Three self-build cities around Lima, Peru

By Jan Bredenoord, PhD, urban planner and housing researcher. July 2025

Nuevo Pachacútec, Peru

Three self-build cities around Lima, Peru: Villa el Salvador, Huaycán and New Pachacútec

From 1970, land was widely parcelled out in Peruvian cities for self-build housing. These were the sites-and-services projects that made it possible to make residential plots available for families. This paper describes urban developments in Peru through self-building in three suburbs of Lima, Villa el Salvador, Huaycán and New Pachacútec. These three suburbs face three challenges, respectively: a) densification, b) integration of hillside housing into existing neighborhoods, and c) earthquake-resistant housing construction. Today, all space around the central city of Lima has been utilized for suburban suburbs. In the coming years, policy attention will focus on improving the residential and living environment throughout metropolitan Lima. This will be accompanied by the introduction of new forms of housing finance and stacked housing.

Housing development in and around Lima

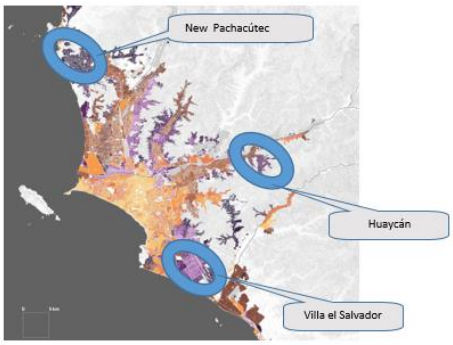
In the middle of the 20th century, large migration flows began from rural areas to coastal cities in Peru. Lima's growth was particularly dynamic; from 1 million inhabitants in 1950 to 10.7 million in 2020. Migrants from remote parts of the country and low-income city dwellers often found shelter in low-quality neighborhoods in and near the inner city - the 'tugurios' - and then in the new settlements around the city - the 'barriadas'. From the early 1950s, governments were still trying to develop policies to build 'decent housing'. This led to some housing projects, but together they produced only small numbers of affordable houses. As public housing was unable to meet the huge housing demand, low-income families built their shelters illegally on the outskirts of the city. This created the spontaneous *human settlements* where almost all amenities were initially missing and housing quality was low. In each case, this orchestrated occupation of land by large groups of families included simple subdivisions, as the start of individual housing construction.

Gradually, the government took steps to regulate illegal settlements by constructing access roads, dividing the land into building plots and issuing them to new residents. From 1970, this was done on a large scale to prevent further growth of these illegal urban extensions. The Lima metropolis was developed from the center in three directions: 'south', 'east' and 'north'. To the west, Lima borders the Pacific Ocean and to the east the various foothills of the Andes Mountains. In the three directions of expansion, numerous land-for-housing projects were made possible, some with starter homes.

Anno 2020, there are still many informal developments outside the established suburbs in and around Lima. Many houses are still built on the slopes of foothills of the Andes mountains that surround the jagged city limits. Today, illegal construction on the mountain slopes around Lima is seen as informal urbanism tolerated by local authorities.

This chapter outlines the background of three large-scale land-for-housing programs, around Lima. These programs gradually became important suburbs.

- Villa and Salvador (VES) in the southern part of the metropolis was developed from 1970. This suburb is about 23 km from the city center.
- Huaycán in the municipality of Ate-Vitarte, in the eastern part of the metropolis, was developed from 1984. This suburb is 20 km from Lima's city center.
- New Pachacútec in the municipality of Ventanilla in the northern foothills of Lima, was implemented from 2000. This new city is part of Ciudad Pachacútec, a large urban area 20-25 km north of Lima.



Location of suburbs around Lima

The suburbs of VES, Huaycán and New Pachacútec

Most major cities in Peru are located on the west coast in a narrow zone between the Pacific Ocean and the Andes Mountains. In this dry zone, land ownership mostly belonged to the state so land could be designated for housing development there. Low-cost housing estates were developed according to new urban planning visions on the layout of neighborhood and residential blocks. Within an urban plan, plots were designated for individual self-build and small-scale businesses. In Peru, illegal, informal and formal housing estates (barriadas, barrios and neighborhood units) sometimes literally coexist.

From 1970, Lima's metropolitan government became the promoter of organized self-build and helped to design urban plans. The three new suburbs are far from the city center, but are part of the extensive urban growth in the three growth directions. During Velasco's military government (1968 to 1975), the young town of Villa el Salvador south of Lima was made possible under the slogan: "anyone who needs a house can get a plot to build its own". There was so much interest in this that within two years many of the plots had been issued and occupied by self-building families.

