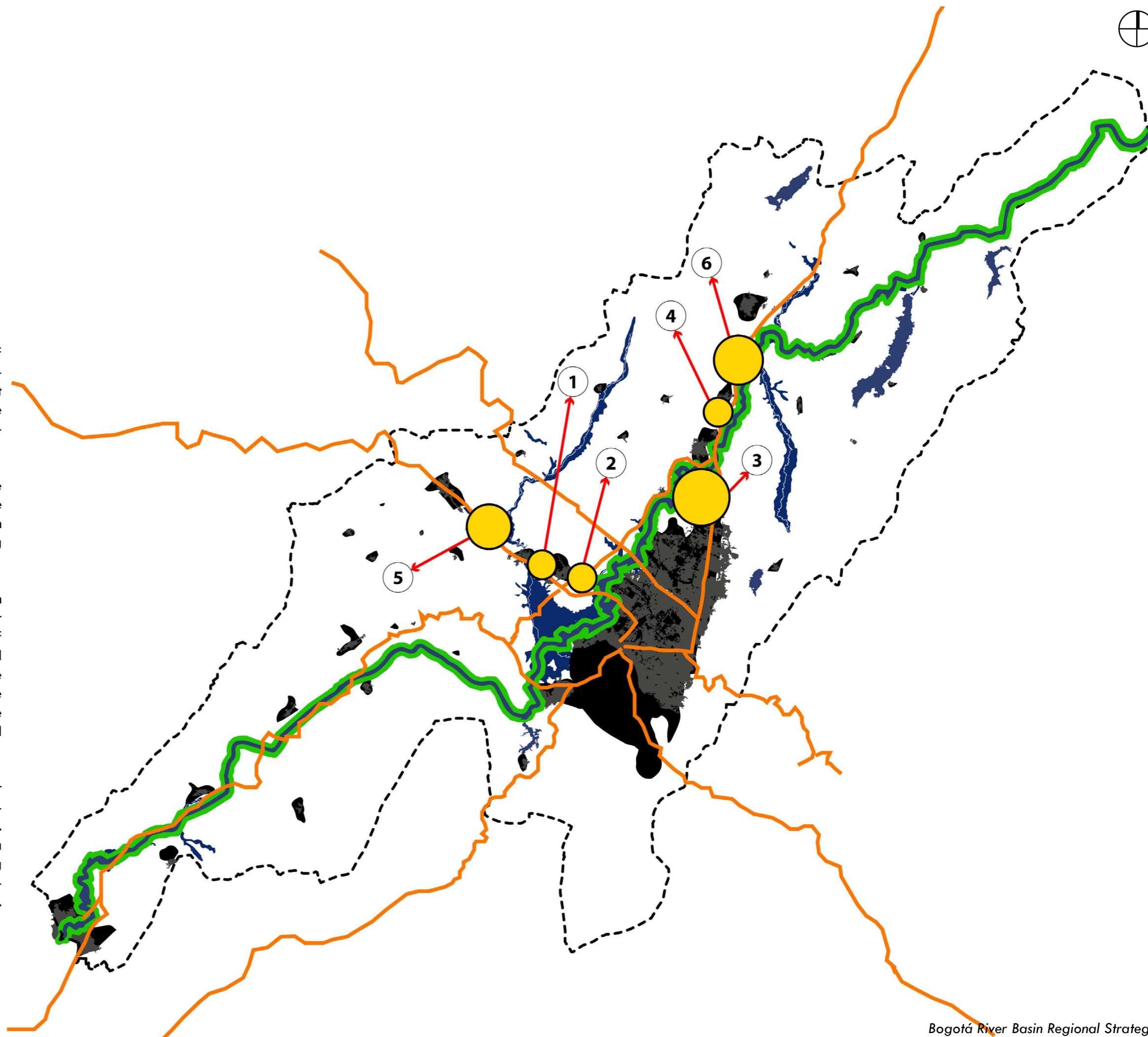
- | | |
|-------------------------|----------------------|
| 1. Madrid – Funza | } Short Term |
| 2. Funza – Bogotá | |
| 3. Bogotá – Chía | } Medium Term |
| 4. Chía – Cajicá | |
| 5. Facatativá – Madrid | } Long Term |
| 6. Cajicá – Zipaquirá | |

The strategy is going to be given by the generation of an interface (a mixed shared area) that I denominated “hybrid city”. The objectives mention before about the different flows, food, waste and energy and the development could be seen as strategic projects involucrated and developed in this hybrid areas.

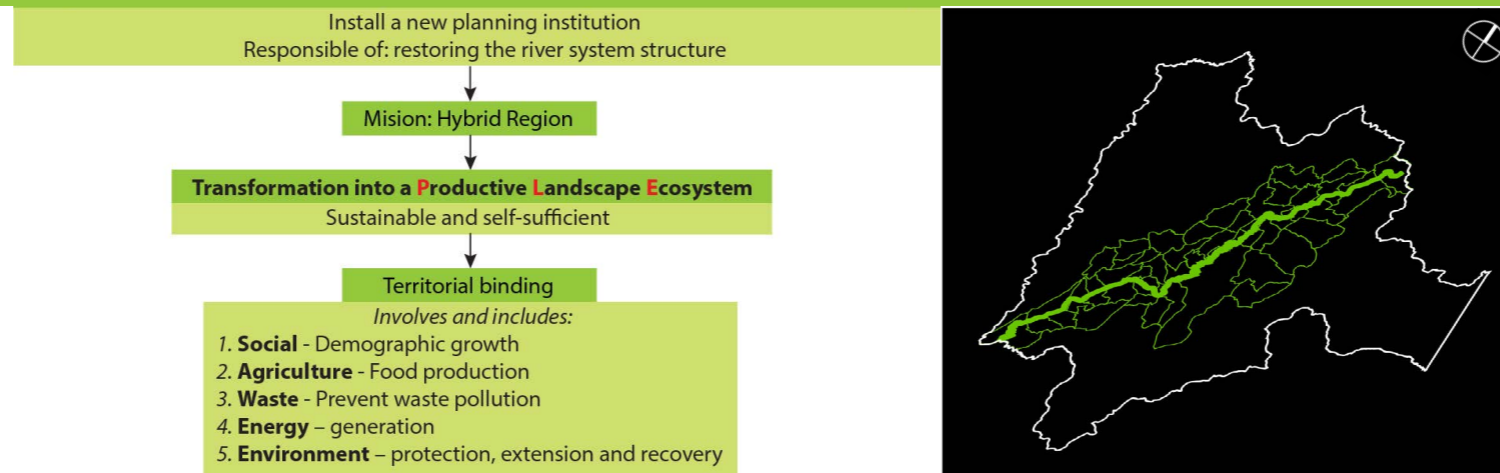
The regional strategy map (previous page), shows the location of the strategy in the whole territory of the department of Cundinamarca. The Bogotá River basin map, shows the location of the hybrid city areas along the territory.

The hybrid region strategy has six areas defined in short, middle and long term developments. With their conurbations between urban areas and absorption of rural areas will threaten more the water structure and the planning of the territory. From these six areas, the design and development will be done between the capital and the north municipality: #3. The objective of it is to show and example of the possible replied interventions in the other five areas.

The recent tradition of understanding and behaviour has been done in a local scale. This has brought pollution to the river and is seen as a constant weakness. But, if the tradition of understanding is upgraded to a regional scale for the generation of a self sustaining system it would bring an opportunity to create an integrated system of the water structure and the territory.



Bogotá River Basin Development, Planning and Protection Authority

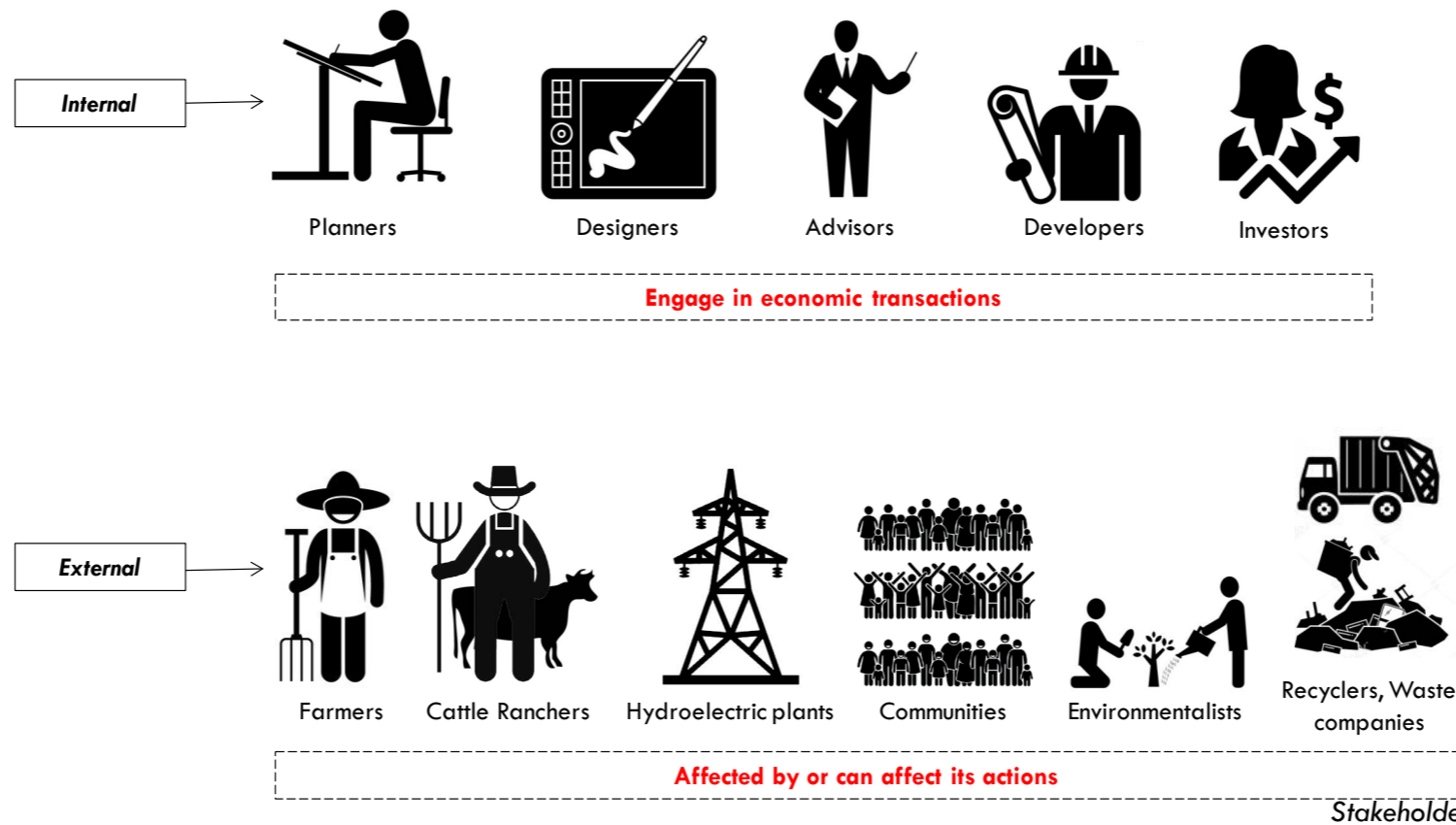


The river basin:
doesn't correspond to an administrative system

Although the
river works as a natural system structure

How to structure this ideal scheme into a realistic one? Through the development and implementation of a planning institution. The organization concept is based on a hybrid region mision (as the regional strategy proposed). Transformation of the river basin into a productive landscape ecosystem, sustainable and self-sufficient.

This concept was based on the fact that the river doesn't respond to an administrative system. Although the river works as a natural system structure. The institution will be responsible of restoring the river system structure, binding social, agriculture, waste, energy

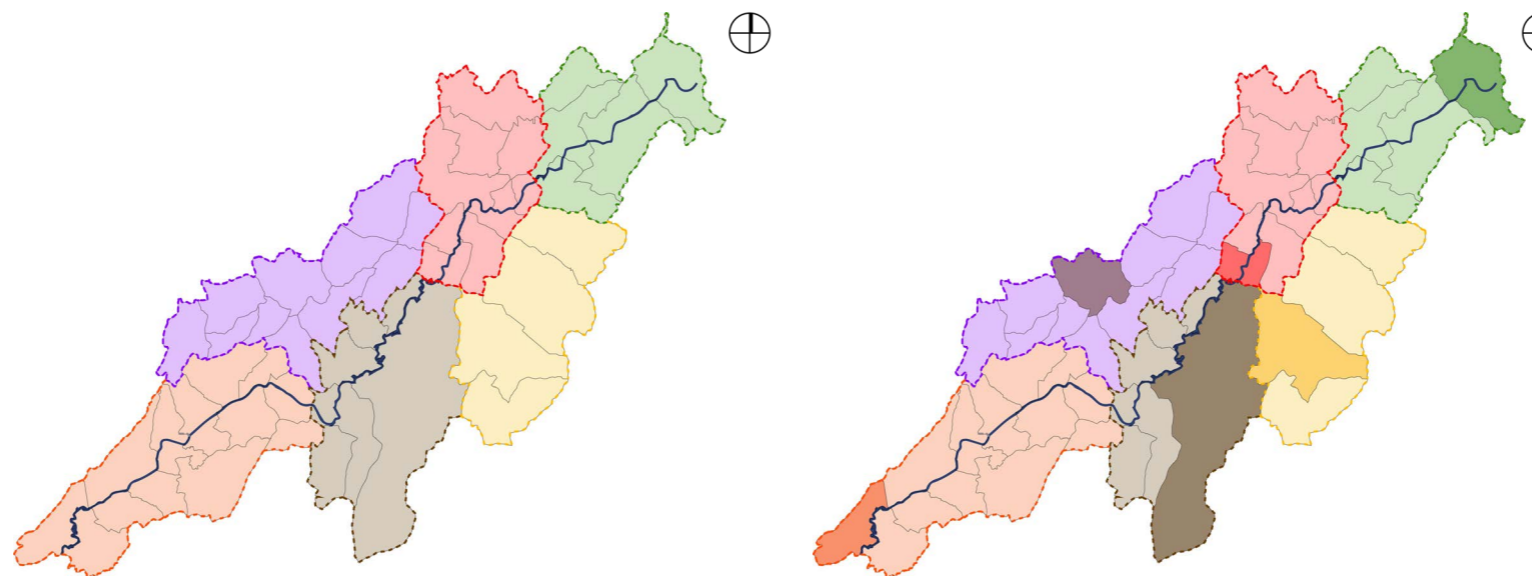


and environment issues. The group of stakeholders involved is as follows:

The internal stakeholders will involve from planners to investors and the external will include the people involved in all the flows mentioned before. The internal are engaged in economic transactions, while the external stakeholders are the ones that will be principally affected by or can affect the actions taken in the project.

The framework in the map distribution (for the planning institution) is given in six groups between the 46 municipalities involved with the Bogotá River. There are two types of members: core and peripheral. The core member groups are the ones that have physical direct contact with the river. The peripheral member groups don't. Every group and the municipality has one representative in the internal structure of the planning institution.

- Core Members**
- Group 1
- Group 2
- Group 3
- Group 4
- Peripheral Members**
- Group 5
- Group 6



River Basin Map Distribution

- Core Members**
- 1. Girardot
- 2. Bogotá
- 3. Chía
- 4. Villapinzón
- Peripheral Members**
- 5. Facatativá
- 6. La Calera

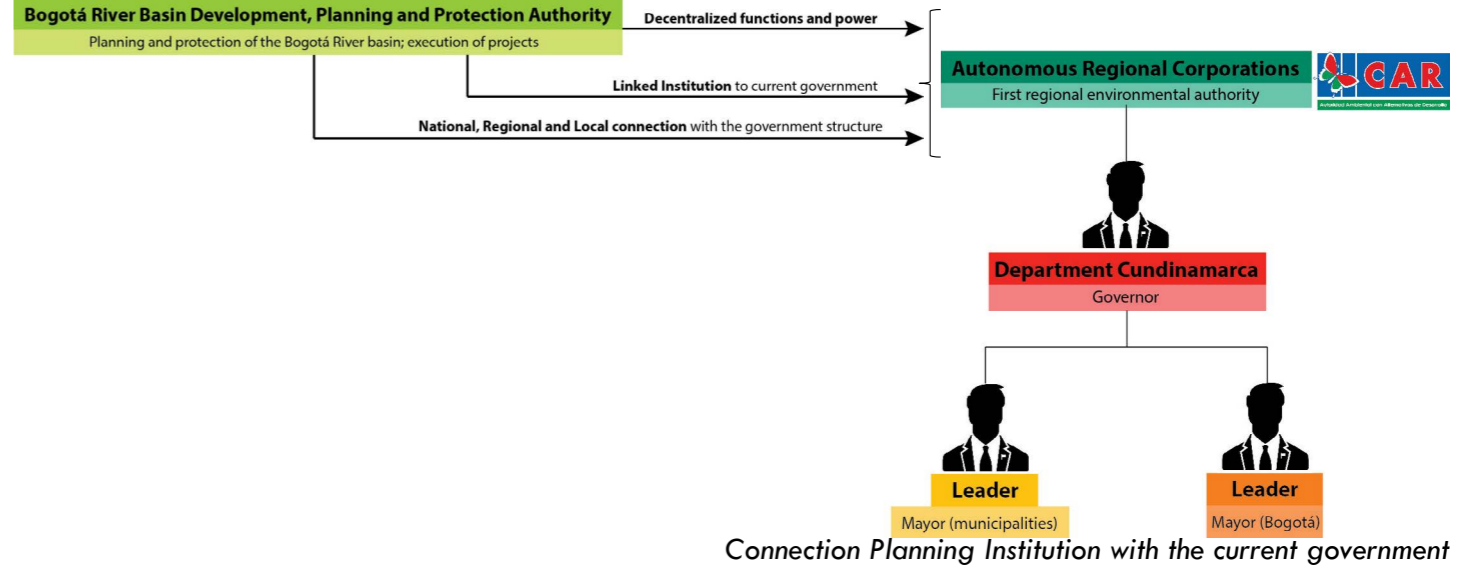
Bogotá River Basin Development, Planning and Protection Authority

Image #1, is the internal structure of the spatial distribution shown before. There are three scale levels interconnected. Local with the municipalities, regional with the six groups representatives and River Basin scale level for the general assembly where internal and external stakeholders make the final decision making.

Image #2 has the relations/tasks structure: bottom up, from the local scale to the River Basin scale. The scheme goes from the bottom to the top. The representatives of the municipalities come from parctical

fields such as: agriculture, waste, energy, environment and local communities. There is a local assembly to then move to the regional assembly and finally the general assembly.

The socialization and decision making map (#3). It has the same structure that the relations/tasks structure. The difference is that the scheme flows from the River Basin scale (top) to the local one (bottom). After the final decision making in the general assembly the projects develop are going to be socialized in this way. The experts/advisors responsibilities are shown in the



Connection Planning Institution with the current government

table (below). It is divided in 4 sections: Legislation, Planning, Design and Documentation Centre.

Each one works in its respective theme although they all work with the improvement and focus in: food, waste, energy, recreation and the natural structure of the general ecosystem in the territory.

The ideal interaction between the institution and the government structure is shown in the scheme above. It will work in three different scales.

It will be a linked institution with the current government, however it will have decentralized functions and power.

Internal Structure

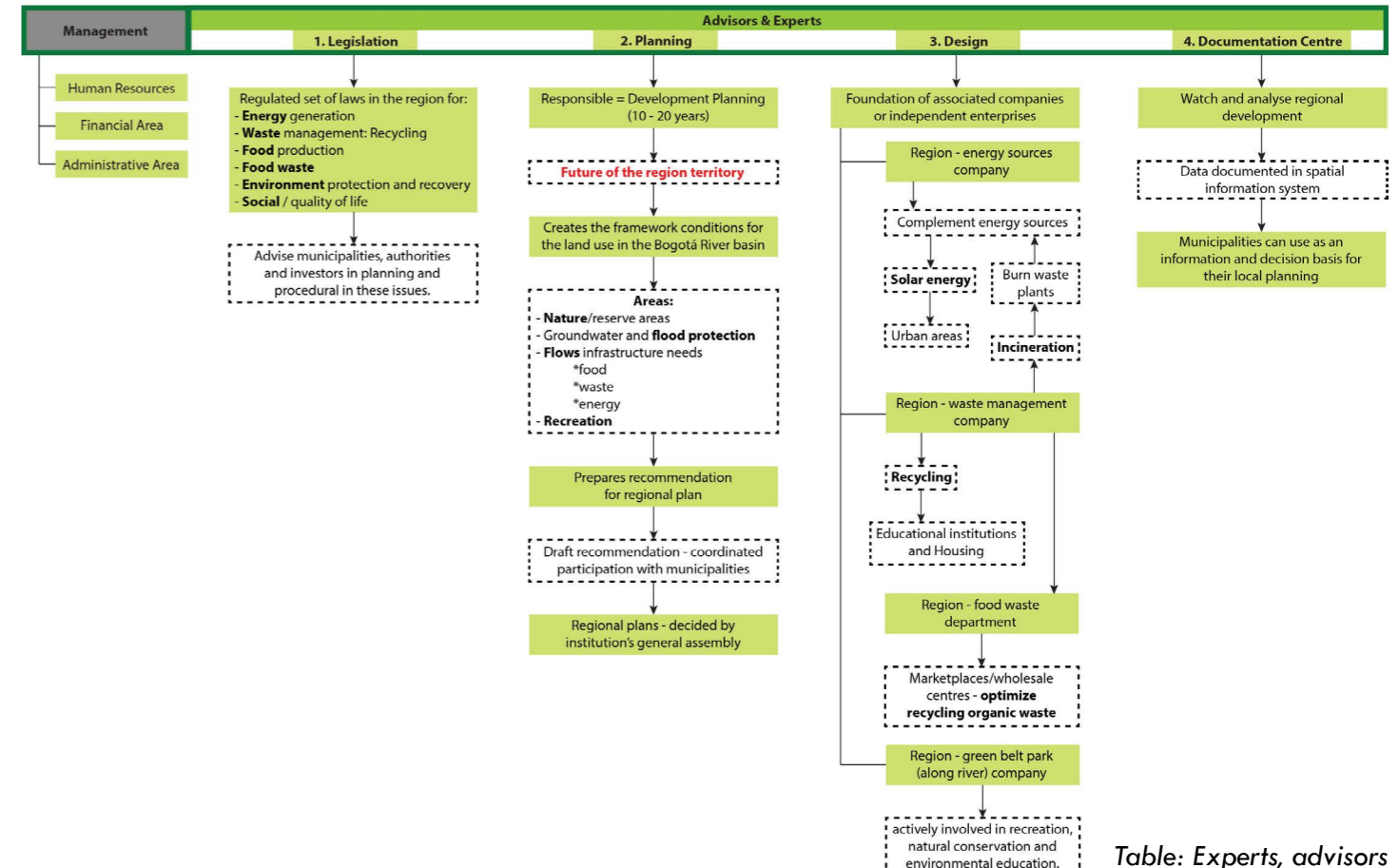
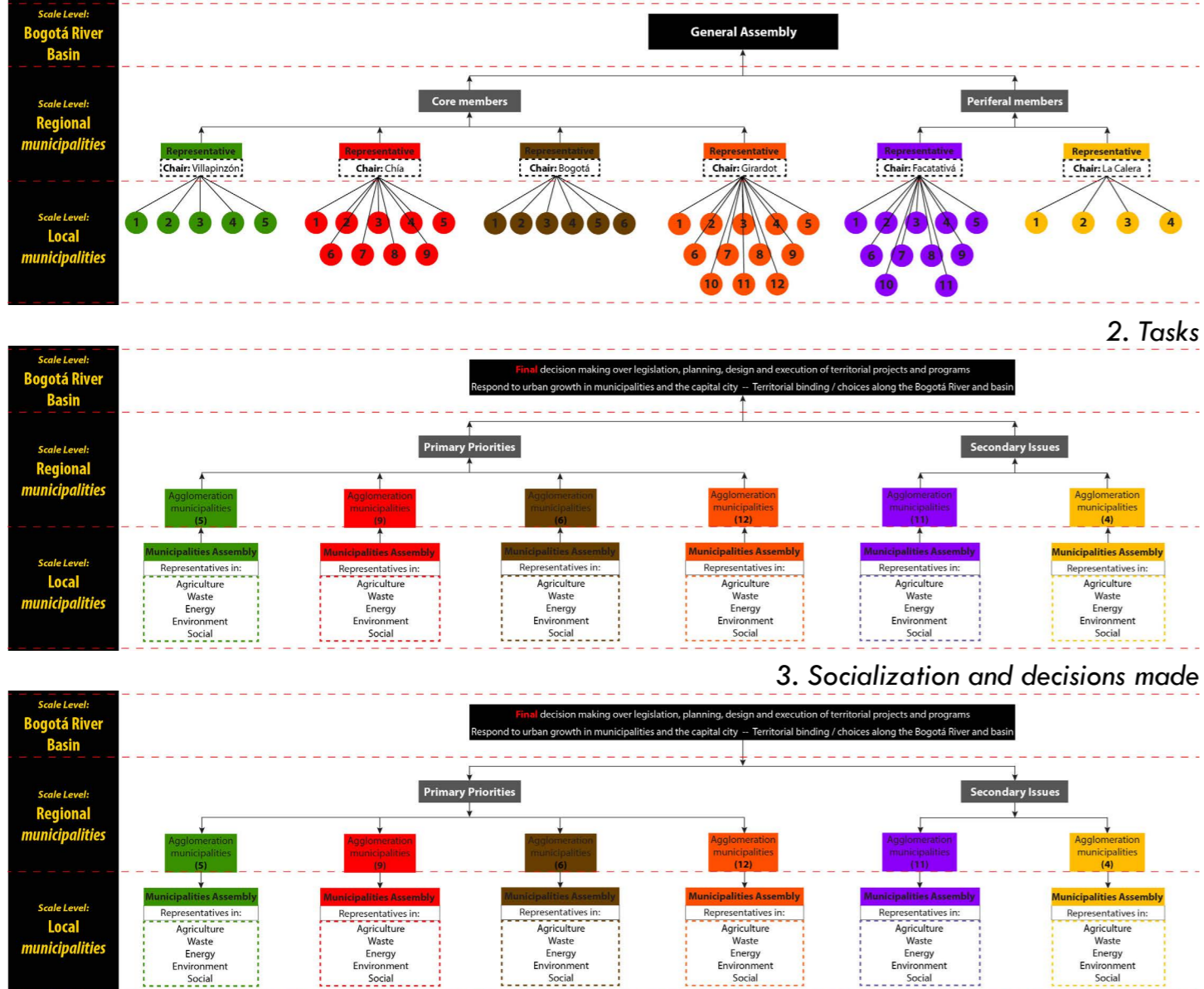
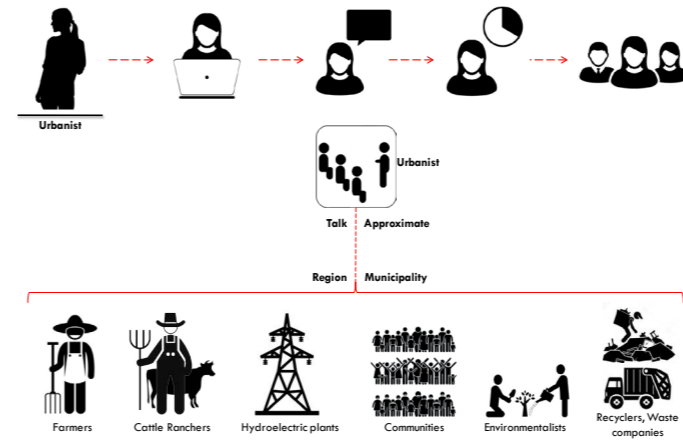
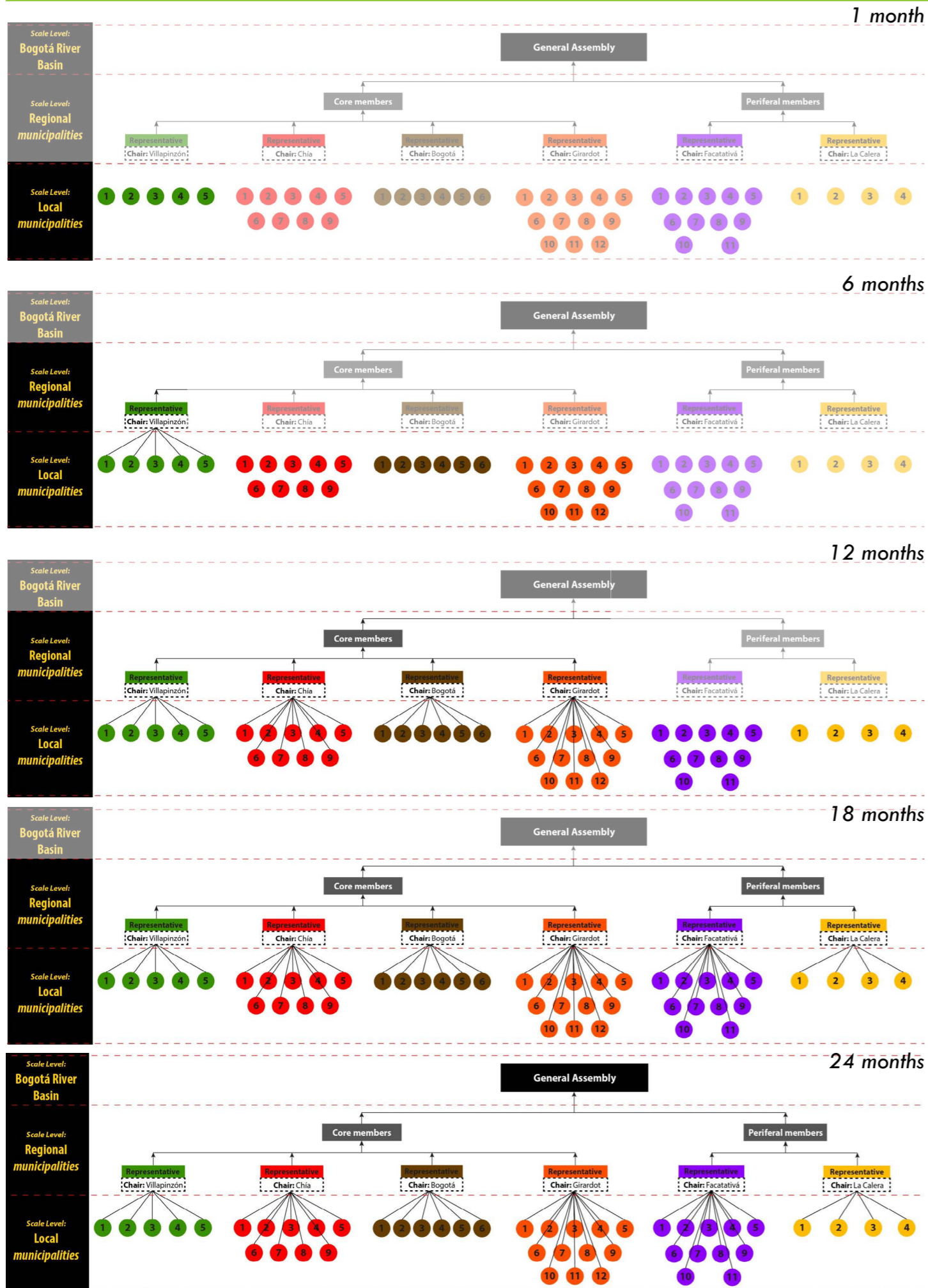


Table: Experts, advisors

Bogotá River Basin Development, Planning and Protection Authority



How is it going to work this planning institution in the short, medium and long term? The starting initiative is to contact and approximate the external stakeholders, then introduce them to the plan project.

The conformation of the institution will be done in approximately two years. The phasing of the planning institution is shown in the scheme of the left. First the local scale is develop in different stages until is complete to consolidate the regional assembly. After the local municipalities representatives is complete, the Chairs are selected to become an active part of the general assembly and the final decision making.

After the first two years, the phasing of the development and improvement of the territory will be given in 30 years, through the spatial interventions shown in the maps. For the first 15 years, the ecosystem will recover completely and for the next 15 years the social interventions will consolidate completely.

To build the scheme of the proposed planning institution, there were some European projects of regional governance that contribute as potential examples of spatial planning and sustainability. The principal reason why these projects were highlighted, was because they **applied spatial strategies in order to improve social, environmental and economic aspects**. The first example deals with the regeneration of the Emscher River, also known as **Ruhr Region Basin** in Germany. The second example, the **Zuidvleugel** or "south wing" is the group of cities and towns in the south-west of the Randstad in the province of South Holland in the Netherlands. They have one principle: co-government. The third example, **the community of communes of Val de Drôme** brings together thirty municipalities of the Drôme Valley located in the region Auvergne-Rhône-Alpes in France. The community has three missions: sustainable & distributed development, enhanced solidarity and environment quality.

30 years



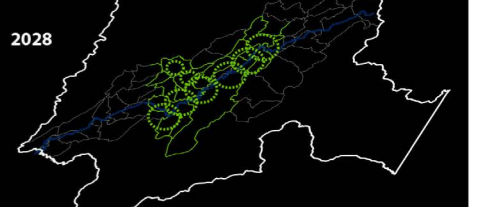
20 years



15 years



10 years



5 years



2 years



Phasing: planning of the territory

Section 5 Design

Ideal Vision

The ideal vision, in the development and design of the hybrid city, is shown in the map below. Spatial planning in line and accomplishing the main goal in the environmental field and the objectives in agriculture, waste, energy and urban development.

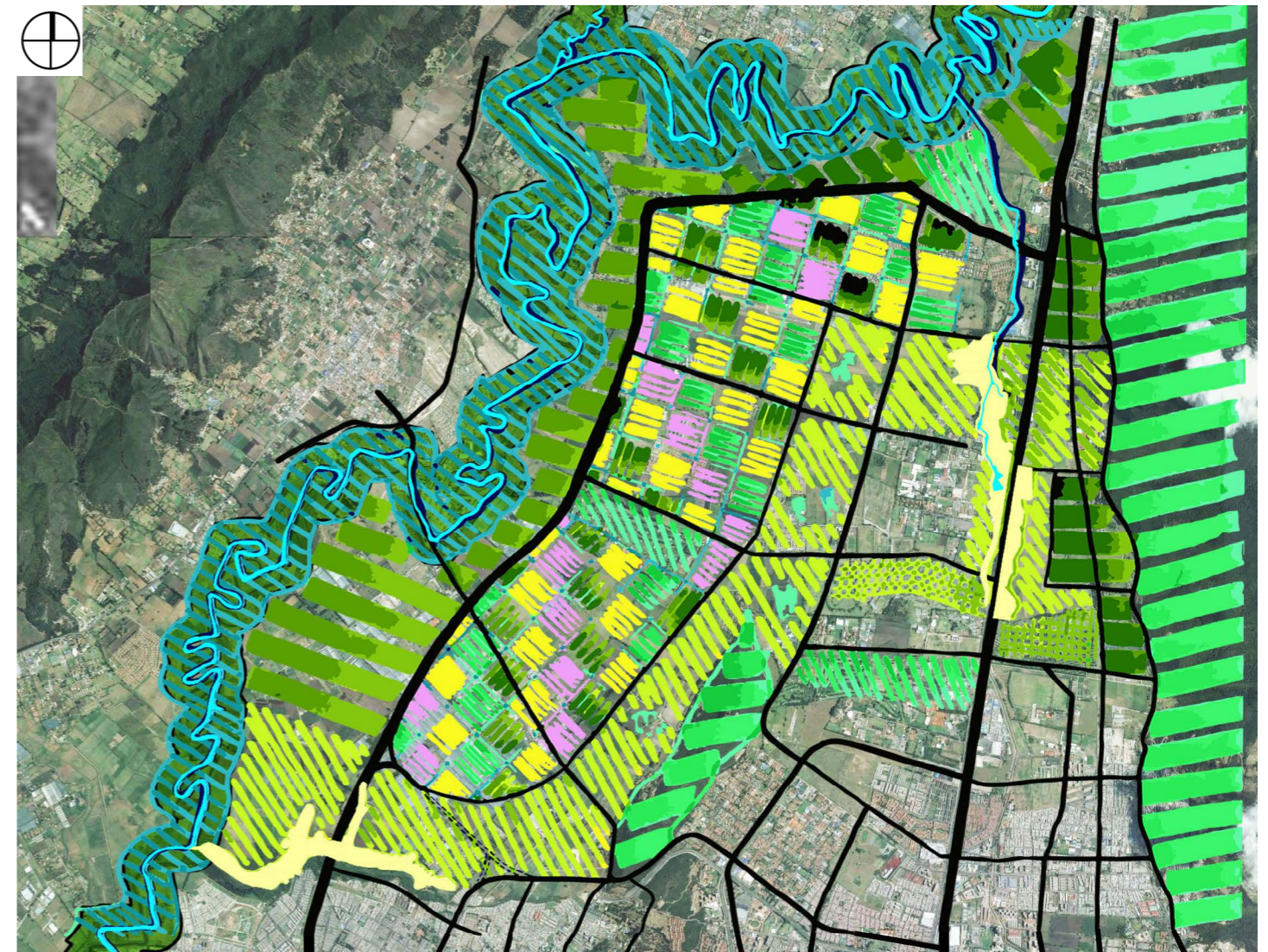
To accomplish in a realistic way the goal and objectives, it is important to optimize three systems and their flows: food, waste and energy; including the so-

cial and environmental factors. The systems have certain demands:












Food: Feed **55%** more population with the same amount of land.

Waste: Manage and locate **141%** more waste
Reduce traffic 50%









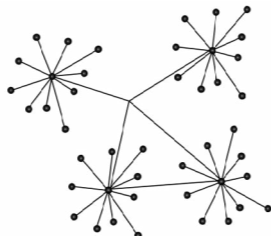


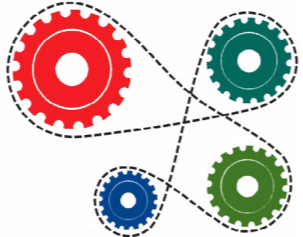





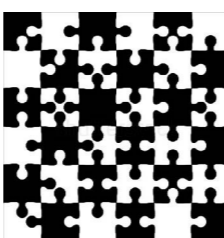
Energy: Energy generation **4 times more**



Hybrid model

- | | |
|---|---|
|  Urban Forest | Predominant Use in the area |
|  Wetlands |  Facilities |
|  Hills |  Housing |
|  Rivers |  Urban Agriculture |
|  Flood Area |  Flower Fields |
|  Sustainable Agriculture | |
|  Private to public green areas | |

Realistic Vision





	Method	Use / Implementation	Transform into: Regional network structure system
GOVERNANCE 	Inclusion	 Landscape	 Balance
CONTAMINATION RIVER 	Recover	 Sources that contaminate	 Sustainability
INFRASTRUCTURE 	Connecting Network	 Bicycle	 Interconnected pedestrian Network
FOOD 	Supply system	 Urban Agriculture/ Sustainable Agriculture	 Integrated Farming
WASTE 	Recycle	 Recycling System	 Reuse Network
ENERGY 	Complement	 Solar Energy/Burn Plant	 Renewable Energy Network

Regional Toolbox

To improve these demands listed in the previous page over food, waste and energy, a regional/local toolbox was developed and will help tackle these issues. The toolbox will allow to reach the hypothesis established since the beginning. The goal system where the conflict between human activities and natural resources coexists in a sustainable way. The toolbox is shown in the left page:

It includes the three flows (food, waste, energy), governance, contamination and infrastructure as the principal key elements for the framework in the design.

To classify, validate and adjust these information, the key elements: governance, contamination, infrastructure, food, waste and energy, are the starting point for the proposal to succeed.





-  **Wetlands** – 500 Ha approx.
-  **Eastern Hills Reserve** – 13.200 Ha
-  **Bogotá River** – 90 km approx.
Passes through the city
-  **Thomas Van der Hammen Reserve** – 1395 Ha

As a result, they will achieve the necessary support to transform the region into a hybrid city model and potentiate sustainability.

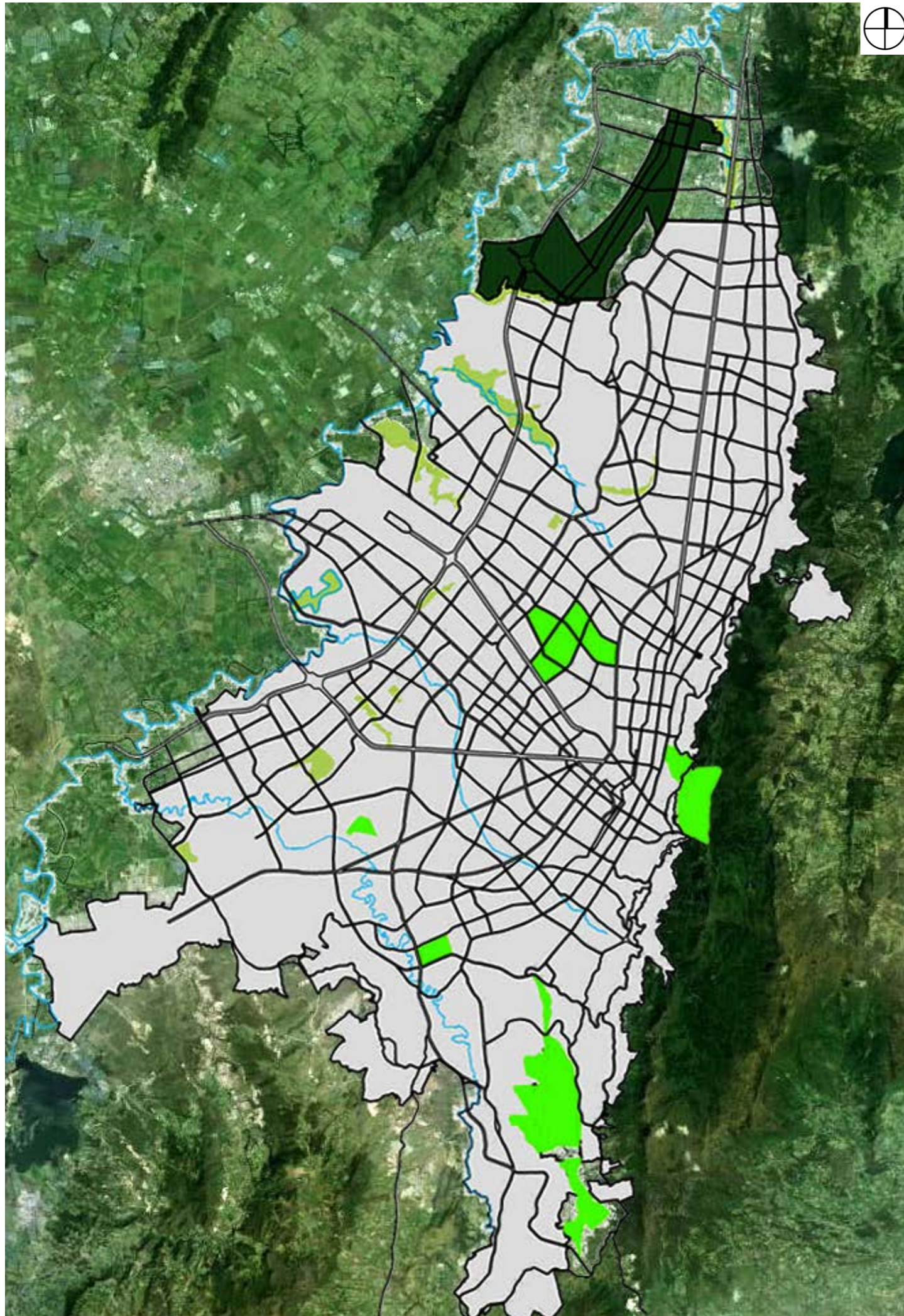
The design shown in the beginning of the section, illustrates the development of the hybrid city model in area # 3 of the regional strategy. It is located in the northern part of the capital city (Bogotá).

Bogotá has a population of **7.800.000** people (2015). In 2065, the population is expected to have **12.900.000**. In this 50 years, the population of the capital will grow 5.000.000 approximately.

In the areas and quantities shown below, it can be seen that the area has a great ecological structure, plus opportunities in food (urban agriculture) and waste fields principally, for the improvement and sustainability of the ecosystem and the population.

-  **Consumes** – 1 kg per day
365 kg per year
-  **City Generates** – 800.000 kg of recycling material
-  **Produces** - 0.28 kg recycling material per day
-  **Usage of** – 1.300.000 Ton per year





Ecological Structure and Urban Development Bogotá

The map in the left, that has the Ecological Structure and Urban Development of Bogotá, shows the dimension of the urbanization in the territory and the amount of natural structures that the city has. The capital has around fifteen wetlands, one natural reserve (Thomas Van der Hammen), the Eastern Hills and the Bogotá River, to mention some of the ecological structures.

To take advantage of the enormous ecological structure that Bogotá has, that is in danger of been urbanized and wasted from the spatial planning of the city, the hybrid city model will be located in the northern part of the capital city where the forest reserve Thomas van der Hammen is located.

The regional toolbox will help explained the planning and design of this specific area.

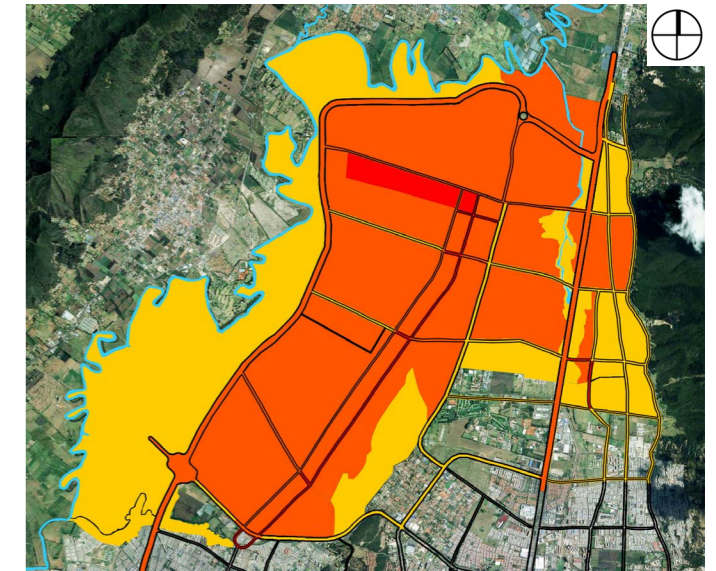
Governance

In the right column, there are two maps that illustrate in different categories what will go, transform or preserve.

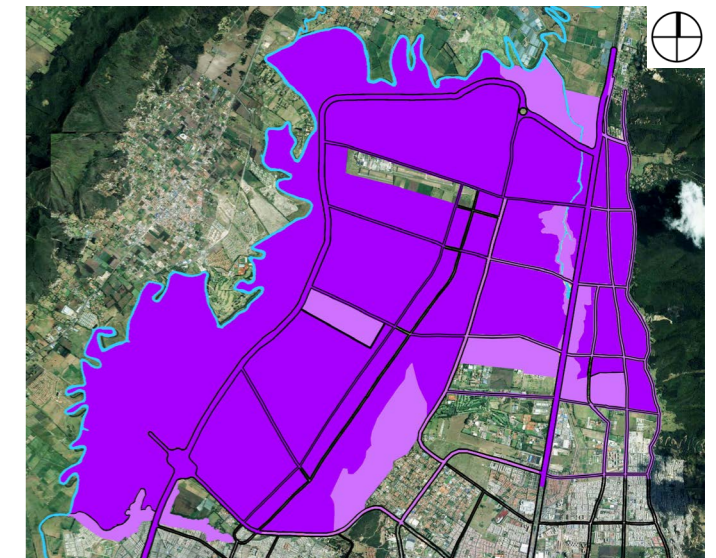
In the top: land use. The majority of the preserved areas in the map are ecological structure. In the middle: Spatial Planning. Around 85% of the area will be transform in its planning distribution.

Finally in the bottom, the timeline where the territory will be transform by the intervention of the new planning institution during approximately 20 years. The area is divided into seven periods. The priority is given to the areas closer to the water structure and the urban forest in the plan.

