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**PERI-URBANIZATION AND LAND
MANAGEMENT SUSTAINABILITY IN
PERUVIAN CITIES.**

***PÉRI-URBANISATION ET GESTION DURABLE
DU TERRITOIRE DANS LES VILLES
PÉRUVIENNES.***

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Abbreviations

CEC	Commission of the European Communities
CIAC-PUCP	Centro de Investigación de la Arquitectura y la Ciudad de la Pontificia Universidad Católica del Perú / Research Center of Architecture and the City of the Pontifical Catholic University of Peru
CODEPACMA	Committee for the Defense of the Cultural and Natural Heritage of Mangamarca
GRC	Gobierno Regional de Cajamarca / Regional Government of Cajamarca
IGN	Instituto Geográfico Nacional / National Geographic Institute (Peru)
IMP-MML	Instituto Metropolitano de Planificación de la Municipalidad Metropolitana de Lima / Metropolitan Planning Institute of the Municipality of Lima
INEI	Instituto Nacional de Estadística e Informática / National Institute of Statistics and Informatics (Peru)
MDP	Metropolitan Development Plan
METI	Ministry of Economy, Trade and Industry (Japan)
MML	Municipalidad Metropolitana de Lima / Metropolitan Municipality of Lima
MPC	Municipalidad Provincial de Cajamarca / Provincial Municipality of Cajamarca
MPSC	Municipalidad Provincial de Sánchez Carrión / Provincial Municipality of Sánchez Carrión
NASA	National Aeronautics and Space Administration (United States)
NDVI	Normalized Difference Vegetation Index
PDP	Peri-urban Development Plan
PUCP	Pontificia Universidad Católica Del Perú / Pontifical Catholic University of Peru
RPP	Radio Programas del Perú / Radio Programs of Peru
SAN	Servicio Aerofotográfico Nacional / National Aerophotographic Service (Peru)
SERFOR	Servicio Forestal y de Fauna Silvestre / Forest and Wildlife Service (Peru)
SPOT	Satellite Pour l'Observation de la Terre / Satellite for Earth Observation
SUP	Specific Urban Plan
UDIP	Urban Development Improvement Plan
UDP	Urban Development Plan
UN	United Nations
UNFPA	United Nations Population Fund
UN-HABITAT	United Nations Human Settlements Programme
ZM	Zoning Map

Introduction

Urban growth is faster in least developed countries where economic and institutional limitations restrict local governments to manage it properly. This kind of uncontrolled urban growth is related to several socio-environmental problems in developing countries like Peru. The increased demand of urban land can produce urban encroachment in non-developable areas like prime farmland or fragile ecosystems and it may produce disordered and unsafe urban settlements. Therefore, it is a challenge for sustainable development objectives.

Certainly, the urban fringe presents an enhanced land-use conflict which makes it a place of interest to geographers (Clark 2002). However, these areas should not be reduced as only the periphery of the city as they present their own dynamics (Peyrache-Gadeau & Fleury 2005). At the same time, it is crucial to improve the planning and land management in these areas, as there will be the future of the city (Guézéré 2013).

It is interesting to note that globalization could be seen as a complex driver of change in the urban fringe, not only due to the diffusion of urban low-density lifestyles and the neoliberal permissive regulation of land market, but also because global investments in small villages can force a rapid urbanization process. Under these circumstances, globalization threatens the sustainability of the peri-urban territory.

In addition, most studies on urban sprawl focus on industrialized countries. However, cities in developing countries present different priorities as well as different resources and ways of governance than developed countries. Therefore specific studies and different policy responses are required for developing countries (Angel et al. 2005). In this regard, this research seeks to contribute to the discussion of the possibilities of urban sustainability in the Global South. As reported by Denise Pumain, the worldwide process of urban expansion is linked with the globalization of economic and cultural standards, but at the same time, urban systems evolve in a different manner corresponding to different urban traditions (Pumain 2004). With this in mind, it is worth studying the urban expansion in a national context.

Therefore, it is necessary to assess the extent to which local strategies or practices related to urban expansion contribute or not to sustainable land management. This with the purpose of orienting new urban areas in safe and compact zones without affecting areas of ecological value. Following this approach, the central research question arises: which are the strengths and weaknesses of the strategies of stakeholders in the management of urban expansion from a sustainable perspective? By stakeholders' strategies we refer to the urban plans and public management as well as common practices of land appropriation and establishment of urban areas in the urban fringe.

The hypothesis is that in the case studies, the recent urban expansion in non-developable areas due to socioecological value is predominantly informal, disorganized and diffuse. This unsustainable process would be the result of serious deficiencies in local public management, as well as the local unconcern in their environment. However, some communal organizations and social leaders contribute to a more sustainable land-use.

The information obtained from this research will allow the development of proposals based on local experiences to contribute to sustainable land management of the peri-urban territory. In order to achieve this, this study combines three dimensions of analysis: spatial analysis, social behavior analysis, and the evaluation of urban management and spatial planning. This research includes the conduction of surveys and interviews that were the main and primary sources of data used in this research. Moreover, to point out the challenges faced by sustainable land-use, the study focuses on three Peruvian cases of urban expansion in non-developable areas due to socio-ecological and risk conditions. These cases correspond to the urban encroachment in: a seasonal fog-oasis in the arid city of Lima; the prime farmlands in Cajamarca valley; and the wetlands of the small city of Huamachuco. These locations correspond to places with different characteristics in cities of different size with the aim of recognizing common problems of the urbanization process in Peru.

The study is organized in four chapters. The first chapter presents the framework of the research problem, including the global trends of urban growth, the conceptual framework, the key problems of unsustainable land-use changes in the urban fringe, and the procedures proposed to address the research question. The second chapter reviews the Peruvian urban structure to contextualize the location of the case studies and describes the urban expansion process in the last three decades in each case study with a special focus on the spatial analysis and identifying the main similarities of the urban dynamics among them. Later, it is examined the community relation with natural and agricultural areas in the urban fringe by the local perception to help comprehend the decision making and the conservation community actions. Finally, the last chapter presents the main challenges for sustainable land management by describing the deficiencies found on urban planning and management, the opinion on housing density, the widespread infringement of urban law, and the estimation of long-term possible consequences of urban expansion in the case studies.

CHAPTER 1:

Urban expansion as a sustainability problem

The study subject is part of a global problem that challenges sustainable development in several ways. In particular, in developing countries like Peru due to the rapid growth and socioeconomic conditions. This chapter aims to present the framework of the research problem and describe the methodology proposed to address the research question. This chapter is divided in four parts: the global trends of urban growth, the conceptual framework, the key problems of unsustainable land-use changes in the urban fringe and the research design.

1.1. Global trends of urban growth

For a better understanding of the problem, this section synthesizes the present global situation of urban growth and urban expansion rates; the projections to the future; and the policy implications of these trends.

As reported by the *World cities report 2016*, 54% of the world's population lives in urban areas, and the urban growth rates in the past two decades have been larger in the least developed parts of the world (United Nations Human Settlements Programme - UN-HABITAT 2016). Notably, urban population has been concentrated in the developed world, at the temperate zone of the northern hemisphere. However, the recent intensification of urbanization is located in the developing world, towards the tropics and sub-tropics (McDonald et al. 2013). Latin America has an intermediate speed of urban growth compared to other regions, with an average annual rate of change of the urban population of 1.74% in the period 1995-2015 (UN-HABITAT 2016).

It should be noted that some researchers criticize the consistency of global urbanization degree and speed, since the data is based on the metrics of urban population provided by national statistics institutes under different criteria (Fragkias et al. 2013, Cohen 2006, Hardoy & Satterthwaite 1986). The main methodological limitation is the absence of a global definition of urban environments. The most common attribute used to classify a settlement as urban is the minimum population size, but the limit value varies from hundreds to tens of thousands. For example, in Peru, 72% of population is urban, considering the inhabitants of settlements with more than 100 dwellings (Instituto Nacional de Estadística e Informática - INEI 2007). However, if the Peruvian government were to apply the same criteria as the Turkish government, where urban settlements have more than 20,000 inhabitants, then the urban population would be only 58% of the total population.

Furthermore, the rural/urban distinction could result impractical over time because “urban functions are being spread over larger and larger geographic areas so that the traditional distinction between urban and rural areas is becoming increasingly redundant for many purposes” (Cohen 2006: 78). In this context, Brenner and Schmid propose a new epistemological framework of the urban, in which the urban should be understood as a process not a bounded unit (Brenner & Schmid 2015).

Regarding population by settlement size, the majority of urban population resides in settlements of less than 500,000 inhabitants. Moreover, all categories show positive growth rates. Considering only cities larger than 500,000 inhabitants, the fastest growing cities between 2000 and 2014 are in the class of 1 to 5 million inhabitants, which total population doubled between 1990 and 2014. Whereas the lowest rates are found in megacities, with a population of more than 10 million. Asia concentrates the largest cities and has the highest growth rates; while, Latin America have in average lower rates, of around 1 to 3% for all classes, and less than 2% in megacities (United Nations - UN 2014; see Figure 1).

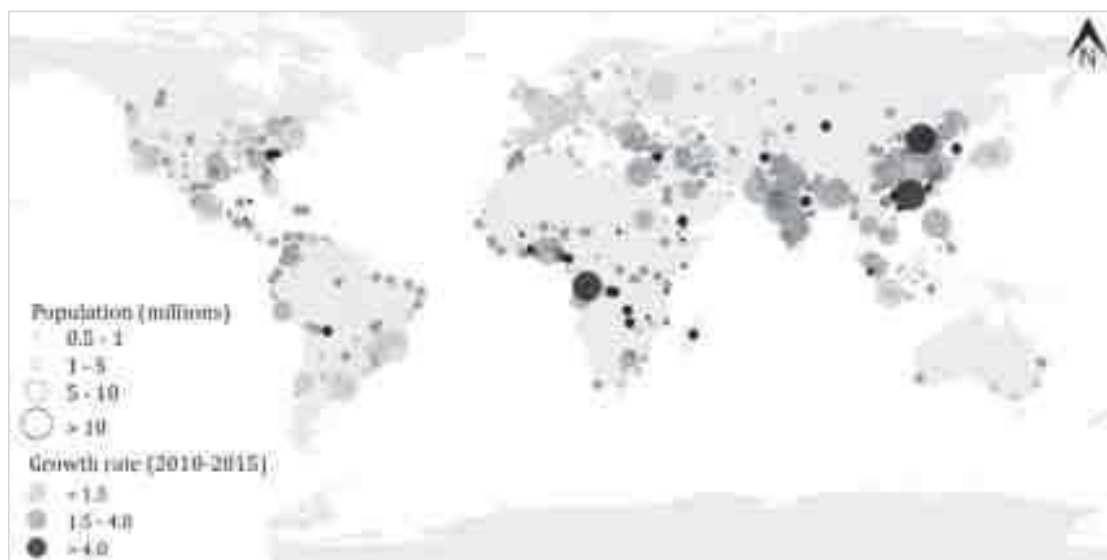


Figure 1: Map of cities' population and growth rates

Prepared by P. Moschella. Source: UN 2014.

Focusing on global trends of cities physical expansion, there are studies of spatial analysis of a sample of cities, showing that new urban areas have a lower density than before in all regions (Seto et al. 2013, Angel et al. 2011). In fact, the urban areas increase at a higher rate than the urban population, with an average growth rate of 28% against 17%, respectively (UN-HABITAT 2016). This leads to dispersed patterns of urbanization, including suburbanization and peri-urbanization (UN-HABITAT 2016).

Karen Seto et al. affirm that, from 1970 to 2000, the highest rates of urban land increase belong to India, China, and Africa; followed by Central and South America; while the vastest urban development occurred in North America. Moreover, this rate is higher in coastal zones worldwide. Additionally, urban land expansion has similar rates far or near to protected areas. (Seto et al. 2011)

Furthermore, Angel et al. (2005) describe the shape of built-up areas by a sample of cities. The results show that, between 1990 and 2000, industrialized countries and high-income cities have a larger decrease in the compactness index and the highest increase in the contiguity index. This means that the built-up area in these cities has become more elongated and continuous; moreover, the magnitude of this variation may be related to urban policies. For both indexes, Latin America has the highest values, and shows little change in the studied years (Angel et al. 2005). In conclusion, the cities in the region are characterized by rounded shapes and continuous built-up areas.

The main causes that explain urban land expansion are urban population growth and gross domestic product growth. However, there are other factors like international capital flows, informal economies, incomes, land use policies, and transportation costs (Seto et al. 2011, Fragkias et al. 2013). In China and Europe, the main driver of urban expansion is gross domestic product growth; in India and Africa, it is mainly driven by population increase (Seto et al. 2011). Similarly, in Latin America, urban population growth is considered the main cause for urban expansion. In this region, natural growth rate is becoming more significant than rural-urban migration to explain population rise (Carrión 2001).

Looking to the future, the projections indicate that total urban land existing in 2000 will double by 2030; therefore, urbanization rates are having an unprecedented magnitude (Fragkias et al. 2013). Likewise, the forecasts suggest that the growth of urbanization in the coming decades will be primarily in the developing countries (United Nations Department of Economic and Social Affairs 2014, Seto et al. 2013, Fragkias et al. 2013). In fact, in developing countries between 2000 and 2030, it is expected that the urban population will double and urban land extension will triple (Angel et al. 2011, UN-HABITAT 2016). Consequently, the average density of built-up areas is constantly declining.

In Latin America urban expansion is expected to have lower growth rates because it is an already highly urbanized region (Seto et al. 2011). Additionally, some authors consider Latin America as the most urbanized region holding the largest social and economic inequalities (Pauchard & Barbosa 2013). This shows up in extremely different urbanization schemes along the region.

Concerning urban settlements by size, it is expected that small cities and towns of less than 500,000 habitants will concentrate 45% of urban population and a total population of more than

2 billion by 2030. As dwellers in cities of 1 to 5 million, will increase from 827 million to 1.1 billion, between 2014 and 2030 (UN 2014; see Figure 2).

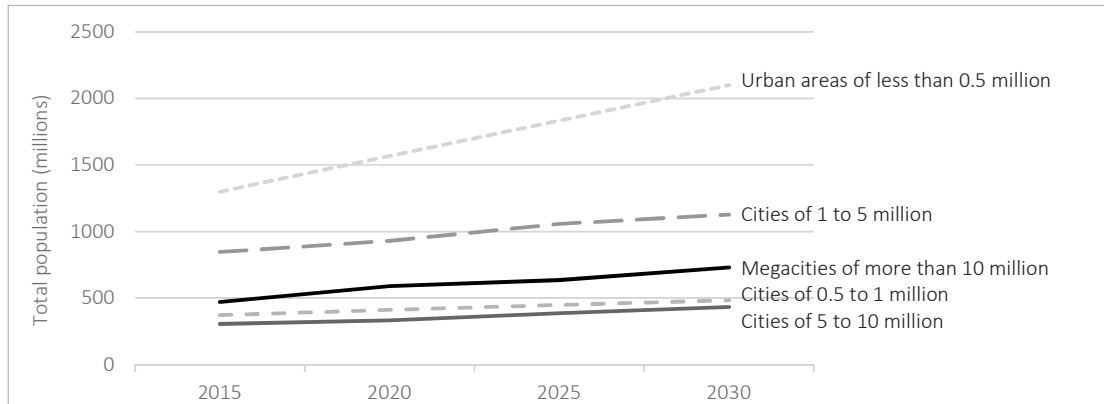


Figure 2: World population projections by settlement size

Prepared by P. Moschella. Source: UN 2014.

Regarding urban density, the study of a sample of 120 cities by Angel et al. (2011) confirms that socio-economic inequalities influence in lower densities. Other factors related to lower densities are (Angel et al. 2011):

- Higher incomes
- Higher income inequality
- Smaller cities
- Existence of extensive arable lands
- Less geographical constraints to urban expansion

The same authors indicate that cities in developing countries are more compact with an average built-up area density in 2000 of 136 inhabitants per hectare, against 67 inhabitants per hectare in cities in Europe and Japan. Even though, developing countries have a faster density decline. The main factors related to faster density decline are: faster income growth, slower population growth and higher initial densities (Angel et al. 2011).¹

In terms of detailed location of new urban areas, different studies demonstrate that rural-urban land change occurs at higher rates in peri-urban arable land and in areas with higher road infrastructure (Cano et al. 2017, Lee et al. 2015, Shi et al. 2012, Aguejdad & Hubert-Moy 2016). Evidencing that accessibility is a very significant aspect defining the land use changes.

Seeing these tendencies of urban growth, it is important to identify the main possibilities and challenges that these changes imply. In general, Cohen identifies a contradiction between the image of urbanization in theoretical debate and the widespread viewpoint. Since, urbanization's

¹ For these measures, Angel et al. (2011) considered the built-up area of the city as the impervious surface within the administrative area of the city, it was calculated in a sample of cities by satellite images with a resolution of 30-meter pixel. These results were similar to those found in all cities of more than 100,000 inhabitants with a less precise resolution of 463-meter pixel, where the average densities were 50 p./ha in Europe and Japan and 129 p./ha in developing countries.

debate mainly considers urban growth as a problem, conversely, it is widely considered as an indicator of success related with industrialization and economic growth (Cohen 2006).

However, Ananya Roy point out that the positive view of large metropolis is restrained to developed countries. The author justifies her point of view explaining that *global cities* are perceived as commanding the world economy while the story is quite different for the *megacities* in the Global South. The concept of megacity is considered as a “subaltern” of urban studies in the dominant narratives, due to their problems of underdevelopment. So the author proposes recognition of the differences and possibilities by emergent analysis strategies from the urbanism of the Global South (Roy 2011).

Given the persistent population growth, it could be considered as a positive matter that this increase concentrates in urban areas facilitating access to diverse opportunities and possibly with a smaller individual ecological footprint than with a rural settlement pattern.

On the negative side, urban growth will occur mainly in least developed countries where economic and institutional limitations will restrict local governments to manage rapid urbanization and orient development in a more sustainable and inclusive manner. In this regard, Linn (1982) considers that rapid urbanization generates a high load for governments and could explain the increasing foreign debt in developing countries. In a similar way, Cohen affirms that “managing urban growth has become one of the most important challenges of the 21st Century” (Cohen 2006: 78). Additionally, considering that urban governance is getting recently bigger importance at the local level, there is an “urgent need to build and support the capacity of local governments to manage the environmental and social service problems that accompany rapid urban growth” (Cohen 2006: 78).

Moreover, the predominance of low density urban growth involves higher environmental impacts and an inefficient land use that threatens agricultural land and ecosystems. Usually, these patterns leave aside the importance of protecting natural or semi-natural areas for its ecological, educational and recreational values, among other advantages augmented by its proximity to cities. These topics will be discussed with more detail in the section 1.3.2.

Another key point is city’s size. Megacities could have a growth limit as some disadvantages appear for new inhabitants; such as traffic jams, insecurity, distance costs, lack of employment and difficult access to services. While medium-size cities still offer more advantages than disadvantages, but they denote bigger challenges to urban planners due to cities great diversity (Bazant 2010).

To address these urban problems, it is important the role of spatial planning instruments, which is oriented towards sustainable and concerted development, considering the characteristics, strengths and limitations of the territory and its spatial distribution process. In that sense, it is also important that planning be oriented to the development of more compact cities with high population density to reduce the need to travel long distances and avoiding the urban encroachment on natural areas. So, it is important to consider that the growth of the urban population is inevitable and to address the problems of peripheral urbanization, it is necessary to plan the expansion of urban areas with high population density and in appropriate locations where environmental impacts are lower. Although, even with urban planning, the urban growth

problems in developing countries may persist due to the “laissez-faire” triumph, the inefficient strategies, the lack of rules application, and the delay of planned inversions (Di Méo 1991).

Given this situation, it is necessary to assess how the peripheral territory is managed in our cities. Since this approach, the central research question arises: which are the strengths and weaknesses of the strategies of stakeholders in the management of urban expansion?

1.2. Urban growth conceptual framework

The present study focuses in urban growth as a process showed in the physical expansion of urban areas. The distinction between forms of urban growth is complicated, as they make reference to complex dynamics that occur with different intensity in a continuous space. Moreover, the terminology to designate this processes and forms may vary in different regions and languages. Hence, this section aims to expose and clarify the main concepts that will be used in the study.

First of all, it is important to consider that urban areas are classified by differences of degree not type, so “urban is not a natural, distinctive type of place, merely a convenient label (...) that reflects social and academic perception and therefore forms a meaningful theme of inquiry” (Hall 1998: 18).

Given this, **urban growth** is a concept used, primarily, in a demographic and physical or spatial sense. Specially, it refers to the absolute or relative increase of urban population (United Nations Population Fund - UNFPA 2007). In a similar way, it also denotes the expansion of cities and towns (George & Verger 2013). But its meaning could be enlarged to refer to all the subsequent qualitative changes. French geographer, Pierre George, described urban growth as the concentration of population and all its consequences, including new forms of use of space and new socio-economic changes (George 1971).²

To emphasize the analysis of urban growth as a process is more used the term **urbanization** or *urbanisation* in British English. It has been defined as the increase of urban population ratio (UNFPA 2007), implying a rural to urban demographical transition, mainly measured in a national or regional level. Another connotation, less frequently used in English but present in French (*urbanisation*) and Spanish (*urbanización*) literature, is urbanization as the process of spatial expansion of cities and urban areas.

In a wider sense, George & Verger (2013) has defined urbanization as the process of urban development in population size and spatial extension, and also in lifestyle. This definition includes a qualitative approach, concerning changes in the way of life from rural to urban activities. Likewise, Pacione emphasize that economic forces are the dominant influence on urban change and mentions that urbanization “occurs when cities grow at the cost of their surrounding countryside” (2006: 12). Therefore, urbanization can be understood as the transformation of the socio-economic structure. Moreover, from a political economy perspective, urbanization is considered as the expansion of capitalism and its impacts on urban systems (Pacione 2005). Furthermore, Brenner & Schmid (2015) propose a conceptualization of urbanization that doesn't depend exclusively on city growth, involving “the abandonment of several major sociological, demographic, economic or cultural definitions of urbanization” (2015: 169).

² La croissance urbaine « c'est d'abord concentration numérique de population ; c'est aussi tout l'ensemble des conséquences résultant de cette concentration numérique, des formes nouvelles d'occupation de l'espace, des formes nouvelles de rapports économiques et sociaux, c'est-à-dire un ensemble de mutations qualitatives. » (George 1971, p. 381-382)

To sum up, urbanization could be defined from quantitative and qualitative approaches in several perspectives: demographical, spatial, physical, social, economic or political. Among them, geographers are particularly concerned in urbanization as a spatial process (Haggett 1994). In a similar way, the present study analyses urbanization as the process of spatial expansion of cities; however, to avoid confusion, the term “urban expansion” will be preferably used to refer to this process.

The urban expansion pressure is located in a zone commonly referred as the **urban fringe**, whose limits are diffuse and transforming. This fringe is a transition zone between the city and the countryside, with a mix of urban and rural land-use and activities (Johnson 1974), but with its own characteristics and problems (Clark 2002). Besides, the urban fringe could differ between regions, time and city’s size (Thomas 1974).

As has been noted, urbanization focuses in rural to urban land use change, as prevalent land-cover change. However, urban expansion can also occur in uninhabited or non-rural areas. Hence, from a different perspective, urbanization also refers to substitution of natural ecosystems by high density built-up centers (Surtees 1971 cited by Sukopp & Werner 1991).

In a general scheme, urban expansion occurs in a series of concentric rings surrounding the consolidated urban area. These rings consist in a succession of phases of urban development, starting with acquisition of land for urban purposes, following the modification and initiation of urban use, and later, the integration of this land to the main urban area (Burgess 1979, Whitehand 1974). Therefore, urban expansion is a permanent process in the borders of cities that starts in scattered or dispersed forms and increases the building density over time until becoming part of the continuous built-up area (Bazant 2008).

Coinciding with Von Thünen spatial model and Burgess’ urban structure model (for a review of these models see Haggett 1994, Pacione 2005), the city center presents the higher land value and higher density of building and population, following this area there is a continuous decrease of land value and densities. Given this, the urban fringe is characterized by an increase in land value while more intensive land-use replace the previous, therefore it presents an enhanced land-use conflict which made it a place of interest to geographers (Clark 2002). With this in mind, the study focuses in the urban fringe, and urban expansion as the progressive agglomeration of built-up areas in this changing and challenging zone.

The main urban expansion processes described in literature are: suburbanization, periurbanization, rururbanization and urban sprawl. All of them are mainly defined from the situation in land-rich developed countries, where urban growth patterns have dependency on the use of private car, differing from the situation in developing countries where population owing a private car is reduced. There are scarce studies about the shapes of urban expansion in Latin American cities (UN-HABITAT 2012) and the mentioned types of urban expansion have little probability to be found in the case studies, but it is useful to identify them for comparison reasons.

Suburbanization is used to designate low density residential land-use increase in the first ring surrounding the central area of the city (UNFPA 2007). It is related to the search of comfort in high income countries and the technological improvements that decreased the transport and communication costs (UN-HABITAT 2002, Capel 2003). Suburbs have dependency on low-cost fossil energy, private car ownership and public investment in infrastructure (UN-HABITAT 2015).

As reported by Bauer & Roux (1976), the suburbs (*banlieues*) are like an enlargement of the city center in a phase to complete the fulfillment of surrounding space while achieving gradually genuine urban characteristics as the central areas of the city.³

The term **periurbanization** or peripheral urbanization denotes the urban expansion in the periphery of cities involving different degrees of urbanization (George & Verger 2013). Periurbanization make reference to the second and, in some cases, also the third ring following the suburban areas (George & Verger 2013). Periurban space is in course of urbanization, so land subdivisions are multiplied (George & Verger 2013) and farmland remains as an interstitial tissue (Couyaud 1973).

Whereas, other authors define periurbanization as the urban expansion in developing countries characterized by disorder, high-densities and mix of uses (Barsky 2005, UNFPA 2007). As a consequence of rural migration and rapid population growth, periurbanization creates informal urban areas without infrastructure and services planning where majority of urban poor inhabits live (Dourojeanni 1999, Rogers 2000). Under these circumstances, a key point to study is the different sequences of urban development main activities, which are: land subdivision, road and basic services infrastructure, and housing construction. The possible sequences of these activities have been classified by Pujadas & Font (1998) in three main groups: planned urban growth, partially planned urban growth with inadequate infrastructure, and informal constructions without planning.

Concerning the term **rurbanization**, it reflects the increase of people moving from cities to rural areas but maintaining a strong bond with the city mainly due to employment. It corresponds to a third ring, where houses and villages are similar with the surrounding landscape in an imbrication with rural areas (Bauer & Roux 1976, Bazant 2010, George & Verger 2013). But this phenomenon doesn't reduce socio-economic differences, because it only consumes the rural space while consuming services and goods in the city. Therefore, it could be considered as a social urbanization more than a physical concentration (Bauer & Roux 1976).

Another concept that describes urban expansion trends is **urban sprawl**. However, there is little agreement on the definition and characteristics of urban sprawl. The main common characteristics of urban sprawl definitions are: lower residential and employment densities than in suburbs, segregated land uses, high level of automobile usage, and alternation with undeveloped land (Johnson 2001). Angel et al. (2011) consider that the consensus in sprawl key manifestations also includes: unclear boundaries between city and countryside, polycentric urban structure and fragmented open space. These features characterize urban expansion everywhere (Angel et al. 2011) but are the prevailing in the North American urban form, with also the spreading of employment and amenities (Glaeser et al. 2004, Merlin 1973).

Since XIX century, all these expansion processes produce the *dispersed city* with predominance of individual houses and low densities, as a result of transportation and communication costs

³ «Les banlieues se sont constituées jusqu'à présent en contiguïté totale avec la ville mère, dont elles apparaissent comme le prolongement spatial ; les habitants des quartiers neufs sont alors, d'une certaine façon, des « sous-citadins », attendant le remplissage de l'espace environnant qui donnera peu à peu à leur cadre de vie la dimension vraiment citadine qu'ont les quartiers plus anciens » (Bauer et Roux 1976 : 13)

decreases (Capel 2003). The preponderant urban form has been outlined as unstructured (Merlin 1973), disseminated in space (Bauer et Roux 1976), dispersed and polycentric (Capel 2003); and also, in many cases, fragmented due to privatization of urban space (Bahr & Borsdorf 2005).

1.3. Unsustainable land-use changes in the urban fringe

This section reviews key concepts and problems to understand the challenge of land-use sustainability in the urban fringe. First, concepts related to urban sustainability are detailed like sustainable development and sustainable city. Second, it is explained the main sustainability or environmental issues related to inappropriate land-use in urban expansion. It includes, low density urban expansion and urban expansion on areas with high ecological or agricultural value.

1.3.1. Urban sustainability

Since 1970, urban population growth started to be discussed as an environmental problem (Newman 2006). Nowadays, urban sustainability is considered one of the main streams in global urban discussion focusing on the significant role of cities in the global environmental crisis (Brenner & Schmid 2015). On the positive side, cities are drivers of development; but on the negative side, urban expansion could be unsustainable when due to its speed and lack of planning it causes environmental degradation and unsatisfactory access to basic services (UN 2014). Urban sustainability is a wide and multidimensional concept (Rogers 2000, Stadel 2000); with this in mind, the study focus in conditions related to sustainable land-use.

In general, urban sustainability reflects the notion of sustainable development in urban areas. Sustainable development has been defined as development that satisfies present needs without comprising future generations' capacity to satisfy their own needs (Brundtland 1987). Thus, sustainability involves maintaining the conditions that will allow the development of future population, to achieve it, three pillars has been pointed out: society, economy and environment. These pillars should be understood in their different nature: improvement of the population's quality of life is the objective of development, environment imposes the conditions and restrictions, while economy consist in the means to achieve the development objective (Ghorra-Gobin 2012).

Two main perspectives could be highlighted among the diverse definitions of urban sustainability: the technological and the socio-ecological (Hamman 2017). The prevailing perspective is the technological view, which focuses in innovative technology that reduces environmental impacts and facilitates economic growth (Brenner & Schmid 2015, Gudynas 2009). Whereas, the socio-ecological view is considered a deeper urban sustainability viewpoint because it breaks the dependence of economic growth to center in quality of life (Gudynas 2009). From this perspective, the term sustainability, instead of sustainable development, suits better to emphasize the reference to a stable condition and not to a continuing process that is commonly confused with growth as an objective (Hamman 2017).

The Brundtland report and the Earth Summit in 1992 encouraged the discussion about environment, including urban environmental problems (Jenks & Burgess 2000). After these events, human development got linked to sustainable development due to the fact that life depends on the environment and natural resources to ensure the prosperity of societies

(Gutiérrez & Sánchez 2008, Barrantes 1993). Currently, this perspective is illustrated in the Sustainable Development Goals established in the 2030 Agenda for Sustainable Development (UN 2015), which demonstrates a multidimensional view of sustainable development with human development in the center. In this regard, the goal n°11 is the focus in urban environments and said « *Make cities and human settlements inclusive, safe, resilient and sustainable* » (UN 2015).

The manifestation of urban sustainability could be reflected in the notion of sustainable city and its attributes. It is important to notice that the concepts of city and nature had been considered as opposites for a long time, but they aren't anymore a strict dichotomy as described by Sukopp & Werner (1991). The concept of sustainable city is very dynamic, as Hamman mentions, it is a transitional concept positioning over time in the dialectic between adaptation and rupture; and it is also a transactional concept, which denotes the result of negotiation of compromises between stakeholders (Hamman 2017).

Rogers defines the sustainable city as a dynamic and complex organism, characterized spatially by its compactness and polycentrism, as well as for reduced environmental impacts (Rogers 2000). Furthermore, from a deep sustainability viewpoint, the sustainable city requires reformulating current development model, focusing in quality of life instead of economic growth, and it is fundamental to face social, economic and political processes that produce the city (Gudynas 2009).

The statistical and lexical analyses of literature highlight that the discussion of sustainable city centers in the following main models: recyclable city, compact city, green city, just city and participatory city (Hamman 2017). In relation with urban expansion, the most significant discussion is the compact city model contrasted with the diffuse city. The lack of consensus is because compactness is appreciated as a more efficient use of space and resources, but residential preferences are predominantly pursuing greener and disperse urban areas (Hamman 2017). This debate between diffuse and compact city is considered a common dichotomy in urban development, which will be reviewed with more detail in the next section.

In brief, it has been outlined that sustainability in the urbanization process needs to integrate the city and its rural surrounding involving environmental, social, economic, political and institutional aspects (UN-HABITAT 2002, Andrade & Bermúdez 2010). In the same way, the sustainability approach implies recognizing the city as part of a dynamic system linked with its surroundings, so it is important to protect singular natural areas that offer ecosystem services to the citizens (Millennium Ecosystem Assessment 2005). In addition, some authors consider that in political ecology the debate of urban sustainability should trespass city limits and analyze peri-urban dynamics to expand to a necessary debate of urbanization, rather than only of urban areas. (Zoomers et al. 2017, Angelo & Wachsmuth 2015).

Specifically, in relation to urban expansion, the targets of the 2030 Agenda for Sustainable Development highlight it is important to enhance planning and management capacities, protect natural heritage, reduce disasters, reduce per capita land consumption and guarantee access to housing and green public spaces (UN 2015). Thus, urban sustainability requires an efficient land-use management oriented to more compact cities but with green public spaces and avoiding the use of inappropriate areas for urban developments (UNFPA 2007, Bazant 2010).

In addition, the New Urban Agenda specifies that the promotion of a sustainable land-use implies the compactness of urban extensions and the prevention of “unnecessary land-use change and the loss of productive land and fragile and important ecosystems” (UN 2016 p. 69). Although the containment paradigm has been questioned for being unsuccessful in developing countries (Angel et al. 2011).

Finally, urban growth increases the pressure on the environment in different ways: land use, resources demand and ecosystems capacity to assimilate contaminated emissions. Concerning land use change, it could be considered as unsustainable when it occurs on high valued ecological or productive land, or on risk areas. Then, as urban population increases it is necessary to plan urban extensions with high population density and in appropriate locations where environmental impacts are lower. Given this, sustainable urban planning should consider the city and its surrounding area as a whole system (Andrade & Bermúdez 2010), and integrate different levels and organizations to define and coordinate land-use management strategies (González 2002, Carrillo 2002).

1.3.2. Environmental problems of low density urban development

Urban growth is related to several socio-environmental problems, but the predominance of low density urban growth involves higher environmental impacts and an inefficient land use that threatens other land uses or land covers. For these reasons, urban sprawl produces elevated social, economic and environmental costs (Capel 2003, Rogers 2000).

Although, some authors identify benefits of low density settlements. As reported by Glaeser et al. (2004), sprawl benefit quality of life, as it is related to large houses and short travel times. Moreover, urban sprawl has been considered as having a technical advantage for medium and long-term planning because scattered urban tissue allows future modifications, like installing public facilities, large infrastructure, or employment and services centers (Bauer et Roux 1976). Also, it is thought that sprawl allows higher rates of home ownership; and many of the negative consequences of sprawl can be ameliorated without varying its density by technology, planning and taxes (Angel et al. 2005).

Based on the literature review (Johnson 2001, Linn 1982, Bazant 2010, Rogers 2000, Capel 2003, Hardoy et al. 2001, Seto et al. 2013, Angel et al. 2005), the main socio-environmental impacts of low density urban extensions are the following:

a. Higher land consumption

Low density urban settlements require more space and produce a higher pressure for land, thus generating potential conflicts with non-urban activities and other land-covers. Also, this pattern is commonly related with unplanned developments that threaten valuable farmland and fragile ecosystems. In this regard, Bazant (2008) sustains that there are not efficient barriers for urban development not even high slopes, flooding areas, collapsible soils, farmland or ecological conservation areas. For these reasons, the loss of land with high ecological or agricultural value is considered a negative effect of low density urban expansion. Even, the land cover change to urban

use is considered “one of the most irreversible human impacts on the global biosphere” (Seto et al. 2011: 1). A more detailed description of the environmental impacts of urban expansion in inappropriate areas will be presented afterwards, due to its significance for the study.

b. Increased energy and resources consumption

Urban population growth already implies an incremental use of energy and resources, but specifically, low density settlements require an increased amount of energy and materials for construction and maintenance. In addition, the predominant construction materials in Peru have large ecological footprints. The production of cement, iron and steel concentrate the industrial energy consumption (Ministerio del Ambiente 2016) and the production of bricks uses clay from the scarce agricultural soils. Technology may increase the energy and resources efficiency by building, but at metropolitan scale, the technological improvements are not enough (Seto et al. 2013). Also, more energy consumption is needed for transportation across longer distances and corresponds mainly to private cars.

Furthermore, low density urban patterns have higher annual energy consumption for cooling or heating, mainly because isolated buildings have higher solar radiation during summer, and doesn't benefit of the energy saving due to the urban heat effect in winter (Salvati et al. 2017).

c. Enlarged greenhouse gases emissions

Urban form and spatial structure are related with the amount of greenhouse gases emissions (Muñiz et al. 2016). Specifically, transport-related energy consumption is directly linked to urban density (Kirby 2008), because residents in lower density settlements require to transport for longer distances and use mainly private cars; therefore, the fuel fossil demand is higher.

Moreover, the carbon storage volume has been found to be much lower in low density housing with small gardens than in higher density housing with backyards and trees (Haase 2013). Also, the loss of vegetation cover due to urbanization implies the reduction of carbon sequestration capacity.

d. Local climate modification

The change of vegetated surfaces to built-up areas produces climatic conditions that differ from its surroundings. Urban areas are distinguished by higher temperature, lower wind speed, lower humidity, and alteration of precipitation patterns (Landsberg 1981). These changes in local climate are caused by the alteration of the exchanges of heat and humidity between the surface and the atmosphere, as well as the presence of pollutants and aerosols (Seto et al. 2013). In this regard, lower density urban expansion, produce these effects in a broader area, and it could have a negative effect on other activities or in biodiversity in the surroundings. Moreover, the urban heat island effect causes an increase in energy demand for indoor cooling in hot and temperate climates, and this demand is higher in lower density urban patterns (Salvati et al. 2017).

e. Alteration on water flows and quality

The conversion to built-up land implies installing impermeable surfaces that reduces infiltration capacity and increases superficial runoff. In low density patterns, this surface conversion occurs in wider areas, and as a consequence, the risk of flooding increases. This risk is augmented by the location of settlements in vulnerable areas leading to disasters.

The urban developments on flooding areas usually refuse inundation episodes and forces drainage, changing regular water flows (Fernandez 2012). Also, the lower volume of water infiltration reduces the recharge of groundwater aquifers, so decreases water availability in the long term. Another common effect related to urban expansion is the channelization of rivers that modifies flow speed, sediment load transportation, water ecosystems and landscapes.

It is considered that global urban growth disturbs in a significant way freshwater ecosystem services and impact water quality by increased erosion, nutrient load, and affecting biogeochemical cycling (McDonald et al. 2013). Moreover, dispersed urban runoff transports chemicals that pollute water bodies, and heavy rainstorms can exceed sewage capacity and carry untreated water to waterways (Bhatta 2010).

f. Higher costs for infrastructure and public services

Low density housing requires longer and costlier extensions of public infrastructure (Angel et al. 2005) including roads, water, sewage and electricity networks. Therefore, basic services result in elevated costs. Also, in dispersed areas, public transportation could not reach enough demand to offer an efficient service.

g. Social segregation

There is general concern about the relation between sprawl and social segregation due to the higher costs for transportation and highly dependence on private cars. Even sprawl supporters admit that “car based cities have been much more accessible to the wealthy” (Glaeser et al. 2004: 5). Moreover, it has been considered that dispersed urban patterns reduce social interaction and generates fragmentation of society (Angel et al. 2005).

In Latin American cities, regulation in the urban fringe tends to encourage low density developments thus it increases the land price so the narrow real state offer is oriented to high-income population (Bouillon 2012, Sabatini 2006). On the contrary, low-income sectors occupy informally the less-expensive land which lack of appropriate services (Abramo 2012, Bouillon 2012). In this way, the expansion areas of Latin American cities also present high socio-spatial segregation patterns.

A study in one hundred Mexican cities, confirms that the majority of low-income households lives in low-density peripheral areas; and this segregation patterns are more significant in larger cities (Monkkonen 2012).

h. Decreased aesthetic value of landscape

As dispersed urbanization has extensive effects, also its impact is significant on landscape aesthetic value. Urban sprawl reduces the view of open spaces (Angel et al. 2005), and modifies rural or natural landscapes with a monotonous built-up landscape.

Given this socio-environmental impacts, urban planners and development institutions encouraged the compact city model in opposition to the diffuse city since the 1990s (Commission of European Communities - CEC 1990, Pacione 2005). Also, there have been social movements supporting compact urban expansion even in United States (Capel 2003), which is characterized for having the lower urban densities.

Although, higher-density urban patterns are commonly not preferred by residents, because of a predominant interest on greener but dispersed urban areas (Hamman 2017). In addition, urban density could not be the main factor to explain urban environmental impacts. For example, the study of Muñiz et al. (2016) in the city of Concepcion (Chile) identifies that the differences in ecological footprints between neighborhoods are more related with income disparities than with density differences.

1.3.3. Environmental impacts of urban encroachment on fragile ecosystems

Urban growth increases the pressure for space which can be manifested by urban encroachment on fragile ecosystems. In this regard, McDonald et al. consider that “the most direct impact of cities on biodiversity is the change in land cover associated with urban growth” (McDonald et al. 2013: 37). Particularly, in South America, by the year 2000, the 60% of urban land was located in biodiversity hotspots, exceeding all other regions (Güneralp & Seto 2013 cited by McDonald et al. 2013).

The principal consequences of the loss and degradation of natural environments are: habitat fragmentation, loss of biodiversity and landscape deterioration. Other related environmental impacts are: topography alteration, native species decrease and increase of introduced or exotic species (Sukopp & Werner 1991). Although, the consequences are significance this impact varies depending on the ecological value of the lost ecosystem.

The overall impacts lead to the reduction of ecosystem services such as food and fiber supply, climate regulation, water and air purification and the cultural services offered by these natural areas to the urban population.

Unfortunately, in most cases, the natural areas in the cities' surroundings have been valued as areas for the future expansion of the city leaving aside the importance of its protection for its ecological, educational, recreational and cultural value (CEC 1990; Sukopp & Werner 1991). These advantages are augmented by its proximity to cities to improve the quality of urban life.

1.3.4. Socio-environmental impacts of urban encroachment on prime farmland

In a certain way, urban expansion on high productivity agricultural land has been frequent because the historical development of many important urban centers has occurred in relation to this resource (Satterthwaite et al. 2010). For example, in Europe, urban expansion occurs primarily on agricultural land (European Environment Agency 2006 cited by Colantoni et al. 2016). However, the loss of these areas is particularly critical in countries with reduced extent of arable land, like Peru, where it is only 3.2% of total surface (World Bank 2017).

The rural to urban land change may cause economic positive effects, like valorization of lots (Haller 2014) and greater economic vitality (Slomp et al. 2012). However, the negative effects are more clearly perceived, being the loss of farmland the main direct impact. This leads to the reduction of rural production and food security as well as the decrease of cultural and ecological value and the alteration of landscape aesthetics.

Studies on the local perception of these impacts also identified the decrease of income security, decrease of natural resources, pollution, habitat degradation, water quality degradation, flood risk, social conflicts related to new inhabitants, and loss of sense of community and sense of place (Haller 2014, Slomp et al. 2012).

In addition, the affected farmland is not only the extent of converted land, but also the nearby croplands. In this way, a study in Montreal shows that proximity to built-up areas involves the decrease of rural population and degradation of agriculture (Marois et al. 1991). Also the degradation of channel networks due to urban sprawl affects rural production (Huang et al. 2012).

Also the loss of prime farmland is a driver for poorer farmers to use hillsides where soil is less fertile and more vulnerable to be eroded (Gardner 1996). The loss of irrigated land is more troubling than the loss of other type of cropland, as it is the more productive land, and over time the irrigation construction costs tend to increase, so there is a downward trend in irrigated area per person (Gardner 1996). There is a continuing decline in cropland area per person, so it is vital to preserve the existing land to be able to supply the future demand for food (Gardner 1996).

Moreover, Lee et al. (2015) highlight the following services of agro-ecological systems: food production, recreation, cultural landscape, and regulation of infiltration, runoff and microclimate. In a similar way, Catherine Brinkley (2012) adds these ecosystem services: carbon fixation, maintenance of agricultural work and lifestyles, community cohesion, educational opportunities, health, maintenance of water, soil and air quality, among others. Given this, the author considers that the benefits of farmland extend to a regional scale (Brinkley 2012).

Local governments' decisions that influence in urban development should be made more "cropland friendly" and cropland should be recognized as a strategic resource which is the base of food supply so it is urgent to protect its extent and quality (Gardner 1996).

1.4. The research design

With the aim to approach to the urban expansion processes in developing countries, the research combines perspectives and methods of urban geography, behavioral geography, spatial analysis and planning. The analysis concentrates in recent urban expansion in Peruvian cities. Specifically, to point out the challenge of sustainable land-use, the study focuses on cases of urban expansion in non-developable areas due to socio-ecological and risk conditions. Considering the differences of some aspects of urban growth, the selected spatial scales of analysis are two: the city and the neighborhood.

Furthermore, the study focuses in the analysis of new urban areas and the urban fringe. Diverse authors emphasize the importance of studying these areas in political urban ecology, due to the necessity of trespassing city limits and analyze peri-urban dynamics (Zoomers et al. 2017, Angelo y Wachsmuth 2015).

In general, the project seeks to assess the extent to which local strategies or practices related to urban expansion contribute, or not, to sustainable land management, orienting new urban areas in safe and compact zones, without affecting areas of ecological value. By local strategies we refer to the urban plans and public management as well as common processes or practices of land appropriation and establishment of urban areas in cities' peripheries. Thus, this information will allow developing proposals based on local experiences to contribute to sustainable land management of the peri-urban territory.

To achieve this, the research combines three dimensions of analysis: spatial aspects, social aspects and urban management. Notably, there are several connections among these components, but this classification is useful to explain the main sources of data and the applied methods in the research. The main and primary source of information of the research were the surveys and interviews that will be detailed in this section.

1.4.1. Objectives of the research

The main objective of the research is to discuss about the possibilities for sustainable urban growth in developing countries with the aim to generate knowledge that contribute to reduce socio-environmental problems of urban expansion. Particularly, from Peruvian cases of urban growth in non-developable areas due to socio-ecological and risk conditions.

The specific objectives are:

- Describe cases of urban expansion, occurred in last decennials, in non-developable areas due to socio-ecological and risk conditions.
- Analyze the structural and behavioral causes of urban growth processes in the case studies.

- Evaluate urban management and spatial planning of urban expansion in the case studies from a sustainable development perspective.
- Propose strategies for spatial planning and sustainable land-use management based in the evaluation of local experiences.

1.4.2. Spatial analysis

Spatial analysis is a key aspect in geographical studies. Among urban studies, the geographical approach is distinguished by its concern in spatial distribution of phenomena. The use of tools of Geographic Information Systems and remote sensing allow describing the main spatial characteristics of urban expansion.

With this in mind, the study includes the analysis of built-up area expansion in the selected cases at the scale of the city and within the specific study areas. The built-up area is considered a precise and comparable measure of the urban areas (Angel et al. 2011), that can be identified based on the analysis of aerial and spatial imagery. For this study, the built-up area is considered as the roofed constructions built for permanent purposes as defined by the Statistical office of the European Union (2013).

There are many different methods for identifying the expansion of urban areas by satellite imagery and a higher spatial resolution and multi-spectral images can help obtaining more accurate results (Skupinsky et al. 2009). Nevertheless, the selected images for this study are from different types, sources and resolution (see Table 1), so the analysis was made by manual detection. First of all, urban expansion in the city scale was analyzed by the delimitation of the continuous built-up area using multi-temporal satellite imagery. For the capital city of Lima, there were available secondary sources of the urban area expansion, mostly based in aerial or satellite high-resolution imagery. In the cases of the cities of Cajamarca and Huamachuco, the continuous built-up area was delimited comprising the roofed constructions that were attached or on both sides of roads and rivers. It also includes the confined non-built-up areas; like gardens, parks, sport fields or cemeteries surrounded by roofed constructions.

Then, this allowed selecting precisely the study areas. The study focuses in the changes between 1985 and 2015, but considering the available data these temporal limits may vary per case study.

Additionally, the Normalized Difference Vegetation Index (NDVI) was estimated in order to describe the vegetation changes in the case studies of Mangamarca and Purrumpampa. Also, diverse spatial data from secondary sources were gathered and overlaid; like topography, land cover, population and housing census, and land-use plans. Thus, the description of urban growth considers attributes like distribution, speed of change, compactness, density, immigration and topography; which were topics suggested in the literature review (Bhatta 2010, Chaline 1973, Angel et al. 2011). For the spatial analysis and maps elaboration, it was used the software ArcGis and Google Earth.

