

# Towards sustainable urban development? Reviewing the practice of urban planning in Ecuadorian Secondary Cities, addressing risk management and climate change

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## ABSTRACT

Urban planning has been defined as an instrument that implements policies and strategies for sustainable urban development. Nevertheless, challenges such as urban sprawl and disaster risk demand combined actions in order to prevent environmental and humanitarian repercussions that pose significant sustainability problems. In a worldwide call, SDG 11 and SDG 13 address the importance of action by cities and communities to cope with challenges that climate change and sustainability demand. Furthermore, international agreements have set up the pathway to reach the reduction of disaster risks through equitable and environmental solutions under climate change adaptation measures. These actions demand the intervention of several stakeholders and disciplines in a cross cutting action force. In this regard, risk management is considered to be a key element within urban planning. Scholars and practitioners have acknowledged the importance of including risk management and climate change adaptation within urban planning as part of the strategies to overcome disaster risk events. However, this seems not to be the case for Ecuador. Its governmental complexity and the rapid population growth in its secondary cities have had an impact on urban planning, offering inadequate spatial solutions due to its lack of capacities and weak accountability on risk management. This resulted in a significant challenge for both the national and local governments. The purpose of this research is to build knowledge on the importance of disaster risk management and climatic change adaptation within urban planning in secondary cities. This study presents two case studies in the Municipalities of Mejía and Latacunga located in the central region of Ecuador; region characterized by the predominance of active volcanoes as well as strong anthropic impacts on natural resources. These circumstances have raised arduous

discussions regarding risk management and climate change adaptation, and therefore, their implementation in real urban planning.

**Keywords:** risk, climate change, urban planning, sustainable urban development, secondary cities, Ecuador

## INTRODUCTION

Cities contend with a myriad of local and global challenges in the twenty-first century. As managers and planners alike seek out sustainable and integrated solutions to face these challenges, different processes are rethought and re-engineered to accommodate the rapidly growing populations within our fragile urban environments. Key among these challenges is addressing the staggering urban risks produced by poorly planned territories and the scarcity implementation of climate change adaptation measures to cope with climate change impacts.

Climate change poses a threat to economic growth and long-term prosperity of many countries around the world. Ecuador is not an exception, considering the actual and potential impacts of climate change and climate variability that will threaten its vulnerable sectors and human populations. Studies and international agreements recognize that risk management is considered a crucial element in planning for climate change. However, country reports regarding environmental impacts have shown how far spatial planning is from considering urban risks into adaptation measures. To establish which are the principal factors that endanger such decisive action, it could be said that governance models and population growth have an essential role. According to the World Bank, by 2018, 55.3% of the world's population lived in urban areas.

Although for some groups, this situation creates economic opportunities (Bolay, 2016), it can also create a potential scenario of social, political, and functional vulnerability that contributes to the construction of disaster risks (Lall and Deichmann, 2012; Lahoz, 2010).

Over the years, many civil manifestations have occurred in Ecuador, demanding equal rights and access to quality housing. The Ecuadorian government responded by establishing new regulations and legal frameworks, embedding the field of spatial planning. However, the increase in the population of smaller urban areas became part of the challenge, bringing environmental and humanitarian repercussions impacting housing, infrastructure, provision of basic services, safety, and natural resources. The challenge becomes more significant when secondary cities face it. Their capacities for action are often reduced, making national governmental goals unachievable.

### ***Establishing a counter-claiming***

In the case of Ecuador, a country in development, addressing urban risks could lead to a broader and necessary discussion. Ecuadorian cities are projected to experience changing rainfall patterns, rising sea levels, and higher temperatures that will affect food security, agricultural production, water availability, and public health, among others. These climate change impacts and climate variability can further produce social and political problems, such as rural-urban migration, land availability, and water resource disputes. The municipalities, however, bear the brunt of the responsibility; they are meant to implement and enforce legislation, implementation of plans, operational and financial capacity.

### ***Outlining purposes***

Secondary cities have emerged as cities with unexpected significant growth (Bolay and Rabinovich, 2004; Bolay et al, 2003; Bazant, 2010). In this regard, addressing urban planning and its role in coping with urban risks and climate change impacts leads to the discussion of management and governance of risk. Seeking to contribute to the current debate on the benefits of development for intermediate cities, this study emphasizes the need to research more in-depth into the challenges of sustainable urban development faced by Ecuadorian intermediate cities. The constraints of

implementing spatial planning strategies and the insertion of climate change adaptation measures within urban planning to reduce disaster risk for territories could represent an opportunity to innovate and to develop local capacities in intermediate cities (Quarantelli, 1996; Cardona, 2008; Benítez et al, 2012; Chan et al, 2016; Kabisch et al, 2018). Furthermore, by disclosing risks to cities, the results presented here can raise awareness, inform planning, inspire further research at local levels, and promote the shift towards managing risk rather than emergencies.

Studies in Ecuadorian intermediate cities that include the dimensions of spatial planning and climate change impacts, as well as urban risks, have been produced separately. Focusing on Mejía and Latacunga as case studies due to their strategic position within the central Ecuadorian region, both municipalities have experienced unexpected growth rates in their small urban centers. Their planning strategies appear to lack the interactions of risk management and adaptation planning for climate change. Furthermore, taking into account their location concerning the Andes Region's geographical conditions, the potential disaster risk scenario may increase more rapidly in its secondary urban centers than in rural areas or in larger cities.

After defining the concept of sustainable development, and articulating it with the definitions of disaster risk in cities and how urban planning is coping with it in a brief literature review, it describes the context for risk management and climate change adaptation carry out by Ecuadorian secondary cities.