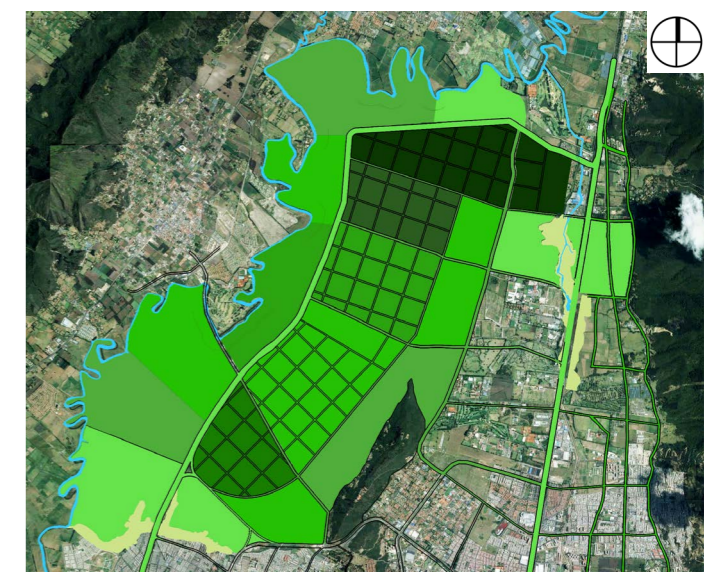
- 2 years
- 5 Years
- 7 years
- 10 years
- 12 years
- 15 years
- 20 years



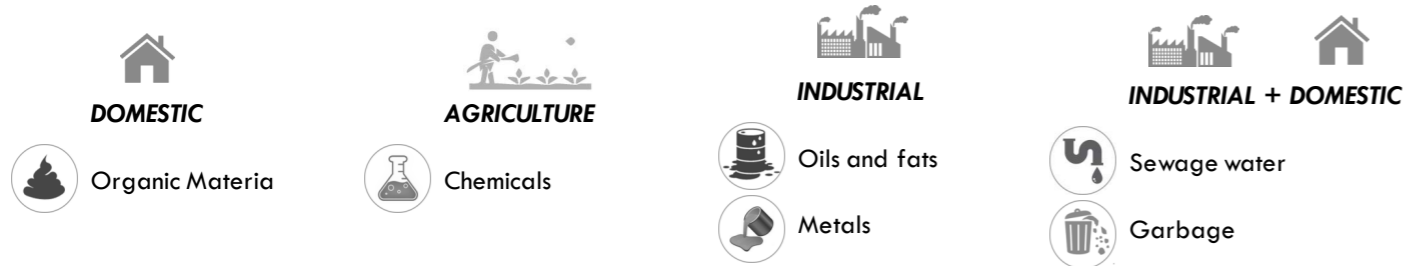
- Go 5 - 10 years
 - Transform 1 - 20 years
 - Preserve
- Land Use*



- Transform
 - Preserve
- Spatial Planning*



Timeline



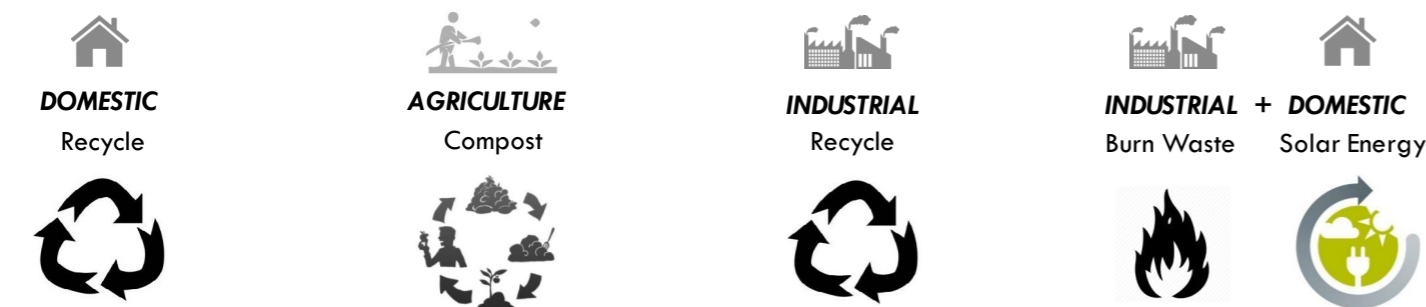
Contamination of the river

The objective is to prevent the contamination and control the amounts thrown to the river. It is possible by identifying the sources that contaminate in higher quantities:

- Domestic
- Agriculture
- Industrial
- Mixed: Industrial + Domestic

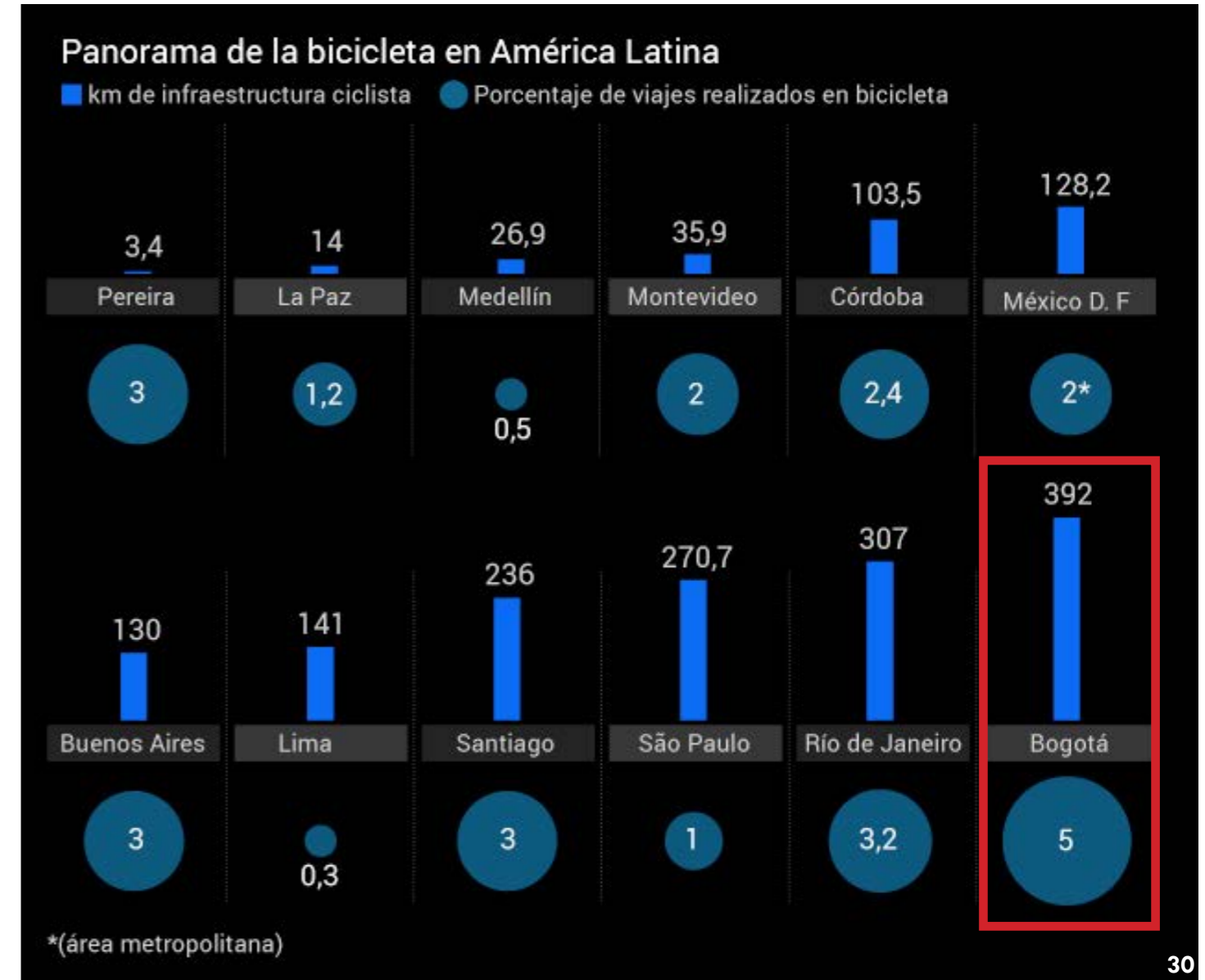
These four principal sources have the opportunity to change the current situation over the river, through the optimization in recycling processes and other solutions such as:

- Domestic
 - Agriculture
 - Industrial
 - Mixed: Industrial + Domestic
- RECYCLE
COMPOST
RECYCLE
BURN WASTE**



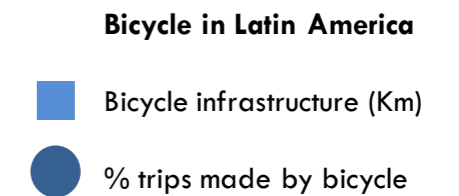
Infrastructure

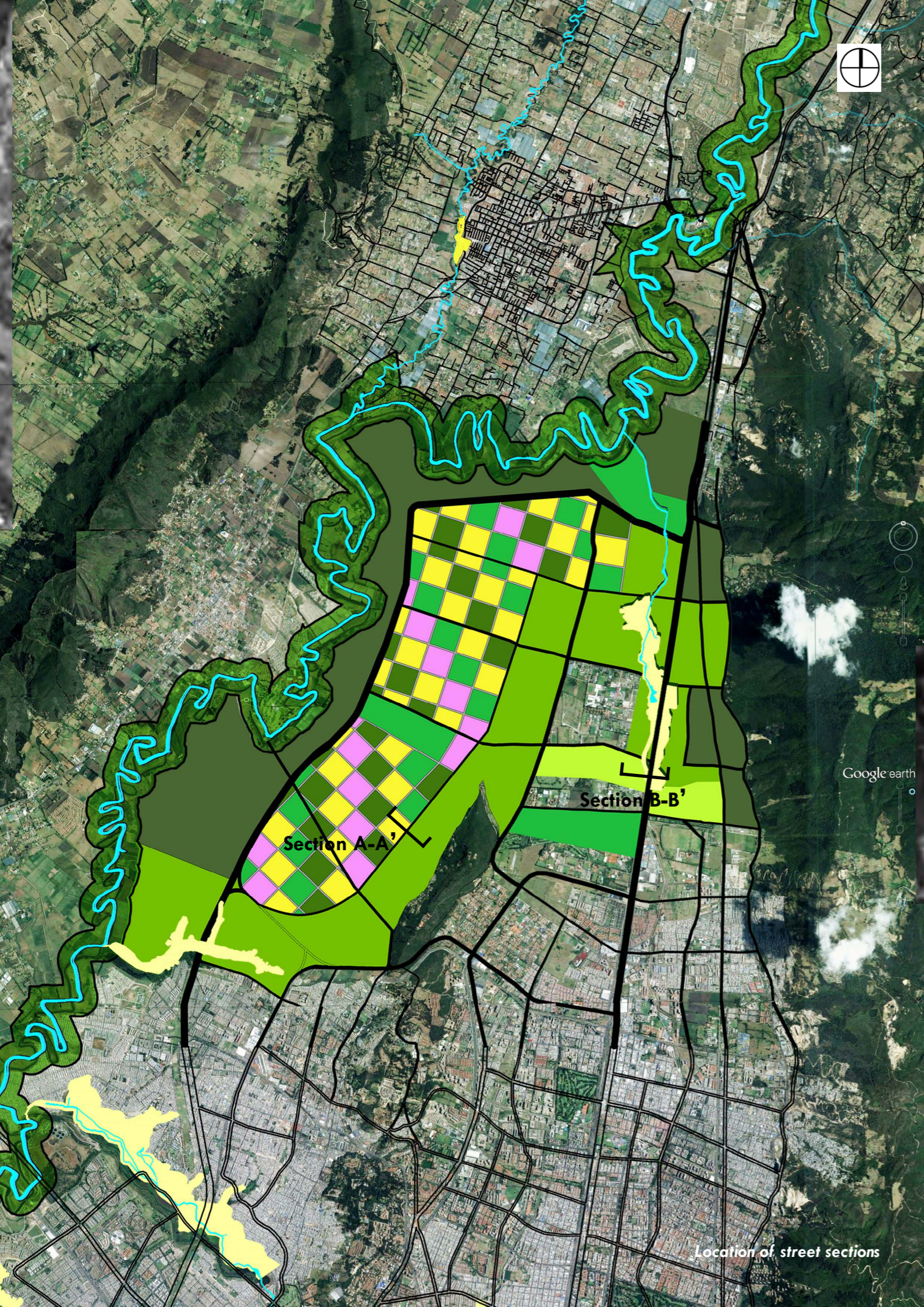
The element highlighted in infrastructure is the bicycle. In Bogotá and other cities around the department, has great reception and potential of improvement. The city has around 392 km of bicycle paths that could be increased in the planning of the hybrid city model.



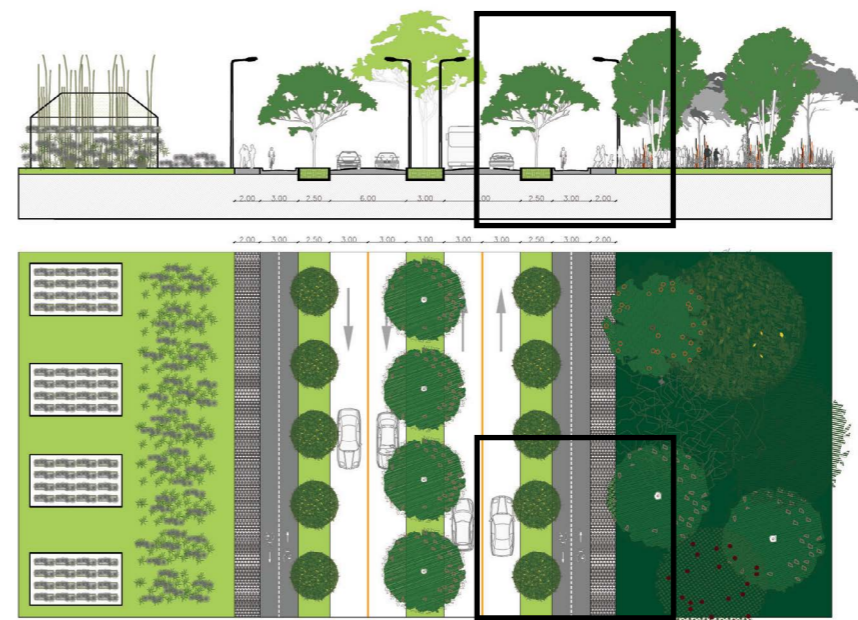
In the map, Location of street sections (page 61), there are highlighted two sections to illustrate the distribution and priority given to the bicycle in the hybrid city.

Also the Bogotá River and its planning and protection area is included to show where the **Bogotá River Basin Development, Planning and Protection Authority** will start its duty and establish the proposed strategies for the protection of the ecological structure of the Bogotá River basin.





Section A-A'

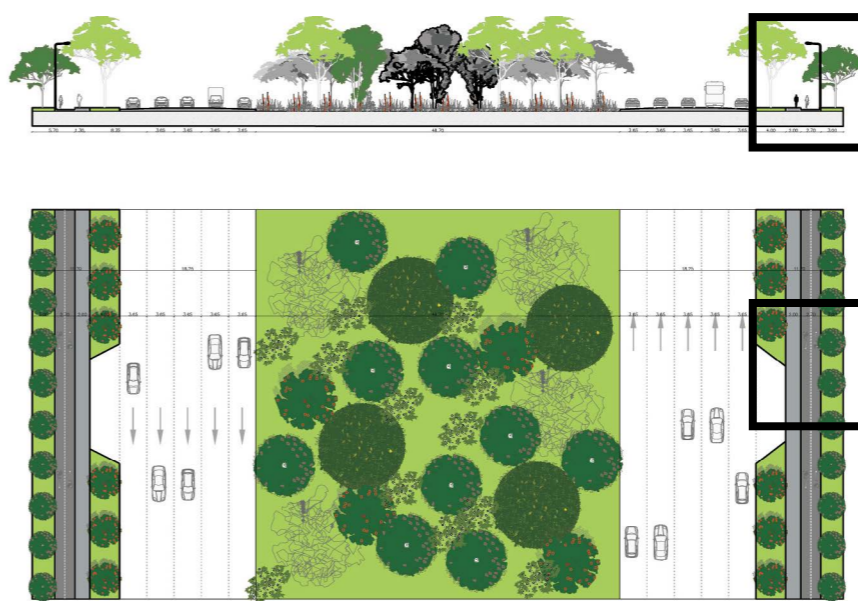


Section general infrastructure

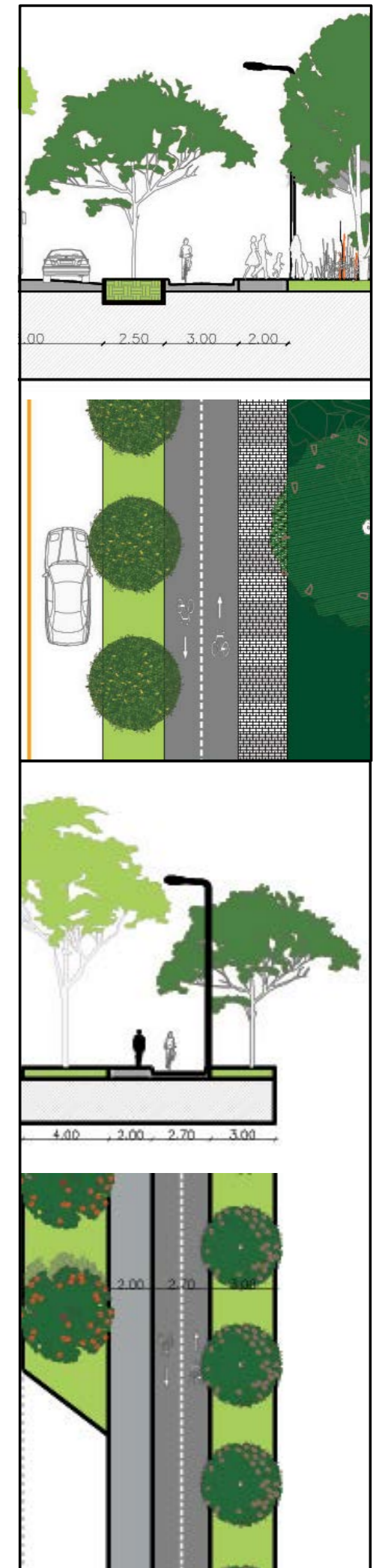
The sections shown in this page, illustrate the distribution of the principal road infrastructure. The priority in design for an enhanced network infrastructure is the bicycle and pedestrian flows. For this reason in every case, there are bicycle paths, pedestrian sidewalks, public transport and finally car lanes.

The sections correspond to a primary road and the relation between the urban forest park and the square framework; and the other to one main arterial road involved along the hybrid city design. In both it is taken into account the needs in public transport and cargo; without forgetting and including the ecological infrastructure.

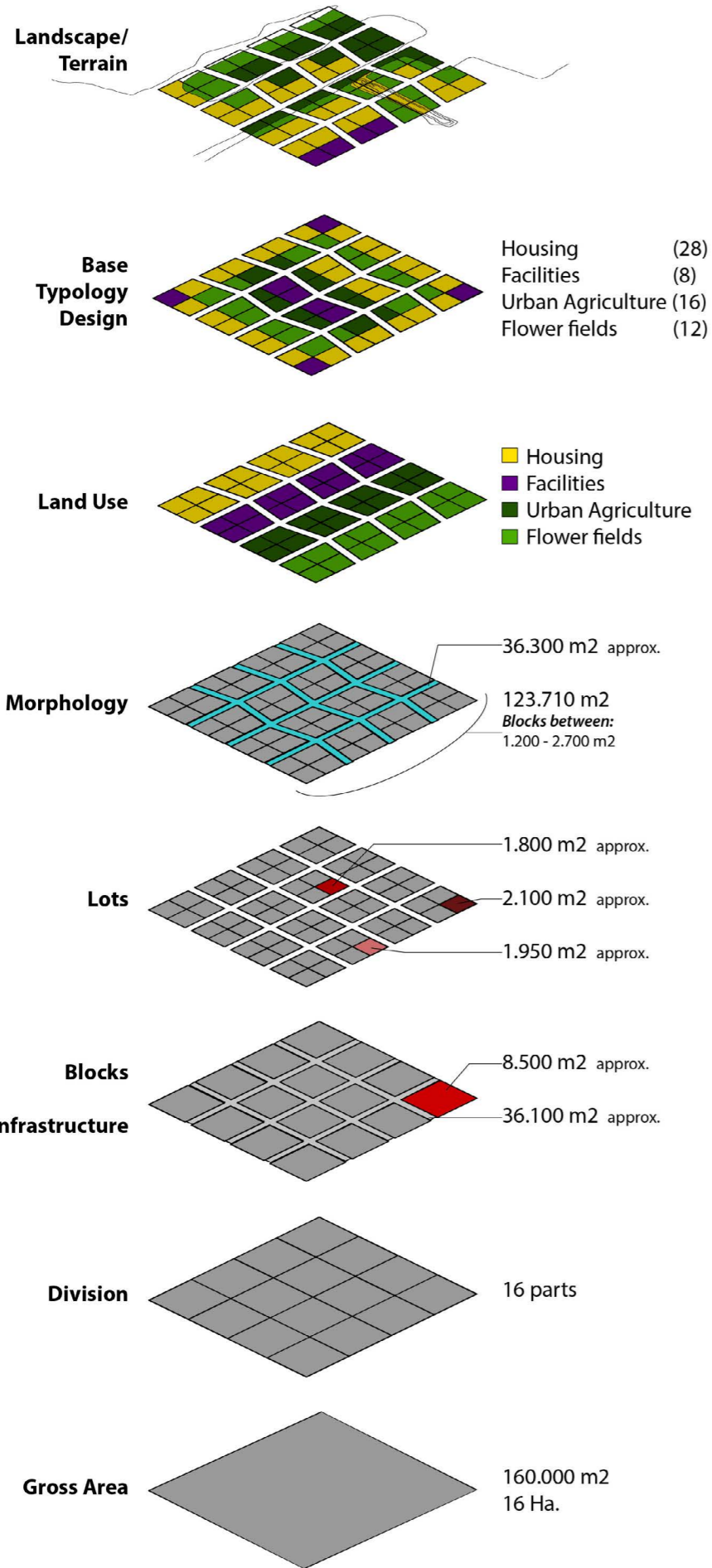
Section B-B'



Section arterial infrastructure



Square Design Framework



Structure and morphology square system

In the next section, it will be explained the remaining three key elements of the regional toolbox: food, waste and energy, related with the connection local/regional scale of the hybrid city model.

During the design process a square system is developed. It has the framework for the planning of the territory that corresponds to the areas assigned for this specific spatial structure.

The main square system starts with a gross area of 16 Hectares (see image Structure and morphology square system). Along the distribution, the infrastructure, blocks and finally lots are defined, which give shape to the morphology of the square. In the end the main typology square has 64 lots divided into 16 smaller blocks with an area between 1.200 and 2.700 m².

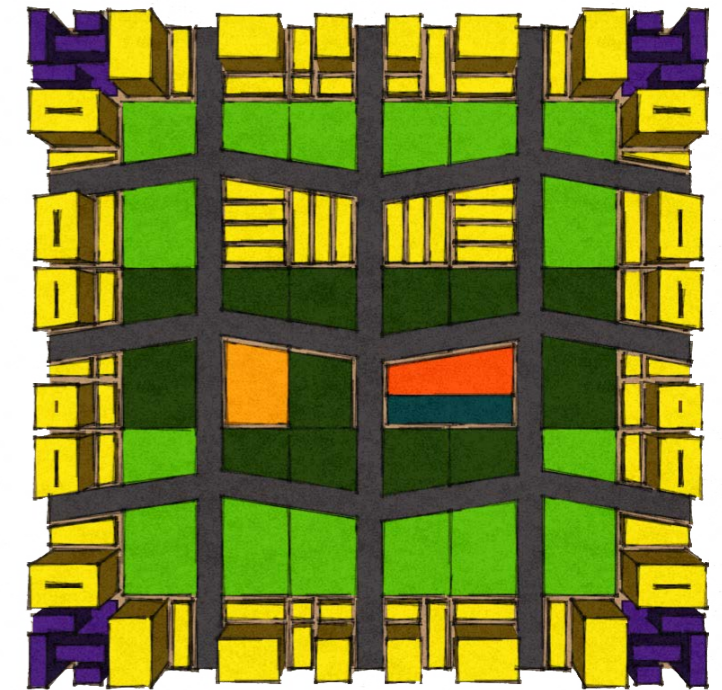
The land use is distributed in four main functions:

- Housing
- Facilities
- Urban Agriculture
- Flower Fields

As a result, the system square has its functions located responding to the

The square system distribution is shown in the image below:

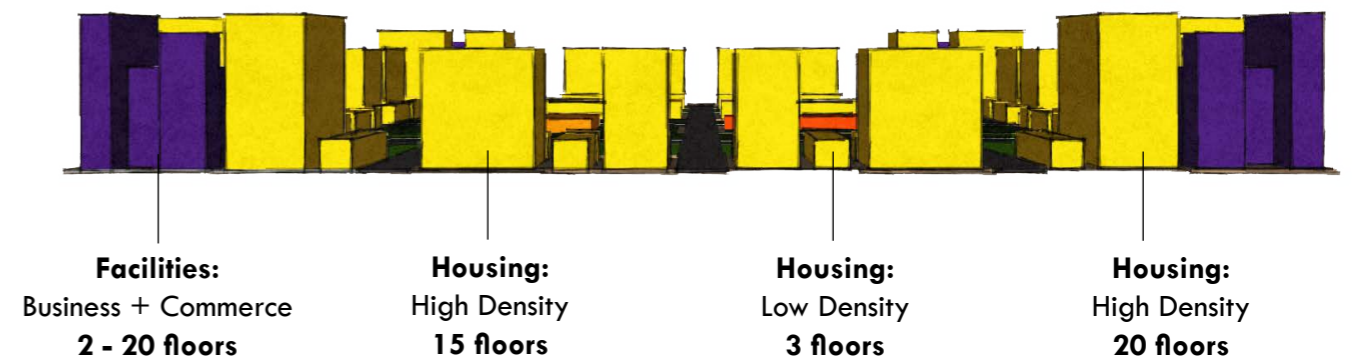
- Housing
- Commerce and business
- School (pre-school)
- Recycling Collection Point
- Urban Agriculture
- Flower Fields



Square System Distribution

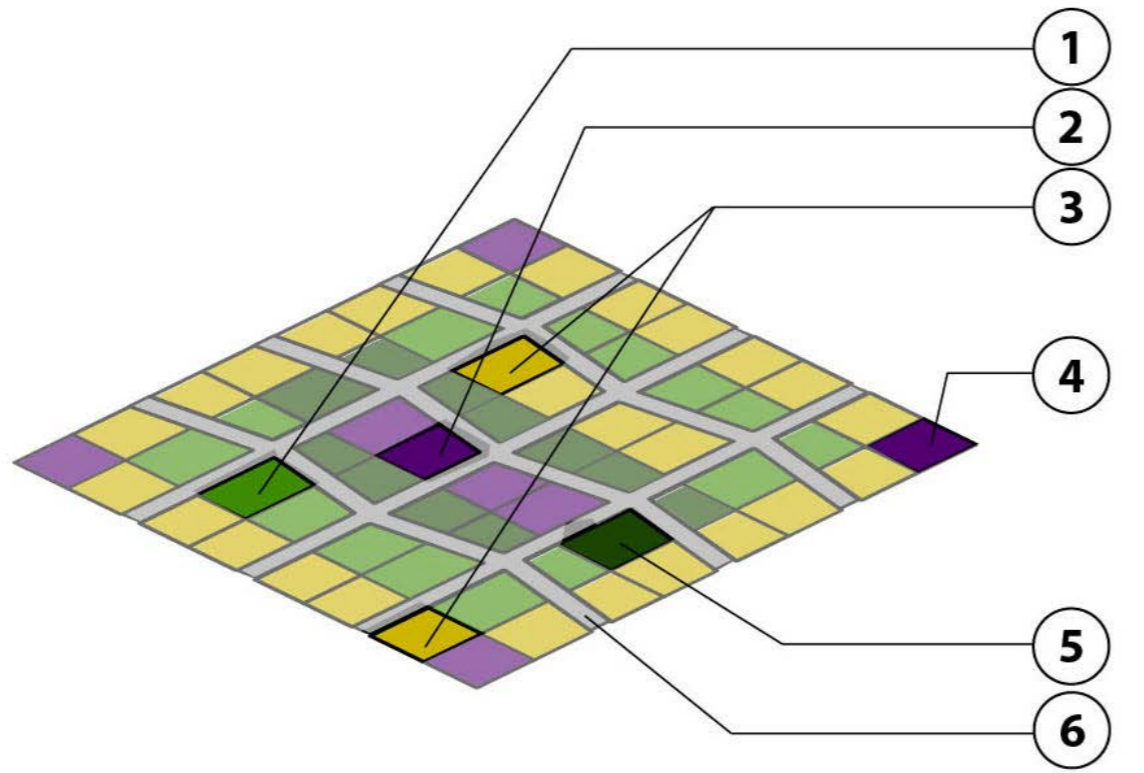
To begin, the buildings have a height of floors depending on the function. The standard and suitable to have a successful model with the goals established, is shown in the section below (Section Square System Distribution):

Facilities and housing near it has the higher buildings. On the other hand, the inner part of the square has lower density and height. The design criteria is focused to reduce demands over urban development, food (agriculture), waste and energy.



Section Square System Distribution

Density

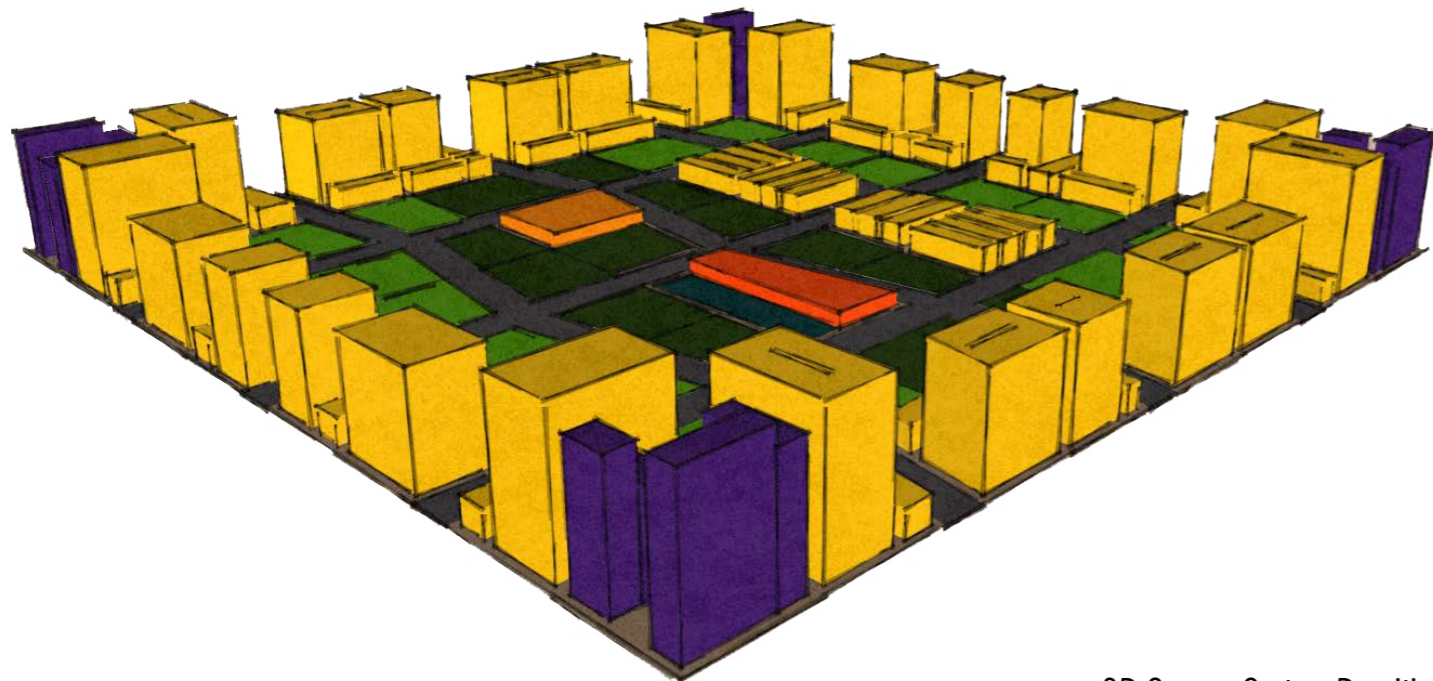


Square Densities

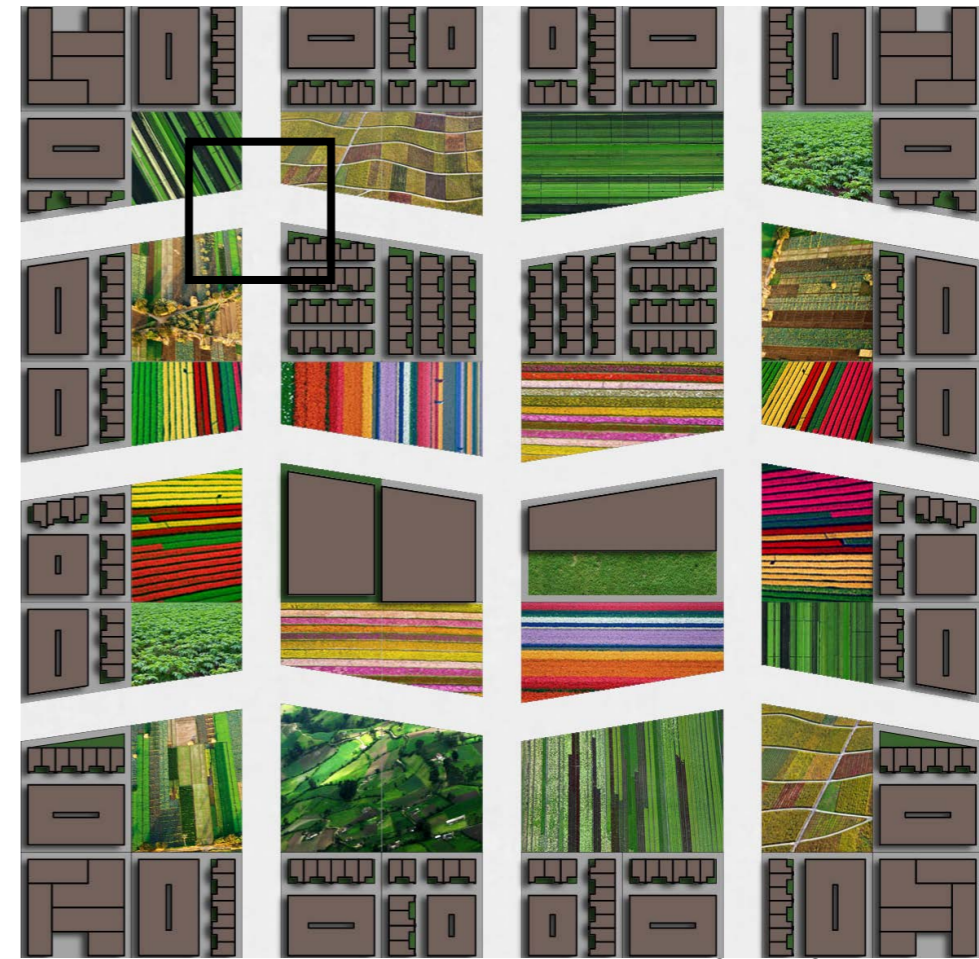
1	Urban Agriculture	16 Lots	3.16	Ha
2	Facilities: Education, Waste	4 Lots	0.46	Ha
3	Housing: High/Low Density	28 Lots	5.62	Ha
4	Facilities: Business, Commerce	4 Lots	0.85	Ha
5	Flower Fields	12 Lots	1.98	Ha
6	Road Infrastructure		3.63	Ha
TOTAL			15.70	Ha

Areas and functions

The qualities and opportunities present in the previous fields brought the densities inside the square system, that are shown in the image Square Densities. Each function has a certain number of blocks and total area. The square will look like the 3D scheme: Square System Densities.



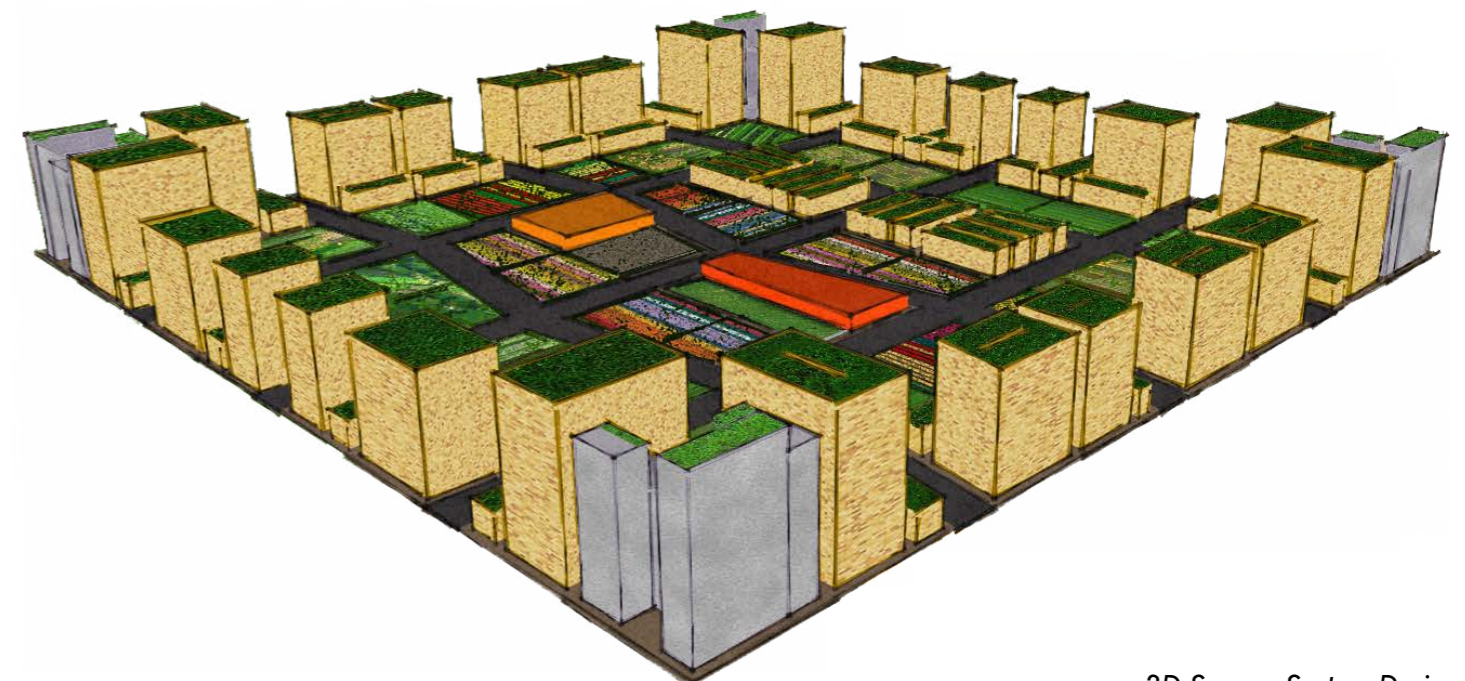
3D Square System Densities



Square System Design

The plant and 3D (Square System Design) shows how the block is going to look like. The distribution of the

open areas (urban agriculture and flower fields) and the location of the housing, facilities, etc.



3D Square System Design

In the following table, there are the calculations (one square system), how many people are going to be located, how many families, the density of people per Hectare and how much is the total floor space and construction index in housing units.

Bogotá has an actual average density of:
197 inhabitants/Ha

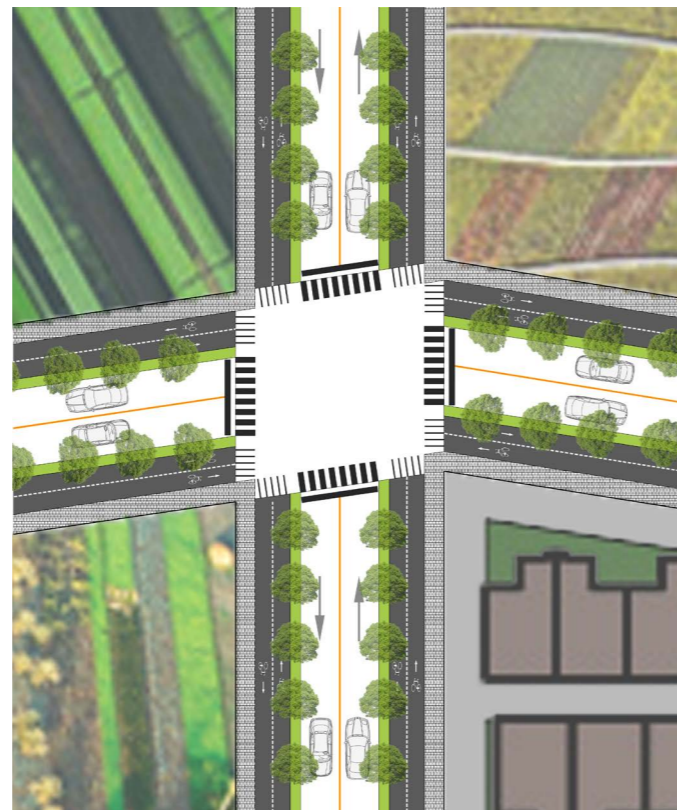
The proposed in the square system will have:
139 inhabitants/Ha

It has a reduction of 60 people per Hectare. The purpose of this is to have other functions such as urban agriculture and flower fields for a more sustainable model of planning in the territory. Also to use the advantages that the land has in its ecological and water structure.

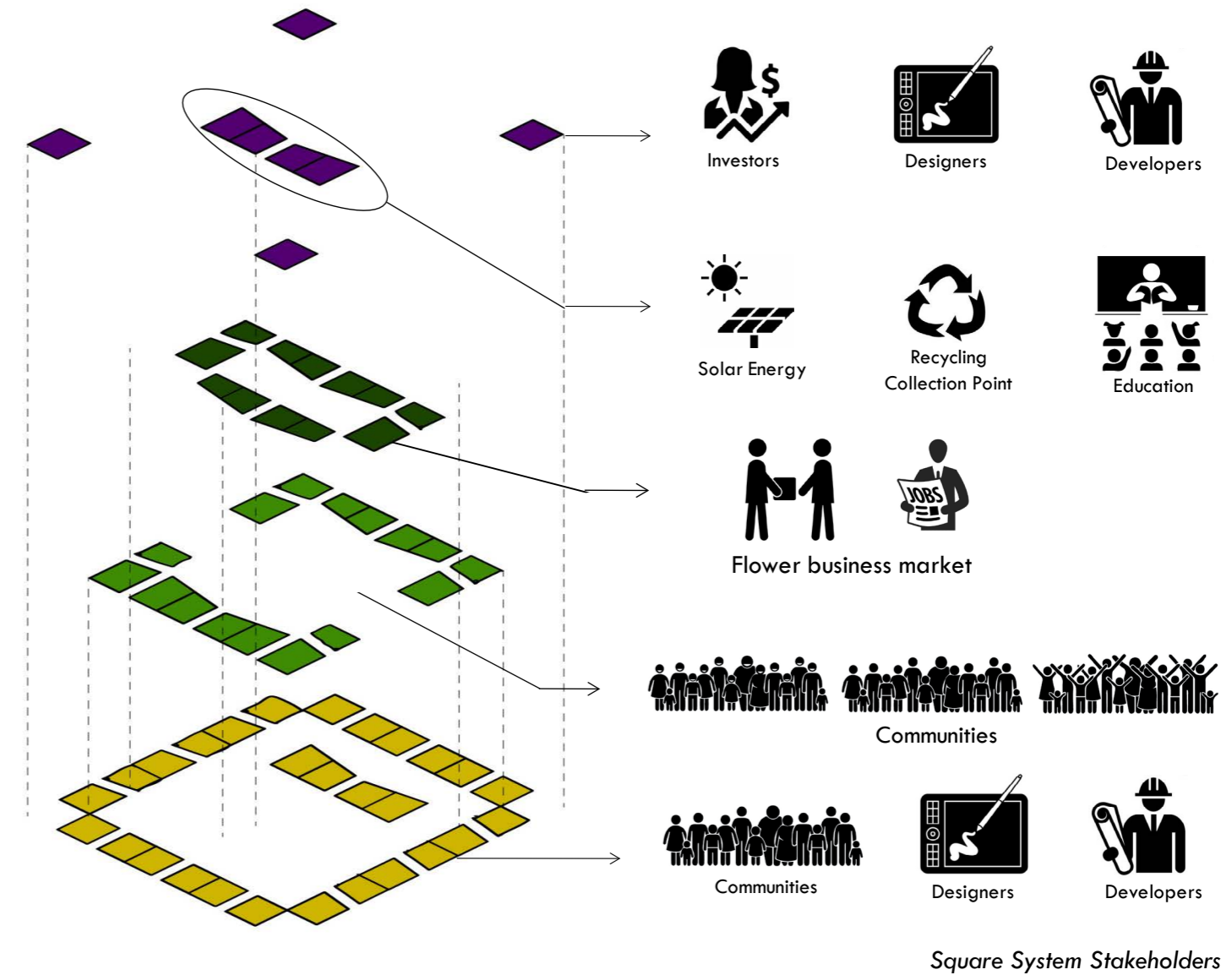
The image (right) details one of the key elements - infrastructure - contained in the square system.