Table 1: Aerial and satellite imagery used

CASE STUDY	DATE	TYPE OF IMAGERY	SPATIAL RESOLUTION	SATELLITE	SOURCE
Mangomarca fog oasis	January 13, 1984	Aerial photo	0.5 m	-	Servicio Aerofotográfico Nacional (SAN)
	March 13, 1990	Aerial photo	0.8 m	-	SAN
	April 21, 2000	Natural-color composite	0.8 m	Ikonos	Google & Digitalglobe
	January 24, 2010	Natural-color composite	0.3 m	Unknown	Google & Digitalglobe
	April 4, 2015	Natural-color composite	0.5 m	GeoEye-1	Google & Digitalglobe
	August 19, 2013	Multi-spectral, 11 bands	15 m	Landsat 8	Landsat
	July 29, 2014	Multi-spectral, 8 bands	15 m	Landsat 7	Landsat
Cajamarca valley	December 10, 1961	Aerial photo	1 m	-	Instituto Geográfico Nacional (IGN)
	June 9, 1971	Aerial photo	0.4 m	-	SAN
	July 15, 1988	Aerial photo	0.4 m	-	SAN
	December 7, 2003	Natural-color composite	0.6 m	Quickbird 2	Google & Digitalglobe
	Mars 31, 2016	Natural-color composite	0.4 m	GeoEye-1	Google & Digitalglobe
Purrumpampa wetlands	August 21, 1952	Aerial photo	1.2 m	-	SAN *
	June 20, 1971	Aerial photo	2.5 m	-	SAN *
	July 29, 1987	Multi-spectral, 3 bands	20 m	Satellite pour l'Observation de la Terre (SPOT)	SPOT*
	June 13, 2014	Multi-spectral, 8 bands	0.5 m	WorldView 2	Digitalglobe*

* Imagery provided by Transversal project.

1.4.3. Social behavior analysis

From a behavioral geography perspective, it is useful to analyze the significance of environmental perception in decision-making about residential preferences and land-use management (Capel 2006, Hall 1998, Pacione 2005). Also, David Harvey emphasizes the importance of studying the city linking the social behavior to the role of space or spatial form, supported by the use of “geographical imagination” (Harvey 1973). Additionally, a structuralist approach in urban geography helps to explain how economic and political forces underlies the land value changes and agents’ decisions related to the urban expansion processes (Pacione 2005). Hence, the behavioral and structuralist approaches contribute to the analysis of the causes of recent urban expansion in the case studies.

These aspects were analyzed based on the information obtained by interviews to key stakeholders as detailed in section 1.4.5. Also, an opinion survey was applied in each study area to support the analysis of behavioral causes of urban expansion with a quantitative approach. The survey specifications are detailed in section 1.4.6.

1.4.4. Urban management and spatial planning evaluation

The role of local governments in urban expansion management was analyzed, on the basis of urban plans, interviews and survey. This information allowed evaluating how the practices and tools of local governments contribute to a sustainable urban development. Also, the analysis comprised the national institutional framework for urban expansion management.

The urban plans analysis included the identification of urban expansion detailed strategies and the overlaid of zoning with current land-uses. Table 2 indicates the land-use plans that were analyzed.

Table 2: Urban and land-use plans analyzed per case study

MANGOMARCA FOG-OASIS	<ul style="list-style-type: none"> - Metropolitan development plan of Lima and Callao 1990-2010 (MML 1992) - Zoning map of Metropolitan Lima 2007 (IMP-MML 2007)
CAJAMARCA VALLEY	<ul style="list-style-type: none"> - Urban development plan 2016-2026 (MPC 2016) - Urban development improvement plan 2006-2010 (MPC 2006) - Peri-urban development plan 1999-2010 (MPC 2000)
PURRUMPAMPA WETLANDS	<ul style="list-style-type: none"> - Urban development plan 2016-2024 (MPSC 2016) - Specific urban plan of Pampas de Purrumpampa 2016-2026 (MPSC & PUCP 2016) - Zoning Scheme 2005-2010 (MPSC 2004)

1.4.5. Interviews

Thirty five stakeholders were interviewed. An interview guide was used (see Annex 1), which included the following subjects:

- Urban expansion process
- Consequences of urban expansion
- Perception of ecological value
- Urban management
- Density in urban development

The interviewed stakeholders were organized by their main role in the following groups:

- Social organizations leaders
- Public functionaries, including present or former directors in urban development and environmental areas
- Non-urban land owners, including present or former land owners and property investors
- Other residents

Table 3 specifies the number of participants in each group and case study. The interviews started in Cajamarca with a large number of respondents that allowed identifying the data saturation point due to repetitive responses and reducing the number of participants in the other cases. The interviewees are listed in Annex 2.

Table 3: Number of interviews per case study

STAKEHOLDERS TYPES	CASE STUDIES		
	MANGOMARCA FOG-OASIS	CAJAMARCA VALLEY	PURRUMPAMPA WETLANDS
Social organizations leaders	4	4	2
Public functionaries	2	11	2
Non-urban land owners	-	3	-
Other residents	2	5	2

The interviews were applied between July 2016 and February 2017. An informed consent form was used. Each interview was recorded to collect the data and it was transcribed later. Then, the relevant information was coded and organized with the software Qiqqa.

1.4.6. Survey

The survey focused on heads of household as responsible for the particular housing decisions. It comprised questions related to the same subjects as the interviews except the description of urban expansion process. The survey format is in Annex 3.

The sample was of 240 to 300 household heads in each study area, chosen by randomly selected blocks. The survey was applied between August 2016 and February 2017, as specified in Table 4. The survey interviews were done by professionals and highly educated students, as detailed in Annex 4.

Table 4: Opinion survey specifications

	MANGOMARCA FOG-OASIS	CAJAMARCA VALLEY	PURRUMPAMPA WETLANDS
TARGET POPULATION	Household heads occupying the two main gullies of the previous extent of the Mangomarca fog-oasis and an area of influence of 200 m.	Household heads occupying the selected section of the previous extent of the irrigated farmland of Cajamarca valley.	Household heads occupying the previous extent of the Purrumppampa wetlands and an area of influence of 200 m.
SAMPLE SIZE	240 household heads	300 household heads	300 household heads
SAMPLING METHOD	Random selection of 24 blocks or groups of houses (12 in each gully) on a satellite imagery	Random selection of 30 blocks or groups of houses on a satellite imagery	Random selection of 30 blocks or groups of houses on a satellite imagery
DATE OF APPLICATION	January 2017	August 2016	February 2017
INTERVIEWERS	2	2	5

1.4.7. Methodology synthesis

The following scheme summarizes the analysis methods and shows their correspondence with objectives and sources of information.

Table 5: Objectives and analysis approaches in the research

SPECIFIC OBJECTIVES	DIMENSION OF ANALYSIS	SOURCES OF INFORMATION
Describe cases of urban expansion in non-developable areas due to ecological and risk conditions occurred in last decennials.	Spatial analysis	<ul style="list-style-type: none"> – Aerial and satellite imagery – Population and housing census – Land-use plans – Field observation – Interviews – Survey
Analyze the structural and behavioral causes of urban growth processes in the case studies.	Social behavior analysis	<ul style="list-style-type: none"> – Interviews – Survey
Evaluate urban management and spatial planning from a sustainable development perspective.	Urban management and spatial planning evaluation	<ul style="list-style-type: none"> – Land-use plans – Interviews – Survey
Propose strategies for spatial planning and sustainable land-use management based in the evaluation of local experience.	Overall analysis	<ul style="list-style-type: none"> – Interviews

1.4.8. Case studies selection

Three areas were selected for study in different Peruvian cities that show recent and rapid urban expansion in non-developable areas due to socio-ecological and risk conditions. At the same time, this cases present evidence of protection of the ecological or cultural value of the non-developable areas. The selected case studies are: the Mangomarca fog-oasis in Lima city, the irrigated prime farmland in Cajamarca valley and the Purrumpampa wetlands in Huamachuco city. The case studies location is shown in Figure 3.

Also, each city represents a different size of city and corresponds to the head of a different administration level: national, regional and local. To better identify the common problems and possibilities in a national context, but also to recognize the existence of differences that could be related to city size. The detailed description of each case is presented in Chapter 2.

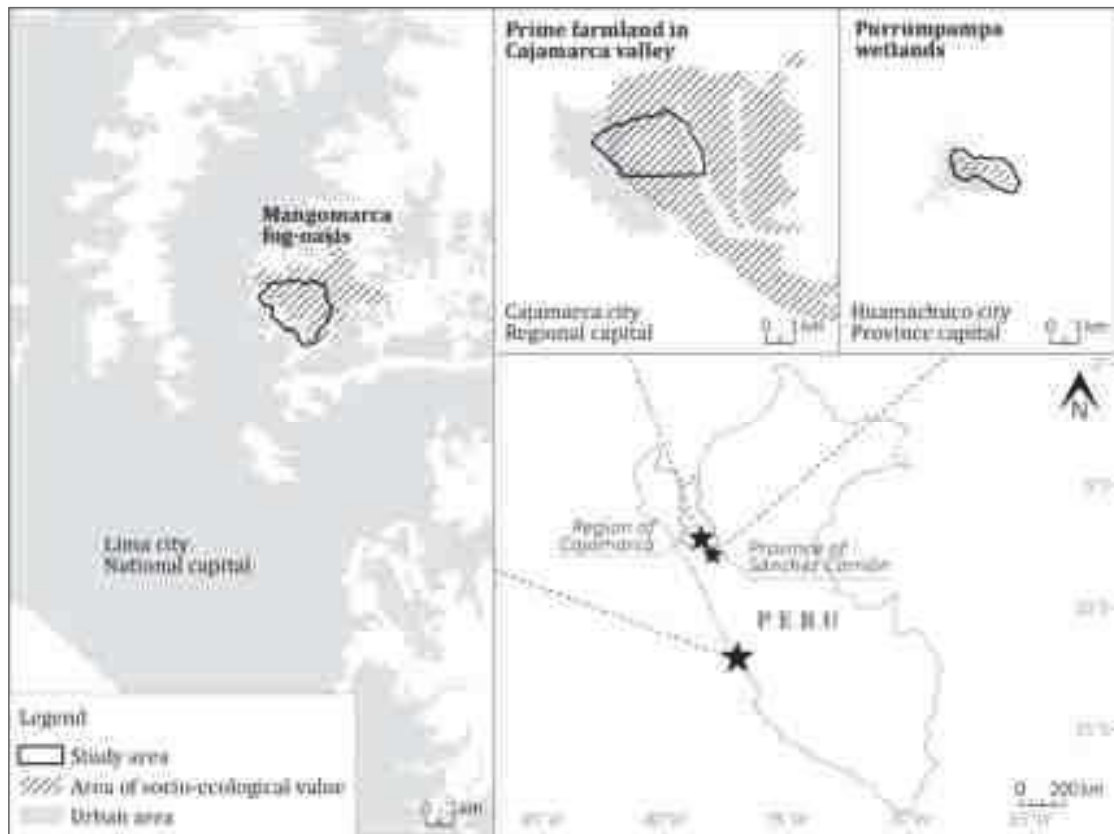


Figure 3: Location of case studies

Prepared by P. Moschella. Sources: Centro de Investigación de la Arquitectura y la Ciudad de la Pontificia Universidad Católica del Perú - CIAC-PUCP 2015, Instituto Metropolitano de Planificación de la Municipalidad Metropolitana de Lima - IMP-MML 2012, Google & Digitalglobe 2018, Gobierno Regional de Cajamarca - GRC 2010, Digitalglobe 2014.

1.5. Chapter summary

In the next decades, urban growth will occur mainly in least developed countries where economic and institutional limitations will restrict local governments to manage rapid urbanization. The new urban areas have lower densities than before and the traditional rural/urban distinction could result impractical over time. The lesser density values are related to higher income inequality, smaller cities, extensive arable land and no geographical constraints to urban expansion (Angel et al. 2011). Whereas, the higher rates of rural-urban land change occur in periurban arable land with higher road infrastructure (Cano et al. 2017, Lee et al. 2015, Shi et al. 2012). All these trends imply a major challenge for orientating urban development in a more sustainable and inclusive manner.

Urban expansion is a permanent process in the borders of cities where the building density increases over time until becoming part of the continuous built-up area (Bazant 2008). These changes take place in the urban fringe, a transition zone between the city and the countryside, whose limits are diffuse and moving. It is also characterized by an increase in land value while more intensive land-use replaces the previous; therefore, it presents an enhanced land-use conflict which made it a place of interest to geographers (Clark 2002).

Urban sustainability is a wide and multidimensional concept, which implies recognizing the city as part of a dynamic system linked with its surroundings. Some authors emphasize that the debate of urban sustainability should analyze peri-urban dynamics to expand to a debate of urbanization (Zoomers et al. 2017, Angelo & Wachsmuth 2015). The discussion of urban sustainability highlights the necessity of efficient land-use management oriented to more compact cities in secure areas with open public spaces, and avoiding the loss of productive land and important ecosystems.

The main socio-environmental impacts of low density urban growth are: higher land consumption, increased energy and resources consumption, enlarged greenhouse gases emissions, local climate modification, alteration on water flows and quality, higher costs for infrastructure and public services, social segregation, decreased aesthetic value of landscape. Urban land consumption can produce the loss and degradation of natural environment, and consequently cause habitat fragmentation, loss of biodiversity, and the reduction of ecosystem services.

The urban encroachment on high productivity agricultural land has been frequent because the development of many important urban centers is related to this resource (Satterthwaite et al., 2010). However, the loss of these areas is particularly critical in countries with reduced extent of arable land, like Peru, where it is only 3.2% of total surface (World Bank 2017). The main negative effects of farmland loss are the reduction of rural production and food security as well as the decrease of its cultural and ecological value. Farmland is a strategic resource, so it is urgent to protect its extent and quality (Gardner 1996).

With the aim to approach to the urban expansion processes in developing countries, the research combines perspectives and methods of urban geography, behavioral geography, spatial analysis and planning. To point out the challenge of sustainable land-use, the study focuses on three

Peruvian cases of urban expansion in non-developable areas due to socio-ecological and risk conditions.

The project seeks to assess the extent to which local strategies or practices related to urban expansion contribute, or not, to sustainable land management, orienting new urban areas in safe and compact zones, without affecting areas of ecological value. By local strategies we refer to the urban plans and public management; as well as common processes or practices of land appropriation and establishment of urban areas in cities' peripheries. Thus, this information will allow developing proposals based on local experiences to contribute to sustainable land management of the peri-urban territory. To achieve this, the research combines three dimensions of analysis: spatial analysis, social behavior analysis, and the evaluation of urban management and spatial planning.

CHAPTER 2:

Three examples of urban expansion. Different circumstances, same problem.

The selected case studies are examples of recent and rapid urban expansion in non-developable areas due to socio-ecological and risk conditions. These cases correspond to the urban encroachment in: a seasonal fog-oasis in the arid city of Lima, the prime farmlands in Cajamarca valley, and the wetlands of the small city of Huamachuco. Therefore, these are places in cities of different size and with different characteristics chosen with the aim of recognizing common problems of the urbanization process in Peru.

This chapter reviews the Peruvian urban structure to contextualize the location of the case studies. Then each case is described by the following elements: the city growth, the characteristics of the natural or agricultural area, the urban expansion process in the last three decades, and the urban development types. The final section identifies the main similarities of the urban dynamics, which are related to land value, forms of urban expansion and social actors involved.

2.1. Peruvian urban hierarchy and urban growth

For a better understanding of the situation of the selected cities in the national territory, it is important to contextualize them in the national urban hierarchy and urban growth tendencies.

Regarding the land use or cover change to urban, international literature focus on it as a rural to urban land-use change. Although, it is important to mention that in Peru a significant extent of urban expansion occurs in non-agricultural lands due to its scarcity. In the first place, Peruvian

population concentrates in the arid coast, where lack of water limits the extent of agricultural land. Secondly, other areas of medium to high population density comprise the Andean region, where high slopes restrict the availability of suitable soils and the magnitude of cultivated land.

Peru's urban hierarchy contrasts with neighboring Andean countries for having only one leading city and which is in the coast instead of the highlands (see Figure 4). However, it is important to notice that during the pre-Hispanic civilizations, the main settlements were located along the highlands. Then, the political center shifted to the coast during the colonial period and over time the concentration of population, economic activities and development intensified towards the coast. In contrast, the weight of traditional urban centers was reduced, like the cities of Cajamarca and Huamachuco, which contain two of the case studies.

Regarding the distribution of urban population in Peru, the main city is Lima-Callao, the conurbation of the national capital and the main port, with more than 9 million inhabitants. The next largest cities have less than one million inhabitants and concentrate specially in northern coast. The highest concentration of cities of all sizes occurs in the north and center coastal region. The highland towns are more dispersed and heterogeneous in size along longitudinal and transverse corridors. Whereas in the lowland Amazon urban system is fragmented, with minor, fewer and even more dispersed settlements.

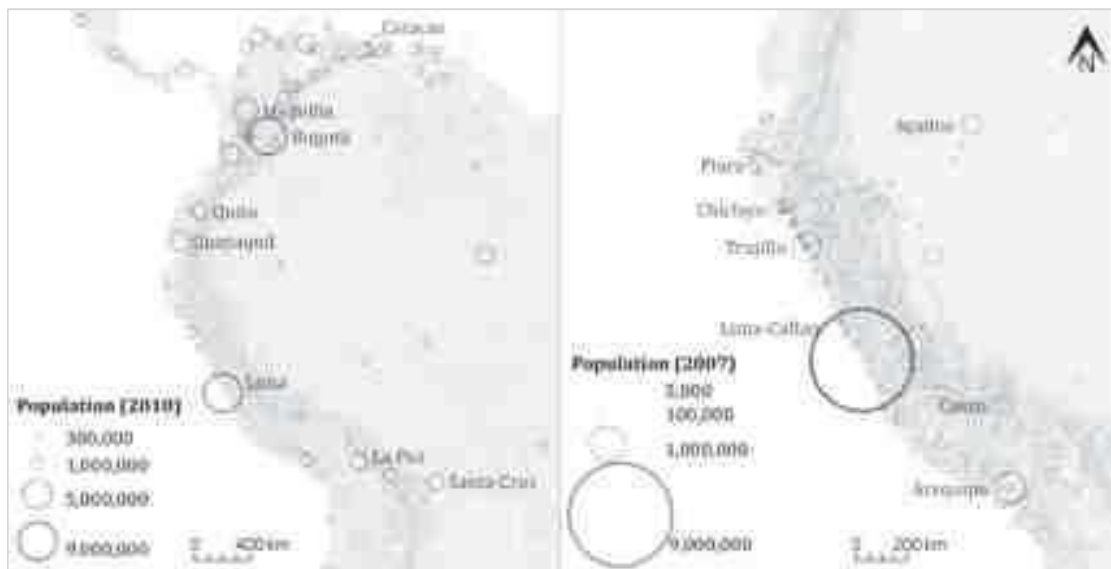


Figure 4: Main cities by population size in the Andean Region (left) and in Peru (right)

Prepared by P. Moschella. Sources: UN 2014 ; INEI 2007 ; Esri, United States Geological Survey & National Oceanic and Atmospheric Administration 2018.

The number of cities by population size shows the existence of a pyramidal structure with a broad base of smaller cities (see Figure 5). In contrast, the total population that lives in smaller cities is reduced compared to the population concentrated in the largest city. The ratio between the population of the largest and the second largest city is much higher than the world average (Pumain 2003). Furthermore, the global and regional trend shows that the concentration of population in smaller cities is much greater than the population living in megacities and large

cities (UNFPA 2007). The opposite situation in the Peruvian case, may be related to the reduced availability of arable land and the high dominance of Lima city.

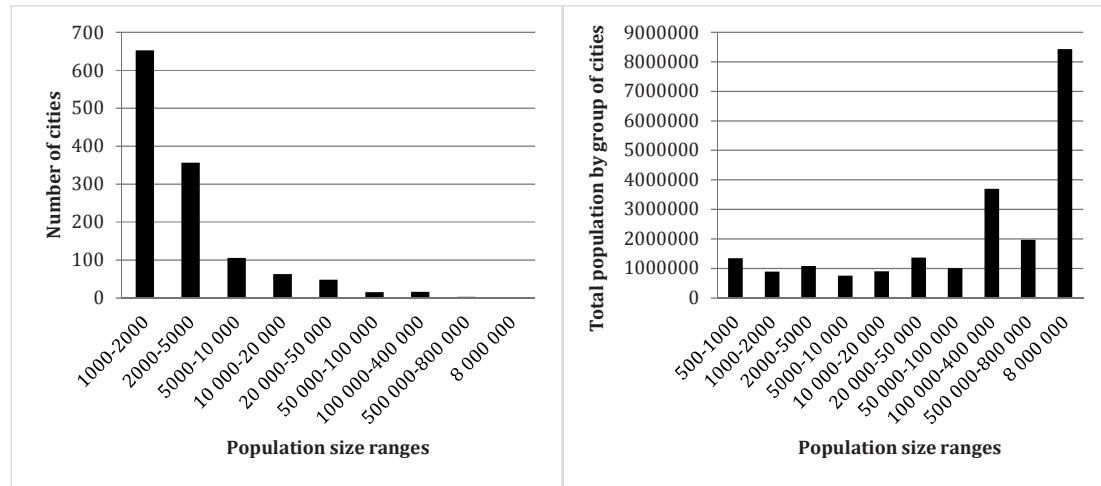


Figure 5: Cities by population size ranges
Prepared by P. Moschella. Sources: INEI 2007.

In Peru, the urban population is increasing constantly. In 1940 it was a little more than two million; in 1972, more than eight million; and in 2007, it exceeded twenty million people (see Figure 6). As for the urban population in percentage, in 1940 it was 35.4% of the total population, in 1972 it reached 59.5% and in 2007 it grew to 75.9%. So, although the urbanization process continues, it is losing intensity. Coinciding with the global trend, the rural to urban migrations have decreased and the vegetative growth of the population is more significant (INEI 2011).

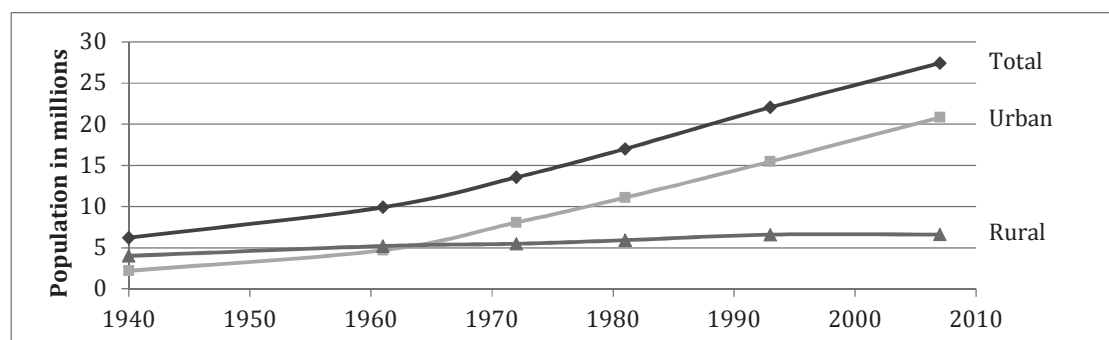


Figure 6: Peru's total and urban population growth
Prepared by P. Moschella. Sources: INEI 2011

The internal migrations of the last 60 years have been oriented mainly toward the coast, because it concentrates more economic dynamism and have a greater access to services. Whereas the highlands have typically had out-migration. In the middle of XX century, migrations intensified due to the industrialization policies with greater presence in the cities of the coast and also because of the crisis in the highland countryside (INEI 2011). Between 1981 and 1993, internal migrations increased again due to the armed internal conflict and the economic crisis (INEI 2011).

Within this structure, the case studies comprise three cities of different size in the central and northern areas. One of them is the coastal city of Lima, where is concentrated about one third of the country's population. The intermediate city of Cajamarca, which is the largest urban center in Northern Andes. And the small city of Huamachuco, also in the Northern Andes. The latter two, show exceptionally large growth rates in the highland region that have usually not attracted immigration.

2.2. Mangamarca fog-oasis, where the informal city reaches the clouds

The first case study is located in the fringe of Lima city, where urban expansion threatens a unique ecosystem locally known as *lomas*. This case is also an example of land trafficking, residential segregation and community organization. For a better understanding, this section begins with a brief presentation of the city expansion. Then, the *lomas* ecosystem and its importance are explained. Lastly, the urban expansion process and main urban development types in the selected area are described.

2.2.1. Lima city growth

The metropolis of Lima-Callao is located on the central coast of Peru and is the largest city in the country with approximately 9 886 647 inhabitants in 2015 (INEI 2017a). This city is considered as an urban continuum composed by 49 districts and 2 provinces: 43 districts belong to the province of Lima and 6 districts to the province of Callao.

Since the 1960s the population size shows a linear growth (see Figure 7), in the inter-census period between 1961 and 1972, the annual growth rate of the population was 5.7%, and gradually decreases to 1.6% in the period 2009-2017 (INEI 2017b). Also, immigration rate decreased over time, although the absolute quantity of migrants increased (INEI 2009). The demographic boom between the 1940s and 1960s was caused by the high concentration in the capital city of services and economic activities, mainly industry, that attracted immigration from rural areas and from the Andean region (Joseph et al. 2009, García et al. 2015). In contrast, between 1970s and 1990s urban growth was related to migration pushed by the economic crisis in agriculture and the internal armed conflict (Joseph et al. 2009). However, other reasons that lead to the general decrease of migration were the decrease on the fertility rate nationwide, and the decline in employment and housing opportunities offered in the city (INEI 2009), as could be expected in large metropolis (Bazant 2010).

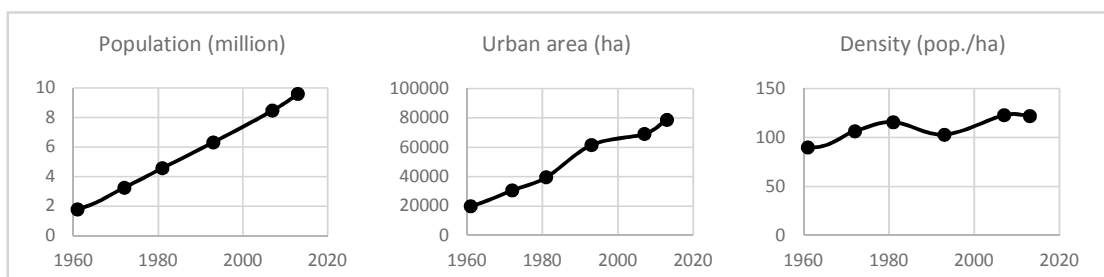


Figure 7: Urban growth in Lima city (1961-2013)

Prepared by P. Moschella. Sources: INEI 1993, 2007, 2012, 2017a, 2017b; Barreda & Ramirez 2004, CIAC-PUCP 2015.

The population growth caused a high demand of social housing, but the low capacity for public planning led to the growth of the city predominantly through the informal use of land (Barreda & Ramirez 2004). Between the 1960s and the 1980s, the State facilitated the transfer of peripheral land with a basic level of design of the road network and public spaces as a solution to the housing demand, and it helped decreased the invasions of land (Driant 1991, Joseph et al. 2009). However, this policy has been criticized as a populist and irresponsible way to satisfy migrants without offering appropriate housing conditions (García et al. 2015). Under those circumstances, the slums were characterized by the formation of associations that organized to resolve the connection to basic services networks and road paving, while the houses are gradually built. This process requires the time, effort and economic contribution of the inhabitants. Since 1990s, initial peripheral neighborhoods consolidated and some became the cores of new urban zones, as new neighborhoods with very low living conditions continue to be formed. An important difference of slums in this period is that population already lived in other areas of the city so they had support from family networks, so it influenced in more fragmented organizations and obstacles to its consolidation (Barreda & Ramirez 2004). Also, urban developments in marginal areas in the last decades, such as hillslopes or unstable soils mean higher costs of urbanization and transportation (Barreda & Ramirez 2004), and involves smaller groups of 30 to 40 families (García et al. 2015). As a result, Lima city has a strong socio-spatial differentiation where central areas are occupied by the middle and upper classes, whereas lower classes reside in the peripheries; and the urban integration level is distributed on a gradient, in correlation with its age (Piron et al. 2015).

Regarding the evolution of the urban extent, it has been highly conditioned by the physical environment. The Historical Center was founded on the left bank of the Rimac River and near to the start of the Andean foothills on the northeast. Therefore, the urban expansion began on the plain areas to the south and to the west in connection with the port. In 1940 the urban area was estimated in more than 5,000 hectares and it quadrupled by 1961 with the conurbation of the port of Callao and near towns covering the alluvial fan of the Rimac River. The expansion of the city continued along the main connecting roads to the north, east and south. Later the urban extent advanced entering the near valleys. By 1981, the urban area had an extent of 40,000 ha and occupied almost all the plain areas, so it begins to encounter the natural limitations of the topography. Thus, the hills that border these valleys constrained five axis of expansion obstructing connectivity between them. In the following decades, the new urban areas started to occupy the slopes and were very fragmented and dispersed. By 2013, the built-up area was of almost 80,000 hectares (see Figure 8).

The increase of the expansion in the hillsides can be seen on the Figure 9. The occupation of terrains with a slope higher of 10° in 1981 was 2.5% of the total urban area; and in 2007 it was 8.2%, equivalent to more than 5,000 hectares.

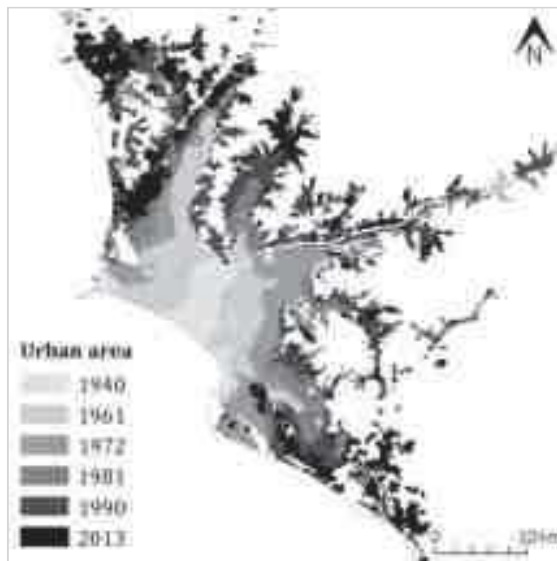


Figure 8: Urban expansion in Lima (1940-2013)
Prepared by P. Moschella. Sources: Barreda & Ramirez 2004, CIAC-PUCP 2015.

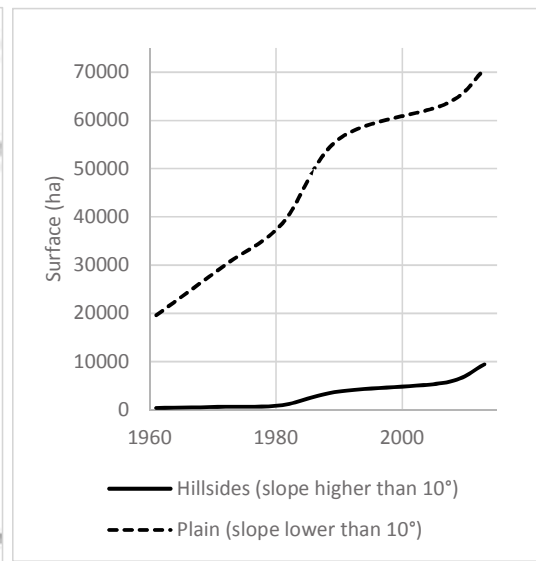


Figure 9: Urban area by slope of the terrain (1961-2013)
Prepared by P. Moschella. Sources: Barreda & Ramirez 2004, CIAC-PUCP 2015.

The annual urban expansion rate does not have a clear tendency (see Table 6). From 1940 to 1981 the percentage of annual urban expansion decreased from 6.5 to 2.9 %. However, in the 1980s it increased to 3.9% with an average annual growth of 1806 hectares. As reported by Joseph et al. (2009), the economic crisis enlarged the informal economy and lead to a lower density urban expansion. Then, the average annual expansion drastically reduced to 619 ha/year for the period 1990-2007, but augmented again after 2007. The changes in expansion rates result in density changes (see Figure 7). There are phases of predominance of extended growth or dense growth, as one develops at the expense of the other (Riofrío 2002). In recent decades there is a tendency to densification, unlike the trend in other cities.

Table 6: Urban expansion rates in Lima city (1940-2013)

PERIOD	AVERAGE ANNUAL URBAN EXPANSION	
	(HA)	ANNUAL URBAN EXPANSION RATE (%)
1940-1961	694	6.5
1961-1972	977	4.0
1972-1981	992	2.9
1981-1990	1806	3.9
1990-2007	619	1.0
2007-2013	2063	2.9

Prepared by P. Moschella. Sources: Barreda & Ramirez 2004, CIAC-PUCP 2015.

The land cover change during this process implied the disappearance of farmland and the reduction of natural areas, such as wetlands and fog-oasis (see Figure 10). Based on the analysis of satellite imagery in two periods: 1990-2007 and 2007-2013, the proportion of urban growth on desert, farmland and wetland remains roughly similar (see Table 7). More than 60% of urban growth occurs on the desert. There are desert plains on the extreme north and south, but desert areas are predominantly in the foothills bordering the city, which due to slope could signify risk areas. Around 36% of urban expansion is on farmland, mainly on the northern valley of Chillon river, as the Rimac river agricultural valley already disappeared. Then, a lower proportion of expansion occurs on fragile ecosystems. Around 1% is on the wetlands of Ventanilla and Pantanos de Villa, with an estimation of 203 hectares of wetland loss since 1990.

Regarding the urban encroachment on fog-oasis, there is lack of data on the extension of these ecosystems before 2011. So, as a reference, between 2011 and 2013 the expansion in fog-oasis was 213 hectares, which represent 2% of urban growth in the last period analyzed. This kind of land-cover change includes 11 different areas of fog-oasis, being the most infringed the *lomas* of Villa Maria, Carabayllo and Mangomarca. Previously, the most deteriorated was de *Lomas de Amancaes*, which are the closest to the city center.



Figure 10: Urban expansion by previous land-cover in Lima (1990-2013)

*The extension of fog-oasis was estimated in 2011.

Prepared by P. Moschella. Sources: CIAC-PUCP 2015, Landsat 1990, IMP-MML 2012.

Table 7: Urban expansion by previous land-cover in Lima

	1990-2007		2007-2013	
	HA	%	HA	%
Urban expansion on desert	6628	63%	7462	60%
Urban expansion on farmland	3770	36%	4629	37%
Urban expansion on wetland	132	1%	71	1%
Urban expansion on fog-oasis*	-	-	213	2%
TOTAL	10530	100%	12375	100%

*The extension of fog-oasis was estimated in 2011.

Prepared by P. Moschella. Sources: CIAC-PUCP 2015, Landsat 1990, IMP-MML 2012.

2.2.2. The Mangamarca fog-oasis

The coastal desert of Peru and Chile present the conditions for the formation of scattered areas of seasonal vegetation due to fog, locally known as *lomas* (see Figure 11). In this region, a thermal inversion is produced due to the cold water of the Humboldt ocean current and the warmer upper air as it is a tropical and subtropical area. Thus, a thick layer of stratus clouds is contained during the winter and some hillsides facing the coast capture the humidity of these clouds. The topography and substrates define different forms of moisture availability for plants in an elevation range that vary between 200 and 1000 meters (Rundel et al. 1991). Moreover, this ecosystem has a very variable extent and duration among years, due to its high dependence on weather conditions, as vegetation cannot develop when the stratus clouds are less constant or in higher elevation during the winter (Dollfus 1965). The vegetation develops between June and November; whereas during the summer, species are forced to tolerate a very dry season. Under those conditions, the species endemism is over 40% (Rundel et al. 1991), as a consequence of the extreme climate conditions and the distribution of these plant communities as islands in a very arid environment. This phytogeographic phenomenon is only repeated in a smaller extent in the Southwest of Africa (Weberbauer 1945).

In the Provinces of Lima and Callao, there have been identified 20 *lomas* formations with a total extent of 20,780 ha (Instituto Metropolitano de Planificación de la Municipalidad Metropolitana de Lima - IMP-MML 2012). Among them, the “Lomas de Mangamarca” has an intermediate size and is the second closest to the city center (see Figure 12). Therefore, it is also one of the most threatened by urban expansion. The boundaries of the fog-oasis are diffuse and variable. In addition, it is difficult to delimit it with satellite imagery because of the thick cloud cover during the months when the extent is larger.



Figure 11: Fog-oasis in Lima

Photo by P. Moschella, 2009.



Figure 12: Map of fog-oasis in Lima

Sources: CIAC-PUCP 2015, IMP-MML 2012.

According to the limits identified by the Metropolitan Municipality, the Mangomarca fog-oasis has an extent of 791 ha. (IMP-MML 2012), and contains one main peak and the higher areas of several small gullies or ravines in the surroundings, in elevations between 285 and 827 meters. The slope is pronounced with an average of 44% and the hills face predominantly to southwest and south-southeast. The northeast face is affected by a rain shadow effect, so it's more arid. The Figure 13 shows the evolution of the intensity of vegetation in Mangomarca during 2014, with the Normalized Difference Vegetation Index (NDVI) obtained by Landsat 7 and Landsat 8 imagery. The higher vegetation intensity occurred between July and September. The NDVI allows identifying the variable extent of the fog-oasis that highlights with its arid surroundings.

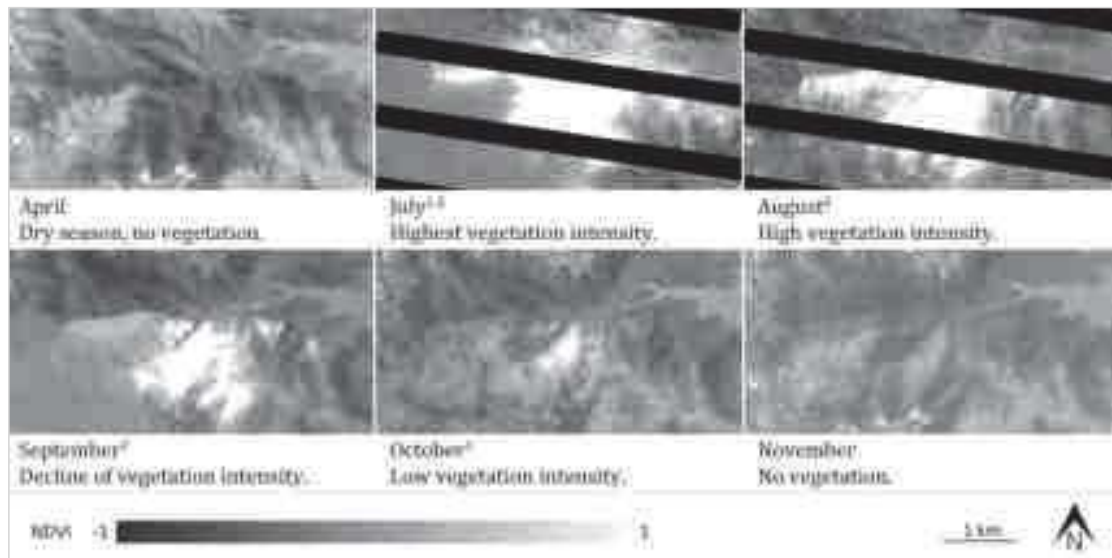


Figure 13: Variation of the vegetation intensity (NDVI) in the fog-oasis during 2014

Source: Google 2017.

¹Images partially covered by clouds.

²Stripes caused by failure in Landsat 7.

This ecosystem can be divided in four zones (see Figure 14), as described below (adapted from Jimenez 2011, Servicio Forestal y de Fauna Silvestre - SERFOR 2014, Rundel et al. 1991, IMP-MML 2012):

- The core zone is in the Mangomarca gully, between 450 and 750 meters. This zone concentrates more moisture due to its direction. The gully bottom accumulates a thicker layer of soil, thus, this zone has a more dense vegetation of bushes and herbs, and some dispersed trees. Based on the NDVI of August 2013, the core zone extent is of 28 hectares.
- The higher hillsides are between 550 and 800 meters and oriented to the south, southeast and southwest of the main peak, including the southern ridges. This zone has rocky outcrops and is characterized by diverse bushes and herbs. The NDVI of July 2014 indicates that this area has an extent of 180 hectares.
- The lower hillsides are between 280 and 550 meters in the southern section as a transition border. This zone has less humidity, so presents a cover of smaller herbs and lower plants.
- The northern ridges, above 600 meters, present rocky outcrops and have less moisture, so in this area are found cactus, mosses and dispersed herbs. Also this zone is more affected by housing encroachment.

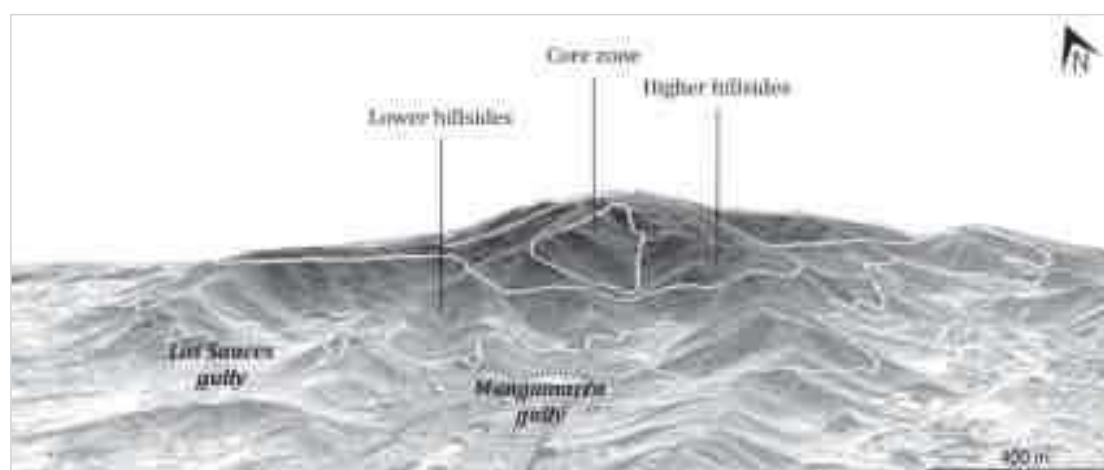


Figure 14: Main zones of Mangomarca fog oasis

Prepared by P. Moschella. Sources: Landsat 2014, Landsat 2013, Google & Digitalglobe 2018, IMP-MML 2012.

Regarding the flora, the Mangomarca fog-oasis has 40 plant species (SERFOR 2014). Another study identified that 38% of the plants species are endemic (Jimenez 2011). Among them, the only critically endangered species is the Mito or Wild papaya (*Carica candicans*), a large bush with an eatable fruit. Another threaten and endemic species is the Amancaes flower (*Ismene amancaes*), which is categorized as vulnerable. This flower was the most representative of the *lomas* in Lima, as it was the focus of an old traditional festivity, the “Fiesta de Amancaes”, where lots of people visited the *lomas* and recollected this flower. Also, the only tree species is the Tara (*Caesalpinia spinosa*) which was cultivated in the *lomas* by pre-Hispanic civilizations (Rostworowski 1981 cited by Nieuwland & Mamani 2017). Other endemic plants present in Mangomarca are types of Tobacco (*Nicotiana paniculata*) and Nettle (*Loasa nitida*) (Jimenez 2011). As reported by Jimenez (2011) it is important to highlight the presence of the Amancaes flower and *Tillandsia sp.*, because these species have disappeared in other nearby *lomas*. This author also affirms that there are evidences in Mangomarca that vegetation in previous times was more dense, and the area is being damaged by urban growth and air pollution of closeness industries and cars. Among the animals that still live in this ecosystem, there are 15 bird species, 2 reptiles and 1 mammal, the vizcacha (*Lagidium peruanum*) (SERFOR 2014). Some decades ago, residents confirm that there could be also found foxes and wild dogs.

Furthermore, this area has evidences of ancient occupation. Three thousand years ago appeared a settlement in one of the ridges at 400 meters of altitude, as well as terraces and corrals of different sizes where different human groups established (Abanto 2009). All of these correspond to the lower fringe of the *lomas*, evidencing the use of this ecosystem, especially as pastures.

It is also important to mention that around a thousand years ago, the Mangomarca archaeological complex was built, 800 meters to the southwest of the *lomas*. This complex was the control center of the Lurigancho domain, a pre-Inca society concentrated downward in the agricultural area (Abanto 2008).

Later, in the XV century, the *lomas* became part of the territory of the community of Jicamarca, where camelids herders were established predominantly in the highlands (Abanto 2008). The community of Jicamarca owned a territory of 100,000 ha that extended from 200 to 4000 meters

of altitude, where they complemented the use of highland pastures during the rainy season in the summer and the *lomas* in the winter (Gutiérrez 1998). Since the Spanish colony, they started to breed goats and sheep (Robles 2004), but the introduction of these species contributed to overgrazing and soil erosion due to their hooves. Under those circumstances is considered that during the Spanish colony started the over-exploitation of the *lomas*, due to the intensification of grazing with new species and, probably, also wood extraction for charcoal production (Nieuwland & Mamani 2017). The Jicamarca community exists until now, but their use of Mangamarca's pastures is not common anymore. Conversely, the lands of the community have being invaded by informal settlements in the last decade, producing a significant degradation of the fog-oasis.

Nowadays, the fog-oasis is primarily valued for some neighbors and visitants as a recreational and educational site, and it has been created an organization to protect them. Also is considered part of a touristic route with the archaeological complex of Mangamarca. Recently, the National Forest and Wildlife Service (Servicio Forestal y de Fauna Silvestre - SERFOR) presented a proposal of limits to protect this fragile ecosystem with a surface of 516 ha. (SERFOR 2014).

2.2.3. Urban expansion process in the study area (1984-2015)

The study area includes the two main gullies where the Mangamarca fog-oasis develops: Mangamarca and Saucos, and an area of influence of 200 m. These gullies present a highly contrasting situation and are physically divided by the Lurigancho hill without connecting roads, thus the expansion process in each one has occurred independently. In this section, it will be described the process of expansion of urban land-use by phases that highlight different characteristics. The temporal limits of each phase correspond to dates of the imagery analyzed, as there were no specific key dates found in the interviews.

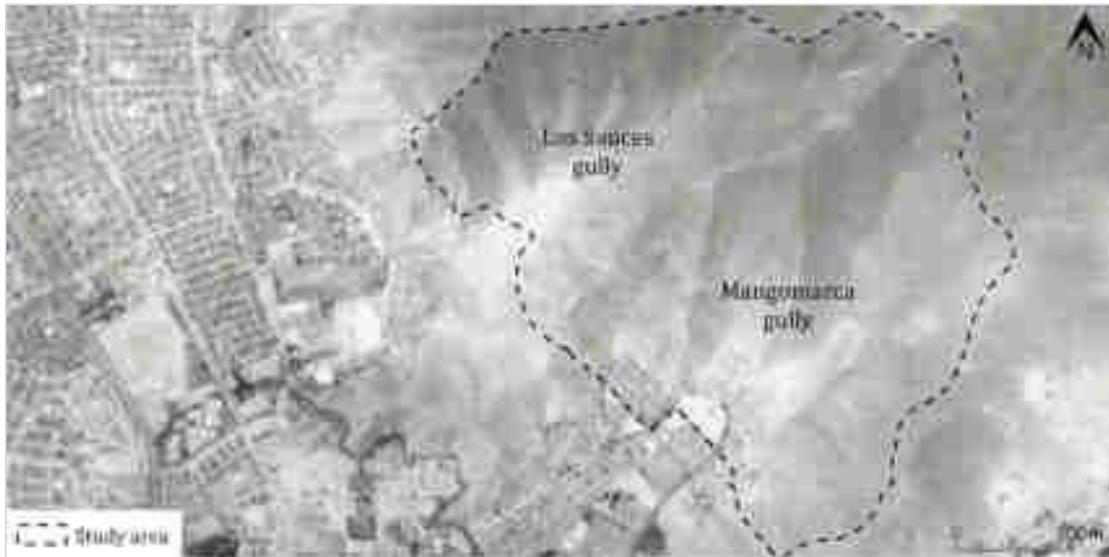


Figure 15: Aerial view of Mangamarca and Saucos gullies in 1990

Source: SAN 1990.

Between 1984 and 1990 only the southern gully was occupied by formal urban developments as continuous extensions from lower areas in a slope below 5%. These developments started in the 1970s on deserted land and were intended as social housing for workers of some public institutions. Meanwhile, the Sauces gully was not occupied, unlike other near gullies by that time, due to its higher slope and the existence of a cemetery that discouraged people from establishing in this area (see Figure 15).