This paper is divided into five sections together with the introduction. The first section summarized the context and body of this research. The second section displays the literature review citing relevant studies that explain the current state of the question to investigate, supporting the theoretical foundation of this research. Section three includes the research design, which explains the methodological approaches selected based on the literature reviewed. Section four thought the methodology application includes findings and discussion, leading to Section 5 Conclusions, where the main findings are provided.

## LITERATURE REVIEW

### ***Sustainable urban development and the challenges faced by intermediate cities***

According to the New Urban Agenda, the world urban population will practically double by 2050, which will make urbanization one of the most transformative trends in the 21st century. Hence, the planning and management of urban development with sustainability criteria becomes an indispensable condition for the management of the territory, where it must be considered the systems of cities and human settlements, including urban and rural areas and their social, economic and territorial particularities (UN Habitat, 2017).

The sustained growth of the urban population brings environmental and humanitarian repercussions that pose enormous sustainability problems in terms of housing, infrastructure, basic services, food security, health, education, decent jobs, security, and natural resources, among others (UNDRR, 2015). In the Latin American region, the estimated urban population is 80% of the total, and by 2050 it is expected to exceed 85%. The persistent economic inequality in the region represents one of the barriers that must be overcome to ensure sustainable development (Moreno and García, 2017). Therefore, unsustainable development models have reached a turning point. The need to incorporate factors such as the environment within visions towards sustainable urban development (Haughton and Hunter, 2004) has been imperative worldwide rather than only in a particular region.

Studies point out that while urbanization offers many opportunities, rapidly expanding cities face many risks, such as economic disruptions, social strife, and environmental repercussions, which are increasingly occurring within their boundaries (World Bank 2018, p.1; Angel et al, 2016). The pursuit of sustainable objectives raises the need for multiple disciplinary approaches to achieve it. Authors such as Watson (2003) and Polk (2015) explain that engaging with the diverse practices, interactions, and rationalities of policymakers, planners, developers, activists, and dwellers best develops the knowledge of urban challenges and how to address them. Although the concepts and definitions of sustainable urban development are clear (Polk 2015, p.4), the biggest challenge is to take them from the theory to the practice. Also, the challenges get considerably complex when the

scale of territories is an extra factor; this means that while metropolitan cities might have the sources and capability to reach sustainable urban development, intermediate cities in developing countries face a different reality (Klaufus, 2010; Martine, 2007; Schteingart and Salazar, 2003; Rueda, 1997). Roberts (2014, p.17) mentioned that many small regional secondary cities in developing economies struggle to raise capital and attract investment, which is needed to build infrastructure and draw new business enterprises, essential to diversifying and generating dynamic economies.

The lack of institutional and business capacity or knowledge of how to create sustainable local economies limits their development (ibid. 2014, pp.17-18). Polk (2015, p.4) addresses this mentioning that the implementation and achievement of a sustainable urban development deal with difficulties of availability and coordination of institutions, finance, frameworks, and stakeholder groups. Local governments are expected to provide services, promote economic and social development, and guarantee safe and healthy environments within the constraints of short-term mandates (Jácome, 2020). These constraints increase social and environmental problems and aggravate financial conditions. Moreover, the different applications of the 'sustainable urban development' concept reflect a variety of political worldviews and values, "from market-driven mechanisms within neoliberal political agendas to ones that call for a total transformation of society based on social and environmental approaches" (Polk, 2015, p.4).

Focusing on which extent sustainable urban development means to the territories and how territories address such challenges, leads to acknowledge that cities are spaces for overlapping, mutually dependent, competing, and conflicting objectives. It could be said that the current traditional organizational structures that drive cities have been exceeded. These constraints are described as "many urban challenges such as climate change, resource constraints, poverty, poor health, and social tensions exceeding the boundaries of the current framework of policy-making, planning, administration, and academic knowledge production" (Polk, 2015, pp.1-2).

### ***Climate Change impacts in Cities***

Climate change negative impacts are generated by the increase in temperature on the planet, linked to

GHG emission, which has an anthropogenic origin. The increase in temperature brings with it climatic variations that are relevant for the quality of life of the population and the development of activities in the territory, such as rainfall, humidity, increased winds and frequency and intensity of occurrence of these extremes events.

According to the UNDP<sup>1</sup> work for the Peruvian case, the impacts of climate change can be evidenced in the population through five interrelated transmission mechanisms, mutually reinforce each other and significantly affect the processes of human development. These mechanisms are (UNDP, 2014):

- Exposure to extreme events
- Degradation of ecosystems and loss of biodiversity
- Stress and water insecurity
- Lower food production and food insecurity
- Impact on human health

Each of these mechanisms will affect the territory to a different degree depending on the natural conditions, the ecosystems present, the degree of resilience, and the social and productive conditions available to manage the effects of climate change. Furthermore, depending on the type of ecosystem that predominates in each area of the territory, the climatic effects vary. In the High Andean mountains region, the impact of the phenomenon on the retreat of the glaciers is evident. Generated by the increase in temperature, it is threatened in their quality of water reserves for the dry season and in their role of cooling the local climate. On the other hand, it is evident that permanent variation of the rains increases or decreases, but with a more marked seasonality: that is, periods of heavy and concentrated rains, and periods of prolonged droughts—another effect in this type of ecosystems. Regarding the damages caused by economic activities in the territory, climate change affects food production, thereby threatening food security (UN, 2016; UNDP, 2014). The agriculture and fishing sectors are highly climate-sensitive activities, as the soil and water resources on which they depend are easily and rapidly eroded and degraded.

Faced with the evident impact that climate change has on the territory, its planning and management must consider the climatic variables to ensure progress on the path of sustainable development,

while solving the effects and taking advantage of opportunities to eradicate poverty and reduce inequalities. Hence, the public policy of the territory and climate change must be thought of and applied with a transversal approach and with the active participation of organized society, the business sector, the academy, the press, and the community.