The design previously mentioned, will be developed through the strong support of the internal and external stakeholders (planning institution). The facilities and housing will be potentiated principally by the private sector. Following the strong guidelines described before:

TOTAL		
Floor Space Index	15,111.72	m2
Construction Index	74,805.88	m2
	782	Families
	2,216	Total Housing Units
	8,864	Total People
Total Block Area	16	Ha
Density	138.5	People per Ha



Square System Design - infrastructure detail

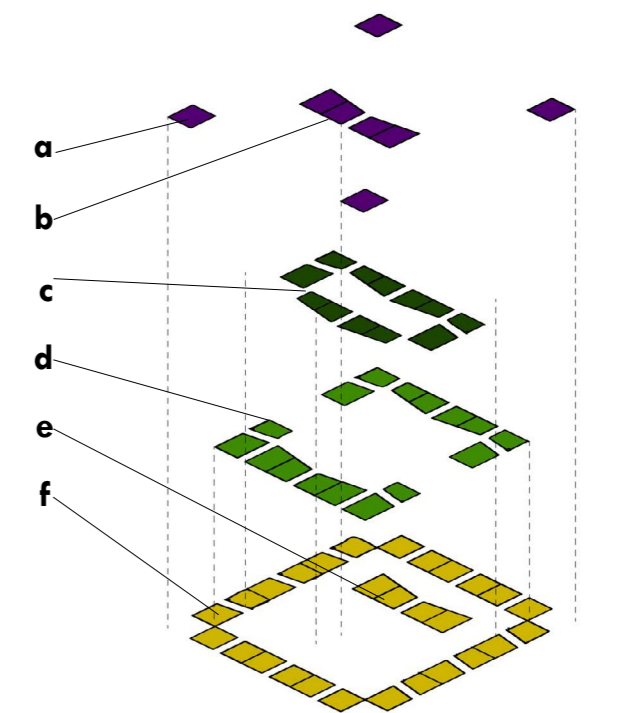


Square System Stakeholders

- Densities - people
- Heights - buildings
- Public Space
- Insulations
- Functions

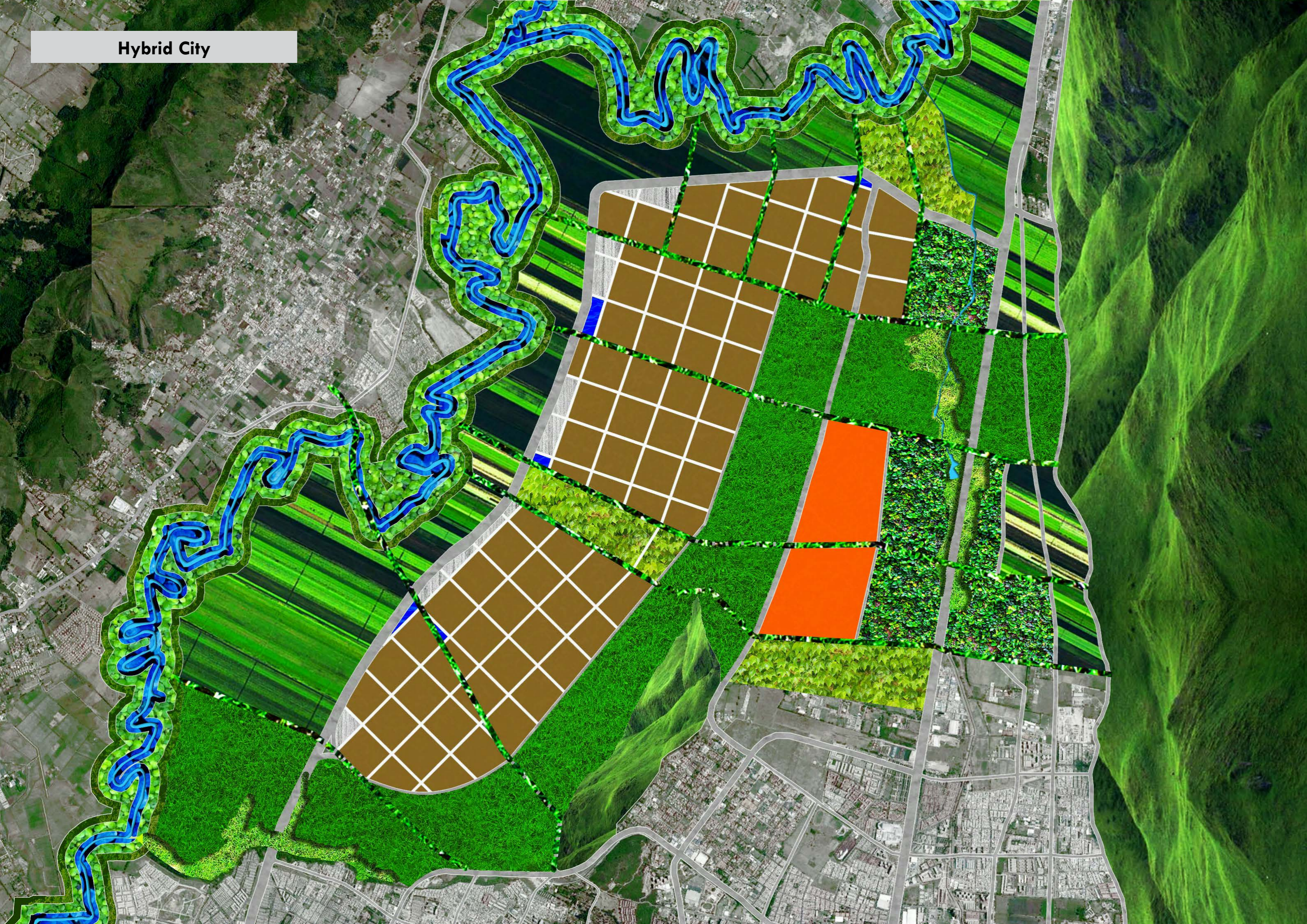
Likewise, the phasing of the square system will be completed in approximately five years. In order:

- a. Facilities - commerce and business **3 years**
- b. Facilities - education, waste, food(compost) **2 year**
- c. Flower Fields **1 year**
- d. Urban Agriculture **1 year**
- e. Housing - Low density **3 years**
- f. Housing - High density **5 years**



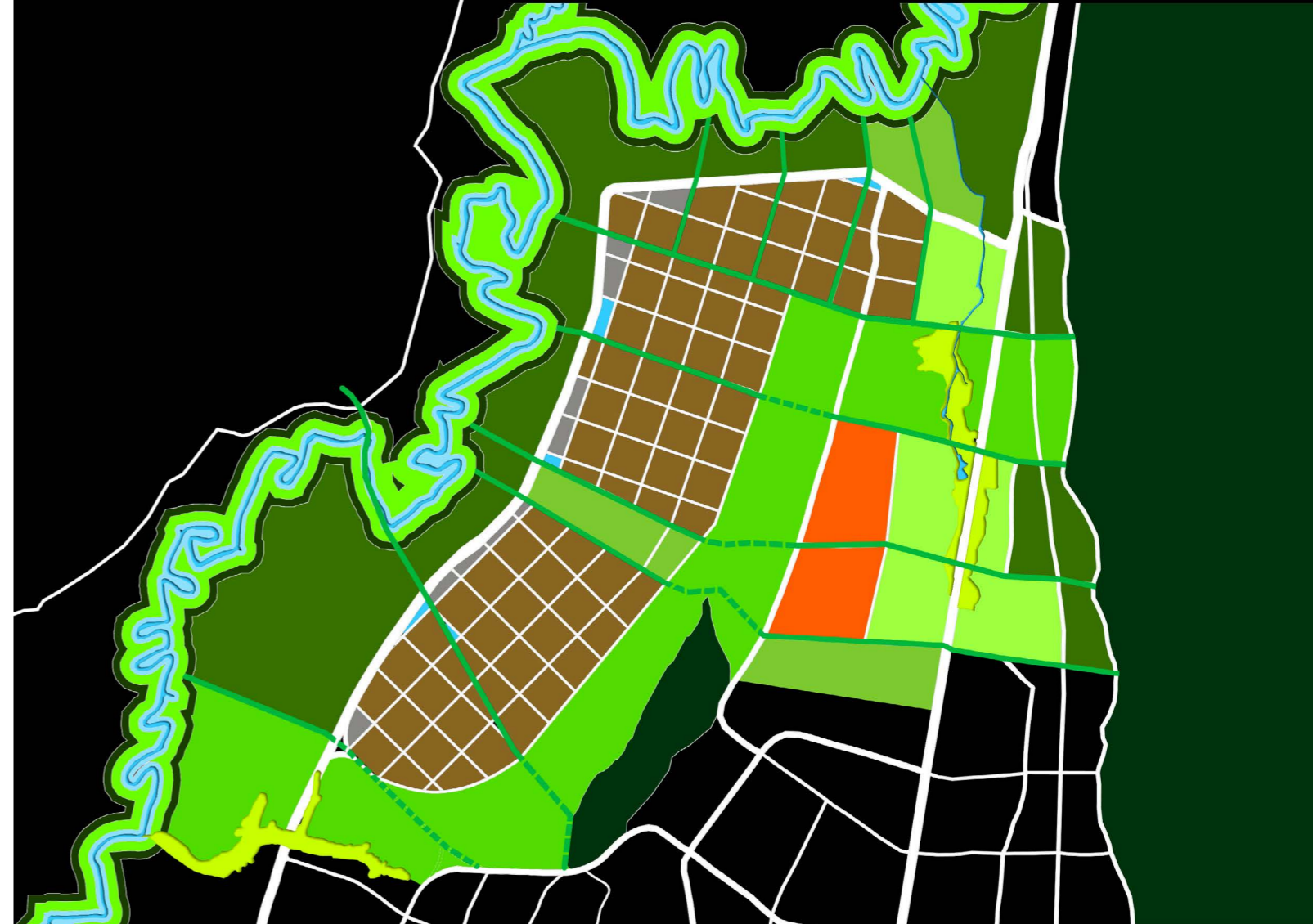
Square System Phasing

Hybrid City















-  **Urban Forest - Park**
-  **Wetlands**
-  **Hills**
-  **Rivers**
-  **Flood Area**
-  **Sustainable Agriculture**
-  **Green Areas**
-  **Wetland's Green Areas**
-  **Infrastructure**
-  **Logistic Parks**
-  **Water Storage**
-  **Reforestation**
-  **Green Belt Park**
-  **Education Hubs**
-  **Blocks**

- Natural Reserve - Thomas van der Hammer
- La Conejera and Guaymaral
- Eastern Hills, Conejera Hills
- Bogotá River & Torca River
- Bogotá River
- ALO, Autopista Norte, between others
- along Bogotá River
- along Bogotá River
- Existing public and private Schools and Universities
- Housing, Facilities, Flower Fields and Urban Agriculture

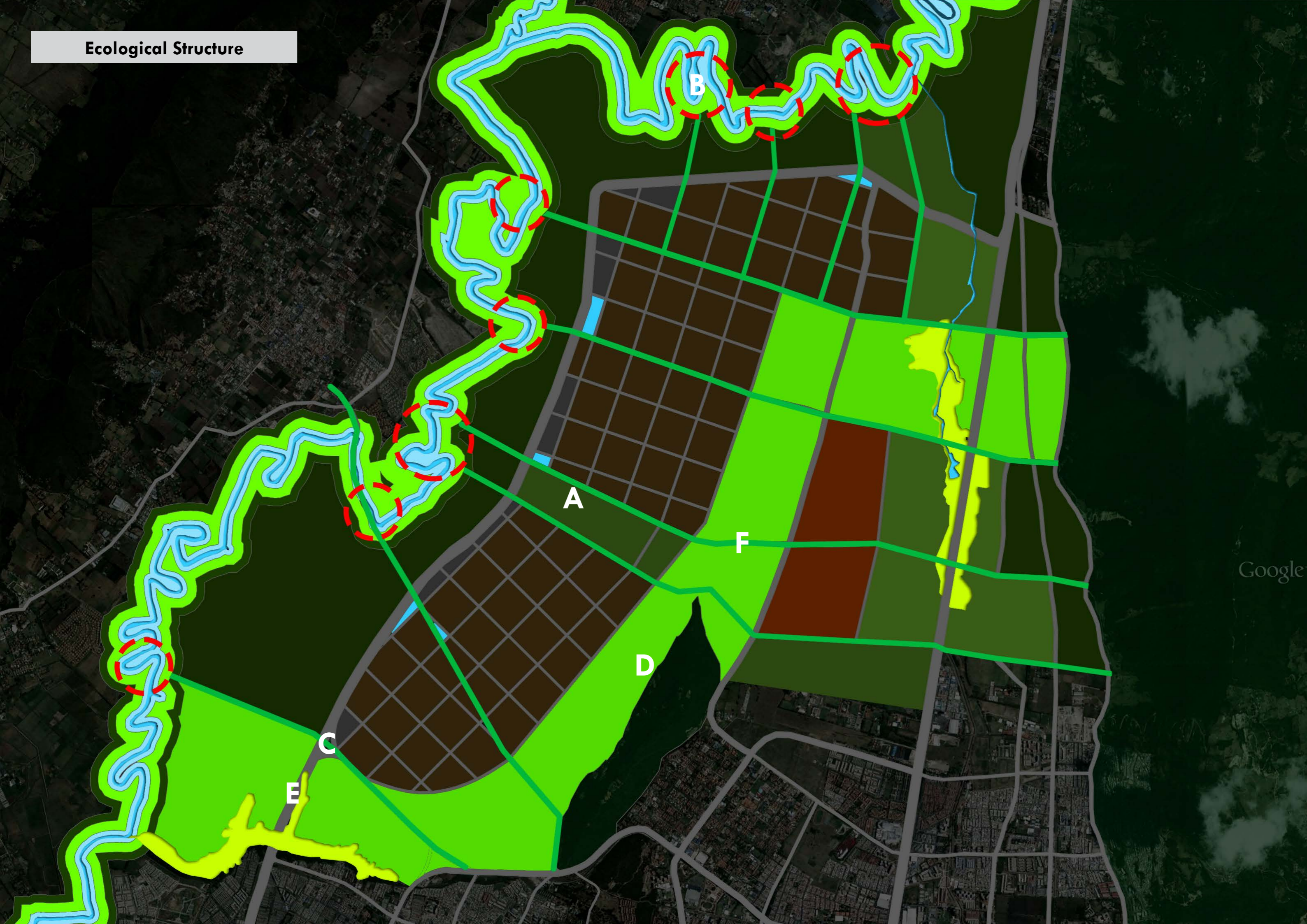


Reference Map for Areas

AREAS			TOTAL ECOLOGICAL STRUCTURE	
	Urban Forest Park/Natural Reserve - Thomas van der Hammen	1,057.01 Ha	2,967.12 Ha	
	Humedal Guaymaral y Torca	30.27 Ha		
	Humedal La Conejera	58.90 Ha		
	Green Areas	258.62 Ha		
	Wetland's Green Areas	329.62 Ha		
	Sustainable Agriculture	1,071.30 Ha		
	La Conejera Hills	161.40 Ha		
			TOTAL URBAN DEVELOPMENT	
	Education Hubs	182.41 Ha	1,485.17 Ha	
	Blocks System Framework + Logistic Parks	1,302.76 Ha		
	Flood Area (Width)	50.00 m		
	Green Belt Park (Width)	100.00 m		
	Reforestation Area (Width)	80.00 m		

Gross Areas Table

Ecological Structure



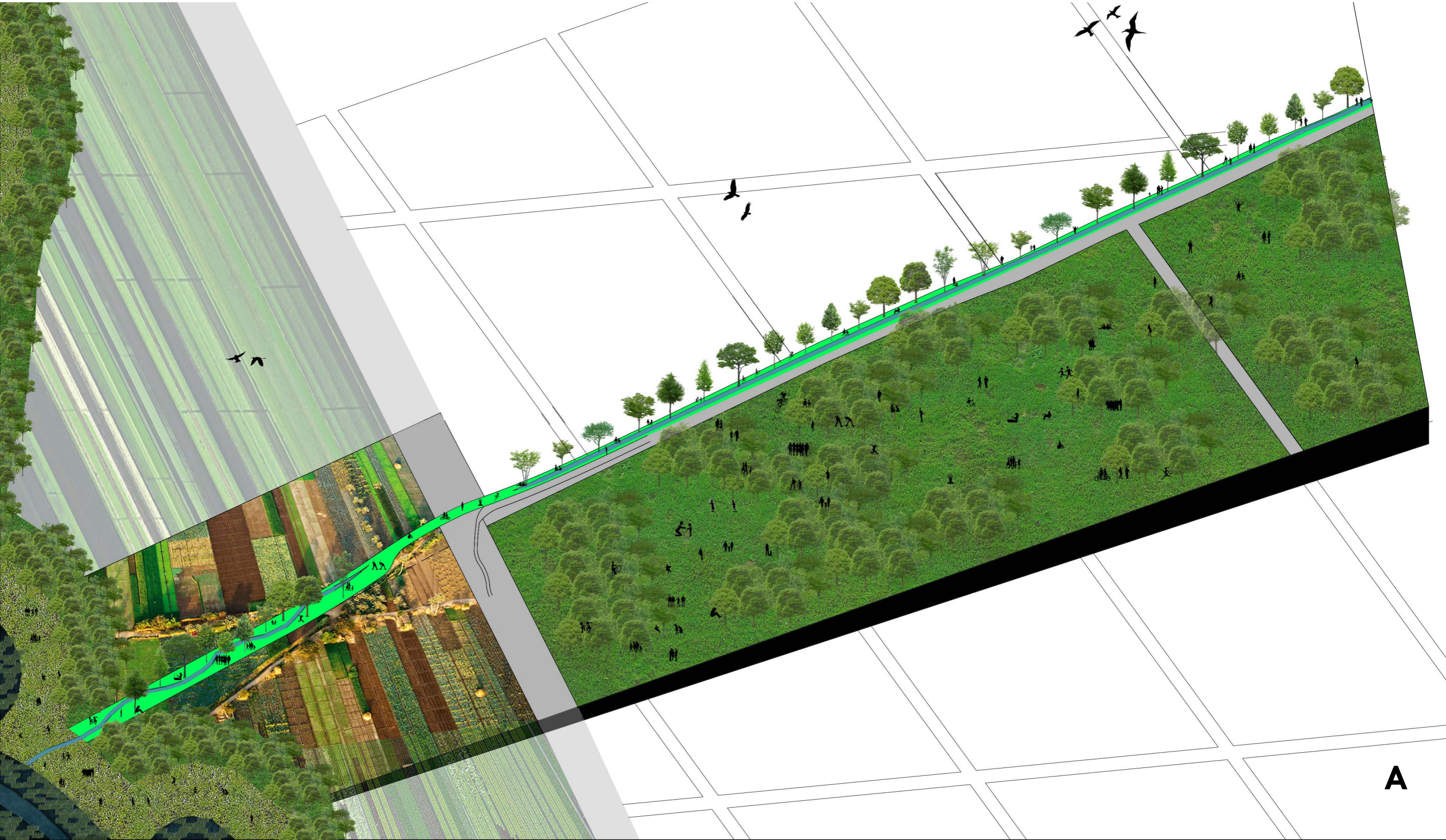
The general map of the hybrid city is shown in page 68 and 69. The description and location of the principal functions and distributions is given in page 70. As it can be seen, the ecological structure is the most important element of the the spatial planning.

On page 71, the gross areas of the ecological structure and the urban development in the hybrid city are given. The ecological structure has a total area of almost **3.000 Ha**; urban development has a total area of half the ecological structure: approximately **1.500 Ha**.

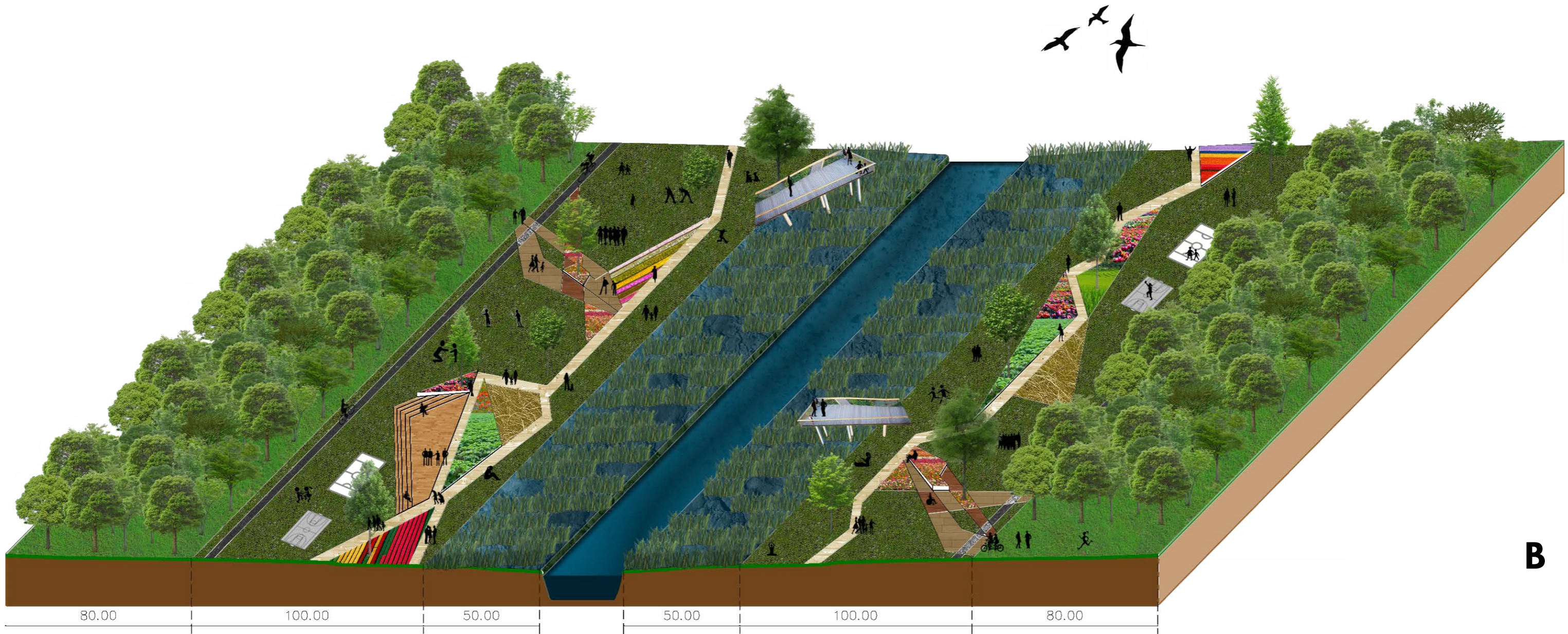
These areas include the urban forest park, green areas, wetlands, wetland's surrounding areas, two existing education hubs that will be preserved and enhanced, the squares design framework, sustainable agriculture, to mention some of the most important proposal interventions. The distances of the Bogotá River plan-

ning and protection area are given in the bottom of this table. The distances to create the River Green Belt and set up the starting point of the planning institution intervention are: **50 metres** of possible flood area, **100 metres** of linear park and **80 metres** of reforestation area.

Green Corridor # 1



A



On page 72 and 73, the connections and interactions of the ecological structure and the rest of the plan are highlighted to understand the strengths and linkages between them. Green corridors connect hills, urban forest park and finally the river green belt.

There are six letters (from A to F), that are shown in the map and locate the areas where an image of the design principles were made. They are all based on the ecological structure priority and key element guidelines.

Image A, shows the connection from the river green belt, crossing a green area and finalizing in the urban forest park. The picture highlights the needed infrastructure (passing by important roads) to connect areas such as the river green belt and the urban forest park.

The green corridor also crosses an area delimited with sustainable agriculture. Due to this area, that is part of the landscape of the hybrid city, provides positive physical and visual relationships and the opportunity

to connect different functions in the hybrid city model.

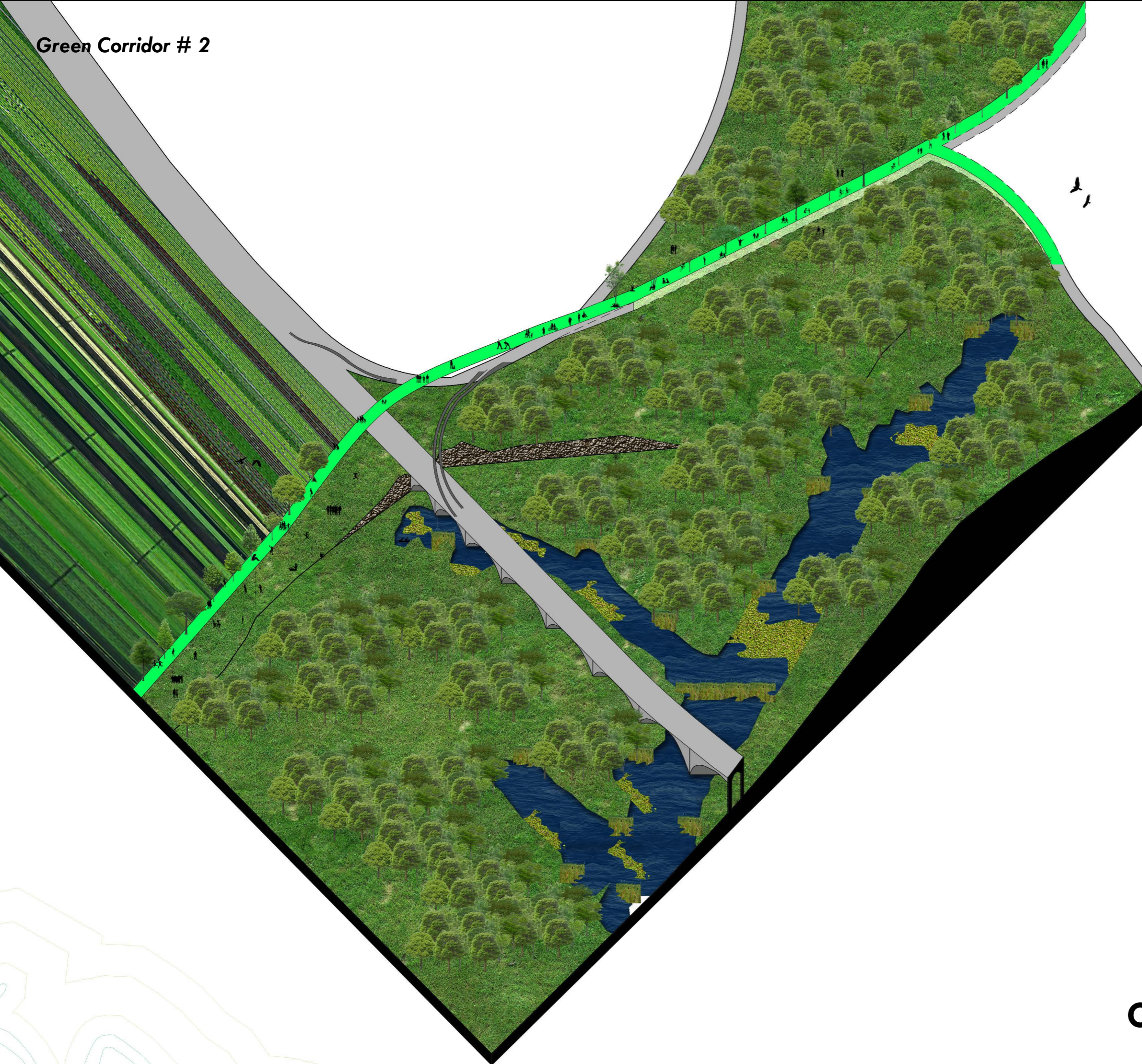
Image B is a zoom in detail of the River Green Belt. It shows the distances mentioned before between the different land use functions, and the integration of the whole ecological structure for the planning and protection of the Bogotá River.

The River Green Belt has an offset of 230 metres in all its extension. The Bogotá River in the current situation has an insulation of 100 metres. However this

extension has not preserved and recover the ecological structure of the water and the soil due to useless administrations.

The study about the forest reserve Thomas van der Hammen had in its maps this distance (230m) from the Bogotá River to the starting point of the natural reserve with the same name (see Appendix VI). So this distance was taken as a referent and example to follow; and take advantage of it, proposing two important areas that the ecological structure needs (flood

Green Corridor # 2



and reforestation area), and one that could be useful for the quality of life of the inhabitants: a linear park for recreational purposes.

The first 50 metres area established as flood area. The next 100 metres are a recreational park with nodes along the river, that identify areas with higher and lower density of visitors. This specific example of a node in the River Green Belt shows the a higher density of visitors and activity around the ecological structure.

Finally, the insulation between the River Green Belt and the other functions (in this specific case sustainable agriculture) is given by a length of 80 metres that has been recovered through reforestation.

Image C shows a second green corridor connection between the Urban Forest Park, passing by sustainable agriculture and the final reaching connection with the River Green Belt.

This specific connection has an underground road infrastructure besides the green corridor. For logistic purposes it is an important connection and this is the reason why it was determined this way.

Also, there is special precaution with the Longitudinal Avenue of the west (ALO road infrastructure) that needs to pass along the wetland (bridge). This connecting element will take particular guidelines to protect the wetland and not burst the connectivity of the Urban Forest Park that includes this ecological structure.

C



Image D is a zoom in detail of the Urban Forest Park. It shows some distances as well between the road that limites the green area with the hill that starts after the flat part. The distances vary between 550 and 580 metres. This distance was given to the projection of the road infrastructure in the right part of the image, that coincided with the delimitation given for the forest reserve Thomas van der Hammen in its study (see Appendix VI).

The Urban Forest Park will have an extension of approximately 1.100 Hectares in the complete hybrid city of Bogotá. It will have recreational areas and also preservation of the ecosystem, its Fauna and Flora. The reference location map in page 82 (for zoom in details of the ecological structure), shows zoom in details of image E and F.

Image E in page 82 and 83 is a zoom in detail of the previous explanation in image C (page 78 and 79).

The image shows the Longitudinal Avenue of the west (ALO road infrastructure bridge) in between the wetland La Conejera.

The image illustrates de strong ecological connections without interruptions with the crossing road infrastructure. From this view, the south west part of the Urban Forest Park can be appreciated with its context.

Image F on the other hand (page 84 and 85), has a

different angle and perspective of the visual of the ecological structure. It is seen from the inside of the Urban Forest Park, and how the mountains become part of the landscape and hybrid city model as well.

The ecological structure is in the planning and design of the hybrid city. The recovery and protection of these example areas shown in the previous pages, allow the territory to restore its natural structure with the surroundings in the local and the regional scale.



Reference location map for zoom in details of the ecological structure

These areas as example of the vision of the ecological structure: Green Corridor # 1, Green Belt of the Bogotá River, Green Corridor # 2, Urban Forest Park and the final two zoom in details, are all connected with the system of squares that interact with each other.

As a result, the structure of the territory becomes more sustainable; with the improvement of the flows, the restoration of the ecosystem and as a consequence the quality of life of the population.

The four icons in the right of the page, show the four ecological structures mentioned in the beginning of the design section and how the four are included and linked with the hybrid city guidelines for the creation of an integrated network.

-  Wetlands
-  Eastern Hills Reserve
-  Bogotá River
-  Thomas Van der Hammen Reserve





Wetlands



Eastern Hills Reserve



Bogotá River



Thomas Van der Hammen Reserve

Hybrid Block Model

In the regional river basin map (page 44), the strategy is going to be given by the generation of an interface (a mixed shared area) denominated “hybrid city”.

The relation between the square system (one block) and its surrounding blocks is really important. The interaction in the area between the blocks, taking into account landscape, infrastructure and flows, is the key element to coordinate the planning and design in the same way.

The first map (top), highlights the ecosystem structure inside this specific part of the hybrid area. Elements such as the Bogotá River and its green belt, hills, urban forest park, green areas and sustainable agriculture conform the adaptative capacity of this territory.

The urban forest park and the green belt will be shown later with its further design and planning of the areas that needed to be improved.

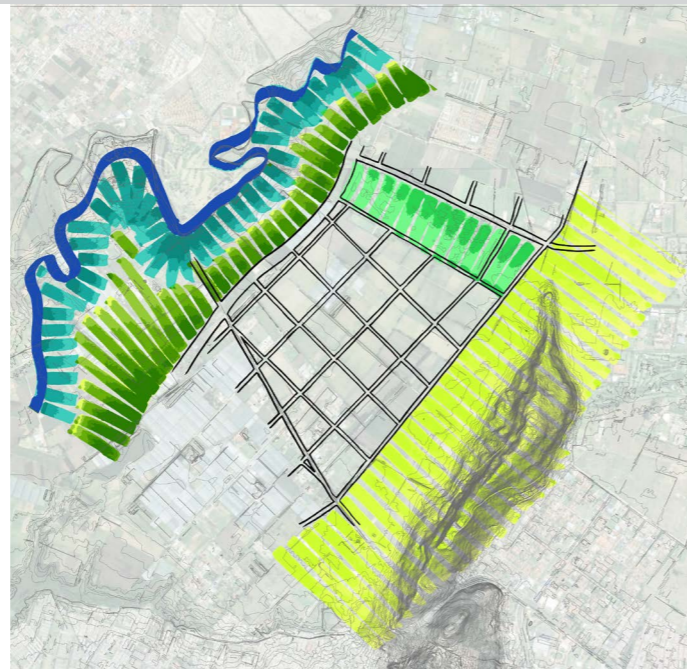
The second map (middle), shows the infrastructure that will be important for the flows in the map below. The map shows a principal artery road and its connections with the secondary and finally local roads.

Finally, the flows map will have the logistic park in the southern part of the map. It is going to have direct connection with the main road infrastructure and will have areas for: recycling collection point, non-recyclable garbage and flower meeting point and distribution. In the west park of the logistic park, due to the topography, it will be located a water storage area for future needs.

The light blue, orange and purple, show the routes that the garbage, recycling and flower trucks will use to optimize the transport and the collection of the sources. The overlap of these three layers, give as a result the optimum profile of the hybrid block model.

The image system of blocks (right), shows the relationship between the design of the urban development and the design and linkages with the ecological structure. In it there are five letters (from A to E) that locate zoom in details of five different areas inside the system of blocks and the interactions with the context.

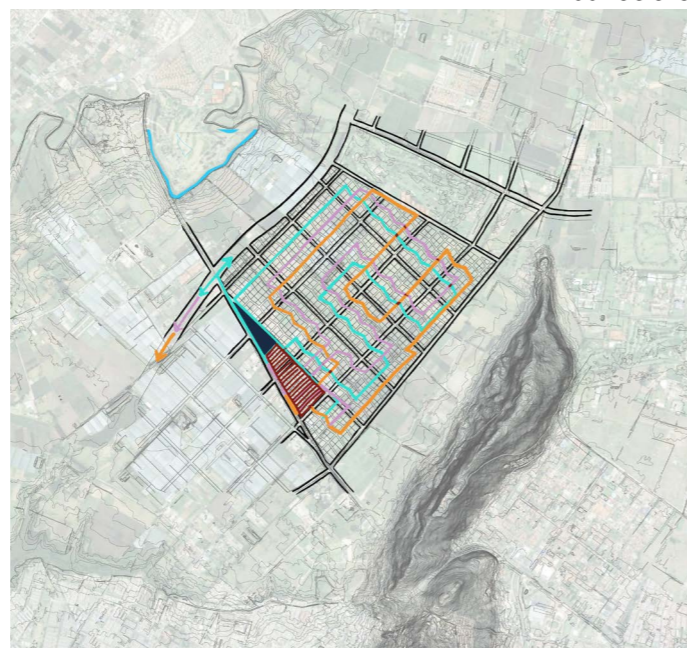
In the following pages, the principal functions of the block (urban agriculture, flower fields, facilities and housing) will be developed and explained.



Adaptive Capacity - Landscape



Infrastructure



Flows - Logistic Park



System of Blocks

Urban Agriculture

The square block system has the following functions that integrate a sustainable use of the land and the resources in the hybrid city model:

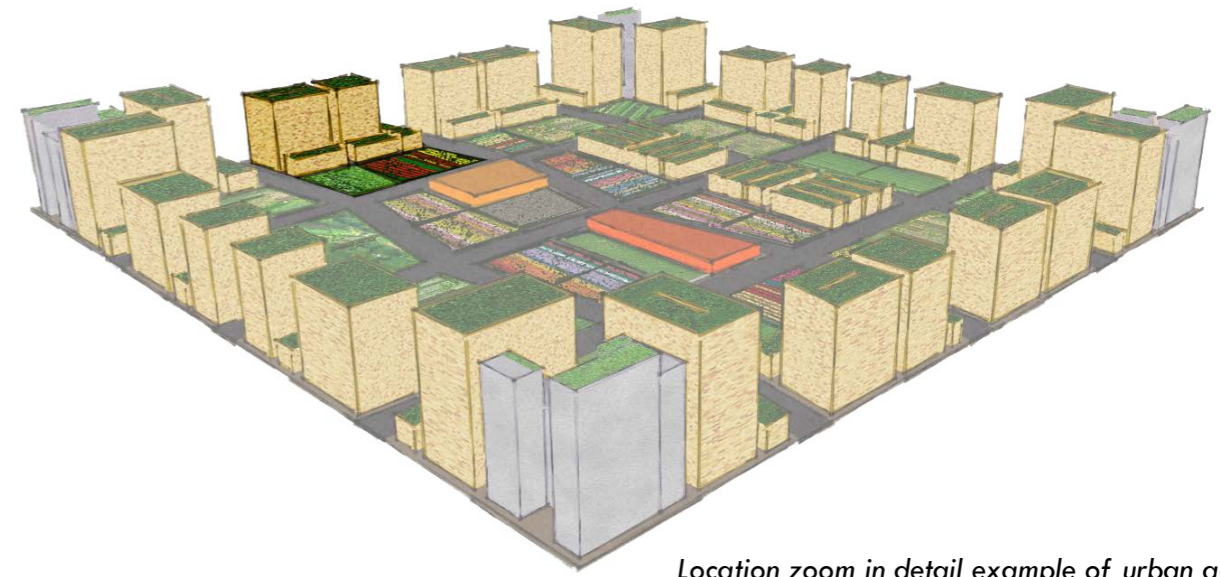
- Housing
- Facilities
- Urban agriculture
- Flower fields

The following design images that are going to be

shown and explained (page 88 to 97), correspond to functions related to productive and re-use areas:

- Urban agriculture
- Flower Fields
- Compost Centre

All of them involved and participating through education to potentiate and enhance these guidelines and develop new habits in the population.



Location zoom in detail example of urban agriculture



Urban agriculture in the main block has an extension of approximately **3.2 Hectares** for production. If it has two harvests in one year it will have a productive area of 6.32 Hectares to produce almost **7.33 Tons** of food per year.

This information concludes that the block is able to feed **22%** of the population living in it. This means that from the 8.864 people living in one block of 16

Hectares, around **1950 people** will have food covering vegetables and fruits.

The figure named zoom in detail example of urban agriculture, shows the location of the design image A. The picture illustrates urban agriculture, its direct connection with housing inside the block and the surrounding context.

In the image, the road infrastructure with its public transport, the energy sources through solar panels the open public space and the near flower fields, create the sustainable atmosphere that the hybrid city model looked for.

The image below, illustrates the social compromise and improvement in the urban agriculture model function for the hybrid city in Bogotá.

For this design guidelines some examples were taken into account. Referents from Michigan, Chicago and Boston in the United States were relevant for the design process (See Appendix V).



Population intervention and interaction with urban agriculture

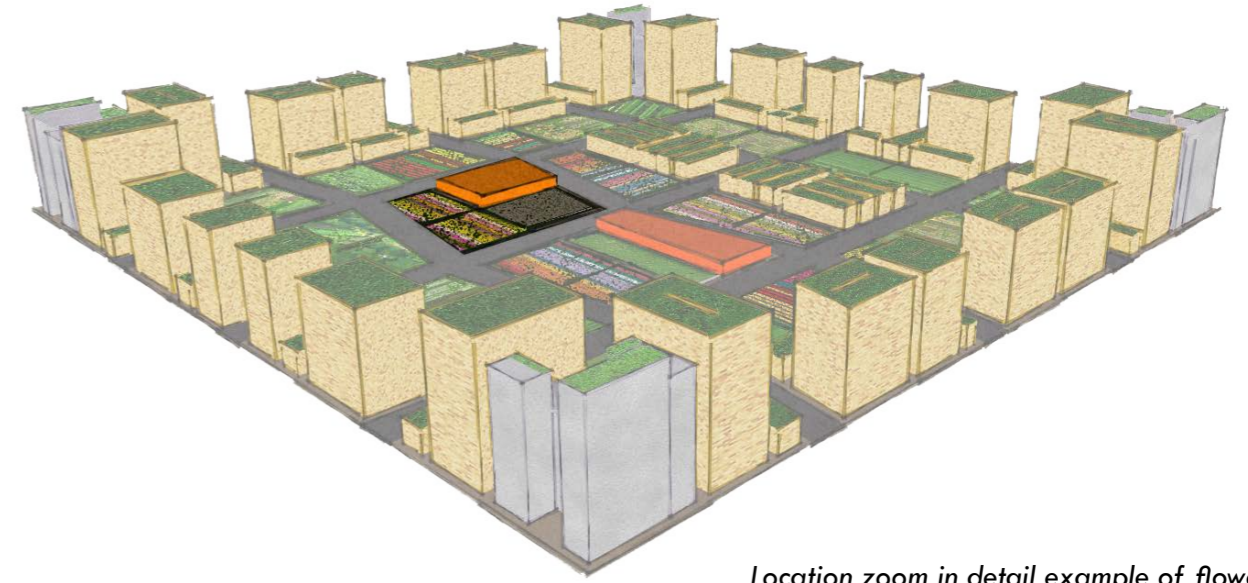
Flower Fields + Education

The flower fields in the main block has an extension of approximately **2 Hectares** for production. With two harvest in one year the area will have a total productive area of almost **4 Hectares**.

The purpose of the flower fields is to will keep the traditional recollection and distribution structure that Colombia has as second world flower producer and first Latin American flower producer.

The flower fields not only will bring a landscape touch to the block but it will also generate a considerable amount of jobs. In the total system of blocks in the hybrid city it will generate around of **8.800 jobs**.

The design example of this system includes the productive area for the flower fields and the location of the recollection point for them.

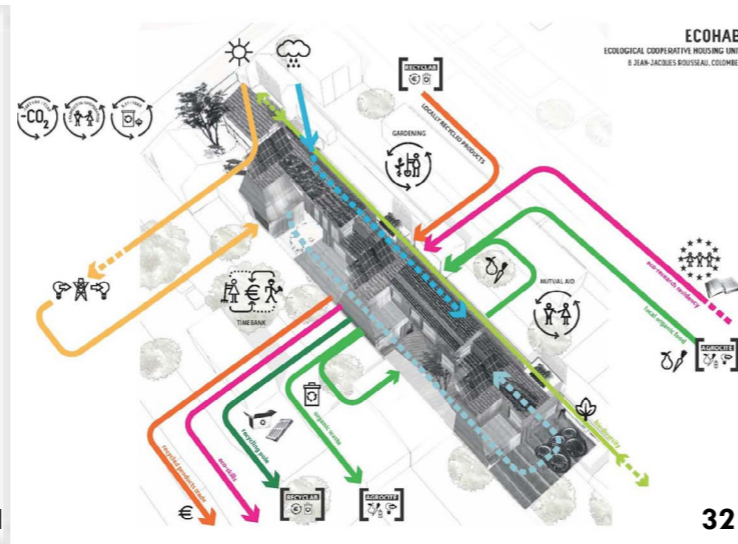


Location zoom in detail example of flower fields





31



32



33

The recollection point and generation of employment will follow the existing structures that Colombia has and it can be seen in pictures 34, 35 and 36. The floriculture is a notable activity in the development of internal relationships of the local economy. It exports **95%** of its production and 59% goes to the United States.

Statistics show that **1.000.000 people** depend on floriculture in the country. **60%** of the labor force is women and **88%** of the flowers produce in the country are grown in the department of Cundinamarca. This intro-

duction of the flower fields function to the main block framework is a great opportunity to potentiate and enhance the flower production and business. As well as increase the number of jobs offered in the market.

On the other hand, the design picture shows the location of an education centre (pre-school). This facility is next to the recollection point and is highly benefit by the surrounding public space.

The educational point will be a starting initiative to promote the incoming knowledge and development about the flows: food, waste and energy. This means,

that education over waste management, waste recycling, sustainable food production, compost production, renewable energy sources and eco-friendly concepts with the colombian ecological structure will be introduce to the new generations since their younger age.

The education centre has an approximate area of **1.800m2** to develop this kind of concept strategies and apply them.

An important referent for the development of this strategic intervention was given by a Colombian school

in Bogotá: Saint George's School. They implement all the concepts mentioned before and applied them in their campus to teach children and encourage upcoming generations to think and act according to the sustainability of natural resources. The school has organic crops of around **1.000 m2**.

Also, referents such as ECOHAB with cyclic networks show the opportunities in sustainable cycles to maintain the positive relationship between human activities and natural resources. (See Appendix VI).



34



35



36

Compost Production Area + Waste and Recycling Collection Point

Related to the education purposes, compost production and recycling are some of the most important concepts to be introduced. For this reason, the next design image shows the local scale intervention for compost and recycling collection point.

The main block has a common compost production area that has **1.420 m²**. It will be located in the centre of the block. Close enough from urban agriculture areas and flower fields to facilitate the transport and logistics.

On the other hand, the recycling and waste collection point has an area of **1.900 m²**. This area will help recollect garbage and recycling elements of approximately **2.200 housing units** that the block has.

Then the recyclable and non-recyclable waste is taken to recycling plants and burning waste plants respectively. To produce new goods with recycling material

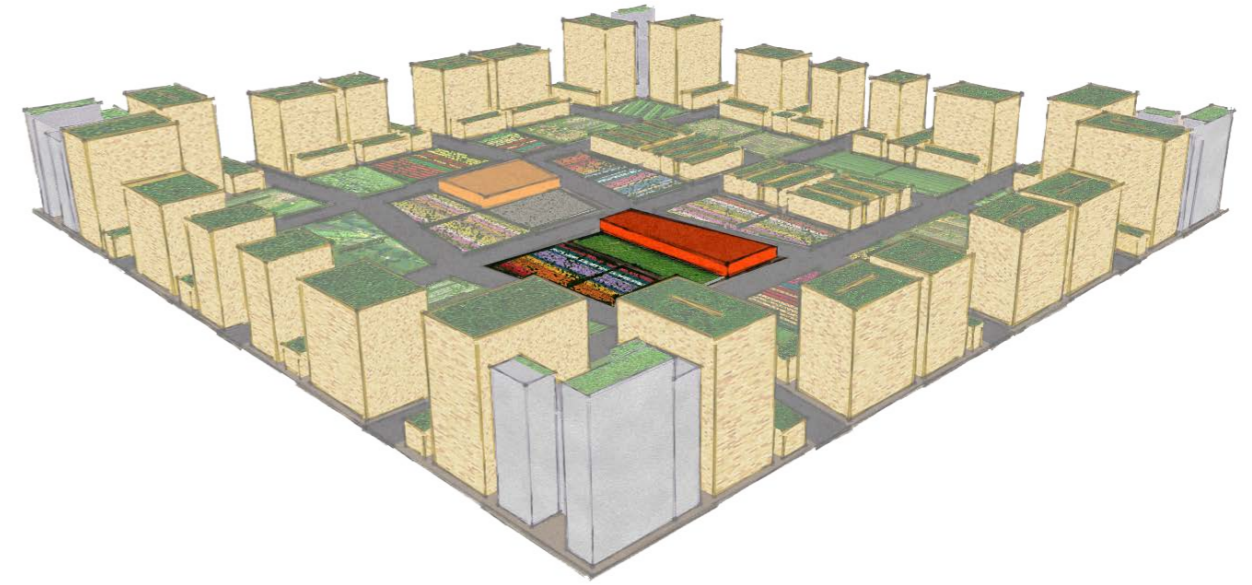
and to generate energy with the burning waste source.

This is another opportunity to generate jobs in this field. Around **11.500 people** and 10.000 homes live from the waste/recycling business in Bogotá.

Also, the capital city produces **6.000 Tons** per day, **30%** recyclable material, **60%** organic material. This high amounts of organic waste will be really helpful for the compost areas and also for the sustainable agriculture established in the hybrid city.

The positive development of these functions is that the social factor gets benefits, generating incomes and jobs and creates the opportunity of development of sustainable projects.

Some primordial referents were taken from Curitiba, Brazil and Rotterdam Urban Metabolism project. (See Appendix VI).



Location zoom in detail example of compost area + recycling recollection point



Housing

This page illustrates the technology implemented in all the constructions, but especially in housing and facilities. The opportunities present for the private sector (developers, investors and constructors) to build sustainable friendly housing and business centres with wind and sun considerations, are enormous. (See Appendix VI).

Also, the strengths of building sustainable housing in the main block and all the system of blocks, bring an important input to the environment and develop infrastructure for solar electricity and water storage.

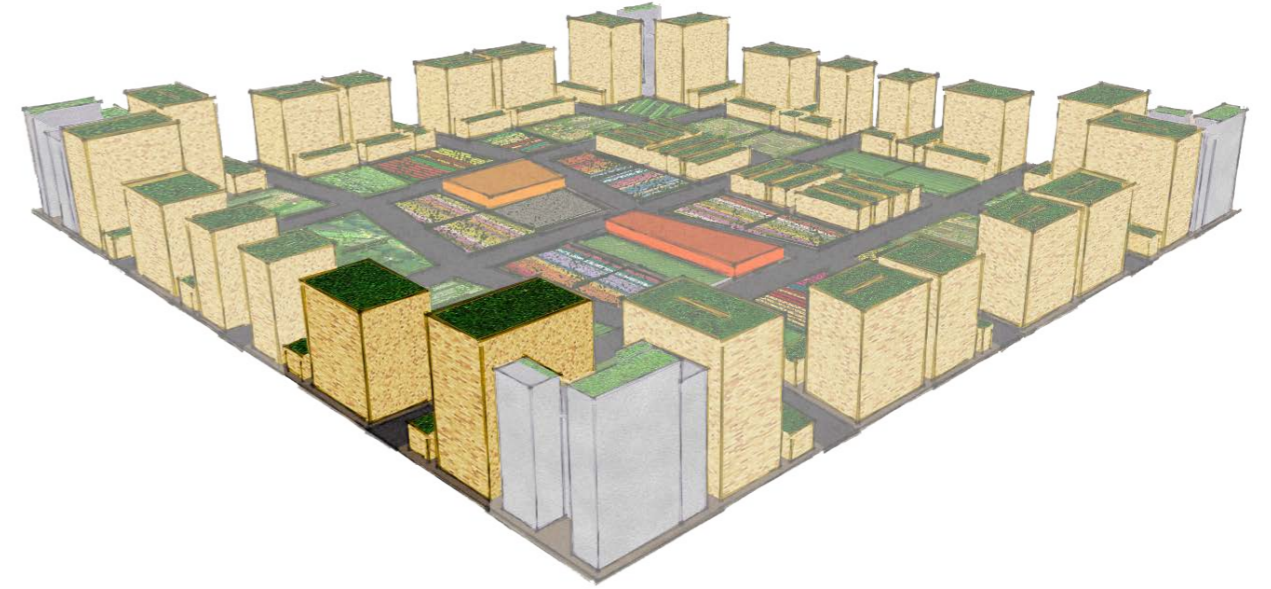
Bogotá has a demand of 703.000 new housing units between 2012 and 2021. This means around 2.500.000 need to have a home. For this it is need an area of about 3.200 Hectares for housing and 1.430 Hectares for other functions.

With the development of this sustainable model, approximately **158.000 housing units** will be develop

and **630.000 people** will be located with a density of around 139 people per Hectare. Improving the 197 people per Hectare that the capital city currently has. Even though its only **25%** of the population that needs to be located in the next five years, it is a start to implement a sustainable model and the protection of the ecological structure in the territory.

The development of more hybrid cities in other municipalities of the Bogotá River basin (as established in the regional strategy) will create this polycentric areas that will protect and plan the territory and improve the quality of the environment and the population. But not only this, it will create the opportunity to locate this other **75%** of the population that is in need of home and in a more sustainable model for the environment.

Image D, the 3D location and the public space image, present the interventions in the public space and how the housing will become part of these guidelines.