Later, by the year 2000, both gullies presented recent urban extensions in the central area or valley floor but with opposite characteristics (see Figure 16). In Mangomarca gully, the new urban development occupied almost all the area available with a slope lower than 10%. Also had a similar design to the previous that seemed to accomplish the formal conditions. But it was in an earlier stage of improvement, as it had unpaved roads and some plots were not built yet.



Figure 16: Mangomarca gully in 2000

Source: Google & Digitalglobe 2018.

On the contrary, the northern gully started to be occupied as urban encroachment in the herder's communal property, with an irregular and dispersed distribution. To access to this sector there is a narrow road that crosses the cemetery, next to it was a large area reserved for public use, and then begins the residential area. Some of the first occupants remember that they were scared of going through this entrance as there wasn't street light and they have to walk next to the graveyard. This is one of the reasons why many inhabitants postponed moving here. During this time lapse, housing was built in terrains up to 20% slope.

Between 2000 and 2010, the pressure for new urban land increased so the hillslopes started to be occupied and the encroachment on the fog-oasis begun (see Figure 17). In Sauces gully, there was a large urban expansion on different directions and in steeper terrains with up to 35% slope. During this time, all the plots in the valley floor got built and the hillslopes were occupied by small associations. The plots in these new areas follow the contour lines, and were built faster than in the previous stage. But, the slope and the lack of appropriate infrastructure make the access more difficult.



Figure 17: Sauces gully in 2000 and 2010

Source: Google & Digitalglobe 2018.

On the other side, invaders attempted to settle in Mangamarca gully as this area is relatively near to the city center. But the urban extent didn't change because the residents didn't allow the six intents of informal settlements since 2008. For this purpose, they organized to dislodge the invasions. Also, as a measure to stop these intentions they reinforced the borders by afforestation.

In recent years, the landscape in Sauces gully changed a lot as more irregular settlements appear in areas up to 40% slope by the year 2015 (see Figure 18). The access is even more difficult, and almost all the expansion in the period 2010-2015 occurred in the area of the fog-oasis. Moreover, these occupations are located in areas where the excessive seasonal haze and low temperature generates health problems, even some interviewees considered it among the main problems of the urban expansion in this area.

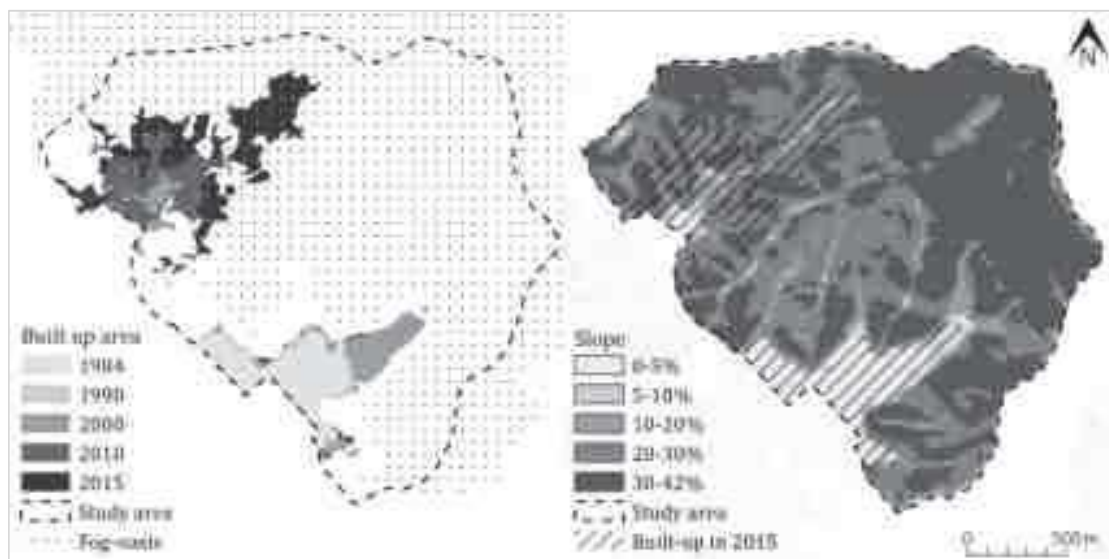


Figure 18: Built-up area (1984-2015) and slope in Mangamarca study area

Prepared by P. Moschella. Sources: SAN 1984, 1990; Google & Digitalglobe 2018; IMP-MML 2012, 2014.

Some residents mentioned that this rapid expansion was due to the municipal election campaign of 2014 as the favorite candidate offered title of property. This strategy is not new, for example, Calderón (2005:190) mentions that in the year 2000 massive land invasions occurred in all the

country as the president Fujimori considered the distribution of title of property an effective and less expensive way to get loyalty and votes for his re-election. Leaving aside the implementation of adequate policies to access to urban land.

2.2.4. Urban development types

There can be identified three types of urban developments in the study area, which are spatially segregated. In Mangamarca gully, there are formal urban developments which are older, and ordered. On the other side, in Saucos gully, there is informal land subdivision and more recently land trafficking.

a. Formal urban developments

In the study area there are three formal urban developments, all in the southern gully. Previously, the land was unused but belonged to a private owner who sold it in different moments to housing cooperatives that had public financial support. At first, these organizations were encouraged by workers of a specific public institution but commonly later they accepted new members not related to the institution. These collective organizations were responsible for the urban design, gathering the new inhabitants and managing the installation of basic service networks, road infrastructure and public facilities.

The plots are smaller than the average in the city and are oriented to medium to low income sectors. They have an ordered distribution, facilities and public spaces. The older of these developments is Vipol and was planned for police officers, it is formed by 500 small plots of 180 m² in average, but only the half of them is inside the study area. The second one is APTL (by the Spanish acronym of Para-municipal Lima Transports Association) and was intended for bus drivers of the municipal transportation company, containing 430 plots of 200 m² in average. The most recent development is Villa Mangamarca formed in the 1990s and planned for members of the army. It comprises 321 plots with a surface of 160 m² in average (see Figure 19)

For example, in APTL every plot was provided with a prefab low cost house. In this case, the Housing Bank offered payment credits in up to 15 years for the plot purchase. After completing the payment, the property was transferred from the cooperative to the private owner. The first residents arrived before some basic service networks were installed, therefore the social organization was focused on this subject that got resolved in a few years. In the 1980s the organization established a community center with a library, kindergarten, and a health post. They received donations and the members contribute to construct them. Later, in 1995 the roads were paved in agreement with the municipality. Besides the formal development, some extra plots have been sold informally in the 1990s on the east side, including large commercial plots.

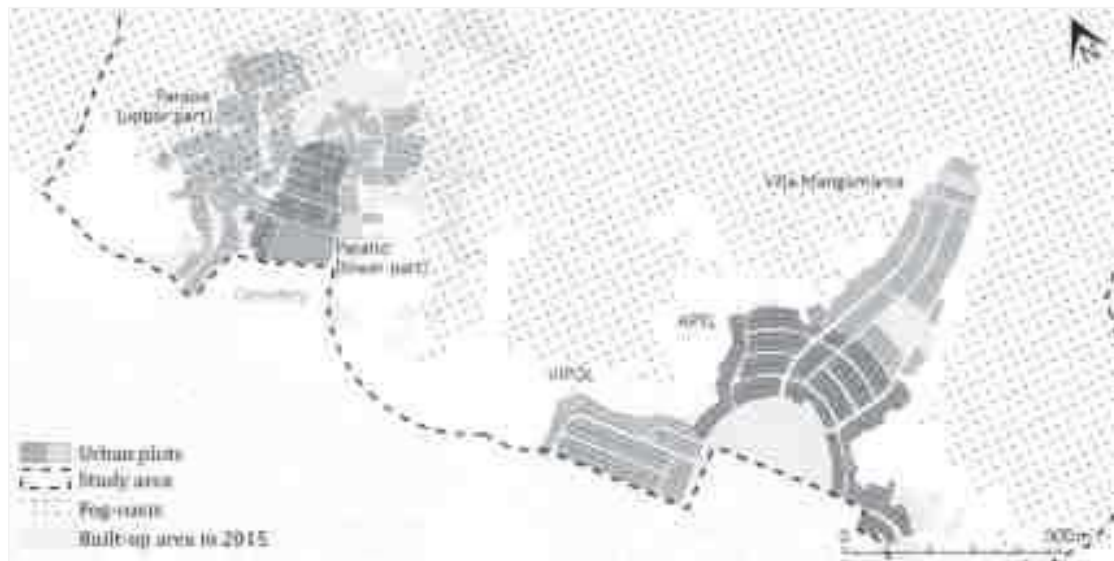


Figure 19: Plots by urban developments in the study area of Mangomarca

Prepared by P. Moschella. Source: Instituto Catastral de Lima 2018.

After the residents got its title of property and the infrastructure and facilities got installed, the communal organization lost relevance. But recently, the main subjects that gathered some residents in social organizations are the defense of cultural and archaeological heritage, as well as the protection of the fog-oasis.



Figure 20: APTL urban development in Mangomarca

Photo by P. Moschella, 2016.

Over time, the greater part of families gradually built and enlarged their houses in more resistant materials, but there are still a few that remain with the initial prefab house while many other houses became buildings of more than 3 floors (see Figure 20 and Figure 21). In addition, security became a relevant problem, so in many streets there were installed steel fences to limit or control the circulation; in relation to this, Ploger (2007) considers the area as a residential enclave.

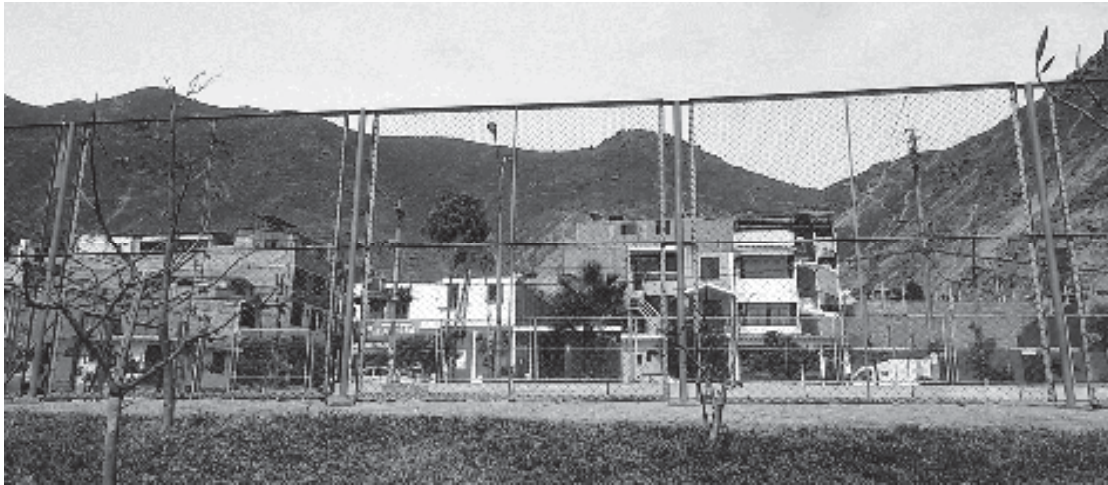


Figure 21: Closed public recreation area in Villa Mangomarca

Photo by P. Moschella, 2016.

b. Informal land subdivision by associations

In Saucos gully, there are small associations that occupied spontaneously the area and then bought the land from the herder's community of Jicamarca to sell it by plots to the members. In these cases, the development does not meet the standards, and there is lack of public spaces and adequate road network design. The first association, El Paraíso de Jicamarca, was located in the lower area with an orthogonal pattern and large plots of 500 m², which were later subdivided by many owners. Some of these owners agreed later to open narrow passages to facilitate the transit. This is the only association legally recognized by the Municipality of Huarochiri.

The other 7 associations occupy the hillsides, therefore, they are more irregular and the plots are smaller with an average surface of 159 m². Due to the slope the zone presents a risk of landslide, so the Municipality of Huarochiri didn't allowed its recognition. But recently, taking advantage of the border conflict, the Municipality of San Juan de Lurigancho recognized them, as part of the offers of the mayor during the election campaign.

The registered plots sum up 720. The only public space is the sports court, located over a previous landfill, which explains why this large area remained unused. The basic service networks are commonly installed by the communal associations with the investing of the members. And the houses are built gradually, the majority remains under construction.

c. Land trafficking

The most recent form of occupation is by irregular tenure of the land and its re-sell by plots, which generates property conflicts. Unlike, previous settlements, the leaders in these cases, seem to already have a house and organize the irregular purchase or invasion just for profits. Almost all consist in encroachments on the fog-oasis. The interviewees mentioned that sometimes individuals get illegally documents of permission by the Municipality, in other cases they get an illegitimate purchase of the land by the herder's community, and even the same terrain could be

sold twice. In these cases, the plots shape is more asymmetrical and smaller. Moreover, due to the high slope the access is very difficult and the incipient paths are very disordered and dispersed (see Figure 22). The interviewees also mentioned that many of these owners have other properties and doesn't live in the area. These occupations are very recent, just a few years, and the constructions remain as prefab houses. Some poor families acquire these plots without any legal guarantee, and there have been complaints of armed offenders that force these families to leave so they can sell the plot again (Latina 2014, ATV 2014).



Figure 22: Land trafficking that encroaches on the Mangomarca fog-oasis

2.3. Cajamarca, a dairy valley threatened

The second study area comprises the eastern urban fringe of Cajamarca city in the valley of Mashcon river. This intermediate size city is located at 2,750 meters above sea level and its expansion is causing the loss of high value agricultural soils, which are a scarce resource in the Andean region. A general overview of the city and the agricultural area is featured below as well as the description of the urban expansion process in the selected portion of the urban fringe. Finally, it is explained the main urban development types identified in this area.

2.3.1. Cajamarca city growth

Cajamarca is the largest city in Northern Peruvian Andes with an estimated population of 226,031 inhabitants in 2015 (INEI 2017a). It's an interesting study area because it has maintained a high growth rate, above 4% annually, since the 1970s, when population was about 50,000 inhabitants (see Figure 23). And in the last decade, Cajamarca has been the Peruvian city with the highest population growth rate (INEI 2017a).

Before the 1990s, the city was mainly an administration and services center of a highly rural region; therefore, it attracted rural immigration (Vega Centeno 2009). Then, immigration was basically related to large mining projects, and the population increased from 92,447 inhabitants in 1993 to 162,326 in 2007 (INEI 1993, 2007).

In 1993, the transnational mine Yanacocha initiated its operations 20 km to the north of the city, and later became the largest gold mine in South America. The investments in mining projects in the region are linked with Peru's neoliberal restructuring in the 1990s and the worldwide metal prices increase (Bury 2005, Pinto 2009). Since then, the city's development has been subordinated to the demands of the mining activity (Santa Cruz 2012), as it rapidly generated an economic dynamism that exceeded the importance of agricultural economy (Vega Centeno 2009). Mining induced the expansion of construction and housing markets (Bury 2005). It also generated changes in the urban socio-spatial structure and high-rent residential enclaves in the periphery of the city (Steel 2013, Vega Centeno 2011).

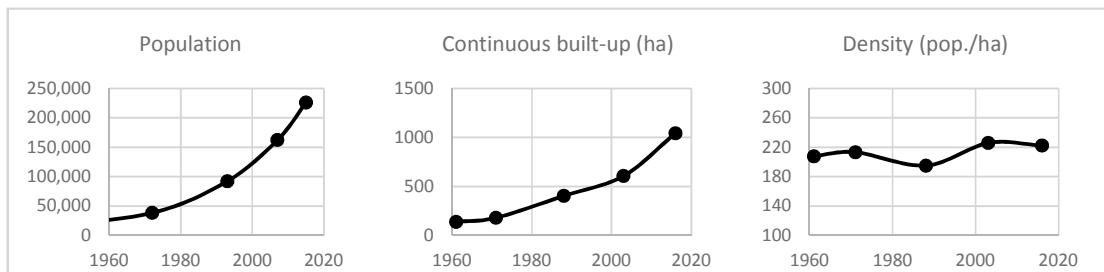


Figure 23: Urban growth in Cajamarca city (1961-2016)

Prepared by P. Moschella. Sources: INEI 1993, 1995, 2007, 2017a; IGN 1961; SAN 1971, 1988; Google & Digitalglobe 2018.

Urban expansion in Cajamarca city was analyzed with aerial and satellite imagery between 1961 and 2016. The extent of continuous built-up area of the city has increased from 139 hectares in 1961 to 1044 ha in 2016, presenting a higher speed in recent decades. The urban expansion rate was in average 4.1 hectares annually between 1961 and 1971. Later, this rate triplicated to around 13 hectares between 1971 and 2003. Then, it almost triplicated again to an average of 33.6 hectares per year of new urban areas between 2003 and 2016 (see Table 8). Regarding the estimated density, it has fluctuated between 195 and 226 inhabitants per hectare (see Figure 23).

Table 8: Annual urban expansion rate in Cajamarca

PERIOD	AVERAGE ANNUAL URBAN EXPANSION (HA)	ANNUAL URBAN EXPANSION RATE (%)
1961-1971	4.1	2.9
1971-1988	13.1	7.3
1988-2003	13.6	3.4
2003-2016	33.6	5.5

Sources: IGN 1961; SAN 1971, 1988; Google & Digitalglobe 2018.

The form of the city enlargement has been determined by the topography. The city center is located on the west edge of the valley next to the base of mountains. So, the higher slope areas are in the west side of the city and it has expanded mostly towards the other directions. Between 1971 and 2003 the expansion predominated to the north and east. Whereas, in the last decade, the city has enlarged principally to the southeast and along two main roads in the north (see Figure 24). Towards the east is located Baños del Inca, a touristic urban center, which in the future could form a physical conurbation with the city of Cajamarca.

Regarding the slope of the terrain, most of the expansion has occurred in flat land. In 2016, 91.6% of the continuous built-up area is areas with a slope below 10°. This proportion hasn't changed much over time, although the percentage of urban area in terrain with a slope higher than 10° shows a slight increase from 3.4% in 1971 to 8.4% in 2016 (see Figure 25). Due to the relief in mountain regions, the valley floor is remarkably vulnerable to rural-urban land use change; hence it presents a high competition for urban expansion on flat land and lower slopes (Haller 2014).

The analysis of urban expansion by type of previous land cover took as initial reference the land-cover identified in 1961, which was classified in: irrigated cropland and pastures, rain-fed cropland and pastures, and desert land (see Figure 26). The irrigated farmland locates towards the northeast and east of the city, due to its relation with the lower areas of the valley. While, on the southwest and west is located the rain fed area, because of the irrigation water availability decrease in more elevated areas.

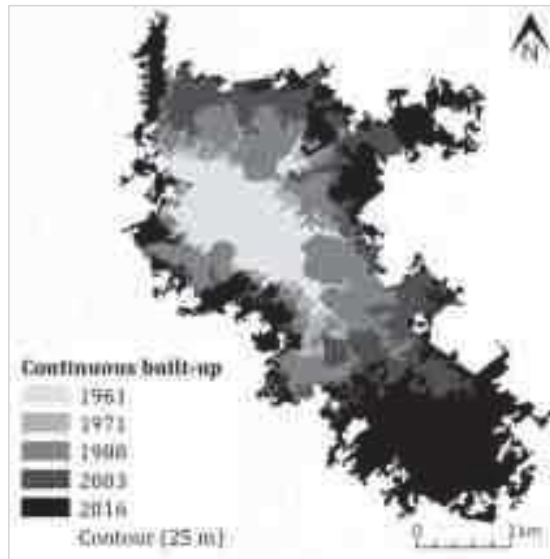


Figure 24: Urban expansion in Cajamarca (1961-2016)

Prepared by P. Moschella. Sources: IGN 1961; SAN 1971, 1988; Google & Digitalglobe 2018; Japan Ministry of Economy, Trade and Industry & United States National Aeronautics and Space Administration – METI & NASA 2011.

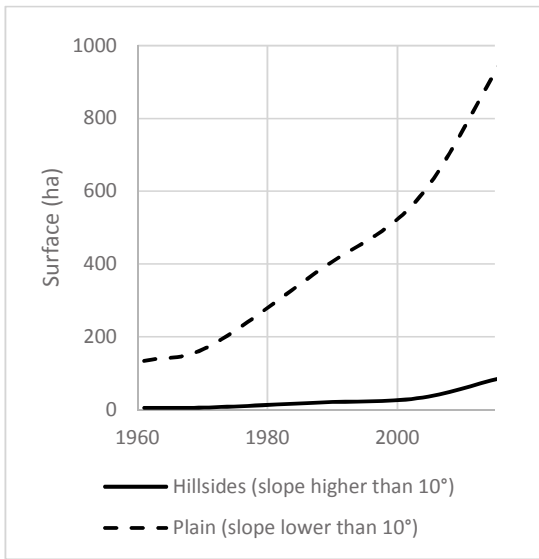


Figure 25: Urban expansion by slope of the terrain in Cajamarca (1961-2016)

Prepared by P. Moschella. Sources: IGN 1961; SAN 1971, 1988; Google & Digitalglobe 2018; METI & NASA 2011.

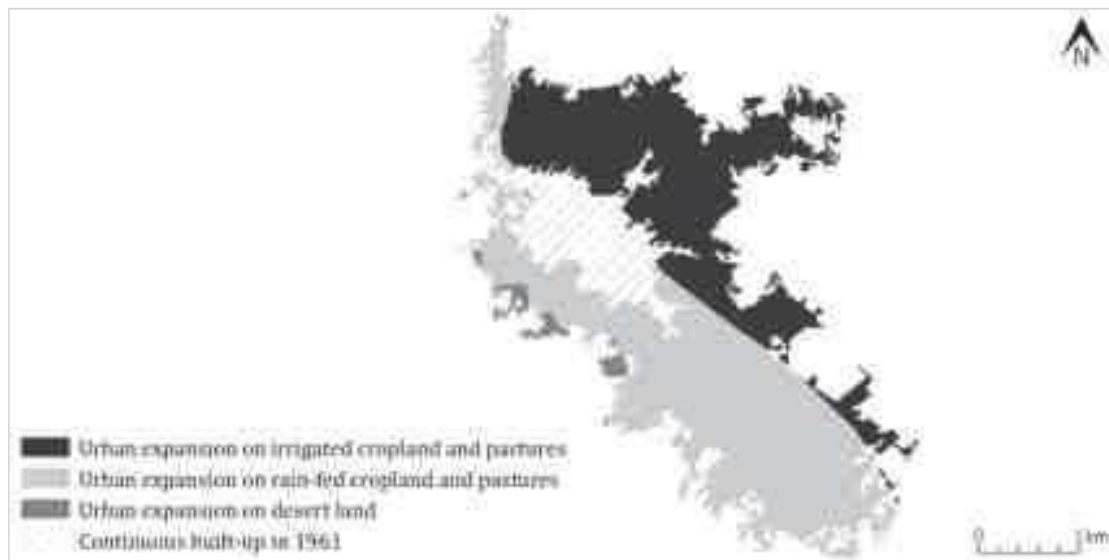


Figure 26: Urban expansion by previous land-cover in Cajamarca (1961-2016)

Prepared by P. Moschella. Sources: IGN 1961, Google & Digitalglobe 2018.

Until 2003, the expansion occurred predominantly on agricultural irrigated land, after that, new urban areas were mainly in rain fed farmland. Between 1961 and 2016, 387 hectares of irrigated

land were converted to urban use. This means that at least 37% of the city was built on agricultural irrigated land (see Figure 27). The urbanization of this area could be considered as unsustainable due to the loss of good quality soils that are a scarce resource in the region. But also due to their inundation risk and the urban expansion impacts in water quality, these aspects will be explained in the following sections.

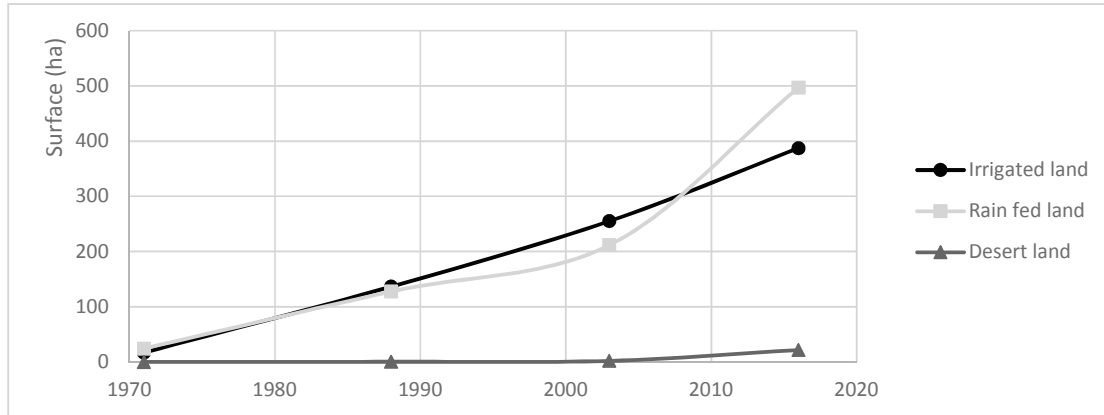


Figure 27: Urban expansion by previous land cover in Cajamarca city (1961-2016)

Prepared by P. Moschella. Sources: IGN 1961; SAN 1971, 1988; Google & Digitalglobe 2018.

2.3.2. The agricultural area of Mashcon valley

The Mashcon River has an orientation from northwest to southeast and presents a wide valley where it encounters the river Chonta. The valley is between 2,750 and 2,600 meters above sea level and is also known as the Cajamarca valley (see Figure 28). The valley has a length of approximately 17 km and a width of 4 km. The weather is temperate (12 to 15 °C) and the average annual rainfall is 600 to 800 mm, with seasonal rains from October to April (NIPPON KOEI 2010). The valley's soils are part of a scarce resource as good agricultural quality land only covers 5.2% of the regional surface (Gobierno Regional de Cajamarca - GRC 2010). This scarcity is mainly due to the mountainous relief of the region.

The valley floor has many irrigation channels although the water availability is not enough to cover the present demands during dry season, thus the productivity is reduced. The demand volume for agriculture is of 15.50 MMC in dry months, and competes with domestic use, so in dry years, waste waters have been used despite its safety problems (NIPPON KOEI 2010).

The production in the valley has been traditionally dedicated to food products; especially cereal grains like wheat, barley and corn (Deere 1990). At the beginning of the XX century some landowners of the valley started to invest in fine quality cattle for milk production (Rodríguez 1994). In 1947, Perulac, a subsidiary of Nestlé, installed a milk processing plant in the valley and stimulated the use of the best and irrigated lands to grow improved pastures (Deere 1990). The arrival of the dairy industry accelerated the production change from foodstuff to cattle breeding;

first in large and medium properties, but over time even small landowners were attracted as direct or indirect milk providers (Rodríguez 1994).

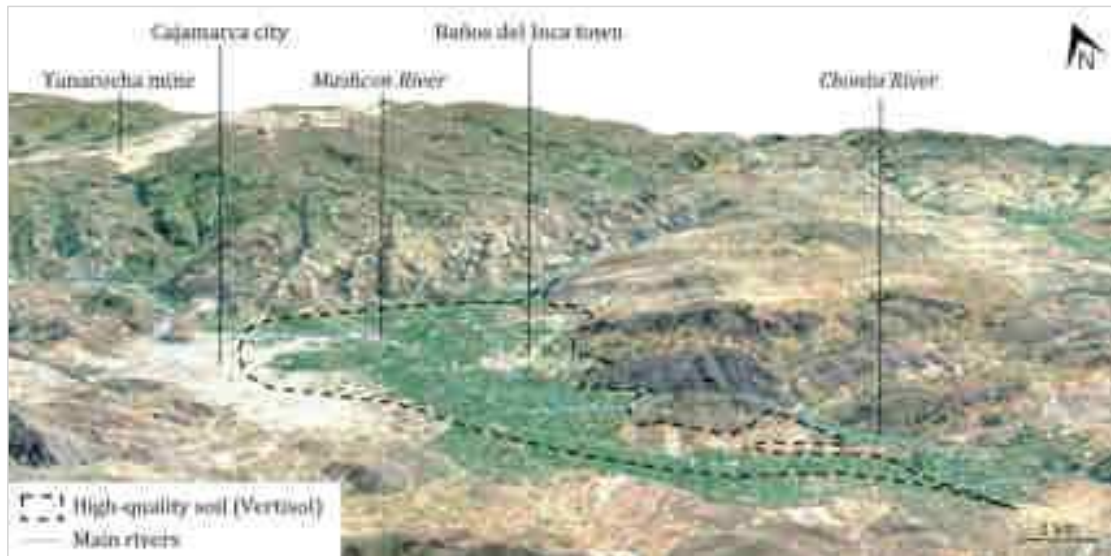


Figure 28: The Cajamarca valley

Prepared by P. Moschella. Sources: Google & Digitalglobe 2018, GRC 2010.

Presently, the two milk factories installed in the valley belongs to the transnational Nestlé and Gloria, one of the biggest corporations in the country. There are also a significant cheese and dairy production by diverse establishments. Given that, Cajamarca is the province with the largest number of dairy cattle in the country (INEI 2013). Though, cattle raising for milk production has decreased its profitability since the 1990s due to the economic openness to imported dairy products in the context of the neoliberal restructuring reforms (Zavala 2010, Aubron & Cochet 2009).

The registry of rural property of about the year 2000, shows in the study area the remain of four large properties with an extent above 30 ha. and the abundance of small properties with less than 1 ha (see Figure 29). In that year, the large properties were located in the center, and the smallest concentrated in three spots: on the north, south and the southeast corner. In total, the study area had 470 rural properties with an average extent of 1.07 hectares (Ministerio de Agricultura n. d.). These results confirm the trend of property fragmentation (INEI 2013).

In most cases, when transferring the farmland to the next generation, the properties have been subdivided among the heirs, resulting in small properties. Apparently, in the last decade the heirs usually prefer to sell the property, as they are no longer working in agrarian activities. Although, the farmers with a more profitable activity are less interested in selling their property.

In recent decades there has been a reduction in the quality and quantity of irrigation water, partly as a consequence of the urbanization process itself. Because the new urban occupations usually close the passage of the irrigation channels, affecting the cropland irrigation. Similarly, several of the new occupations that lack a connection to the sewerage network, discharge their wastewater to the channels or crop fields, reducing the quality of the irrigation water. A study reveals a high

level of fecal contamination in Cajamarca's vegetables, related to the discharge of untreated wastewater in rivers and channels used in irrigation (Rivera-Jacinto et al. 2009).

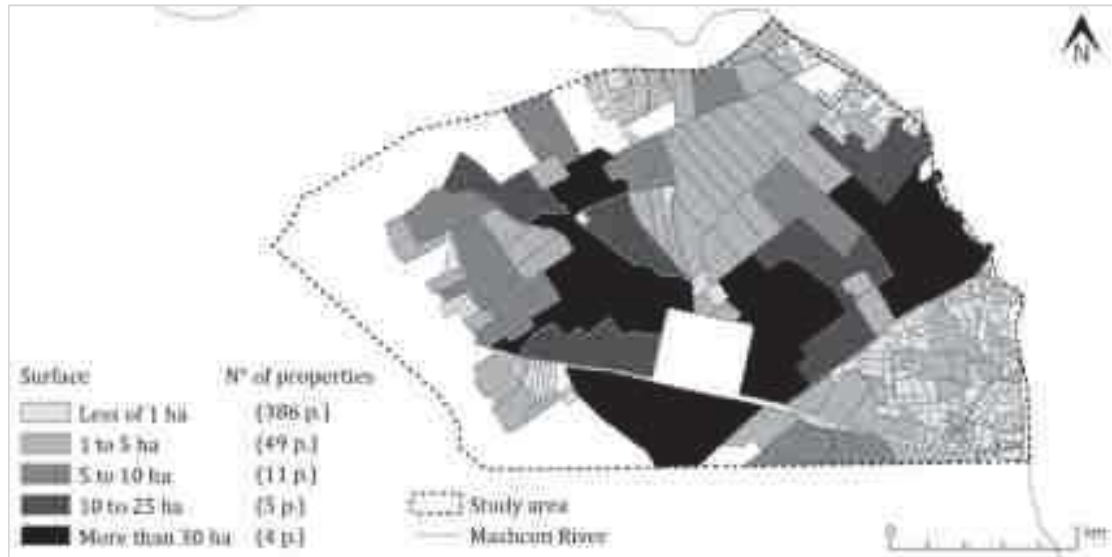


Figure 29: Map of rural property in the study area of Cajamarca valley

Prepared by P. Moschella. Source: Ministerio de Agricultura n.d.

A survey made in a fieldwork course of Social Sciences Faculty of the Pontifical Catholic University of Peru in 2007 shows that 39.6% of the city residents thinks that the main environmental action needed in Cajamarca is conserving forests and rural areas. The valley is considered one of the most important identity elements of inhabitants, and urbanization is threatening it (Vega Centeno 2011).



Figure 30: Cattle next to the new urban areas

Photo by P. Moschella, 2016.

2.3.3. Urban expansion process in the study area (1988-2016)

The study in depth of urban expansion in Cajamarca valley focuses in a section of the urban fringe with the presence of different stages of the transition from irrigated prime farmland to urban land. The selection also considered the existence of two land-use conflicts: residential use in non-developable land, and the persistence of farmland in areas planned as urban. The selected area is delimited by the Hoyos Rubio avenue to the North, Mario Urteaga avenue to the west, the highway to Baños del Inca to the South, and the Mashcon River to the East (see Figure 31). This section describes the land-use changes and the process during the last three decades.

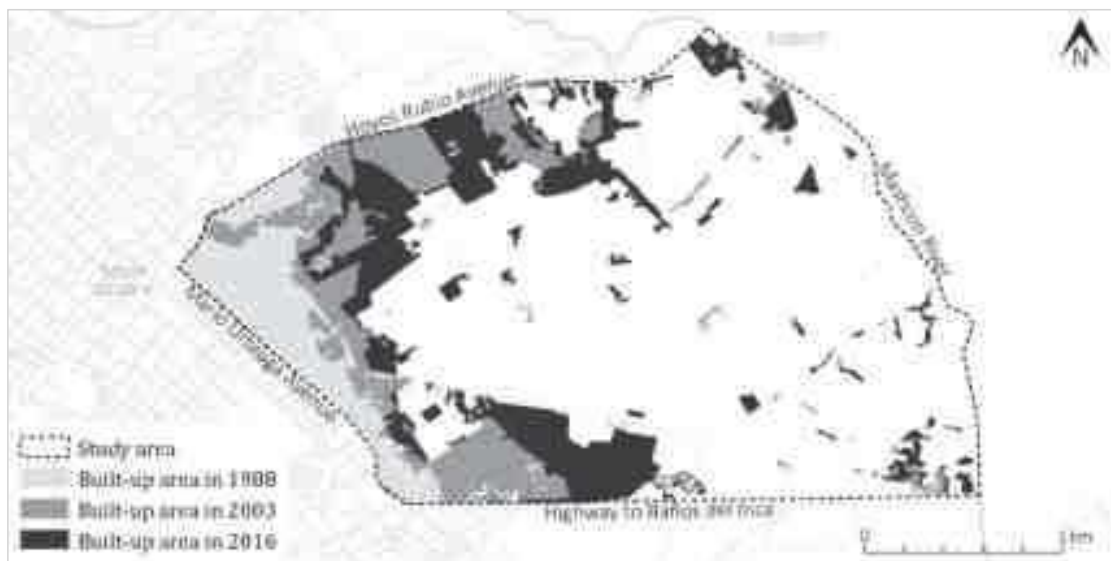


Figure 31: Map of urban expansion in the study area of Cajamarca valley

Prepared by P. Moschella. Sources: SAN 1988, Google & Digitalglobe 2018.

The rural landscape 30 years ago

The image of that time in the study area was described by the interviewees as predominantly pastures for cattle and also crops of corn, beans and other vegetables. Other important elements in this landscape were irrigation channels and rivers, as well as the trees along them and dividing yields. An aerial photography of 1988 shows the prevailing of pastures in medium to large farmlands with a few farmhouses. The built-up zone and the rural area were divided by the “Via de Evitamiento”, an unpaved road designed to redirect heavy traffic out of the city. In addition, two paved roads crossed the Via de Evitamiento, one in direction to the nearby town of Baños del Inca and the other towards the airport (see Figure 32).

On the west side of the Via de Evitamiento, almost all the blocks were defined, and about 80% of the urban plots were built. Many streets were unpaved and a few crops remain mixed among the urban land. On the east side of the Via de Evitamiento, an urban configuration could be observed only in the northern crossroads, 800 meters away from the main square or “Plaza de Armas”. Close to this intersection, there were about 50 medium-sized plots (with an average area of 250 m²)

mainly of attached houses with backyards. Moreover, there were a few subdivided farmlands into medium or large urban plots next to the southern road. The farmland comprised approximately 6 large properties of more than 30 hectares, and many medium-size to small properties, including some with less than 1 ha. By that time, other structures in this area were the wastewater treatment plant and the regional office of the Ministry of Agriculture.



Figure 32: Cajamarca valley in 1988

Prepared by P. Moschella. Source: SAN 1988

The housing demand increase after 1990s

Since 1990s, the city had a higher population and economic growth, in the context of large mining inversions. In the next decade, the impact of this growth on the landscape of the study area consisted in a progressive expansion of residences, a new highway, schools and commercial establishments.

These changes can be observed in the comparison of the previous aerial view with the imagery of 2003 (see Figure 33). The western fringe, between the limit of the study area and the Via de Evitamiento, became a consolidated urban area. In this area, almost all plots were built, the streets were paved and the construction of public parks and gardens was finished. Also, the number of bridges to cross the river San Lucas increased from three to seven.

On the east side of this portion, the residential land-use extended on the north and south, in proximity with the main crossroads. In the northern sector, at least eight residential urban developments can be distinguished in different stages of advance. This was clearly the result of the subdivision of different farmlands, and their extent was between 2 and 6 ha. Only one of them was detached from the continuous built up area. In this sector was constructed a new and wider northern branch of the Via de Evitamiento, surrounding the new urban areas. Its construction occurred in the middle 90s, ten years after the construction of the Via de Evitamiento, with the aim of alleviating the traffic due to the urban expansion towards the northeast. In the southern

sector, the main urban development was Villa Universitaria with a surface of 17 ha. Scattered houses in the rural area also increased.



Figure 33: Main changes in the study area 1988-2003

Prepared by. Source: SAN 1988, Google & Digitalglobe 2018.

Along the main roads appeared diverse commercial establishments. The most significant non-residential establishment constructed in this period, was Davy College in 1995. This private school was originally founded to satisfy the demand of the high-income families related to the mine.

Regarding the farming activity, in this period, three large farmlands of the study area started to sell their property for urban developments, as well as some medium-sized properties. Despite these changes, the dairy farming remains a significant activity in this area. In relation with this, interviewees mention it was still common to see cows crossing and stopping the traffic in the main roads of the study area.

New investments for a growing city

In the last decade, the main urban changes in the study area are the arrival of malls, universities, and new administrative and sports facilities (see Figure 34). The Via de Evitamiento, far from being the limit of a green belt as purposed in the urban plan of 2006, became a concentration of commercial activity. The first mall in the city established in 2006 in a place adjacent to the study area. In 2013 and 2015, two other malls opened inside the study area, so the three malls were located very near in a 300-meter radius. Along this way many other commercial establishments are situated. About in 2010, also two private universities opened its regional campuses in this corridor. The local government also built in this area a new administrative, cultural and sports center, called the Qhapac Ñan complex.

Regarding the residential land-use between 2003 and 2016, previous built-up areas got a higher building density. Moreover, a new housing type appears in this period: two apartment complexes

of 6 and 8 towers. Also, only one new urban development is larger than 5 ha, the rest is smaller and dispersed. In addition, the new houses are dispersed and correspond to different sizes. Unlike previous periods, some single-family homes were built in plots larger than 1500 square meters, which were commonly located in other areas of the valley.

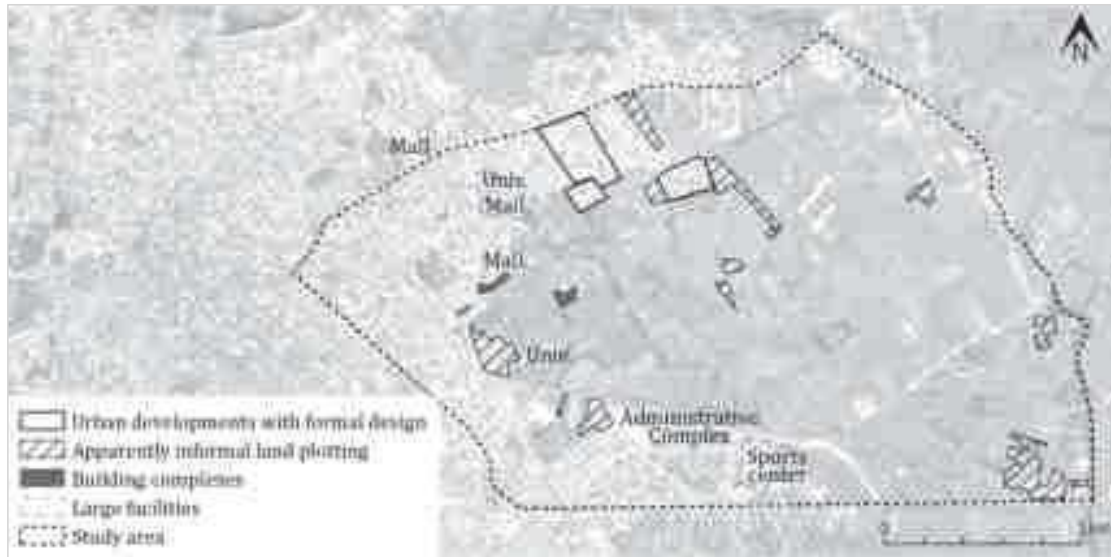


Figure 34: Main changes in the study area 2003-2016

Prepared by. Sources: Google & Digitalglobe 2018.

Undeveloped land: Farmland in residential zoning

Despite the urban expansion process in the study area, there remain some medium to large farmland adjacent to consolidated urban land. Since the Urban Plan of 2006, these areas have a residential zoning, so it stands out the persistence of agrarian activities. For example, an interviewee close to the owners of one of these farmlands explained that the whole family has the desire of maintaining their ranch, and they also benefit with the proximity to urban areas to offer educational and recreational services like visits to the farm, workshops for children and rentals for camping or special events. Another example is the Argentina Ranch; whose owner is president of a proprietors' association. In 2011, he denounced the killing of four of his horses as an intimidation attack by land traffickers (Radio Programas del Perú - RPP 2011). This fact reveals the high pressure for urbanizing the area.



Farmland in the study area.

Photo by Ana Paula López, 2017.

2.3.4. Urban development types

The main types of urban development in the study area have been defined on the basis of the processes explained in the interviews, and the spatial analysis of land-use changes and urban fabric. This analysis allowed identifying five main types of urban development, including four with the predominance of residential-use.

a. Informal land subdivision by small owners

It is the predominant type of urbanization in the study area. In this case, small farmlands of less than 4 hectares are subdivided and sold for urban land-use without complying with the zoning ordinance. Usually, the land owner requests an engineer to draw the plan of the land subdivision, and then a notary prepares the public deed of sale of the subdivided land. The result is a very disordered fabric with the absence of public spaces and facilities. The design of roads is very precarious, often with discontinuity and narrow passages that obstruct access to houses. In addition, the plot's size and forms are frequently very irregular. For example, the block in Figure 35 was previously two rural properties, which were subdivided informally in 44 plots with very different sizes, ranging from 32 to 1277 m². Due to the intention to profit from the total surface and the lack of an appropriate urban design, the internal passages are narrow and insecure. In the same way, land-use is mixed, including residential and medium or small businesses.

Many interviewees consider the disorder in the street network as one of the main problems of the urban expansion in the city. It is very common that owners that informally subdivide land avoid the contributions to streets, and sometimes this situation leads to social conflicts. For example, there have been cases where land owners have not recognized some streets as public space and informally sold the terrain even when it blocked the entrance to other houses.

National law allows land owners to sell in this way, despite the zoning ordinance establishes lot sizes and other considerations. Moreover, the new owners do not obey the land-use and edification coefficient determined in the zoning ordinance. In fact, in 2007, an inspection of the Municipality identified seven cases of informal land subdivision in the study area, among a total of 20 cases in the city.



Figure 35: Example of irregular land subdivision (left) and narrow passages (right)

Prepared by P. Moschella. Sources: Google & Digitalglobe 2018, Municipalidad Provincial de Cajamarca - MPC 2006.

After the plot sale, the new owners build by their own means. Often, without the building approval by the municipality. Therefore, constructions are very varied in terms of size, height and design. Frequently, the road infrastructure and basic services networks are connected after the dwellers already live there. They organized and present the request for connection to the potable water and sewerage services provider in Cajamarca, SEDACAJ. In a similar way, the users request for connection to the electricity network to the energy provider, HIDRANDINA. Therefore, these companies coordinate directly with the users.

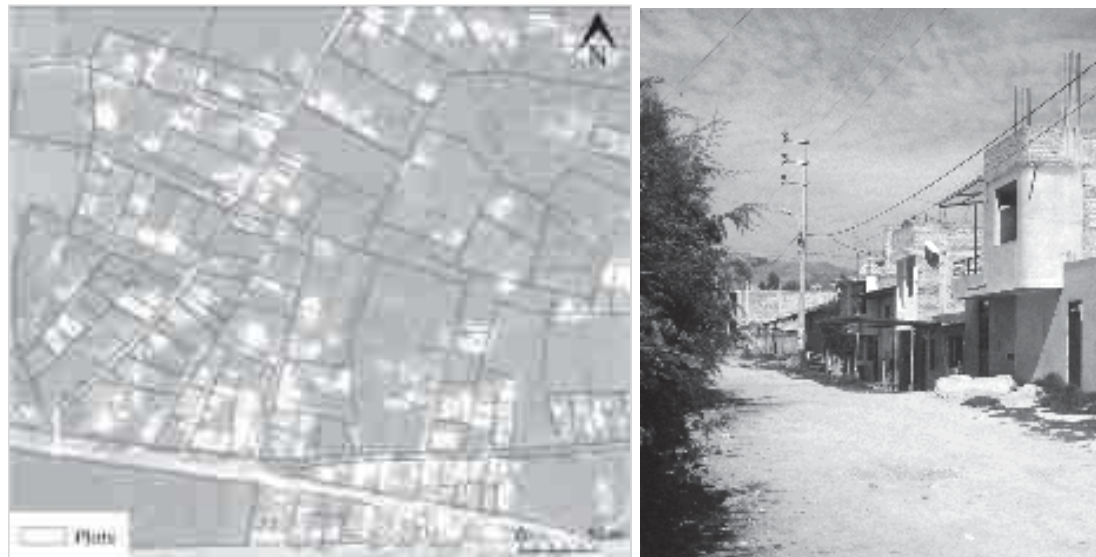


Figure 36: Irregular land subdivision in Cajamarca valley

Prepared by P. Moschella. Source: MPC 2006. Photo by Evelin Raico, 2017.

The informal land subdivision has also occurred in less dense areas and with a fewer intensity (see Figure 36). Also, in this cases the plots are commonly disordered and in varied sizes, but still alternated with agrarian activity.

b. Formal urban developments

There are some urban developments that appear to be according to the standards. All of these have in common having surfaces between 5 and 8 hectares and the land was previously large farms. The urban design considered the widths of roads and trails as regulated and the contributions for facilities and public spaces. In many cases, basic service networks are installed before housing construction. The plots are larger than in informal land subdivisions and oriented to medium to high income sectors. Among this type of urbanization are the San Roque Ranch and University Village (see Figure 37).



Figure 37: Urban development “University Village”

Photo by Evelin Raico, 2017.

One example is the San Roque Ranch, which was traversed by the two traces of the Via de Evitamiento. The former manager, José Amambal Vargas, described it as a very productive ranch before 1986. It was specialized in dairy cattle and also cultivated corn, vegetables, potato, among other products. The first urban development in the ranch was planned after a talk with the major, when they agreed to contribute with some area of the property for the trace of the Via de Evitamiento. At the same time, it motivated the urban development in the strip that was going to be separated of the property. This strip has an extent of 2 hectares approximately and was less productive for not having irrigation. San Roque’s owner followed the formalities required, such as demanding a zoning change, paying taxes and providing public spaces. This urban development had 40 plots of an average extent of 423 m² and a small park (see Figure 38).