### ***Urban risk and urban planning: towards risk management and urban management***

The territorial system is an inevitable social construction that reveals the norms with which a society develops. According to Gómez (2008), it is comprised of a structure that integrates the physical component, human settlements, institutions, and others. The interrelationships between specific places and spaces in the territory are usually organized in territorial units of different levels and hierarchies, which correspond to specific ranges for planning, solving problems, or taking advantage of opportunities. In this framework, territorial management can be understood as the set of concrete actions on the territory aimed at achieving the objectives emanating from a planning policy in which guidelines are set out to configure a desirable territorial model (Mondragón, 2017, p.8). These practices must, necessarily, be systemic and ordered in terms of the role of the actors and temporality of the actions, under a certain level of uncertainty that is always present in the interrelations of the territory. As part of the global planning process, the very management of the territory is based on instruments of a normative and technical nature, and socio-political agreements between actors. Hence, the importance of praxis or territorial intervention demands continuity, institutional infrastructure, economic resources, and professional capacities for dialogue with various actors (Mondragón, 2017, p.8).

In recent decades, there has been an important trend in the generation of a series of instruments for the ordering and planning of the territory in the Latin American and Caribbean region (Irazábal, 2009). Poor management, little use, and low execution also accompany this trend. It has been characterized by inconsistencies, contradictions, and conflicts in the management of the territory, as well as between the public and private interests and between the objectives of economic growth of sectorial policies with those of environmental protection, conservation of natural resources and social well-being embodied in land-use planning

<sup>1</sup> United Nations Development Program

<sup>2</sup> National Development Plan "Toda una Vida"

## METHODOLOGY

policies (Massiris, 2012). In this challenge, territorial management's role is highlighted by having the potential to articulate the actors and their interests and demands in the space, proposing clear lines of development and concrete actions for their achievement. Furthermore, if we consider that in the current context, it has been shown that the transformative effects on global dynamics come precisely from local actions, and such would be the case of global trends such as inequality, poverty, economic crises, and the climate change.

Added to what has been mentioned, the growing rate of urbanization experienced by smaller cities can lead to the construction of risk scenarios, with a high probability of occurrence when urbanization is rapid, poorly planned, and occurring in a context of segregation and poverty. In 2015, urban planning failures were identified as a distinct risk factor (UN Habitat 2015, cited in UNDRR 2015, n.p.). Cities are becoming more and more exposed and are creating new patterns of absolute risk. In this regard, some studies pointed out that inadequately planned and managed cities also create new risks (Brecht et al. 2013, p.2; UNISDR 2013, cited in UNDRR 2015, n.p.) that threaten to compromise the process towards sustainable development. The combination of a lack of adequate infrastructure and services, unsafe housing, variation in natural cycles associated with climate change, can switch natural hazards into disasters.

While natural hazards and ongoing urbanization are inevitable, disaster losses can be minimized through adequate risk management. The risk assessments, land use planning and regulations, and planning for response and recovery could lead to significantly reduce disaster impacts (Jácome 2020). Public and private actors evoke mitigation actions as the cornerstone of the nation's approach to addressing the environmental risk (Mileti 1999, p.267). Although researchers acknowledge the role of multiple actors in risk management and the importance of including population, scientists, and academy for successful implementation (Pelling 2003, p.57; Donovan 2019, n.p.), most of the strategies found in studies are implemented primarily as top-down approaches (Donovan and Oppenheimer 2014, pp. 150-151). Although these initiatives are established under legal frameworks, accurate urban planning and development approaches are needed to secure its effectiveness (Pierson et al. 2014, n.p.).

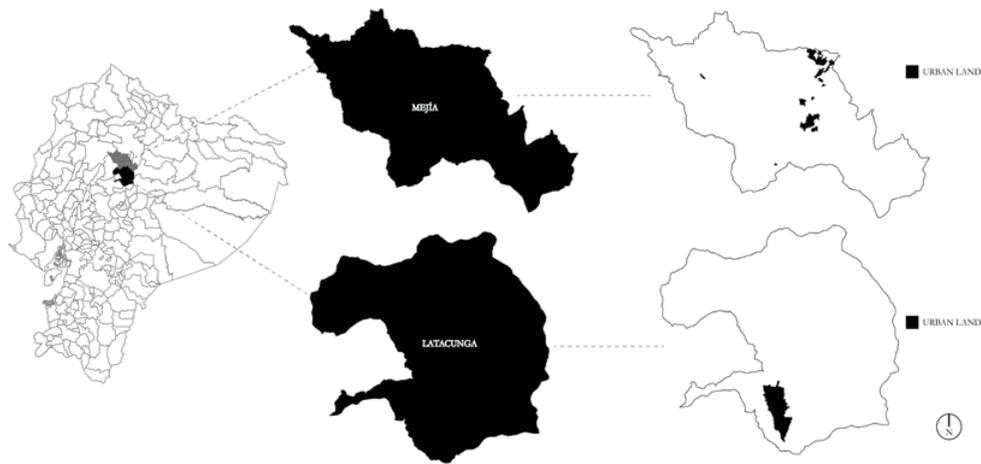
To evaluate objectives and strategies addressing sustainable urban development goals, the units of analysis have a Cantonal scale. Objectives and strategies embedded in the Development and Spatial Planning Plans of both municipalities regarding how they address sustainable urban development goals have been measured and compared with the SDG 11 Sustainable cities and communities targets. To study the land-use changes from rural to urban, a multitemporal analysis method was implemented by superimposing polygons, through this method the evolution of a region or locality, and the human repercussions on the environment can be analyzed (Ruiz et al., 2013, p. 117). In a time frame between 1970 and 2018, the urban areas of the study municipalities were taken as data, and the urban and population growth rates were calculated. Based on the analysis of the urban and population growth of the study municipalities, the core areas were identified. Finally, to understand the construction of risk, based on the urban expansion and how spatial planning legal frameworks have shaped the territories, a vulnerability assessment was added to the analysis. To measure how vulnerable a population settled in a specific area is, the first indicator to know the socio-economic characteristics of the population of the canton is accessibility to basic services. To form this indicator, variables such as percentage of access to drinking water by a public network, percentage of connectivity to the public sewer system, percentage of connection to the network of the public energy company, and percentage of solid waste collection per car collector, was considered. This indicator allows us to analyze how able to adapt and resilient populations are. Unsatisfied basic needs estimated poverty; a household has a higher percentage of poverty due to unsatisfied basic needs if it has two or more of the following conditions: housing with inadequate physical characteristics, housing without adequate basic services, a home without access to education, and access to health services.