Location zoom in detail example of housing

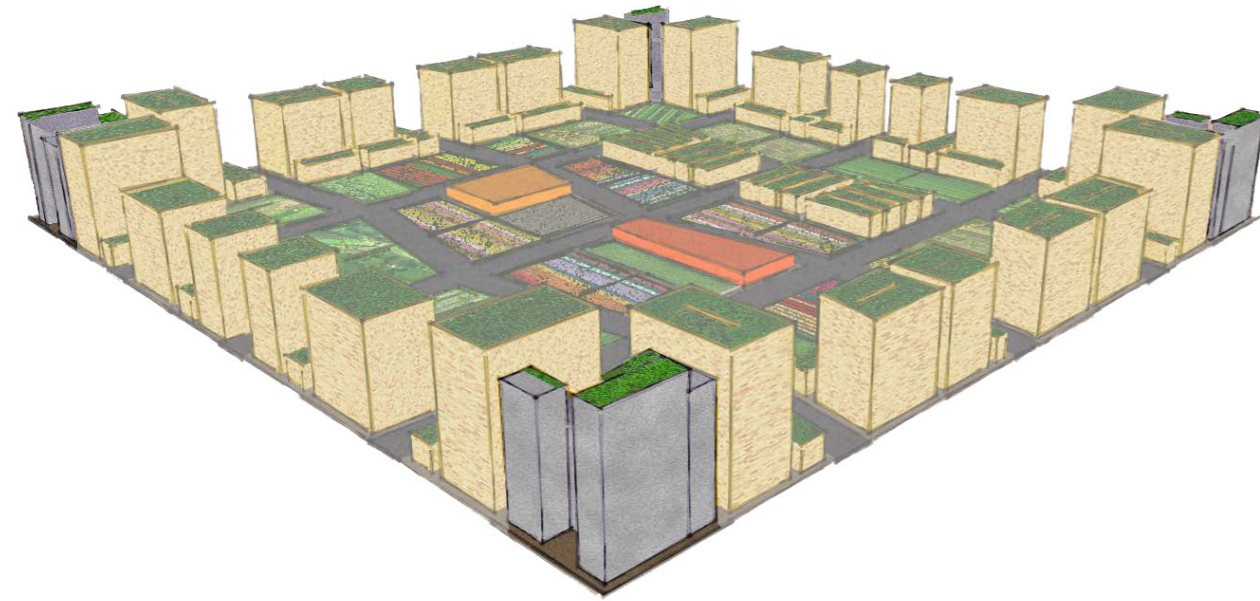


D



Public Space along housing areas

Facilities / Infrastructure Logistic Park and Sustainable Agriculture



Location business and commerce facilities

Image E (page 87), shows the location of a fragment of the logistic park, the relation with the road infrastructure and the connection with the sustainable agriculture of the hybrid city.

The hybrid city model located **140 Hectares** for logistics parks along the territory. In each area where one logistic park is located, the area shelters: food production from the sustainable agriculture area, waste collection to take to the final destination point (burn waste plant or recycling plant) and water storage area.

The area of the sustainable agriculture is located in the other side of the ALO road infrastructure, and the logistic parks are located near the system of blocks. For this reason, **the process to transport and distribute the food is given by an underground platform** (as it can be seen in the image below) to transport the production from one side to the other where the logistic park is.

The sustainable agriculture has an area of approximately **1.000 Hectares** and can have two harvest every year of around **2.500 Tons of food** per year. With this number, the people who lived in the hybrid city model can complete the demand of **88%** that was missing from the urban agriculture production. Also, it

has a **17%** extra that can feed other part of the population in Bogotá.

This road infrastructure provides with public transport (Transmilenio), car lanes and a train line to transport the goods if necessary. The train line goes from south to the north of the capital city.

Also the availability of this areas for sustainable agriculture will generate as well another percentage of jobs that is useful for the hybrid city model.

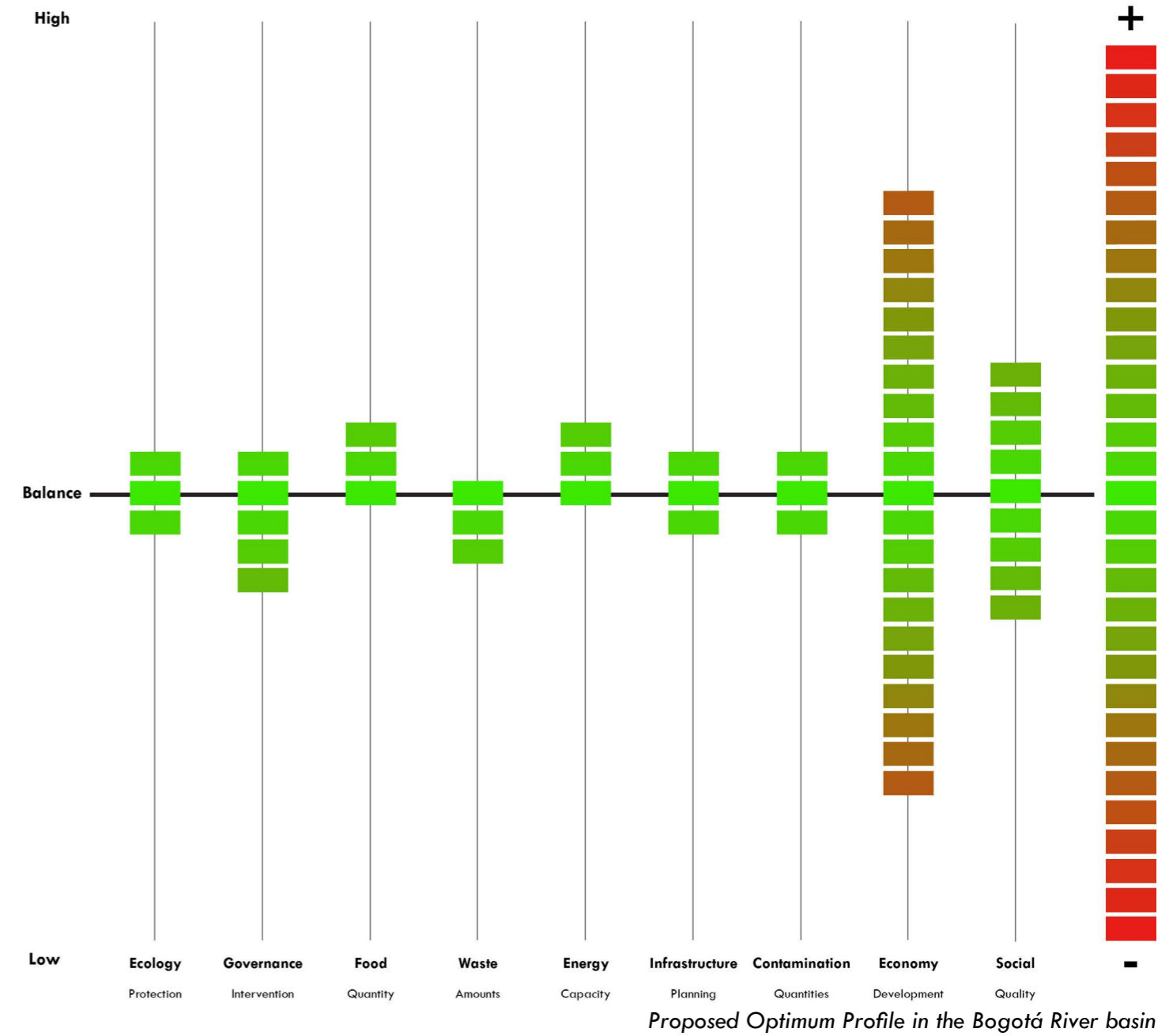
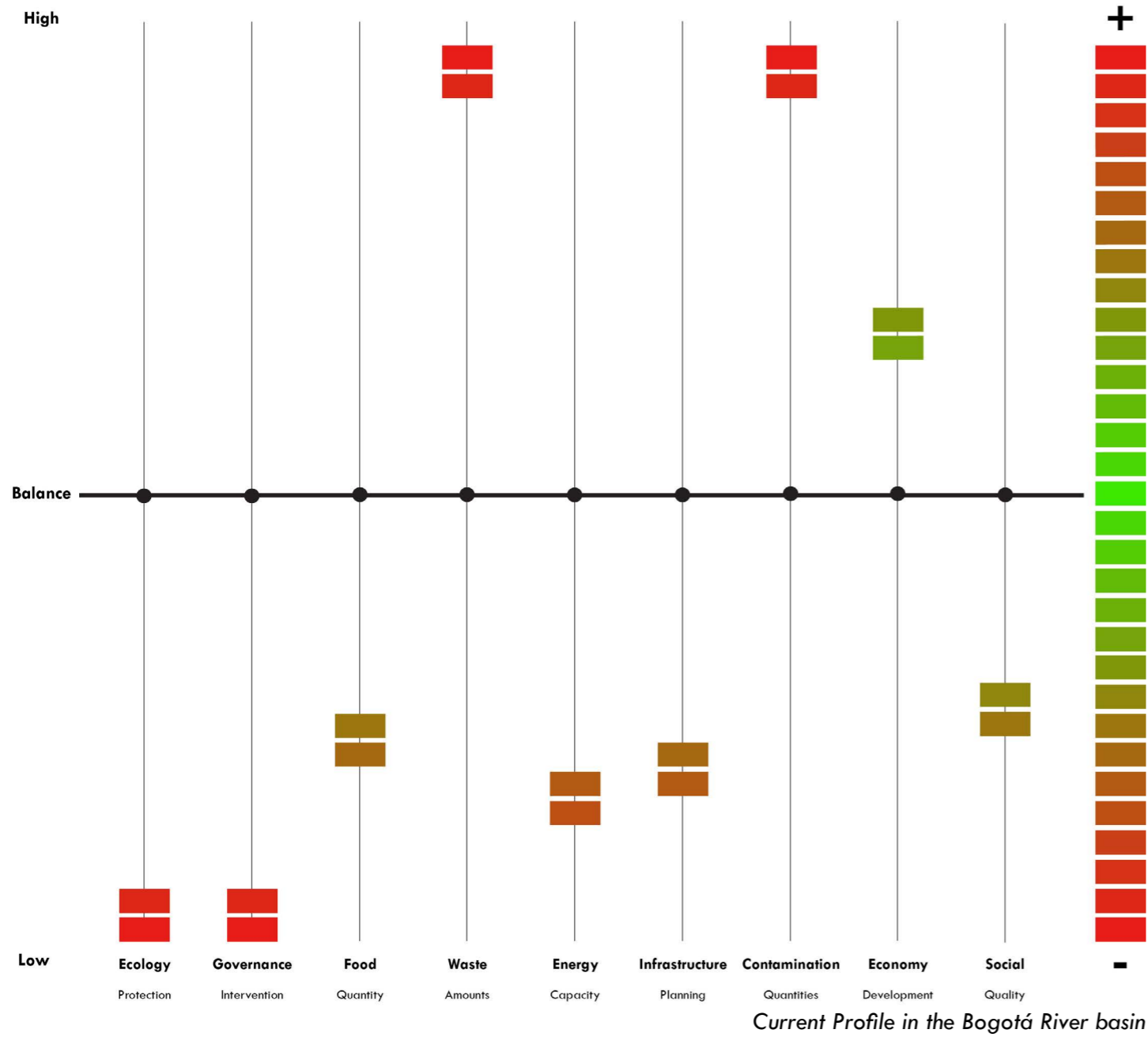
The logistic park is not only to receive and keep goods but also for logistic, transport and distribution processes needed by the system of blocks correspondent to it.

The routes of trucks for waste, flowers and food collection are established as it was shown in page 86 in the map: flows - logistic park.

On the other hand, in the corner areas of the main block, there are some areas establish only for facilities: commerce and business. This areas per block are approximately **1.450 m²**. The opportunities present for the private sector again (developers, investors and constructors) to build sustainable and modern facilities are of great importance. To also supply the needs of the population.



Optimum Profile



The schemes shown in this page, illustrate the actual and proposed profile of the Bogotá River basin. The current situation presents an unsustainable model where the unbalance and division between the guidelines highlighted in the project, threaten the territory.

- Energy
- Infrastructure
- Contamination
- Economy
- Social

These guidelines are:

- Ecology - Ecosystem
- Governance
- Food
- Waste

In every guideline the problematic is different, but when it has really high or low categories is a difficulty. The main four guidelines that generate sustainability and involve the rest of the guidelines are: Economy, Ecosystem, Social and Governance.

This way, the proposed profile applicable for this hybrid city model has the variations show in the scheme of the right. Although is not a rigid profile, it can give the advantages and disadvantages of increasing or decreasing one of the made key elements taken into account.

In economy, the production, consumption, use, technology, labour and infrastructure have a bigger field area.

In the ecosystem: water, soil, Flora, Fauna, area protected. Food, energy and waste are planned, and in

that way reach the balance shown for a sustainable and self-sufficient river basin.

The social guideline involved a lot of participation, projection and recreation (health and well-being).

Finally, governance through the implementation of the new planning institution with its mobile location (thematic offices in every municipality with monthly meetings) along the territory of the water structure, will improve the quality of the ecological structure and the administration of the natural system in a proper way.

The connection of scales, the inclusion of rural, semi urban and urban areas and the spatial planning of the territory lead to the final approach for a regional integration in a sustainable network and protection of the Bogotá River and its ecological structure in the river basin.

The proposed model gives clear densities and possible sustainable interventions for the improvement of the ecological structure. If the political entities like mayors that are involved in part of the process of the hybrid city, want to implement the model and increase the densities is possible. Although, faces the responsibility of assuming the consequences over the territory and for sure it will not provide the sustainable goal system that has been established from the beginning.

The calculations shown in the next page, are a summary of the information explained before in every detail function of the main block and the system of blocks.

They provide the standard needs that are necessary to achieve the sustainable and self-sufficient river ba-

sin that is needed in the territory. All the functions are mentioned: from housing, facilities and logistic parks, to flower fields, urban agriculture and sustainable agriculture.

Finally, the linkage and embedding of the block unit in the regional system is designed as follows:

The development of a new model of governance based on examples, allow the development of the hybrid model in the Bogotá River Basin.

On the other hand, the planning innovation of the proposed planning authority for the river and the basin in general, gave considerable input for the final product. The validation of the gathered information let the improvement of the key elements highlighted in the regional toolbox. The principles involved in the planning of the territory and the future vision and direction.

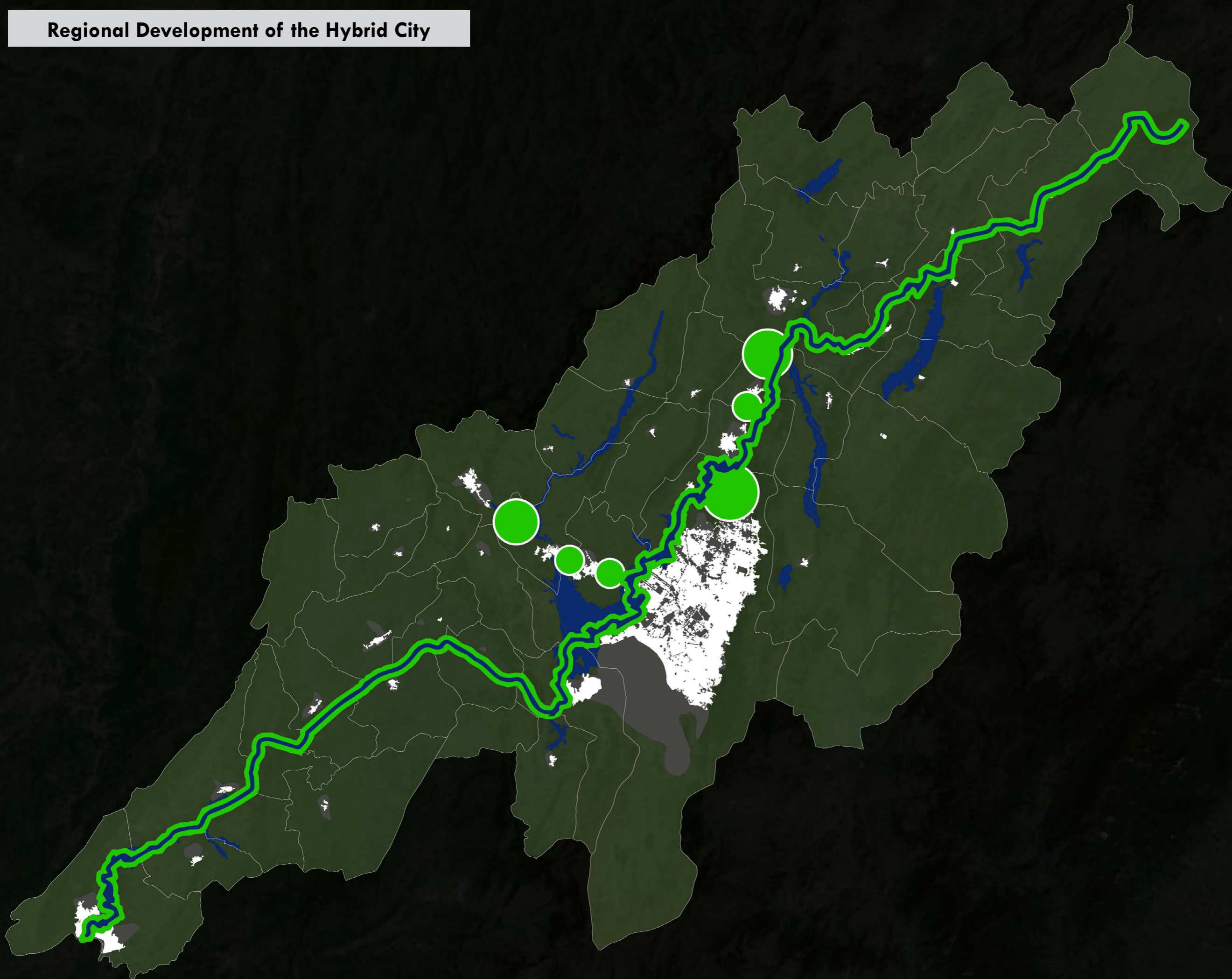
The territorial binding between social, economic, recreational and environmental fields was a success in the design and its future sustainability.

HOUSING			
Bogotá Population	2015	7,800,000	
Bogotá Population	2065	12,900,000	
People to locate		5,100,000	
Square System - 1 block (16 Ha)	Total People	8,864	Population per block
	Density	139	People per Ha
	Total Housing Units	2,216	
Hybrid Model - 71 blocks (16 Ha)	Total People	629,344	Population Located in Hybrid System of Blocks
	Total Housing Units	157,336	
Percentage Population Located in Hybrid City Model		12 %	
URBAN AGRICULTURE			
Bogota Food Footprint	2015	2,900,000	Tons per year
Bogota Ecological Footprint		2,500,000	Ha per year
Bogota Food Footprint	2065	4,700,000	Tons per year
Bogota Ecological Footprint		4,200,000	Ha per year
Food Footprint	Square System - 1 block (16 Ha)	3,295.59	Tons per year
		2,841.03	Ha per year
Food Footprint	Hybrid Model - 71 blocks (16 Ha)	233,986.87	Tons per year
		201,712.82	Ha per year
Square System - 1 block	Area for production	3.16	Ha
	Harvest - 2 per year	6.32	Ha per year
	Production	7.33	Ton per year
	Food produced will feed	22%	
Hybrid City Model - 71 blocks	Total Area for production	224.37	Ha
	Total Harvest - 2 per year	448.74	Ha per year
	Total Production	520.54	Ton per year
	Total Food produced will feed	22%	
Population Feed - 1 block (16 Ha)		1,950	People
Population Feed - 71 block (16 Ha)		138,456	People
FLOWER FIELDS			
National Production		7,290	Ha
Department Production		5,832	Ha
Total Jobs		182,174	People
Square System - 1 block (16 Ha)	Area	1.98	Ha
	Harvest - 2 per year	3.96	Ha per year
Hybrid City Model - 71 blocks (16 Ha)	Total Area	140.55	Ha
	Total Harvest - 2 per year	281.11	Ha per year
Population employed in Hybrid City Model		8,781	People
SUSTAINABLE AGRICULTURE			
Hybrid City Model	Area for production	1,071.30	Ha
	Harvest - 2 per year	2,142.60	Ha per year
	Production	2,485.42	Ton per year
Percentage Population Feed in Hybrid City Model		105.04 %	
		661,080	People
FACILITIES			
Waste			
Square System - 1 block (16 Ha)	Produces	642.64	kg per day
Hybrid City Model - 71 blocks (16 Ha)	Produces	45,627.44	kg per day
For the population			
Square System - 1 block (16 Ha)	BUSINESS AND COMMERCE	0.15	Ha
	SCHOOL (pre-school)	0.17	Ha
	RECYCLING COLLECTION POINT	0.19	Ha
Hybrid City Model - 71 blocks (16 Ha)	BUSINESS AND COMMERCE	10.30	Ha
	SCHOOL (pre-school)	12.39	Ha
	RECYCLING COLLECTION POINT	13.51	Ha
LOGISTIC PARK			
Total Area destiny to logistic parks in Hybrid City Model	Area 1	5.29	Ha
	Area 2	12.14	Ha
	Area 3	12.17	Ha
	Area 4	12.83	Ha
	Area 5	97.71	Ha
TOTAL		140.15	Ha

RECYCLING MATERIAL

RECYCLING MATERIAL

Regional Development of the Hybrid City



The following maps in these pages and page 109, show the development of the Bogotá hybrid city area in a regional level. The implementation of this design in the other located areas to intervene in the regional scale, will generate an impact that could connect the territory into one integrated network. The regional map shows the starting initiative with the development of the hybrid city models and how is visualized in the river basin scale.

The future interaction of these models will improve the ecosystem structure and the use of the natural resources. Transforming as well the river basin into a polycentric region.

A accomplishing the optimization of the systems in food, waste and energy, involving social and environmental factors will be one of the most important achievements of the project.

All the key elements mentioned before, are the starting and defining point of the project to use, achieve and potentiate different elements along the process.

To conclude, the hybrid city vision is given in page 112 - 113 and how it could look like. The result:

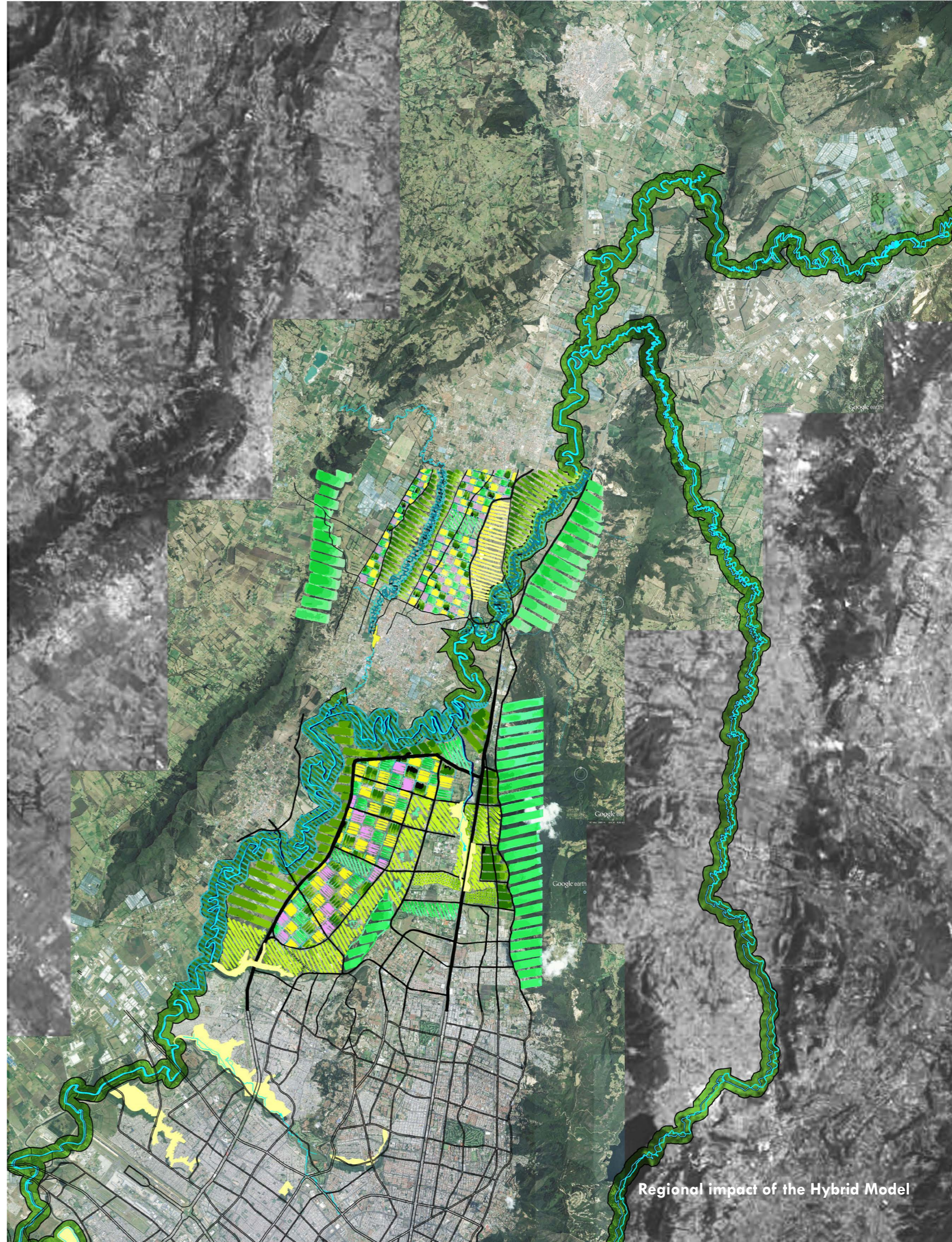
- 1. An enhanced planning of the geographical regional scale.**
- 2. The recovery of the ecosystem.**
- 3. Improvements in the three flows: food, waste and energy.**
- 4. Finally, the social inclusion and participation of the population.**

The regional vision in the planning of the territory will look like the map in page 110 - 111. It shows the river basin scale with the future developments of the land. Spatial planning in line and accomplishing the main goal and objectives. A Regional Integration and a Sustainable and Self-sufficient territory.

The last scheme shows the improvement of the region with the river basin applying a sustainable model of governance, from this day to the year 2065.

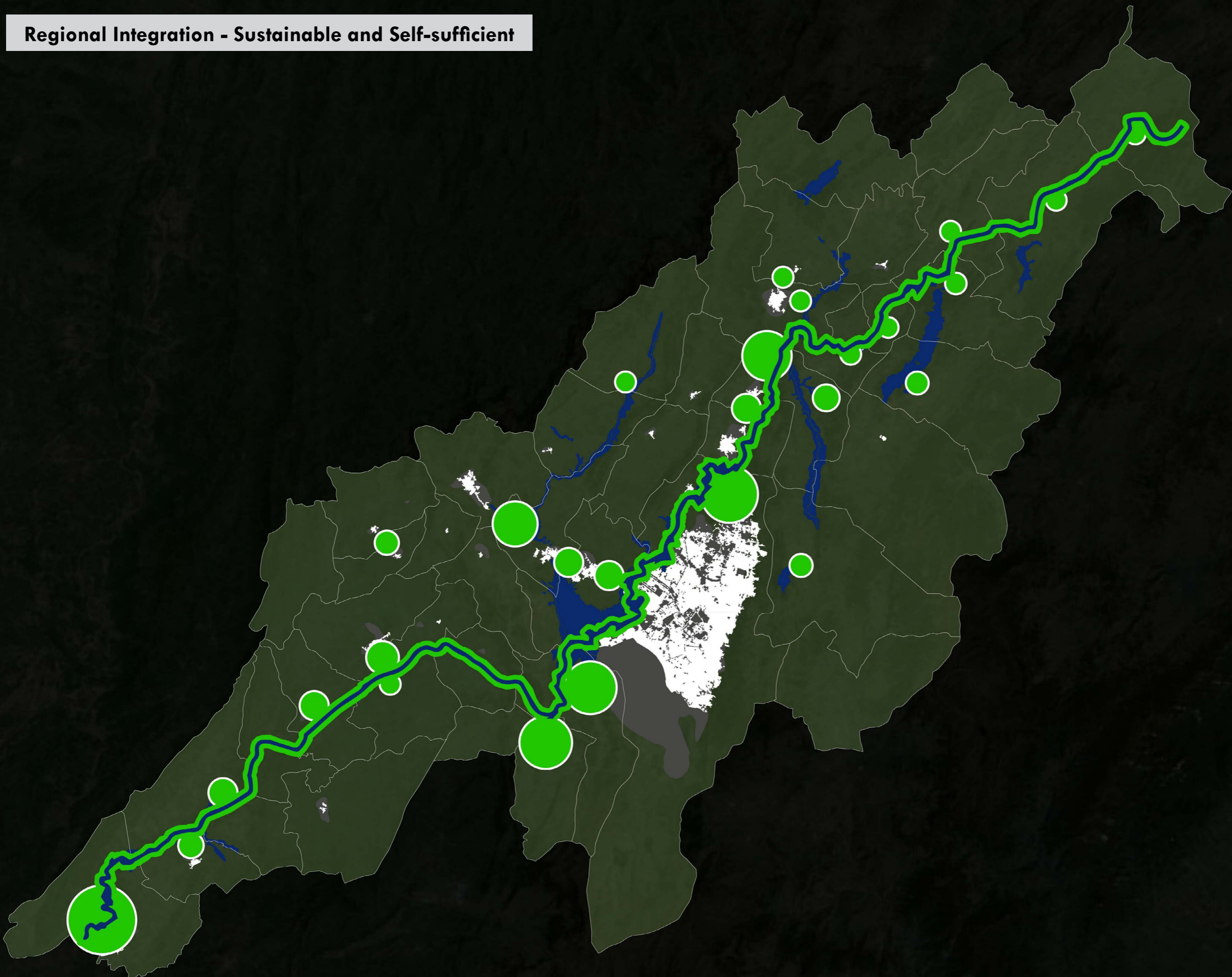


Sustainable Hybrid Model



Regional impact of the Hybrid Model

Regional Integration - Sustainable and Self-sufficient

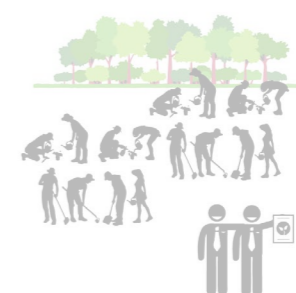
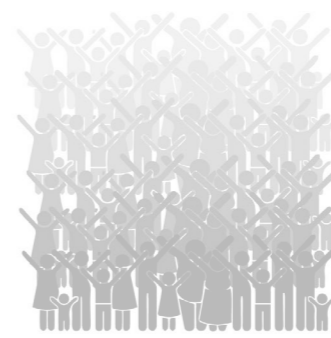
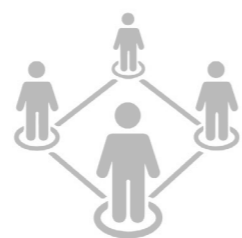


Hybrid City Vision



30 years

2048



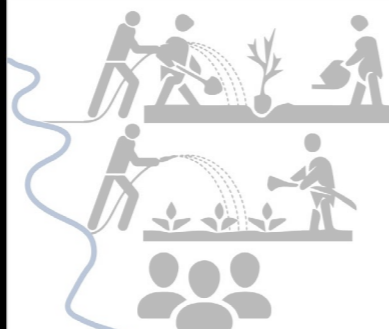
20 years

2038



15 years

2033



10 years

2028



5 years

2023



2 years

2018



Farmers



Cattle Rancher



Hydroelectric Company



Community



Environmentalists



Companies and recyclers

Agriculture

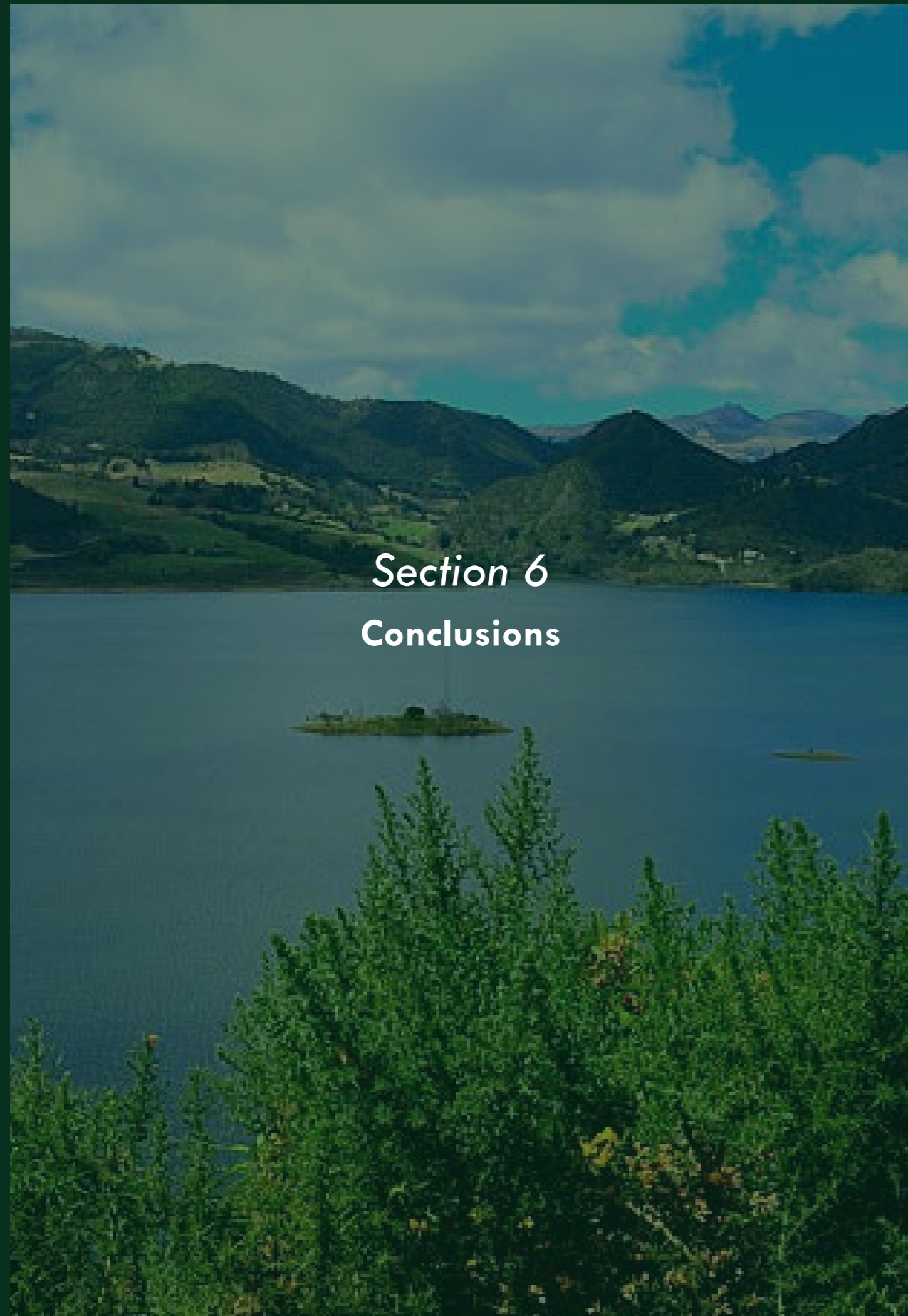
Livestock

Energy

Social

Environment

Waste



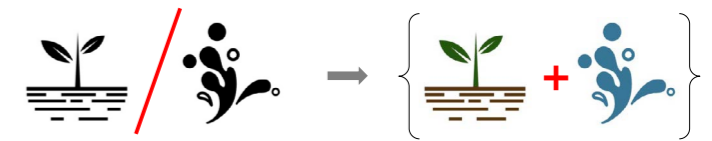
Section 6 Conclusions

Motivation- Social and Scientific relevance

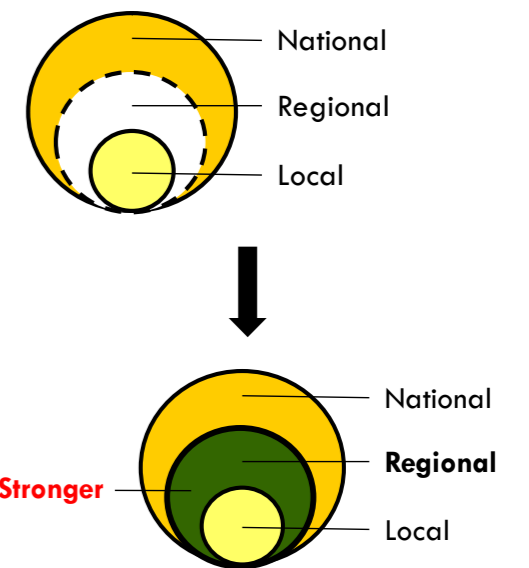
The principal motivation of this project in a **social perspective** is to stand out the importance of the Bogotá River and its basin for the people in the region. The magnitude of the explosion and contamination of the natural resources doesn't compensate the protection and balance in the recovery of the area. Contribute to the generation of a sustainable system structure for a healthier quality of life and improve habits for upcoming generations of people with the immediate context.



Prioritize and create interest in the generation of a sustainable system structure. **How?** Through the three activities that are highlighted in the right image (top).



On the other hand, for a **scientific relevance**, it is known that the Bogotá River has had a considerable number of studies and programs written for the protection and recovery of its structure, although none of them have been implemented. The quantity of those papers, essays or plans are not directly proportional to the efforts done in the defence of this environmental structure and its natural resources.



These documents have principally emphasized on the study of the water resource or the soil quality, but not in the joined natural system structure that includes both and other physical elements in this specific case. Overall they constitute the cycle by which human activities are benefit from.

Also, the lack of a regional law that covers the entire area gives as a consequence the actual situation: a national law that is not valuable and a local law that is accomplished by some of the municipalities around the river.

NATIONAL; LAW 2811 – 1974: Article no. 1

“El ambiente es patrimonio común. El Estado y los particulares deben participar en su preservación y manejo, que son de utilidad pública e interés social.”

“The environment is common heritage. The State and individuals must be involved in its preservation and management, which are of public utility and social interest.”

“La preservación y manejo de los recursos naturales renovables también son de utilidad pública e interés social.”

“The preservation and management of renewable natural resources are also of public utility and social interest.”

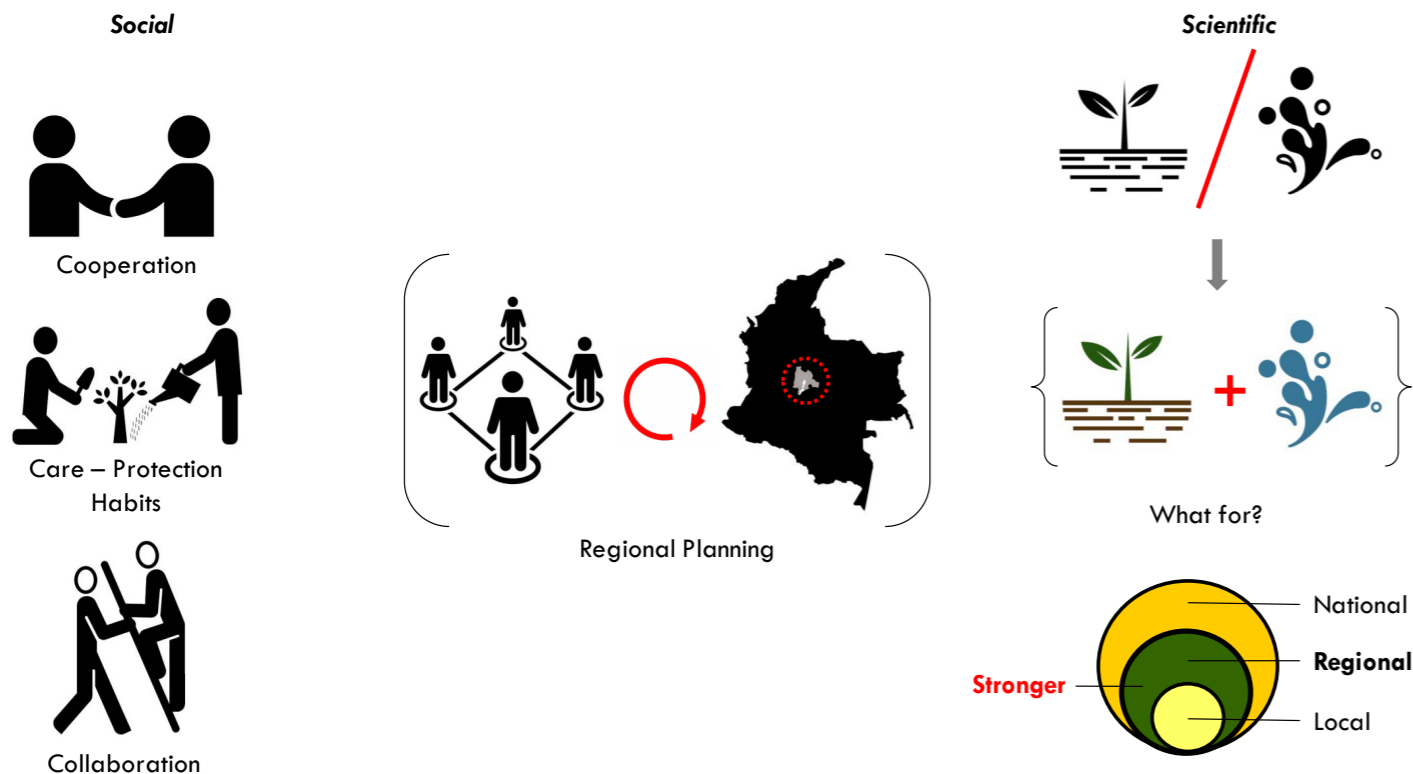
For this reason, it would be significant for the project to contribute to this body of knowledge in a more integral and sustainable way. In the research group - Complex Cities - it could give an approach of how thinking from the environmental field as starting point, could give another perspective in governance and strategic planning to apply different choices for the improvement of the Bogotá River.

The environmental field would be essential given that focuses on the needs of the population and damages

over the natural structure; instead of focusing only on economic problematics or urban growth.

Moreover, a more concrete connection with the research group - Complex Cities - could contribute with its planning methods in the regional strategy that I would like to approach.

What for? Well this will allow the generation of alternatives more in line with the planning of the territory. As a result, this is going to integrate the region with the Bogotá River and basin.



Theme and case study relationship

The graduation project: HYBRID CITY, a Planning strategy for the Sustainable Development of the Bogotá River Basin, explored the overlapping of urban and rural areas, into one hybrid model of planning and governance. The goal system was to acquire the development of the Bogotá River water structure and basin, into a sustainable system of inter-connected functions; ensuring the protection and restoration of the ecosystem in the river basin. The world has been increasingly modified by human activities. For this reason, the conservation of biodiversity is essential as insurance to maintain resilient ecosystems and ensure a sustainable flow of ecosystem goods and services to society (Angelstam, Bengtsson, Elmqvist, Emanuelsson, Folke, Ihse, Moberg and Nyström, 2003: 389).

The Studio Complex Cities has provided the directives and guidelines through spatial planning and strategy. The appliance of them to my graduation project, have allowed me to comprehend, recognize and value the processes needed to work in different scales at the same time. During the first year of the master in Urbanism (third quarter), I learned the role of urbanists. Their task is to offer appropriate futures on which society can debate and decide what direction is favourable. Also, that the implicit goal of the future interventions is quality (quality of life, quality of the environment, etc). For this reason, in my personal opinion, the connection between different scales (local, regional and national) and the projection involving both urban and rural areas together was and still is of importance.

It was studied that Urbanism is the spatial organization of land and dynamics in regions and cities. To maintain the “quality” it is necessary to compare, evaluate and develop flexible and durable designs, which have a minimum impact over the environment and its natural resources. For this reason, the project intervention in the Bogotá River Basin was a perfect study case option for the demonstration. It involved the decision of taking a sustainable direction, the challenge for quality and the development of long-term initiatives

to recover and protect the ecosystem. The project is motivated by the increasing contamination and deterioration of the natural resources in the Bogotá River and the surrounding territory.

There are three central elements that make possible the creation of sustainable future plans for promising regions: planet (environment sustainability), people (social coherence), and profit (economic vitality). The project took as starting initiative the environment, although it includes all three to improve the river basin into a sustainable and self-sufficient area.

On the other hand, the project shows interest and awareness in the improvement of the model of governance and planning subject; that involves not only political or administrative structures, but also the conflict between urban development and the ecosystem. The rapid transition of the land use from urban to rural areas, has threaten the future sustainability of the region.

The Studio Complex cities gave me a strong theoretical framework and a clear objective: the development of a perspective for the study area (image of a possible future), through regional design and spatial strategy in the Bogotá River Basin in Colombia. The result, a satisfying approach given the complexity of the project and the concept spatial planning provided opportunities in every different field to work through. That is the reason why I chose it; due to the variety of directions that it can take and the flexibility that it can have.

Research and design relationship

The research of the project is based on: How to generate an integrated system between urban development, food production, waste management and energy generation given the increasing pressure of urbanization without damaging the environment contained in the Bogotá River and its basin? And without forgetting the important role that governance has in

this matter. It became one of the most important pivots to transform the situation of the study case.

To accomplish the planning of the territory and a balanced model of governance for a sustainable region, it was needed to optimize spatial issues and elements along with government dynamics. In my opinion, the project conceived the idea that this should be achieved through the improvement of the relation human activities (urban development) and natural resources; as well as the governance interaction and intervention with these matters. So as a consequence, the goal of the research was focused to find how rural and urban areas could overlap in determined strategic projects and balance the misuse and waste of the resources apart from the contamination of the river.

In other words, recover the ecological structure. This was the moment when I found the definition of the general objectives (specific research questions) of the project, and accomplished them through the design improvements of a square system of blocks and the establishment of a planning institution. This two elements will create the hybrid city model that I was looking for the sustainability of the region.

The specific search questions were:

- **DEVELOPMENT** - How to generate land for urban development without harming the river system?
- **FOOD** - How to create a balance between the natural structure and food production in cattle and agriculture activities?
- **WASTE** - How to adequate areas for waste management and treatment along the Bogotá river and basin?
- **ENERGY** - How to improve water and soil for energy generation?

Identifying the four elements mentioned before involving the governance participation, made me realize that all the flows plus the land use and the ecological structure have interconnected functions. However the balance in these connections is what is threatening

and destroying the ecosystem. Including the governance connection that is null. The objectivity and common good of the population is controlled and ruled by a few number of people with personal and economic interests. Even though, the governance structures have a coherent and logical structure inside them, they are completely disconnected from the regional ecological structures such as rivers principally.

This was the reason why the system has not being sustainable. When I realize the linkages between them and the importance of the positive and balanced relations, I could propose the suitable solutions for each case. The relationship between food production and the ecosystem; the relationship between waste management and the ecosystem; the relationship between energy generation and the ecosystem; the relationship between urban development and the ecosystem; and most importantly the relationship between governance and the ecosystem; which established the required objectives and the principles that needed to be improved.

On the other hand, the design improvements (square system of blocks - hybrid city model) were defined with a specific mission: it was given through the union of a variety of aligned research: contamination / flows / government structure / and infrastructure that were organized in a framework. The result was a regional toolbox which allowed the establishment and settlement of priority issues and planning guidelines to apply in the designed hybrid city model. The spatial opportunities for the future of the territory by upgrading these key ingredients would not only develop and outstanding new framework, but also involved a considerable number of stakeholders. With the establishment of a new planning institution that will guide the future of the ecological structure in the river basin.

The mission was a complex job. During the process of analysis of these elements, all the information overlapped not only in themes but in different scales; which made the task much more difficult. Over time, the concepts and ideas became clearer and the organization of the dynamics (key elements) allowed me set up priorities.

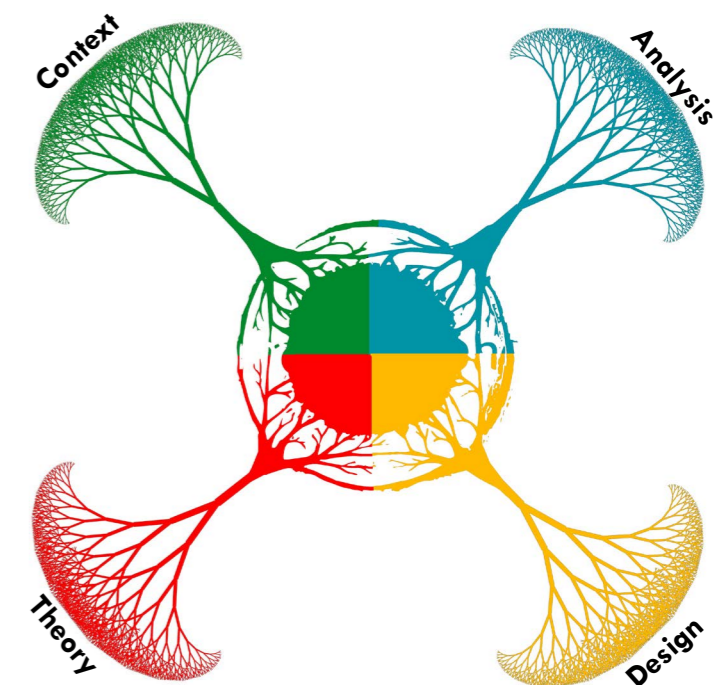
In the end, the optimum profile for the improved model of governance and planning was given to the result between the regional toolbox, the strengths of the territory, the need of a decentralized planning authority, and the design square system of blocks (hybrid city model). The objectives were accomplished, the approach questions were answered and the hybrid city model became an example of possible sustainability in the Bogotá River basin. The possible future scenario that I was looking for since the beginning without knowing which direction to take, appear to be a reality and a transformation of the region.