In the mid-1980s, the development of Huaycán took off east of Lima in the municipality of Ate-Vitarte, which was an initiative of Mayor Barrantes of Lima. Huaycán was developed as the *Huaycán Special Project*, which consisted of a participatory design process that provided cheap land for housing to thousands of people.

An extension of Ciudad Pachacútec, north of Lima, was developed from 2000 as the *Nuevo Pachacútec Special Project*. Then-President Fujimori initiated this plan to win voters for his re-election in 2000. However, he was not re-elected and no new land-for-housing programs were developed thereafter. Since then, many land occupations took place on the mountain slopes around Lima. This eventually happened on a large scale and was always illegal at first.

Street scene in VES

Land ownership

Since 1996, the government has been legalizing the property rights of informal family housing plots through the *Organisation of Formalisation of Informal Property* (COFOPRI). This is a parallel land registry

for land ownership in human settlements. The *National Urban Land Registry and Municipal Support Project* program was implemented over five years with a budget of US$80 million, of which US$50 million came from the World Bank and US$30 million from the Government of Peru. Part of this budget was spent on legalizing plots of land in the new suburbs around Lima. Legalizing the ownership of plots and houses is necessary for families/owners, among other reasons because they need ownership papers to apply for subsidies and loans.

Challenges in three suburbs

The Villa el Salvador suburb ('VES') is consolidated, meaning development is complete and basic services such as roads, water, electricity and sewerage are in place. All plots in VES have long been built on, but housing quality varies widely and so does the intensity of housing construction. Families often wait to plaster and paint exterior walls until the house is complete. The biggest challenges in VES are renovating homes and eliminating the backlogs that remain in many neighborhoods. Residential environments still need to be taken to the next quality level, which applies to housing quality and environmental quality.

In Huaycán, the original planning area is rather flat or slightly sloping. It was built up years ago, while in 2020 only informal extensions took place on the surrounding mountain slopes, which can be dangerous because the stability of the subsoil is uncertain. Huaycán's original development plan is considered 'beginning to be consolidated'. The challenge is to integrate the informal residential areas on the slopes into the urban area, which is done by building stairs and retaining walls.

In (New) Pachacútec, large expansions have been built north of Ventanilla, an early satellite city of Lima, over the past two decades. By 2020, the space to build new houses has already been used up, but most houses can still be enlarged vertically. The area is prone to earthquakes, so efforts are being made to raise awareness of the residents of earthquake-resistant construction.

Street scenes in the three suburbs

VES: house almost completed

Huaycán: 2004 street scene

Pachacútec: starter home

Densification studies

Jorge Burga Bartra is a well-known Peruvian architect who made proposals for public housing in the new suburbs where self-construction was the norm. Strong seismic activity could damage many homes in Lima and the surrounding area. This architect argued that professionals should be involved in the preparation of construction and renovation plans for self-construction, but this happened only incidentally. In many housing blocks in Peruvian cities, the plots are often fully built on without leaving enough clear spaces for patios and ventilation. This is a disadvantage because ventilation and light penetration are really necessary. The architectural quality of self-built houses is not high, for example, the appearance of facades is often shabby and the use of color is limited. Burga came up with examples to improve the architecture of houses in the streets. He suggested building external staircases to create separate entrances for apartments on the upper floors. Years ago, Burga had already designed models for the densification of suburban residential blocks through designs for elevated residential streets. However, this required a collective approach and the cooperation of all individual owners. However, his

plans for collective densification were not implemented. In present times, housing densification needs renewed attention, as the remainder of this chapter will show.

Architectural studies by Jorge Burga on densification

Source: Jorge Burga

Building on mountain slopes

There is widespread building on the slopes around Lima. This informal development is tolerated by the municipalities and little controlled. An estimated 30 per cent of Lima's population lives on the slopes of the surrounding hills and slopes, where some 2.8 million people live. As early as the 1930s, Cerro San Cristóbal near the city center was made habitable. Since 1990, people began to occupy several mountain slopes around the valleys of the Rímac, Chillón and Lurín rivers, as well as in the hills and sandy areas next to the coast. The residents who moved to the highland locations often find themselves in social isolation, as amenities are in the lower-lying districts. Housing development on mountain slopes is no longer countered by the lack of construction sites and by the lack of strategies to enable social housing on secure sites. The *2016 Limápolis* project started studies on densification of first-generation residential areas, as well as better integration of hillside residential areas with older neighborhoods.