## MEJÍA AND LATACUNGA AS CASE STUDIES

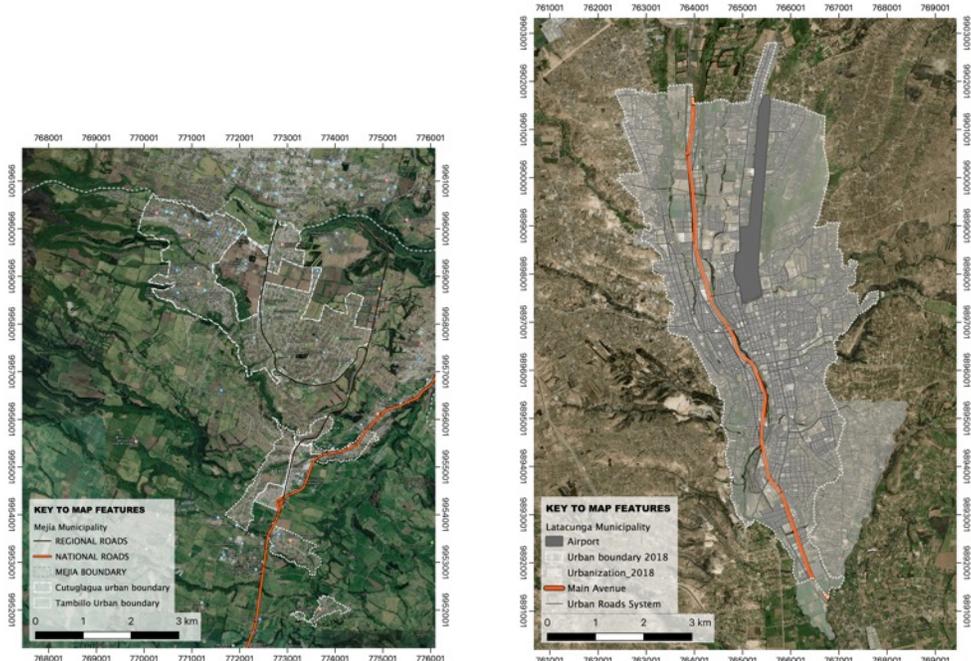
The anthropic intervention of the land influences the intensity, frequency, and occurrence of mass movements, generally by changes in the soil structure for urbanizations, infrastructure facilities, deforestation, and mining (Comunidad Andina-

Predecan, 2009, p. 111). More than half of the Andean Community population is exposed to mass movements. In Ecuador, the percentage of the population exposed to this phenomenon reaches 50%, mainly due to the increasing occupation of slopes and valleys, the removal and change of terrain, cutting of slopes, and deforestation (Comunidad Andina-Predecan, 2009, 116). Another relevant phenomenon is El Niño, which causes heavy rainfalls and – in the reverse phase La Niña – draughts because of a decrease of rainfalls. This climatic phenomenon causes floods and therefore has a high impact. Ecuador is situated in a zone with very high geological activity and part of the so-called Ring of Fire. There are 84 volcanoes on Ecuadorian territory with different states of activity.

Currently, there are ten continental volcanoes on monitoring; seven of them are active. In the past, Ecuador has been affected by several multi-hazard events. In this regard, this study has decided to analyze three urban areas identified as secondary cities due to their transformation and role within the Ecuadorian development process. These cities are located in the central region of Ecuador, which faces several and potentially hazardous events for human settlements. Furthermore, the outcomes of how plans and national strategies have been shaping and conditioning the development of such cities bring the opportunity of constructing a comparative case study between Latacunga and Mejía Municipalities.



**Figure 1 Case study selection: Latacunga and Mejía geographical location in the central Ecuadorian Region, and land use classification in urban and rural areas**  
 Source: Jácome 2020



**Figure 2 Unit of analysis: Left, Cutuglagua and Tambillo; Right, Latacunga**  
 Source: Jácome 2020

### ***Intermediate cities addressing sustainable urban development***

The end of 2012 conceived the firsts development and spatial planning plans conceived in almost all the local governments in Ecuador (Cordero 2013, p. 375). With a new presidential mandate, the National Development Plan 2017-2021 was approved. In this regard, local governments were required to upgrade and adjust their objectives and strategies. PNDTUV<sup>2</sup> has identified the strategic position of Latacunga and Mejía municipalities in the Ecuadorian central region corridor. With an evident influence of metropolis such as Quito, high transport flows, economic dynamics, a predominance of agricultural activities and agro-production, make their location as strategic within the national system. Consequently, these external influences have been shaping Mejía and Latacunga development patterns (Jácome, 2020).