The complex calculations made along the process gave me a dimension of what I was dealing with. Even though, is not a perfect model and can supply the demands in a 100% for the totality of the areas, it gave a light in the end of the tunnel to initiate changes over the habits of the population and improve the degradation of the environment. For this reason, this would be the best model to develop in these circumstances. The results especially in governance generated the vision that I had: from a fragmented territory to a connected network. All these, through the implementation of the spatial strategy in the land use. It was due to the location between urban areas that had higher possibilities of conurbation which brought the perfect scenario to apply and develop the hybrid region concept.

Personal and Studio line of approach relationship

The product, process and planning of the graduation project, made me understand the methods (how) and the argumentation (why) of the concepts needed to reach the level I wanted. The Studio approached me in the exploration of regional and local scales; which helped me to develop the entire context, theory, analysis and design processes. It gave a broader overview of the current situation in the researched field and the vision of the future scenarios at the same time. Understanding not only the social and economic context; but also the environmental field brought bigger possibilities of developing a more sustainable and self-sufficient productive landscape ecosystem.

Thanks to the guidance achieved and received through the research group, my personal methodology was divided since the beginning in four branches: theory, context, analysis and design. These branches worked together overlapping along the complete process to develop a balanced and coherent strategy and design product. Together, the personal and Studio's methodology, directed to the understanding of the environmental structure. Both of them worked simultaneously throughout the whole planning process. They helped to achieve the main goal, objectives, strategy and final design.



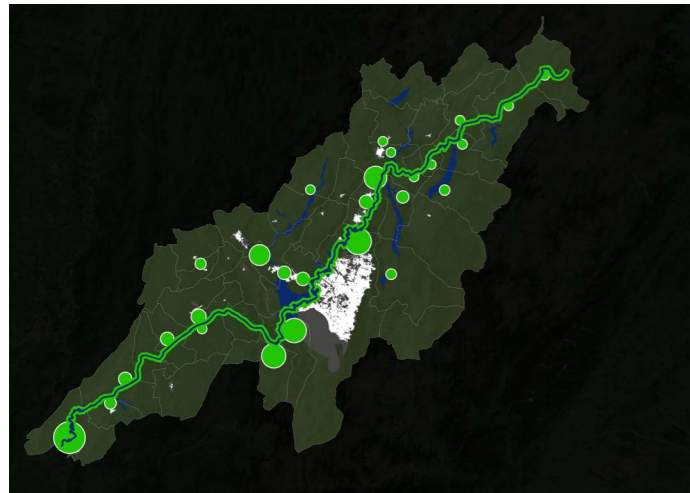
Graduation project and the wider social context relationship

The Bogotá River basin, both water and land, have been threaten by different factors such as: extensive food production, waste and energy generation. The biggest weakness confronted is involved with the government structure. The administrative division of the territory is only convenient for bureaucratic purposes; so the natural system structure is left aside in the

black hole of consumption and destruction. However, the strengths and opportunities are contained in the wide biodiversity of the territory. The mountains and its topography help to provide enormous amounts of water to be consumed in populated areas. The fertile land and the variety of heights supply any possible need that the population could demand.

The preservation of the ecosystem and protection of biodiversity could not only improve the physical and mental health of the community, but also the planning and development as means to improve the territory. The hybrid city model in the region is developed from a long-term perspective and the results were evident in three principal achievements:

- Enhanced planning and governance administration in the geographical regional scale.



- Recovery of the ecosystem structure in the city scale.



- Involvement - Social inclusion and participation of the river basin population through the local scale.





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Governance and Development towards a sustainable exploitation of the Bogotá River Basin

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Urbanism

Section 8 Appendices

Abstract- The Bogotá River in Colombia has the strongest economic potential and productive basin in the country (it represents around 5% of the GDP). The increasing necessity for food production, energy availability and urban development due to the demographic growth during the last two decades, has caused an excessive transformation of the regional ecosystem and contamination of the river.

The lack of commitment to protect the water and the environment, the abuse of natural resources for economic purposes and the absence of a solid governance model have caused a disconnection between law, planning and development. There is a lack of territorial planning in terms of environmental, social and economic integration.

The question that arises from this problematic is how to generate an integrated system between urban development, food production, waste management and energy generation, given the increasing pressure of urbanization and the need to protect the environment contained in the Bogotá River and its basin.

This paper will tackle the need for an improved model of development and governance for the river basin with its built and natural environment. It discusses the necessity to redefine and restructure the human activities (interventions on the territory such as agriculture and urban development), in order to improve the quality of the environment and the social life of the region.

Key words - environment, sustainability, river basin, urban development regional governance, model of development, strategic spatial planning

1. Introduction

For the last two decades, urban development has transformed the ecosystem in the Bogotá River basin. The industrial revolution increased natural resource exploitation, urban growth and pollution (Botequilha Leitão, and Sousa Ferreira, 2006: 150). The development of new technologies has intensified the use of resources without considering their exhaustion.

“In a world increasingly modified by human activities, the conservation of biodiversity is essential as insurance to maintain resilient ecosystems and ensure a sustainable flow of ecosystem goods and services to society” (Angelstam, Bengtsson,

Elmqvist, Emanuelsson, Folke, Ihse, Moberg and Nyström, 2003: 389). As it is stated in the previous quote, from the article of the Royal Swedish Academy of Sciences, it is crucial for the wellbeing of society that a sustainable management of the ecosystem's natural resources is carried out.

Many sources point out the same conclusion, as visualised in Figure 1, for instance in the article Biodiversity concepts and urban ecosystems, it is stated that “more people live in cities; restoration, preservation and enhancement of biodiversity in urban areas become important” (Clergeau, Mennechez, & Savard, 2000: 131).

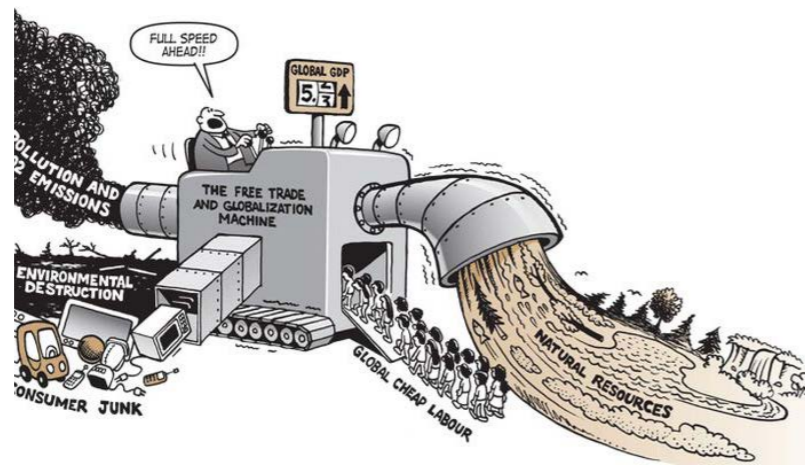


Figure 1: The picture shows the general concept of the degradation of the natural resources and the contamination progression.

Source: <https://www.pinterest.com/ateamb/globalisation-and-the-environment/>

My research is inspired by the work of Professor Thomas Elmqvist. As researcher at Stockholm Resilience Centre, he addresses the conflicting role between ecosystems, human activity and the role of governance. In his work *Cities and Biodiversity Outlook*, he talks about the world's first assessment of biodiversity in cities and highlights the importance of biodiversity contained in cities. He illustrates how innovation in the transition to sustainable processes is fundamental and essential in environments life expectation (Elmqvist, 2013: 635).

In Colombia, like in other countries, the main cause of excessive use of natural resources is human activities, related to economic production. The current situation shows that rivers near cities are being channelled and contaminated due to the pressure of urban development, and as a consequence, the pressure over the rural landscape is putting the territory and the ecological structure of the country in a dangerous position. In the case of the Bogotá River basin, both water and land have been threatened by different factors such as extensive food production, waste and energy generation. For example, in the year 2009, food production (agriculture) used 49% of hectares of the total area in the river basin.

Moreover, the administrative system of the territory has not applied strong policies, with the objective to articulate a coherent spatial logic for land use regulation and resource protection. The eroding influence of national party politics in the local political organisation (functional/sectoral) has broken governance relations (Albrechts, Healey and Kunzmann, 2003: 113-114). This has disabled programs and actions to take over the sustainability of the ecosystem's future.

In this context, the issue I want to tackle in this paper is the indispensable need for an improved model of development and governance. It can be

translated spatially into a strategic vision for the territorial development and the capacity of creating strategic interventions at the urban and regional levels. As stated in the theory of Albrechts, Healey and Kunzmann, the focus on the spatial relations of territories embraces the guarantee of a more effective way of integrating economic, environmental, cultural and social fields (2003). In other words, a sustainable and self-sufficient productive landscape ecosystem, that is planned by considering short, medium and long-term development for the future.

At this point, there are four questions that arise from the context of the current government: 1. How is it possible to generate an integrated system between urban development, food production, waste management and energy generation? 2. How to do it without damaging the environment contained in the Bogotá River basin? 3. In what way could it respond to the increasing demographic growth? 4. How could this proposal build a realistic scenario which is linked with the governance configuration?

In order to address all these issues, this paper is divided into four sections. Section 2 presents the current situation in the Bogota River basin. Section 3 examines some examples of successful new forms of regional governance. Section 4 discusses how these examples can be applied in the river basin in an innovative proposal. And finally, the conclusions give recommendations for a planned transformation and implementation.

2. The problematic in the Bogotá River Basin: law, pollution and exploitation.

In the following section, I will introduce the main problem that the Bogotá River basin and the natural resources in Colombia are facing. Colombia has

a National Law to ensure and protect the ecological biodiversity of the country which includes ecosystems with their natural resources and water structures. This act number 2811 in existence since 1974 claims in its article #1: *"The environment is common heritage. The State and individuals must be involved in its preservation and management, which are of public utility and social interest. The preservation and management of renewable natural resources are also of public utility and social interest."*¹

As will be explained below, the complex structure of the government renders this law useless. And even though it is present in the management of the Bogotá River basin, it is not implemented due to the economic benefits derived from the land use. There is a need to build strong spatial organising concepts and persuasive institutional alliances to carry a strategy across a diffused power context (Albrechts, et al., 2003: 127). Strategic spatial planning is a key component of political and administrative efforts in city regions to guide their development processes (Albrechts, et al., 2003: 116). Therefore, the spatial structure plan that is proposed, aims to provide structuring principles capable of imposing some order on the currently perceived chaos (Albrechts, et al., 2003: 121). There is an urgent need for the transition from a traditional regulatory land use planning system to the provision of a strategic framework. This would mean a shift from the practice of allowing dispersed development to the concept of managing growth according to sustainable development principles; and from rather closed processes to more open processes involving larger numbers of stakeholders (Albrechts, et al., 2003: 116)

On the contrary of what is stated in this national law, the impulse of demographic growth constantly requires the provision of supplies, which translates into the transformation of natural ecosystems into productive areas. Because of this, the conflict between human activities and the use of natural resources is growing every day. According to Guerrero Legarreta (2010: 121) the rivers become sewers; wetlands are drained and filled with urban development; marshes turn into output fields establishing livestock and agriculture. The impacts are so disastrous in the Bogotá River basin that human activities are defined as "the destructive hand" (Guerrero Legarreta, 2010: 123).

As it is stated in the national law previously mentioned, the preservation and management of renewable natural resources are of public utility and social interest. This means that natural resources should provide benefits to all inhabitants equally,

and for this, a balanced use of them is needed. In the case of the Bogotá River Basin, which has the most fertile and productive soil of the country as well as a large biodiversity, it is seen that there is a high exploitation of the land only for economic purposes, which is not taking into account the sustainability of the natural system.

Cities have grown immensely without planning, which has created not only problems for the natural resources but also with respect to the social dimension in every populated area in the Bogotá River basin. It is essential to maintain and protect the biodiversity of the river basin for a sustainable future of its surroundings, including the populated areas. The results of my research show the need for the water and environmental structure of the Bogotá River basin, to recover.

3. Best practises in Regional Governance

The following section highlights three European projects of regional governance that will be exposed as potential examples of how to pass from a long-term successful planning to a sustainable structure and recovery of the ecosystem. The reason because these examples were chosen, was because they applied spatial strategies in order to improve social, environmental and economic aspects.

The first example deals with the regeneration of the Emscher River, also known as Ruhr Region Basin in Germany. It was one of the most polluted and environmentally devastated regions of the world. There was a conflict between environmental and development goals. The main objective was to encourage the ecological, economic and urban revitalization of the Ruhr Valley and the Emscher River. This aimed to re-establish connectivity between green spaces creating a robust ecological system, converting a post-industrial district and housing sewer into a recreational area.

The main idea was the conception of a green connector with a cohesive green infrastructure. So the new model of governance was changed, transforming the region into a polycentric urban development which was more sustainable: known as sustainable - oriented regeneration.

The second example, the Zuidvleugel or "south wing" is the group of cities and towns in the south-west of the Randstad in the province of South Holland in the Netherlands. They have one principle: co-govern-

1. Secretaria General de la Alcaldia Mayor de Bogotá D.C., (1974). Decreto 2811 de 1974 Nivel Nacional. Retrieved August 31, 2015, from <http://www.alcaldia-bogota.gov.co/sisjur/normas/Norma1.jsp?i=1551>

ment. “The central government involves the provinces, the municipalities, or both in the formulation and implementation of its policies.”(Spaans and Stead, 2013: 8).

In this model of governance, the city regions are called Joint Arrangements Act Plus. These areas are characterized by having one large city surrounded by municipalities that share or become part of a single urban system. These city regions have responsibilities over fields that cover environment, transport, housing and regional economy.

The third example, the community of communes of Val de Drôme brings together thirty municipalities of the Drôme Valley located in the region Auvergne-Rhône-Alpes in France. The community has three missions: sustainable & distributed development, enhanced solidarity and environment quality. It also involves spatial planning, protection of the environment, economic development, sports facilities, social & cultural activities and social housing policies, among others. The model of governance focuses on development, maintenance and management of the priorities and needs of the province.

The three examples and the statements previously mentioned, contribute to the structure plan of the new planning institution proposed in this paper, the Bogotá River Basin Development, Planning, and Protection Authority through strategic spatial planning.

The takeaway from the Emscher River project is the recovery of the environmental ruin and the ecological structure through a sustainable green infrastructure connector and the incorporation of the future scenarios in their model of governance. Ecological principles began to be included into planning as a result of an increased environmental awareness motivated by general environmental degradation and increasing urban sprawl and industrial development (Roberts and Roberts 1984; Ndubisi, 1997; Botequilha Leitão, and Sousa Ferreira, 2006: 151).

From Zuidvleugel project, the lesson learnt is the principle of co-government to achieve a balanced and coherent coordination in spatial planning, as well as its economic, social and environmental responsibilities. The article Strategic Spatial Planning and Regional Governance in Europe stated, that the spatial concept balanced development offered a development focus across the regions of the EU. This general approach is developed through concepts of polycentric development, redefining urban-rural relations, securing access to infrastructure and knowledge and at the same time promoting more compact

development and resource conservation (Albrechts, et al., 2003: 115).

From Val de Drôme, the priority was focused on the community and environmental value for the improvement of the quality of life. The potential is to produce principles of spatial development through strategic spatial planning. It is evident in the production of the European Spatial Development Perspective (ESPD). The document articulated the sustainable development ideal in a way that combined the EU’s objectives of economic competitiveness, environmental sustainability, and social cohesion (Committee for Spatial Development [CSD], 1999; Faludi & Waterhout, 2002; Albrechts, Healey, and Kunzmann, 2003).

For this reason, the ideal model of development and governance, balancing natural resources, human activities, and government structure, is a spatial strategy applied through the implementation of a “hybrid dynamic”, a term created in my research and that I will explain in the next section through the theory urban-rural linkages. It will be based on a measured and more sustainable use of the resources, by developing a framework that will transform the region from a fragmented unsustainable dynamic into an incorporated sustainable system. This will generate employment that will result in economic development for the region and in a good quality of life for the people living there. The three examples and regional governance statements built the necessary arguments to develop the hybrid model on a regional scale in the Bogotá River basin. In the following section, I will explain how the framework mentioned before, as I call hybrid region, could be developed.

4. A new planning institution: Bogotá River Basin Development, Planning, and Protection Authority

I will explain how the proposal of the planning institution could work, based on the theory of urban-rural linkages.

The overlap between rural and urban areas, generating a third area called hybrid, which can be seen in Figure 2. The United Nations Conference on Housing and Sustainable Urban Development stated that urban and rural areas depend on each other. Urban areas depend on rural areas due to a range of goods and services: food, clean water, environmental services, and raw materials, among others (Habitat III Issues Papers, 10 Urban-Rural Linkages, 2015:

3). The explanation of the hybrid dynamic could be linked to the theory “urban-rural linkages”. This refers to complementary and cooperative functions in flows of people, natural resources, capital, goods, employment, ecosystem services, information and technology between rural and urban areas (Habitat III, et al., 2015: 1).

As an example of how this mutual relation can work, the hybrid region will be represented in a planning institution and a spatial framework, which will show the new model of governance and development of the Bogotá River Basin. This spatial regional structure plan is shown in Figure 3. The framework of the hybrid spatial strategy is located in the areas more

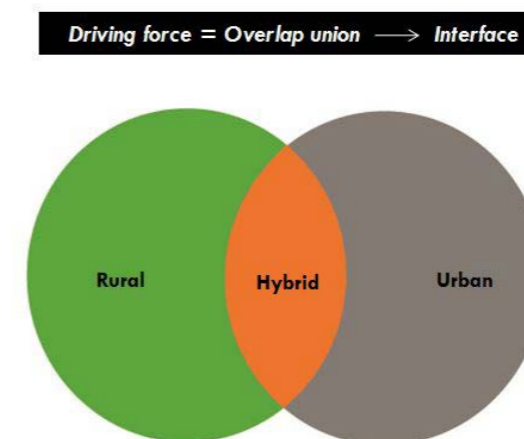


Figure 2: Scheme hybrid dynamic. Source: Scheme by author.

Nolan and White (1984) suggest that the urban-rural relations (hybrid dynamic) should be structured to reflect one principle: “Urban-rural relationships should change from being exploitative to mutually beneficial” (Funnell, 1988: 270). The partnership between urban and rural areas develops the cooperation to reach common and sustainable goals (Habitat III, et al., 2015: 1).

likely to present future conurbation between rural and urban areas (yellow circles). This principle will be applied in strategic projects along the river basin, implementing the hybrid mission concept protecting the ecosystem of the Bogotá River and land. Also, it will generate a more sustainable dynamic between the use of natural resources and human activities.

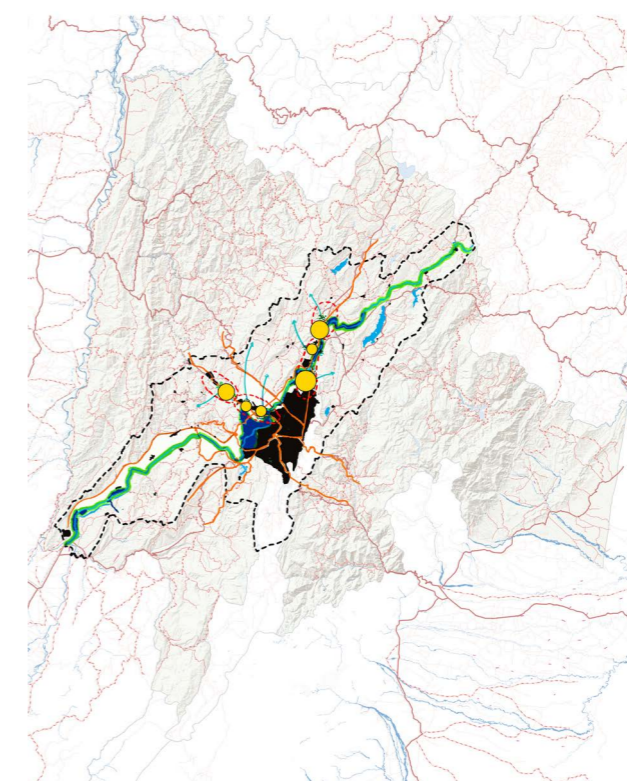


Figure 3: Map hybrid spatial strategy on the Bogotá River basin territory. Source: Map by author.

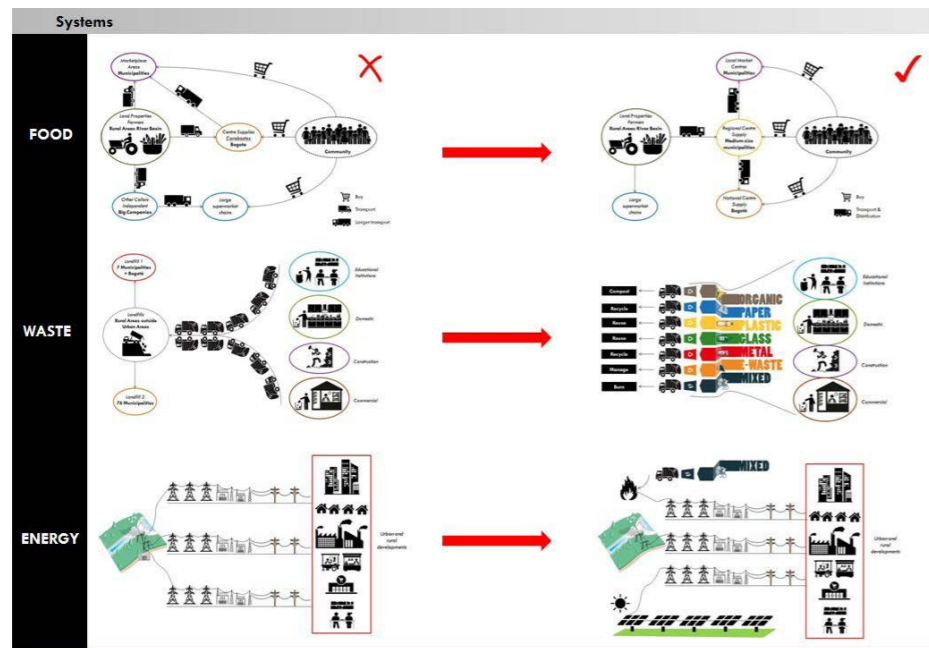


Figure 4: The hybrid mission outcome: inclusion of three flows: food, waste, and energy. Source: Image by author.

Ecosystems are needed for the production of food, the generation of energy and the significant quality of life of the population. They are beneficial to humans and all living things, and they provide services, which need to be used in a conscious manner. The hybrid mission will be developed with the inclusion and overlapping of three flows: food, waste, and energy. In Figure 4, the illustration shows how it could work, enhancing the regional network and the outcome to generate sustainability with the increasing population growth.

Through the development and implementation of a new planning institution, a spatial framework can be built in relation to the existing governance structure. The proposal of the organization concept of the river authority (see Figure 5) will be based on the hybrid mission (spatial regional strategy). The transforma-

tion of the river basin into a productive landscape ecosystem: sustainable and self-sufficient.

The concept is based on the fact that the river does not respond to an administrative system in the current situation; although the river works as a natural system structure. This way, the institution would be responsible for restoring the river system structure, binding social, agriculture, waste, energy and environmental issues. Furthermore, the actual lack of government contribution over the regional scale in this issue; presents the opportunity to widen governance relations and incorporate new local community stakeholders (Albrechts, et al., 2003: 114). The community participation is highly valuable for the foundation of the planning institution.

The stakeholders (see Figure 6) involved in the creation of the planning institution are the peo-



Figure 5: Development and location of the planning institution. Source: Image by author.

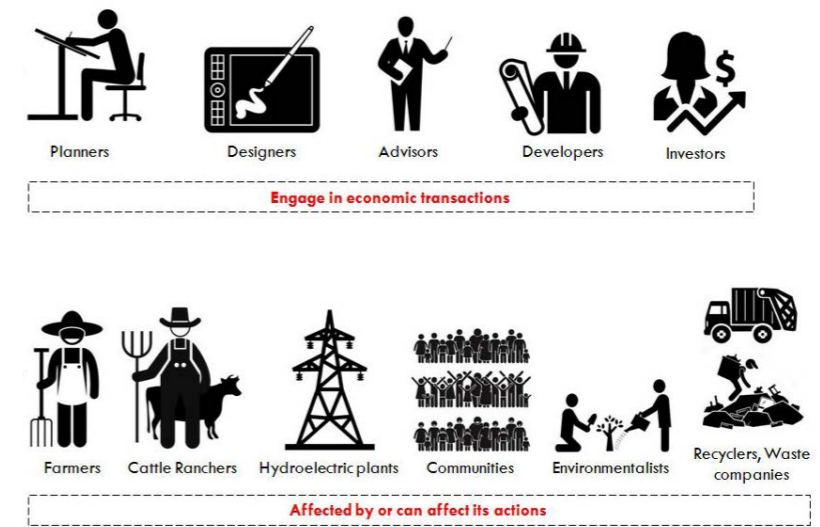


Figure 6: Stakeholders. Source: Image by author.

ple involved in the flows previously mentioned; and will range from planners to investors.

There are two types of members: core and peripheral. The core member groups have physical con-

proximately two years. First, local scale, then organization of assemblies on the regional scale and finally the establishment of the general assembly in the river basin scale. After the initial two years, the development of the territory will be planned to take

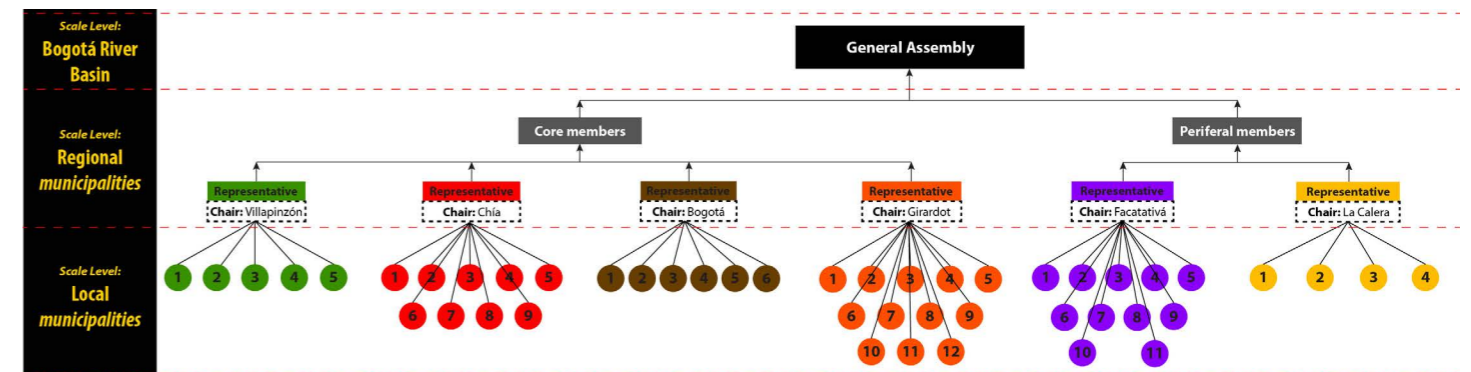


Figure 7: Planning institution internal distribution. Source: Image by author.

tact with the river, whereas the peripheral member groups don't. In figure 7 is shown, that every group and the municipality has one representative in the internal structure of the planning institution.

There are three scale levels interconnected. Local with municipality representatives; regional with the six groups representatives and River basin scale level for the general assembly where internal and external stakeholders make the final decision making. How is the planning institution going to work in short, medium and long term? The first initiative is to contact external stakeholders such as farmers, cattle ranchers, hydroelectric plants, communities, recyclers, waste companies and environmentalists and introduce them to the planned project.

The following step is related to the foundation of the institution, which will be done in ap-

place over a span of thirty years. For the first fifteen years, the focus will be the complete recovery of the ecosystem and for the next fifteen years, the social interventions will complete the whole vision.

As it was stated in the article Strategic Spatial Planning and Regional Governance in Europe, the spatial strategies are not only long-term orientation scenarios. The shift in governance cultures is itself a long-term process. But the hope is that the areas of the river basin, through the implementation of the new planning institution, are going to be able to achieve a transition to creative and flexible spatial strategies. The ambition is realising an open, innovative, and collaborative governance practice, which will translate into a sustainable environment and an improved quality of life (Albrechts, et al., 2003: 128).

5. Conclusions

Innovation and coexistence

Every day more water is needed for consumption, for agriculture and generation of energy; more land is needed for production and cultivation of food, but also for landfills and storage of waste in an unsustainable way.

In populated areas, in this case, the Bogotá River basin, the implementation of a sustainable model of development and governance, brings with it the opportunity for innovation, authority influence and support. As Thomas Elmqvist stated, the innovation lays 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 (Elmqvist. 2012).

Also, he stated that ecosystems, biodiversity, and urbanization are related and need to coexist. Cities have enormous potential in taking better advantage of the biodiversity located in, around and flowing through them (Elmqvist. 2012). He suggests that urbanization should be managed in a more sustainable way to protect the environment.

Hybrid region planning and development principle: river ally and ecosystem's conservation

The preservation of the ecosystem and protection of biodiversity could not only improve the physical and mental health of the community, but also the planning and development as means to improve the territory. The hybrid region is developed from a long-term perspective and the results will be evident in four principal achievements:

- Enhanced planning at the geographical regional scale.
- Recovery of the ecosystem structure.
- Food production, waste generation and energy consumption improvements.
- Involvement - Social inclusion and participation of the river basin population.

The product of this essay helped me understand the dimension of the problem and the different scales that are involved. The water system should be taken as an ally of planning and development, not as an enemy that is disturbed across the territory. It is part of the ecological structure. The regional planning scale allows to focus in the ecosystem structure, taking care of the conservation of natural resources, flood control, and broad economic and governmental problems (MacLean Lewsi, Wiley, and sons, 1949: 116).

Planning Institution goal

With the establishment and empowerment of the planning institution in the territory, the goal shown in figure 8 will be accomplished, leading to a progressive future and conscious use of the natural resources.

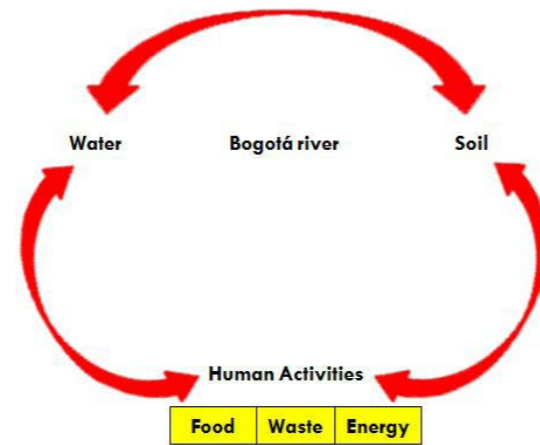


Figure 8: Hypothesis: responsible consumption/sustainable.

Source: Image by author.

Future Vision

Finally, my vision of the Bogotá River basin is focused on creating a positive potential of the region, combining environmental, social and economic objectives in the spatial structure of the territory as well as development investment programs and more participation of stakeholders. The first defined by Albrechts, Healey and Kunzmann (2003: 114) as sustainable development; and the second territorial development.

The two concepts aim to:

- Stop the deterioration of the environment
- Change the existing attitude of influential stakeholders towards planning, by establishing a new planning culture and shifting from passive planning towards a more action-oriented form (Albrechts, et al., 2003: 121).
- Introduce sustainability principles
- Integrate more actors in the planning process
- Give an alternative to the spatial demands in recreation, agriculture, infrastructure, and housing, among others.

The encouragement of stabilizing and improving the previous five points above, in the hybrid mission, will be a fundamental point to be examined in the future design and planning of the territory.

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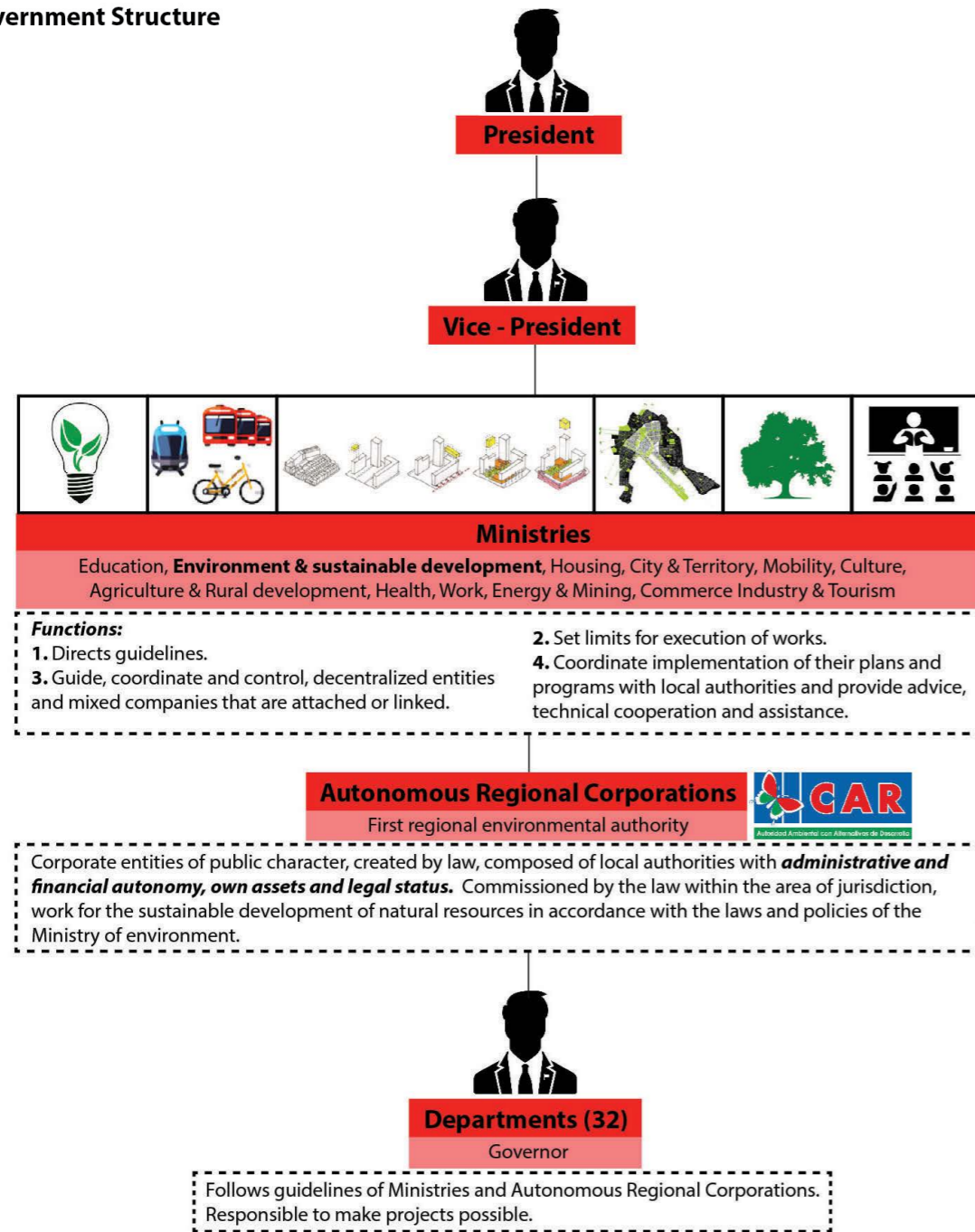
United Nations, CBD COP11, (2012). *Cities and biodiversity. Rich biodiversity CAN exist in and around cities*. Retrieved January 5, 2016, from <http://www.stockholmresilience.org/21/research/research-news/10-4-2013-rich-biodiversity-can-exist-in-and-around-cities.html;jsessionid=EE27EC423400B-556BADBA81652B70DB6?state=viewUnsubscribe&sv.url=12.33db2ae01355ec8e8f21d36>

Habitat III Issues Papers, (2015). *Issue paper on urban rural linkages*. New York.

Val de Drôme. Retrieved January 5, 2016, from <http://www.valdedrome.com/3-missions.html>

Appendix II - Current Governance Structure

National Government Structure



The current government structure in the Bogotá River basin and the department of Cundinamarca is given in the following schemes.

The red flowchart (National Governance Structure), shows the political charges passing from the President through the Ministries, the Autonomous Regional Corporations, and finally the governors of the departments in the country.

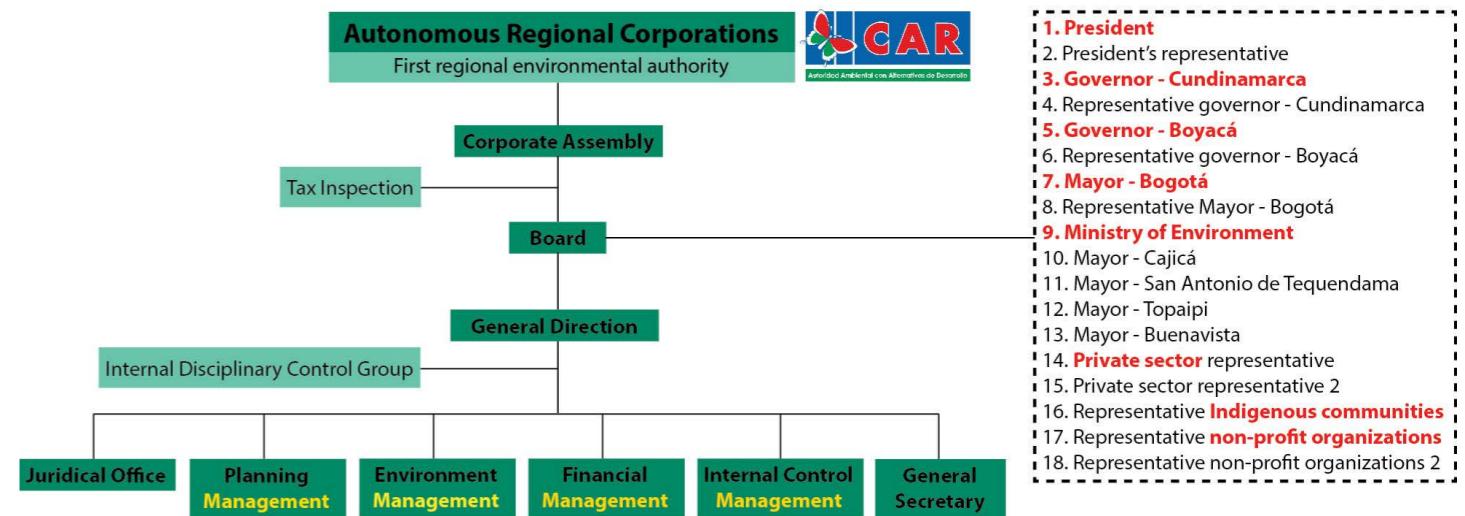
They have clear established and written guidelines, laws and policies; although the administrations for in-

dividual purposes, avoid fundamental protection interventions over the ecosystems.

The autonomous regional corporations are responsible for the well-being and protection of the ecological structures in the country. In the green scheme the flowchart illustrates the charges inside the organization.

Due to burocratic matters, the majority of the members in the Board of the corporation, are people that already have other political charges. For example, the president, governors, mayors and ministries.

Autonomous Regional Corporation Government Structure

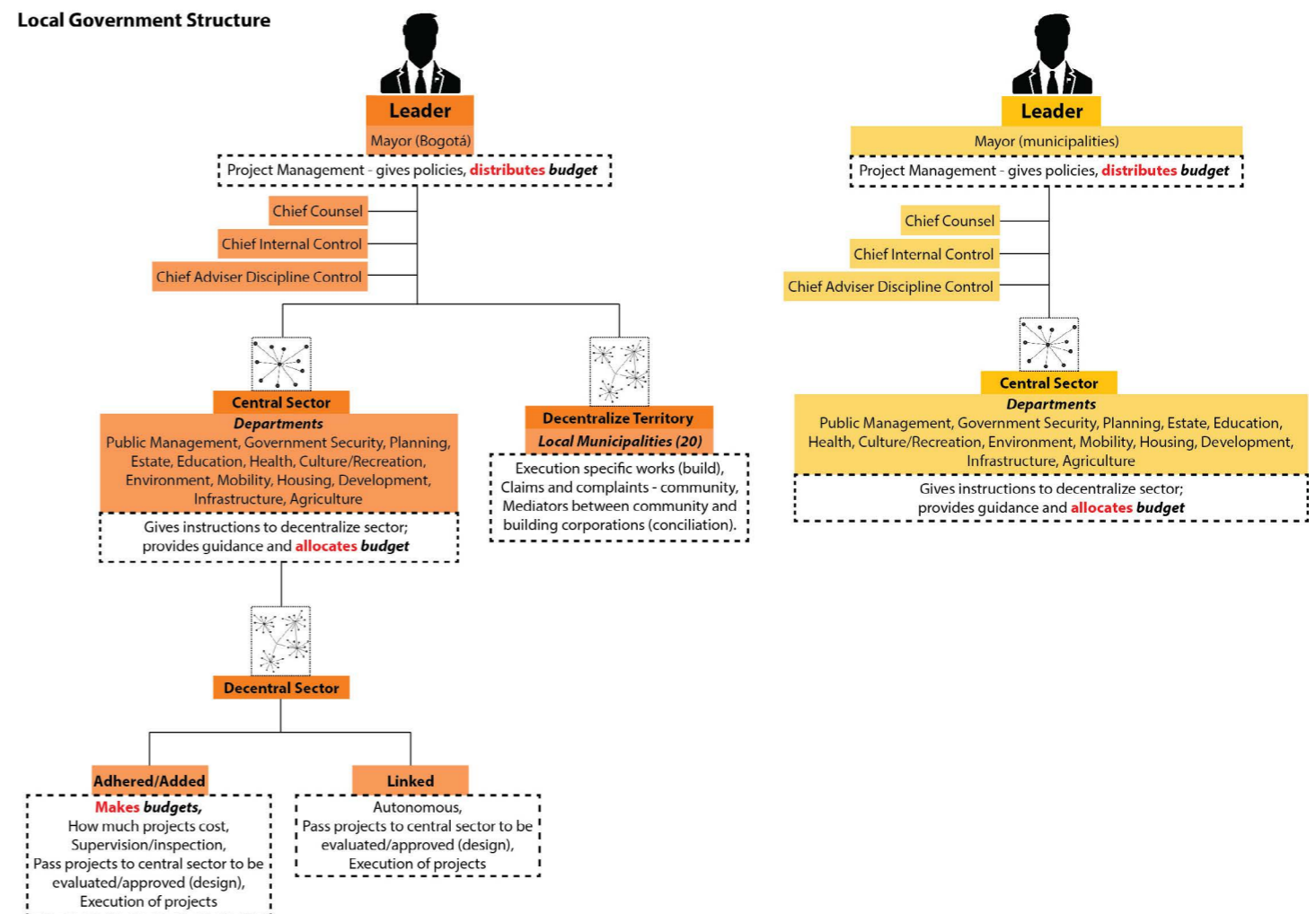


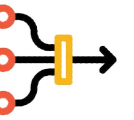
As a result, the objectivity and common good of the population is controlled and ruled by a few number of people with personal and economic interests.

The local government structure is illustrated through two examples: the mayor administration charges

structure of the capital city (orange), and the mayor administration charges structure of other municipalities (yellow). Both share a similar flowchart structure, however due to the complexity and the size of Bogotá, the administration has more departments and more budget as well to improve general demands for the

Local Government Structure





city.

Even though, the three structures shown before have a coherent and logical structure inside them, they are completely disconnected from the regional ecological structures such as rivers principally.

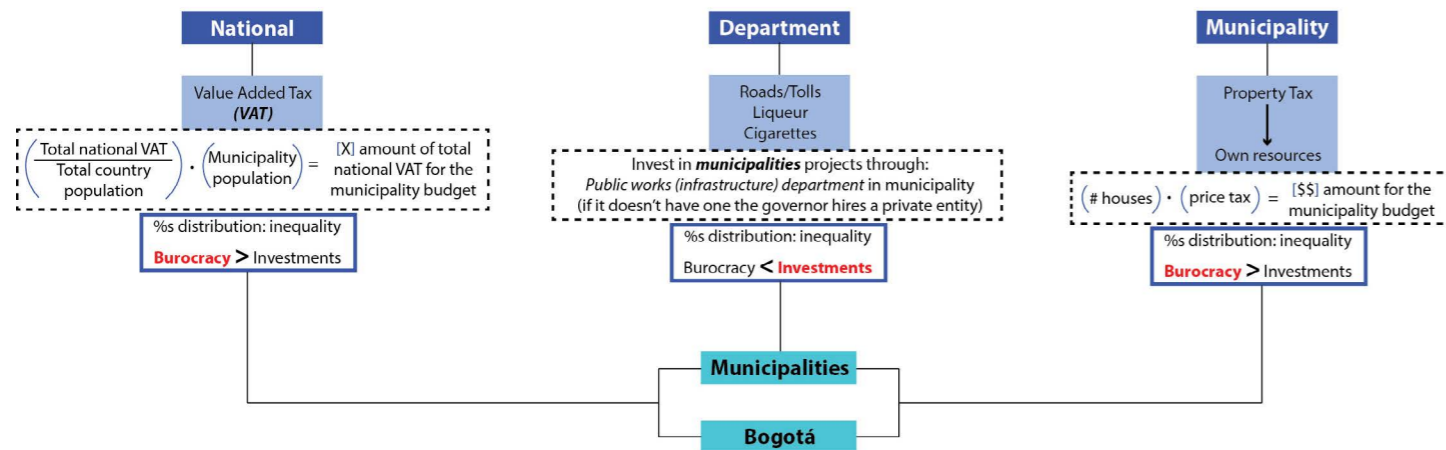
The need of urbanization and demands for the population uncover the real need of protection and planning for the ecological structure.

Finally, the last scheme (blue) shows the economic resources that are destined from the national govern-

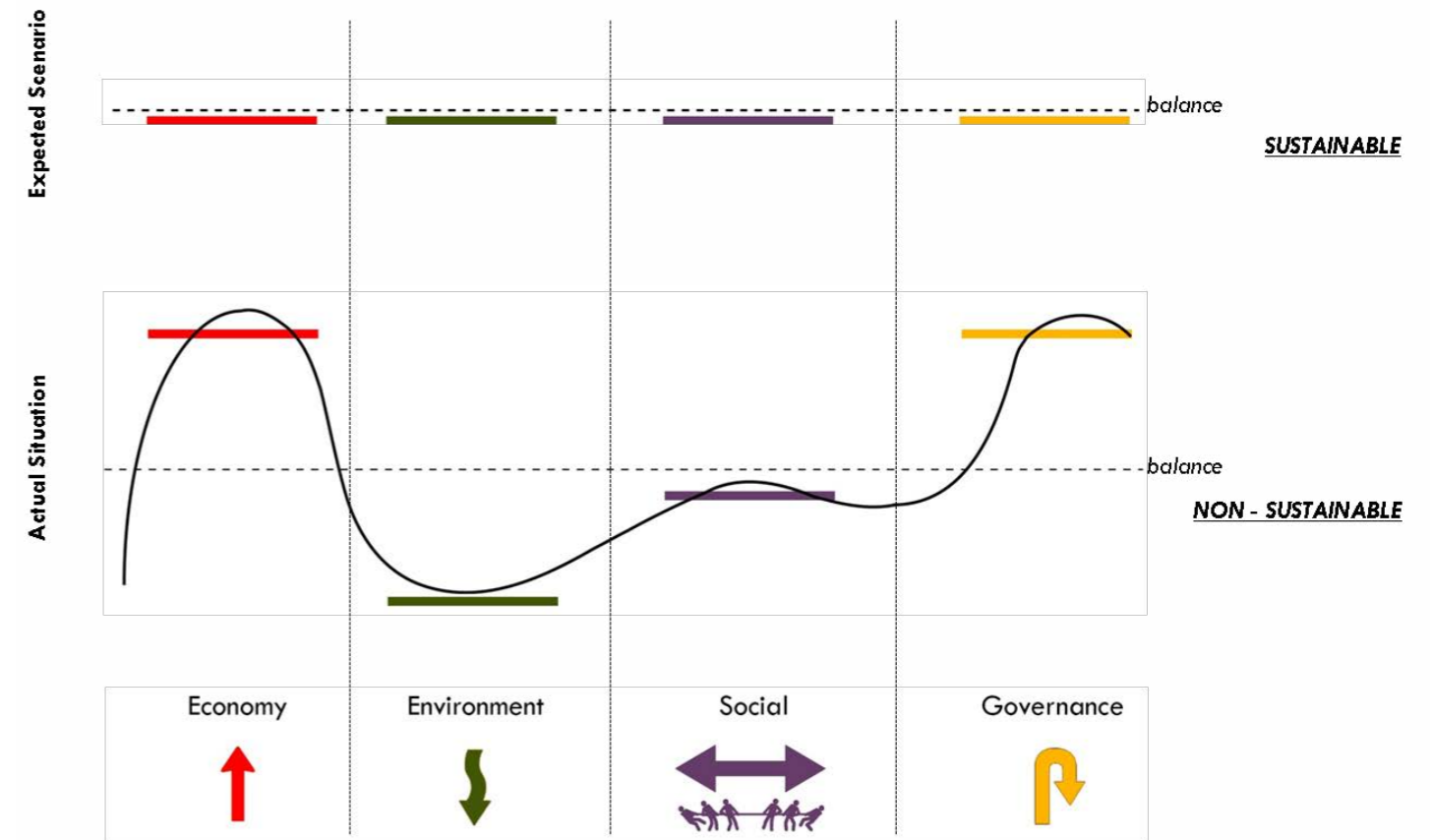
ment to the capital city and other municipalities. National and municipal budgets receive a considerable income, but the burocracy is bigger and more powerful than the investments required. Also, in the case of the municipalities, the population that it has directly depend on the amount of money that arrives to the administration.