Earthquake-resistant construction

Along the coastal region of Peru runs a fault line in the earth's crust, the *cadena del fuego*, where major earthquakes regularly occurred. The 1974 earthquake that hit Lima and its surroundings caused major damage to Lima and the coast towards Pisco. The quake caused the death of 73 people and 23,000 were otherwise affected. The 2007 quake in Pisco was also felt in Lima, which was then the most recent event.

According to the earthquake hazard map for metropolitan Lima (including the port city of Callao), hazard levels are set at, 'low', 'medium', 'high' to 'very high'. The scenario presented shows that much of the coastal area of Lima and Callao is at very high to high risk, which also applies to the peripheral urban areas discussed in this chapter. The districts (municipalities) in the central part of Lima province pose a medium risk. There has been a seismic silence since the aforementioned earthquakes, but it is feared that an even more devastating earthquake may occur in Lima in the future. Therefore, all homes

and other buildings should be earthquake-resistant. This practice is well developed in Peru, but this is not always the case with self-built constructions.

▪ Villa el Salvador, Lima South

Villa El Salvador (VES) already has more than 500,000 inhabitants by 2020. The city was started in 1971 as a human settlement after settlers occupied an undeveloped private land in Pamplona south of Lima. After days of negotiations with the government, these people were relocated to a sandy area 25 kilometers south of Lima. VES temporarily met the high demand for building plots for self-construction. The settlement grew rapidly and became an organized sites-and-services location.

In 1973, the *self-governing Villa el Salvador Urban Community* was created, a special council charged with developing the new suburb. By 1973, it turned out that there were already more than 109,000 inhabitants. At first, drinking water was still supplied by water trucks. In 1975, the World Bank, through their sites-and-services program, ensured that water and electricity services were funded. In 1983, VES became a separate municipality within metropolitan Lima. During the development phase, main roads were constructed and then the area was subdivided, residential block after residential block, while at the same time plots were transferred to families who were given formal ownership.

VES was long considered a pilot area for self-construction by families and the setting up of micro-enterprises. Spatial development was carried out first under the guidance of the national government and the city of Lima, and later by the new borough. The NGO DESCO helped many families to build the houses and provided loans and technical assistance. Many families managed to build a house, others came halfway, which can still be seen in many streets.

Street scenes in VES in 2005

Source: Ennrique Lopez

Source: author

Urban structure VES

VES has a designed urban grid. Each neighborhood unit consists of 16 residential blocks, while each residential block has 24 plots of 140 square meters each; at the corners, the plots are 190 square meters. Each neighborhood unit of 288 by 288 m - a 'super residential block' - has a central park area with children's play facilities, recreational facilities, a primary school and a community center. Such a park area is managed by a neighborhood committee. A neighborhood unit has about 2,500 inhabitants. The population of VES grew from 381,000 in 2007 to 508,000 in 2017. Growth took place through expansion of houses on private plots. Theoretically, vertical densification is possible, but the cooperation of private landowners is uncertain. This calls for a new densification vision and an adequate way to cooperate with the owners.

City map of VES

Source: UN-Habitat

VES in 2020

In 2020, the level of services in VES is high. Health care is widely available through the realization of health posts, clinics and some hospitals. Education is provided at all levels. Higher education is provided by four universities. Public transport is provided by bus services, 'moto taxis' and taxis, while VES is connected to Lima's metro network. However, neighborhood committees still often have to consult with the municipal administration to get improvements done in the public area. The spatial image is mainly determined by the changing building heights on residential streets ranging from 1 to 4 story's. In many main streets, mixed functions occur, such as shops and businesses on the ground floor and residential functions on a second floor. In the western part of VES, large areas were reserved for industry and commercial services.

Street scenes in VES

Av. Jorge Chavez. Source: RE/MAX Metrópolis.

Houses in a residential street

The VES industrial park is an important manufacturing area in the southern part of the Lima metropolis. Its proximity to the railway stations, 'Parque Industrial' and 'Villa el Salvador', makes the area accessible to visitors and workers. An estimated 1,500 businesses are present. UN-Habitat considers VES a prominent example of a planned city for incremental housing development.