Contrary to national and regional trends, the proportion of the urban population in Mejía and Latacunga is approximately 1/3, and the rural is 2/3. The purely rural nature of these municipalities has not changed over time. In the last decade, the average urban population has been 32% concerning the average rural population of 68%. Therefore, it is rurality that defines these territories and their development needs. Hence, based on RIMISP's (2017, n.p.) definitions, these territories can be understood as urban-rural territories, which become those that are not classified as large metropolitan cities or as remote and dispersed rural areas. They are those intermediate territories that "gravitate" around urban areas between 15 thousand and 400 thousand inhabitants. The reciprocal and repeated flows of people, goods, services, money, and environmental services are characterized. Agricultural activities have an essential presence in urban-rural territories, and around them, meaningful connections are established. However, both municipalities have addressed these development patterns in different ways, which could be identified through their spatial changes. Unlike Latacunga development patterns and spatial impacts are reflected mostly over its central city Latacunga, Mejía has faced spatial changes in almost all its urban settlements besides its principal city Machachi.

By the time PDOTs<sup>3</sup> were elaborated by the Municipalities of Mejía (2016) and Latacunga (2016), the SDG goals were already presented worldwide. However, as seen in Table 1, it seems like the objectives and strategies promoted by both municipalities are not aligned to the SDGs' current international agenda. One could argue that municipalities were following national rules regarding development plans by that time rather than observing international guidelines. It was not until 2016 – during the Habitat III conference – that Ecuador engaged with the international community to force the SDG.

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<sup>2</sup> National Development Plan "Toda una Vida"

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<sup>3</sup> Development and Spatial Planning Plans

**Table 1 Development and Spatial Plans (PDOT) addressing SDGS 11 sustainable cities and communities and SDG 13 climate action**

| Development plans addressing SDG 11: Sustainable Cities and Communities   | Spatial planning objective/strategies   |   | Risk Management objectives/strategies      |   |
|---|---|---|--|---|
|   | Mejía<br>PDOT 2015-2025: Upgrading in 2016  | Latacunga<br>PDOT 2016-2028   | Mejía<br>PDOT 2015-2028: Upgrading in 2016 | Latacunga<br>PDOT 2016-2028   |
| <b>11.3</b> Inclusive and sustainable urbanization<br>11.3.1 Sustainable urbanization rates<br>11.3.2 Urban planning management   | <b>Goal:</b><br>Guarantee access to quality basic services to the population; Promote a healthy and sustainable habitat of human, urban, and rural settlements: guaranteeing the right to enjoy the city and public spaces in democracy; Urban Reinforcement and Regeneration (Cutuglagua and Tambillo)<br><b>Strategy:</b><br>Upgrading water and sewerage supply systems for all; Social-Housing projects; Public-space plan; Land use and Land management plan | <b>Goal:</b><br>Regulate informal human settlements; Improve public services to reduce NBI index; Implement Urban Structuring Plans<br><b>Strategy:</b><br>Control of human settlements in the urban-rural frontier; Investment prioritize to reduce NBI index. | N/I  | N/I   |
| <b>11.5</b> Reduce the adverse effects of natural disasters<br>11.5.1 Deaths and injuries from natural disasters<br>11.5.2 Economic losses from natural disasters   | N/I   | N/I   | N/I  | <b>Goal:</b><br>Prevent risks and recover spaces due to natural or anthropic adverse effects<br><b>Strategy:</b><br>Infrastructure and Equipment Relocation in areas outside of lahars risk |
| <b>11. A</b> Strong national and regional development planning<br>11.A.1 Urban and regional planning  | <b>Goal:</b><br>Strengthen territorial identity, through the consolidation of urban centers, to reduce pressure on agricultural and conservation areas; Set limits for urban expansion and agricultural production<br><b>Strategy;</b><br>Land use and land management plan   | N/I   | N/I  | N/I   |
| <b>11. B</b> Implement policies for inclusion, resource efficiency and disaster risk reduction<br>11.B.1 Integrated disaster risk management<br>11.B.2 Local disaster risk management   | N/I   | N/I   | N/I  | <b>Goal:</b><br>Prevent risks and recover spaces due to natural or anthropic adverse effects<br><b>Strategy:</b><br>Infrastructure and Equipment Relocation in areas outside of lahars risk |
| <b>Development plans addressing SDG 13:</b><br>- Strengthen resilience and adaptive capacity to risks related to climate and natural disasters.<br>- Incorporate climate change measures into policies, strategies and plans.<br>- Promote mechanisms to increase effective planning and management capacity in relation to climate change. | N/I   | N/I   | N/I  | N/I   |

Source: Author's own table based on UN n.y., n.p.; World Bank 2018, p.5.

## Urban risks and urban planning: Spatial Impact

To incorporate urban land within the eight parishes, Mejía applied two urban planning legal instruments (1) Ordinances in 1987 and 2006, (2) PDOT 2016, and the planning instrument Cadaster in 2018. In the case of Cutuglagua, the tendency of expansion

does not justify its increase (see Table 2). Cutuglagua morphology exemplifies how the implementation of three different urban planning tools, in addition to external factors such as the proximity to a large city as Quito, have influenced the land-use change (Jácome 2020).

**Table 2 Cutuglagua Urban Area surface changes through three different spatial planning tools according municipality legal framework**

| Urban boundary according legal ordinance (2006)(hec.) | PDOT: urban land (2016)(hec.) | Increase of urban land between 2006 and 2016 |               | Surface of urban land according cadaster (2018) (hec.) | Surface of urban land according cadaster (2018) within the current urban boundary (2006) (hec.) | Difference between cadaster and urban boundary surfaces |      |
|---|-------------------------------|--|---------------|--|---|---|------|
|   |                               | Hectares                                     | % In 10 years |  |   | Hectares  | %    |
| 814.53  | 910.54                        | 96.01  | 1.12          | 712.40   | 648.46  | 63.94   | 9.86 |

Source: Jácome 2020

Tambillo's current urban boundary was established in 1987 through an ordinance that determinates the urban area of the parish. Tambillo has a direct influence of the leading national and international

road Pan American E35, which is known as the main channel for high transport flows in the central Ecuadorian region (see Table 3).