For this reason, the capital receives quite a considerable amount but it is still the most important and difficult urban development that contaminates and threatens the Bogotá River.

Economic resources destine to Bogotá and Municipalities



Conclusion - "Less departments in the governance structure in poorest (reduced budget) municipalities"



The current scenario is illustrated in the scheme above. Economy, environment, social and governance are in an unbalanced situation provoking threatens in many of this fields in a non-sustainable scenario. The proposed scenario is one in which the four fields try to maintain certain balance and cooperate one another.

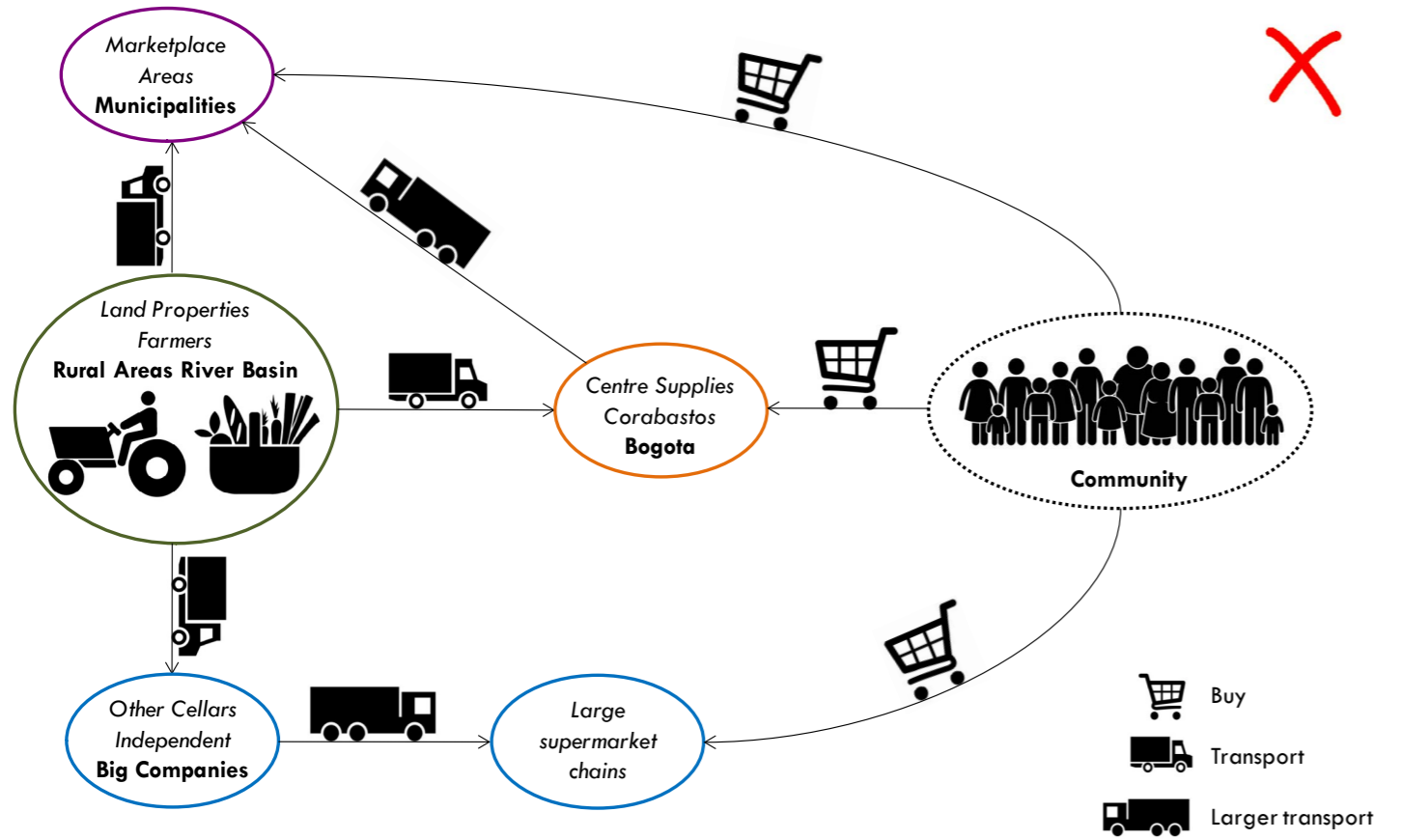
Human activities deal in a wrong way with the region. The effects on the declined of the environment threaten by climate change and influenced by the problematic behaviour of excessive use of the natural resources of the population, have carried general consequences. Re-establish the network connections involving the environment in a sustainable and self-sufficient way is the goal system that can restore the linkages lost in the department.

For this reason, I propose to implement some princi-

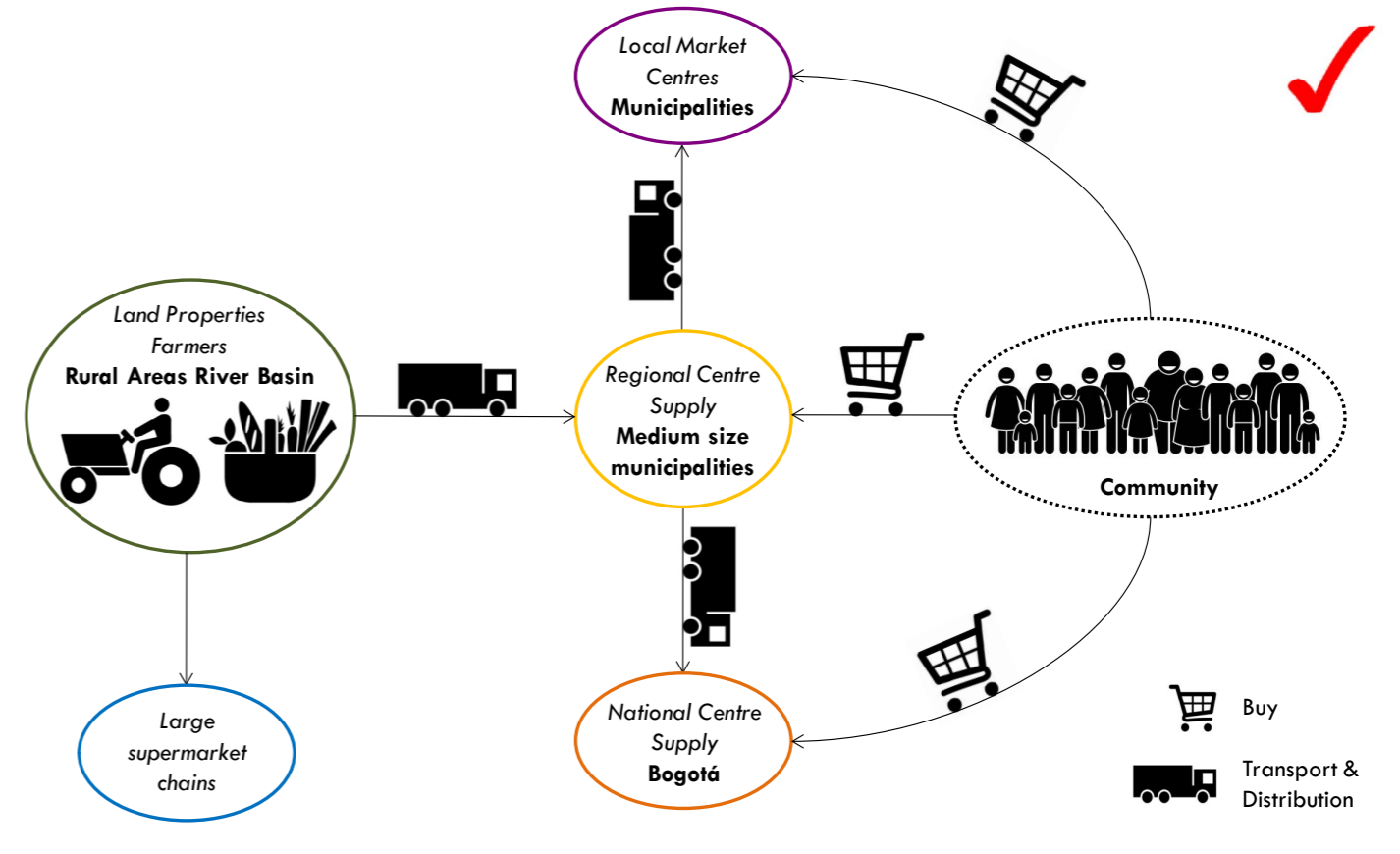
ples that are illustrated below. Through the analysis of three flows (food, waste and energy), it can be concluded that each one of them has a specific strategic intervention. For food the philosophy is a supply system; for waste is recovery; and finally for energy is complement source. They need an improvement to generate a optimum model of governance. The development of this criteria allowed to design solutions consistent with the Bogotá River basin.

The solutions applied were checked against the base criteria and let find out if they were accurate for the strategic interventions.

To begin I will show the detailed study of the three flows: food, waste and energy. The intention is to point out how the analysis and further design of the flows contained in the strategy could be accomplished.



Actual food flows in the region network



Proposed food flows in the region network

The scheme above illustrates the actual food flows in the network. The connections structure is centralized, creating re-processes in transport and distribution. This generates traffic congestion, air contamination and deterioration of road infrastructure. **How could it be improved?**

A proposal arises in the next scheme; it presents how the flows should be employed. To prove the applicability and positive improvement of this flow

in the strategy, some key elements are going to be analyzed: transport + production. After the results, the conclusions will indicate if it could work or not in the region.

The approximation of the areas where these strategic interventions could take place for the improvement of the food flow are given in the regional strategy map.

The scheme above (right) illustrates the proposed food flows in the network and how they should work like. The

proposed scheme shows the re-structuring of the connections that apply the decentralization concept. The intermodal points are distributed among the region and are located in the most populated municipalities which have the biggest flows of goods in food (**Regional Scale**).

The regional centre supply is going to be the pivot for local and national supply centres. This will decongest the road infrastructure and optimize the processes in

transport and distribution.

On the other hand, the production will go in line with a sustainable system taking care of the water and soil without harming the environment in the surroundings.

How is it possible to achieve and prove this theory of model in the food flow?



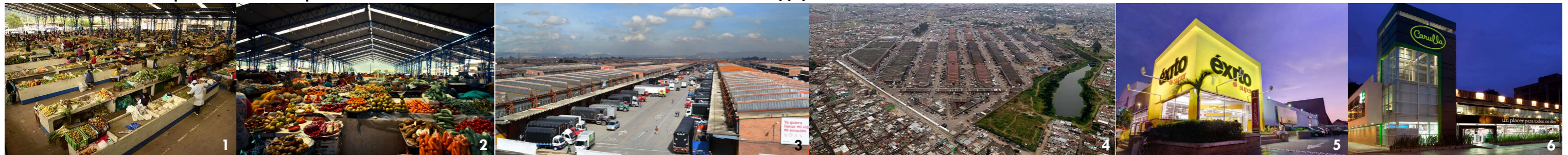
Marketplace Areas Municipalities

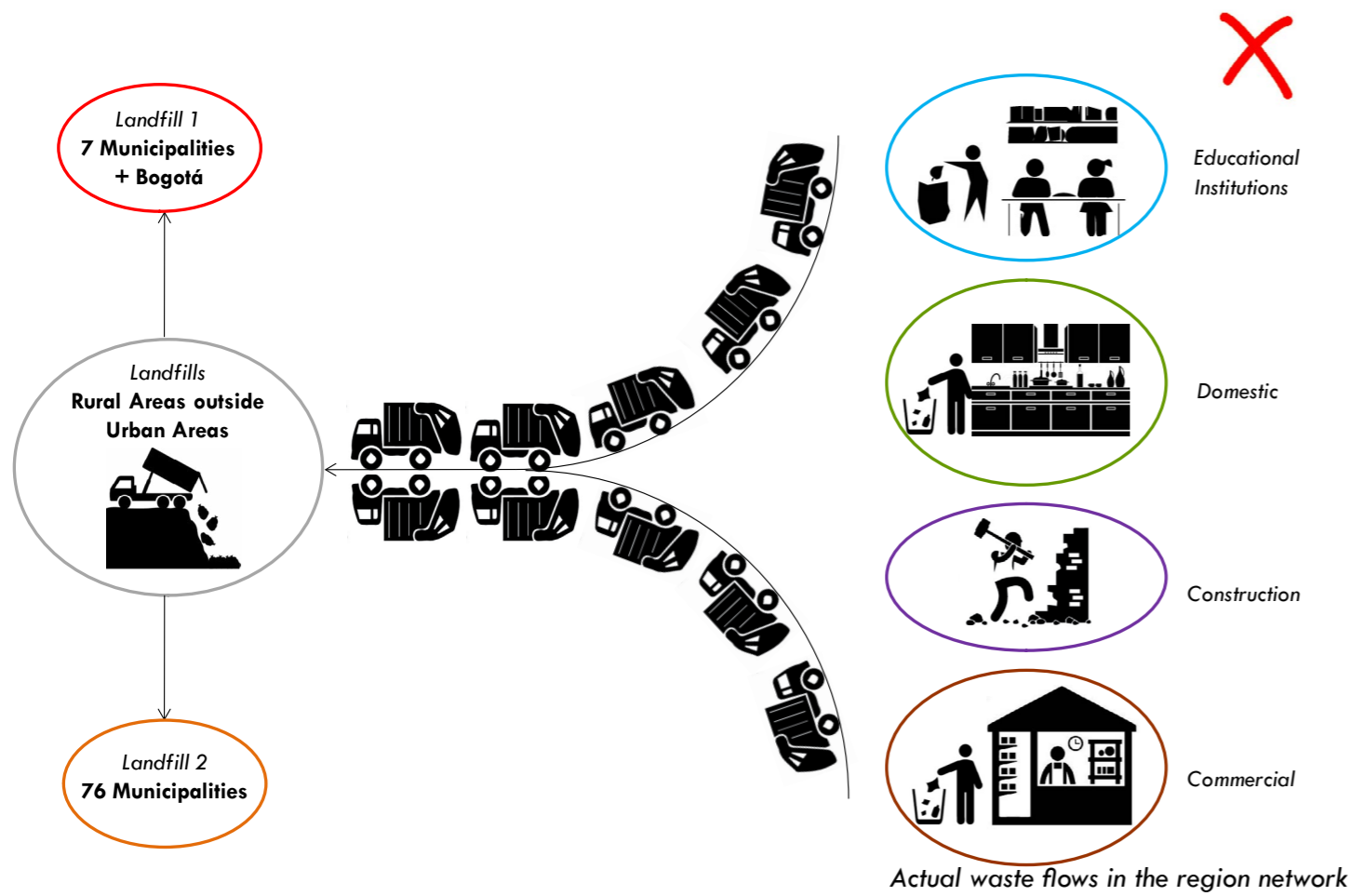


Centre Supply Corabastos



Large supermarket chains



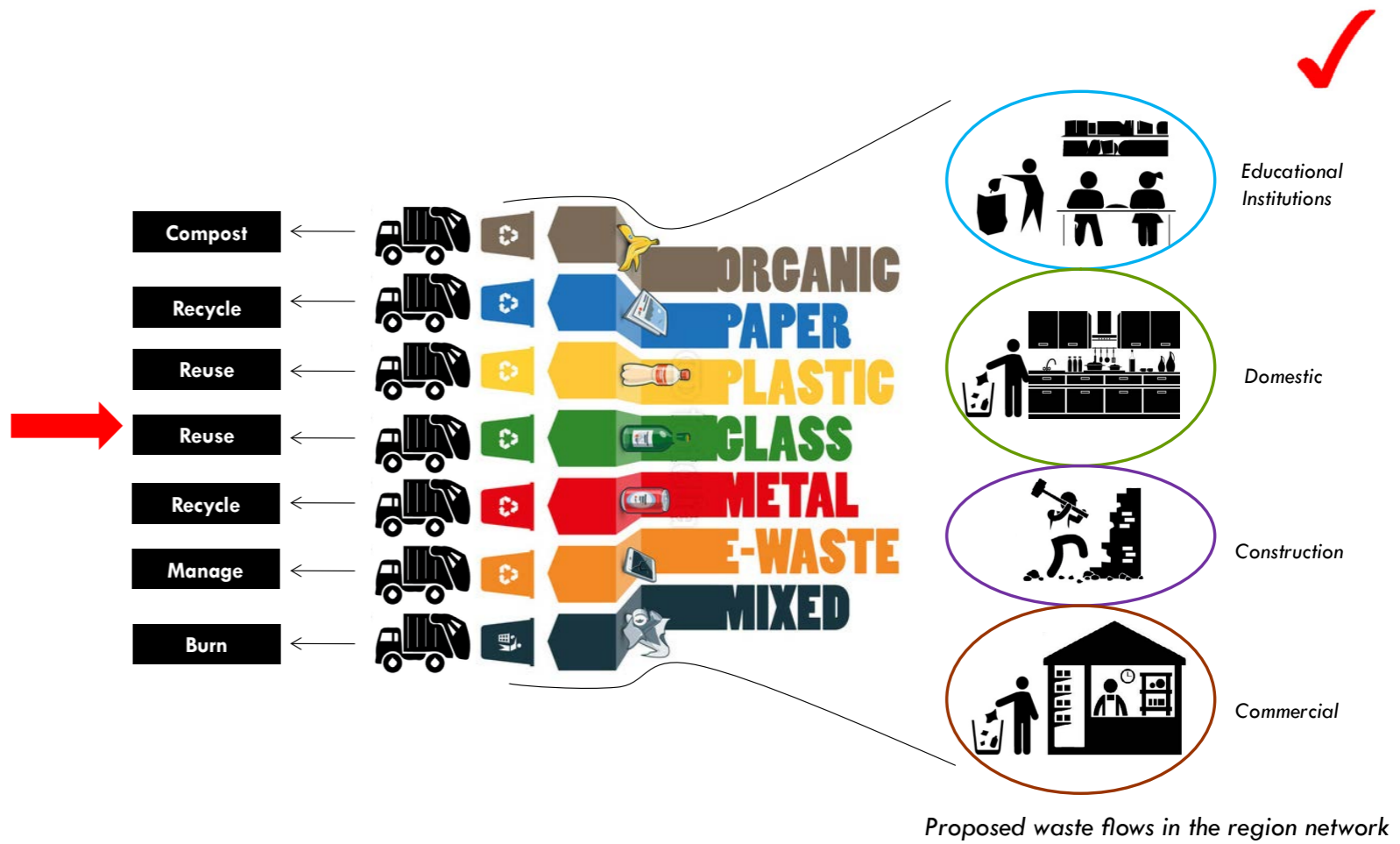


The scheme above illustrates the actual waste flows in the network. The connections are centralized in two landfills in the region. The waste management and recycling problem is not only affecting the health and well-being of the population living around this areas, but also traffic congestion and road infrastructure. **How could it be improved?**

The proposal is given in the next scheme. It presents how the flows should be conducted. To prove the ap-

plicability and positive improvement of this flow in the strategy, some key elements are going to be analyzed: transport + sources and producers + dumping. After the results, the conclusions will indicate if it could work or not in the region.

The approximation of the areas where these strategic interventions could take place for the improvement of the waste flow are given in the regional strategy map.



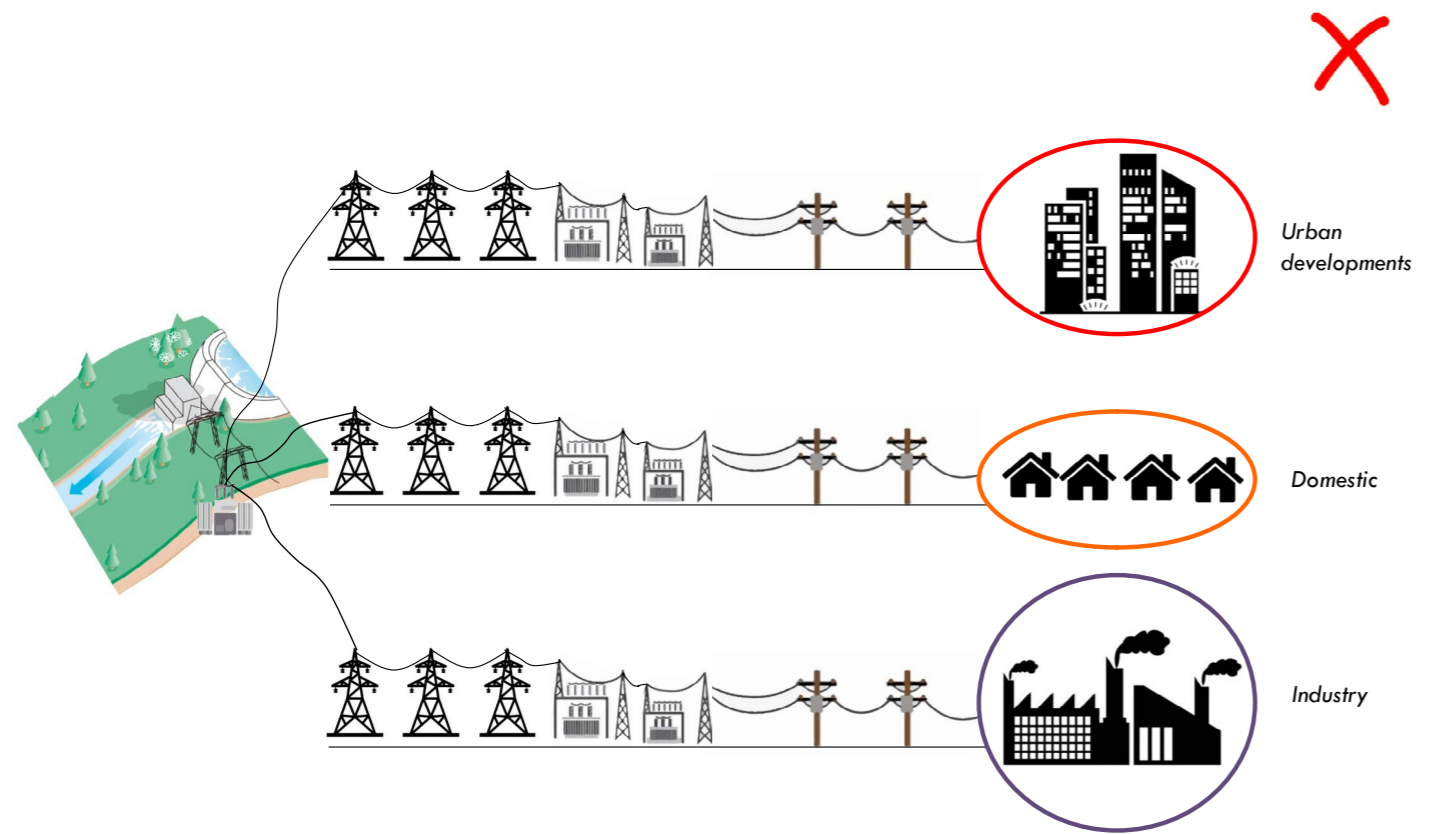
The scheme above illustrates the proposed flows in the system and how they should work like. The proposed scheme shows the re-organization of the flows taking into account waste management and recycling processes. The intermodal points are distributed among the region and are located in the most populated municipalities which have the biggest flows of waste amounts (**Regional Scale**).

Education is a key element solution to strength and

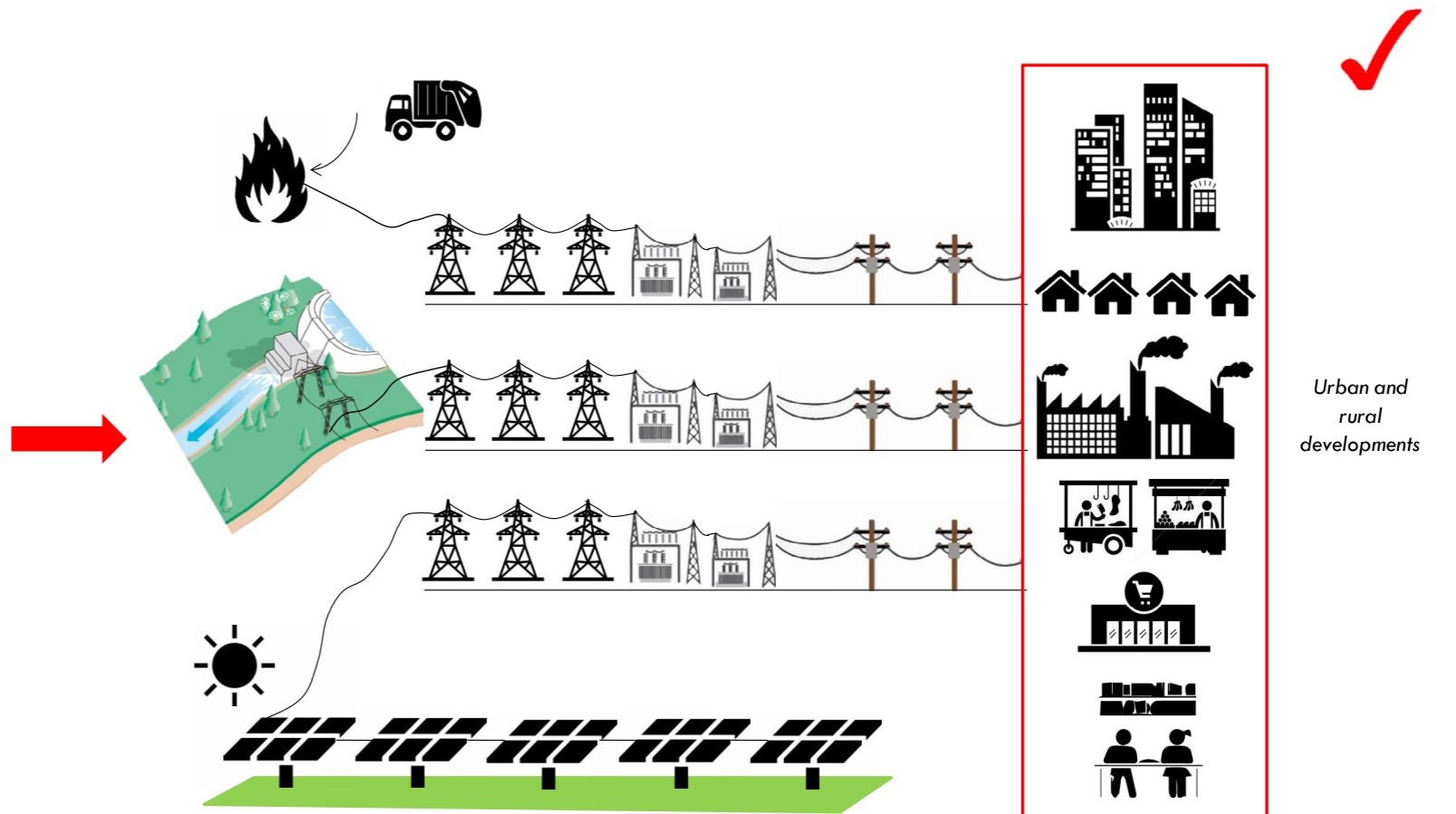
enhance strategies that want to be applied in the waste flow. **The way and treatment of the collection of garbage and recycling material will be the central purpose of the strategic intervention.** This will not only reduce contamination but it will apply a new function for waste (burn waste to produce energy).

How is it possible to achieve and prove this theory of model in the food flow?





Actual energy flows in the region network



Proposed energy flows in the region network

The scheme above illustrates the actual energy flows in the network. The system is centralized in the use of only one source of energy in the region. Hydroelectric Plants is not only affecting the ecological structure of the river basin, but is also contaminating the water structures of the Bogotá River basin. **How could it be improved?**

The proposal is given in the next scheme. It presents how the flows should be improved. To prove the ap-

plicability and positive improvement of this flow in the strategy, one key element is going to be analyzed: sources. After the results, the conclusions will indicate if it could work or not in the region.

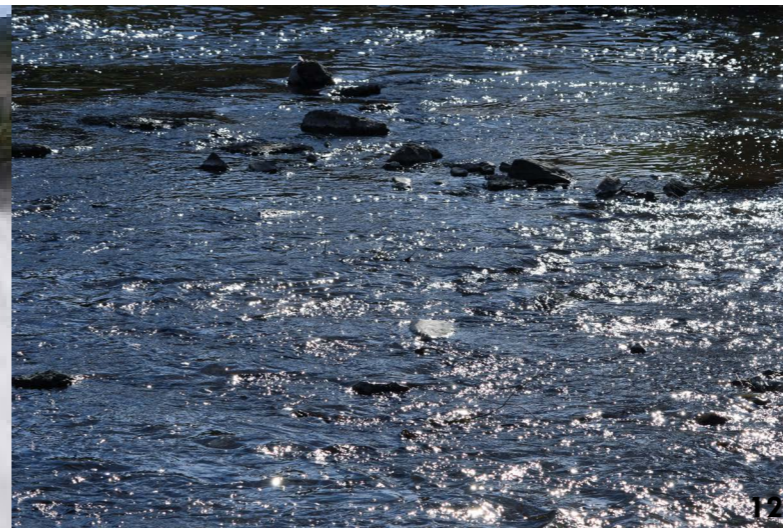
The approximation of the areas where these strategic interventions could take place for the improvement of the energy flow are given in the regional strategy map.

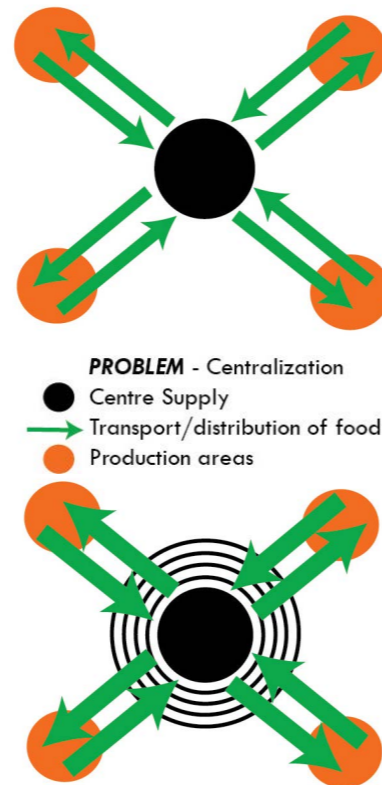
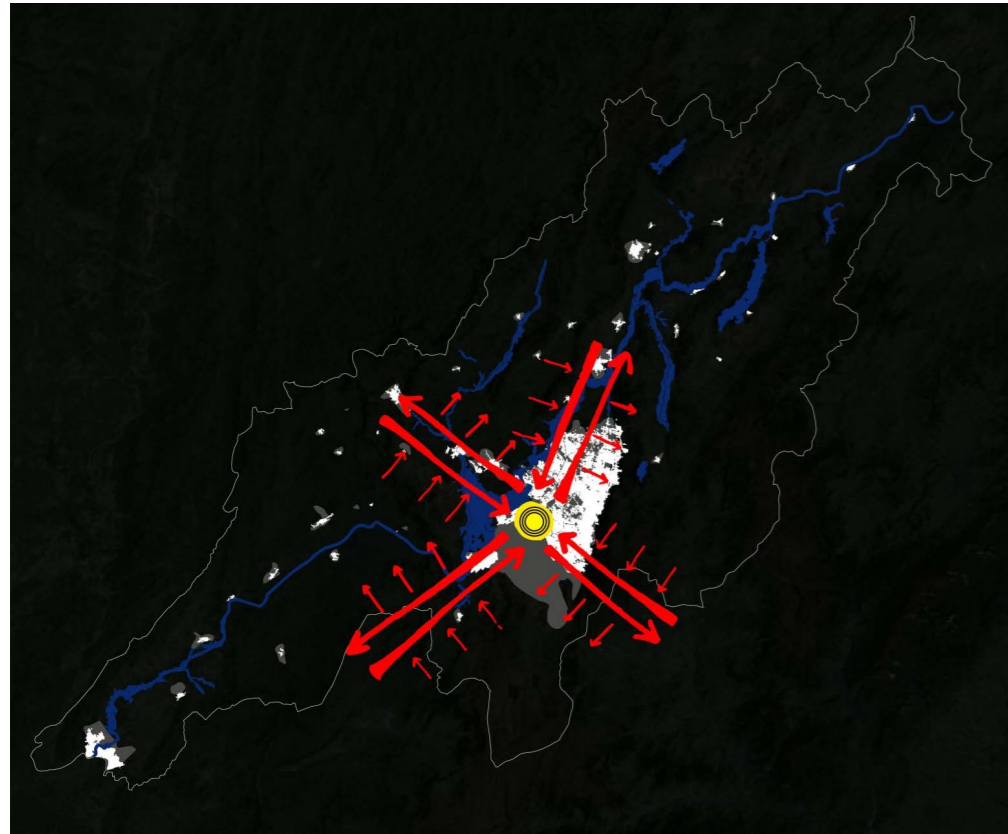
The scheme above illustrates the proposed flows in the system and how they should work like. The proposed scheme shows the complementation of the hydroelectric plants energy source, with solar and wind energy. The intermodal points are included in the hybrid city model and are located in the most populated municipalities which have the biggest needs of generation of energy (**Regional Scale**).

Solar panels, windmills and burn waste energy plants

are the key element solutions to develop strategies that can improve the energy flow. **The usage of new renewable energy sources is the most important objective of the strategic interventions.** This will not only reduce the impact of hydroelectrics over water structures, but it also complement the sources and generators of energy in the region.

How is it possible to achieve and prove this theory of model in the food flow?





the food is sent to the centre supply in the capital city to then go back to many of the points where it came out. As it was said before, this generates traffic congestion, air contamination and deterioration of road infrastructure. The images below show part of the effects that are happening in the region.

The regional map draws attention to the road infrastructure; all connecting the centre supply in the capital city and how they are saturated given to the issues mention before.

The weaknesses include:

- Topography (expensive infrastructure)
- Increase of transport to mobilize more food (traffic, not enough accurate road infrastructure)
- Toll in roads (take longer routes: Provoke damage and maintenance of roads)

They enlarge the difficulties presented and complicates the achievement of a solution.

What is causing a shortcut in the food flow? There is a threat due to the need of feeding 55% more population (growing population) with the same amount of land.

What could possibly be done?

In the food flow two key elements were highlighted for further analysis and research. First, transport and distribution; it is made by trucks and the existing road infrastructure is starting to have sudden collapses during some periods of the year.

The conceptual scheme shown above illustrates how

Threat

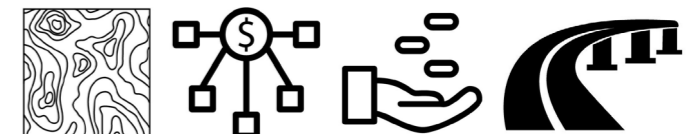


Population Growth

Weakness



Tolls in roads - \$\$



Topography - \$\$



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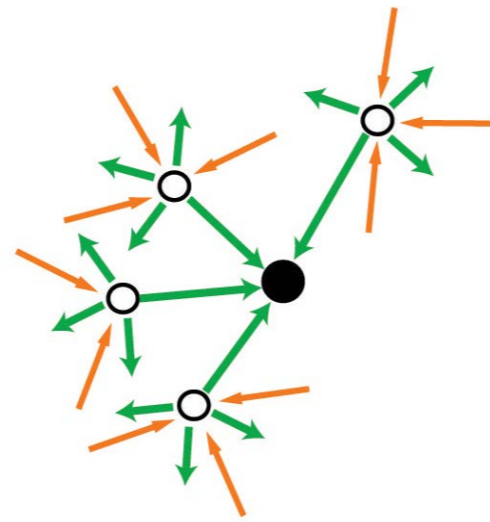
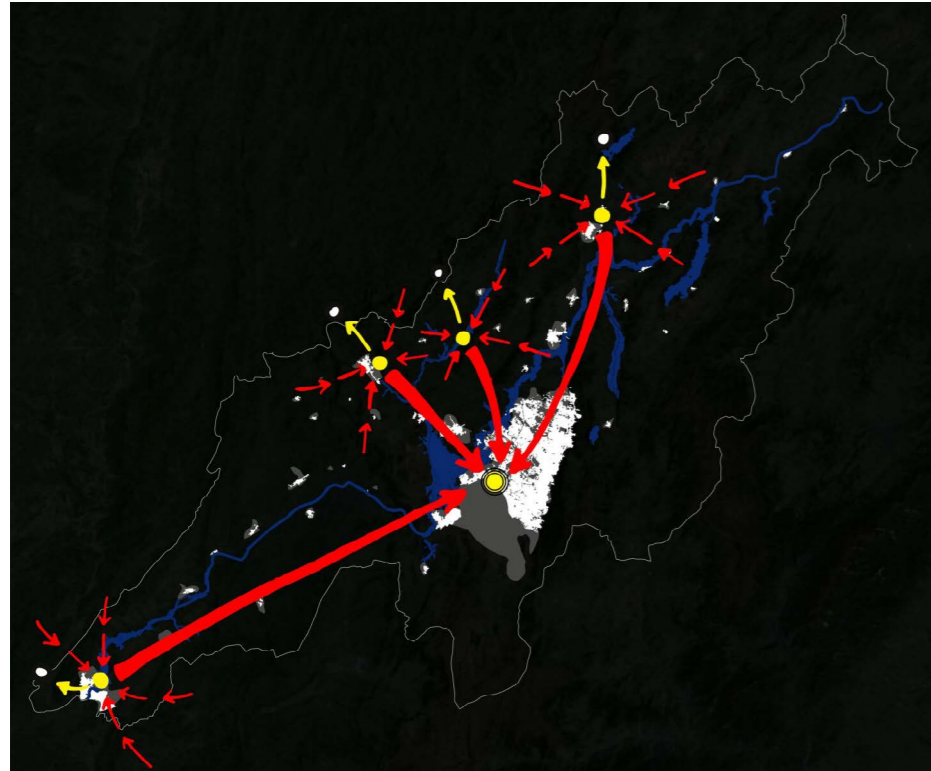


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Intervention



STRATEGY - Decentralization

- National Centre Supply
- Transport/distribution of food
- Regional Pivot: Centre distribution
- Production food

The strategy applied will be based on the concept of decentralization. There are going to be located regional pivots which will be centres of distribution in the most populated municipalities in the river basin. This with the purpose of decongest the road infrastructure and optimize processes along the transport and distribution of food.

The philosophy and principle is applied as the interconnected supply system. In the same infrastructure development every regional centre supply will have a local centre supply that is going to help the distribution in a more local scale.

As a result the intervention is not only going to improve the transport and distribution of the goods but it can generate employment opportunities in infrastructure and the future intermodal pivots in the region.

Opportunity



Generation of employment



For improvement of infrastructure

Referent: Rungis Market Paris



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The market has a strategic position, 7km south of Paris. It has 232 Hectares.

It lies in the centre of an exceptional network of transport links, located in a major business area (Orly-Rungis), which facilitates relations with the various food industry sectors: local, national or international.

- **Road network**

- **Airports**

Orly
Roissy Charles de Gaulle

- **Waterways**

The Bonneuil-Sur-Marne port: combined river-rail-road platform
Handles 1.1 million tons by river, and 300,000 tons by rail per year.

- **Rail network**

The rail terminal at Rungis handles approx. 200,000 tons of fruit and vegetable per year.

- **Public transport**

24/7 access by tramway and bus, with connections to the overground and underground services.

The market has the following characteristics:

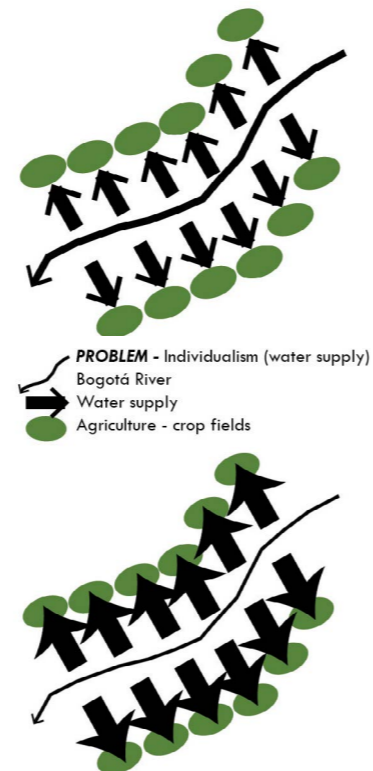
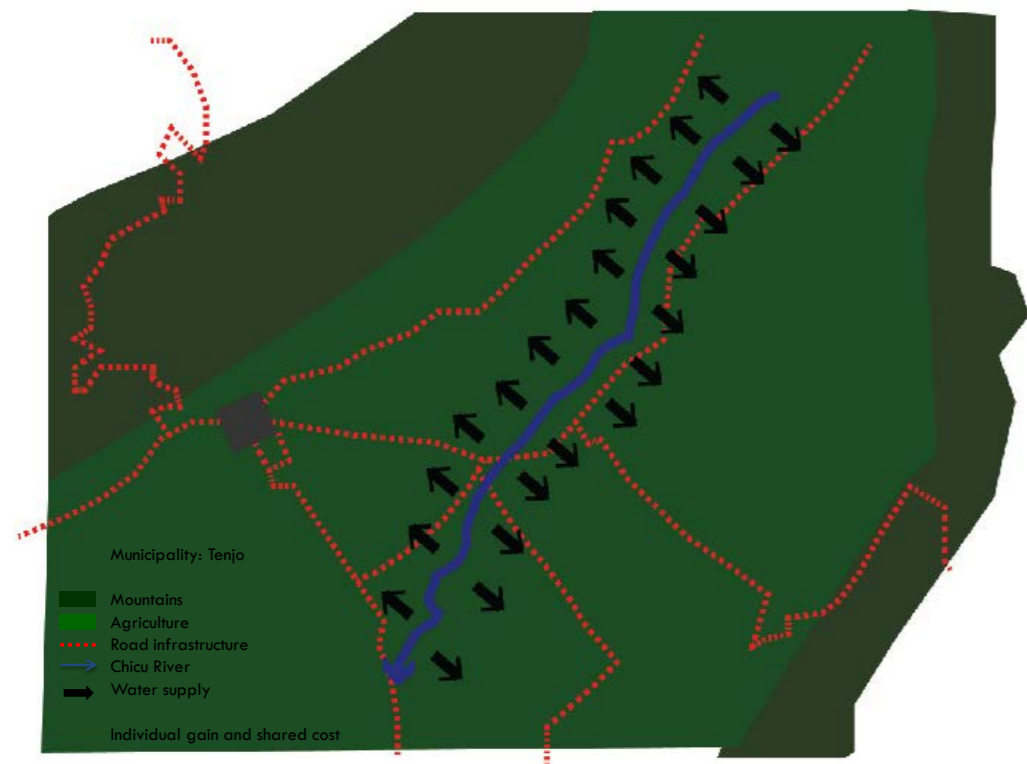
- National network - 19 platforms
- Urban logistics actor: catering trade, mass distribution, organize transport and food supply
- Food industry centres, logistic parks and multimodal hubs
- Regional economic development centres

Criteria - strategically located near towns and rapid communication:

- A site with vast, empty tracts, easily constructible.
- Central in relation to major road, rail and air routes.
- Easy access for Parisian and provincial vendors and buyers.
- Practical for incoming goods.

The referent demonstrates the facilities given through an organized and accessible infrastructure. Also the decentralized structure of the system makes it possible to cover and supply the country and even to the continent.

It is a perfect example to take into account for further study in the design and planning of the local, regional and national centre supplies in the Bogotá River basin.



water is available and the quality of the environment in the river is declining.

As it is shown in the pictures below the Bogotá River is been contaminated and nobody cares and protects the priceless and helpful water and soil that human activities use in their daily activities.

The map (left) draws attention to the water structure in blue. And how farmers take the resource in an immeasurable manner. Then the consequence is individual gain and shared cost over the natural system structure.

The weaknesses include:

- Contamination - water and soil
- Hygiene and health of slaughterhouse
- Water demand: reduced availability, quantity and quality – less accessible for irrigate.

They enlarge the difficulties presented and complicates the achievement of a solution.



Climate change

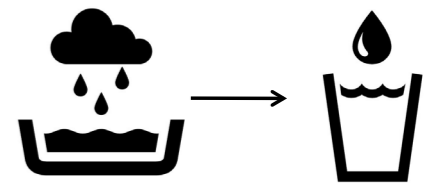
Weakness



Contamination - water and soil



Hygiene and health of slaughterhouse



Water demand: reduced availability

What is **causing another shortcut** in the food flow? Another threat is **climate change** and is affecting the soil and the water which are the elements in charge of the hydrological cycle. There is still the **need of feeding 55% more population** with the affectations present on the natural system.

What could possibly be done?

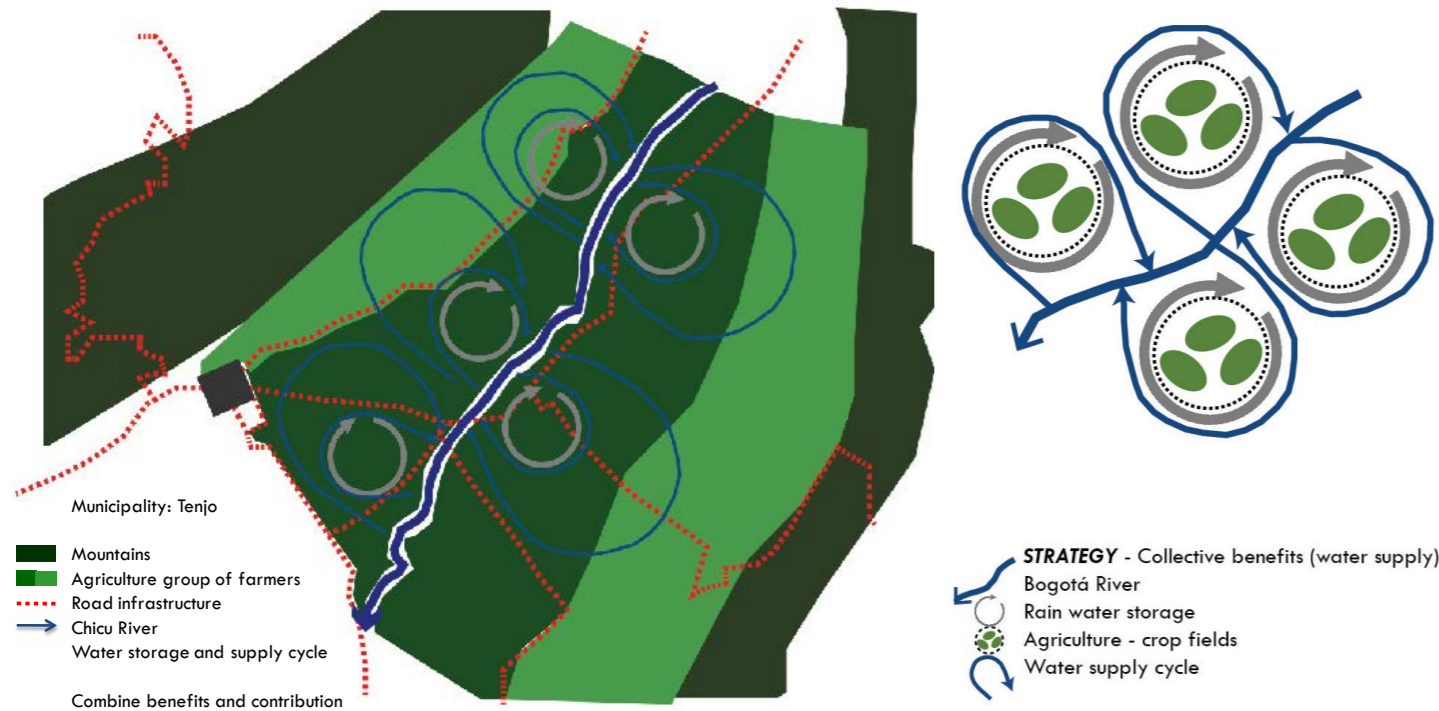
The second key element analyzed and researched in the food flow is the production. Farmers, original producers of all the products that are transported and distributed in the region, are incharged of get-

ting water for the irrigation and growth of their crops. They are really creative in finding different methods to achieve quantities of this valuable resource. Although, there is something called “the tragedy of the commons”; this concept talks about the shared community resources that don’t have owner but everyone is able to use them.