A few times, these individual densifications have led to the development of small apartment buildings on two or three combined plots. This type of development has its limitations as there are also many plots where houses are still marginally developed. Low-rise houses are common on the urban fringe of VES, according to the author's observations via Google maps and Street view. The spatial dynamics there are low.

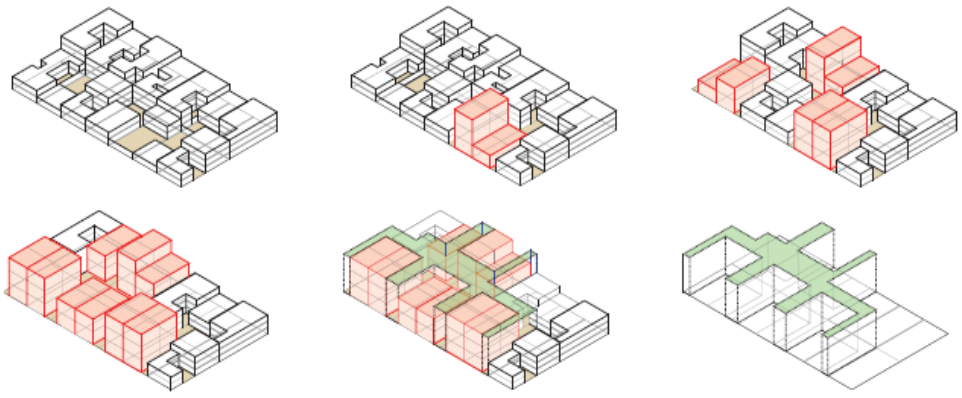
Low-rise housing on the edge to VES

Source: Google Street view

In the initial phase of VES, all units were single-family houses on private plots, but in some cases stacked apartments were built. There is hardly any collective ownership of plots and housing cooperatives are rare. Planned densification is still possible on some outdated industrial estates. In 2019, apartment buildings were built for athletes participating in the Lima 2019 Pan-American Games. 1096 flats of 70 to 75 m2 floor area were built in 20-storey residential towers. These residences were in use in 2021 and 2022 to care for Covid-19 patients. These apartment buildings are a stark visual contrast to the majority of individual houses in VES.

Near this high-rise complex, the government has made an area of 1.9 hectares available for experimental housing projects. The Ministry of Housing, Construction and Sanitation (MVCS) and the MiVivienda Fund (FMV) have called on architects for a *Build to Grow 2021* competition to develop prototypes of collective social housing solutions for application in Lima. The image below shows densification options within a normal residential block, according to design studies carried out under the *Barrio Mío programme,* which in turn is part of the Lima and Callao Metropolitan Plan for Urban Development 2035. Better internal zoning of residential blocks is proposed so that there is always space left at the rear of the houses for light and air to enter.

Densification model for residential blocks in Villa María el Triunfo, Lima.

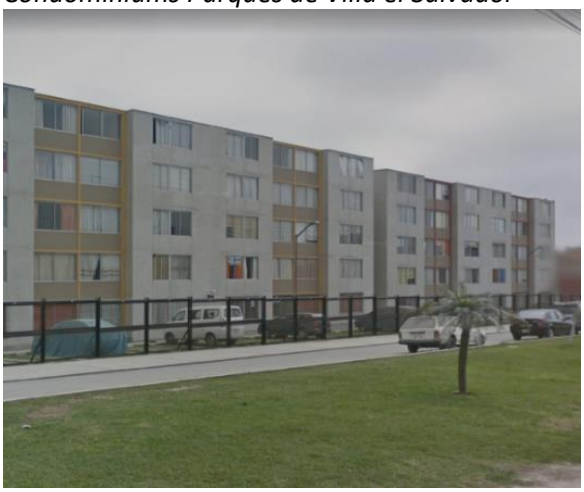


Source: Rodríguez and Muñoz.

In VES, there are also some flat blocks in 4 or 5 residential floors, as there are elsewhere in Lima. These housing units are available in Parques de Villa el Salvador and Condominium Parques de Villa el

Salvador II (see image of a housing complex below, location Avenida 1ro de Mayo.) Other housing units in VES are available in small-scale private housing complexes.