**Table 3 Tambillo Urban Area surface changes through three different spatial planning tools according to Mejía Municipality legal framework**

| Urban boundary according legal ordinance (1987)(hec.) | PDOT: urban land (2016)(hec.) | Increase of urban land between 1987 and 2016 |      | Surface of urban land according cadaster (2018)(hec.) | Surface of urban land according cadaster within the current urban boundary (hec.) | Difference between cadaster and urban boundary surfaces |       |
|---|-------------------------------|--|------|---|---|---|-------|
|   |                               | Hectares                                     | %    |   |   | Hectares  | %     |
| 265.22  | 727.86                        | 462.64                                       | 3.54 | 310.58  | 215.48  | 95.10   | 44.13 |

Source: Jácome 2020

Latacunga's urban expansion shows a drastic increase between the years 2001 and 2016. Although by 2016, Ecuador was already implementing the new tools of planning for almost four years, the amount of land added to the urban area of Latacunga does not reflect sustainable

urban development patterns. In the same case as Cutuglagua and Tambillo, implementing a planning tool, Latacunga (see Table 4) compiled a surface of 3,417.00 hectares as an urban area (Jácome 2020). It could be estimated that in 2016 almost 40% of the plots in the urban area were empty.

**Table 4 Latacunga Urban Area surface changes through different spatial planning tools according to Latacunga Municipality legal framework**

| Urban boundary (2001) (hec.) | Urban boundary + PDOT urban land (2016) (hec.) | Increase of urban land between 2001 and 2016 |               | Urban boundary + PDOT urban land (2016) (hec.) | Urban land (2018) (hec.) | Increase of urban land between 2016 and 2018 |              |
|------------------------------|--|--|---------------|--|--------------------------|--|--------------|
|                              |  | Hectares                                     | % in 15 years |  |                          | Hectares                                     | % In 2 years |
| 1,824.51                     | 3,497.48                                       | 1,672.97                                     | 4.43          | 3,497.48                                       | 3,417.092                | -80.38                                       | 0,988        |

Source: Jácome 2020

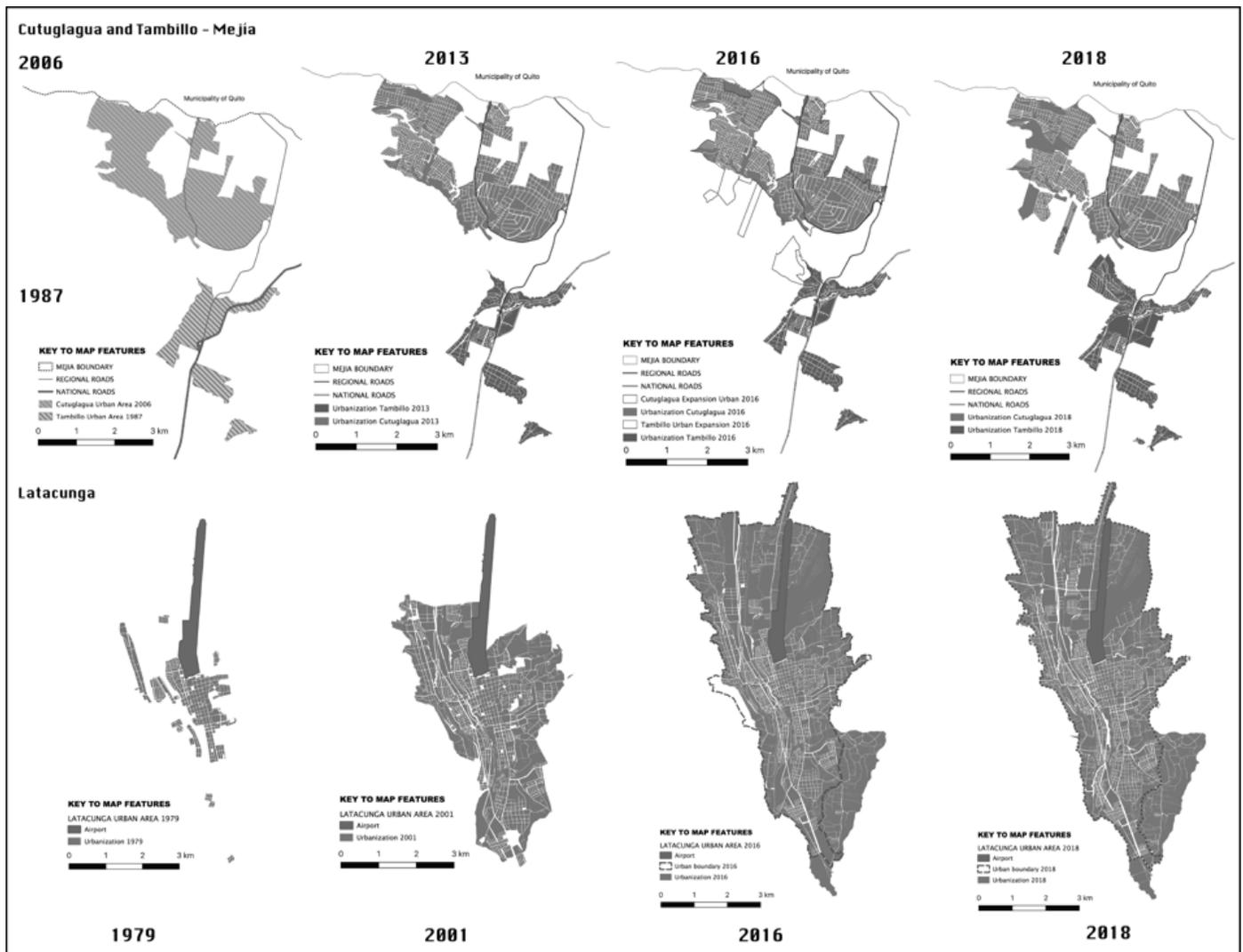


Figure 3 Urban expansion of Cutuglagua, Tambillo, and Latacunga  
Source: Jácome 2020