Ten years later, the construction of the second trace of the Via de Evitamiento motivated the ranch’s administration to plan another urban development of around 10 hectares of the ranch. The process was very similar and the causes too. As the urban areas expanded on the north, the

irrigation channels were altered and water's quality and quantity declined. At the same time, the proximity to urban areas and main roads in a growing city largely increased the urban land value.



Figure 38: Urban developments in San Roque Ranch in 1988 (left) and 2003 (right).

Prepared by P. Moschella. Sources: SAN 1988, Google & Digitalglobe 2018, MPC 2006.

Moreover, the ranch offered payment credits in 5 years. The plots were offered only with water and sewage network connections. The former manager considers that the lack of all services and infrastructure reduced the cost, so the terrain was more affordable to buyers. Frequently, the new owners organized to demand the connection to electricity network, and the road and sidewalk paving. After that, the municipality started to charge taxes and offered the waste management.

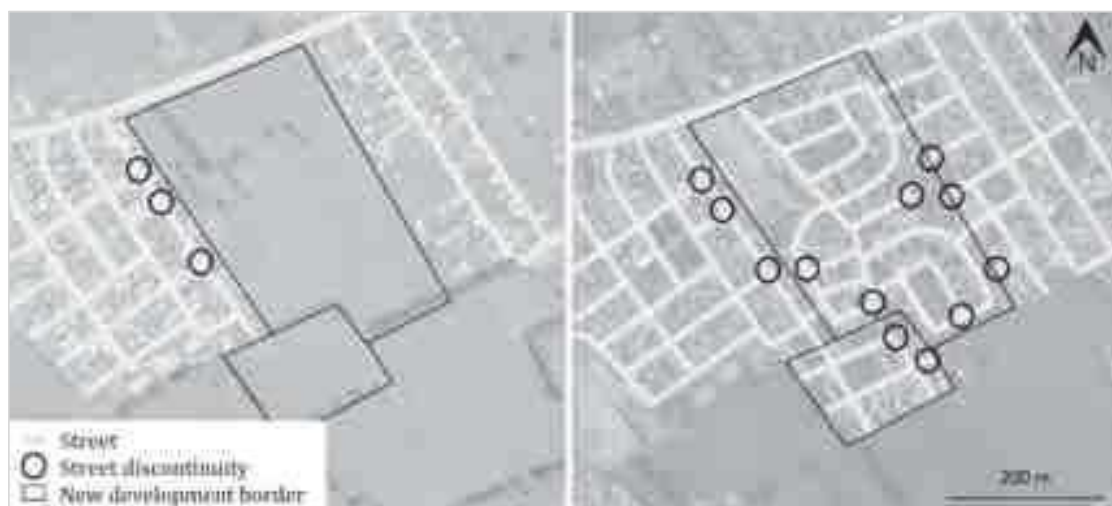


Figure 39: Street discontinuity in urban developments in 2003 (left) and 2016 (right).

Prepared by P. Moschella. Source: Google & Digitalglobe 2018.

Even though, this type of developments meets the standards, the street network can present discontinuity between different developments, and the urban fabric is fragmented (see Figure 39). Therefore, the accessibility could be difficult in some areas, and if this pattern continues it will be more complicated for the dwellers far from main roads.

c. Land invasion

Another kind of development sequence occurred in the southwest of the study area, where the land was illegally appropriated by invasion in the 1980s of more than one hundred families. This is the only land invasion in the study area, but there are others in the city, as it was a usual process in the 1970s and 1980s. The aerial image of 1988 shows the tight location of about 120 shacks. Interviewees mentioned their arrival generated a conflict with the police but they were a large number of people to confront. So they negotiated with the owner and the municipality to stay. Apparently, each household paid a very small quantity and they accessed to a new distribution with slightly larger plots and a wider space for a road. The result is a development with 225 plots with an average area of 77 m², distributed in long blocks with very narrow streets and absence of green areas and public recreation spaces (see Figure 40).

After the occupation, followed the houses construction by phases that can extend many years. Then the basic services network connection was requested by the dwellers, as mentioned before. Currently the majority of buildings in this area have between 3 and 4 floors. The plots facing the avenue reach 5 floors and have businesses on the first floor predominantly of vehicle repair and sale of auto parts.



Figure 40: Land invasion in 1988 (left), redistribution of plots (center) and present view (right)
Prepared by P. Moschella. Sources: SAN 1988, Google & Digitalglobe 2018, MPC 2006. Photo by Evelin Raico, 2017.

d. Apartment complexes

Recently, closed apartment condominiums have been built. They are located next to the shopping center Real Plaza and to the back of this. The land of these was sold by large farmlands, one of them, by the San Roque Ranch. The first condominium has 6 towers of 7 floors and some small gardens inside (see Figure 41). The second condominium has 8 towers of 8 floors and more green spaces and common areas. These developments have been designed and built by local construction companies, and the apartments are targeted to upper middle class.



Figure 41: Apartment complex in Cajamarca valley

Photo by Evelin Raico, 2017.

e. Large urban facilities

Besides the residential land-use, in the study area stands out the existence of the Qhapaq Ñan complex, where diverse public offices are concentrated, such as the Provincial Municipality of Cajamarca and the Superintendence of Public Registers, among others public offices. In addition, here are located varied public services like the stadium, a sports complex, an artisanal complex and recreational spaces. The 30 hectares of this center were bought to the heirs of a farm owner, and the inversion was facilitated by the charitable association of the Yanacocha mine.

Other large urban facilities that have been built in the study area include commercial and educational purposes. For example, the San Roque Ranch sold the land to the Real Plaza mall. The adjacent farmland was sold in two large plots for the Open Plaza mall and the North Private University (see Figure 42). The next larger commercial plot in the sector belongs to a hardware and construction store. In all cases, the investors negotiated directly with large farmland owners to buy a large plot of sizes between 1.5 and 3 hectares.



Figure 42: Open Plaza mall and the North Private University in the study area

Photo by Evelin Raico, 2017.

2.4. The buried wetlands of Purumpampa

The third case study shows the urban encroachment on the Purumpampa wetlands which have a historical and ecological value and contain an important recreational area for the citizens and visitors. For these reasons, the community has taken some actions to protect them. In addition, these soils have bad conditions for construction, so these new urban areas represent a risk. This site is located in the Andean city of Huamachuco, the capital of the Province of Sanchez Carrion in the region of La Libertad. The city is situated at 3,200 meters above sea level and surrounded by mountains. This section presents an overview of the city and the wetlands, then it is described the process of urban encroachment on the wetlands and the main types of urban developments in the area.

2.4.1. Huamachuco city growth

According with the Census data, the city had a population of 11,773 inhabitants in 1993, and it has more than doubled in 14 years, reaching a total of 28,330 inhabitants in 2007 (Bensús & Pérez 2014). At the district level, which contains also the rural settlements, the population has shown a larger growth than other Andean districts of a similar size.

Huamachuco has had similar migration and economic dynamics as Cajamarca in the last decades, but in a smaller scale. Both have been traditional Andean urban centers, during the 1980s the armed internal conflict caused the immigration of rural peasants, and later mining attracted new migrants and caused a rapid urban expansion. Although, in the periphery of Huamachuco there are no enclaves of mining elites as in Cajamarca (Steel 2013, Vega-Centeno 2011). Due to the predominance of mining investments in a smaller scale near to the city, moreover, the high-income employees of the largest mine prefer to establish in the bigger coastal city of Trujillo.

Before the 1990s, Huamachuco was mainly an administrative and commercial center in close relation with its rural hinterland. Traditionally, the main economic activity are the markets and the weekly fair that congregate the agricultural producers of the province (Elías 2012). However, since the decade of 2000 the mining activity intensified in the mountains near to the city producing a high demand of services like restaurants and hotels, among others.

The analysis of the landscape changes in the territory under the influence of the city, shows that the main driver of change is large-scale mining investments, due to the open-pit mines, and indirectly, because of the urban expansion in Huamachuco (Moschella 2017). As has been mentioned, the increase of mining investments in the country is related with the neoliberal restructuring in the decade of 1990s and also to the worldwide metal prices increase (Bury 2005, Pinto 2009). In this context, large mines started to operate around the city, like La Arena, La Virgen and El Toro, all of them found in a 15 km. radius. However, the larger project is Lagunas Norte, managed by Barrick Gold Corporation and it is located at 25 km. from the city. This mine initiated its operation in 2005. In contrast, also artisanal and informal gold mining occurs in the skirts of El Toro Mountain at 3 km. to the southeast of the city. Due to its characteristics, this type of mining

involves closer economic and social relations with the city and specifically it is related with the urban expansion in Purrumpampa.

As a result, the city has had an accelerated urban expansion, as its extent almost triplicated in three decades (see Figure 43). In 1987 the continuous built-up area had a surface of 89 hectares, and in 2014 it enlarged to 268 hectares. Hence, the annual urban expansion rate in this period was of 7.4%, significantly larger than in previous periods (see Table 9).

Given that, Bensús & Pérez (2014) mention that the main perceived changes by the citizens in the last years are the increase of housing and land value, moreover it is difficult to acquire a house in the consolidated area of the city.

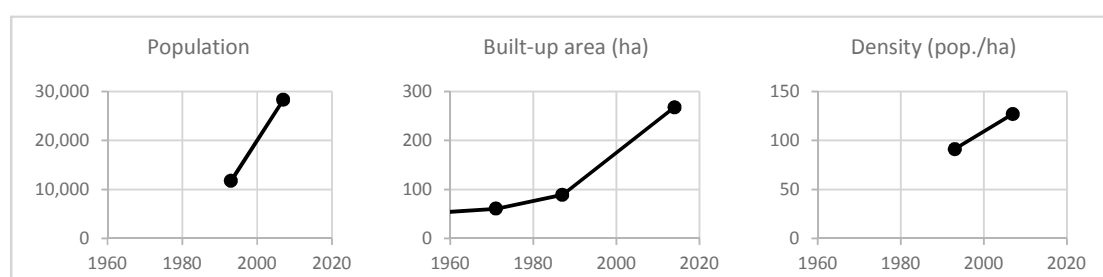


Figure 43: Urban growth in Huamachuco city

Prepared by P. Moschella. Sources: INEI 1993, 2007; SAN 1952, 1971; SPOT 1987; Digitalglobe 2014.

Table 9: Urban expansion rates in Huamachuco city (1952-2014)

PERIOD	AVERAGE ANNUAL URBAN EXPANSION (HA)	ANNUAL URBAN EXPANSION RATE (%)
1952-1971	0.6	1.2
1971-1987	1.8	2.9
1987-2014	6.6	7.4

Prepared by P. Moschella. Sources: SAN 1952, 1971; SPOT 1987; Digitalglobe 2014.

The distribution of the expansion areas has been initially along the three main roads that connect the city with other towns. The most important is the way to the southeast that connects to the coast and the capital city of the department, although it has been unpaved until 2014. The other important roads at a regional scale are to the east and the north. Since 1990s the city expansion is predominantly to the northeast, which corresponds to the closer plain areas (see Figure 44). However, in this direction are located the Purrumpampa wetlands and their extent is reducing due to draining and filling for urban encroachment, as will be described in the next section.

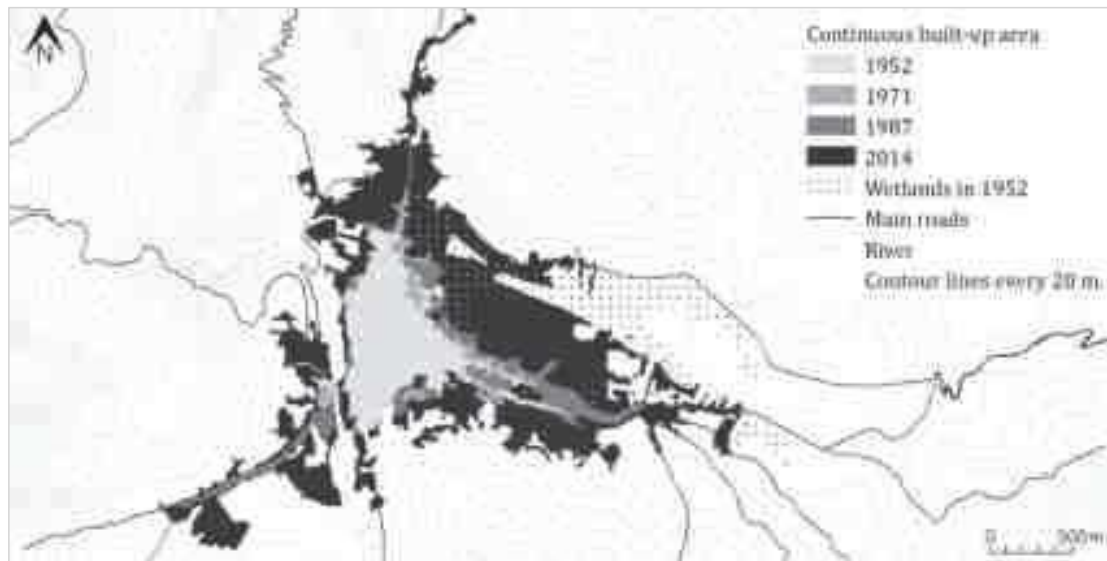


Figure 44: Urban expansion in Huamachuco (1952-2016)

Prepared by P. Moschella. Sources: SAN 1952, 1971; SPOT 1987; Digitalglobe 2014; Ministerio de Transportes y Comunicaciones 2013; METI & NASA 2011.

Specifically, the encroachment of the continuous built-up area on wetlands has been of 31 hectares considering the wetlands extent in 1952. But it is important to mention that the main part of this encroachment has occurred on wetlands that showed a decrease of soil humidity becoming pastures before the urban expansion. In fact, 8 hectares of wetlands have been directly in-filled and turned into the continuous built-up area in the last three decades (see Figure 45). In addition, 45% of the city expansion in this period have occurred on farmland, especially in areas on the south fringe and fragmented portions with a rise in slope.

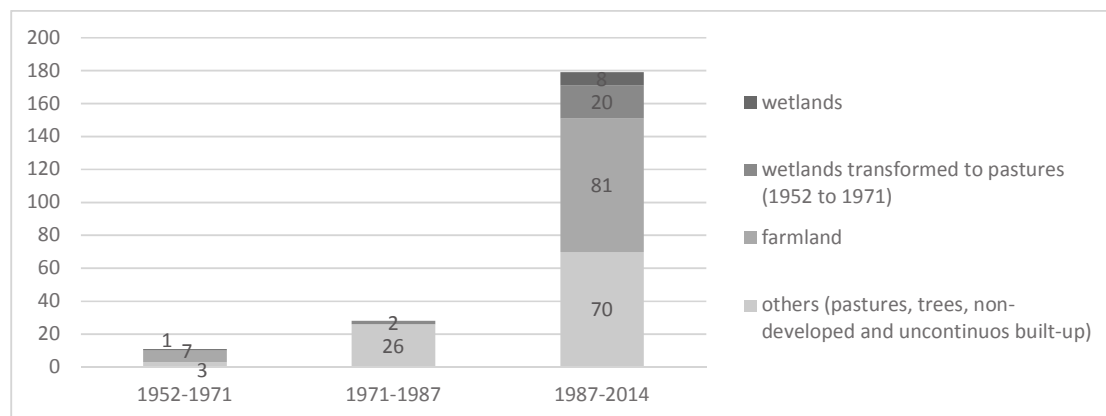


Figure 45: Urban expansion by previous land-cover in Huamachuco city

Prepared by P. Moschella. Sources: SAN 1952, 1971; SPOT 1987; Digitalglobe 2014.

2.4.2. The Purrumpampa wetlands

Purrumpampa is a frequented recreational area, an historical site and a natural area of wetlands. For these reasons, it has been established as a Zone of Ecological and Historical Protection with an extent of 59 hectares. In 1883, the Battle of Huamachuco during the Peru-Chile war occurred in a wide extent in this area; therefore, it is appreciated as an historical site.

Regarding its environmental conditions, it is located in a depression to the east of the city of Huamachuco, where the water table is very shallow and allows the development of a wetland ecosystem. The area comprises different habitats distinguished by the degree of humidity of soil which is related to slight elevation differences. This area has ponds, marshes, humid pastures and dry pastures.



Figure 46: Eutrophic pond in Purrumpampa, view to the south

Photo by P. Moschella, 2016.

The main pond has a surface of 1.4 ha. and there are other two elongated ponds. Although, these are constantly covered by floating plants due to eutrophication processes related to the pollution of domestic drains (see Figure 46). During the rainy season, several small pools are formed. These characteristics are partially explained by the geology of the area, because it consists of lacustrine deposits accumulated during the Pleistocene (Instituto Geológico, Minero y Metalúrgico 1980), thus it has a low permeability and poor drainage. The surface and subsurface water is fed by streams from the south and also by the groundwater flow. In the plain areas, the shallow slope let the water flow to the west, so the main drainage goes through a covered channel by the city and then flow out to the river Grande (see Figure 47). There exists an old network of several channels, that enables the drainage of water, presumably it was created to prepare the land for agricultural production.

The vegetation is dominated by herbaceous plants such as grasses, sedges, and reeds. Although, some interviewees mention that reeds have reduced in extent. The main resident and migratory birds that inhabit this zone are herons, wild ducks, the Puna Ibis (*Plegadis ridgwayi*), and the Andean lapwing (*Vanellus resplendens*). The Andean lapwing, locally known as *liclic*, is the most appreciated and recognized by its singing. Many interviewees also remember the abundance of little frogs that nowadays are difficult to find.

Besides being a habitat for wildlife, this wetland provides other important ecosystem services. It is a source of water and it offers resources such as reed fiber for the manufacture of handicrafts and utilitarian elements. In addition, it helps regulate water quality and microclimate. Likewise, it offers cultural services for recreation and enjoyment of the landscape; also it is a recognized

element in the identity of the population. Additionally, the pastures have been used to feed sheep and other farm animals, but this used is being reduced over time.

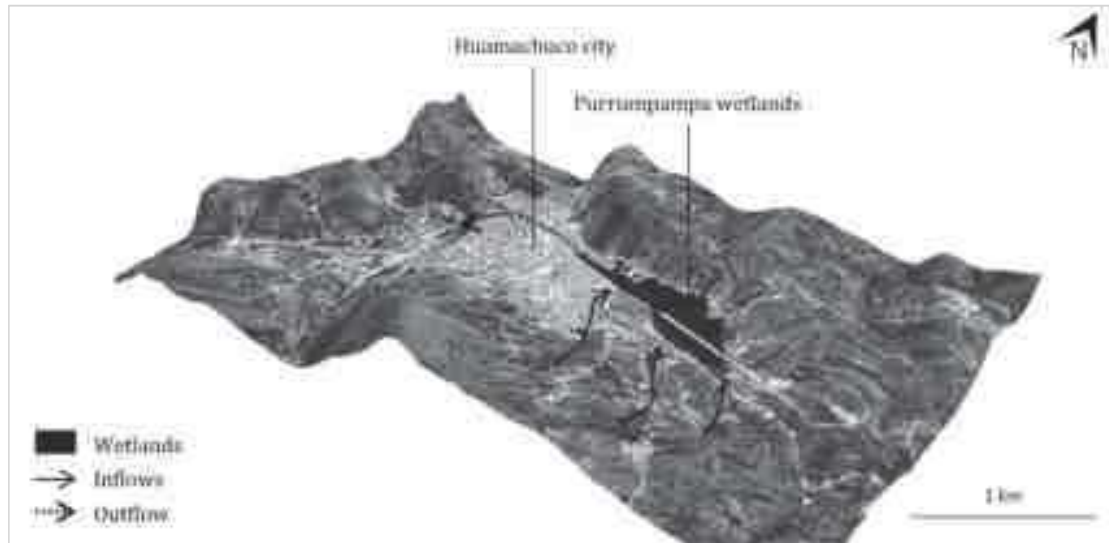


Figure 47: Water flow in Purrumpampa wetlands

Prepared by P. Moschella. Source: Municipalidad Provincial de Sánchez Carrión & Pontificia Universidad Católica del Perú – MPSC & PUCP 2016.

The recreational use of Purrumpampa has a long tradition among the citizens. The drier pastures have an intensive use for recreation and the practice of some sports. Besides, it is an area commonly visited by people who come to the city to the Sunday market, also for school excursions, and until a few decades ago it was used by bathers. It should be noted that, that there are small public recreational areas in the city and in the vicinity of this sector are the most densely blocks of the city, so the recreational use of Purrumpampa is of great importance.

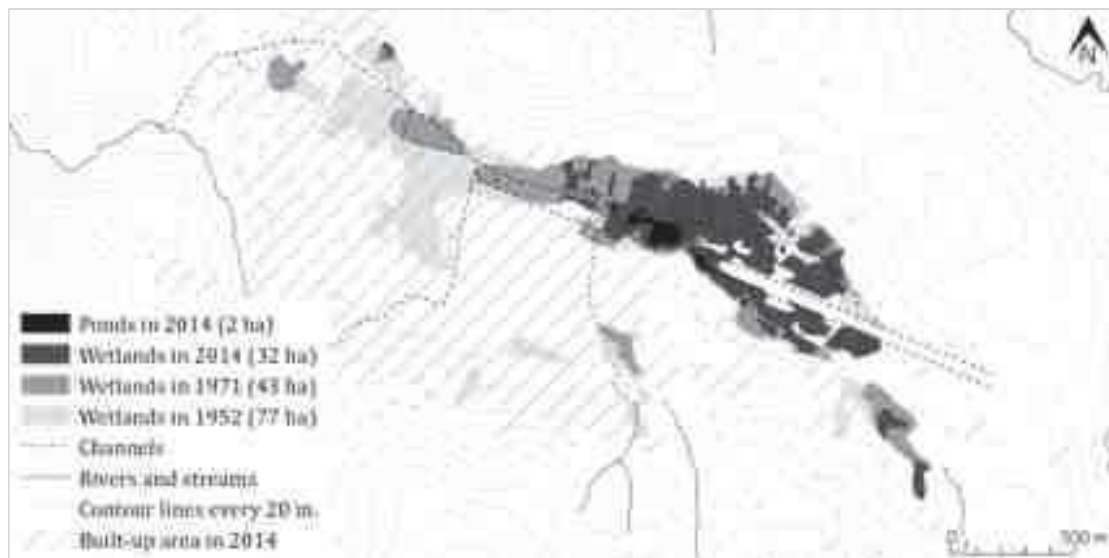


Figure 48: Variation of wetlands' extent in Purrumpampa (1952-2014)

Prepared by P. Moschella. Sources: SAN 1952, 1971; Digitalglobe 2014, MPSC 2004, METI & NASA 2011.

However, the disturbances on surface and subsurface flows, as well as the filling with land and urban encroachments have reduced the extent of the wetlands. The analysis of satellite images and aerial photos during the dry season indicate approximately a reduction of 57% of the wetlands between 1952 and 2014 (see Figure 48). In consequence, the wetlands are now concentrated on the eastern extreme of the depression with an extent of 33.2 ha (31.6 ha of wetlands and 1.6 ha of ponds). Even some parts in this area show more humidity than in previous periods.

These forms of degradation of the wetlands caused the decrease and fragmentation of habitat for wildlife. Additionally, it seems that many animals have abandoned the site due to the pollution generated by the visitors, and the sound and dust produced by the explosions of the nearest mine at 2 km. Likewise, the new urban areas are built without any care to maintain harmony with the environment, thus the landscape value decreased. Another problem is the discharge of wastewater in the channels that reach the wetland, and that of some of these channels were enclosed (see Figure 49). Moreover, the construction of roads that cross the area, through which even motorized vehicles pass. This disorderly growth of the city affects, not only the ecosystem, but also the conditions of health and safety for the users of the recreational areas.



Figure 49: Urban encroachment on the wetlands. View to the northeast.

Photo by Transversal, 2015.

Due to the critical situation of Purrumpampa, part of the community has organized for actions like define its limits, collect waste, remove the excess of floating plants, forest, try to repopulate wildlife, among other activities. For this purpose, the Association for the Protection of the Ecological Park of Purrumpampa was created in 2011. Also, the Urban Plan of 2005 defined the Zone of Special Regulation for Ecological and Historical Protection, an area of 59 hectares, of which 78% is municipal property and the remaining 22% is private property (Municipalidad Provincial de Sánchez Carrión & Pontificia Universidad Católica del Perú – MPSC & PUCP 2016).

2.4.3. Urban expansion process in the study area (1987-2014)

The study area has been defined as the previous extent of the Purrumpampa wetlands and an area of influence of 200 m. By 1987, the city extension in the study area was less than 20 blocks in the surroundings of the main square, which maintained the orthogonal tissue. Also, the terrain for the stadium was fenced, and an airstrip was created across the southern part of Purrumpampa. This airstrip was used by the army during the fight against terrorism in the region, after that it remains unused.

Then, the less humid grassland contiguous to the north, started to be gradually sold by plots. In the decade of 1990s, land invasions occurred on the west part of the wetlands and to the north of the stadium. The families that occupied this area were predominantly rural migrants that arrived during the internal armed conflict. In this decade was also built a marketplace for the city, and to the northeast of the market many plots were sold for merchants.

In 2005 was approved the Urban Plan of the city, which defined the remaining area of Purrumpampa as non-developable. Nonetheless, the plan also projected a belt highway in all the northern limit of Purrumpampa, although it remains unpaved. This main road motivated the occupation of the northern area of the wetlands faster than the planned expansion areas. Consequently, since the decade of 2000 there is informal land subdivision on the north of Purrumpampa, as a fragmented form of urban expansion along the road. (see Figure 50).

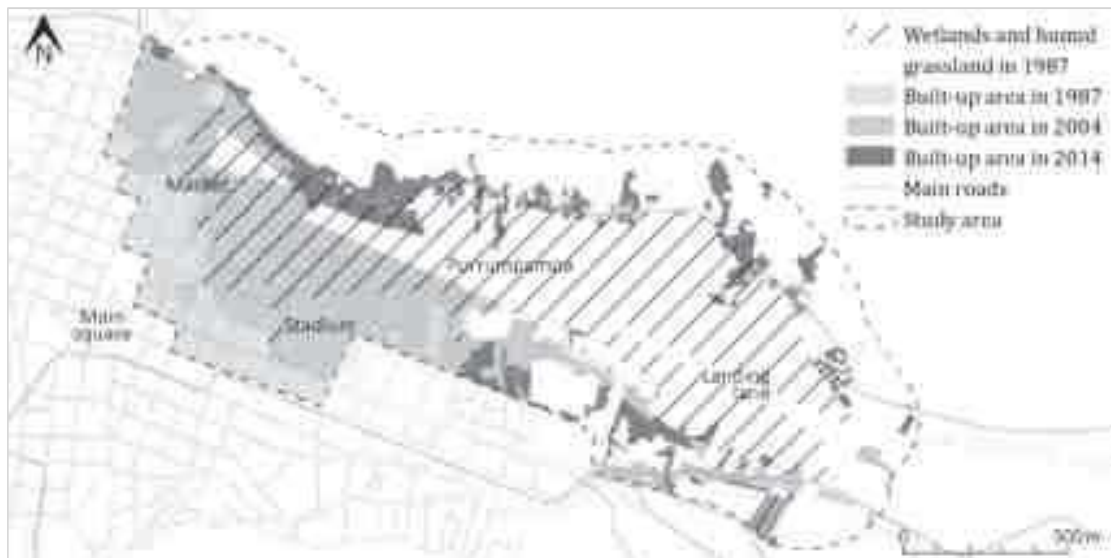


Figure 50: Urban expansion in the study area

Prepared by P. Moschella. Sources: interviews, MPSC 2004, SPOT 1987, Digitalglobe 2014.

2.4.4. Urban development types

The main urban development types in the study area are land invasion and informal land subdivision; both consist in forms of encroachment on the wetlands, as shown in Figure 51. There are also areas with not regulated housing subdivision previous to the urban zoning in the western area.

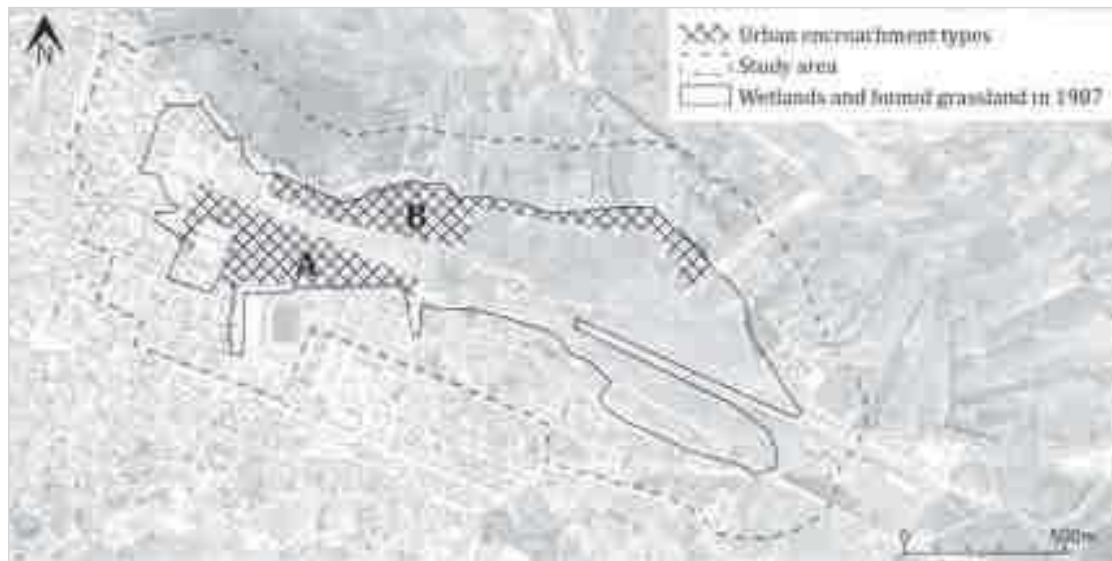


Figure 51: Main forms of urban encroachment on Purumpampa wetlands: (A) land invasion and (B) informal land subdivision.

Prepared by P. Moschella. Sources: interviews, MPSC 2004, SPOT 1987, Digitalglobe 2014.

a. Land invasion

In the 1990s land invasions of the western zone of the wetlands was carried out, mainly by low-income families of migrant origin from nearby rural areas during the internal armed conflict. This occupation occurred on public land without use that was considered as marginal and semi-humid zones. An interviewee mentioned that the organization of the invasion was directed by a political party. The invasion was made by stages, and maintained the orthogonal tissue of older sectors of the city.

It consists in approximately 690 plots with an average surface of 147 m². The houses were built gradually. Many of the initial constructions were made of adobe of a single plant and with traditional tile roof (see Figure 52), but also some houses were remodeled in brick and cement adding more floors.

Later, other intentions of invasions on the south section of Purumpampa have been evicted in 2003 and 2014.



Figure 52: Land invasion present view

Photo by *Transversal*, 2015.

b. Informal land subdivision

Initially, the northern area of Purrumpampa was divided in 36 private agricultural properties. The main part of these terrains was unused due to the bad drainage of soils, only some herders used the pastures. Since the decade of 2000, this land has been informally sold in subdivisions as urban plots, although it corresponds to a non-urban zoning (see Figure 53).

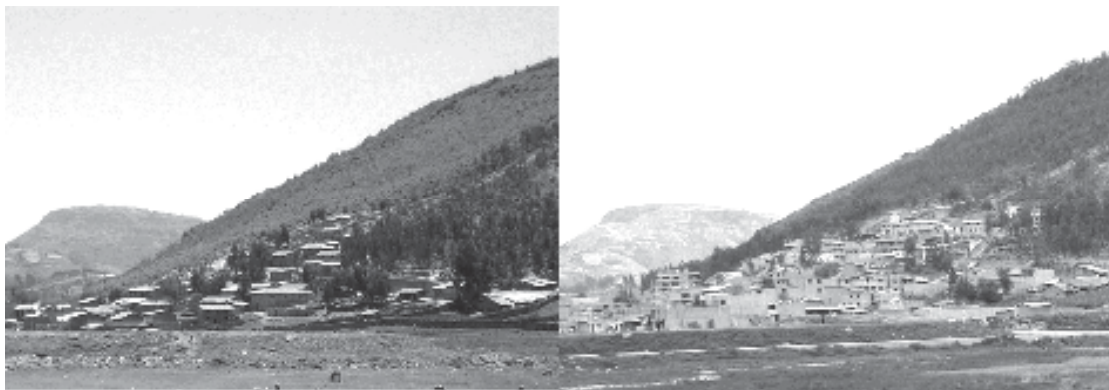


Figure 53: Landscape changes in Purrumpampa between 2010 and 2015, view to the northwest.

Photos by *Proyecto Amigo* 2010 (left) and *Transversal* 2015 (right).

The urban encroachment process begins with the accumulation of debris on top of the wetlands to elevate the terrain and avoid the groundwater. Nevertheless, the existence of a thick layer of organic matter saturated with water and the low consolidation of the upper layer makes it unsafe for building (MPSC & PUCP 2016).

The land subdivision maintains the elongated shape of the initial properties with roads that enter into the wetlands, but without a clear conformation of blocks (see Figure 54). Due to the lack of urban design there are no public space contributions, besides the narrow roads.



Figure 54: Urban expansion in the northern area of Purrumpampa

Photo by Paola Moschella, 2016.

The buildings are characterized by different materials and heights. The first houses were made of adobe and the latter are made of bricks. Also, there have been introduced many modifications to traditional architecture through elements not suitable for cold and rainy regions such as: straight roof, unfinished exterior side, ceramics on the front side, and large windows. The construction time is relatively short in comparison to other areas of the city, as it could be less than 2 years for a building with several floors. This reveals higher incomes of these new owners, as many are miners or merchants.

2.5. Urban dynamics similarities

The three case studies correspond to places of different character in cities of different size; nevertheless, the recent urban expansion processes show several similarities, that will allow to identify common problems in a national context. This section presents the main similarities of the urban dynamics in the case studies: the sharp increase of land value and its reasons; the predominant characteristics of urban expansion as dispersed and informal; and the various social actors involved.

2.5.1. Fast growing cities and sharp increase of land value

The cities where the case studies are found had an important expansion in the last decades. This process implies a high pressure for land-use change. In the case of Lima city, its expansion has been faster in the 1980s and maintains a significant expansion rate to the date. While, the Andean cities of Cajamarca and Huamachuco have presented an explosive urban expansion (see Figure 55) which, in both cases, has been related to mining investments. Moreover, in Lima and Huamachuco, the scarcity of appropriate and accessible land for urban expansion, stimulated many dwellers to occupy hazard areas, such as the high-slope terrains in Mangomarca and the unstable soils in Purrumpampa.

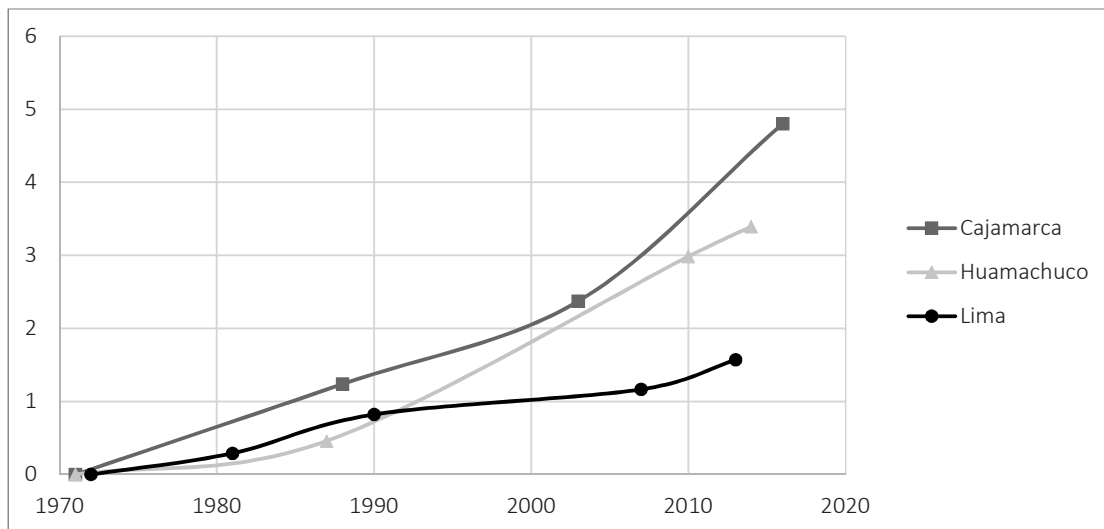


Figure 55: Cities' expansion rate since 1971-72

Prepared by P. Moschella. Sources: Barreda & Ramirez 2004; CIAC-PUCP 2015; IGN 1961; SAN 1971, 1988; Google & Digitalglobe 2018; SPOT 1987; Digitalglobe 2014.

As reported by David Harvey, urban growth increments rental value both in central areas and in the urban periphery, so that land and property values arise (Harvey 1973: 192). The main factors that have generated the elevation of the land value at the city scale is similar in the cities of Cajamarca and Huamachuco where the context of mining investment motivated immigration and a growing demand for housing. Even the undeveloped mining projects generated real estate speculation in Cajamarca as well as the expectation of greater demand for services such as lodging, restaurants and shops without considering the temporality of these mining projects. In the case of Lima city, the rise in the land value is due to two main factors: the demand for housing in a metropolis in continuous growth and the scarcity of available and accessible areas for urban expansion.

Specifically, the study areas also show an important rise of land value. The cases of Cajamarca and Purumpampa show similarities also in this scale. In both cases, important roads facilitated accessibility and raised the land value. For example, in the Cajamarca study area in 1986, agricultural land used to cost approximately US \$ 3,000 / ha (or US \$ 0.3 / m²), and urban plots were sold with property title and services at US \$ 90 / m². Subsequently, in 2016 the price of plots without services is approximately US \$ 250 / m². This large increase in land value explains that most farmers are interested in selling their land, a situation common to the urban periphery of other cities (Torre 2014).

Whereas in Mangamarca, the context of high demand for housing and scarcity of available areas, made the sloped areas became attractive for residential occupation. In addition, these sloped areas in Mangamarca have the advantage of relative proximity to the city center. In this way, in Los Sauces gully, land without any infrastructure or services was sold at only US \$ 2 per square meter in 1990. In 2016, those same plots were offered at US \$ 300 / m² with property title and electricity and sewage connections. While in the upper part the land without property title or services is sold at US \$ 30 / m². It is noted that even informal ownership results in a profitable business, which is why Ananya Roy states that "informality is a fully capitalized domain of property" (Roy 2009).

On the other hand, it is important to refer to the reduction of the land value for previous non-urban uses; these would be the agricultural use in Cajamarca and the grazing in Mangamarca and Purumpampa. In Mangamarca and Purumpampa, the herding of animals was carried out extensively by few families; later, the degradation of these spaces did not allow them to continue.

In Cajamarca, the study area had a high value for agricultural activity; however, in recent decades several landowners were affected by the low profitability of farming, in the context of economic opening that affected the national production of dairy products (Zavala 2010, Aubron and Cochet 2009). Likewise, the increase in the subdivision of property (INEI 2013) has resulted in a large number of small properties where it is less viable to continue raising cattle. Also, the agrarian owners and ex-owners in the area affirm that among the main problems that have affected their activity is the reduction of the quality and quantity of irrigation water that affects the cultivation of pastures for cattle; added to the low price of milk by the existing collectors in the valley. The decline of water quality and quantity is partly due to the urban expansion as new urban developments usually close the passage of the irrigation channels, and some discharge their wastewater to the channels or rivers.

The great revaluation of land in the three cases largely explains the decision to change land use. In that sense, Harvey explains that in a capitalist economy rent dominates the urban structure exercising "an almost tyrannical control" and when the value determines the use under speculation there is no orientation to the efficient organization of the urban form (Harvey 1973: 190). In addition, as reported by Chaléard & Mesclier, the transport infrastructure directs investments and generates changes in the structure of land ownership. At the same time, the restructure of the land contributes to generate changes in the structure of the territory, so the territorial dynamics and the land restructure are closely intertwined (Chaléard & Mesclier 2010: 588-589).

It is interesting to note that, particularly in the case of Cajamarca, the dynamics of change from rural to urban use exemplify the effects of globalization on the territory, through global investments in mining and the economic opening that has affected local dairy production.

2.5.2. Dispersed and informal urban expansion

The urban encroachment in the selected non-developable areas of socio-ecological value shows a higher intensity since the decade of 1990s in Cajamarca and Purrumpampa, and since the decade of 2010 in Mangomarca. Likewise, in the three cases, the built-up area tends to be more fragmented in recent decades (see Figure 56), as a result of independent subdivisions or smaller housing associations.

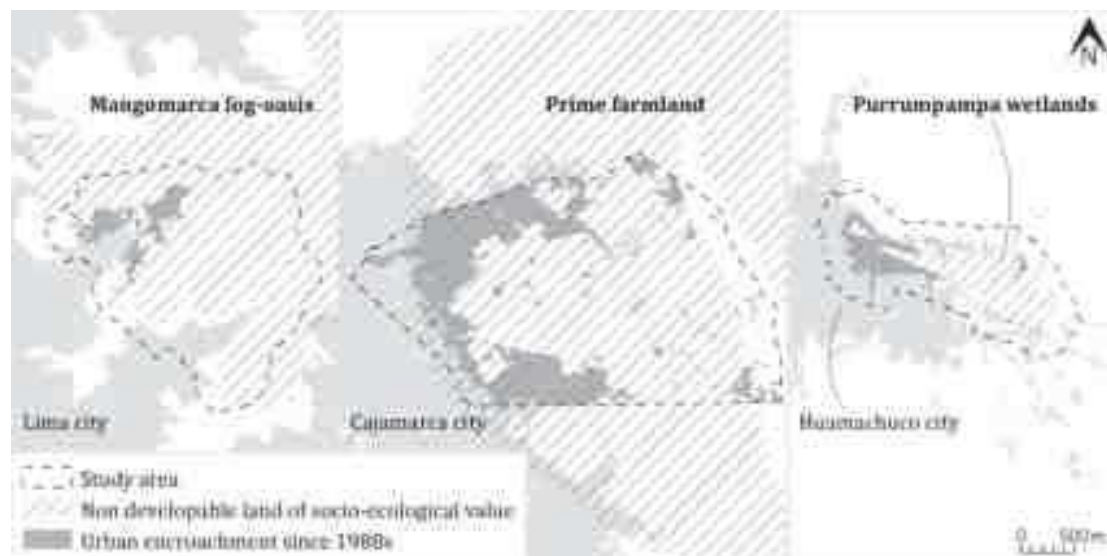


Figure 56: Urban encroachment in the selected areas

Prepared by P. Moschella. Sources: Barreda & Ramirez 2004, Google & Digitalglobe 2018, GRC 2010, IMP-MML 2012, SAN 1988, SPOT 1987, Digitalglobe 2014.

The spatial distribution of housing indicators could be compared only with the census data of the year 2007. There is a trend of inferior housing conditions towards the city limits; as the more recent urban areas usually have residents during the long process of building and infrastructure installation. Nevertheless, this situation typically improves in around a decade. These conditions include lack of sewage network connection (see Figure 57), lack of electrical connection and inadequate building materials.

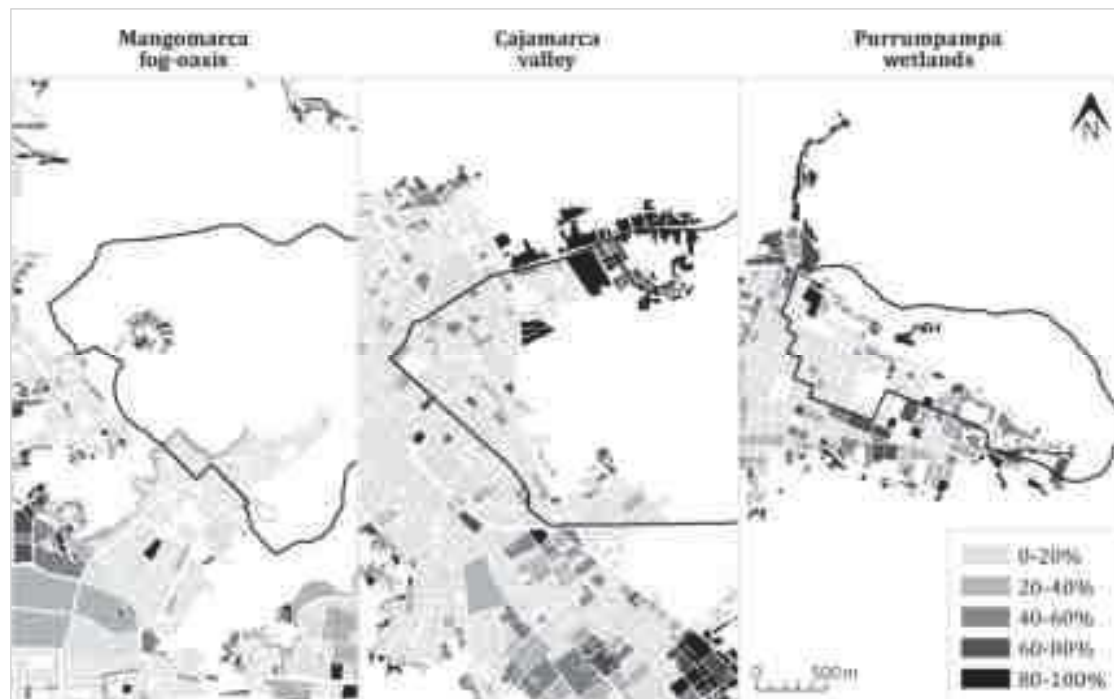


Figure 57: Percentage of houses without sewage network connection in 2007

Prepared by P. Moschella. Source: INEI 2007.

There were identified five types of residential urban developments in the case studies, which can be separated in formal and informal types. At least two informal types were found in each case, making informality the most significant characteristic of urban development (see Table 10).

The informal land subdivision has been found in the three cases. In Cajamarca and Purrumpampa the previous owners were small farmland owners that subdivide their land; whereas in Mangomarca, the land was acquired from the large peasant community of Jicamarca and then the leaders or associates subdivided it. The latter case has similarities with a land invasion as some residents occupy the area spontaneously, but the majority made a purchase. The urban tissue in these cases is very disordered and has narrow roads and insecure passageways. Whereas, the recent land trafficking in Mangomarca generates property conflicts and worst urban conditions as the access is more difficult and the slope make it unsafe.

The two cases of land invasion in Cajamarca and Purrumpampa are easier to identify as the resulting urban form is narrow and ordered. In these cases, the arrival of the new occupants produced a tense situation where the local administration intervened for a better spatial arrangement.

Table 10: Types of urban developments in the case studies

CASE STUDY	MANGOMARCA FOG-OASIS	CAJAMARCA VALLEY	PURRUMPAMPA WETLANDS
Reasons to consider it a non-developable area	<ul style="list-style-type: none"> - Ecological protection - Landslide hazard 	<ul style="list-style-type: none"> - High agrological value - Flood hazard - Soil not suitable for multifloor buildings 	<ul style="list-style-type: none"> - Ecological protection - Historic site - Flood hazard - Soil not suitable for construction
Residential urban development types	<ul style="list-style-type: none"> - Informal land subdivision by associations - Land trafficking - Formal urban developments 	<ul style="list-style-type: none"> - Land invasion - Informal land subdivision by small owners - Formal urban developments - Appartment complexes 	<ul style="list-style-type: none"> - Land invasion - Informal land subdivision by small owners

In all cases, the informal urbanization processes tend to generate conditions of inadequacy and poor quality of public space. In the case of Mangamarca, the unsustainability of the occupation is increased by strong socio-spatial inequalities which also intensify the vulnerability of low-income populations.

Moreover, the large majority of new urban areas in the case studies (by formal and informal processes) had a progressive construction of basic services networks and roads, while the dwellers already lived there. Therefore, the social organizations had a key role in the construction of the basic infrastructure. This situation shows the response of low and middle income population to the high demand of housing. The urban regulation needs to adapt to this demand while ensuring safe and inclusive settlements, not just by formalizing the irregular procedures.

2.5.3. Various social actors involved

The main actors related to the urbanization process are basically similar between the study areas. They have been classified in five groups as detailed below.

a. Government and public institutions

Provincial or District Municipalities

It is the authority responsible for the planning and urban management of the city as well as territorial management at the provincial level. In the cases of Cajamarca and Mangamarca, the same entity is in charge of the provincial and district levels because these cities are capital of

district and province. The authority in the case of Mangomarca has a more complicated situation, as the main city of Lima-Callao is subdivided in two provinces and 50 districts, so the case study is under the authority of the Municipality of the District of San Juan de Lurigancho and the Municipality of the Province of Lima. In addition, in the upper area there is a border conflict which claims the authority of the District of San Antonio that belongs to the Province of Huarochiri.