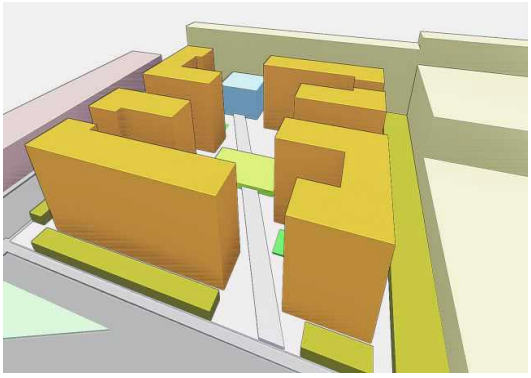
Condominiums Parques de Villa el Salvador



Source: http://www.viva.com.pe/nuestros-proyectos

Some architecture students have designed social housing solutions in the form of stacked flats. One example is the thesis by Diana Vilchez Quispe (2020) from the University of Ricardo Palma, to demolish an old market hall in VES and build a mid-rise residential complex on the site at Avenida 1° De Mayo.

Architectural study by Diana Vilchez Quispe



Source: Diana Vilchez

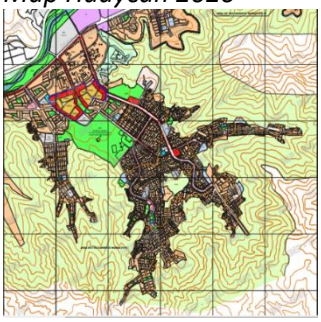
Because VES borders the Pacific Ocean, there are potential dangers of submarine earthquakes off the coast, so the population must be prepared for an earthquake. All houses must be built earthquake-resistant or still be reinforced. The technical assistance programs secure that, but probably not all self-builders have done it well. In VES, a densification task is essential, to provide more space for urban housing solutions.

▪ Huaycán, urban community with self-government Lima East

Huaycán is located east of Lima on the main road along the Rimac River. The suburb lies on the south side of the main road and is connected to it by three urban roads. The plan of Huaycán is bounded by the surrounding mountains that form a very irregular boundary. At the edges of the suburb, houses were built informally on the mountain slopes.

The self-governing urban community Huaycán was established in 1984 in a dry valley 15-20 km east of Lima. Housing construction was started within the *'Special Project Huaycán*' under the direction of Lima's city government. It involved organized groups such as housing associations, neighborhood associations and trade unions, enabling many families to obtain a plot here. After the initial pioneering years, the project came under the leadership of the Ate-Vitarte municipality, while several tasks were delegated to the established Central Committee 'CUAH'. A participatory structure was designed with Committees of zones (major neighborhoods) designated with capital letters (A, B, C, etc.). The zones consist of 'UCVs' or neighborhood units indicated by a number. Each UCV and zone committee has its delegates who take part in a higher level of participation. The central committee coordinates all zones. In 2007, the area had a population of 120,000. In 2017, steps were taken to make Huaycán a separate municipality, a living and working area that would now have a population of 160,000.

Map Huaycán 2020



Source: IMPLA Lima

Urban structure of Huaycán

A standard housing block (UCV) consists of 60 plots of 90 m2. Some UCVs have a common area intended for education, healthcare and recreation. Business or mixed-use housing is located on some main streets. From the time the plots were occupied, people lived in temporary shelters made of reed mats, plastic, wood and the like. Gradually, families started building their houses with more sustainable building materials. Many of the houses have 'spontaneous architecture', meaning that the owners did not have a fixed building plan, but followed the proposals of the hired builders.

Between 1984 and 1986, technical assistance was provided by some architects and social workers from the Lima municipality. Architect Eduardo Figari was project manager and representative of the municipality of Ate from 1984 to 1986. His technical office had developed some housing types as examples for self-builders. But by 1987, the technical assistance office was already dismantled, which was a handicap for the self-building families. From 2000, people were already starting to build homes informally on mountain slopes around Huaycán. The organization for formalization of informal land ownership (COFOPRI) had already issued some ownership certificates to households there, despite the ban on building on the slopes.

In the 1980s and 1990s, the Building Materials Bank (BANMAT) - a government agency - provided loans to households for individual housing construction. In the present era, there are other opportunities to qualify for housing finance for new construction and home renovation, such as the MiVivienda program for lower middle-income households, which in practice, however, is hardly open to the lowest income groups. Between 1985 and 2000, about 25,000 plots were completed for self-build in Huaycán. There are still single-story houses facing the street, standing between completed two- and three-story houses.

Industrial buildings have also been erected in Huaycán. Industrial estate No 1 consists of 94 plots of 140 sq. m serving small manufacturing businesses.