Around 85% of Cutuglagua's urban area, presents a range of 1 – 10 constructions per hectare, representing the category of *Expansion*. The areas near the conurbation with Quito present a range of 11 – 50 constructions per hectare, representing the category of *Consolidation* (see Figure 4). Tambillo has a predominant 58.55% of its urban area in a range of 1 - 10 constructions per hectare, representing the category of *Expansion*. 41.45% of the Tambillo urban area is in a range of 11- 50 constructions per hectare, representing the category of *Consolidation*. Unlikely to Cutuglagua and Tambillo, the inner center of Latacunga with

9.48% of its urban area presents a range superior of 51 constructions per hectare, representing the category of *Densification*. The further these areas are from the city center, the number of constructions per hectare reduces in a range of 11 – 50 being 31.95% of its urban area, representing the category of *Consolidation*. However, as well as Cutuglagua and Tambillo, the land added to the urban area of Latacunga presents the lowest number of constructions per hectare in the range of 1 -10 being 58.57%, which represents the category of *Expansion* (see Figure 4).



Figure 4 Compactness of Cutuglagua, Tambillo (left), and Latacunga (right)  
Source: Jácome 2020

**Urban risks and urban planning: limitations to overcome disasters**

Cutuglagua presents a predominance of low ranges of accessibility to basic services. The range of high and very high access to basic services is in the areas that form the conurbation with Quito. In the case of Tambillo, 90% of its territory has access to basic services. In Latacunga, it is observed that the centrality of the urban area is the one with the most significant access to basic services. However, this is reduced as it approaches the peripheries. It is observed that more than 70% of the urban area would be affected by the proximity to bodies of

water that divide the urban area. According to the updated cadaster of Mejía, 78.57% of the constructions in Cutuglagua are settled in areas considered as potentially hazardous. Taking the same indicators, the estimated scenario for Tambillo considers that its buildings do not meet the requirements issued by building codes. In the case of Latacunga, although its characteristics are visibly different from Cutuglagua and Tambillo, based on its updated cadaster, around 40% of its constructions are settled in the Cotopaxi's borders of lahar areas. Furthermore, essential services and central infrastructure will be disrupted, affecting an essential part of the province of Cotopaxi.



Figure 5 Left, Social vulnerability Cutuglagua and Tambillo Access to basic services 2010; Right, Social vulnerability Latacunga Access to basic services 2010  
 Source: Jácome 2020

Cutuglagua stands out for presenting high and very high ranges of poverty throughout its urban area. On the other hand, Tambillo, in its areas closest to the Pan-American Highway E35, has average and high poverty ranges. The highest levels of poverty occur in peripheral urban areas (see Figure 6). Specifically, in Latacunga, according to NBI 2010 data, the areas near the urban center, where the

city initially originated, have the lowest levels of poverty, which do not exceed 20% of the population. Poverty is increasing concentrically towards the peripheries, these being practically entirely poor areas.