The conceptual scheme above illustrates the actual situation: different farmers take water from the river for personal benefit for individual profit. The increasing problematic of the individual behaviour is bringing effects over the water structure. As time passes by less



Intervention



The strategy applied will be based on team work; **combine benefits and contribution** in the agriculture areas in the region. Develop an organized group structure in the different crop fields to take part of and be able to use the resource but also to participate in the protection and health of the water structure.

As they need the water for their own incomes this operation is going to be done by the same farmers. They administrate, check and look after their interests.

The philosophy and principle is applied as the interconnected supply system. With team groups it is going to make it possible to restore and recover the quality of the water structure.

As a result the intervention is not only going to improve the production in the agricultural field but it can create the opportunity of developing an integrated system between food, water and human activities.

As the soil has the quality of water holding capacity and the region is a really fertile land, this will be a plus to really make the system work.

Opportunity



Soil: water holding capacity
Basin + paramos



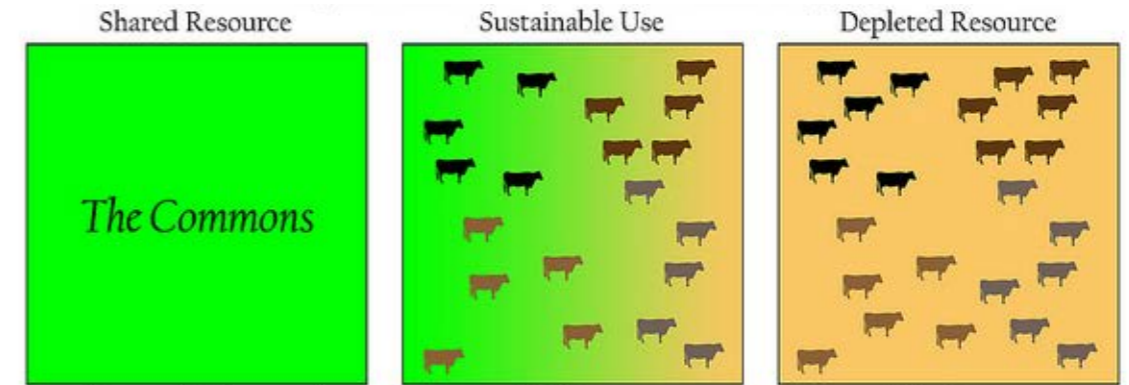
Connection link: food, water, human activities = integrated planning

Strength



Referent - Shared community resources - Elinor Ostrom

"Imagine an open pasture shared by multiple cattle owners. Each owner increases their herd to maximize their benefit. With an unregulated resource this is "logical" since the benefit is enjoyed by the individual and the impacts are shared by all. This leads to the ultimate overgrazing of the pasture."



Usually shared areas in the environment are deteriorated because of a terrible management and extreme use of the resources.

The Victory of the Commons: Nobel Prize-winning economist Elinor Ostrom proved that people can and do work together to manage commonly-held resources without degrading them.

"When local users have a long-term perspective, they are more likely to monitor each other's use of the land, developing rules for behavior".

This theory structure is operated by the same farmers. They have eight principles for managing the commons:

- Limits
- Benefits
- Collective choice
- Monitoring
- Sanctions
- Conflicts resolution
- Recognition
- Nested enterprises

"What we have ignored is what citizens can do and the importance of real involvement." What Ostrom has demonstrated is the existence of social control mechanisms that regulate the use of the commons without having to resort to property rights."

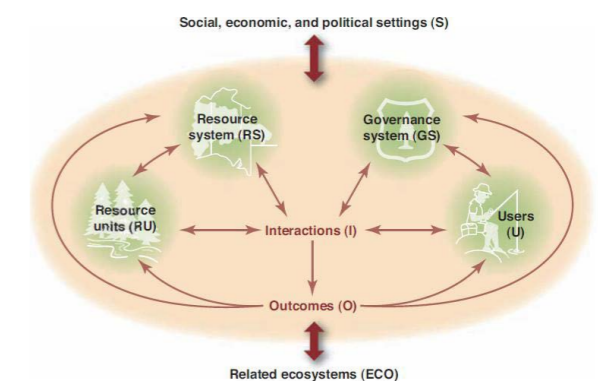
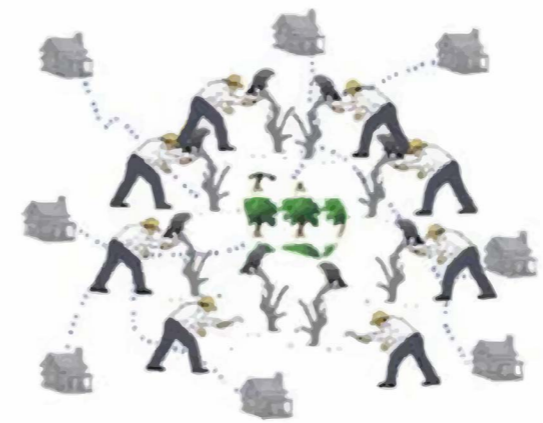
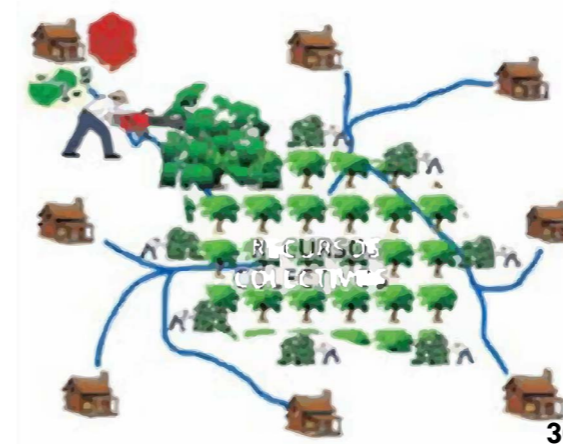
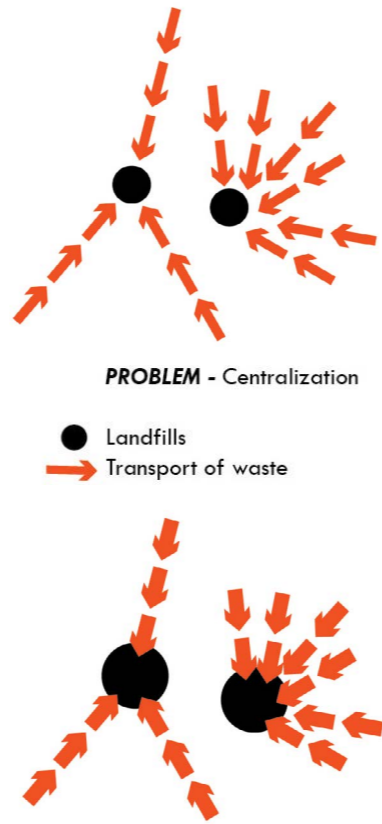
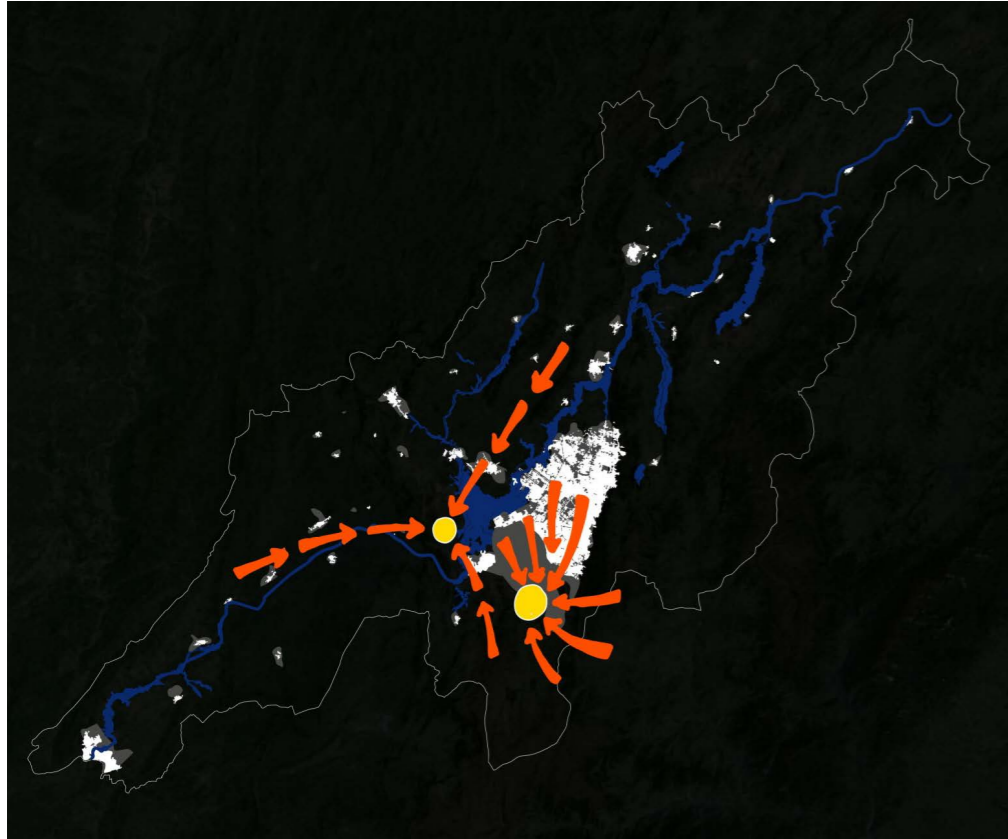


Fig. 1. The core subsystems in a framework for analyzing social-ecological systems.



What is **causing a shortcut** in the waste flow? There is a threat due to the **need of managing and locate 141% more waste with the same amount of land.**

What could possibly be done?

In the waste flow three key elements were highlighted

for further analysis and research. First, transport; it is made by trucks and the existing road infrastructure is starting to have sudden collapses given that every day they have to take enormous amounts of waste. The conceptual scheme shown above illustrates how the waste is sent to the landfills. One in the capital city and the other one close by in another municipali-



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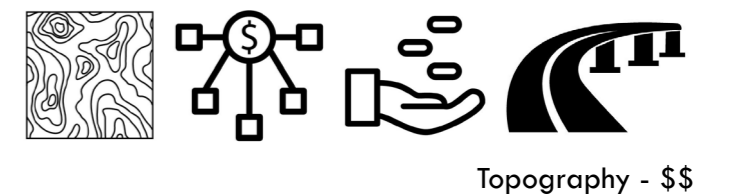
ty. This generates traffic congestion, air contamination and deterioration of road infrastructure. The images below show part of the effects that are happening in the region.

The regional map draws attention to the road infrastructure; locating the landfills and how they are saturating the road infrastructure.

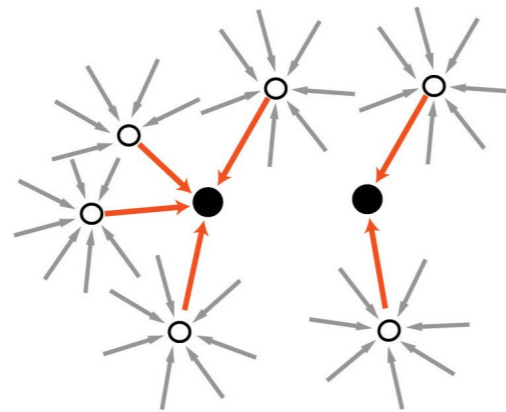
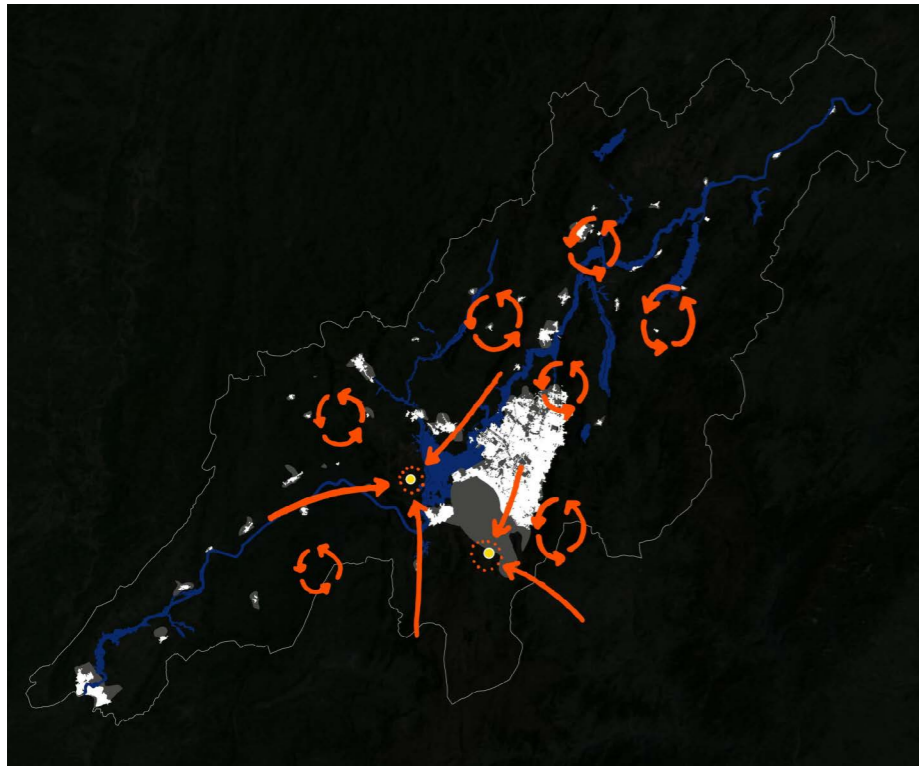
The weaknesses include:

- Topography (expensive infrastructure)
- Increase in the need of waste transportation to the landfills
- Toll in roads (take longer routes: Provoke damage and maintenance of roads)

They enlarge the difficulties presented and complicates the achievement of a solution.



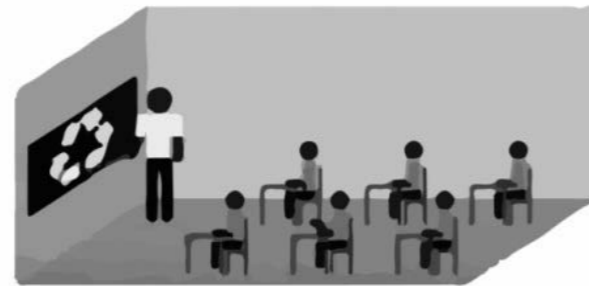
Intervention



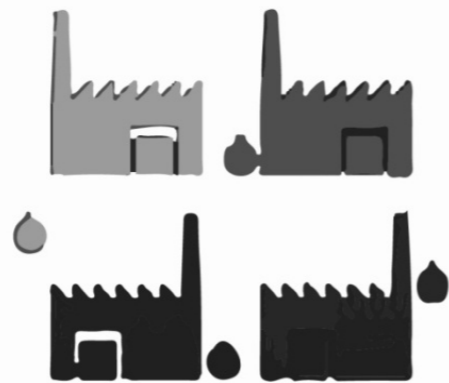
STRATEGY - Decentralization

- Landfills
- Management/treatment plants
- Transport of waste

Opportunity



Education – Recycle



Waste Management / Treatment

The strategy applied will be based on the concept of decentralization. There are going to be located regional pivots which will be recycling collection plants, in the most populated municipalities in the river basin. With the purpose of change the process and mentality of waste management. Re-use everything that can be recycled. In the case that definitely it can't be recycled, the garbage will be transport to existing landfills, where a burn waste plant will be located.

The philosophy and principle is applied through recovery concept. The waste will be first recollected and categorized in groups in the local neighborhood scale. Then the recycling waste will be transport to the regional pivots (recycling collection plants) and the non-recycling waste will be transport to the burn waste plants to produce energy.

As a result the intervention is not only going to improve the transport of the waste but it can generate employment opportunities in new infrastructure and the future intermodal pivots in the region.

Referent: The Swedish Recycling Revolution

Towards Zero Waste

The recycling revolution in Sweden started in 1975. Since then, recycling has increased from 38% of households waste in that year, to almost 99% nowadays.

The established recycling stations by law are no more than 300 metres from residential areas.

"In this stationary vacuum system, users throw their waste into ordinary inlets, where the bags are stored temporarily. All full inlets are then emptied at regular intervals through a network of underground pipes."

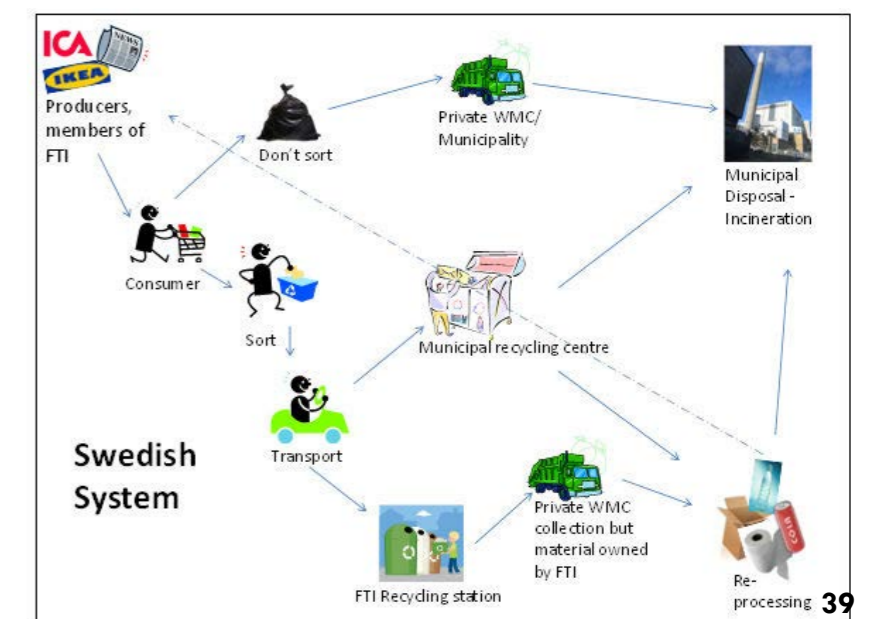
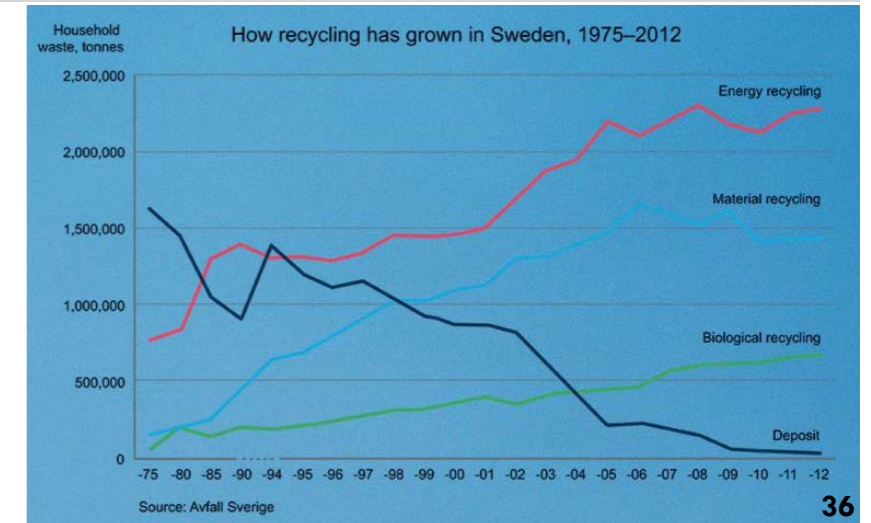
In the Swedish Waste Management and Recycling Association, they explain that reusing materials allows to use less energy to create another material, than burning one and making another from the beginning.

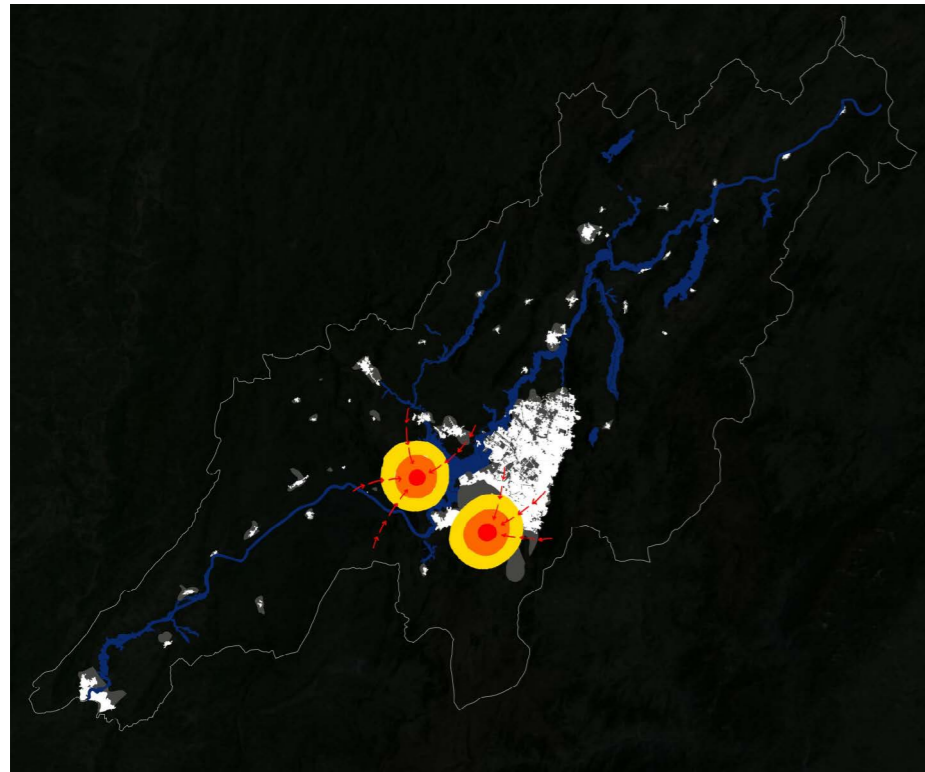
The philosophy starts with the pyramid in the right: reduce, reuse, recycle, recover and dispose. This five steps are the backbone of waste management to organize, categorize and treat any kind of waste.

The swedish system of waste management is shown in the image in the right. It has a destination and final purpose for any and every element that is list as waste.

The referent demonstrates the infrastructure facilities that a country like Sweden has established to put an end to contamination problems.

It is an applicable and outstanding example to take into account to provide solutions in the design and planning of the local and regional scales of the hybrid city model in the Bogotá River basin.





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PROBLEM - Amount of waste



What is **causing another shortcut** in the waste flow? There is another threat that **needs the management and location of 141% more waste with the same amount of land. There is not a proper and organized recycling system and no education about it.**

What could possibly be done?

The second key element analyzed and researched in the waste flow is sources and producers.

The conceptual scheme shown above illustrates how the waste is been accumulated in the landfills with some treatments that are harmful to the environment (land and soil).



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60% of the organic waste produced in Bogotá is thrown in the landfills; 30% of the recycling waste that is produce in Bogotá is also thrown in the landfills. This generates enormous health problems of the people living in the surroundings and also the need of more area destined for landfills.

The images below show this useful renewable material that can be useful for so many reasons, for example in agriculture as compost.

The regional map draws attention to the unmeasurable growth of the two principal landfills in the region that affect directly the Bogotá River and the territory.

The weaknesses include:

- Contamination of the river = water + soil
- Increase in the amounts of waste in the landfills and the danger of throwing them any place in the ecological structure.

They enlarge the difficulties presented and complicates the achievement of a solution.

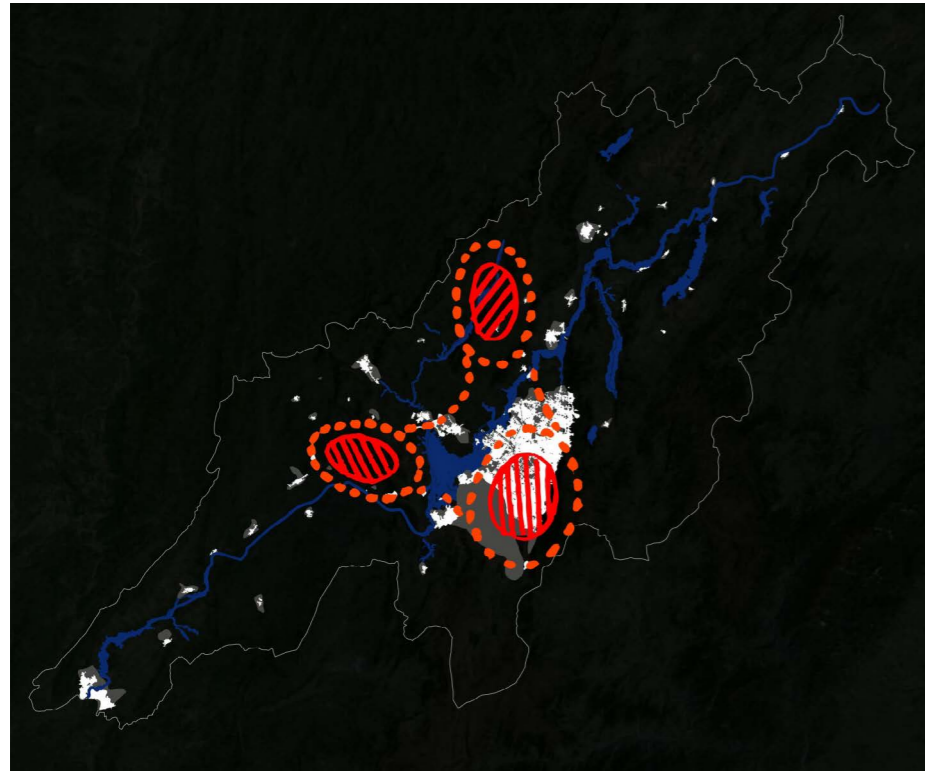
Threat



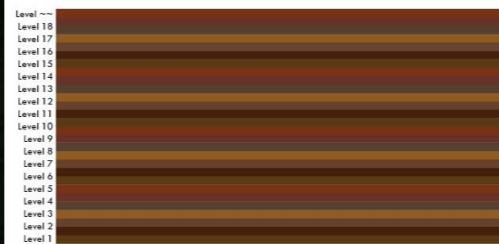
Weakness



Contamination water + soil



PROBLEM - Excess



What is **causing a third shortcut in the waste flow**? There is a threat given to the **need of managing and locate 141% more waste with the same amount of land**. Urbanization and population growth are putting in grave danger the waste processes.

What could possibly be done?

The third key element, dumping; the excessive amounts of waste in the landfills have produce also consequences in along the environmental structure of the Bogotá River basin.

The conceptual scheme shown above illustrates how the waste is increasing in size in the landfills. The problem is increasing every day of every year and any kind of sustainable solutions are been implemented. This generates air, land and water contamination. The images below show part of the effects that are happening in the region.

The regional map draws attention to the areas where the problem is principally threatening the territory and where the most populated municipalities are.



The weaknesses include:

- Contamination of the river = water + soil
- Increase in the amounts of waste in the landfills and the danger of throwing them any place in the ecological structure.
- Environmental degradation of the ecological structure
- Health deterioration
-

Threat



Population Growth



Urbanization / Urban development



No recycling system



No Education

Weakness



Increase of transport and amount quantities of waste

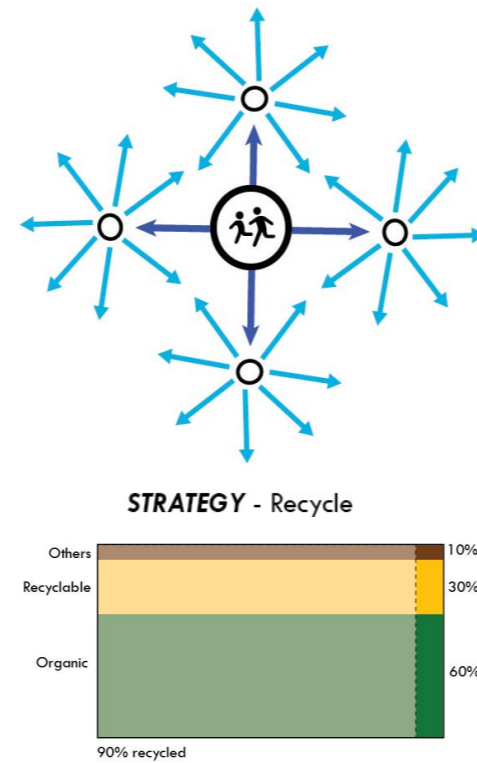
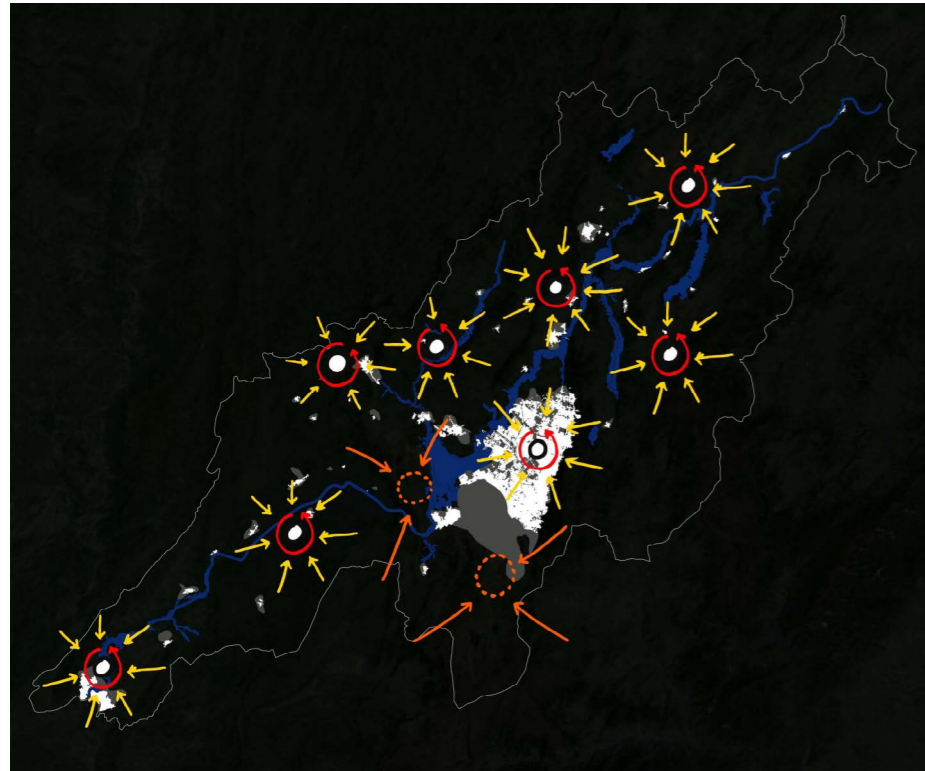


Contamination water + soil



Environmental degradation – health deterioration

Sources and Producers Intervention



In the case of the key element - Sources and Producers - the strategy applied will be based on the concept of recycling. There are going to be located regional pivots which will be recycling collection plants, in the most populated municipalities in the river basin. Education will be the start initiative and base fundamentals to improve the situation in long-term for the Bogotá River basin.

In the case that definitely it can't be recycled, the garbage will be transport to existing landfills, where a burn waste plant will be located.

As it was mentioned in the previous key element, the philosophy and principle is applied through recovery concept.

As a result the intervention is not only going to improve the waste management and involve recycling processes, but it will also include the participation of the population through the generation of jobs, but most importantly education.

Opportunity

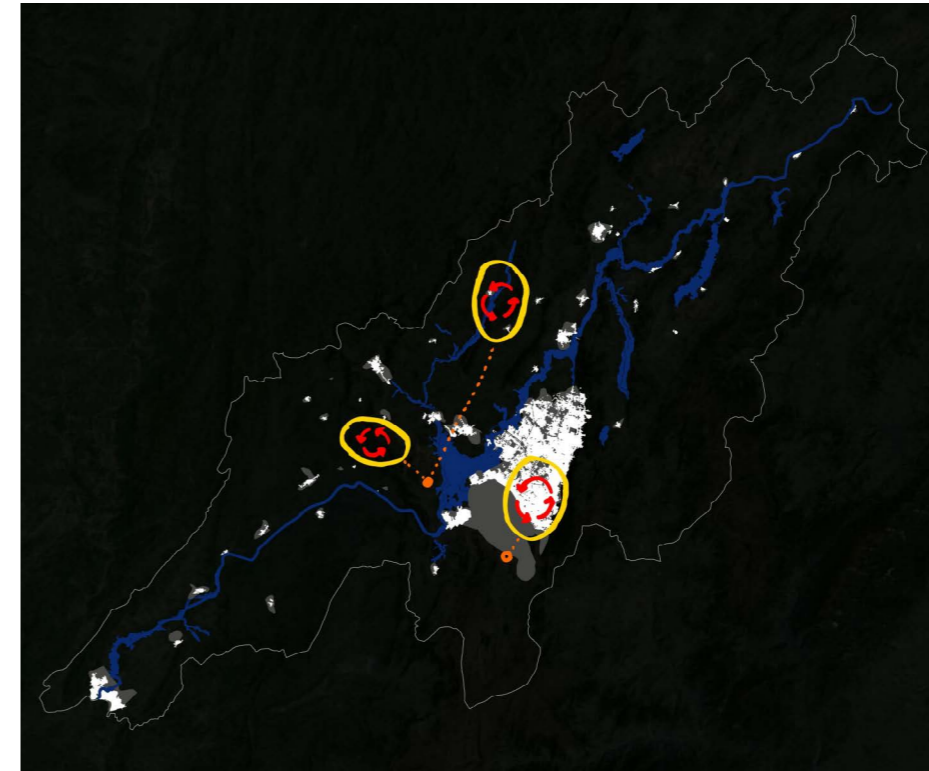


Education – Recycle



Generation of employment

Dumping Intervention



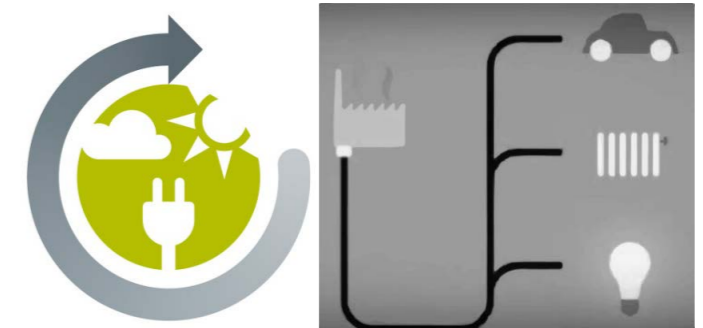
STRATEGY - Transform

In the case of the key element - Dumping - The strategy applied will be based on the concept of transformation. There are going to be located in the beginning two burn waste plants near the existing landfills in Bogotá and the municipality next to it. The objective is to develop a new source of energy using the non-recyclable waste.

The philosophy and principle is applied through recovery concept.

As a result the intervention is not only going to develop and build infrastructure for a new source of energy, but it can generate employment opportunities in new infrastructure and the future intermodal pivots in the region.

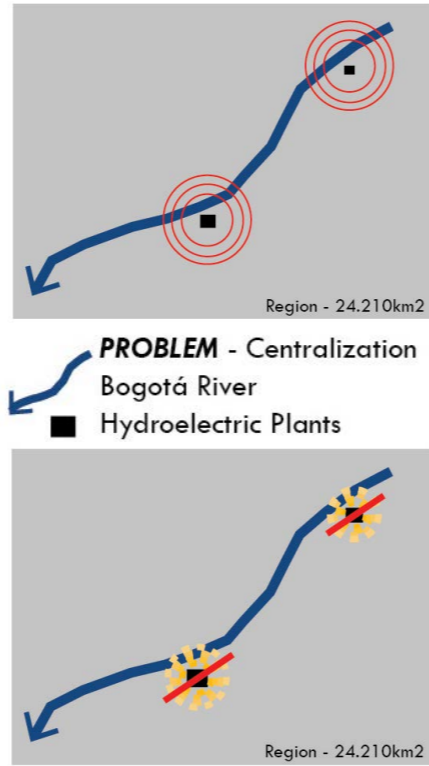
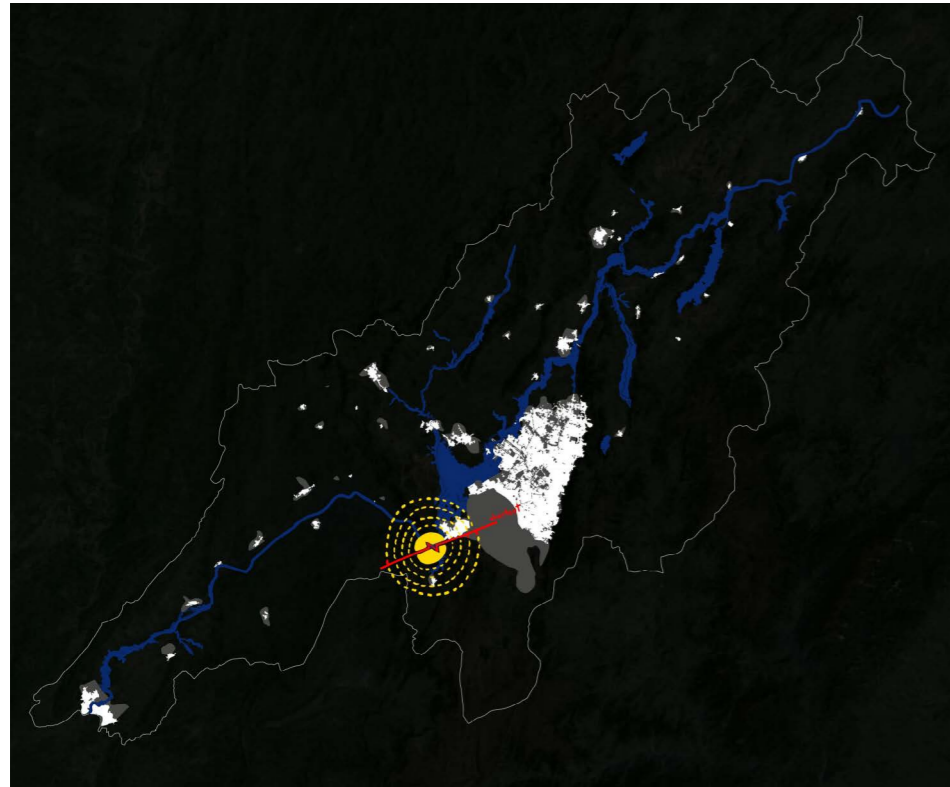
Opportunity



Energy production



Generation of employment



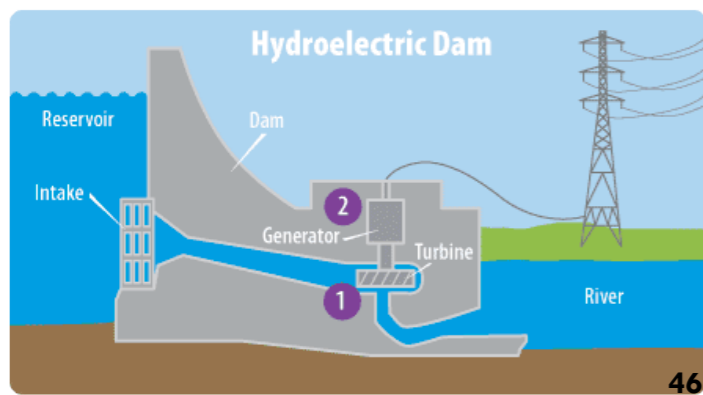
What is **causing a shortcut** in the energy flow? There is a threat due to **energy generation that in upcoming years needs to produce 4 times more** than in the current situation. This is been pushed by three factors: climate change, population growth and urbanization.

What could possibly be done?

In the energy flow one key element was highlighted

for further analysis and research. Sources, it is the most problematic given that the energy of the region and the entire country, depends exclusively from Hydroelectric power plants.

The conceptual scheme shown above illustrates how the energy generation is concentrated in two points and that given to the climate changes and contamination of the Bogotá River, they can collapse in any



moment. This is causing a series of weaknesses that are going to be shown in a moment. The images below show how the hydroelectric power plants need the rivers for the generation of energy, and the complex infrastructure that needs to be built to make it work.

The regional map draws attention to the hydroelectric plant in the south west of the capital city that not only provides energy for Bogotá, but to the rest of the municipalities in the river basin and the general region. .

The weaknesses include:

- Contamination of the river = water + soil
- Environmental degradation of the ecological structure
- Health deterioration

They enlarge the difficulties presented and complicates the achievement of a solution.

Threat



Population Growth



Urbanization / Urban development



Climate change

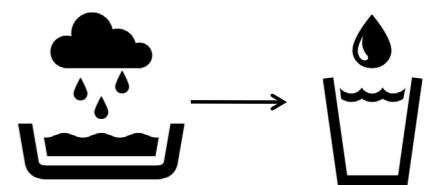
Weakness



Contamination water + soil

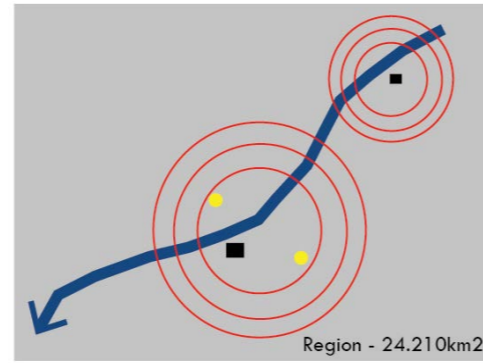
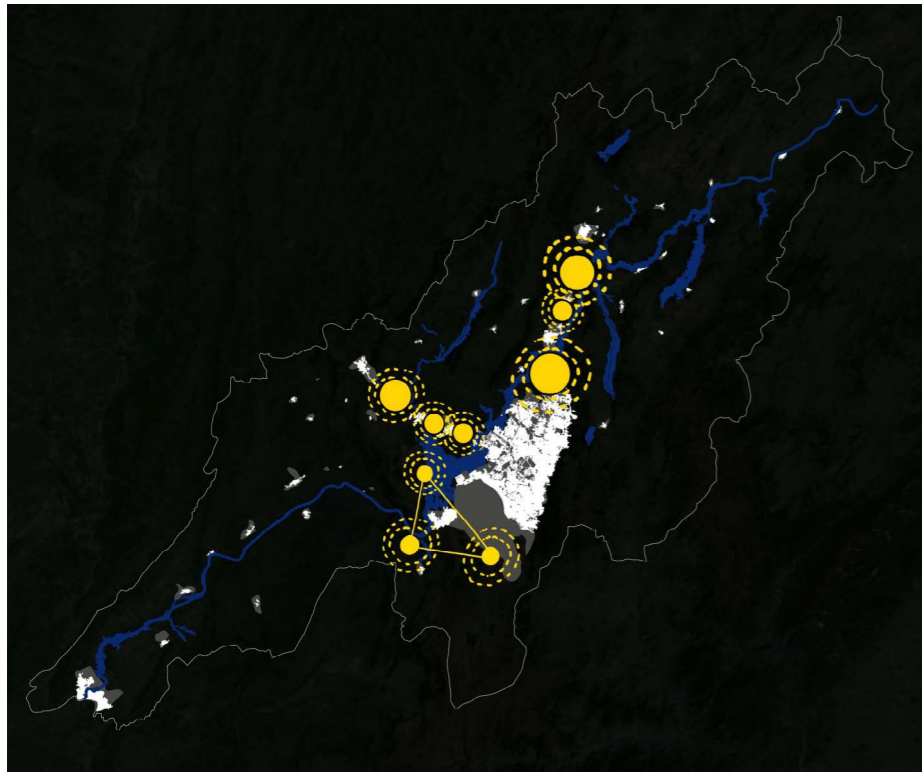


Environmental degradation – health deterioration



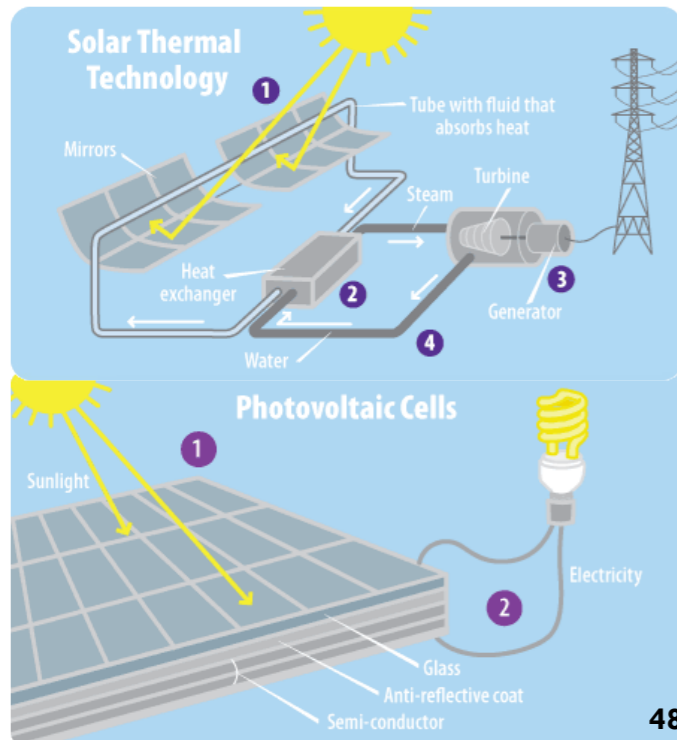
Water demand: reduced availability

Intervention

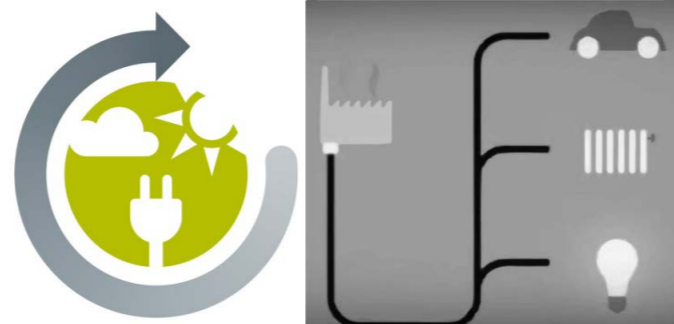


- STRATEGY - Decentralization**
- Burn Waste Plants
 - Bogotá River
 - Hydroelectric Plants

The strategy applied will be based on the concept of decentralization. Other complementary energy sources will be part of the solution to this threat. Energy panels and burn waste plants will be located, in the most populated municipalities in the river basin. **The philosophy and principle is applied through complement concept.** For a more sustainable generation of energy, these solar panels and burn waste plants, will improve the network and complement the services that are required. As a result the intervention is not only going to develop a new source of the energy, but it can also generate employment opportunities in new infrastructure.



Opportunity



Energy production



Generation of employment

Referent: The Swedish Recycling Revolution

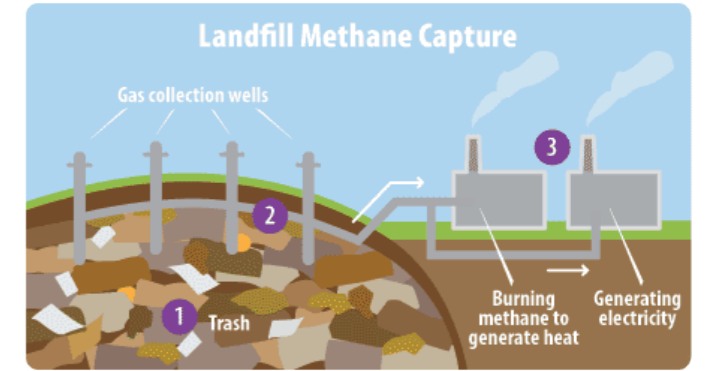
Waste to Energy

The first incineration plant was set up in Stockholm in 1904. In 2012, 2,270,000 tonnes of household waste was burnt, and that way turned into energy.