In the case studies, the local authority on urban expansion is exercised in a weak manner as will be detailed in chapter 3.3. Their main actions related to the management of urban expansion are the approval of Urban Development Plans, the projection of main roads and the approval of building permits. The Mayor plays a relevant role since several people consider that it can guide or facilitate processes related to urban expansion for political reasons or for their own benefit.

Regional government

It is the entity responsible for territorial planning at the regional level, so it must coordinate the compatibility with the provincial and district levels. Although, the territorial planning process has been through several restraints in Peru, as described in the chapter 3.3.1. Therefore, the development of studies for territorial planning in the selected cases is very dissimilar, only the region of Cajamarca counts with studies of hazard areas, soil quality and urban potential, which are useful for the planning of urban expansion areas in a regional scale analysis. The regional government is also responsible for the titling and formalization of rural property, which may be later subdivided as urban plots.

Organism for the Formalization of the Informal Property - COFOPRI

It is responsible for formalizing the invasion of land freely available by the State and facilitates the acquisition of land property titles. It started in the 1990s as a temporary commission under the believe that property rights will allow the owners insertion in the formal land market and thus improve their economic situation based on the ideas of De Soto (2000), although this hypothesis and its results have been criticized (Calderón 2011, Ramírez & Riofrío 2006).

b. Social organizations

Associations of owners

Most cases of informal or vulnerable new settlements form a social organization as an association or cooperative of owners, housing or families. In some cases, they are formed before the land subdivision and are responsible for the procedures for registering properties. During the initial stage of occupation, the main functions of these organizations are to manage access to basic services and the asphaltting of roads. When these objectives are achieved most associations lost importance, in other cases they continue with other collective affairs like the installation of public facilities or the organization of public social programs.

Urban “Rondas”

In the Andean cities of Cajamarca and Huamachuco it is maintained a traditional organization for security and conflict conciliation, which is originally known in the rural areas as Peasant “Rondas” and then its similar has been established in the cities. Among their functions, they are responsible for the conciliation of conflicts, which in areas of urban expansion include conflicts over land ownership and the delimitation of public spaces.

Conservation and cultural associations

In Mangamarca and Purrumpampa have been created associations for the protection of the natural and cultural value of their environment. These associations are formed mainly by benevolent neighbors. Their main actions include reforestation, maintenance, invaders expulsion, and cultural activities. The activities and results of these associations are detailed in chapter 4.1.

c. Basic services providers

Potable water and sewerage service providers

Each city has a local provider of the potable water and sewerage service. The representatives of the municipalities are part of its directory. Among its functions, it handles requests for connection to the drinking water network to new urban occupations, by direct management of users.

Electricity providers

Each city has a local private company which provides the public service of distribution and commercialization of electric energy. It handles requests for connection to the electricity network to new urban occupations by direct management of users.

d. Former owners

Agrarian owners

In the cases of Cajamarca and Purrumpampa the previous land owners are individual agrarian owners. It is mostly people dedicated to livestock. When these landowners decide to sell, they are in charge of land subdivision and selling to third parties under different mechanisms.

Peasant Community of Jicamarca

This community had the property of the upper-part of Mangamarca as well as other elevations surrounding the city of Lima. The original members were estimated between 50 and 200 families located in the highlands, but later thousands of new members have been added in the urban fringe and now have control of the community property (Gutiérrez 1998, Robles 2004). The new members, mostly migrants, have formed different annexes of the community in the periphery of Lima city, and many of them are involved in land trafficking.

e. Other actors

Notaries

They provide services for the elaboration of land trade contracts and public deeds, including the process of subdivision of agrarian land. They usually do this work without coordination with the municipality or the application of urban design parameters, following only the criteria of the owner.

Consultants in urban planning

In the cities of Cajamarca and Huamachuco, the formulation of urban plans and large facilities projects are usually commissioned to external consultants from other cities. This situation may be a problem when local dynamics are not considered properly. Also, local functionaries may not be involved so they do not have a good knowledge of the proposals, as explained in chapter 3.3.

Advisors in urban design

They are mostly civil engineers who provide services for the urban design and elaboration of plans of the land subdivision, roads, sidewalks and networks of basic services.

Real Estate investors and construction companies

In the study areas, there are few cases of individuals or companies that purchase farmland and then sell it as housing plots. The companies may offer housing construction services and in some cases develop urban projects where they are responsible for land subdivision, managing the basic services network connections and the construction of streets and sidewalks.

2.6. Chapter conclusions

Peru's urban population is increasing constantly and the internal migrations have been oriented mainly towards the coast. The case studies comprise the city of Lima that concentrates about one third of the country's population, the intermediate city of Cajamarca and the small city of Huamachuco. The latter two are in the Northern Andes and show exceptionally large growth rates in the highland region due to mining investments.

The case of the Mangamarca fog-oasis in the urban fringe of Lima exposes how urban expansion threatens the unique and fragile ecosystem of *lomas*. At the city level, more than 200 hectares of this ecosystem have been transformed to built-up areas. This case presents high socio-spatial inequalities that intensify the vulnerability of low-income populations. Moreover, it shows a contrasting relation of the community with the *lomas*. It is also an example of land trafficking in recent years.

The urban expansion in the valley of Cajamarca has caused the loss of 251 hectares of irrigated prime farmland since 1988. This area is a significant identity element for locals, and this type of soils is a scarce resource in the Andean region. There are diverse formal and informal processes of urban expansion in this area. Particularly, the drivers of change in the case of Cajamarca exemplify the territorial effects of globalization, through global investments in mining and the economic opening that has affected the local dairy production.

The urban encroachment on the Purrumpampa wetlands in the city of Huamachuco, show the loss of 28 hectares of previous wetlands since 1987. It also implies the decrease in size of an historical and ecological site that contains an important recreational area. Moreover, it presents different informal processes of urbanization in a hazard area.

The sharp increase of land value in the case studies largely explains the decision to land-use change and is mainly related to urban population growth and main roads. It is an example of how rent dominates the urban structure and determines inefficient distribution of uses in a capitalist economy (Harvey 1973).

The recent built-up areas are generally more dispersed and, in all cases, the increased demand of urban land provokes the urban encroachment in non-developable areas. The land-use or land-cover change generates irreversible impacts and leaves aside the importance of protecting the ecological, cultural and recreational values of the selected areas.

The types of social actors involved in the urban expansion process are quite similar. These include: local governments, social organizations, basic services providers, former owners, notaries and consultants in urban planning or design.

The informal urbanization processes tend to generate conditions of inadequacy and poor quality of public space. Moreover, the large majority of new urban areas in the case studies (by formal and informal processes) had a progressive construction of basic services networks and roads, while the dwellers already lived there. Therefore, the social organizations had a key role in the construction of the basic infrastructure. This situation shows the response of low and middle

income population to a high demand of housing not adequately attended by the market nor the government. Under those circumstances, the urban regulation needs to adapt to this demand while ensuring safe and inclusive settlements, not just by formalizing the irregular procedures.

CHAPTER 3:

The community relation with natural and agricultural areas in the urban fringe

Under the behavioral geography approach, studying the mental image that people have about a place is essential to understand the decision making and actions that they carry out in relation to that geographical space (Argent & Walmsley 2009, Gold 1980, Capel 1973, Desai 1985). Therefore, the analysis of local perception from primary data by interviews and surveys will help comprehend the decision making in land-use change, and opinions on urban expansion management.

Moreover, the three case studies present evidence of local initiatives to protect the study areas from uncontrolled urban expansion which reveal the significant relation of the community with its environment and define a starting point in the path to sustainability of the urban fringe. This chapter is organized in three main sections: the environmental perception of the selected areas, the perception of problems related to urban expansion, and the community actions

3.1. The local perception of natural and agricultural areas

3.1.1. Types of experiences and images of the selected areas

This section presents the results and discussion of the general perception of the selected natural and agricultural areas. Thirty-five interviews were applied to different stakeholders, as has been detailed in section 1.4.5. Specifically, one question demanded a description of the study areas thirty years ago. The responses obtained were classified by groups. Some interviewees expressed good memories, whereas others mentioned a simplified image or even ignorance of the area, showing different levels of past experiences and appreciation of these areas.

a. Good memories of the past landscape

Some interviewees described as a pleasant experience their memory of the landscape of the three case studies thirty years ago. The Mangamarca fog-oasis was remembered as a special scenery of vegetation and animals by community leaders who are also teachers. Following, there are some fragments of their responses:

*"There were some birds. There were lots of lizards. How many times have we climbed! All that you see, in the upper part, was full of plants... It was beautiful."*⁴ (Edgar Bejarano, community leader in Los Sauces gully, Mangamarca case study)

*"... there I saw the tremendous greenery. It seemed that we were in the rainforest because there was a lot of greenery and since I come from a rainforest area, it reminded me (my place of origin) (...) we have seen many birds, animals, we could see even herds of goats that grazed and packs of wild dogs."*⁵ (Sarita Cristóbal, community leader, Mangamarca)

Similarly, one interviewee reminded the landscape of Cajamarca valley as a place of nature, evoking an impression perceived by different senses.

*"... you could feel the existence of rivers, feel and see them. The Mashcon river was very big, it had a lot of water and there were a lot of green spaces."*⁶ (Rosa Castañeda, neighbor, Cajamarca)

⁴ "Había algunas aves. Había lagartijas, bastantes. ¡Cuántas veces hemos subido! Todo eso que ves, que se sube, era llenecito de plantas... Era hermoso." (Edgar Bejarano)

⁵ "... ahí vi el verdor tremendo. Parecía que estábamos en la ceja de selva porque había bastante verdor y como yo vengo de una zona de ceja de selva, entonces me hacía recordar (...) hemos visto muchas aves, animales, lográbamos ver hasta manadas de cabras que pasteaban y jaurías de perros salvajes." (Sarita Cristóbal)

⁶ "... se podía sentir la existencia de los ríos, sentir y ver. El río Mashcón era muy grande, tenía mucha agua y había bastante área verde." (Rosa Castañeda, vecina, Cajamarca)

Also Purrumpampa was described by some people as a nice area with diverse birds and plants, where kids used to go to play and bathe.

b. Passive experiences and generalization of the landscape

A larger group of participants described a simplified image of the past landscapes. Apparently, their past knowledge of these spaces was limited due to a lack of familiarity and shallow experiences. For instance, Purrumpampa wetlands were described by some as just desolate pampas or vast plains. Similarly, Mangamarca fog-oasis was considered only a temporary green space.

In addition, when asked about its memories of Cajamarca valley 30 years ago, most interviewees emphasized that it was completely a rural area; all covered by pastures, and entirely formed by ranches for cattle breeding. Some of them mentioned an additional element of the landscape; like crops, irrigation channels, rivers, or trees. As an example, the description of a neighbor is shown below.

“All this was cattle breeding, when we came to study we went through the road (...) there was a fence of agave plants around the edge and all cattle breeding”⁷ (Juana Chavez, neighbor, Cajamarca)

These kind of generalized and simplified images seem to demonstrate the lack of more active past experiences in the study areas. As a consequence, the identification with the area would be less significant.

c. Production imprint in the valley’s landscape

In the case of Cajamarca valley, many linked their memories of the past landscape to the appreciation of milk production as an important economic activity for the region. The persons with this kind of perception were related to the activity: present or past farmers and an official of the Ministry of Agriculture. Some examples of their thoughts are:

“...it was very productive, especially in dairy cattle...”⁸ (José Amambal, farmer, Cajamarca)

“(The region of) Cajamarca was one of the first milk producers thanks to the Cajamarca countryside, where we had an average of at least 15 to 18 liters per cow/day.”⁹ (César Bardales, functionary of the Ministry of Agriculture, Cajamarca)

⁷ “Todo esto era ganadería, cuando veníamos a estudiar pasábamos por la vía (...) era un cerco de pencas en todo el borde y para acá todo ganadero” (Juana Chavez)

⁸ “...era muy productivo, sobre todo en lo que es los vacunos de leche...” (José Amambal)

⁹ “Cajamarca era uno de los primeros productores de leche gracias a la campiña de Cajamarca, donde teníamos un promedio por lo menos de 15 a 18 litros por vaca/día.” (César Bardales)

In contrast, a pair of interviewees had a critical view of the production in Cajamarca valley that influenced their image of the landscape. They described it as vast monoculture farms instead of a more diversified production. One of them affirmed that:

"There were vested interests, for example, of the dairy company Incalac, formerly Perulac, then all those lands destined for staple food crops were diminished and were destined for animal fodder."¹⁰ (Alejandro Moncada, former agrarian owner, Cajamarca)

d. Unfamiliarity with the lomas

Among the case studies, only the past landscape of the fog-oasis was unknown for some interviewees. Because it has a more difficult access due to slope in comparison with the other areas. Therefore, a few participants mentioned that 30 years ago they didn't know of the existence of this seasonal ecosystem although they lived in its proximity. Some examples of these testimonies are shown below.

"Look, the Lomas of Mangamarca was a total ignorance, nobody knew that there were lomas (...) we did not know what the Lomas meant, but the Lomas are discovered because there are young boys, who like to climb the hills then, in one of those, in a winter season you can see that there is a verdure, but huge."¹¹ (former community leader, Mangamarca)

"(My friends) used to tell me 'let's go to the Lomas of Mangamarca' but it never called my attention (...) I had no intention of climbing. I only saw the greening and drying from here (...) Then, the first time I knew the Lomas, I was surprised, it seemed to me like being in another space."¹² (Yovita Barzola, community leader, Mangamarca)

e. Recreation in Purrumpampa

An additional source of the perceived landscape was the collective map of Purrumpampa prepared in a workshop of the Transversal project in 2013 by a team of twelve persons including local leaders, municipal officials, teachers and upper level students. The map shows the study area as a significant place within the city. The identification of well differentiated sectors inside is observed. The sector that is most known and valued is the recreational and sports area, represented with an extension much larger than its real proportion and where two soccer fields

¹⁰ *"había intereses creados, por ejemplo, de la empresa láctea Incalac, antes Perulac, entonces todos esos terrenos destinados para cultivo de panllevar estaban disminuidos y se destinaban para forrajes de los animales."* (Alejandro Moncada)

¹¹ *"Mire, las lomas de Mangamarca era un desconocimiento total, nadie sabía que había lomas, (...) no sabíamos lo que eran las Lomas, pero las Lomas se descubren porque hay muchachos, jóvenes, que les gusta subirse a los cerros pues, entonces en una de esas, en una época de invierno se ve que hay un verdor, pero enorme."* (Interviewee of Mangamarca)

¹² *"(Mis amigos) me decían 'vamos a las lomas de Mangamarca' pero nunca me llamó la atención (...) No tuve la mínima intención de subir. Nada más que veía reverdecer y secar desde acá (...) y la primera vez que conocí las Lomas, he quedado impactada, me parecía como que estuviera en otro espacio."* (Yovita Barzola)

have been drawn with line markings, although in reality it doesn't have markings only the arches in the pasture. Within Purumpampa, there are three types of vegetation per degree of humidity that also delimit areas: the driest grass in the recreational area, the floating and semi-submerged plants contouring the ponds; and the waterlogged pastures in the north zone. The knowledge of these differences could be related to the experience of difficulty accessing flooded sectors. Two ponds were also drawn in the center of the image of Purumpampa where the main channel begins. However, the extent of the ponds is reduced to its real proportion, evidencing that it would be a less frequented and known area (see Figure 58).

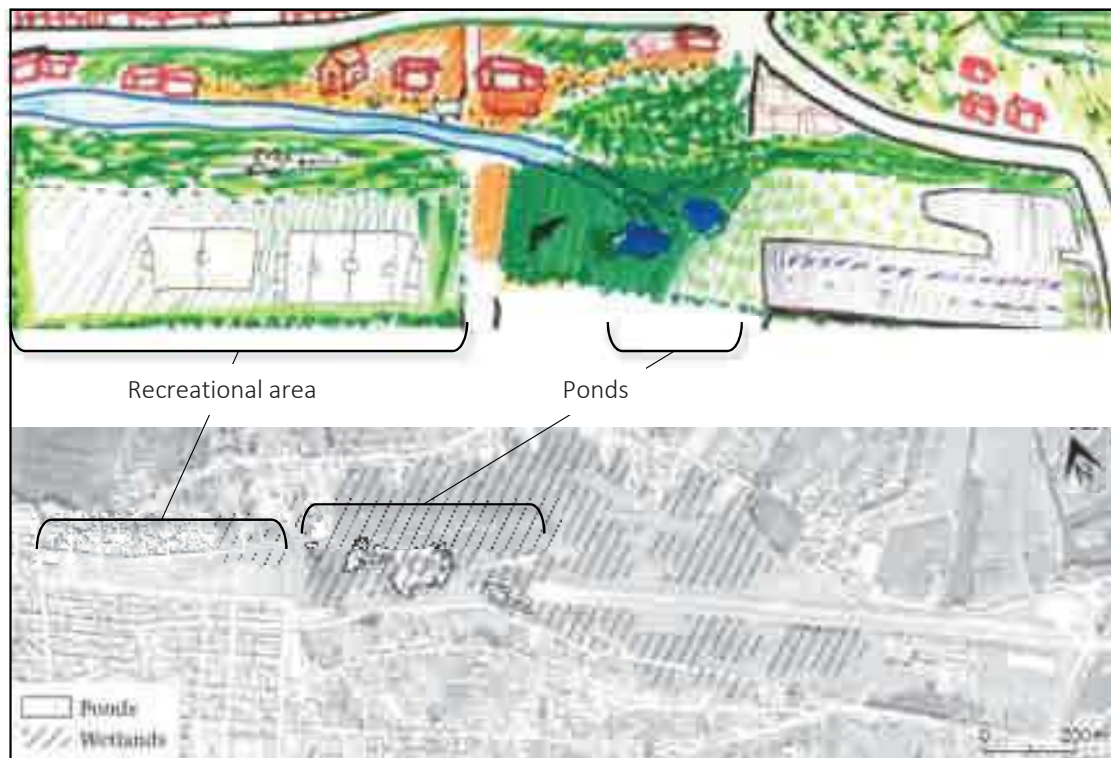


Figure 58: Comparison of a collective map and a satellite imagery of Purumpampa

Sources: *Transversal* 2013 (top), *Digitalglobe* 2014 (bottom).

3.1.2. Appreciation degree of the selected areas

The survey results to the inquiry of how much do household heads like the natural or agricultural area show an intermediate to high level of appreciation (see Table 11). In the three cases the majority of respondents indicated the levels 4 and 5 out of 5 as the highest appreciation. The study area of Cajamarca was the most appreciated, perhaps due to its productive condition and larger extent.¹³

¹³ The questionnaire of the survey can be seen in Annex 3, and the demographic characteristics of the survey sample are in Annex 5.

In Mangomarca case study, it is interesting to observe the result distinguished by sectors, due to the existence of a highly contrasting socio-spatial situation. With this in mind, Mangomarca gully have 79% of households who indicated a good appreciation (levels 4 and 5 out of 5). Whereas in Sauces gully these responses achieve only 55% of respondents. This difference could be related to the communal activities in Mangomarca to promote the protection of the fog-oasis.

Table 11: Level of appreciation of the selected areas

	MANGOMARCA FOG-OASIS	CAJAMARCA VALLEY	PURRUMPAMPA WETLANDS
5 - High	42.9%	54.0%	20.0%
4	23.3%	23.0%	38.0%
3	20.8%	19.0%	32.7%
2	6.7%	2.7%	5.0%
1 - Low	5.8%	1.3%	1.3%
No opinion	0.4%	0.0%	3.0%
Total	100%	100%	100%
N	240	300	300

Source: Field surveys 2016-2017.

In addition, the response segmented by sex and age groups shows that all the groups show a quite positive image of the corresponding study area (see Figure 59). The average appreciation degree in all cases is between 3.6 and 4.4 out of 5.

The differences of appreciation by sex are not similar in all cases. In Mangomarca and Purrumpampa, men have a tendency to report a higher appreciation. Although, in relation to Cajamarca valley, women show a slightly higher valuation of the area. The results by age groups are alike in the three cases, showing a tendency of a slightly higher valuation of older household heads. Other studies of environmental perception, in different contexts, also show a greater sensitivity of women, but they do not present a common pattern in terms of age groups (Jim & Chen 2006, Soini et al. 2012, Moschella 2011).

While, the results according to the time of residence in the area or place of origin, do not reveal a significant difference in valuation. In Mangomarca, the household heads coming from outside Metropolitan Lima have only a 5% higher appreciation. Whereas in the other two cases, the immigrants to the district have a little lower valuation, -1% in Cajamarca and -6% in Purrumpampa.

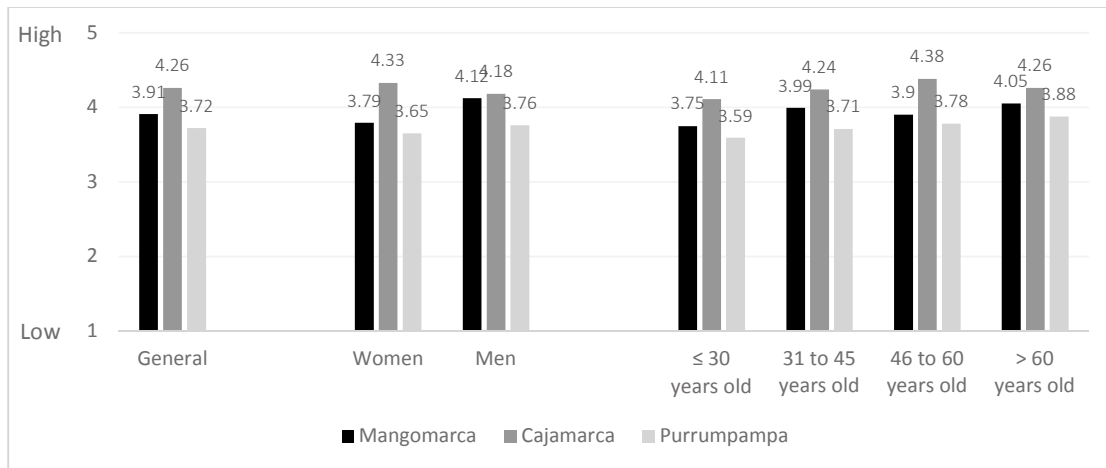


Figure 59: Average appreciation degree of household heads separated by sex and age group.
 Source: Field surveys 2016-2017.

Moreover, it is observed that the main differences in the appreciation are related to the frequency and reason of visit of the natural or agricultural area (see Figure 60 and Figure 61). Purumpampa and Cajamarca valley are visited frequently, more than 14% of neighboring household heads visits these areas daily and more than 75% visit them at least once a month. Likewise, the main reason for visiting the three study areas is recreation in a share of more than 40%. The most visited study area is Cajamarca valley, and the reasons of visit have a more dispersed distribution than in the other cases.

On the contrary, Mangomarca is frequently visited by only 13% of household heads, although it is also visited once a year by 11% of respondents during the fog season. In this case, the main reason for not visiting it is because they are not interested, and a smaller group mentioned that they don't visit it because the access is too difficult.

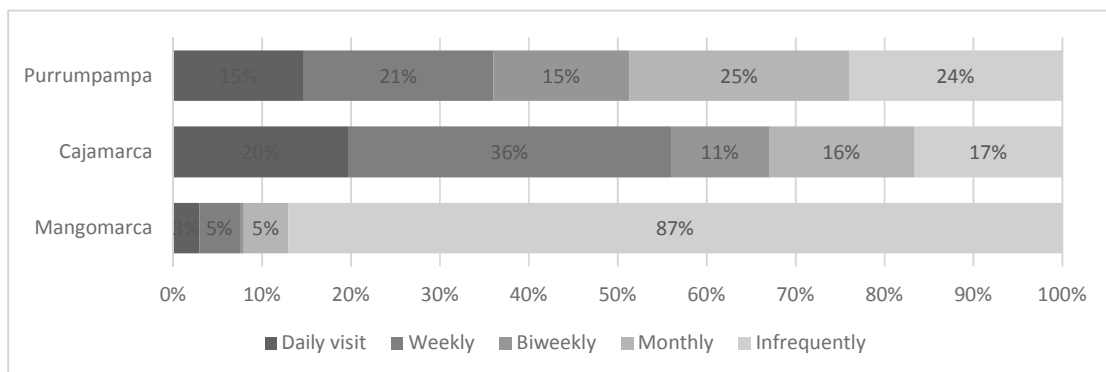


Figure 60: Frequency of visit of the study areas.
 Source: Field surveys 2016-2017.

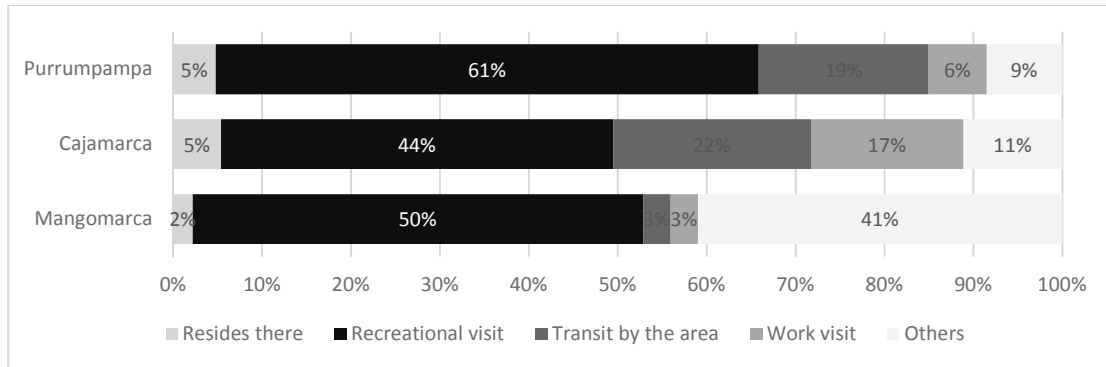


Figure 61: Main reason of visit of the study areas.

Source: Field surveys 2016-2017.

The appreciation degree was between 5 and 15% higher among the households that visit the place at least once a month in comparison with the opinion of those who have infrequent visits (see Figure 62). Although, when observing the more specific groups of frequency of visits there is not a common trend linking a higher frequency with a higher satisfaction with the area.

It is also interesting to notice that some respondents consider themselves as inhabitants of the natural or agricultural study areas. As they mentioned that the main reason for visiting the areas was that they live there. It is only a small amount of household heads, between 2.2 and 5.3% (see Figure 61), but it reveals a strong identification with these areas. In this situation, the appreciation shows contrasting results (see Figure 62), in Cajamarca this group have the best valuation of the valley (4.8 out of 5), but in Mangomarca its appreciation of the fog-oasis is very low (2.8 out of 5).

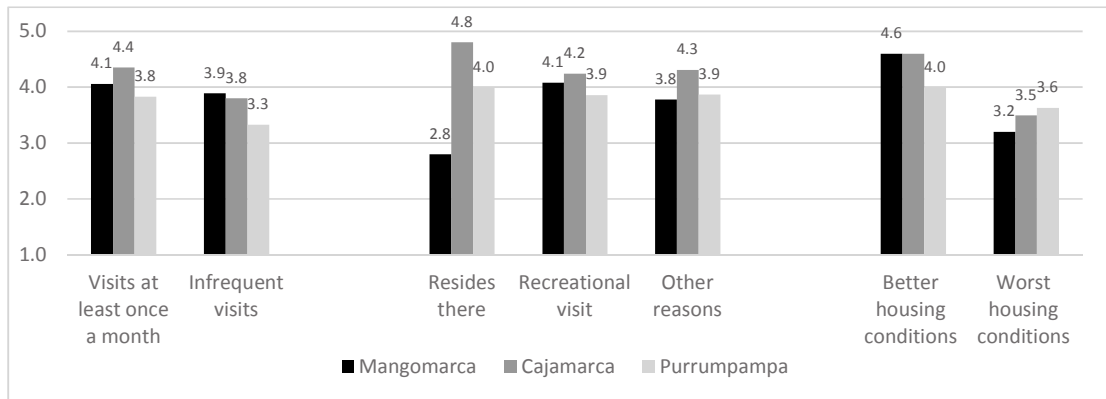


Figure 62: Average appreciation degree of household heads segmented by frequency and reason of visit.

Source: Field surveys 2016-2017.

Another group that shows a very good valuation is characterized by better housing conditions, considering the houses with electric service connection, garage and outdoor garden. These housing conditions are considered as an evidence of a better economic situation. Thus, the wealthier interviewees in the three study areas have a 10 to 40% higher appreciation than the household heads with a lower economic condition.

In summary, the study areas present a good appreciation degree. In a similar way, another study on peri-urban perception identify that environmental and landscape amenities are highly valued (Zasada 2011). Also, the appreciation degree of the selected areas was around 10% higher among those who have frequent visits. As Soini et al. affirm, based on a study of the peri-urban landscape perception in Finland, the sense of place is made up of physical and social ties to the place (Soini et al. 2012). Therefore, the proximity and frequent visiting contribute to a more significant perception of this areas. The other factors related to a greater appreciation are a better economic condition and older age.

3.1.3. Perception of benefits of the selected areas

The survey results indicate that a large majority of respondents (between 73 and 91%) consider that the selected areas bring benefits to the city and the citizens (see Figure 63). In Mangomarca fog-oasis a significant portion of household heads (17%) thinks that it doesn't produce any benefits, unexpectedly, more than a third of them mentioned that they appreciated the area. Whereas in Purrumpampa there are a large percentage of respondents (16%) that had an uncertain answer, although a quarter of them visit the area for recreation.

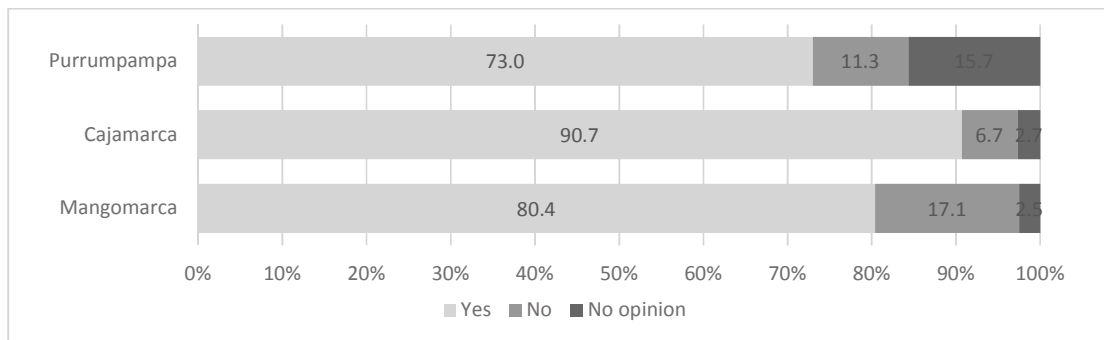


Figure 63: Household heads considering that the selected areas bring benefits to the city.

Source: Field surveys 2016-2017.

The survey included an open question about which were considered as the main benefits provided by the selected areas. Due to the substantial differences among these spaces, the benefits they provide are also perceived very different. The type of benefit identified more clearly in all cases was recreation and tourism, mentioned by more than 20% of the interviewees that recognized the existence of benefits (see Figure 64). Other identified benefits were air quality improvement, aesthetic enjoyment, peace and health. Whereas, the provision of food and livelihood means were identified almost only in Cajamarca valley, as a productive socio-ecosystem. In fact, food provision was largely the main benefit identified by 59% of interviewees, among which dairy production were highlighted. In the three case studies, a higher level of appreciation is related with the identification of more benefits from it.

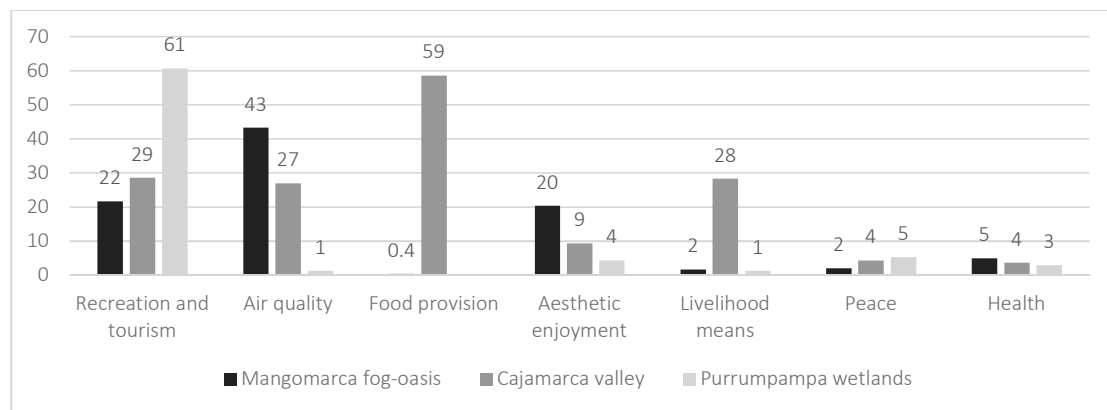


Figure 64: Main benefits of the selected areas (multiple answer, values in percentage)

Source: Field surveys 2016-2017.

This result is similar to the findings of Gilg (2009) that mentions fresh air and exercise as the most important aspects of the environmental perception of open spaces, instead of their particular environmental characteristics. It is also interesting to notice that a large majority mentioned benefits considered as non-mercantile values.

From the perspective of the ecosystem services framework established by Millennium Ecosystem Assessment (2005), the main benefits indicated would correspond to the categories of cultural, regulating and provisioning services. Also, each selected area is appreciated from a different viewpoint, because the main benefit identified in Purrumpampa is a cultural service, while in Cajamarca is a provisioning service, and in Mangomarca is a regulating service. The latter could be considered as a generalized appreciation because of the lack of a more particular value of the fog-oasis.

3.2. The perception of the environmental consequences of urban expansion

3.2.1. A predominant image of construction and destruction

Many of the interviewees consider that the urban expansion in the study areas represents a conflict where the rapid and growing construction of houses eliminates or destroys the green areas. Specifically, some interviewees described an image where cement is replacing irreversibly the green areas, as the following examples:

*"Everything has been sold, cement has been 'planted'."*¹⁴ (Anonym, Cajamarca)

*"The concrete spot has grown disproportionately and is winning us every year, every year, every year."*¹⁵ (Alex Huaccha, Sub-Manager of Urban Planning, Cajamarca)

*"We may see with pity how the cement is winning the green part, and the ranchers are disappearing."*¹⁶ (César Bardales, official in the Ministry of Agriculture, Cajamarca)

In a similar way, the urban expansion in Mangomarca has been described as the cause of destruction of the fog-oasis. One of the interviewees linked the human settlement with a negative impact on the microclimate that allow the development of this ecosystem, however, in the first place, the building process causes the degradation of soil, seeds and roots that lie dormant.

*"...where there is housing, where there is people, it does not turn green anymore. It seems to be a lie but with the human heat we kill those green areas."*¹⁷ (Walter Moreno, community leader in Los Sauces, Mangomarca case study)

Another example of the collective perception of urban expansion as a conflict with the previous land-use or land-cover was observed in a workshop of Transversal Project in Huamachuco in 2013. In this workshop, a varied group of 12 persons prepared drawings of the landscape of Purumpampa before and after the year 2000 (see Figure 65). The result shows a strong opposition between the previous landscape of nature and rural activity, which became a place with a lot of constructions, contamination, disappearance of the fauna, and accumulation of waste to bury the wetlands.

¹⁴ "Todo lo han vendido, se ha sembrado cemento." (Anónimo)

¹⁵ "La mancha de concreto ha ido creciendo desmesuradamente y nos está ganando cada año, cada año, cada año." (Alex Huaccha)

¹⁶ "Vemos tal vez con pena cómo el cemento le está ganando a la parte verde, y los ganaderos están desapareciendo." (César Bardales)

¹⁷ "...donde hay vivienda, donde llega gente ya no se convierte verde. Parece mentira, pero con el calor humano matamos pues, esas áreas verdes." (Walter Moreno)



Figure 65: Collective images of Purumpampa, before (left) and after (right) the year 2000.

Source: *Transversal 2013*

Some authors consider that this idyllic or idealized view of the rural landscape is a result of urbanization. As reported by Bauer & Roux (1976), the meaning of campaign linked to the idea of calm and good air is an urban significance, opposing the city. Moreover, Lefebvre (1971) considered that nature becomes symbolic for the city dwellers. In addition, Gilg (2009) affirms that idealized rurality is resistant to change when it became part of cultural values.

3.2.2. Perception differences by city size

In the survey the heads of households were consulted if they consider that the expansion of the city over the natural or agricultural areas under study generates negative problems. The result in the cases of Cajamarca and Mangamarca is that more than 70% recognizes these negative impacts. Nevertheless, the city growth in Purumpampa wetlands is not seen as a significant problem in the city of Huamachuco (see Figure 66). It could be highlighted that where there is a weak appreciation of nature, urban sprawl is less viewed as a problem.

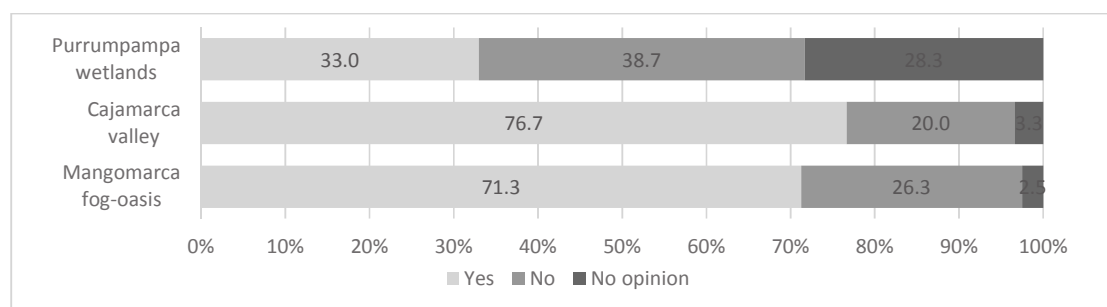


Figure 66: Household heads who consider that the expansion of the city over the selected areas generates negative problems

Source: *Field surveys 2016-2017*.

In Purumpampa, 38.7% of respondents consider that the urban expansion does not generate a problem, although, the majority of them have a good appreciation of Purumpampa (4 and 5 out of 5), visit it for recreation regularly, and recognize it brings benefits to the city. This is one of the

answers with the greatest difference in results between cities. It seems that the opinion in this issue is related with the fact that the city of Huamachuco is quite small and its expansion is considered firstly as positive and a sign of prosperity or modernity. Also, the majority of respondents of this smaller city do not consider as a problem the encroachment of the wetlands, perhaps due to the fact that they have easier access to open spaces in the surroundings of the city. This result would reinforce the idea that the concern of an idealized nature is a perception of city dwellers as a result of urbanization (Bauer & Roux 1976, Lefebvre 1971, Gilg 2009).

3.2.3. Main problems identified

The main environmental problems perceived as a result of urban expansion in the three study areas are pollution and the loss of green areas. An open question was asked in the survey and the answers were grouped by topics. These results show that between 15 and 30% of the respondents consider that the urban expansion has generated contamination of the natural and agricultural areas under study (see Figure 67), especially in reference to the elimination of waste by neighbors or visitors, and contamination of the water and soil due to the lack of adequate sewage connection. The second most mentioned issue is the loss of green areas, especially in the cases of Mangomarca (19%) and Cajamarca (35%). Other less frequent answers were related to the degradation of the landscape (0 to 9%) and the loss of habitat of fauna and flora (0 to 2%).

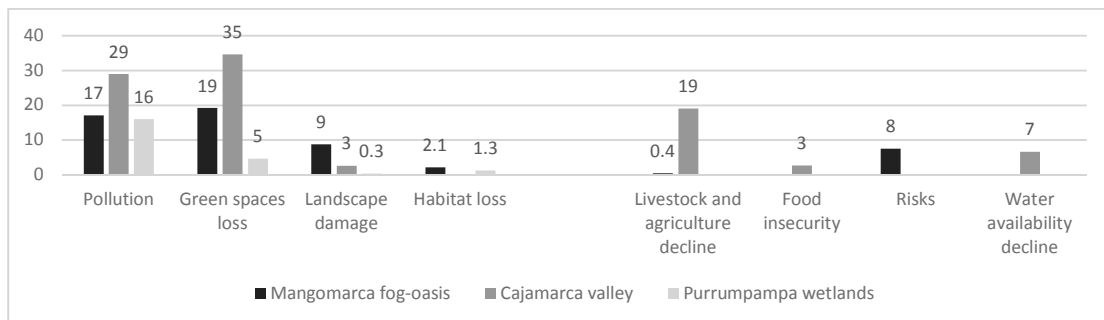


Figure 67: Environmental problems identified as a consequence of urban expansion

Source: Field surveys 2016-2017.

Other types of problems are related to the loss of ecosystem services. For example, in the case of Cajamarca, respondents mentioned the reduction in agricultural activity (19%) which is related to the decrease of available water for irrigation (7%) and the loss of food security (3%). Even some respondents explicitly indicated that urban sprawl expels peasants.

Similarly, in the interviews in Cajamarca, the impact on agricultural activity and the production of dairy products and food was emphasized. As mentioned in the following extracts:

"There were a lot of channels in that area, carrying water from the Mashcon River. (...) they already subdivided it, built houses and did not give a pass. And (...) all those farms ran out of water, what they did, plot it and sell it. (...) is now buying milk from other valleys, not from

*our central valley as it was in the past.*¹⁸ (Julio Marín, President of the Regional Federation of Indigenous and Urban Peasant Rounds of Cajamarca)

*"They only see money and do not worry about food."*¹⁹ (Anonym, Cajamarca)

Likewise, some interviewees in Cajamarca commented on the contamination of the rivers and ditches with sewage, which end up contaminating the crops.

Meanwhile, in Mangamarca, less than 1% of respondents mentioned the reduction in agricultural activity, of which very few knew of its existence. Rather, they considered the increase in disaster risks (8%), specifically, landslides due to the steep slope. Contradictorily, some argued that inhabiting the hills would be safer because the rocky area would provide greater stability against earthquakes. In Purrumpampa, despite also being a hazard area, no participant mentioned this problem.

It should be noted that despite not being properly an environmental problem, several responses indicated that the urban expansion in the study areas generated social problems such as conflicts, delinquency, bad habits, etc. This type of response was indicated by 31% in Mangamarca, 15% in Cajamarca and 7% in Purrumpampa. This reflects a considerable degree of distrust and aversion with the new occupants. This situation is more significant in the Mangamarca gully with a marked socio-spatial difference. It would indicate that for a sector the protection interest is mainly for maintaining a socio-spatial status than for defending the ecosystem services. Similarly, Haller's study of the perception of the consequences of urban expansion in another Andean city also identifies this strong aversion towards new inhabitants who are qualified as evil-living and uneducated people (2014).

In an overall view, other studies of the perception of urban growth in the urban fringe identified as the main perceived negative consequences: the loss of farmland and ecosystems, decrease of income security, decrease of natural resources, pollution, habitat degradation, water quality degradation, flood risk, social conflicts related to new inhabitants, and loss of sense of community and sense of place (Haller 2014, Slemph et al. 2012). Therefore, the general results are similar, except by the loss of sense of community that was not mentioned by any interviewee in our study.

¹⁸ "Había cantidad de canales que se iban hacia allá, llevando el agua del río Mashcón, (...) ya lo lotizaron, construyeron casas y no dieron pase. Y (...) todito esas chacras se quedaron sin agua, qué hicieron, lotizarlo y venderlo. (...) está quedando ahora comprar leche de otros valles, ya no de nuestro valle central como era en el pasado." (Julio Marín)

¹⁹ "Todo lo ven plata y no se preocupan por los alimentos." (Anonym)

3.2.4. Protection requirement

The heads of households who identified negative consequences of urbanization on the selected areas were asked about how important they considered the protection of those spaces. The results indicate that the majority, between 54 and 87% according to the case, think that the protection of these areas is very important. If we count those who thought that protection is of high and intermediate importance, the result reaches more than 90% in all cases (see Figure 68).

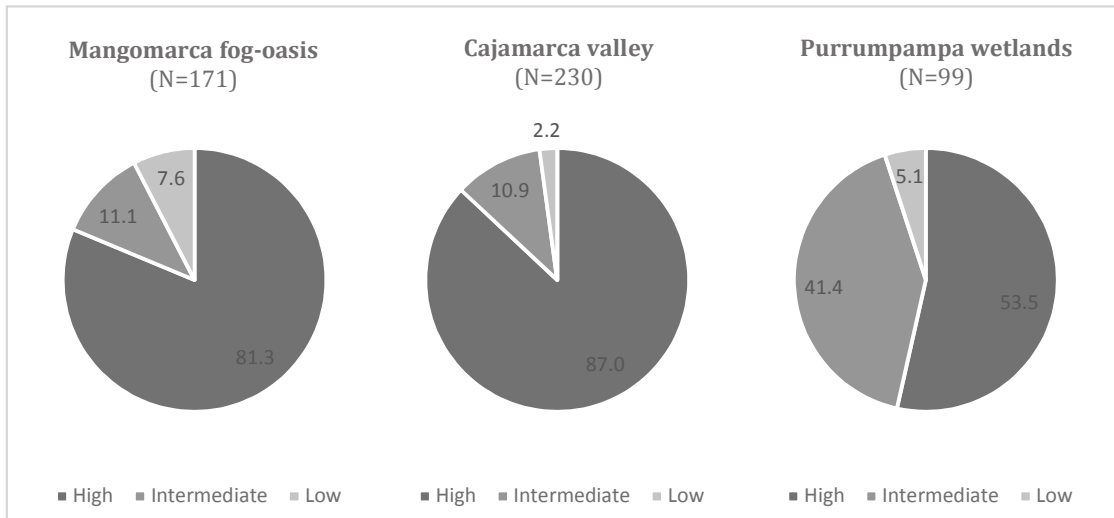


Figure 68: Opinion about the importance of protection of the selected areas by household heads that consider urban expansion generates negative problems

Source: Field surveys 2016-2017.

In Mangomarca, even more than half of those who indicated that urban expansion did not generate negative impacts; do consider its protection very important.

The comments in relation to the need for protection reinforce the assessment of certain aspects of the selected spaces. In all three cases, there are those who consider that protection is important above all because of their interest in creating tourist attractions that can generate economic benefits for the community. In the cases of Mangomarca and Cajamarca, located in the larger cities, several related the need for protection in the first place because they are "lungs of the city" and their utility to improve air quality. In the same sense, some interventions related the importance of maintaining green areas for the future. As in the following statements:

*"Protection is very important because it is our lung of the city (...) Preserving the intangibility of the valley will preserve our environmental future. If we don't protect it we will only have cement and continue with the contamination that is already large, all of that will further exacerbate our urbanization problems."*²⁰ (Fresia Chunga, neighbor, Cajamarca)

²⁰ "La protección es muy importante porque es nuestro pulmón de la ciudad (...) Preservar la intangibilidad del valle será preservar nuestro futuro ambiental. Si no vamos a tener solamente cemento y seguir con la

"It is very important that these areas are not urbanized, that they remain green. I recommend that if any entity sees with eyes of humanity, that those green areas are not destroyed, because we have a good future for those who still come."²¹ (José Amambal, farmer, Cajamarca)

In contrast, others consider that there is not much to do, and that the land-use change is only a question of time. Even among those who support urban expansion, one interviewee expressed his criticism to those who maintain agricultural areas in the valley:

"There are neighboring owners who do not want it to be urbanized; it does not suit them because they live off that. They have large farms and the dairy is more profitable, but deep down they are hampering the urbanization process. It is true that it tends to become contaminated in the urbanization process, which will always have to take place sooner or later, sometimes it takes longer or takes less, but it occurs..."²² (Alejandro Moncada, former agrarian owner, Cajamarca)

This position seems to be common in peri-urban areas, Torre (2014) points out that often, farmers are interested in selling their land for urban use because of the increase in the price of land and the income they would obtain. On the contrary, other residents are interested in conserving open spaces and resisting new inhabitants, in order to maintain the peri-urban landscape that surrounds them and the high prices of their properties (Torre 2014, Gilg 2009).