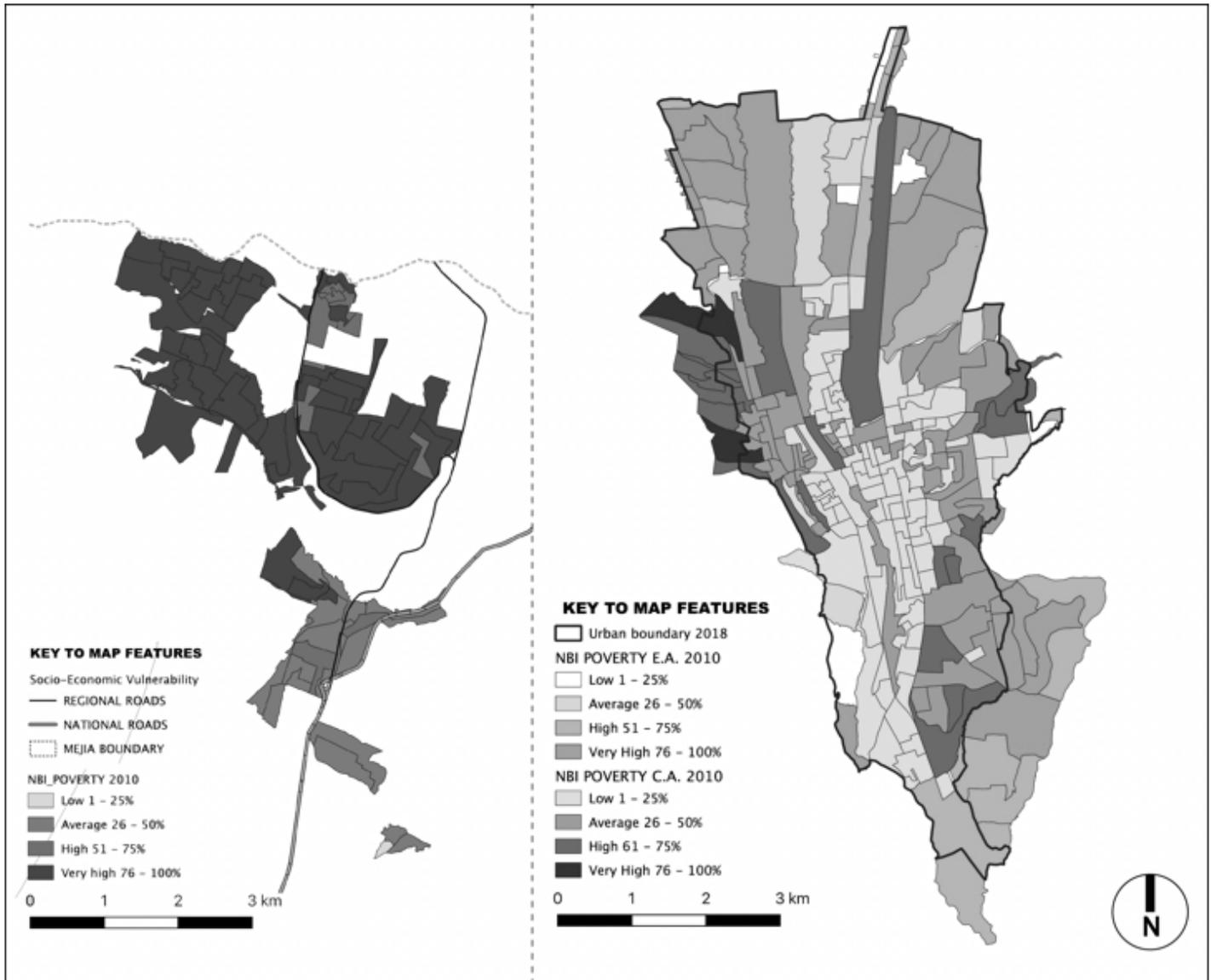


Figure 6 Left, Socio-economic vulnerability Cutuglagua and Tambillo Poverty Levels 2010; Right, Socio-economic vulnerability Latacunga Poverty Levels 2010  
Source: Jácome 2020

## DISCUSSION

In Ecuador, by 2018, 64% of the population was considered urban. The problems at the country level are replicated concerning the Latin American region. In the Ecuador's Sierra region, the urban population is 56% of the total population in the region. This indicates that it remains in the trend of being mainly urban. Furthermore, the vast majority of its urban territories are considered small cities (50% of its population not located in metropolis cities) (CITE, 2015; Fernández and Vivanco, 2017). This group of cities, however, is the one that shows a larger population growth than other cities considered medium, large, or metropolis. Its total

population growth rate at the 2010 Census was 28.5%.

After analyzing the case studies presented, an explanation could be that, when the urban development model has not been sustainable, it generates unequal urban areas with a strong presence of poverty and social vulnerability. Due to the municipalities' lack of capacity to regulate, manage, and plan the use of the land, as well as the absence of coordination between the different actors that intervene in the territory. Territory management highlights the tensions between urban and rural areas, as urbanization is a process that profoundly restructures peri-urban and rural areas,

and has positive and negative capacities that affect its economy, inclusion and sustainable development (UN Habitat 2015).

After comparing the both municipalities development plans' objectives and strategies with the SDGs 11 and 13's targets, although in 2015, SDGs were promoted worldwide, Mejía and Latacunga development plans did not include SDGs 11 and 13' targets. Taking into account the benefits of establishing common targets among cities, it was identified that factors such as sustainable urbanization or actions to reduce risk were not found in both municipalities' plans.

The persistence in the traditional model by both municipalities, based on the false conception of the existence of infinite resources, with unsustainable consumption and production patterns - reflected in the change in land use, loss of biodiversity, reduction and contamination of water sources, combined with soil erosion and desertification - it will inevitably exacerbate the multiple adverse effects of climate change. The urban expansion experienced by Cutuglagua, Tambillo, and Latacunga shows that land use policy, in which the different levels of government and civil society interact, lacks environmental management standards and measures to promote resilience and adaptation climate change. This compromises the use and access of natural resources to future generations. To all this is added alarming percentages of urban poverty, which with limited access to basic services condition the population's capacities to face and overlap events caused by the impact of climate change.

## **CONCLUSION**

Sustainable urban development and climate change have a strong causal relationship, although this is not exclusive. The disorderly growth processes of cities bring about the transformation of the natural environment and the increase in GHG emission processes that cause atmospheric and climatic variations.

Public policies on climate change are becoming more relevant in cities due to increasing urbanization processes. This leads to a multiple understanding of cities: as the main territorial areas of development, with their highly dependent energy systems and external resources, but which also contribute definitively to the generation of greenhouse gases. Additionally, their populations

are increasingly affected by climate change impacts; however, decision-makers generally have great difficulties in understanding and responding effectively to complex problems (UN 2016, p.13). Thus, city planning itself influences the felt effects of climate change. The urban area's growth puts pressure on the provision of services, energy, water, sanitation, and others.

Another important impact of urban expansion is the aspect of greenhouse gas generation issues related to deforestation for expanding the agricultural frontier. Among the effects of poor management of the plans in the territory, the following were identified:

- Lack of essential data for decision-making and to generate historical sources of information;
- A weak comprehensive vision of the territory and its planning;
- Confusions and conceptual errors that translate into diagnoses deviating from reality, inadequate implementation of tools, in the ineffectiveness of measures and plans applied.

Thus, the future of territories strongly depends on the mitigation and adaptation activities carried out in urban areas to manage climate change effects. For this, coordinated action is essential to reduce the vulnerability of natural and social systems and improve capacities to reduce disaster risk in cities.

## **ACKNOWLEDGEMENTS**

To the different stakeholders, practitioners, and representatives of government institutions in my country, who shared with me their valuable time and knowledge, thank you! Your work and willingness to make a positive change in our country have inspired me to the core. I hope this research can contribute to the complexity of urban planning, climate change impacts, and risk management realities of Mejía and Latacunga.

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