The 32 plants in Sweden today produce heat for 810,000 households and electricity for 250,000 private houses. Heavy metal emissions have been reduced by 99 per cent since 1985, even though Sweden emits three times more waste today.

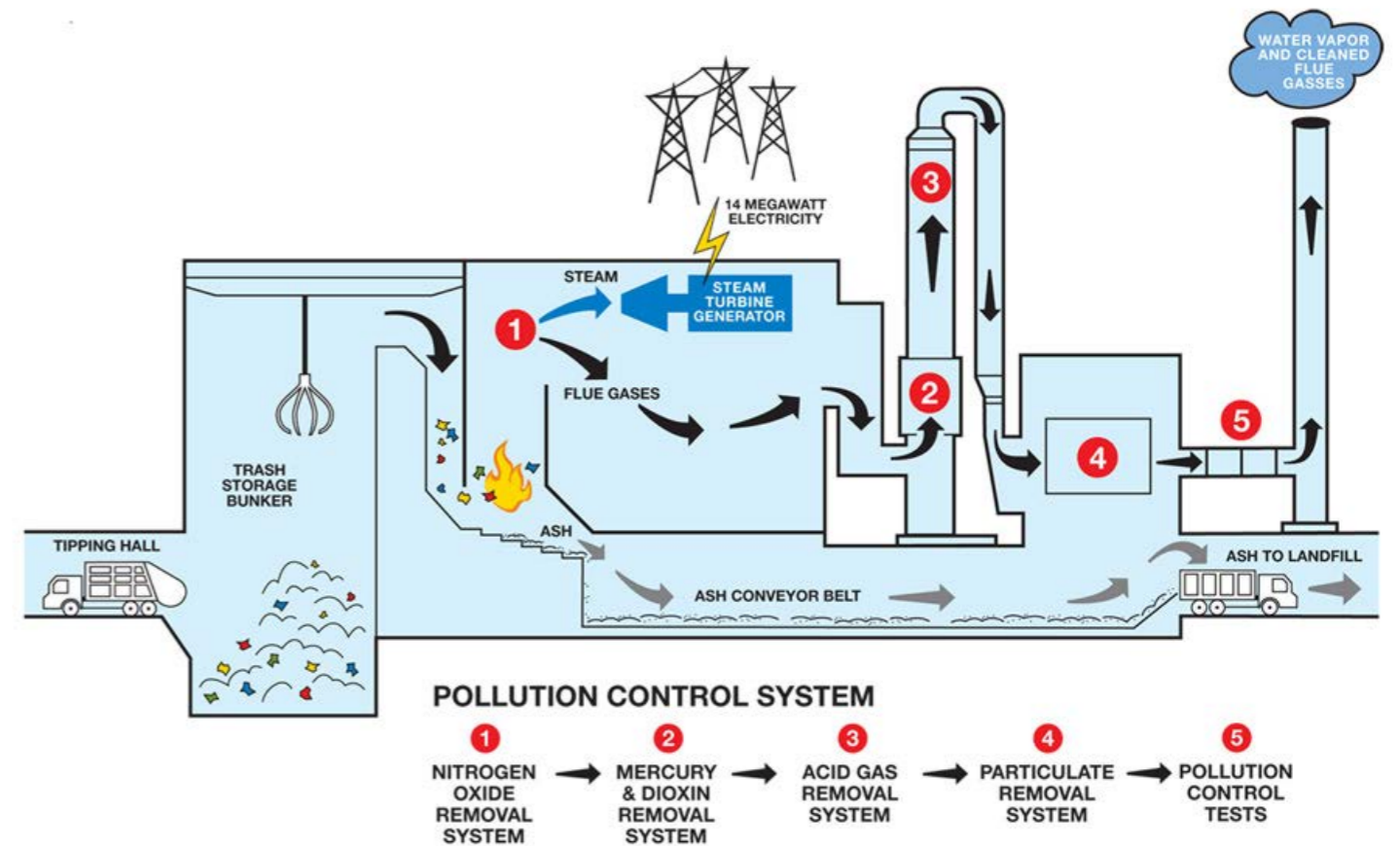
(<http://www.avfallsverige.se/avfallshantering/energiatervinning/>)

“With the methane produced from the waste heat is created and, by pumping hot water plumbing, residential and commercial buildings are heated in cities.”



The referent demonstrates the need of implementing this type of technology.

It is a perfect example to take into account to provide solutions in the design and planning of the energy sources of the hybrid city model in the Bogotá River basin.



Waste-to-Energy

- 90% reduction of trash volume
- Power generation
- Pollution control

ecomaine
the future of regional waste systems

www.ecomaine.org

1. Urban Agriculture



Michigan Urban Farming Initiative (MUFI).



MS Volunteers harvesting green beans at urban farm (Chicago, IL, United States).

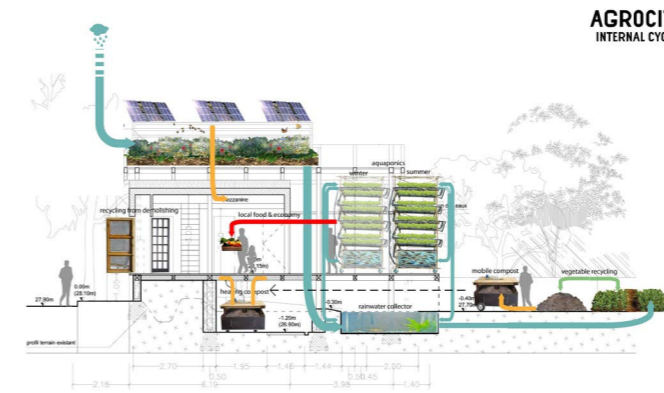


Boston is leading the way for rooftop greenhouses, aquaculture and aquaponics facilities, urban farms and other food production opportunities.



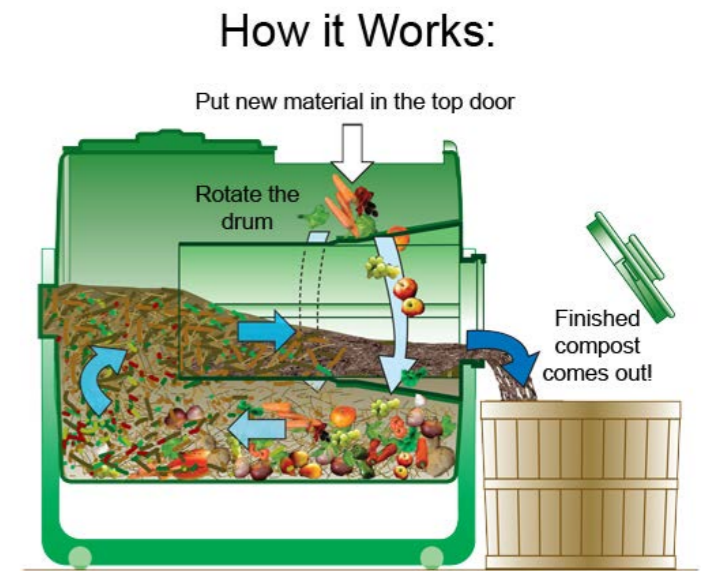
Urban Agriculture comprehensive farm review (design review for urban farms).

2. Compost Production Area



55

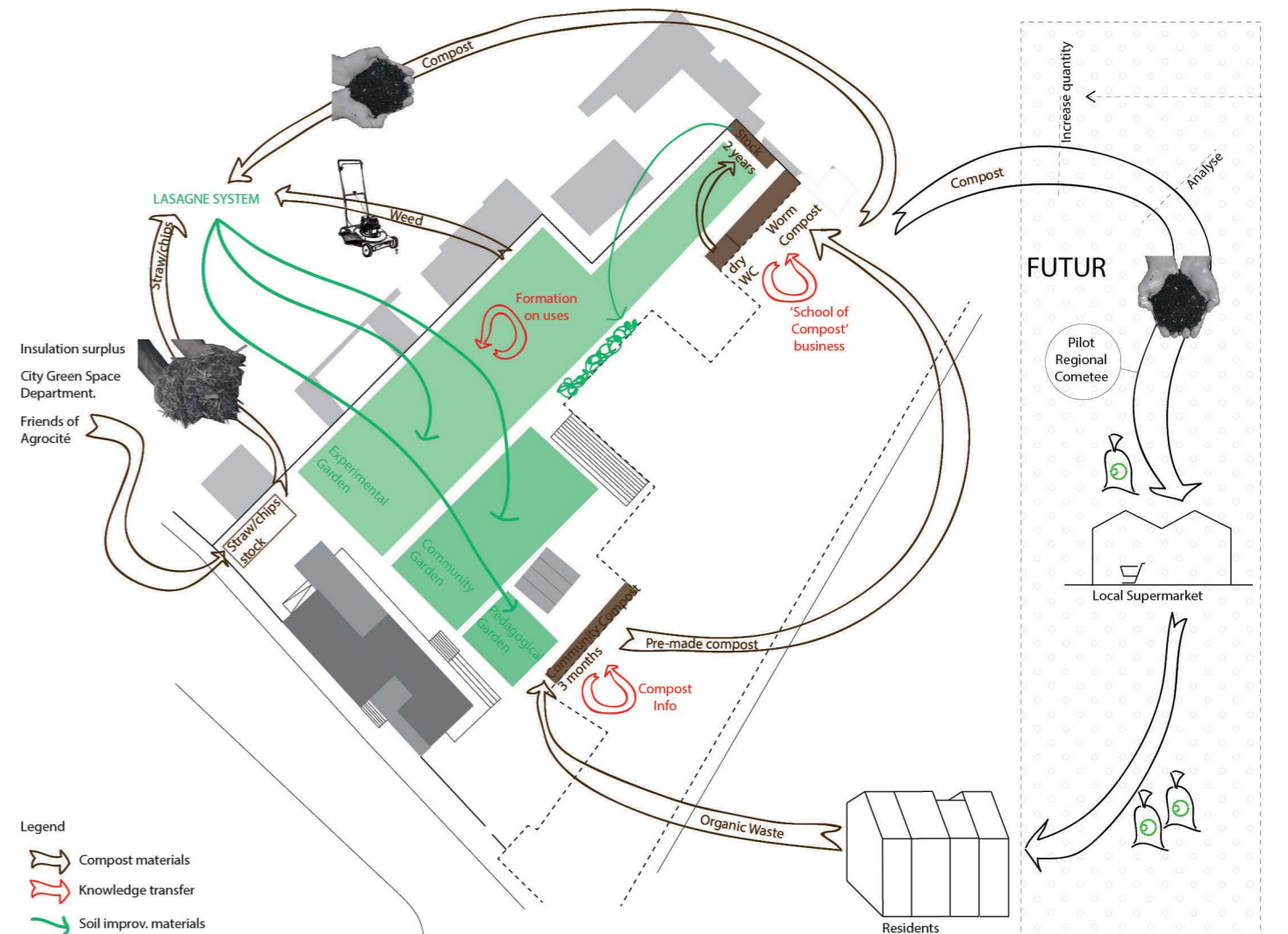
Above: Mapolis Architektur + BIM, Project: Gewinner des Zumtobel Group Awards 2012 gekürt. Preisträger 2012. Kategorie: Forschung and Initiative, R-Urban, Paris, Frankreich.



(Please note, it takes on average 6 weeks for new materials to be completely composted.)

56

Right: Composting: a way of disposing organic matter (food, leaves, trees) to create a natural fertilizer for soils.



Legend
 Compost materials
 Knowledge transfer
 Soil improv. materials

57

Claire Pelgrims, Project: Green Slide for soil improvement. Alternative city farming Brooklyn Grange/rooftop farming.

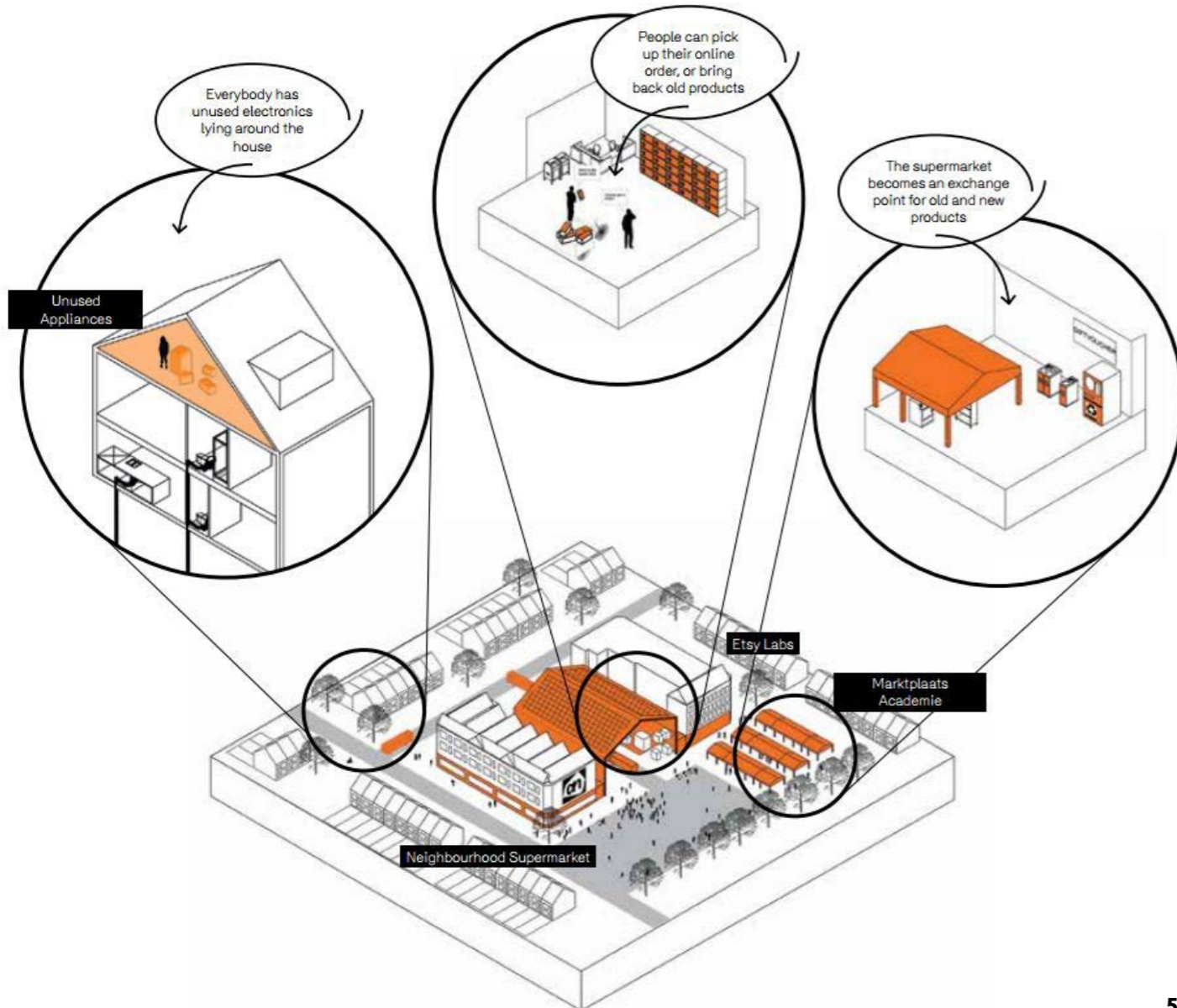
3. Waste and Recycling Collection Point



58

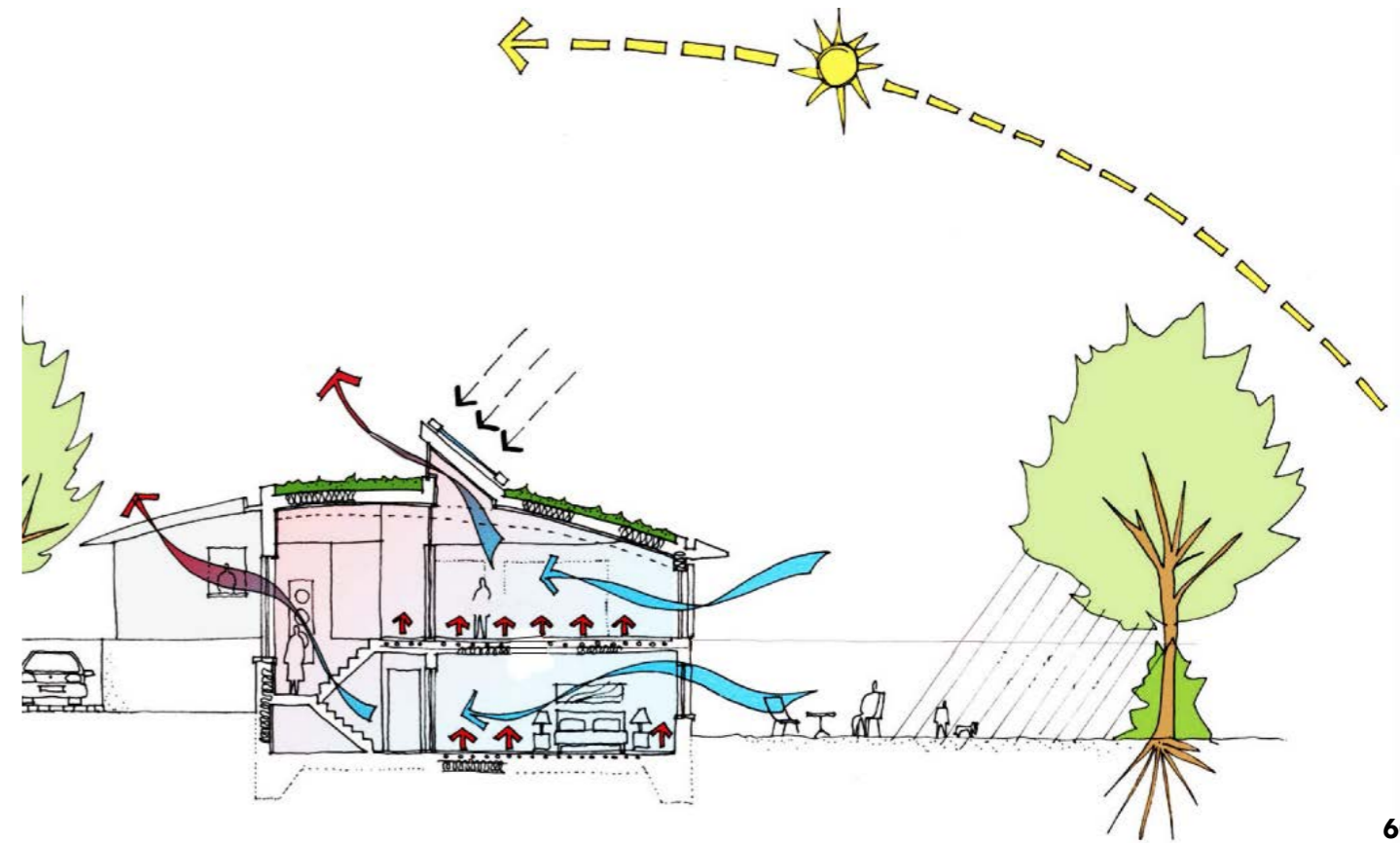
Together with Renato Lima of the Ministry of the Environment of Curitiba, the participants visited one of the "Sustainability Points" of the city, which encourage waste separation and recycling.

Recycling collection point and processes. Urban Metabolism, (Rotterdam, The Netherlands).



59

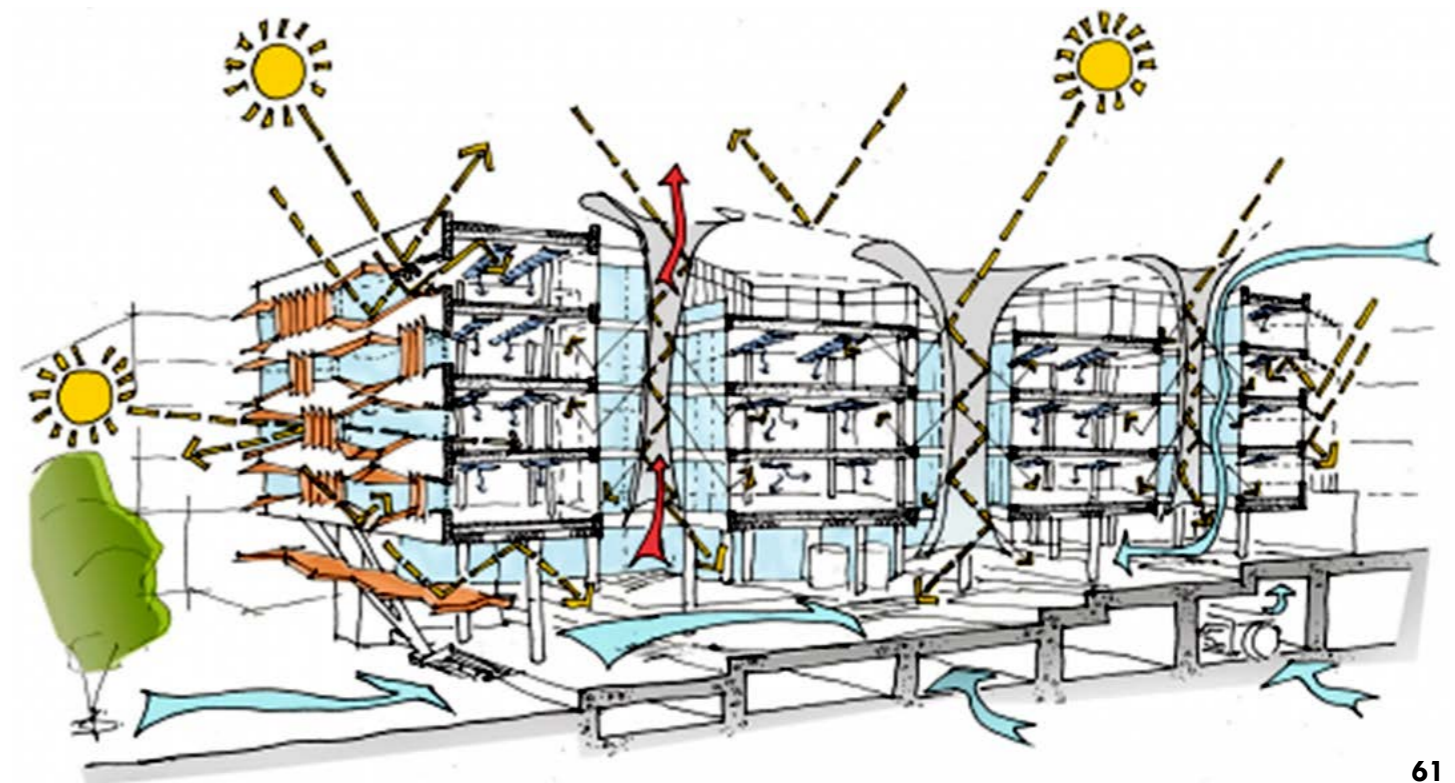
4. Housing



60

Patrick Gibson, Engineer of Biotechnology. Building a Sustainable Home in Victoria. Sustainable features.

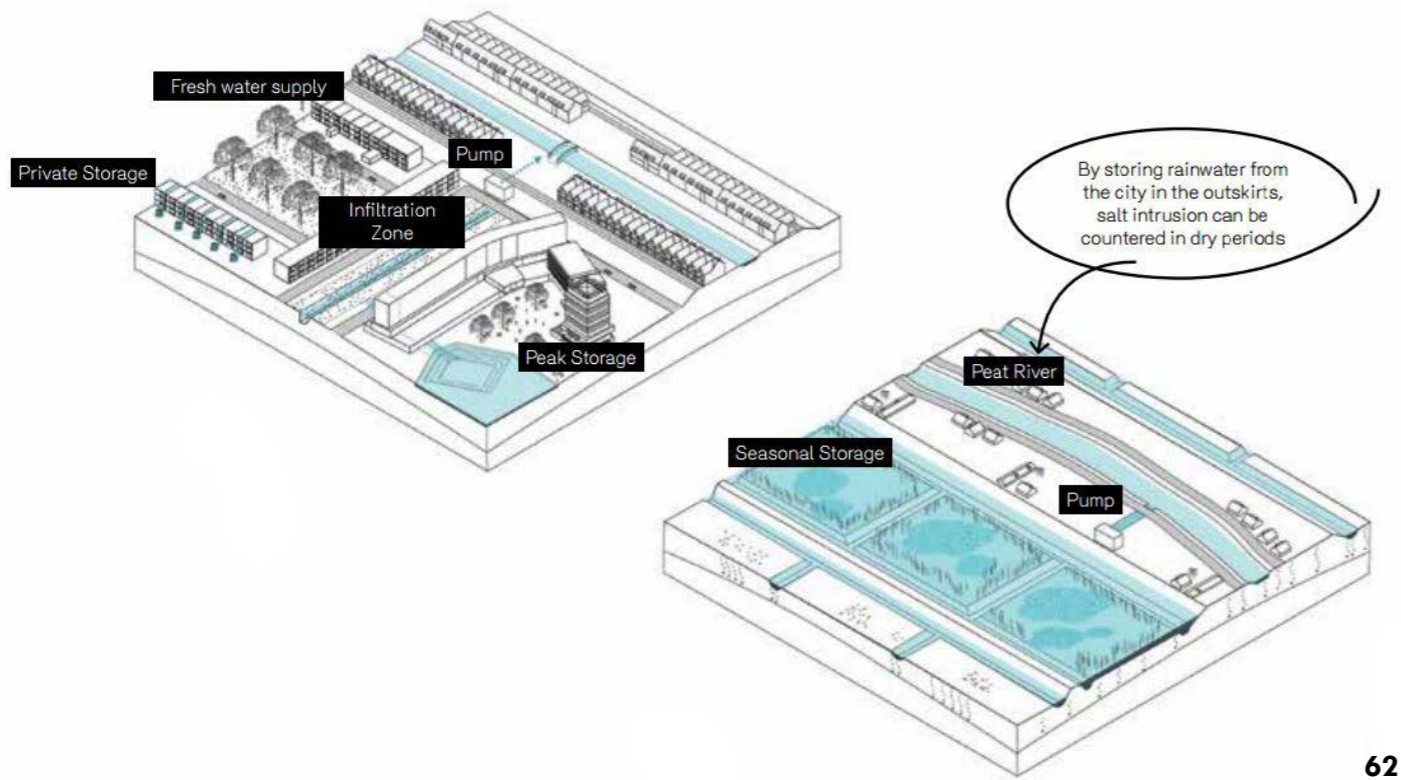
Sheppard Robson, Project: Siemens Middle East Headquarters Masdar City, Abu Dhabi.



61

5. Water Storage

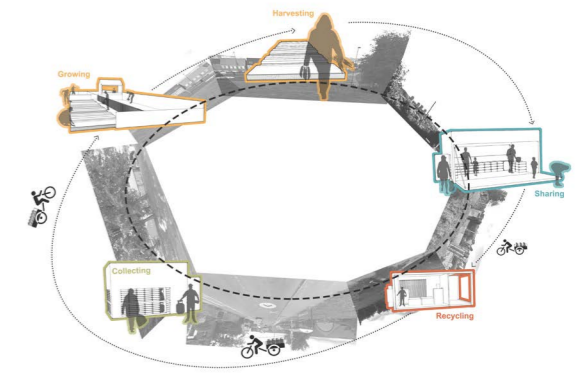
Water Storage
Urban Metabolism, (Rotterdam, The Netherlands).



62

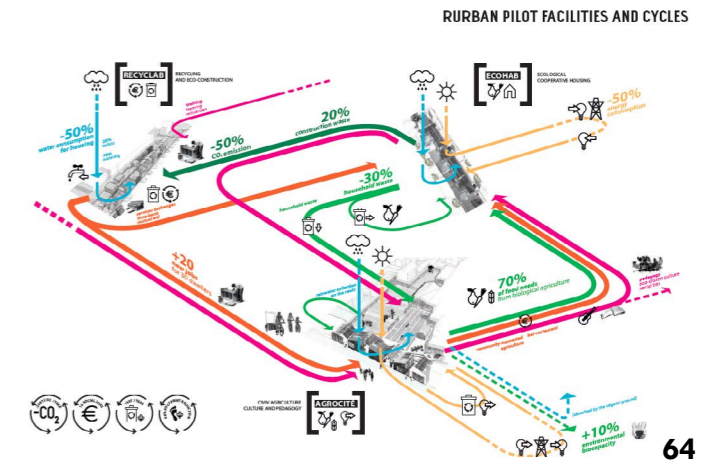
6. Cycle Networks

“Heeley Vege-network” , aiming to facilitate local resilience through a closing-loop of vegetable from growing, harvesting, sharing to recycling and collecting.



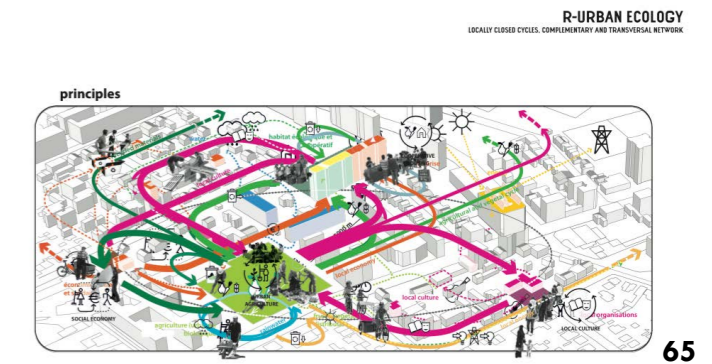
63

Presentation of the research project POLURB 2015. Through which the analysis and proposals on resilience and new urban policies after 30 years of local democracy arises. The project’s general objective is to present a new analytical framework of urban policies in Spain.



64

The units of R-URBAN have distinct functions but are networked for continual cooperation and communication.



65

Atelier d'Architecture Autogérée. (56 Rue Saint-Blaise - Paris 20e - France).



66

7. Urban Parks



67



68



69



70



71

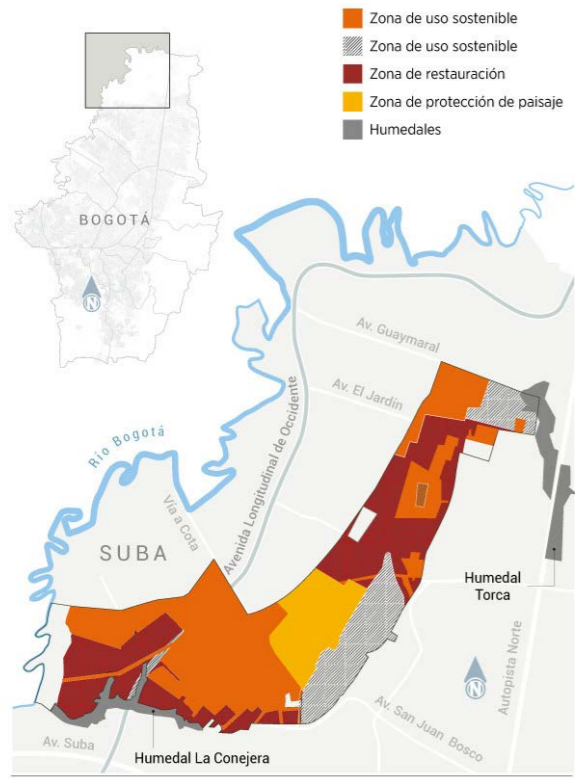
Central Park (New York).

Chapultepec Park (Mexico City).



Appendix VI - Forest reserve Thomas van der Hammen

Reserva Thomas Van der Hammen

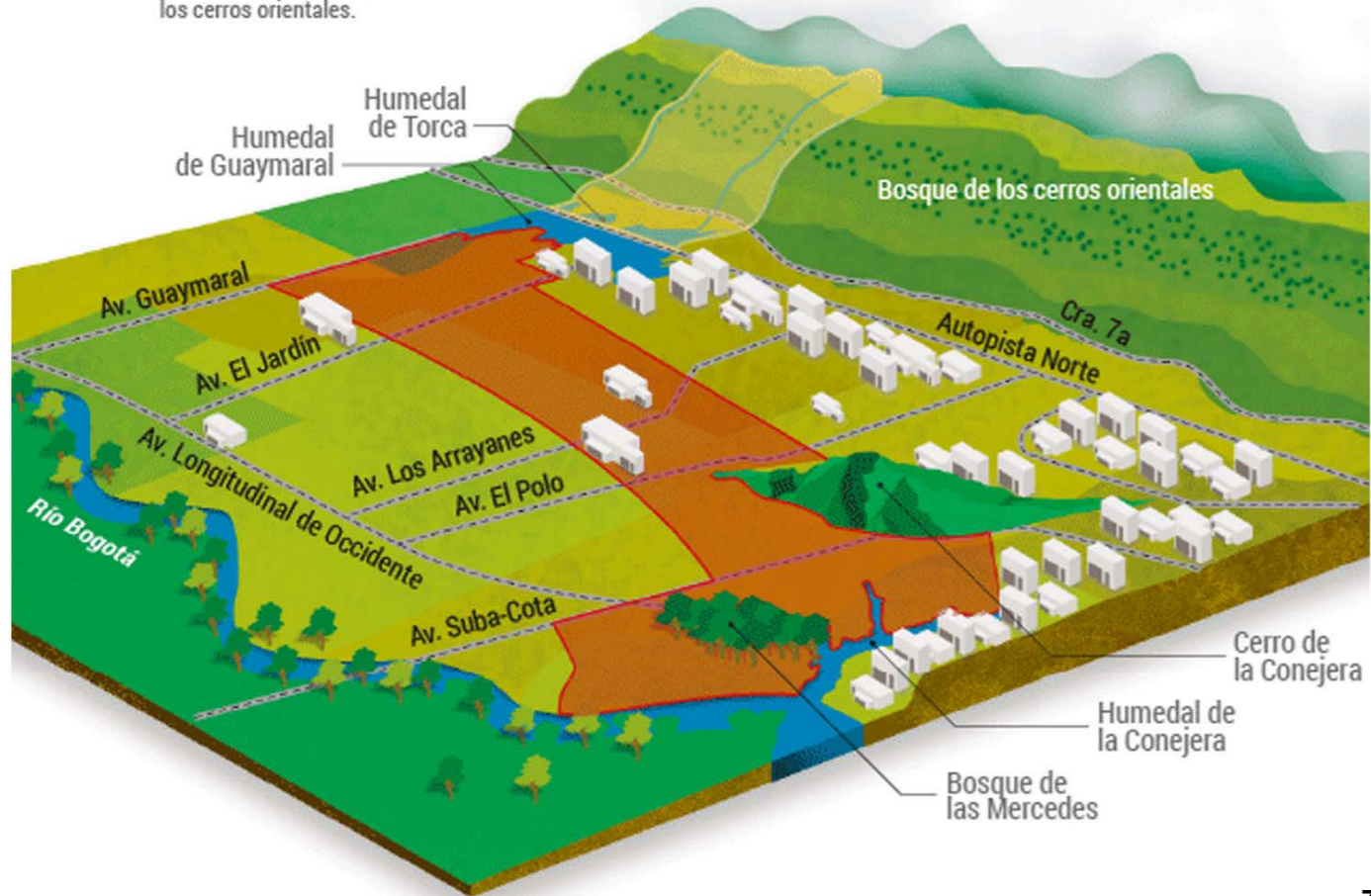


Location and land use map of the reserve Thomas van der Hammen.

3D image of the natural reserve location and the infrastructure connections.

Perímetro urbano Área protegida 73 Vías

Con el futuro bosque que será recuperado, el objetivo es consolidar la conexión ecológica entre el río Bogotá, la reserva, el humedal Torca-Guaymaral y los cerros orientales.



Appendix VII - Calculations

Housing

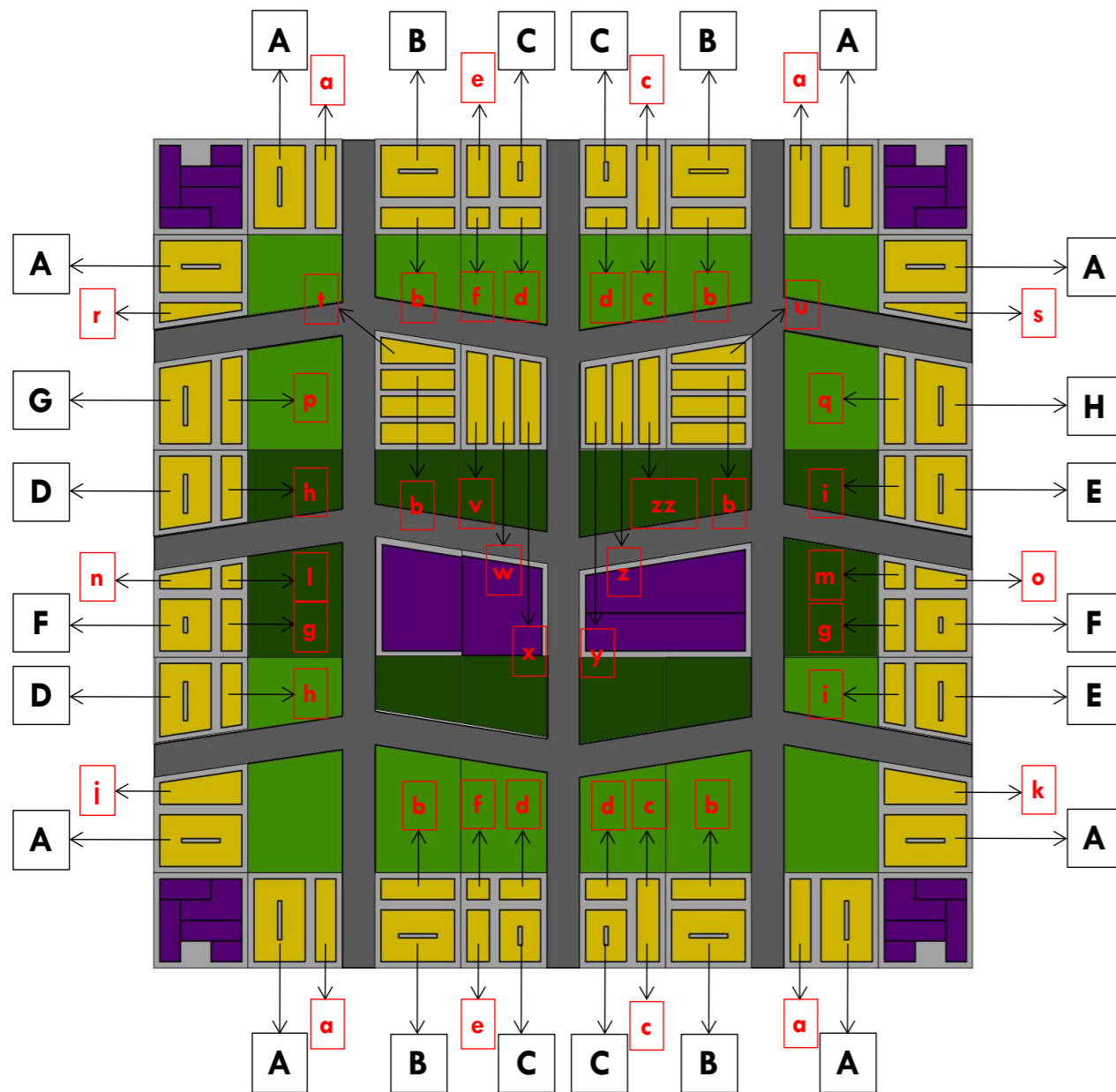
	HOUSING								TOTAL	
	BUILDINGS									
	A	B	C	D	E	F	G	H		
Floor Space Index	1,000.00	900.00	500.00	841.77	830.41	625.00	955.98	964.52	m2	6,617.68 m2
Construction Index	10,000.00	6,300.00	3,500.00	5,892.39	5,812.87	4,375.00	6,691.86	6,751.64	m2	49,323.76 m2
Total Floors	20	15	15	15	15	15	15	15		
Housing Floors	19	14	14	14	14	14	14	14		
Height	50	38	38	38	38	38	38	38	m	
# Apartments per floor	5	6	5	5	5	4	7	7		
# Apartments per building	95	84	70	70	70	56	98	98		
# Families	95	84	70	70	70	56	98	98	Approx.	641 Families
# People	380	336	280	280	280	224	392	392	Approx.	
# Buildings	8	4	4	2	2	2	1	1		24 Buildings
Total Apartments	760	336	280	140	140	112	98	98		1,964 Total Apartments
Total People	3,040	1,344	1,120	560	560	448	392	392	Approx.	7,856 Total People

	HOUSING									TOTAL	
	HOUSES										
	a	b	c	d	e	f	g	h	i		
Gross Area											
Floor Space Index	400.00	360.00	440.00	200.00	275.00	110.00	250.00	303.38	293.96	m2	2,632.34 m2
Construction Index	1,200.00	1,080.00	1,320.00	600.00	825.00	330.00	750.00	910.14	881.88	m2	7,897.02 m2
Height	9	9	9	9	9	9	9	9	9	m	
# Houses in a row	7	6	7	3	4	2	4	5	5		
# Families	7	6	7	3	4	2	4	5	5	Approx.	43 Families
# People	28	24	28	12	16	8	16	20	20	Approx.	
# Houses with same pattern	4	10	2	4	2	2	2	2	2		30 Houses
Total Houses	28	60	14	12	8	4	8	10	10		154 Total Houses
Total People	112	240	56	48	32	16	32	40	40	Approx.	616 Total People

	HOUSING									TOTAL	
	HOUSES										
	j	k	l	m	n	o	p	q	r		
Gross Area											
Floor Space Index	416.30	418.88	115.36	124.93	205.98	215.55	415.36	425.99	262.39	m2	2,600.74 m2
Construction Index	1,248.90	1,256.64	346.08	374.79	617.94	646.65	1,246.08	1,277.97	787.17	m2	7,802.22 m2
Height	9	9	9	9	9	9	9	9	9	m	
# Houses in a row	7	7	2	2	4	4	7	7	3		
# Families	7	7	2	2	4	4	7	7	3	Approx.	43 Families
# People	28	28	8	8	16	16	28	28	12	Approx.	
# Houses with same pattern	1	1	1	1	1	1	1	1	1		9 Houses
Total Houses	7	7	2	2	4	4	7	7	3		43 Total Houses
Total People	28	28	8	8	16	16	28	28	12	Approx.	172 Total People

	HOUSING									TOTAL	
	HOUSES										
	s	t	u	v	w	x	y	z	zz		
Gross Area											
Floor Space Index	237.53	340.73	249.58	438.75	418.18	397.61	372.29	392.86	413.43	m2	3,260.96 m2
Construction Index	712.59	1,022.19	748.74	1,316.25	1,254.54	1,192.83	1,116.87	1,178.58	1,240.29	m2	9,782.88 m2
Height	9	9	9	9	9	9	9	9	9	m	
# Houses in a row	3	6	5	7	7	7	6	7	7		
# Families	3	6	5	7	7	7	6	7	7	Approx.	55 Families
# People	12	24	20	28	28	28	24	28	28	Approx.	
# Houses with same pattern	1	1	1	1	1	1	1	1	1		9 Houses
Total Houses	3	6	5	7	7	7	6	7	7		55 Total Houses
Total People	12	24	20	28	28	28	24	28	28	Approx.	220 Total People

TOTAL	
8,494.04	m2
25,482.12	m2
141	Families
48	Houses
252	Total Houses
1,008	Total People



Urban Agriculture / Flower Fields / Sustainable Agriculture

URBAN AGRICULTURE	
	1,645.78 m2
	1,399.91 m2
	1,682.15 m2
	1,789.67 m2
	1,507.43 m2
	1,561.74 m2
	2,397.09 m2
	2,477.97 m2
	1,461.78 m2
	1,377.74 m2
	2,581.09 m2
	2,457.09 m2
	2,177.93 m2
	2,071.58 m2
	2,350.74 m2
	2,661.98 m2
1 Block	31,601.67 m2
TOTAL	3.16 Ha
	0.65 %

FLOWER FIELDS	
Production	4500 Ha
	1,461.78 m2
	2,397.09 m2
	2,289.09 m2
	1,231.91 m2
	1,514.15 m2
	1,621.67 m2
	1,339.43 m2
	2,477.98 m2
	1,377.74 m2
	1,339.43 m2
	1,514.15 m2
	1,231.91 m2
1 Block	19,796.33 m2
TOTAL	1.98 Ha
	0.04 %
TOTAL	140.55 Ha

SUSTAINABLE AGRICULTURE			
	3,672,211.82 m2	367.22 Ha	
	3,935,818.39 m2	393.58 Ha	
	1,413,768.73 m2	141.38 Ha	
Sustainable Agriculture	199,645.31 m2	19.96 Ha	
	359,594.98 m2	35.96 Ha	
	414,762.31 m2	41.48 Ha	
	381,259.07 m2	38.13 Ha	
	335,944.12 m2	33.59 Ha	
TOTAL	10,713,004.73 m2	1,071.30 Ha	

- Marketplace in Chia, department of Cundinamarca.** Source: Marketplace Chia, 2012. photograph, viewed 30 November 2015, < <https://www.flickr.com/photos/dyetransfer/6870424045>>
- Marketplace in Chia, department of Cundinamarca.** Source: Marketplace Chia, 2012. photograph, viewed 30 November 2015, < <https://www.flickr.com/photos/macamahandi/6879199497>>
- Transport and distribution located in Central Supply (Corabastos) in Bogotá.** Source: El Tiempo. Corabastos, 2015. photograph, viewed 30 November 2015, < <http://www.corabastos.com.co/>>
- Location of Central Supply (Corabastos) in Bogotá.** Source: Corabastos, n.d. photograph, viewed 30 November 2015, < <http://www.el-tiempo.com/bogota/imagenes-aereas-de-bogota-asi-se-ve-el-suroccidente-desde-el-cielo/16423440>>
- Large supermarket chain: Exito, in Colombia.** Source: Exito, n.d. photograph, viewed 30 November 2015, < <http://www.rutanoticias.com/almacenes-exito-a-la-baja-su-accion-pero-busca-exito-en-su-expansion/>>
- Large supermarket chain: Carulla, in Colombia.** Source: Carulla Smartbrands, n.d. photograph, viewed 30 November 2015, < <http://www.smartbrands.com.co/carulla>>
- Detail of pollution that afflicts the Bogota River.** Source: Revista Semana, Bernate, C. photograph, viewed 10 January 2016, < <http://sostenibilidad.semmana.com/medio-ambiente/articulo/rio-bogota-contaminacion-tregua/32929>>
- Principal landfill of Bogotá: Doña Juana.** Source: Relleno Sanitario Doña Juana, n.d. photograph, viewed 14 June 2016, < Exploratumedio.blogspot.com>
- Advance of the urban footprint along the Bogotá River (Bosa, Bogotá).** Source: Bogotá River, Wilches-Chaux, G. photograph, viewed 10 February 2016, < <http://wilchesespecieurbana.blogspot.nl/2014/01/conversaciones-con-el-rio-bogota.html>>
- Hydroelectric Plant in Colombia.** Source: Hydroelectric, n.d. photograph, viewed 6 June 2016, < <http://www.radiosantafe.com/2016/03/22/colombia-no-puede-suplir-demanda-con-hidroelectricas-y-debe-buscar-otras-fuentes-energeticas/>>
- Star Tribune, Hydroelectric Plant (Minneapolis, United States).** Source: Shaffer, D. 2016, Hydroelectric Plant in the U.S., photograph, viewed 10 June 2016, < <http://www.govtech.com/fs/Minnesota-PUC-Approves-Canadian-Imported-Hydro-power.html>>
- River Water shows waves, ripples and splashes as a river flows around a few rocks.** Source: Unknown River, n.d. photograph, viewed 20 April 2016, < <http://www.photos-public-domain.com/2012/04/13/river-water/>>
- Electrical Network, how it works in Colombia.** Source: Electricity Network, n.d. photograph, viewed 27 November 2015, < <http://www.portafolio.co/economia/finanzas/gobierno-sigue-blindando-sector-electrico-30732>>
- Transportation congestion along Colombian Roads.** Source: Trucks congestion, n.d. photograph, viewed 12 January 2016, < <http://www.lafm.com.co/noticias/paro-nacional-habilitan-paso-144828>>
- Transportation congestion along Colombian Roads.** Source: Trucks traffic, n.d. photograph, viewed 12 January 2016, < <http://www.colombia.com/actualidad/nacionales/sdi/36771/unos-400-camiones-articulados-salen-en-caravana-de-protesta>>
- Transportation congestion along Colombian Roads.** Source: Trucks traffic, n.d. photograph, viewed 12 January 2016, < http://www.larepublica.co/el-transporte-de-carga-hacia-venezuela-ha-ca%C3%ADdo-50_150091>
- Transportation congestion along Colombian Roads.** Source: Road infrastructure deterioration, n.d. photograph, viewed 12 January 2016, < <http://www.elpais.com.co/elpais/valle/noticias/invertiran-50000-millones-en-tres-vias-del-valle-del-cauca>>
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