3.2.5. Being part of the problem

Finally, it is interesting to point out that the majority of interviewees recognized themselves as part of the process of urban encroachment in the natural and agricultural study areas. In fact, 79% recognized their house occupies prior farmland in Cajamarca, whereas in Purrumpampa, 68% mentioned they reside in prior wetlands, and in Mangamarca, 20% recognized to inhabit prior area of fog-oasis (see Figure 69). These amounts are near to the estimation obtained by the spatial analysis of land cover change.

contaminación que ya es grande, todo eso va a agudizar aún más nuestros problemas de urbanización." (Fresia Chunga)

²¹ "Es muy importante que esas áreas no se urbanicen, que sigan siendo verdes. Yo recomiendo que si alguna entidad ve con ojos de humanidad, que esas áreas verdes no se destruyan, porque tenemos un buen futuro todavía para los que vienen." (José Amambal, farmer, Cajamarca)

²² "Hay propietarios vecinos que no quieren que se urbanice, no les conviene porque viven de eso. Tienen fundos grandes y la lechería les resulta más rentable, pero en el fondo están obstaculizando el proceso de urbanización. Es cierto que tiende a contaminarse en el proceso de urbanización, que siempre va a tener que darse tarde o temprano, a veces demora más o demora menos, pero se da..." (Alejandro Moncada)

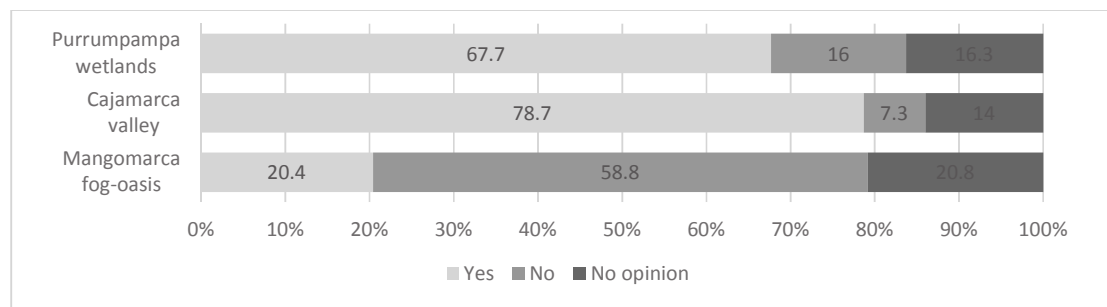


Figure 69: Household heads that consider their house occupies the prior area of fog-oasis, farmland or wetland

Source: Field surveys 2016-2017.

These results demonstrate a contradictory position in a large part of interviewees because on one side there is a high appreciation of the selected areas and identification of urban expansion problems, while in the other side; they admit being part of the problem. In a similar way, the study of Soini et al. (2012) also point out that there is a weak link between sense of place and willingness to contribute to landscape management. Whereas Gilg (2009) identify a paradox between conservation ethos together with pro-growth behaviors related to land-use, as environmental land use concern does not imply willingness to change practices. Presumably, this position is explained “often because individuals feel powerless and think that acting alone will have little impact” (Gilg 2009, S77).

Notably, there is a contradiction between values and actions. In spite of the good assessment, identification of problems and support of protection; all these thoughts do not imply the taking of actions for the defense of the collective interests. Hence, the decision of house location is not affected by the environmental impact it may generate.

3.3. Community actions for the protection of areas of ecological or cultural value

In the three case studies, citizen initiatives were identified for the protection of areas of ecological or cultural value over the threat of urban expansion. So they are good examples of the significance of community actions to contribute to the sustainable management of the peri-urban territory. These actions are described below, ordered by case study.

3.3.1. The defense and tourism promotion of the Mangamarca fog-oasis

In the study area, three social organizations were formed for the protection of Mangamarca fog-oasis: the Committee for the Defense of the Cultural and Natural Heritage of Mangamarca (Codepacma for its acronym in Spanish), the Lomas de Mangamarca Ecotourism Association, and the Association for Ecological Purposes. All these organizations are located in the southern gully. The sector of the Mangamarca gully is characterized by having several social organizations and a particularly high level of commitment of neighbors for their community, although some interviewees criticize the lack of neighborhood participation at present. This greater organizational culture may be related to two main aspects: the neighborhood origins in cooperatives linked in several cases to trade unions and the certain social homogeneity in a space physically confined by hills and an industrial area.

Codepacma was formed in 2007, since then they have carried out various cultural activities and the promotion of the archaeological sites and the fog-oasis. For 10 years they have faced, together with other organizations of Mangamarca, the urban invasions in these places. The president, Sarita Cristóbal, a solid defender of Mangamarca and a *lomas* enthusiast, says that they have received threats and aggressions from land invaders as a result of their denunciations. In addition, she declares her disappointment with the mayor's indifference and the lack of institutional support for the proposals and demands to protect and promote de Mangamarca fog-oasis.

In 2012, the Lomas de Mangamarca Ecotourism Association was formed, with support from the Codepacma and the Municipality of Lima. This association, formed mostly by young people from the area, promotes tourism in the *lomas* and carries out awareness-raising activities. They have also prepared tourism guides, and done activities with volunteers like paths improvement, and tree planting. In addition, it is part of the network of Lomas of Lima, which unites similar organizations of the main *lomas* of the city. This network allows them to know the strategies taken in other districts of the city, and together they have elaborated proposals and denunciations. The president of this association points out that her community have a great willingness to help protect the fog-oasis, as exposed below.

"The neighbors always brave and fighters have defended hand-to-hand areas of the lomas. Suddenly because we have other expectations, another cultural level, I do not know why. But the residents of Mangamarca are willing to fight to preserve our spaces, not only the lomas, but the hills."²³ (Yovita Barzola, president of the Lomas de Mangamarca Ecotourism Association)

Both organizations have been concerned to constantly denounce this problem to the municipalities of San Juan de Lurigancho and Lima, as well as other institutions such as the environmental prosecutor's office, the Ministry of Culture, and the Ministry of Environment. The main demand is that the legal protection of the fog-oasis is guaranteed, with its declaration as a fragile ecosystem or at least of local interest. They have also elaborated project proposals to the municipality without getting their support. They have even organized a protest march to the municipality for its lack of commitment and concrete actions. Likewise, last year they took the mayor to the top of the hills to see the diversity of flora and fauna and the growth of the invasions.

It is important to mention that neighborhood participation has been reinforced with certain actions of external collaboration. Mainly, the previous management of the Municipality of Lima, under the command of Susana Villarán, was concerned to promote the conservation of these ecosystems in Lima city. In Mangamarca, they supported the formation of leaders and creation of the association; also, they carried out technical studies for the proposal of protection and launched an awareness campaign. Unfortunately, the current management did not continue with this support.

The District Municipality has only supported from the environment division, which has limited resources. In coordination with the Ecotourism Association they have carried out information and awareness actions through the distribution of flyers and the installation of panels that indicate the prohibition of urban settlements in the upper part. In addition, they supported the tree planting campaigns. The urban development division has not collaborated with these organizations; it seems that they not see it as a strategy of prevention of informal settlements that could be part of their competencies. They only indicate that by not having municipal property documents of the area, they cannot proceed to evict the invaders with the police.

Similarly, there has been support in specific actions by university students, especially of Biology and Tourism. They have done research, trainings and supported activities like tree planting, watering and paths improvement.

On the other hand, recently the United Nations Development Program is executing a project for the conservation, management and rehabilitation of fragile lomas ecosystems in Lima; through which they plan to collaborate with social organizations and local governments for the protection

²³ "Los vecinos siempre aguerridos y luchadores han defendido cuerpo a cuerpo las zonas de los cerros. De repente porque tenemos otras expectativas, otro nivel cultural, no sé qué influiría. Pero la cosa que los vecinos de Mangamarca están dispuesto a luchar por conservar nuestros espacios, no solo las lomas, sino de los cerros." (Yovita Barzola)

of these ecosystems in the city. Specifically, one of their action lines is land use management with a participatory approach.

3.3.2. The community conservation efforts in Purrrumpampa

The civil society in Purrrumpampa also carries out actions for the protection and conservation of wetlands, in the face of an increase in urban expansion and the lack of adequate management by responsible public institutions.

In 2011, the Association for the Protection of the Purrrumpampa Ecological Park was formed with the objective of protecting the wetland from future invasions and environmental restoration of Purrrumpampa. The association has 82 members, among them, several neighbors from the eastern area of the wetland. It should be noted that the association protects the municipal property area but the wetland area extends to the northeast also on private land.

The actions carried out by the association are: installation of a perimeter fence, cleaning, planting of trees and flowers, recovery of wild species, complaints to the municipality of invasions or management problems, and preparation of proposals and projects. For example, forestry engineer, Domingo Mauricio, who is current president of the association, has voluntarily taken care to reintroduce species. He has brought from other lakes frogs and certain plants for nesting birds to encourage the return of these birds.

In addition, the associates impose a permanent resistance against new attempts of invasion. One of the interviewees and founding partner, Modesta Ríos remembers with pride having defended the public space from the invaders even in violent altercations.

The edge protection by the organized civil society had a high positive impact by consolidating wetland boundaries against misuses, such as: housing invasions, parking of trucks and cars, transit of minor and heavy vehicles through the wetland, and accumulation of construction materials. The cleaning of the ponds allows giving visibility to the surfaces of the water and increasing the presence of birds. In this way they have managed to maintain a large recreational public space, improve the urban landscape and protect the wetland ecosystem

The action of the Association is spread mainly through a local radio and workshops. The activities were financed with the funds of a public contest won by the association and with the voluntary work of the members. These actions that showed the citizen's commitment to the protection and recovery of public space were then extended to the south-east boundary by another association that also installed a perimeter fence.

This type of actions aimed at protecting the wetland and maintaining its recreational, cultural, and historical character exemplify the possibility of participation in the management of the peri-urban territory from civil society.

Apart from this association, other social organizations related to participation and citizen security have also carried out actions for the maintenance of Purrrumpampa. In the sectors adjacent to the wetlands, the neighborhood councils have supported cleaning and awareness actions. Likewise,

the Urban "Rounds", formed for surveillance and security, contribute to the control and cleanliness.

Regarding external collaboration, it is important to highlight the role of the priest Antonio Campos, who has continually supported and encouraged neighbors to organize and take effective actions to protect this space. Other institutions have cooperated for specific actions. The Ministry of Agriculture has donated plants for planting on the edges and has counted with the collaboration of municipal personnel in the area of environment on certain occasions such as the installation of fences.

3.3.3. Attempts to protect the Cajamarca valley

In Cajamarca, no active neighborhood organizations were identified for the protection of the valley. There has only been one movement to avoid the construction of a bus terminal and failed initiatives to demand a greater protection of green open spaces.

In the first case, in 2011, a movement was formed to avoid the location of the bus terminal in the study area because it was considered to have a negative impact in the Cajamarca valley. So they sought to preserve the intangibility of the Valley, according to the urban plan of 2006. One of the leaders expressed that the valley constitutes an element of vital importance for the local development and improvement of the quality of life, as well as a potential for the development of tourism (Díaz 2011). The movement had representatives of the College of Architects and the College of Engineers of Cajamarca that gave technical support to their arguments. The actions carried out include protests that had a significant citizenship support. It should be noted that in a meeting of leaders of this movement with the mayor of Cajamarca, they reminded him of the urgent need to update the Urban Development Plan foreseeing future urban growth and that it should be transparent, participatory and carried out with local multidisciplinary teams (Díaz 2011).

In the second case, it was found that some neighbors have tried to demand the protection of the valley to the owners or to the municipality without success. For example, a group of neighbors from the study area met with municipal officials to demand the protection of green areas. The main proposal was that the Municipality purchase areas destined for public recreation before they are subdivided for housing. However, the proposal was not accepted due to the cost involved, and the proponents were discouraged from continuing, as indicated by two of the members:

"They told us there was a general law that owners can do what they want with their land and the municipality would have no interference. In addition, the owners put a very high price for their land."²⁴ (Rosa Castañeda, neighbor, Cajamarca)

²⁴ "Nos dijeron que había una ley general de que los propietarios pueden hacer lo que quieran con sus terrenos y el municipio no tendría ninguna injerencia. Además que los propietarios ponen un precio muy alto para sus terrenos." (Rosa Castañeda)

"That's when we realized that the Municipality has its wings cut off, right?"²⁵ (Julio Marín, President of the Regional Federation of Indigenous and Urban Peasant Rounds of Cajamarca)

²⁵ "Allí es donde nos dimos cuenta de que el Municipio tiene como las alas cortadas, ¿no?" (Julio Marín)

3.4. Chapter conclusions

The open spaces under study tend to present a good appreciation, above all for offering a contrasting environment with the city. In addition, the positions that explain their assessment are diverse, based on different interests and experiences.

Opinion trends are very similar among householders of bigger cities in appreciation of natural spaces and urban sprawl problems. Instead, in a small city, householders seem to have a strong expectation of developing a modern city with hard infrastructure rather than maintaining large green spaces. In this way, as in other studies on the perception of changes in the urban area, it is confirmed that nature and the rural environment acquire special importance among urban inhabitants, but in particular, in bigger cities.

Regarding the opinion of urban encroachment in the selected areas, the majority of positions show that the social and economic aspects (such as the right to housing, comfort and land market) tend to be more significant than the strictly environmental aspects. Likewise, there is a contradiction between values and actions. Despite the good assessment, identification of problems and support of protection; all these thoughts have little significance in housing decisions and does not imply the taking of actions for the defense of the collective interests. In a similar way, the main interest of some owners to protect these areas from invasions would not be to defend an ecological value, but to avoid the arrival of unknown neighbors that alter the established order.

The discussion of urban sustainability highlights the necessity of efficient land-use management that integrates multiple stakeholders, including local citizen organizations, to define and coordinate appropriate strategies. In this regard, the citizen initiatives in the study areas are fundamental as they demonstrate that the organized population can take concrete actions to fulfill objectives of interest for the common good. In addition, these actions seem to fill the gaps in the government structures to manage the peri-urban space. Unfortunately, the results of the cases presented are not always encouraging and this can determine to a large extent the duration of the actions and affect the tenacity of the members.

The formation of citizen organizations of this type demonstrates a high degree of commitment from the neighbors and reinforces the impact of their activities. As shown by Enqvist et al. (2014), a more stable structure of citizen participation is more efficient than loose structures, although the latter can facilitate more members to participate.

It is interesting to note that the collaboration of specialists or external organizations has played a fundamental role in strengthening these initiatives. Since, in the case studies, external actors have contributed to the formation of leaders, reinforcement of their motivation and, in two of the cases, they have encouraged the creation of organizations to legitimize and give continuity to their work. However, all these initiatives are mainly developed by neighbors, which would guarantee their greater acceptance. On the contrary, the study by Ostrom et al. (1999) shows that when external actors impose norms or control of the commons without local participation, it tends to generate great resistance.

Furthermore, it stands out that the leaders in these community actions are mainly women. It could be related to particular conditions as found by Rocio Silva in the study of women leaders in ecoterritorial conflicts in Peru. The author identifies that leadership of women environmental defenders is characterized by: greater willingness to common work, greater persistence in the struggle, leadership performance in smaller scale spaces (local or communal), greater sacrifice of family responsibilities and the discourse of defense of the territory as something familiar rather than political (Silva 2017).

CHAPTER 4:

The challenge of sustainable land management in the urban fringe

The discussion of urban sustainability highlights the necessity of efficient land-use management oriented to more compact cities in secure areas with open public spaces, and avoiding the loss of productive land and important ecosystems. With this in mind, this chapter describes the deficiencies on urban planning and management in the case studies. It is also presented other key social aspects concerning challenges to sustainable land management: the opinion related to housing density and the widespread infringement of urban law. Finally, it is estimated the long-term possible consequences of urban expansion in the case studies, considering the spatial dynamics, demographic trends, urban projects and local management characteristics.

4.1. Deficiencies on urban planning and management

This section analyzes the practices and instruments of planning and management of the peri-urban territory in the case studies, with the aim to identify the deficiencies that allow uncontrolled urban expansion in non-developable areas and reducing areas of ecological or agrological value. As Hardoy et al. (2001) mentions, usually the problem is not the absence of vacant land for new developments, but the lack of appropriate government action to guide urban developments on suitable land. Therefore, the section begins presenting the national framework of urban expansion management. Then, it is exposed the situation in the case studies concerning the lack of political interest in urban planning, the main deficiencies on urban plans, the undesirable consequences of this kind of deficiencies, and the householders' opinion of the public management of this matter.

4.1.1. Legal and institutional framework

The capabilities related to public management of urban expansion cover essentially two levels. The first level corresponds to the definition of political and legal framework on a national scale by the Ministry of Housing, Construction and Sanitation (MHCS). The second level concerns the approval and application of the planning and management instruments of the urban expansion areas under the responsibility of the provincial and district municipalities, corresponding to the intermediate and lower level in the hierarchy of administrative units in Peru.

In this way, the Department of Urban Planning and Urban Development of the MHCS is in charge of regulating, giving assistance and giving an opinion on the urban plans, required to the municipalities since three decades ago (D.S. No. 007-85-VC). According to its directives, the urban plan defines the areas of urban expansion and those that cannot be urbanized. However, there is no methodological precision for this and the zoning categories for the protection areas fall into the contradiction of being actually reserve areas until a further complementary plan defines the way to urbanize them (D.S. No. 022-2016-VIVIENDA).

It should be noted that until 2017, there was an overlap in the policies and regulations of territorial planning at the provincial level, between the MHCS and the Ministry of the Environment. The latter had an extensive and detailed methodological process for the elaboration of territorial plans where urban vocation areas are identified. However, this entity has suffered a political weakening in recent years under the neoliberal intentions of environmental deregulation to encourage investment in extractive industries, which has led to the "voluntary resignation" of the Ministry of the Environment in the direction of this matter (Cooperacion 2017, Giesecke 2017).

In relation to the implementation of these instruments, most municipalities have weaknesses in human and financial resources, which limit the preparation and efficient implementation of the plans. As evidence, the National Registry of Municipalities shows that 75.2% of municipalities do not have an urban plan; and among these, 73.6% do not have it due to lack of resources for its formulation (INEI 2016).

Regarding the formal urbanization process in Peru, the national regulations establish the following main steps controlled by the local municipalities:

1. Zoning as urban or developable land in the local urban plan
2. Authorization for land subdivision and urban development (services and infrastructure implementation)
3. License to building construction

The urban plans are expected to be prepared with citizen participation, be communicated and supervised their application. In the next step, the authorization for urban development projects should comply with the established requirements in terms of lot size, and provide free contributions for recreation and public services such as educational facilities, among others. Once approved, they must comply with the installation of electricity, water and sewerage networks, in addition to the implementation of road infrastructure (tracks and sidewalks) and public lighting

(Law 29090). Finally, the construction of buildings must have a municipal license and comply with the areas and characteristics defined in the zoning of land uses and the National Building Regulations.

Unfortunately, the reality is very different and informality predominates in the three steps described. In addition, the sequence of the actual process is very variable. In this regard, Julio Calderón synthesizes this process from the approach of obtaining satisfactors in the following sequence: land, property titles, basic services and housing improvement, being the last two stages of improvement slower and progressive (Calderón 2005).

Webb et al. (2006) approaches to the analysis of the construction of the property right. The authors identify three stages: the expectation (invasion), the legal (title) and the registration. The right expectation would be an extralegal regulation that is based on the perception of the owner as on the consent and recognition by society" (Webb et al., 2006: 33). In addition, the processes of construction and installation of services and roads are elements that reinforce the construction of the law and have a certain level of recognition from the State. However, the occupation of risk areas would be a circumstance that prevents legal sanitation in the vast majority of cases (Webb et al 2006, 29).

In addition, the planning of the peri-urban space is divided and disarticulated between urban plans, territorial plans and development plans. Urban plans focus on physical and regulatory aspects, lacking more comprehensive strategies. The territorial plans are not yet sufficiently valued by the authorities and are poorly developed. On the contrary, development plans tend to lack a greater spatial approach.

4.1.2. Postponed plans and lack of political willingness

In all case studies, the formulation of urban and territorial plans has been a delayed and extended process, mainly due to the lack of political will. Two of the case studies have a recent update of their urban development plans; while Metropolitan Lima does not have a current urban plan due to the discontinuity of policies with the change of authorities. The previous administration of Metropolitan Lima elaborated an extensive and valuable proposal of urban plan, but this was not approved by the current administration.

In the last decade, the three case studies have presented periods of between 5 and 8 years without the existence of an urban plan (see Table 12), although, formally, it is usually established the extension of the validity of the previous plan by ordinance. Nevertheless, this situation shows the lack of political interest in the planning of the city.

Among the general aspects of these plans, it has been identified that several cases have counted on the advice of an institution specialized in planning, either public or private. The technical teams incorporate specialists from various disciplines, among whom the presence of architects predominates. Although, it is not common to incorporate municipal officials in the formulation of plans and their participation would be limited to public presentations and workshops.

Surprisingly, two of these documents do not comply with basic conditions regarding an orderly and clear presentation and writing.

Table 12: Urban plans in the case studies

	MANGOMARCA FOG-OASIS – LIMA CITY	CAJAMARCA VALLEY – CAJAMARCA CITY	PURRUMPAMPA WETLANDS – HUAMACHUCO CITY
Present urban plan	- There is no current plan	- Urban development plan (UDP) 2016-2026	- Urban development plan (UDP) 2016-2024 - Specific urban plan (SUP) of Pampas de Purrumpampa 2016-2026
Previous urban plan	- Metropolitan development plan (MDP) of Lima and Callao 1990-2010	- Urban development improvement plan (UDIP) 2006-2010 - Peri-urban development plan (PDP) 1999-2010	
Responsible of approval	Metropolitan Municipality of Lima ²⁶	Provincial Municipality of Cajamarca	Provincial Municipality of Sanchez Carrion
Time without plan	8 years	5 years	5 years
Zoning maps without plan	- Zoning map (ZM) of Metropolitan Lima 2007		- Zoning map (ZM) 2005-2010

Sources: MML 1992; IMP-MML 2007; MPC 2000, 2006, 2016; MPSC 2004, 2016; MPSC & PUCP 2016.

In the cases of intermediate and minor cities, due to the insufficiency of technical capacities in local governments they opt for the hiring of foreign consultants. In both cases, the preparation of plans was responsibility of consultants who reside outside the city and who subcontract other people, resulting in low quality products whose approval is delayed and complicated. These situations reveal the little importance that the authorities give to the plans. Moreover, it hinders the achievement of a participatory process and reduces the likeliness that key stakeholders involve in the execution of the plan.

²⁶ The authority responsible of urban management in the case of Mangamarca is divided in the provincial and district level, due to the large extension of Lima city, so the case study is under the authority of the Municipality of the Province of Lima and the Municipality of the District of San Juan de Lurigancho. In addition, in the upper area there is a border conflict which claims the authority of the District of San Antonio that belongs to the Province of Huarochiri, although these entities have not made relevant actions in the study area.

Likewise, the low level of direct participation of key government officials means that they do not take ownership of these instruments or at least are very familiar with them. For example, an official from the area of urban development expressed "we hope that in the urban development plan they include it" in relation to the protection of a study area, demonstrating distancing from the formulators despite having a position of decision in the matter. Similarly, the Deputy Manager of Urban Planning of Cajamarca, Alex Huaccha, indicated that the study area would be maintained for agricultural use, stating that they want to make a special regulation because it is "one of the parts that remain as a valley". However, four months later, the Urban Plan was approved, changing the zoning of the entire sector to residential use. This would indicate their low participation despite having an important role in this matter.

In addition, the existence of the plans does not guarantee their compliance, in all cases criticisms have been raised due to the lack of application and control of the strategies established in the plans. Even, several municipal officials evidenced the little knowledge of the contents of the plans in matters concerning their functions.

It is common that with the change of authorities, the strategies proposed by the previous administration are abandoned. The clearest example of this is the current administration of the Metropolitan Municipality of Lima, which not only did not approve the urban plan proposal elaborated during the previous administration, but also developed a new development plan despite the fact that there was already one in force. The previous administration approved the Regional Plan for Concerted Development 2012-2025 and the new management also approved a Local Plan for Concerted Development 2016-2021, taking advantage of the exceptional status of the government of Metropolitan Lima with regional and local competencies at the same time. This new document shows a very low quality of analysis compared to the previous one and shows the maneuvers to impose a change of priorities in municipal policies.

Due to the focus of the study, it also interested to observe the role of the area or environmental management of each municipality. The officials of these areas have not participated in the elaboration of the territorial plans, because it is not considered as part of their competences. Likewise, a very low collaboration between the areas of environment and urban development was identified to jointly deal with the management of natural spaces in the face of a disorderly urban expansion.

4.1.3. Weak planning strategies

The guidelines and strategies of the urban plans are analyzed below, in relation to the areas of study and the treatment of urban expansion.

It should be recalled that the Urban Plan is the one that defines the areas of urban expansion and non-developable areas, as well as the road network and the strategies for urban development. The policies related to urban expansion could be also proposed in other management instruments like the Territorial Plans (Provincial level) and the Development Plans (District or provincial level).

The problem of urban expansion in the study areas is especially relevant in the urban plans of the cities of Cajamarca and Huamachuco, which is explicitly mentioned in the diagnoses of these plans.

However, the attention of this problem is not directly included in the objectives of the most recent urban plans.

In the urban plan of Metropolitan Lima, the area of Mangomarca does not obtain relevance due to the wide extension of the city. In this plan, the problem of urban expansion is mentioned only in relation to the reduction of agricultural areas.

In the three case studies, a zoning was established that grants some type of protection to critical areas. However, the latest plans of Cajamarca and Huamachuco shrink this protection (see Figure 70 and Figure 71). In the case of Purumpampa, the zone of ecological and historical protection was reduced, excluding areas that were already occupied and more consolidated.

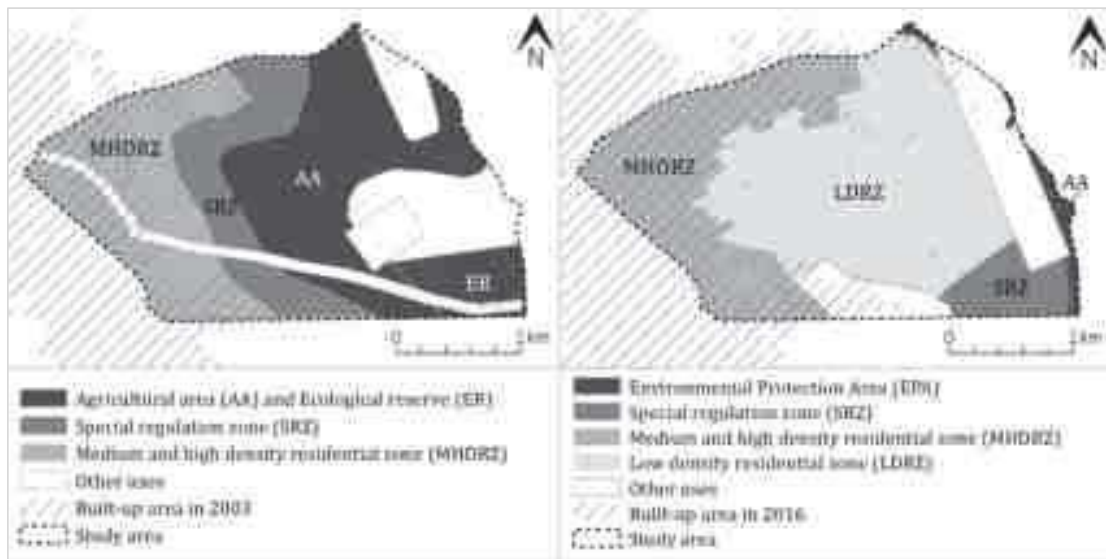


Figure 70: Zoning in Cajamarca study area in 2006 (left) and 2016 (right)

Prepared by P. Moschella. Sources: MPC 2006, 2016.

In Cajamarca, the change was more drastic. Previously, the Plan of Improvement of Urban Development of 2006 proposes non-urban lands to protect the valley and a transition zone where alternative activities are promoted. The standards in the transition zone authorized to build up to one floor of height with 80% of free area, and the approved uses are housing-orchard, recreation and sports. Before the plan, the 54% of urban growth was located in irrigated land; and after the plan, this rate decrease to 30%.

Regrettably, this regulation was not fully respected and continued the sale of plots without following the formal urbanization procedures. Subsequently, the UDP changed the zoning to low-density residential, eliminating the previous protection.

On the other hand, it is observed that all the documents establish areas of urban expansion, but there are no appropriate strategies to encourage the occupation of these areas and discourage it in critical areas. For example, none of the plans propose specific public facilities in the expansion areas, which could encourage the occupation of these areas. On the contrary, the areas of expansion seem to be empty areas in the plans. However, the MDP of Lima proposes mixed and

productive uses in the expansion areas, but without specific public investment proposals that lead the elevation of the attractiveness of the expansion areas.

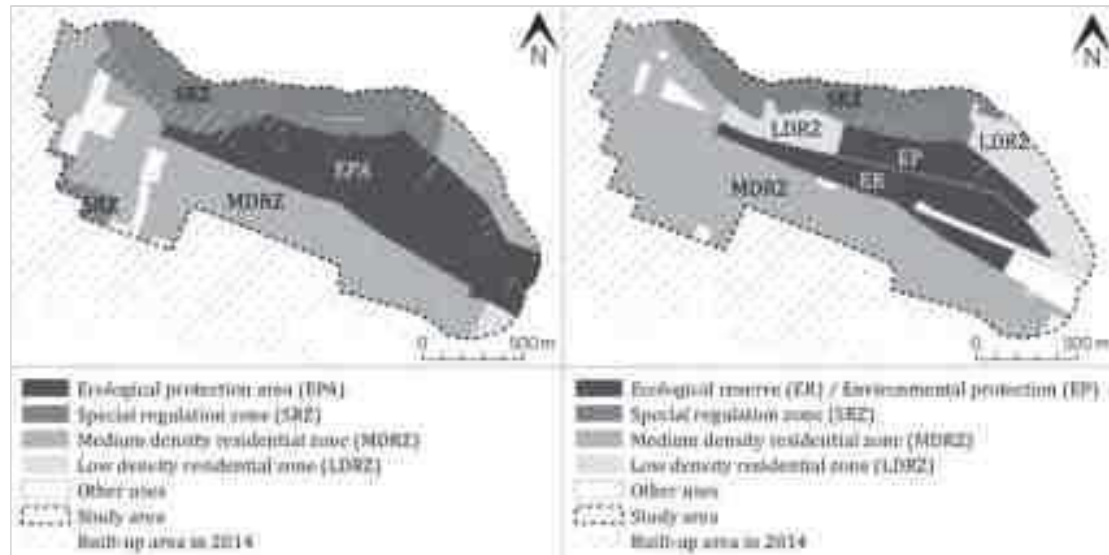


Figure 71: Zoning in Purrumpampa study area in 2005 (left) and 2016 (right)

Prepared by P. Moschella. Sources: MPSC 2004, MPSC & PUCP 2016.

Another inconsistency identified in Cajamarca is the case of landowners in residential zoning areas without desiring to change their use, thus they have had to request the municipality for an exception to be considered "rustic islands". These cases show the inconsistency of the supposed objectives of protection of the valley by the local government and the weak institutional support for the development of farming in the valley.

The role of road planning to encourage or discourage occupation is not considered properly either. In the three case studies have been established road proposals that cross or border the study area and as a result encourage its occupation. On the contrary, in some cases expansion areas tend to present a poor planning of roads and therefore a lower incentive of occupation.

On the other hand, these plans also lack of more comprehensive strategies that complement spatial zoning, such as fiscal or administrative incentives that promote orderly urban expansion. Rather, they focus almost exclusively on the normative aspects concerning the characteristics of urban developments.

As for the density of the city, most documents consider it an important aspect and propose a densification while maintaining large open spaces. Particularly, the UDP of Cajamarca proposes a strong socio-spatial segregation, differentiating the low-density expansion towards the valley with express and arterial routes and diverse facilities. Opposite to the expansion towards the south and west where high density is concentrated without express ways and without definition of open spaces or important facilities. All the aspects revised in the evaluation of urban plans are summarized in Table 13.

Table 13: Evaluation of urban plans in study areas

Plan or map	MANGOMARCA		CAJAMARCA			PURRUMPAMPA		
	ZM 2007	MDP 1990	UDP 2016	UDI P 2006	PDP 1999	UDP 2016	SUP 2016	ZM 2005
Consider urban expansion in the study area as a problem	-	x	✓/x	✓	✓/x	✓/x	✓	-
Proposes objectives related to order urban expansion	-	✓	x	✓	✓	✓/x	✓	-
Proposes objectives related to protecting the study area	-	x	x	✓	✓	x	✓	-
The assigned zoning defines some type of protection of the study area	✓	x	x	✓	✓	✓	✓	✓
Areas of urban expansion are established	✓	✓	✓	✓	✓	✓	-	✓
The location of facilities and commercial areas is separated from the study area	✓	✓	x	✓/x	?	✓/x	✓/x	✓
The location of facilities encourages the occupation of expansion areas	x	x	x	x	?	x	-	x
Road planning avoids crossing the study area	x	✓	x	x	?	x	✓	x
Road planning encourages the occupation of expansion areas	✓	✓	x	✓	?	✓/x	-	✓/x
Fiscal or administrative incentives are proposed for an orderly expansion	-	x	?	✓	x	x	-	-
Densification is proposed maintaining large open spaces	✓	✓	x	✓	✓	✓	-	x

✓ satisfactory

x unsatisfactory

✓/x scarcely satisfactory

- not applicable due to the type of document

? lack of information as only an incomplete version of the plan was accessible

As has been demonstrated, these plans focus on the zoning of land uses and are not properly articulated with more diverse strategies such as road planning or tax incentives. In this regard, Catenazzi and Reese (2008) criticize the application of normative tables of European inspiration in the Latin American context, where the real possibilities of planning urban expansion are quite limited. In addition, Reese considers that there must be articulation between urban plans with fiscal, administrative, tax and economic policies tools (Reese 2006: 11).

Similarly, Bazant criticizes the planning of urban growth based on urban regulations, as he considers that it is useless to seek to control urban land through regulations of only its physical-spatial aspect. Moreover, he considers there is a lack of understanding of the urban dynamics, such as the processes of dispersion, atomization and revaluation of urban land; and due to this failure the urban expansion in Latin American cities is anarchic (Bazant 2010: 501). Thus, a large part of the deficiencies identified in the urban plans of the case studies would reflect the ignorance or lack of understanding of urban dynamics. Similarly, this weakness will be exposed as some undesirable effects of urban plans presented in the next section.

4.1.4. Undesirable effects of urban management

It is important to notice that public management plays a role in facilitating the occupation and densification of certain areas, which can result in a perverse incentive if the indirect effects of policies and investments that influence the value of urban land are not considered. Especially, the public investment in urban infrastructure that generates surplus value in adjoining land and, as a consequence, promotes densification and change in land use (Bazant 2010). In the case studies there have occur this kind of undesirable effects that encourages urban use opposing to the protection zoning.

In Cajamarca and Purrumpampa, there were identified public investments in roads and facilities that, contrary to what is planned, encourage urban development in non-developable areas (see Figure 72). In both cases were projected belt highways, known as "Vía de Evitamiento", that cross the zones under study, without considering the impact that this would have on the elevation of the land value and the pressure for its urbanization. The most significant example is the belt highway crossing the study area in Cajamarca valley. It was created with the intention of diverting heavy traffic from the city, and by many it was considered as a limit between the urban and rural area. Nevertheless, it motivated the occupation of the area as it became more accessible and attractive for residential and commercial uses.

Similarly, the construction of the Qhapac Ñan Administrative Complex in Cajamarca also motivates the occupation of the valley and contradicts the intangibility policy of the valley. This administrative complex is a use of land not in accordance with the zoning established in the urban plan, so it could be considered as the production of informality from public authorities, paraphrasing the category of urban informality described by Belguidoum and Mouaziz (2010: 110).

In the case of Purrumpampa, the municipality built the House of Public Safety within the protection area, and on the edge, over the wetlands area; also a municipal deposit was built. Likewise, attending the request of the neighbors, the municipality enclosed a channel with concrete, turning them into roads for transit (see Figure 49), action that further promoted housing building in this edge of the wetland. Demonstrating a contradiction in the public management of this space despite being an area of ecological and historical protection.

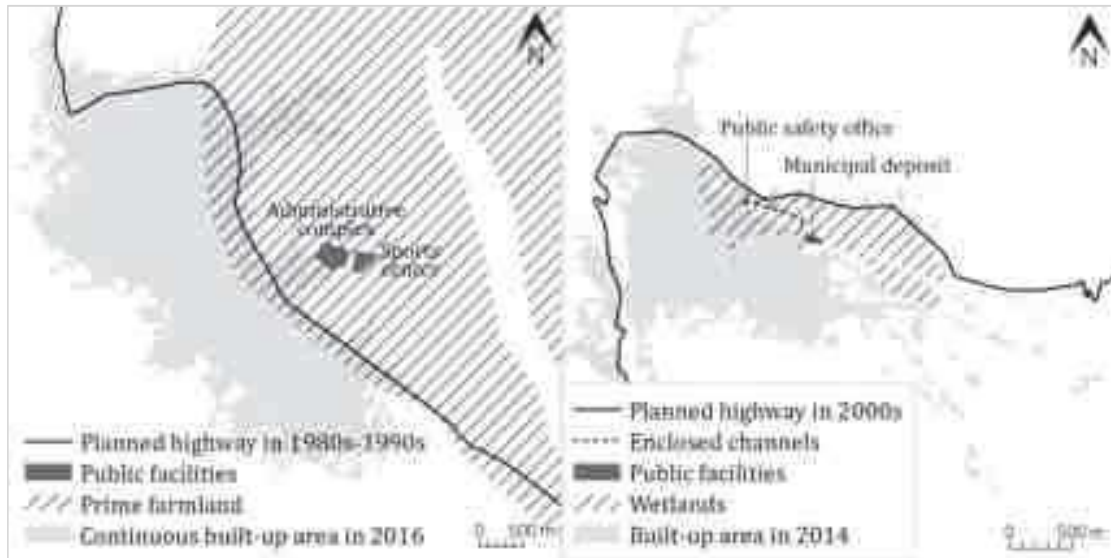


Figure 72: Inappropriate roads and public facilities in Cajamarca (left) and Huamachuco (right)

Prepared by P. Moschella. Sources: MPC 2006, GRC 2010, Google & Digitalglobe 2018, MPSC 2004, SPOT 1987, Digitalglobe 2014.

Another contradictory strategy from public management in Cajamarca the change of land-use to urban with the rise of taxes, even when some landowners want to maintain the agricultural land-use. So, it promotes the sale of the land because the payment of taxes becomes excessive for these owners. In a similar way, there is weak institutional support for the development of farming in the valley.

Whereas, in Mangomarca, a related example is the irresponsible offer of property titles to obtain votes by the present major, that encouraged a rapid informal land subdivision of non-developable areas. As well as the installation of basic services in non-developable areas that ends up giving legitimacy to informal settlements. Although, there are norms that do not allow basic services providers to do so. For example, in the case of Mangomarca, informal settlements have achieved the installation of electricity with false plans of approval from the municipality.

4.1.5. Urban management disapproval

Regarding urban growth at each city as a whole, the respondents of bigger cities considered that they have grown in a disorderly way (87% in Lima and 79% in Cajamarca), and in the smaller city of Huamachuco this percentage is lower (34%) (see Figure 73).

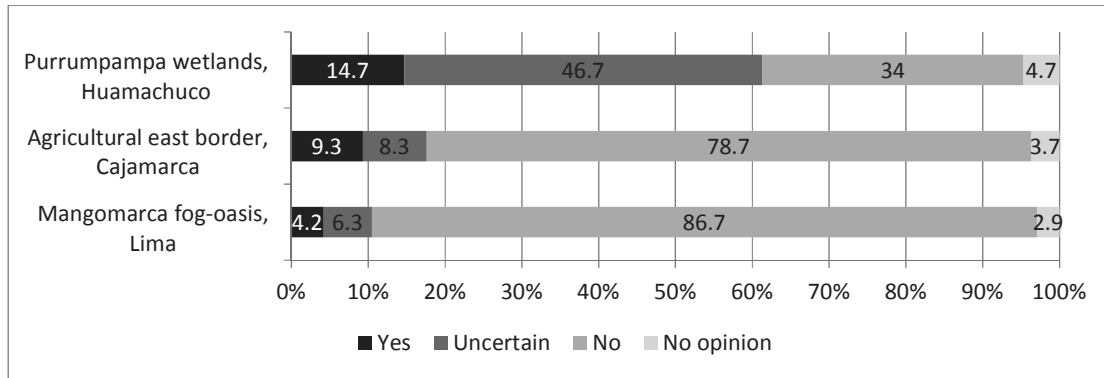


Figure 73: Householders that consider that urban expansion of the city is ordained

Source: Field surveys 2016-2017.

The opinion of urban growth management by local administration has similar results; in the study areas of Lima and Cajamarca, the majority considered that management is deficient (65% and 69%, respectively). While in Huamachuco, the majority thinks that the management is acceptable (see Figure 74).

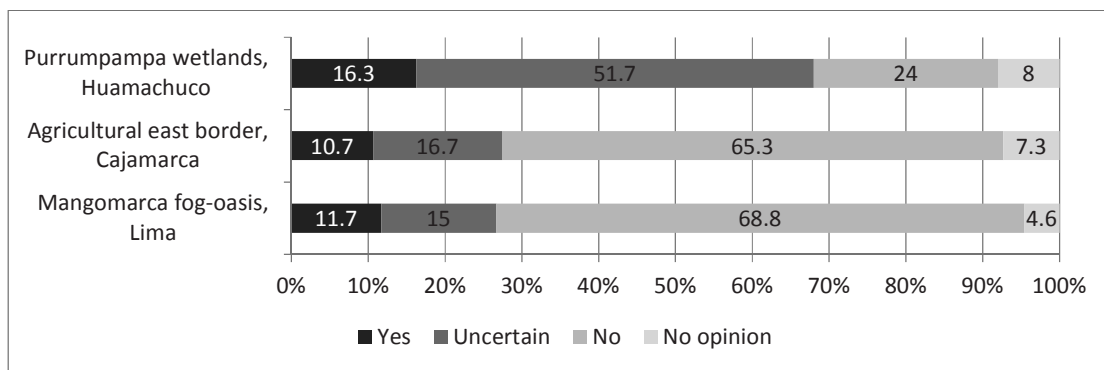


Figure 74: Householders that consider that local administration is doing a good management for an ordained urban expansion

Source: Field surveys 2016-2017.

The disagreement of the management of the expansion over the valley of Cajamarca is summarized in the following statement: "There have been local governments that have tried to control the occupation of the valley. (...) But there is no proposal, there is no alternative. They are

simply declarations, they are inconsequential actions."²⁷ (V́ctor Vargas, former councilman, Cajamarca)

In Cajamarca and Mangamarca some participants point out that the municipality does not accomplish its role as authority or sometimes is responsible for expansion problems. For example, one of the interviewees pointed out that "what happens is that there is lack of authority, the authority does not care and then everyone does what they want"²⁸ (Arico Che, Mangamarca). Even several respondents indicated that in Mangamarca the municipality supports the invasions.

On the contrary, there are also those who consider that the responsibility is joint between the citizenship and the authorities, indicating for example that "we create disorder; it is not only the government's fault" (Anonym, Cajamarca).

It is also important to note that many participants demonstrated ignorance of the existence of plans and regulations on urban development. Therefore, their disagreement may also be greater due to the lack of information or socialization of actions by the municipalities. Moreover, the key stakeholders should be involved in special ways during the planning process to approve the proposals and be engaged to collaborate in its execution. For example, the Specific Urban Plan of Purumpampa had participatory and consensus workshops, but did not implicated more closely the social organizations that have voluntarily contribute to the protection of the wetlands. Consequently, some of these stakeholders have firmly expressed their disagreement to the plan; however, their criticism is of minor details.

²⁷ "Ha habido gobiernos locales que han intentado controlar la ocupaci3n del valle. (...) Pero no hay una propuesta, no hay una alternativa. Simplemente son declaraciones, son acciones intrascendentes." (V́ctor Vargas)

²⁸ "Lo que pasa es que falta autoridad, la autoridad no se preocupa y entonces todo el mundo hace lo que quiere" (Arico Che)

4.2. Low density housing customs and expectations

One of the sociocultural factors that have contributed to the urbanization of agricultural areas is the generational change towards urban lifestyles and the aspiration of a single-family home. Therefore, the opinion housing customs and expectations have been also analyzed.

4.2.1. Type of housing in the case studies

At the city level, the figures from the 2007 National Population and Housing Census (INEI 2007) indicate that the proportion of apartment type housing is low or non-existent and there would be a tendency to be minor in smaller cities (see Table 14). The capital city of Lima has 15% of apartment type homes. In the middle city of Cajamarca 4% of the houses are apartments, while in the smaller city of Huamachuco this figure reaches only 0.2%. So in the three cities there is a large predominance of independent housing and this would be related to a low-rise urban structure and larger land occupation. It should be noted that these figures do not include the rental of rooms, which is quite common in low-income sectors (Calderón 2011), a situation that increases population density but not housing.

Table 14: Type of housing in the cities under study

TYPE OF HOUSING	LIMA	CAJAMARCA	HUAMACHUCO
Single-family home	77.8%	84.8%	97.5%
Apartments	14.6%	4.1%	0.2%
Others	7.6%	11.1%	2.3%

Source: INEI 2007

The distribution of apartments in the study areas, according to the 2007 census data, can be seen in Figure 75. In Mangamarca and Cajamarca apartment type dwellings are randomly located in the sectors of greatest consolidation. The most precarious sectors or in the process of urbanization, do not have the presence of apartments. While in Purrumpampa apartments are virtually non-existent.

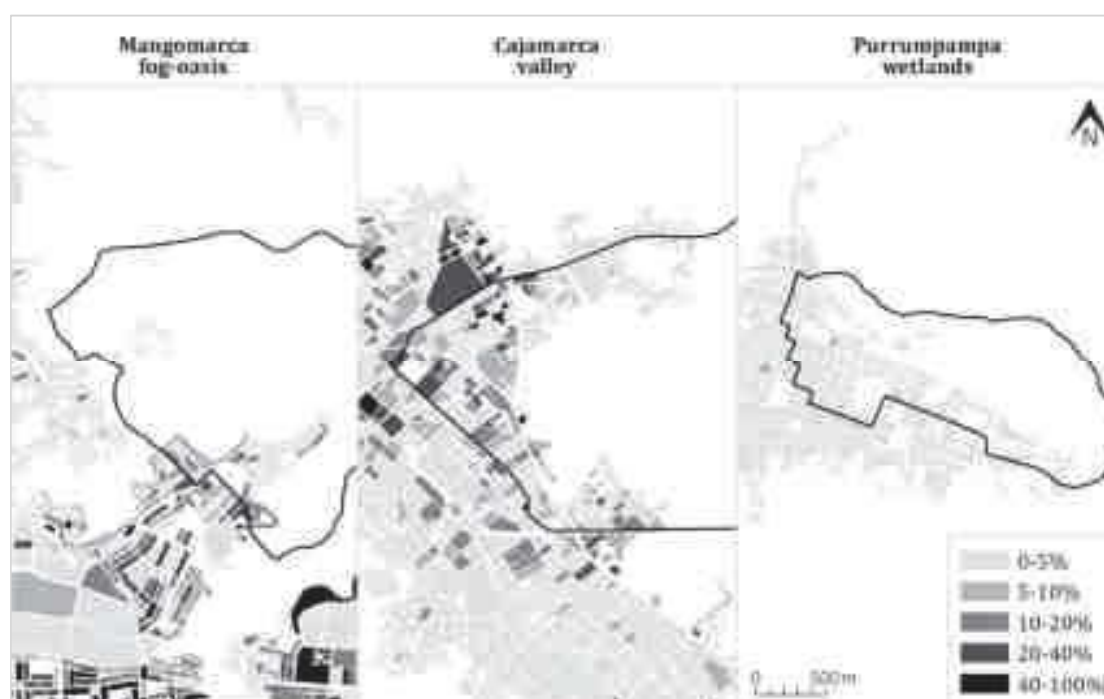


Figure 75: Proportion of apartment type housing per block in the case studies.

Source: INEI 2007.

Despite this predominance of independent housing, the population density is high in some sectors and there are even several overcrowded houses. The average density in the study areas is similar in the three cases, with values around 150 inhabitants per hectare (see Table 15). The density per block reaches values of more than 600 inhabitants per hectare (see Figure 76). In all three cases, the zones occupied by land invasion are the ones that concentrate the highest population density.

Table 15: Density in the study areas in 2007

	MANGOMARCA FOG-OASIS	CAJAMARCA VALLEY	PURRUMPAMPA WETLANDS
Population density (pop./ha) in the built-up areas in 2007	145	159	151

Source: INEI 2007.

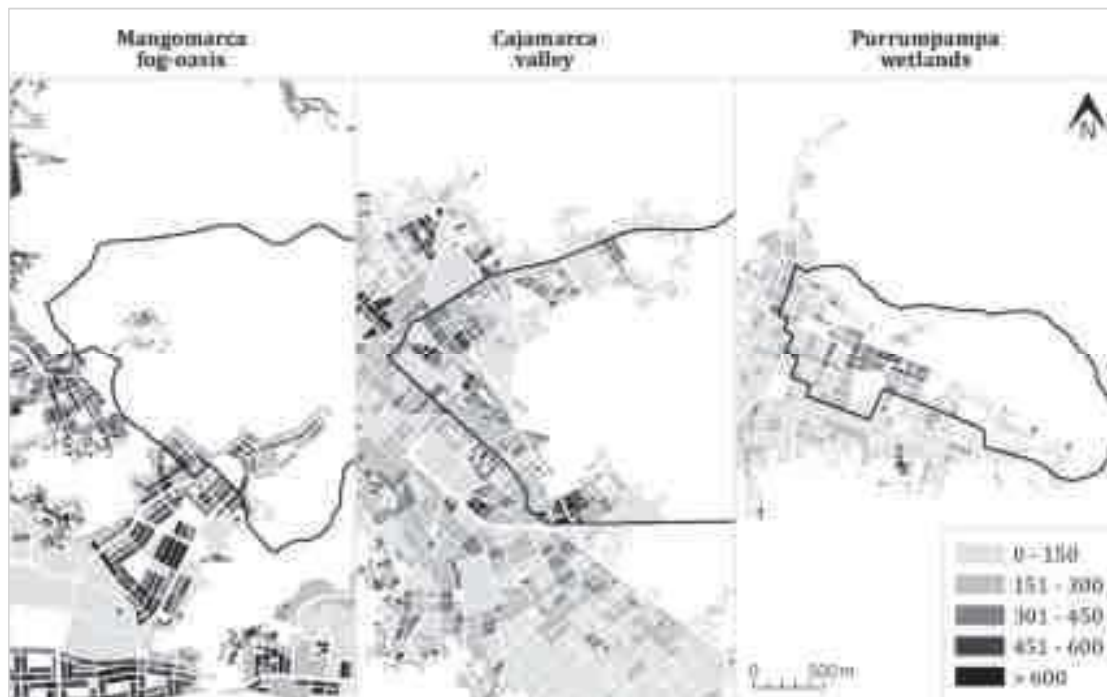


Figure 76: Population density per block in the case studies

Source: INEI 2007.

According to the INEI, it is considered that overcrowded houses are those with more than 3 people per room. In this way, in Cajamarca and Mangomarca 9% and in Purrumpampa 11% of the houses are overcrowded (see Figure 77). In Mangomarca and Cajamarca, overcrowded dwellings tend to be located in the most recent occupation zones at the edge of the urban area. In Purrumpampa they do not present a defined distribution pattern. In addition, in the cases of Cajamarca and Purrumpampa, it is observed that the invasion zones have high density but do not present a high proportion of overcrowding.

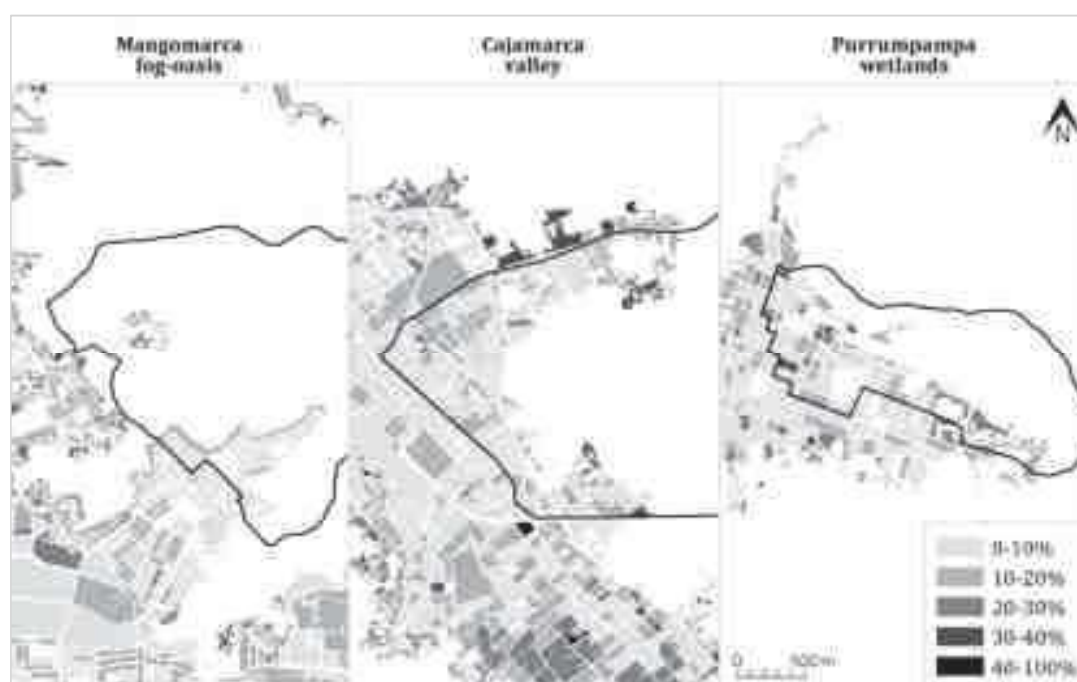


Figure 77: Proportion of overcrowded houses in the case studies

Source: INEI 2007.

The comparison of the proportion of houses and apartments in the census year of 2007 with the field survey results confirm the low presence of apartments in the study areas (see Table 16). However, almost 10 years after the Census, there would also be some slight changes, such as the increase in single-family homes in Mangomarca and, conversely, an increase in apartments in Cajamarca.

Table 16: Comparison of type of housing in the case studies

	MANGOMARCA FOG-OASIS		CAJAMARCA VALLEY		PURRUMPAMPA WETLANDS	
	Census	Survey	Census	Survey	Census	Survey
Single-family home	92.3	97.1%	80.8	84.7%	98.3	97.0%
Apartment	6.1	2.1%	6.5	8.3%	0.4	0.3%
Other/No opinion	1.6	0.8%	12.7	7.0%	1.3	2.7%

Source: INEI 2007, Field surveys 2016-2017.

4.2.2. Advantages and disadvantages of living in apartments

A large part of interviewees (35 – 45%) considered that higher density housing is useful to control urban sprawl. There is little disparity in correlation with the size of the city, where bigger cities tend to exhibit more acceptance of multi-level buildings (see Figure 78). Also, the uncertain answers are reduced in bigger cities. Possibly, because residents of bigger cities are more familiar with the apartment lifestyle.

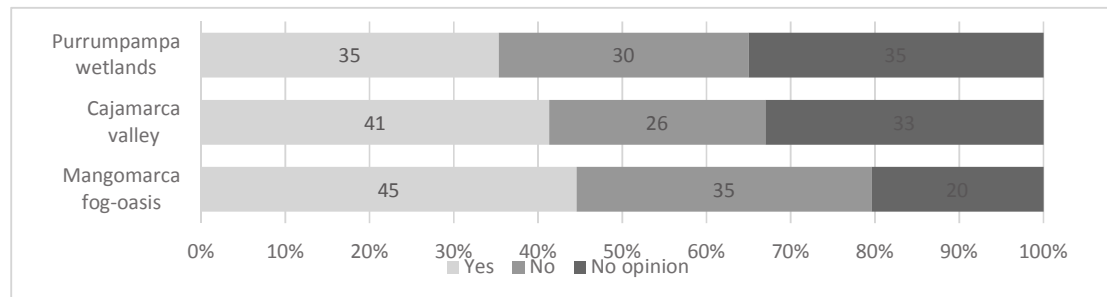


Figure 78: Household heads opinion on the suitability of apartments to manage urban expansion
Source: Field surveys 2016-2017.

This question opened a discussion about the main advantages and disadvantages that the interviewees saw in the apartments. Those who were officials in urban development areas evidently had a clearer position in this regard. However, the relationship between the type of growth of the city and its implications, was a topic widely commented by the diverse participants in the surveys and interviews.

A large part of the interviewees made explicit the relationship between the previous topics dealt within the questionnaire and the advantage that more apartment buildings would imply. So, several participants commented on the utility of the apartments to avoid expansion over adjacent green areas, some of these statements are found below.

*"It would be good to make buildings. In other cities many families live in buildings and we avoid getting into our green areas."*²⁹ (Anonym, Cajamarca)

*"As it is a vertical growth, it would help you to have more green area. If you have your shack in every 120 meters is worse (...) Maybe the municipality could be tough with that and make more apartment complexes but with large green areas."*³⁰ (Rosa Castañeda, neighbor, Cajamarca)

²⁹ "Sería positivo hacer edificios. En otras ciudades viven en edificios muchas familias y así evitamos meternos a nuestras áreas verdes." (Anonym)

³⁰ "Como es un crecimiento vertical, te ayudaría para tener más área verde. Si tienes tus casuchitas en cada 120 metros es peor (...) Tal vez el Municipio podría tener mano dura con eso y hacer más complejos habitacionales pero con grandes áreas verdes." (Rosa Castañeda)

"If we use more buildings and preserve green areas, at least we can have another type of conformation of the city."³¹ (Manuel Tavera, official Sub-management of Urban Planning, Cajamarca)

Similarly, other interviewees highlighted that the main advantage would be to avoid the decrease of agricultural areas and thus maintain the provision of food, as the examples below.

"The politicians had to have planned to use the hills for buildings construction so people can live as in other countries and those agricultural lands would have served us better in the future for our food."³² (Walter Moreno, Mangamarca)

"A way of being able to take care of our valley or our countryside is logically growing in height and there we would prevent to be advancing towards the part of the valley or where the livestock breeding are."³³ (Jesús Rodríguez, National Service of Agrarian Health official, Cajamarca)

On the other hand, some interviewees focused on the economic advantages that the vertical growth of the city implies, both for builders, buyers and for the provision of basic services. Below is this type of opinion.

"It is much more profitable to build in a small area of many floors (...) that supplies the need for housing and a cheaper, more affordable price."³⁴ (Fresia Chunga, neighbor, Cajamarca)

"I think it is extraordinary that there is densification, because it reduces the costs of basic services. With this I can stop the disproportionate expansion of houses, and urban developments. For me, it is very important, and what's more, we are encouraging it with the change of zoning."³⁵ (Alex Huaccha, Sub-Manager of Urban Planning, Cajamarca)

On the contrary, several interviewees also demonstrated its opposition to the apartments due to the perception of disadvantages in economic aspects, safety, comfort and quality of life. For many, the main obstacle to accessing an apartment is the high price compared to a land without building.

³¹ "Si nosotros utilizamos la edificación vertical y conservamos áreas verdes, por lo menos podremos tener otro tipo de conformación de la ciudad." (Manuel Tavera)

³² "Los políticos tenían que haber planificado utilizar los cerros construyendo edificios para que puedan vivir como en otros países y esos terrenos agrícolas nos hubieran servido mejor en un futuro para nuestra alimentación" (Walter Moreno)

³³ "Una manera de poder cuidar nuestro valle o nuestra campiña es lógicamente crecer hacia arriba y allí impediríamos estar avanzando hacia la parte del valle o hacia donde están las crianzas ganaderas." (Jesús Rodríguez)

³⁴ "Es mucho más rentable construir en una pequeña área de muchos pisos (...) está supliendo la necesidad de vivienda y a un precio más económico, más módico." (Fresia Chunga)

³⁵ "Me parece extraordinario que exista la densificación, porque reduce los costos de los servicios básicos. Con esto puedo frenar la expansión desmesurada de viviendas, de urbanizaciones. Para mí, es muy importante, y es más, nosotros lo estamos alentando con el cambio de zonificaciones." (Alex Huaccha)

For example, one of the respondents indicated: "we cannot afford to have a flat", while another said that "only the wealthy can access the apartments".

Another related aspect that was mentioned is that acquiring an apartment does not allow the house to be expanded, both horizontally and vertically. Even one interviewee pointed out that a house expansion is considered a sign of progress. In this regard, many aspire to build more rooms or floors in their house as the family grows or for rental incomes.

In addition, others consider that buildings are vulnerable to earthquakes. This type of opinion was presented in the cities of Lima and Cajamarca that are located in seismic zones. Among other reasons, several respondents saw the increase in apartments as synonymous with overcrowding and an undignified life. For example, several indicated that apartments are very small, uncomfortable, and that children do not have space to play. Within this group of opinions, one of the respondents indicated that:

"In the apartments you cannot live comfortably and everyone should have the right to live in the countryside."³⁶ (Anonym, Cajamarca)

Also, others made reference to the opposition between buildings and customs of greater contact with nature, noting as a disadvantage of the apartments that there cannot be raised animals or have a garden. For example, an intervention of this type is detailed below.

"Living in buildings is not the same as having a nice house in the countryside so you can have your animals, your gardens, your flower gardens and everything."³⁷ (Alejandro Moncada, real estate investor and former agrarian owner, Cajamarca)

In addition, some participants in Cajamarca explained that buildings interrupt the typical landscape, both in the historic center and in the rural environment, for that reason their refusal to this type of growth of the city.

In summary, various disadvantages of living in an apartment have been easily identified. The main one is the high price compared to a purchase of land and the progressive construction of housing. However, in cities with more apartments, most heads of households consider that this type of housing is useful to avoid urban expansion over green or agricultural areas.

4.2.3. Housing expectations

The surveys allowed having a clearer idea of the prevailing housing preferences. Householders that are planning to move in the next 10 years were inquired about the type of housing that they would search. As a result, it is observed that a strong predominance of preference for single-family

³⁶ "En los departamentos no se vive cómodamente y todos deberían tener derecho a vivir en el campo." (Anonym)

³⁷ "Eso de vivir en edificios, no es lo mismo que tener una bonita casa en el campo para que uno tenga sus animales, sus biohuertos, sus jardines de flores y todo." (Alejandro Moncada)

homes is maintained. However, in the three case studies, the proportion of those who would look for an apartment in the next decade increases compared to the current proportion of apartment-type dwellings (see Figure 79).

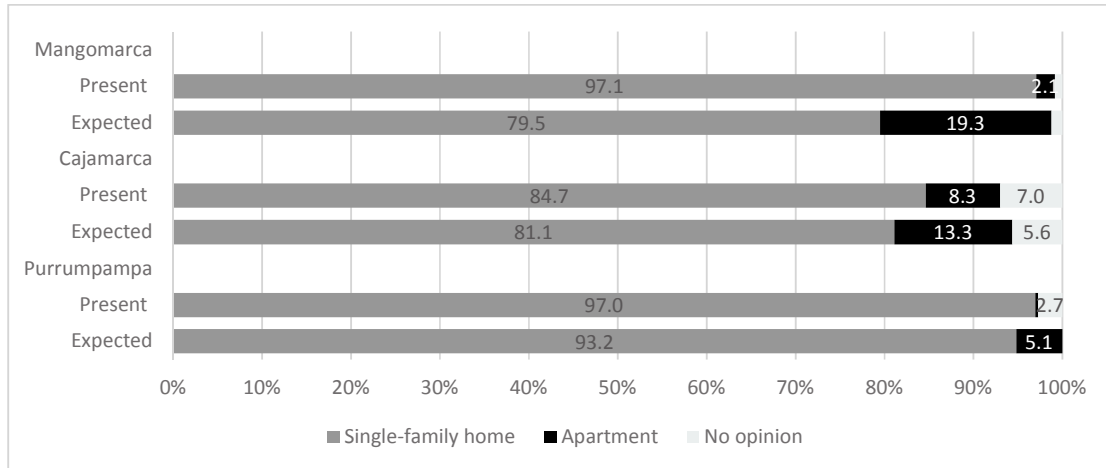


Figure 79: Type of house present and expected in the case studies.

Source: Field surveys 2016-2017.

Regarding the difference of preferences of type of housing according to ages, young people show a slightly higher acceptance of the apartments than older householders. According to sex, there is no common pattern among the case studies.

In relation to other characteristics of the house that those who plan to move would look for, it is worth noting that between 84 and 95% look for a house of the same size or larger (see Figure 80). Thus, the housing preferences of the respondents suggest a lower density growth, due to the search for larger independent houses. While the location that would be preferred according to the distance to the center shows disparate results among the case studies (see Figure 81). In Mangomarca and Purumpampa, a location closer to the center of the city is preferred, while in Cajamarca the greater part of householders would prefer to live further away from the center.

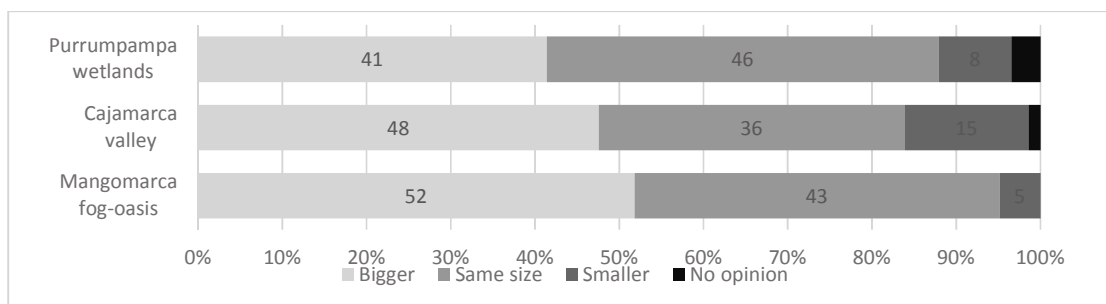


Figure 80: Preferred size of house

Source: Field surveys 2016-2017.

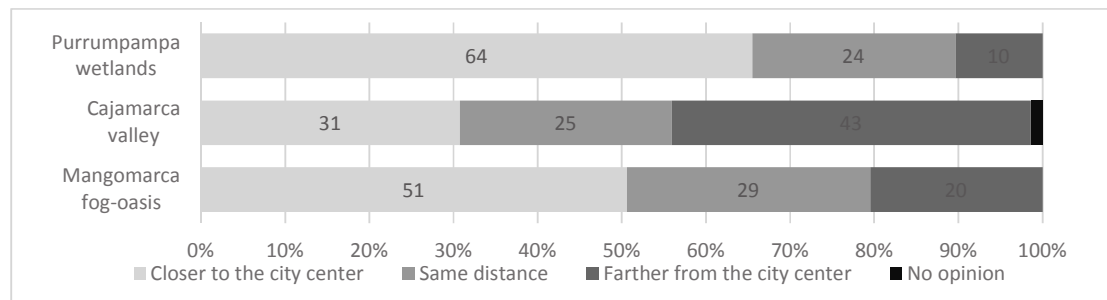


Figure 81: Preferred location of house in relation to the city center

Source: Field surveys 2016-2017.

On the other hand, several interviewees emphasized that having a large house is a custom or a cultural issue. As in the affirmations below.

*"We, provincials, are used to being free and I do not think they would get used to living in an apartment. Maybe, the next generations, but there is no way I'm getting into an apartment."*³⁸ (Edgar Bejarano, social leader, Mangamarca case study)

*"Here in the mountains, growth is not like on the coast, here the growth is horizontal because nobody wants to live on top of the other. Here we are used to living differently than in Lima. We do not like that the neighbor is very close to us; here all the people have their house from the ground floor."*³⁹ (Juana Chávez, neighbor, Cajamarca)

In this way, the opinions collected show resistance to living in apartments, especially in the Andean cities of Cajamarca and Huamachuco. In addition, the preference for a growth model of lower density and even scattered in the case of Cajamarca. According to what Merlin (1973) mentions the considerations for choosing the location of the dwelling that predominate are the economic situation and the lifestyle or culture of the region.

These results demonstrate another contradiction between personal and collective interests. Higher density housing is considered useful to control urban sprawl, but a large majority would prefer to live in a single-family home. There's a slight trend in relation with the size of the city, where bigger cities tend to exhibit more acceptance of multi-level buildings.

³⁸ "Los provincianos estamos acostumbrados a estar libres y no creo que se acostumbrarían a vivir en un departamento. De repente las siguientes generaciones, pero yo ni loco para meterme en un departamento." (Edgar Bejarano)

³⁹ "Acá en la sierra, el crecimiento no es como en la costa, aquí el crecimiento es horizontal porque nadie quiere vivir encima del otro. Acá estamos acostumbrados a vivir de otra manera que en Lima. No nos gusta que el vecino esté muy pegadito a nosotros, acá toda la gente tiene su casa, desde el suelo." (Juana Chávez)

4.3. The culture of informality

Various collected testimonies show that all kinds of actors intervene in informal practices: authorities, officials, notaries, judges and lawyers, engineering or architecture professionals; as well as owners and new inhabitants. In the case of Lima, Julio Calderón attributes the anarchic urban expansion to the state's inconsistency in complying with the laws and the weak legal culture of the inhabitants (2005). Unfortunately, this situation is common in different cities where it has been normalized the informal occupation of land and its later regulation.

Informal practices have been generalized throughout the urban development process, including the occupation of areas not destined for urban expansion, as well as the subdivision of land without urban authorization. In this way, plots of land that violate the National Construction Regulations are sold and do not comply with the formal urbanization procedures established by the local government.

The disorganization of the informal land subdivision process in the three cases is summarized in the following statement by a municipal official: "It is informal, completely informal. It does not pass through the municipality, (...) they go with an engineer and they make their plan, they go to the notary and they make their minutes and everyone is gone."⁴⁰ (Juan Manuel Siccha, Ex-Manager of the Urban Development Division, Cajamarca)

Likewise, a social leader exclaimed that "The authority seems to be absent. You do not see respect for authority, the laws are not followed. Nobody defends them. Here, everyone does what they want and nobody opens their mouths, nobody says anything. There is no penalty, there is nothing. That is why people who sells land and has money, does what they want, period."⁴¹ (Anonym, Cajamarca)

Below are described the key aspects of informality in the urban expansion process: poor attention to the demand for social housing, the avoidance of costs, informality due to negligence and corruption from public actors, informality due to ignorance of urban law, and organized crime in property market.

⁴⁰ "Es informal, completamente informal. No pasa por la municipalidad, (...) van con un ingeniero y hacen su planito, van donde el notario y hacen su minuta privada y cada uno ya se va" (Juan Manuel Siccha)

⁴¹ "No se ve la autoridad. No se ve el respeto a la autoridad, no se cumplen las leyes. Nadie le defiende. Como le digo, acá cada uno hace lo que quiere y nadie abre la boca, nadie dice nada. No hay una multa, no hay nada. Por eso el que vende terrenos y tiene plata, hace lo que quiere y punto." (Anonym)

4.3.1. Deficient housing policy as a major driver of informality

The absence of an efficient policy of access to housing at the country level can be considered the major driver of informality. Specially, the unsatisfied demand for social housing in contexts of rapid growth of the urban population. In that sense, Joseph et al. (2009) agree that the absence of massive programs to respond to the demand of poor migrants consolidated self-construction and informality as the most used modalities to generate affordable housing.

The demand of the right to housing was explicitly mentioned in interviews with phrases such as "everyone deserves a shelter to live in," "people need housing," "everyone has the right to have their house." These interventions were especially present in the northern gully of Mangamarca case, where the most precarious occupations are concentrated.

4.3.2. Avoidance of costs: from necessity to custom

Informal access to land may be the only affordable option for low-income population, as it avoids costly procedures. The purchase of a plot without formal authorization implies the omission of expenses in: municipality procedures, preparation of the technical file by specialists, land contributions for facilities and public space, basic infrastructure, and taxes for the commercialization of real estate. Therefore, the cost reduction is significant.

Given the complications of cost and time involved for a formal urban development, many landowners opt to avoid these proceedings and regulate the plots later. Hence, it could be considered that in many cases informality is a questioning of social legitimacy against institutional legality (Belguidoum and Mouaziz 2010: 102). In fact, one interviewee said that the urban development is made spontaneously and the subsequent approval is achieved "by hook or by crook".

The regularization of informal property began as an alternative for the low income population, but it became a common procedure for various socio-economic sectors. In Huamachuco informal urbanization practices on wetlands began as a means of obtaining housing in response to the strong demand of the population in the 1960s, but later this process became a regular situation even in the middle-income sectors, with enough purchasing power for the construction of multi-floor buildings in a few months.

Moreover, as has been noted in the housing expectations section, many aspire to build apartments in their house as the family grows or to rent these spaces. In this regard, informal access to land is seen as a way of obtaining a property with a high potential to increase its value, and not only as a way to solve a housing problem.

4.3.3. Informality from public actors

Some public actors in the case studies had acted informally or promoted informality through negligence, lack of inspection, ignorance, or corruption. For example, the local governments legitimize informal settlements in non-developable areas when they provide basic services, infrastructure or legal modifications such as change of zoning.

In addition, there has been a poor information dissemination of the norms to citizenship and a lack of oversight. There is even a lack of understanding of the usefulness of urban regulation among public actors. For example, municipal officials in Huamachuco openly explained that the dwellers of an informal settlement have to request a change of land use for the provision of basic services, without showing concern that it was a hazard zone.

In intermediate and smaller cities, governance has contradictory aspects; on the one hand, the relationships between actors are less complex; but on the other hand, the greater proximity between owners and officials may involve less respect for the rules by both parties. For example, in one of the cases, members of a housing cooperative informed the donation of plots to the mayor so he "make a great effort" in the procedures of regulation and connection to services networks. Similarly, several interviewees expressed the existence of a high permissiveness of municipal authorities to avoid conflicts with voters or to get votes.

Additionally, in the case of Mangamarca, several respondents indicated that the municipality supports the invasions and even referred to the mayor as "the godfather of the invaders". Because he offered property titles during the election campaign and at the beginning of his term the Municipality of San Juan de Lurigancho recognized several informal settlements in hazard areas.

Belguidoum & Mouaziz (2010) consider that the idea that the authorities are surpassed is simplistic and that frequently the State itself manages informality as a palliative of its inability to take care of everything (2010: 112). In Peru there are multiple examples of this kind of governmental manage of informality at different levels. At the level of plots, it is common practice to regularize properties or change land use as a simple procedure. At the level of neighborhoods, the creation of the Law of Marginal Neighborhoods in 1961 (Law 13517) legalizes informal settlements by allowing their posterior legal and physical ordering (Castro & Riofrío 1996), or the authorization of "progressive urban developments" in 1979 that opens the possibility of private entrepreneurs to plot and sell land of the State without investing in basic infrastructure (Riofrío & Rodríguez 1980). Thus, urban regulations seem to be systematically adapting to the informal ways of producing the city.

4.3.4. Infringement due to ignorance of the urban law

The collected information shows that many landowners do not know the existing regulations for an urban development. For example, there is widespread ignorance about the free contributions for public open spaces and facilities that an urban developer should provide. An official said that a "problem of interpretation" of the law has been generated and many of the occupants of informal land subdivision expect the municipality to buy the area for the streets. Even though, when an urban development is design, the streets should be a forced contribution to public space.

In addition, there is a lack of understanding of urban regulations, for many owners the change in land use is a procedure that must be granted by the municipalities regardless of the reasons why these uses were defined. This is demonstrated in the statement of a social leader: "I do not know if they do not know, or they do it out of selfishness, or why, but a paperwork that can take a week, they do it in years. (...) It has taken us over ten years, ten years to get the change of land use, everything was already organized, and they were looking for unimportant faults."⁴² (Enrique Pérez, former social leader, Cajamarca)

4.3.5. Organized crime in property market

It was identified that in the upper part of the northern gully in the Mangamarca case, there are groups of scammers who enter the area and subdivide plots without having any type of property. Then, they illegally obtain the approval of plans by corrupt officials of the municipality of San Juan de Lurigancho and sell the lots deceiving the buyers. Even some armed groups, after some time, force the buyers to leave and re-sell the plot.

At the national level, there have been a great number of complaints against organizations of this type that are conformed by armed criminals and can count on the support of dishonest officials, judges and police officers. For example, recently in a major police operation, 30 people were arrested, including the mayor of the Lima district of Santa Rosa, accused of leading a criminal organization dedicated to land trafficking and hired killers (La República 2018).

Additionally, in Mangamarca one of the social leaders who works for the defense of the fog-oasis, Sarita Cristóbal, reports receiving threats for her standing against invaders. In the same way, the owner of the Argentine Ranch, in Cajamarca study area, denounced the killing of four of his horses as an intimidation attack by land traffickers (RPP 2011).

⁴² "no sé si desconocen, lo hacen por egoísmo, o por qué, que el trámite que puede ser de una semana lo demoran años. (...) nos ha demorado algo de diez años, diez años para que nos den el cambio de uso, estando ya todo ya organizado, y nos pusieron un montón de peros".

4.4. Long-term possible scenarios in the case studies

4.4.1. Future urban expansion in the study areas

The spatial dynamics of the urban growth in the study areas have high possibilities to continue although; the speed of these changes is expected to be slower.

In the three cities under study, the speed of growth of the urban population is expected to be lower than that of the last decades. On the one hand, due to the global decrease of fertility rate and, on the other hand, due to the declining trends of immigration rates in these cities. In Lima, it would be expected that the immigration rate continues to decrease. As well as in Cajamarca and Huamachuco as they have gone through a decrease in the mining sector that could last longer. Although, these smaller Andean cities maintain the possibility that the implementation of a new large mining project attracts immigrants and increases urban growth rates.

In the three study areas the existing road projects will continue to incite the urban encroachment in the natural and agricultural areas. Similarly, in Cajamarca the recent zoning as low-density residential will continue the rural to urban land use change. Whereas in Mangomarca and Purumpampa, the current zoning by itself will not be enough to discourage the urban encroachment.

Considering the spatial dynamics in the last three decades, demographic trends, existing road and zoning projects and the continuity of the lack of management of urban expansion, it can be expected that by the year 2050 the built-up areas in the case studies have a significant increase.

In Cajamarca valley, low density residential growth will be promoted by the recent zoning change and public investments projects. One of them is the new expressway in the valley proposed in the UDP 2016 that once again resembles an outer ring road. The other relevant public investments in the valley are the artificial ponds for recreation and sports which are part of the initial project of the Qhapac Ñan Complex and implicate the removal of the oxidation ponds. This project signifies the maintenance of a large public space in the valley, although it will also promote the land-use change in the surrounding. Therefore, in the study area by 2050 it is expected the infillment of the already occupied areas, the subdivision of existing plots, more urban developments and dispersed housing (see Figure 82).

In this context, Vega Centeno affirms that in the absence of a solid urban project, the city and the valley become vulnerable spaces, capable of being transformed freely by real estate strategies (Vega Centeno 2011: 128). Moreover, the Environmental Development Manager of Cajamarca confirms this unfavorable projection due to an unrestricted context dominated by economic interests, as shown by the affirmation below.

"You know, the economic side is stronger than the environmental one, so if the undeveloped mining projects are initiated, surely the valley will disappear. That is the trend and there is no way to stop it."⁴³ (Antenor Florindez, Environmental Development Manager of Cajamarca)



Figure 82: Possible urban expansion in Cajamarca valley by 2050

Prepared by P. Moschella.

Whereas in Purrumpampa, the asphaltting project of the belt road proposed in the UDP 2016, will increase the interest of occupying the northern zone of the wetlands. For this reason, it would be expected the consolidation of this area, with more subdivisions forming elongated blocks. In addition, there will probably be new proposals to cover channels for healthiness and to create roads. The increase in urban population around the wetlands will also demand more recreational public spaces. So the municipal property would possibly be maintained as a public space, but mainly as a recreational area than an ecological and historical protected area (see Figure 83).

In a similar way, in Mangamarca, the asphaltting project of the road that crosses the upper part, according to the Metropolitan Road System approved by Ordinance N° 341-MML, will encourage the creation of secondary roads and greater occupation of the upper part of the fog-oasis (see Figure 84). Until now, the population of the Mangamarca gully has defended the central sector of the fog-oasis from invasions. However, there is a lack of legal security to guarantee the protection of this space, since the communal defense may be insufficient to face a greater interest in invasion by land traffickers who could use violence.

⁴³ "Usted sabe, la parte económica tiene más fuerza que la ambiental entonces si es que se activan los proyectos mineros que están detenidos, seguramente el valle desaparecerá. Esa es la tendencia y no hay forma de detenerlo." (Antenor Florindez)



Figure 83: Possible urban expansion in Purumpampa wetlands by 2050

Prepared by P. Moschella.

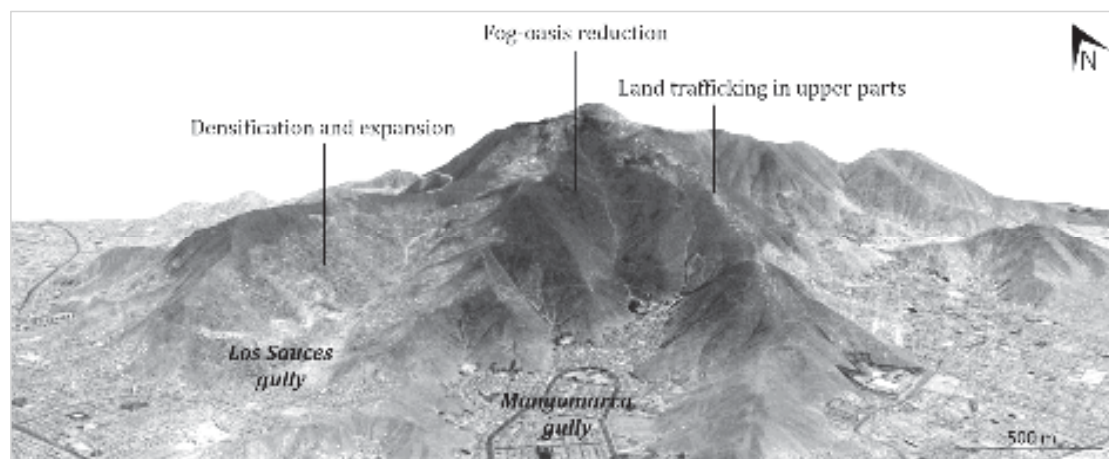


Figure 84: Possible urban expansion in Mangomarca fog-oasis by 2050

Prepared by P. Moschella.

4.4.2. Predictable negative consequences

The urban expansion foreseen in the study areas by the year 2050 will generate various socio-environmental problems. These negative consequences are common to all three case studies, but with different intensity, as will be explained below (see Table 17).

Table 17: Main consequences of urban expansion projection to 2050 in the study areas

	MANGOMARCA FOG-OASIS	CAJAMARCA VALLEY	PURRUMPAMPA WETLANDS
Disasters	***	*	**
Inefficient infrastructure and public services	***	*	**
Pollution and unhealthy conditions	**	***	**
Loss of open spaces and aesthetic value	**	**	**
Loss of productive land		***	*
Biodiversity decrease	**	*	**

*** High impact

** Medium impact

* Low impact

a. Disasters

The study areas are also forbidden or not recommended for urban settlements due to hazards. Therefore, the urban expansion in these areas will expose the inhabitants and their houses to floods and landslides.

The most problematic is Mangomarca case, due to the informal settlement in high-slope terrains (up to 40% slope) in a highly seismic region. The study of the historical records of earthquakes in Lima shows a very high probability of occurrence of an earthquake of more than 7.5 degrees which will trigger landslides on unstable slopes. Moreover, in Los Sauces gully, most of the constructions are precarious and without technical guidance. So there is a high probability that landslides in this sector will result in the loss of human lives and the destruction of houses. Likewise, the debris would also affect the inhabitants of lower and plainer areas.

In Purrumpampa and, with less intensity, in Cajamarca, the existing hazards are flood and soil instability. The conversion to built-up land implies installing impermeable surfaces that reduces infiltration capacity and increases superficial runoff. Therefore, the artificialisation of soil in the valley and wetlands will increase flood events in these areas. In the past, floods have already occurred, as shown in Figure 85.



Figure 85: Flood in the recreational area of Purumpampa in 2016.

Photo by Yosmer Layza, 2016.

In addition, in the northeastern area of Purumpampa, informal constructions are carried out on inappropriate soils. The existence of a thick layer of organic matter saturated with water and the low consolidation of the debris accumulation on the top makes it unsafe for building (MPSC & PUCP 2016), as there can be land subsidence. Likewise, a portion of the Cajamarca study area is not suitable for multi-story buildings due to the characteristics of the soil. So, some buildings could collapse in case of an earthquake.

b. Inefficient infrastructure and public services

In the case studies, the probable future increase of informal urban developments will mean more people living in inadequate conditions. Informal land subdivision probably will continue with inadequate road networks and insecure access. In Purumpampa and Mangamarca the informal occupation in non-developable areas would be a legal impediment for the connection to basic services networks.

Also the high slope in Mangamarca will imply a costlier connection to water and sewage networks, and for roads and sidewalks. Likewise, the public transportation could not reach enough demand to offer an efficient service. These conditions will amplify the social segregation in this sector and the vulnerability of its inhabitants. Even, if these dwellers organize and construct themselves the infrastructure and services connections, they are unable to manage large facilities and articulate at a metropolitan scale (Sáez et al. 2010).

c. Pollution and unhealthy conditions

The urban expansion will probably increase water pollution in Cajamarca and Purrumpampa if the new informal developments also discharge their wastewater to the rivers and channels. In Cajamarca, this situation will further affect agricultural activity. Likewise, the provision of contaminated food could affect the health of more citizens, as there has already been identified the wastewater pollution of vegetables that are sold in the markets of Cajamarca (Rivera-Jacinto et al. 2009).

In Purrumpampa, this will increase eutrophication processes in the ponds and channels of the wetland, so the floating plants covering the water will expand. Also, the lower quality of water will be a health problem for users of this public space.

Whereas in Mangamarca, the location of new dwellers in areas of high presence of seasonal fog, will produce more respiratory diseases especially in the most vulnerable people such as children and the elderly.

d. Loss of open spaces and aesthetic value

The study areas are largely valued as open spaces for recreation and tourism, as well as for its function in environmental quality improvement. Therefore, the foreseen urban expansion in the following decades will reduce these ecosystem services, and thus reduce the citizens' well-being.

Similarly, the continuation of disordered urban encroachment in these areas will decrease the aesthetic value of landscape. Consequently, the tourist attraction will also be reduced. Likewise, the worse conditions of the urban landscape will affect the quality of life of the inhabitants. Furthermore, it could be considered as the loss of the landscape common goods.

e. Loss of productive land

In Cajamarca, the continuity of rural to urban land-use change will imply the irreversible reduction of prime farmland. This problem will affect directly the areas of land-use change but also will have a negative effect in the surrounding land, as new urban developments usually close the passage for irrigation channels, and some divert their wastewater to the channels, thus the decline of water quality and quantity affects a more extended agricultural area. At the same time, this issue involves diverse socio-environmental impacts, like: the decrease of local dairy production and food supply, the loss of the means of life for several farmers, and the reduction of the natural capital of the region.

In Purrumpampa, the productive use of wetlands is reduced, but the expansion of urban developments could force to leave the small herders that still use this area. Whereas in Mangamarca, the herders have already leaved the area.

f. Biodiversity decrease

The biodiversity decrease will be more significant in Mangamarca fog-oasis and Purrumpampa wetlands due to the presence of a more diverse wildlife in these areas. In both cases, the urban expansion will continue to produce habitat fragmentation. Probably, by 2050, the core areas of

these ecosystems will be maintained by communal efforts, but the land-use changes in the surroundings and their effects will reduce the number of species and individuals of plants and animals. Also, the limited economic and institutional capacities will restrain the possibilities of restoration of these ecosystems.

4.5. Chapter conclusions

There are institutional weaknesses at the national and local levels for a sustainable management of urban growth. It has been demonstrated a lack of political will to orient urban expansion and take concrete measures to protect natural and agricultural important areas. Urban plans are not highly valued by authorities and are not efficiently used by municipal officials. In addition, there is lack of continuity of the plans proposals with the change of authorities.

Also, there are weaknesses in planning instruments and in the socialization and implementation of the proposed strategies. There was identified a poor specification of strategies to avoid the occupation of non-developable areas and to orient the urban expansion towards the areas identified for this purpose. Specifically, urban plans focus mainly in zoning and road proposals, leaving aside the inclusion of more diverse strategies. In addition, there is a poor execution and compliance of these plans. It should be emphasized the lack of strategies and public investment to encourage the occupation of the areas defined for urban expansion. Likewise, there is evidence that local governments do not anticipate the effects of public infrastructure in spatial dynamics and thus in the actual location of urban expansion.

There seems to be a poor coordination between institutions and actors involved in the urban expansion processes (government entities, public services provider companies, public notaries, construction companies, housing associations and landlords). Under these circumstances, is difficult to promote an orderly land use change in appropriate areas. In part, this could be caused by an inappropriate and fragmented regulatory framework that benefits informal urban settlements and private property above all.

Regarding national regulations, the main disadvantages are the freedom to subdivide land without considering local regulations; and the inaccuracy of technical criteria for the delimitation of developable and non-developable areas. In addition, there is a lack of innovation and adaptation of urban planning instruments to the Peruvian reality which are characterized by a weak legal culture and a highly unsatisfied demand of social housing.

There are strong weaknesses in the governance of the peri-urban space and the urbanization process related to negligence, corruption and lack of information. Moreover, there has been given poor attention to the demand for social housing. Finally, there is an absence of local policies to support the farming production in the peri-urban zone or the preservation of areas of high ecological value.

A large part of interviewees (35 to 45% per case) believe that higher density housing is useful to control urban sprawl, and dwellers of bigger cities tend to exhibit a little more acceptance of multi-level buildings. Specifically, it is considered as a way to avoid expansion over adjacent green areas. Nevertheless, there is resistance to living in apartments, especially in the Andean cities of Cajamarca and Huamachuco. The disadvantages of living in an apartment were easily identified: the high price compared to a purchase of land and the progressive construction of housing. The majority prefer an independent house due to safety, comfort or quality of life.

Informal practices have been generalized throughout the urban development processes including the occupation of areas not destined for urban expansion as well as the subdivision of land without urban authorization. All kinds of actors intervene in informal practices: authorities, officials, notaries, judges and lawyers, engineering or architecture professionals, as well as owners and new inhabitants. There is a general ignorance about the free contributions for public spaces that an urban developer should provide and the importance of zoning for a sustainable development. Some public actors in the case studies had acted informally or promoted informality through negligence, lack of inspection, ignorance, or corruption; for example, there has been a high permissiveness of municipal authorities to avoid conflicts with voters.

The absence of an efficient national policy of access to social housing can be considered the major driver of informality. The regularization of informal property began as an alternative to solve the housing problem of low-income population, but it became a common procedure for various socio-economic sectors and a way of obtaining a property with a high potential to increase its value. Under these circumstances, urban regulations seem to be systematically adapting to the informal ways of producing the city.

The spatial dynamics of the urban growth in the study areas have high possibilities to continue although; the speed of these changes is expected to be slower. The existing road projects will continue to incite the urban encroachment in the natural and agricultural areas. In Cajamarca valley by 2050 it is expected the infillment of the already occupied areas, the subdivision of existing plots, more urban developments and dispersed housing. In Purrumpampa the municipal property would possibly be maintained as a public space, but mainly as a recreational area rather than an ecological and historical protected area. In Mangamarca the communal defense may be insufficient to face a greater interest in invasion. The main consequences of the urban expansion projection to 2050 in these areas are: disasters related to floods and landslides, inefficient infrastructure and public services, pollution and unhealthy conditions, loss of open spaces and aesthetic value, loss of productive land and biodiversity decrease.

Conclusions

The current actions in the urban fringe will leave a permanent footprint in the city's future. Therefore, it is crucial to understand the urban expansion in non-developable areas in order to improve the strategies for spatial planning and sustainable land-use management. In this regard, the analysis of spatial dynamics, perception, behaviors, planning and local management is very useful to comprehend the dynamics of urban expansion as well as its causes and consequences.

In essence, the results of this research support the hypothesis that, in the case studies, recent urban expansion is predominantly informal, disorganized and diffuse. Moreover, urban expansion is a consequence of serious deficiencies in local public management as well as the local unconcern in their environment. However, it should be noticed that some communal organizations and social leaders contribute to a more sustainable land-use. Indeed, informal processes, inappropriate management and certain communal initiatives are substantial aspects determining the urban extension. Although, in one case study some of the other characteristics were not as expected concerning the diffuse pattern, the local unconcern, and the lack of communal organizations. In this regard, it was found that the new urban areas were not as diffuse as global trends, but rather they were fragmented and, over time, almost all space was filled.

The surveys' conducted were also a source to assess local environmental concern. In this regard, the surveys' results show that most householders have a good appreciation, identification of problems and support of protection. However, these results had little significance in housing decisions and the taking of actions for protection.

Each case study showed particular characteristics of the peri-urban territory and its population. The urban encroachment in the "Lomas de Mangamarca" in Metropolitan Lima threatens a unique and fragile ecosystem in a very arid environment. There is a simplified image of this space in the local perception, and even many neighbours are unfamiliar with it due to its seasonal nature and difficult access.

At the same time, this case is an example of land trafficking, residential segregation and community organization. The northern sector of this study area reveals the tough housing

problems faced by vulnerable population that inhabit a landslide hazard area in precarious conditions. Whereas, the southern sector is characterized by a good organizational culture related to the neighborhood origins linked to trade unions and a certain social homogeneity in a space physically confined. Consequently, community initiatives demonstrate great willingness to protect the fog-oasis in this sector.

The second case study is found in the small city of Huamachuco; where the urban encroachment on 28 hectares of the Purrumpampa wetlands has reduced a historical, ecological and recreational area. This ecosystem has a good appreciation mostly for its use for recreation and sports. There is a weak appreciation of nature and urban sprawl is not seen as a problem by many locals as they have easy access to open spaces and the urban expansion is considered a sign of prosperity. Moreover, informal land subdivision and building without technical advice on wetland and debris is producing unsafe settlements. Under these circumstances, civil society in Purrumpampa also carries out actions for the protection and conservation of wetlands, in the face of inadequate management by public institutions.

The third case study is the urban expansion in the valley of Cajamarca that has caused the loss of 251 hectares of irrigated prime farmland since 1988. This case illustrates some unsustainable effects of globalization in the territory, through global investments in mining that produce a high immigration and the economic opening that shrank dairy production in the valley. It also exemplifies some deep contradictions of private and common interests. Because the rural environment is well appreciated by locals; especially, milk and food production were considered as the main benefits of this socio-ecosystem. In the same way, the negative impact of urban encroachment on agricultural activity was widely identified. Nevertheless, the rural landscape is not seen as a common good, neither the fertile soils are considered a strategic resource. They are just perceived as private property and the individual decisions on this land are not matter of common concern.

An important result of this study is that, despite the different characteristics among the case studies, we found significant similarities in the urban expansion processes. Moreover, these findings allowed to identify common problems in a national context. One of the main similarities of the urban dynamics is the sharp increase of land value, mainly due to urban population growth and main roads design. This dynamic largely determines the land-use change evidencing that profits, and not urban planning, define the urban form.

Second, the informal urbanization processes that was found in all cases tend to generate conditions of inadequacy and poor quality of public space. Moreover, the large majority of new urban areas in the case studies that were created both by formal and informal processes had a progressive construction of basic services networks and roads, while the dwellers already lived there. Therefore, the social organizations had a key role in the construction of the basic infrastructure. This situation shows the response of low and middle income population to a high demand of housing not adequately attended by the market nor the government. Taking into account this evidence, one policy recommendation from this study is that urban regulation needs to adapt to this high demand while ensuring safe and inclusive settlements, not just by formalizing the irregular procedures.

From the surveys' results it was found that the open spaces under study tend to present a good appreciation, above all for offering a contrasting environment with the city. The positions that

explain their assessment are diverse, based on different interests and experiences. Opinion trends show that nature and the rural environment acquire special importance among urban inhabitants, but in particular, in bigger cities. Whereas, in a small city, householders seem to have a strong expectation of developing a modern city with hard infrastructure rather than maintaining large green spaces.

Regarding the opinion of urban encroachment in the selected areas, it was found that the social and economic aspects, such as the right to housing, comfort and land market, tend to be more significant than the strictly environmental. Likewise, there is a contradiction between values and actions. The good assessment, identification of problems and support of protection have little significance in housing decisions and does not imply the taking of actions for the defense of the collective interests. Even, the main interest of some owners to protect these areas from invasions would not be to defend an ecological value, but to avoid the arrival of unknown neighbors that alter the established order.

Urban sustainability requires the coordination of multiple stakeholders, including local citizen organizations. In this regard, the citizen initiatives in the study areas are fundamental as they demonstrate that the organized population can take concrete actions to fulfill objectives of interest for the common good. In addition, these actions seem to fill the gaps in the government structures to manage the peri-urban space. It is interesting to note that the collaboration of specialists or external organizations has played a fundamental role in strengthening these initiatives. It stands out that the environmental leaders in the case studies are mainly women, who present great persistence and their leadership performance is focused on the communal space rather than the political sphere.

There are institutional weaknesses at the national and local levels for a sustainable management of urban growth. It has been demonstrated that there exists a lack of political will to orient urban expansion and take concrete measures to protect natural and agricultural important areas. Urban plans are not highly valued by authorities and are not efficiently used by municipal officials. In addition, there is a lack of continuity of the plans proposals due to the change of authorities.

Moreover, there are weaknesses in planning instruments and in the socialization and implementation of the proposed strategies. It was identified that strategies had a poor specification in order to avoid the occupation of non-developable areas and to orient the urban expansion to the areas defined for this purpose. Specifically, urban plans focus mainly in zoning and road proposals leaving aside the inclusion of more diverse strategies. In addition, there is a poor execution and compliance of the plans. It should be emphasized, the lack of strategies and public investment to encourage the occupation of the areas defined for urban expansion. Likewise, there is evidence that local governments do not anticipate the effects of public infrastructure in spatial dynamics and thus in the actual location of urban expansion.

There seems to be a poor coordination between institutions and actors involved in the urban expansion processes: government entities, public services provider companies, public notaries, construction companies, housing associations and landlords. This could be caused in part by an inappropriate and fragmented regulatory framework that benefits informal urban settlements and private property above all.

Regarding national regulations, the main disadvantages found were the freedom to subdivide land without considering local regulations and the imprecision of technical criteria for the delimitation of developable and non-developable areas. In addition, we found a lack of innovation and adaptation of urban planning instruments to the Peruvian reality, characterized in particular by a weak legal culture and a highly unsatisfied demand of social housing.

A large part of interviewees think that higher density housing is useful to control urban sprawl. Moreover, dwellers of bigger cities tend to exhibit a little more acceptance of multi-level buildings. Specifically, it is considered as a way to avoid expansion over adjacent green areas. Nevertheless, there is resistance to living in apartments, especially in the Andean cities of Cajamarca and Huamachuco. The disadvantages of living in an apartment were easily identified from the surveys' results: the high price compared to a purchase of land and the progressive construction of housing. The majority of interviewees preferred an independent house due to safety, comfort or quality of life.

Informal practices have been generalized throughout the urban development process, including the occupation of areas not destined for urban expansion, as well as the subdivision of land without urban authorization. There is a general ignorance about the free contributions for public spaces that an urban developer should provide, and the importance of zoning for a sustainable development. Some public actors in the case studies had acted informally or promoted informality through negligence, lack of inspection, ignorance, or corruption. The absence of an efficient national policy of access to social housing can be considered the major driver of informality. The regularization of informal property began as an alternative to solve the housing problem of low-income population, but it became a common procedure for various socio-economic sectors and a way of obtaining a property with a high potential to increase its value. Under those circumstances, urban regulations seem to be systematically adapting to the informal ways of producing the city.

The spatial dynamics of the urban growth in the study areas have high possibilities to continue. Although, the speed of these changes is expected to be slower. The existing road projects will continue to incite the urban encroachment in the natural and agricultural areas. In Cajamarca valley by 2050 it is expected the infillment of the already occupied areas, the subdivision of existing plots, more urban developments and dispersed housing. In Purrumpampa the municipal property would possibly be maintained as a public space, but mainly as a recreational area than an ecological and historical protected area. In Mangamarca the communal defense may be insufficient to face a greater interest in invasion. The main consequences of the urban expansion projection to 2050 in these areas are: disasters related to floods and landslides, inefficient infrastructure and public services, pollution and unhealthy conditions, loss of open spaces and aesthetic value, loss of productive land and biodiversity decrease.

To sum up, road planning, the culture of informality and communal initiatives are the most significant aspects in shaping the extension of the city in the case studies. Certainly, the design of the future road network should be carefully planned considering the prospective scenarios it will motivate. In the same way, it is essential that urban policies attend to the infringement of law by public and private stakeholders. Additionally, local management should integrate community organizations as they represent a great potential for the sustainable management of the territory.

Résumé long en français

La croissance urbaine est plus rapide dans les pays les moins avancés où les gouvernements locaux ne peuvent la gérer correctement en raison des contraintes économiques et institutionnelles. Ce type de croissance urbaine incontrôlée est lié à plusieurs problèmes socio-environnementaux dans les pays en développement comme le Pérou. La demande accrue de terres urbaines peut produire un empiétement urbain dans des zones non urbanisables comme des terres agricoles de première qualité ou des écosystèmes fragiles. Cela peut donner lieu à des agglomérations urbaines désordonnées et dangereuses. Par conséquent, c'est un défi pour les objectifs de développement durable.

Certes, la frange urbaine présente un conflit accru de l'utilisation des terres, ce qui en fait un lieu d'intérêt pour les géographes (Clark 2002). Cependant, ces zones ne doivent pas être réduites à la périphérie de la ville car elles présentent leur propre dynamique (Peyrache-Gadeau & Fleury 2005). La plupart des études sur l'étalement urbain concernent les pays industrialisés. Néanmoins, les villes des pays en développement présentent des priorités, des ressources et des modes de gouvernance différents. Des études spécifiques et des réponses politiques différentes sont donc nécessaires (Angel et al. 2005). Il est crucial de comprendre l'expansion urbaine afin d'améliorer les stratégies d'aménagement du territoire, car les actions actuelles dans la frange urbaine laisseront une empreinte permanente dans l'avenir de la ville. En ce sens, cette recherche vise à contribuer à la discussion sur les possibilités de durabilité urbaine dans les pays du Sud global.

Il est intéressant de constater que la mondialisation pourrait être considérée comme un facteur de changement complexe dans la frange urbaine. Non seulement en raison de la diffusion des modes de vie urbains à faible densité et de la régulation néolibérale permissive du marché foncier, mais aussi en raison des investissements mondiaux dans les petits villages qui peuvent forcer un processus d'urbanisation rapide. Dans ces conditions, la mondialisation menace la durabilité du territoire périurbain.

Selon Denise Pumain, le processus mondial d'expansion urbaine est lié à la mondialisation des normes économiques et culturelles. Mais, en même temps, les systèmes urbains évoluent différemment selon les différentes traditions urbaines (Pumain 2004). Dans cette perspective, il convient d'étudier l'expansion urbaine dans un contexte national.

Il est donc nécessaire d'évaluer dans quelle mesure les stratégies ou les pratiques locales liées à l'expansion urbaine contribuent ou non à la gestion durable du territoire en orientant les nouvelles zones urbaines dans des zones sûres et compactes, sans affecter les zones de valeur écologique. Depuis cette approche, la question centrale de la recherche se pose : quelles sont les forces et les faiblesses des stratégies des parties prenantes dans la gestion de l'expansion urbaine dans une perspective durable ?

Dans les études de cas, l'hypothèse présentée est la suivante : l'expansion urbaine récente dans les zones non développables en raison de leur valeur socio-écologique est principalement informelle, désorganisée et diffuse. Ce processus non durable est le résultat de graves déficiences dans la gestion publique locale, ainsi que de l'inconscience locale des problématiques environnementales. Cependant, certaines organisations communautaires et certains dirigeants sociaux contribuent à une gestion plus durable du territoire.

Ainsi, cette information permettra de développer des propositions basées sur des expériences locales pour contribuer à la gestion durable du territoire périurbain. Pour ce faire, la recherche combine trois dimensions de l'analyse : l'analyse spatiale, l'analyse du comportement social et l'évaluation de la gestion urbaine et de l'aménagement du territoire.

En outre, pour souligner le défi de l'utilisation durable du territoire, l'étude se concentre sur trois cas péruviens d'expansion urbaine dans des zones non urbanisables en raison des conditions socio-écologiques et des risques présents. Ces cas correspondent à l'empiétement urbain dans : une oasis de brouillard saisonnier dans la ville aride de Lima, les terres agricoles de première qualité de la vallée de Cajamarca et les zones humides de la petite ville de Huamachuco. Par conséquent, des lieux de caractère différent dans les villes de taille différente seront étudiés dans le but de reconnaître les problèmes communs du processus d'urbanisation au Pérou.

L'étude est organisée en quatre sections. La première section présente le cadre du problème de recherche, elle inclut les tendances mondiales de la croissance urbaine, le cadre conceptuel, les problèmes clés des changements non durables en ce qui concerne l'utilisation des terres dans la frange urbaine et également les procédures proposées pour aborder la question de recherche. La deuxième section examine la structure urbaine péruvienne pour contextualiser le lieu des cas d'études et décrire le processus d'expansion urbaine au cours des trois dernières décennies dans chacun des cas avec un accent particulier sur l'analyse spatiale. Ensuite, la relation de la communauté avec les zones naturelles et agricoles dans la frange urbaine a été examinée d'un point de vue local afin d'aider à comprendre la prise de décision et les actions communautaires de conservation. Enfin, la dernière section présente les principaux défis de la gestion durable des terres en décrivant les déficiences de la planification et de la gestion urbaine, l'opinion sur la densité du logement, la violation généralisée du droit urbain et l'estimation des conséquences possibles de l'expansion urbaine sur le long terme.

1. L'expansion urbaine, un problème de durabilité

À l'échelle mondiale, les nouvelles zones urbaines ont des densités plus faibles qu'auparavant et la distinction traditionnelle entre les zones rurales et les zones urbaines pourrait s'avérer inutile au fil du temps. Les valeurs de densité moindre sont liées à une inégalité de revenus plus élevée, à des villes plus petites, à des terres arables extensives et à l'absence de contraintes géographiques face à l'expansion urbaine (Angel et al., 2011). Tandis que les taux les plus élevés de changements d'utilisation du sol de rural à urbain se produisent dans les terres arables périurbaines avec une infrastructure routière plus élevée (Cano et al., 2017, Lee et al., 2015, Shi et al. 2012). Toutes ces tendances impliquent un défi majeur pour orienter le développement urbain d'une manière plus durable et inclusive.

L'expansion urbaine est un processus permanent à la périphérie des villes où la densité de construction augmente avec le temps jusqu'à devenir une partie de l'agglomération continue (Bazant 2008). Ces changements se produisent dans la frange urbaine, une zone de transition entre la ville et la campagne, dont les limites sont diffuses et mouvantes. Ils se caractérisent également par une augmentation de la valeur des terres tandis que l'utilisation des terres plus intensive remplace la précédente (Clark 2002).

La durabilité urbaine est un concept large et multidimensionnel, qui implique de reconnaître la ville dans le cadre d'un système dynamique lié à son environnement. Certains auteurs soulignent que le débat sur la durabilité urbaine devrait analyser la dynamique périurbaine pour l'étendre à un débat sur l'urbanisation (Zoomers et al., 2017, Angelo & Wachsmuth 2015). La discussion sur la durabilité urbaine souligne la nécessité d'une gestion efficace de l'utilisation des terres orientée vers des villes plus compactes, dans des zones sécurisées avec des espaces publics ouverts, et évitant la perte de terres productives et d'écosystèmes importants.

Les principaux impacts socio-environnementaux de la croissance urbaine de basse densité sont : la consommation accrue des terres, la consommation accrue de l'énergie et des ressources, l'augmentation des émissions de gaz à effet de serre, la modification du climat local, la modification des flux et de la qualité de l'eau, la ségrégation sociale et la diminution de la valeur esthétique du paysage. La consommation de terres urbaines peut entraîner la perte et la dégradation de l'environnement naturel et, par conséquent, entraîner la fragmentation de l'habitat, la perte de biodiversité et la réduction des services écosystémiques.

Le projet cherche à évaluer dans quelle mesure les stratégies ou les pratiques locales liées à l'expansion urbaine contribuent ou non à la gestion durable des terres, en orientant les nouvelles zones urbaines vers des zones sûres et compactes, sans affecter les zones de valeur écologique. Par stratégies locales, nous nous référons aux plans d'urbanisme et à la gestion publique, ainsi qu'aux processus et pratiques communes d'appropriation des terres et d'urbanisation dans les périphéries des villes. Ainsi, cette information permettra de développer des propositions basées sur des expériences locales pour contribuer à la gestion durable des terres du territoire périurbain.

L'empiétement urbain sur les terres agricoles à haute productivité a été fréquent, car le développement de nombreux centres urbains importants a été lié à cette ressource (Satterthwaite et al., 2010). Cependant, la perte de ces zones est particulièrement critique dans les pays ayant une superficie réduite de terres arables, comme le Pérou, où elles ne représentent que 3,2% de la

surface totale (Banque mondiale 2017). Les principaux effets négatifs de la perte de terres agricoles sont la réduction de la production rurale et de la sécurité alimentaire, ainsi que la diminution de sa valeur culturelle et écologique. Les terres agricoles sont une ressource stratégique, il est donc urgent de protéger leur étendue et leur qualité (Gardner 1996).

Dans le but d'aborder les processus d'expansion urbaine dans les pays en développement, la recherche combine des perspectives et des méthodes de géographie urbaine, de géographie comportementale, d'analyse spatiale et de planification. Pour souligner le défi de l'utilisation durable des terres, l'étude se concentre sur trois cas péruviens d'expansion urbaine dans des zones non aménageables en raison de conditions socio-écologiques et des risques présents.

2. Trois exemples d'expansion urbaine : différentes circonstances, même problème

La population urbaine du Pérou augmente constamment et les migrations internes se sont orientées principalement vers la côte. Les cas d'étude comprennent la ville de Lima qui concentre environ un tiers de la population du pays, la ville intermédiaire de Cajamarca et la petite ville de Huamachuco. Les deux derniers se situent dans les Andes septentrionales et montrent des taux de croissance exceptionnellement élevés dans la région montagneuse en raison des investissements miniers.

Le cas de l'oasis de brouillard de Mangamarca dans la banlieue urbaine de Lima, présente la façon dont l'expansion urbaine menace l'écosystème unique et fragile de Lomas. Au niveau de la ville, plus de 200 hectares de cet écosystème ont été transformés en zones bâties. Ce cas présente des inégalités socio-spatiales élevées qui intensifient la vulnérabilité des populations à faible revenu. De plus, il démontre la relation contrastée de la communauté avec les lomas. C'est également un exemple du trafic des terres ces dernières années.

L'expansion urbaine dans la vallée de Cajamarca a causé la perte de 251 hectares de terres agricoles irriguées depuis 1988. Cette zone est un élément identitaire important pour les habitants. De plus, ce type de sols est une ressource rare dans la région andine. Il présente divers processus formels et informels d'expansion urbaine. En particulier, les moteurs du changement dans le cas de Cajamarca illustrent les effets territoriaux de la mondialisation, à travers des investissements mondiaux dans l'exploitation minière et l'ouverture économique qui a affecté la production laitière locale.

L'empiétement urbain sur les zones humides de Purrumpampa dans la ville de Huamachuco, montre la réduction de 28 hectares des zones humides depuis 1987. Il implique également la diminution d'un site historique et écologique où se trouve une zone récréative importante. En outre, il présente différents processus informels d'urbanisation dans une zone dangereuse.

La forte augmentation de la valeur des terres dans les études de cas explique en grande partie la décision de changement d'utilisation des terres et est principalement liée à la croissance de la population urbaine et aux routes principales. C'est un exemple de la façon dont le loyer domine la structure urbaine et détermine la distribution inefficace des usages dans une économie capitaliste (Harvey 1973).

Les zones construites récemment sont généralement plus dispersées et, dans tous les cas, l'augmentation de la demande de terres urbaines provoque un empiètement urbain dans les zones non aménageables. L'évolution de l'utilisation des terres ou de la couverture des terres engendre des impacts irréversibles et laisse de côté l'importance de protéger les valeurs écologiques, culturelles et récréatives des zones sélectionnées.

Les types d'acteurs sociaux impliqués dans le processus d'expansion urbaine sont assez similaires. Ceux-ci incluent : les gouvernements locaux, les organisations sociales, les fournisseurs de services de base, les anciens propriétaires, les notaires et les consultants en urbanisme ou en design.

Les processus d'urbanisation informelle tendent à créer des conditions d'inadéquation et de mauvaise qualité de l'espace public. De plus, la grande majorité des nouvelles zones urbaines dans les études de cas a connu une construction progressive de réseaux de services de base et de routes alors que les habitants y vivaient déjà. Par conséquent, les organisations sociales ont joué un rôle clé dans la construction de l'infrastructure de base. Cette situation montre la réponse de la population à revenu faible et moyen à une forte demande de logements qui ne sont pas suffisamment pris en charge par le marché ou par le gouvernement. Dans ces circonstances, la réglementation urbaine doit s'adapter à cette demande tout en garantissant des établissements sûrs et inclusifs, et pas seulement en formalisant les procédures irrégulières.

3. La relation de la communauté avec les zones naturelles et agricoles dans la frange urbaine

Les espaces ouverts ont tendance à présenter une bonne appréciation, surtout pour offrir un environnement en contraste avec la ville. Les positions qui expliquent leur évaluation sont diverses et elles sont basées sur des expériences et des intérêts différents.

En ce qui concerne l'appréciation des espaces naturels et les problèmes d'étalement urbain, les tendances d'opinion sont très similaires chez les ménages dans les grandes villes. Parallèlement, dans les petites villes, les ménages semblent s'attendre fortement à développer une ville moderne avec des infrastructures dures plutôt que de maintenir de grands espaces verts. Ainsi, tout comme dans d'autres études sur la perception des changements dans la zone urbaine, il est confirmé que la nature et le milieu rural acquièrent une importance particulière parmi les citoyens, et en particulier dans les grandes villes.

Au regard de l'opinion concernant l'empiètement urbain dans les zones sélectionnées, il a été constaté que les aspects sociaux et économiques (tels que le droit au logement, le confort et le marché foncier) tendent à être plus significatifs que les aspects strictement environnementaux. De même, il existe une contradiction entre les valeurs et les actions. La bonne évaluation, l'identification des problèmes et le maintien de la protection ont peu d'importance dans les décisions en matière de logement et n'entraînent pas la mise en place de mesures pour la défense des intérêts collectifs. Aussi, l'intérêt principal de certains propriétaires pour protéger ces zones contre les invasions ne serait pas de défendre une valeur écologique, mais d'éviter l'arrivée de voisins inconnus qui altèrent l'ordre établi.

La discussion sur la durabilité urbaine met en évidence la nécessité d'une gestion efficace de l'utilisation des terres qui intègre de multiples parties prenantes, y compris les organisations citoyennes locales, pour définir et coordonner des stratégies appropriées. En ce sens, les initiatives citoyennes dans les zones d'étude sont fondamentales car elles démontrent que la population organisée peut prendre des mesures concrètes pour atteindre des objectifs d'intérêt commun. En outre, ces actions semblent combler les lacunes des structures gouvernementales pour gérer l'espace périurbain.

Malheureusement, les résultats des cas présentés ne sont pas toujours encourageants et cela peut déterminer dans une large mesure la durée des actions et affecter la ténacité des membres.

La formation d'organisations citoyennes de ce type démontre un haut degré d'engagement de la part des voisins et renforce l'impact de leurs activités. Comme l'ont montré Enqvist et al. (2014), une structure plus stable de la participation citoyenne est plus efficace que des structures lâches, bien que cette dernière puisse faciliter la participation de plus de membres.

Il est intéressant de noter que la collaboration de spécialistes ou d'organisations externes a joué un rôle fondamental dans le renforcement de ces initiatives. Depuis, dans les études de cas, les acteurs externes ont contribué à la formation des leaders, au renforcement de leur motivation et, dans deux cas, ils ont encouragé la création d'organisations pour légitimer et donner une continuité à leur travail. Cependant, toutes ces initiatives sont principalement développées par des voisins, ce qui en garantirait une meilleure acceptation. Au contraire, l'étude d'Ostrom et al. (1999) montre que lorsque des acteurs externes imposent des normes ou un contrôle des biens communs sans participation locale, ils tendent à générer une grande résistance.

De plus, les leaders dans ces actions communautaires sont principalement des femmes. Cela pourrait être lié à des conditions particulières telles que celles trouvées par Rocío Silva dans l'étude des femmes leaders dans les conflits éco-territoriaux au Pérou. L'auteur identifie que le leadership des femmes défenseurs de l'environnement se caractérise par : plus de volonté de travail commun, plus de persistance dans la lutte, performance de leadership dans des espaces plus restreints (locaux ou communaux), plus grand sacrifice des responsabilités familiales et discours de défense du territoire comme quelque chose de familier plutôt que politique (Silva 2017).

4. Le défi de la gestion durable des terres dans la banlieue urbaine

La gestion durable de la croissance urbaine présente des faiblesses institutionnelles au niveau national et local. Un manque de volonté politique pour orienter l'expansion urbaine et prendre des mesures concrètes pour protéger les zones importantes naturelles et agricoles a été démontré. Les plans d'urbanisme ne sont pas très appréciés par les autorités et ne sont pas utilisés efficacement par les autorités municipales. De plus, les changements de pouvoir entraînent un manque de continuité des propositions de plans.

En outre, les instruments de planification, la socialisation et la mise en œuvre des stratégies proposées présentent des faiblesses. Une faible spécification des stratégies afin d'éviter l'occupation des zones non aménageables et pour orienter l'expansion urbaine vers les zones

définies à cet effet a été identifiée. Plus précisément, les plans urbains se concentrent principalement sur les propositions de zonage et de routes, laissant de côté l'inclusion de stratégies plus diverses. D'ailleurs, il y existe une mauvaise exécution et la conformité des plans n'est pas toujours respectée. Il convient de souligner le manque de stratégies et d'investissements publics pour encourager l'occupation des zones définies pour l'expansion urbaine. De même, il existe des preuves que les gouvernements locaux n'anticipent pas les effets des infrastructures publiques sur la dynamique spatiale, et donc, sur la localisation réelle de l'expansion urbaine.

Il semble y avoir une mauvaise coordination entre les institutions et les acteurs impliqués dans les processus d'expansion urbaine (entités gouvernementales, sociétés prestataires de services publics, notaires publics, entreprises de construction, associations de logement et propriétaires). Dans ces circonstances, il est difficile de promouvoir un changement ordonné de l'utilisation des terres dans les zones appropriées. Cela pourrait être causé en partie par un cadre réglementaire inapproprié et fragmenté, qui profite avant tout aux établissements urbains informels et à la propriété privée.

En ce qui concerne les réglementations nationales, les principaux inconvénients sont la liberté de subdiviser les terres sans tenir compte des réglementations locales et l'imprécision des critères techniques pour la délimitation des zones développables et non-développables. En outre, le manque d'innovation et d'adaptation des instruments d'urbanisme à la réalité péruvienne est caractérisé notamment par une culture juridique faible et une demande fortement insatisfaite de logements sociaux.

Il y a de fortes faiblesses dans la gouvernance de l'espace périurbain et dans le processus d'urbanisation lié à la négligence, à la corruption et au manque d'information, en plus de la faible attention à la demande de logements sociaux, ainsi que l'absence de politiques locales pour soutenir la production agricole dans la zone périurbaine ou la préservation des zones de grande valeur écologique.

Une grande partie des personnes interrogées (de 35 à 45% par cas) pense que les logements à densité plus élevée sont utiles pour contrôler l'étalement urbain, et les habitants des grandes villes ont tendance à accepter un peu plus les bâtiments à plusieurs niveaux. Plus précisément, cela est considéré comme un moyen d'éviter l'expansion sur les espaces verts adjacents. Néanmoins, il existe une réticence à vivre dans des appartements, en particulier dans les villes andines de Cajamarca et Huamachuco. Les inconvénients à vivre dans un appartement ont été facilement identifiés, comme, par exemple, le prix élevé par rapport à l'achat d'un terrain et la construction progressive de logements. La majorité préfère une maison indépendante pour des raisons de sécurité, de confort ou de qualité de vie.

Les pratiques informelles telles que l'occupation des zones non destinées à l'expansion urbaine et la subdivision des terres sans autorisation ont été généralisées tout au long du processus de développement urbain. Toutes sortes d'acteurs interviennent dans des pratiques informelles : autorités, fonctionnaires, notaires, juges et avocats, professionnels de l'ingénierie ou de l'architecture; ainsi que les propriétaires et les nouveaux habitants. Il existe également une ignorance générale au sujet des contributions gratuites pour les espaces publics qu'un promoteur urbain devrait fournir et au sujet de l'importance du zonage pour le développement durable. Dans les études de cas, certains acteurs publics avaient agi de manière informelle ou encouragé l'informalité par négligence, manque d'inspection, ignorance ou encore corruption. Par exemple,

il y a eu une grande permissivité des autorités municipales pour éviter les conflits avec les électeurs.

L'absence d'une politique nationale efficace d'accès au logement social peut être considérée comme le principal moteur de l'informalité. La régularisation de la propriété informelle a commencé comme une alternative pour résoudre le problème du logement des populations à faible revenu. Cependant, elle est devenue une procédure courante pour divers secteurs socio-économiques et un moyen d'obtenir une propriété avec un fort potentiel pour augmenter sa valeur. Dans ces conditions, les réglementations urbaines semblent s'adapter systématiquement aux modes informels de production de la ville.

Dans les zones d'étude, la dynamique spatiale de la croissance urbaine désordonnée a de grandes possibilités de continuer bien que, la vitesse de ces changements devrait être plus lente. Les projets routiers existants continueront à inciter l'empiétement urbain dans les zones naturelles et agricoles. Dans la vallée de Cajamarca d'ici 2050, on s'attend à assister au remplissage des zones déjà occupées, à la subdivision des parcelles, à un développement urbain important et à l'apparition de logements dispersés. A Purrumpampa, la propriété municipale pourrait être conservée en tant qu'espace public, mais plutôt comme zone récréative que comme aire protégée écologique et historique. A Mangamarca, la défense communale peut être insuffisante pour faire face à une invasion croissante. Les principales conséquences des projections d'expansion urbaine à 2050 dans ces zones sont : les désastres liés aux inondations et aux glissements de terrain, des infrastructures et services publics inefficaces, la pollution et l'insalubrité, la perte d'espaces ouverts et de valeur esthétique, la perte de terres productives et la diminution de la biodiversité.

5. Conclusion

Il est crucial de comprendre l'expansion urbaine dans les zones non aménageables afin d'améliorer les stratégies d'aménagement et de gestion durable du territoire. En ce sens, l'analyse de la dynamique spatiale, de la perception, des comportements, de la planification et de la gestion locale est très utile pour appréhender la dynamique de l'expansion urbaine, ses causes et ses conséquences.

Les résultats appuient essentiellement l'hypothèse selon laquelle l'expansion urbaine récente dans les études de cas est principalement informelle, désorganisée et diffuse ; et qu'elle est la conséquence de sérieuses déficiences dans la gestion publique locale, ainsi que de l'insouciance locale de leur environnement. De plus, certaines organisations communautaires et certains leaders sociaux contribuent à une utilisation plus durable du territoire. En effet, les processus informels, la gestion inappropriée et certaines initiatives communautaires sont des aspects importants qui déterminent l'extension urbaine. Il a été constaté que les nouvelles zones urbaines n'étaient pas aussi diffuses que les tendances mondiales, mais qu'elles étaient plutôt fragmentées et qu'au fil du temps presque tout l'espace était occupé. En ce qui concerne la préoccupation environnementale locale, les résultats de l'enquête montrent que la plupart des ménages ont une bonne appréciation et identification des problèmes et qu'ils soutiennent la protection ; mais cela a peu d'importance dans les décisions de logement et la prise de mesures de protection.

Chaque étude de cas a montré des caractéristiques particulières du territoire périurbain et de sa population. L'empiètement urbain dans les « Lomas de Mangamarca » de la région métropolitaine de Lima menace un écosystème unique et fragile dans un environnement très aride. Il existe une image simplifiée de cet espace dans la perception locale. De plus, de nombreux voisins ne le connaissent pas en raison de sa nature saisonnière et de son accès difficile. Aussi, cette affaire est un exemple de trafic terrestre, de ségrégation résidentielle et d'organisation communautaire. Le secteur nord de cette zone d'étude révèle les problèmes de logement des populations vulnérables qui habitent une zone de risque de glissement de terrain dans des conditions précaires. Le secteur sud se caractérise par une bonne culture organisationnelle liée aux origines du quartier liées aux syndicats et une certaine homogénéité sociale dans un espace physiquement confiné. Les initiatives communautaires démontrent donc une grande volonté de protéger l'oasis de brouillard.

Dans la petite ville de Huamachuco, l'empiètement urbain sur 28 hectares de zones humides de Purumpampa a réduit la taille d'une zone historique, écologique et récréative. Cet écosystème est apprécié principalement pour son utilisation pour les loisirs et les sports et non pour la nature. L'étalement urbain n'est donc pas considéré comme un problème par de nombreux habitants, car ils ont un accès facile aux espaces ouverts et l'expansion urbaine est considérée comme un signe de prospérité. De plus, la subdivision informelle des terres et la construction sans avis technique sur les zones humides et les débris produisent des habitats dangereux. Dans ces circonstances, la société civile de Purumpampa mène également des actions de protection et de conservation des zones humides, face à une gestion inadéquate par les institutions publiques.

Tandis que, l'expansion urbaine dans la vallée de Cajamarca a causé la perte de 251 hectares de terres agricoles irriguées depuis 1988. Ce cas illustre certains effets insoutenables de la mondialisation sur le territoire, à travers des investissements mondiaux dans les mines qui produisent une forte immigration et l'ouverture économique qui a réduit la production laitière dans la vallée. Cela démontre également certaines contradictions profondes au niveau intérêts privés et communs. D'une part, l'environnement rural est bien apprécié par les locaux et, en particulier, la production laitière et alimentaire car elle est considérée comme le principal bénéfice de ce socio-écosystème. De la même manière, l'impact négatif de l'empiètement urbain sur l'activité agricole a été largement identifié. D'autre part, le paysage rural n'est pas considéré comme un bien commun et les sols fertiles ne sont pas considérés comme une ressource stratégique. Ils sont simplement perçus comme des propriétés privées et les décisions individuelles sur ces terres ne sont pas d'intérêt commun.

Les études de cas présentent également des similitudes significatives qui ont permis d'identifier des problèmes communs dans un contexte national. L'une des principales similitudes de la dynamique urbaine est la forte augmentation de la valeur du sol, principalement liée à la croissance de la population urbaine et à la conception des routes principales. Cette dynamique détermine en grande partie le changement d'utilisation du sol, ce qui prouve que les profits, plus que l'urbanisme, ont défini la forme urbaine.

Les processus d'urbanisation informelle présents dans tous les cas ont tendance à générer des conditions d'inadéquation et de mauvaise qualité de l'espace public. La réglementation urbaine doit s'adapter à la forte demande de logements de la population à revenu faible et moyen qui ne sont pas suffisamment pris en charge par le marché tout en garantissant des établissements sûrs et inclusifs, et pas seulement en formalisant les procédures irrégulières.

Les espaces ouverts présentent une bonne appréciation, surtout pour offrir un environnement en contraste avec la ville. La nature et le milieu rural prennent une importance particulière pour les citadins, et ce, en particulier dans les grandes villes. Alors que dans les petites villes, les ménages espèrent plutôt développer une ville moderne avec des infrastructures dures plutôt que de maintenir de grands espaces verts.

Il existe une contradiction entre les valeurs et les actions concernant l'empiètement urbain dans les zones sélectionnées. La bonne évaluation, l'identification des problèmes et le maintien de la protection ont peu d'importance dans les décisions en matière de logement et n'entraînent pas la mise en place de mesures pour la défense des intérêts collectifs.

La durabilité urbaine nécessite la coordination de multiples parties prenantes, y compris les organisations de citoyens locaux. Les initiatives citoyennes dans les zones d'étude sont fondamentales car elles démontrent que la population organisée peut prendre des mesures concrètes pour atteindre des objectifs d'intérêt de bien commun. En outre, ces actions semblent combler les lacunes des structures gouvernementales pour gérer l'espace périurbain. Il est intéressant de noter que la collaboration de spécialistes ou d'organisations externes a joué un rôle fondamental dans le renforcement de ces initiatives. Il ressort que les leaders environnementaux dans les cas d'étude sont principalement des femmes, qui présentent une grande persistance et que leur performance de leadership est centrée sur l'espace communal plutôt que sur la sphère politique.

La gestion durable de la croissance urbaine présente des faiblesses institutionnelles au niveau national et local à cause du manque de volonté politique, l'inefficacité des plans d'urbanisme, et le manque de continuité des propositions avec les changements de pouvoir. En outre, les instruments de planification, la socialisation et la mise en œuvre des stratégies proposées présentent des faiblesses. Les plans urbains se concentrent principalement sur les propositions de zonage et de routes, laissant de côté l'inclusion de stratégies plus diverses. Il y a un manque de stratégies et d'investissements publics pour encourager l'occupation des zones définies pour l'expansion urbaine. De même, les gouvernements locaux n'anticipent pas les effets des infrastructures publiques sur la dynamique spatiale, et donc, sur la localisation réelle de l'expansion urbaine.

En ce qui concerne les réglementations nationales, les principaux inconvénients sont la liberté de subdiviser les terres sans tenir compte des réglementations locales et l'imprécision des critères techniques pour la délimitation des zones urbanisables et non urbanisables. De surcroît, le manque d'innovation et d'adaptation des instruments d'urbanisme à la réalité péruvienne est caractérisé notamment par une culture juridique faible et une demande fortement insatisfaite de logements sociaux.

Une grande partie des personnes interrogées pensent que les habitations à plus forte densité sont utiles pour contrôler l'étalement urbain. Néanmoins, il existe une réticence à vivre dans des appartements, en particulier dans les villes andines de Cajamarca et Huamachuco. Les principaux inconvénients à vivre dans un appartement sont le prix élevé par rapport à l'achat d'un terrain et la construction progressive de logements. La majorité préfère une maison indépendante pour des raisons de sécurité, de confort ou de qualité de vie.

Les pratiques informelles telles que l'occupation des zones non destinées à l'expansion urbaine et la subdivision des terres sans autorisation ont été généralisées. Il existe également des acteurs publics qui ont agi de manière informelle ou encouragé l'informalité. L'absence d'une politique nationale efficace d'accès au logement social peut être considérée comme le principal moteur de l'informalité. La régularisation de la propriété informelle est devenue une procédure courante pour divers secteurs socio-économiques et un moyen d'obtenir une propriété avec un fort potentiel pour augmenter sa valeur.

En somme, dans les études de cas, la planification routière, la culture de l'informalité et les initiatives communautaires sont les aspects les plus significatifs dans la construction de l'extension de la ville. Certes, la conception du futur réseau routier devrait être soigneusement planifiée compte tenu des scénarios futurs qu'il motivera. De la même manière, il est essentiel que les politiques urbaines s'occupent de la violation de la loi par les acteurs publics et privés. De plus, la gestion locale devrait intégrer les organisations communautaires car elles représentent un grand potentiel pour la gestion durable du territoire.

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Annexes

Annex 1: Interview Guide

Section 1: About the interviewee

1. How many years have you lived in this sector? If you do not live in the sector, since when do you know the area?
2. How many years have you lived in this city? If you come from another place, in what district and province were you born?
3. What is your main occupation? Age and Sex?

Section 2: Urbanization process

4. Could you describe what the area was like 30 years ago, that is, in the mid-80s (or since you know it)?
5. About 30 years ago, how far did land ownership go?
6. How have the lands been occupied?
7. Who subdivides the land in plots? How do they decide how to do it?
8. Who builds the houses? Are there real estate entrepreneurs or does each owner build?
9. Do they build in stages? How do you finance the construction?
10. Do they have basic water, sewage and light services? How and since when did they get them?
11. What ownership documents do the new owners have? Do they have a property title from the beginning or are they formalized afterwards?
12. What do you consider the main reasons why people choose to live in this sector and not in another?

Section 3: Municipal management of urban expansion

13. What have been the main actions of the Municipality on the issue of urban expansion in the sector? What is your opinion about it?
14. What would be the main obstacles to managing urban growth?

Section 4: About the ecological/agricultural area

15. Do you like (according to the place) "Lomas de Mangamarca" / "Pampas de Purumpampa" / "this sector of the valley"?
16. What kind of benefits do you think they provide to the city and the citizens?
17. How important is the protection of this area?

18. Do you consider that this space is being degraded? How?
19. Do you know if there are neighborhood organizations for its protection?
20. If so, what kind of actions have you done and what is your opinion about it?

Section 5: Urban density

21. Do you think that these new areas have a lower density than the rest of the city, that is, if fewer people live in the same area?
22. What do you think this is due to?
23. Do you think it can be positive or negative? Why?
24. Do you think it can bring benefits that more citizens live in apartments or smaller areas? Why?

Section 6: Consequences

25. What do you think are the main advantages of the expansion of the city in the study area?
26. What do you think are the main problems of the expansion of the city in the study area?
27. What elements would you change to the study area?

Annex 2: Interviewees List

Case study: Cajamarca valley

Code	Name	Occupation	Date
CAJ01	Fresia Chunga Castro	Neighbor	05/08/2016
CAJ02	Anonym	Social leader	05/08/2016
CAJ03	Flor Maldonado Albarracín and Walter Ibañez Juárez	Land owners and public functionaries	05/08/2016
CAJ04	José Amambal Vargas	Farmer	06/08/2016
CAJ05	Rosa Castañeda Gamarra	Neighbor	06/08/2016
CAJ06	Julio Melquiades Marín Rodríguez	Presidente de la Federación Regional de Rondas Campesinas Indígenas y Urbanas de Cajamarca Perú	08/08/2016
CAJ07	Alex Huaccha	Official in Urban planning	09/08/2016
CAJ08	Alejandro Moncada	Former land owners and property investor	10/08/2016
CAJ09	Amalia Castrejón	President of the Federación de Rondas Campesinas Femeninas del Norte del Perú	10/08/2016
CAJ10	Manuel Tavera	Official in Urban planning	11/08/2016
CAJ11	Pablo Florez Riquelme	Official in Urban planning	11/08/2016
CAJ12	César Bardales Barrantes	Official in the Ministry of Agriculture	12/08/2016
CAJ13	Jesús Rodríguez Chavez	Official in SENASA	12/08/2016
CAJ14	Enrique Pérez Effio	Neighbor and former community leader	13/08/2016
CAJ15	Victor Vargas Vargas	Neighbor and former social leader	15/08/2016

CAJ16	Juan Carlos Granados	Official in COFOPRI	04/08/2016
CAJ17	Juan Manuel Siccha	Former official in Urban planning	04/08/2016
CAJ18	Alicia Quispe	Official in Gobierno Regional Cajamarca	04/08/2016
CAJ19	Gino Vasquez	Official in Urban planning	05/08/2016
CAJ20	Juana Chavez and Julián Blanco	Neighbors	07/08/2016
CAJ21	Antenor Florindez	Official in Environmental Direction	08/08/2016

Case study: Mangamarca fog-oasis

CODE	NAME	OCCUPATION	DATE
MAN01	Walter Moreno	Social leader in Los Sauces	01/2017
MAN02	Edgar Bejarano	Social leader in Los Sauces	01/2017
MAN03	Arico Che	Neighbor and former community leader	01/2017
MAN04	Yovita Barzola	President of Lomas de Mangamarca Ecotourism Association	01/2017
MAN05	Sarita Cristóbal Suarez	President of CODEPACMA	01/2017
MAN06	Roy Robles	Official in Environmental Direction	02/2017
MAN07	Isaías Manuel Tacuri Casaño	Official in Urban planning	02/2017
MAN08	Anonym	Neighbor	01/2017

Case study: Purumpampa wetlands

CODE	NAME	OCCUPATION	DATE
PUR01	Paul Rodríguez	Official in Urban Planning	07/2016
PUR02	Antonio Campos Castillo	Communicator and former councilor	07/2016
PUR03	Modesta Ríos	Treasurer of the Association for the Protection of the Purumpampa Ecological Park	07/2016
PUR04	Domingo Mauricio Ramos	Official in the Ministry of Agriculture and President of the Association for the Protection of the Purumpampa Ecological Park	07/2016
PUR05	Anonym	Neighbor	02/2017
PUR06	Anonym	Neighbor	02/2017

Annex 3: Survey Format

CENTRO DE INVESTIGACIÓN DE LA ARQUITECTURA Y LA CIUDAD
 INSTITUTO LINGÜÍSTICO Y LINGÜÍSTICO DEL PERÚ

Número de encuesta:

Moneda:

Investigador/a:

ENCUESTA A LOS DIESTROS - EXPANSIÓN URBANA URBANIZACIÓN

INTRODUCCIÓN: Durante el día/hoy, mi nombre es _____, trabajo para la Universidad Nacional del Perú y estamos realizando una investigación sobre la expansión de la ciudad. Le agradeceríamos si el jefe o jefe de hogar pudiera brindarnos este minuto para responder a las siguientes preguntas. Las preguntas que nos harán serán breves de manera amigable y nos serán de mucha utilidad. Puede abstenerse de responder cualquiera de las preguntas si así lo desea. Muchas gracias por su participación. 45

DATOS PERSONALES	
1. Edad:	años <input type="text"/>
2. Sexo:	<input type="checkbox"/> Hombre <input type="checkbox"/> Mujer
3. ¿En qué distrito y provincia nació?	
Distrito: _____	
Provincia: _____	
4. ¿Hace cuántos años vive en Huancavelica?	
(APROXIMADO) _____	
5. ¿Hace cuántos años vive en este sector?	
(APROXIMADO) _____	
6. ¿Cuál es su ocupación principal? (MENCIONE LA OPCIÓN MÁS ADECUADA)	

PURUMPAMPA	
7. En una escala del 1 al 5, donde 1 es nada y 5 es mucho, ¿qué tanto le agrada las pompas de Purumpampa?	
<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	
8. ¿Con qué frecuencia visita Purumpampa? ESPERAR RESPUESTA	
<input type="checkbox"/> Diariamente <input type="checkbox"/> Semanalmente <input type="checkbox"/> Quincenalmente <input type="checkbox"/> Mensualmente <input type="checkbox"/> No va regularmente	
9. ¿Cuál es el principal motivo por el que lo visita? ESPERAR RESPUESTA	
<input type="checkbox"/> Visitarlo <input type="checkbox"/> De paso <input type="checkbox"/> Recreación <input type="checkbox"/> Trabajo <input type="checkbox"/> Otro: _____	

10. ¿Cree que las pompas de Purumpampa brindan beneficios a la ciudad y los ciudadanos?
<input type="checkbox"/> Sí <input type="checkbox"/> No <input type="checkbox"/> No sabe
11. ¿Qué tipo de beneficios dan a la ciudad? (PUEDE SEÑALAR MÁS DE UNO)

12. ¿Cree que la expansión de la ciudad sobre Purumpampa genera problemas negativos?
<input type="checkbox"/> Sí <input type="checkbox"/> No <input type="checkbox"/> No sabe
13. ¿Qué tipo de problemas genera la expansión sobre Purumpampa? (PUEDE SEÑALAR HASTA 3)

14. ¿Qué tan importante considera la protección de Purumpampa?
<input type="checkbox"/> Poco o nada <input type="checkbox"/> Más o menos <input type="checkbox"/> Mucho

EXPLICACIÓN DE LA VIVIENDA

14. Tipo de vivienda:
 Casa Departamento Otro
15. ¿Cuántos años de antigüedad tiene su vivienda?
(APROXIMADO) años No sabe
16. ¿Su vivienda se encuentra sobre una antigua zona de suelos húmedos?
 Sí No No sabe
17. ¿Cuántas personas habitan en esta vivienda? _____
18. ¿Cuál es la condición de propiedad de su vivienda?
 Propia Alquilada Otras:
19. ¿Cuál es el área aprox. de su terreno? m²
20. ¿Su vivienda cuenta con servicios de...
... agua potable? Sí No
... desague? Sí No
... luz? Sí No
21. ¿Su vivienda cuenta con cochera? Sí No
22. ¿Su vivienda cuenta con jardín interior? Sí No

PREFERENCIAS DE VIVIENDA

23. ¿Tiene sus planes cambiar de vivienda en los próximos 10 años?
 Sí No No sabe \rightarrow P. 29
24. ¿Desea mudarse a otro barrio de la ciudad?
 Sí No No sabe
25. ¿Prefiere una vivienda de qué área?
 Más grande Igual Más pequeña
26. ¿Prefiere una casa o departamento?
 Casa Departamento Otro
27. ¿Le gustaría vivir más cerca o más lejos del centro de la ciudad?
 Más cerca Igual Más lejos
28. ¿Cuál es la principal razón por la que prefiere quedarse/mudarse del barrio? *COMPLIAR EN ESPAÑOL*
 Trabajo / Estudios
 Ambiente
 Costo de vivienda/suelo
 Seguridad
 Otro: _____

EXPANSIÓN URBANA

29. ¿Considera que la ciudad ha crecido de manera ordenada?
 Sí Más o menos No No sabe
30. ¿Considera que la municipalidad hace una buena gestión para el crecimiento ordenado de la ciudad?
 Sí Más o menos No No sabe
31. ¿ cree que para controlar la expansión de la ciudad sería mejor que más personas habiten en departamentos?
 Sí No No sabe

¡GRACIAS POR SU COLABORACIÓN!

Observaciones:

Annex 4: Fieldwork Team

Case study: Cajamarca valley

- Narella Gutiérrez, geographer (surveyor and coder)
- Ana Paula López, Geography student (surveyor and coder)
- Fresia Vargas, geographer (interviewer)
- Paola Moschella (interviewer and coordinator)

Case study: Mangamarca fog-oasis

- Ana Paula López, Geography student (interviewer, surveyor and coder)
- Alejandro Villavicencio, Geography student (interviewer, surveyor and coder)
- Paola Moschella (interviewer and coordinator)

Case study: Purrumpampa wetlands

- Guillermo Prieto, sociologist (interviewer, coordinator and surveyor)
- Jhorandy Contreras, technical higher education student (surveyor)
- Diana Mardely Rodríguez, university student (surveyor)
- Karina Edith Salvatierra, university student (surveyor)
- Dennis Jhoel Sánchez, technical higher education student (surveyor)
- Ana Paula López, Geography student (coder)
- Paola Moschella (interviewer and coordinator)

Annex 5: Demographic characteristics of the survey sample

	MANGOMARCA FOG-OASIS		CAJAMARCA VALLEY		PURRUMPAMPA WETLANDS	
	ABSOLUTE	(%)	ABSOLUTE	(%)	ABSOLUTE	(%)
Women	150	63	158	53	93	31
Men	90	38	142	47	196	65
≤ 30 years old	57	24	65	22	63	21
31 to 45 years old	88	37	112	38	119	40
46 to 60 years old	51	21	78	26	88	29
≥ 61 years old	43	18	43	14	30	10
Not immigrant	66	28	122	42	162	54
Immigrant	171	71	172	59	138	46
TOTAL	240	100	300	100	300	100

Annex 6: Articles published as part of the thesis

Moschella, P. (2017) Variación del paisaje para la gestión sostenible del territorio. In: Canziani, J.; Vilela, M.; Dam, P.; Stillemans, J. (eds.) *Transversal: Acciones de integración en el territorio peruano*. Lima: Académie de recherche et d'enseignement supérieur de Belgique, Université Catholique du Louvain, Université de Liège, Pontificia Universidad Católica del Perú. Pp. 333-346.

Vilela, M. & Moschella, P. (2017) Paisaje y expansión urbana sobre espacios naturales en ciudades intermedias. El caso de Purrumpampa en Huamachuco, Perú. *Bulletin de l'Institut Français d'Études Andines*, 46 (3), pp. 529-550.



Paola MOSCHELLA MILOSLAVICH



PERI-URBANIZATION AND LAND MANAGEMENT SUSTAINABILITY IN PERUVIAN CITIES.

PÉRI-URBANISATION ET GESTION DURABLE DU TERRITOIRE DANS LES VILLES PÉRUVIENNES.

Résumé

La croissance urbaine incontrôlée est liée à plusieurs problèmes socio-environnementaux dans les pays en développement comme le Pérou. Afin de comprendre l'expansion urbaine dans les zones non aménageables, la recherche combine trois dimensions de l'analyse : l'analyse spatiale, l'analyse du comportement social et l'évaluation de la gestion urbaine et de l'aménagement du territoire. L'étude se concentre sur trois cas péruviens : une oasis de brouillard saisonnier dans la ville aride de Lima, les terres agricoles de première qualité de la vallée de Cajamarca et les zones humides de la petite ville de Huamachuco. L'expansion urbaine dans les études de cas est principalement informelle et désorganisée; à cause de sérieuses déficiences dans la gestion publique locale, la planification routière et la culture de l'informalité. Cependant, certaines organisations communautaires et certains leaders sociaux contribuent à une utilisation plus durable du territoire.

Mots-clés : étalement urbain, aménagement urbain, développement urbain durable, perception, frange urbaine

Résumé en anglais

Uncontrolled urban expansion is related to several socio-environmental problems in developing countries like Peru. In order to understand the urban expansion in non-developable areas, the research combines three dimensions of analysis: spatial analysis, social behavior analysis, and the evaluation of urban management and spatial planning. The study focuses on three Peruvian cases: a seasonal fog-oasis in the arid city of Lima, the prime farmlands in Cajamarca valley, and the wetlands of the small city of Huamachuco. Urban expansion in the case studies is predominantly informal and disorganized as a consequence of serious deficiencies in local public management, road planning, and the culture of informality. However, some communal organizations and social leaders contribute to a more sustainable land-use.

Keywords : urban growth, urban planning, sustainable urban development, perception, urban fringe