Street scenes in Huaycán in 2005/6

Huaycán 2020

Many private plots in Huaycán are still marginally developed in 2020. This means that Huaycán has a theoretical vertical growth potential for housing. The municipality of Ate-Vitarte does not yet have an established policy for housing built informally on mountain slopes. The municipal building regulations include a classification of urban habitation and buildings on mountain slopes, which could be allowed when building on slopes above 20 degrees (see next section). Before dwellings can be built there, research into the stability of the subsoil is needed. Moving housing from mountain slopes to safe locations is likely to be possible only on a small scale.

NGO CENCA, an urban development institute in Lima, studied some pilot projects in the municipality of San Juan de Lurigrancho, another municipality within metropolitan Lima, where attempts were made to combine densification with social housing. Densification within existing neighborhood units (UCVs) is difficult because many houses do not comply with building regulations and hardly any open spaces and patios remained on house plots. Homes were usually built without planning permission.

Houses built on terraces, with retaining walls

Source: municipality of Ate

Houses built on mountain slopes

After 2000, Huaycán's growth took place on mountain slopes greater than 20 degrees (slope 35% - 47%). When building on mountain slopes greater than 25 degrees (slope above 47%), urban development is not desirable. Nevertheless, houses are built in that risk zone, but on a small scale. Steep terraces have to be built, which is very tough for self-builders.

It would be better to build stacked social housing in the formalized districts as an alternative to the dangerous construction on mountain slopes. This is also more socially justified than the difficult and sometimes dangerous and remote housing in the higher zones. The Ate municipality is obviously aware of the dangers of housing construction on mountain slopes, as are other government agencies. SIGRID is the disaster risk management information system. A seismic-geotechnical zoning map showing the dynamic behavior of the soil shows for Huaycán that there are many hazards, such as rocks and stones

coming down. The Ate municipality is already building retaining walls and stairs to connect the high-lying areas with the lower-lying neighborhoods. According to the earthquake hazard map for Metropolitan Lima and Callao, Huaycán is classified as 'medium' to 'high' risk, especially on the mountain slopes.

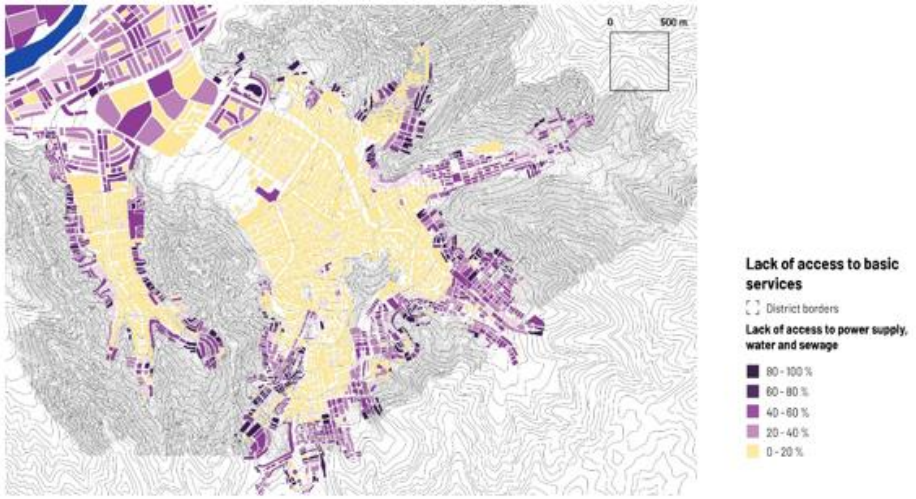
Architecture

Architectural quality in Huaycán varies widely. In many cases, the quality is low due to the temporary state of the facades, which may change in the future through individual housing improvements. The houses on the mountain slopes are often starter homes that are mostly made of wood. In many cases, the houses are built with terracotta bricks and the roofs with corrugated iron sheets. Usually, the intention is to plaster the facades, which are then painted, but these intentions are often not carried out or only very late.

Left: Dwelling in bricks. Right: Houses made of wood on mountain slopes

Source: municipality of Ate

Map of Huaycán with city outskirts



Source: Pablo Muñoz Unceta

The map of Huaycán shows access to electricity, water and sewerage according to the 2007 population and housing census, see the color yellow. In that year, the purple areas (note the different shades of purple) had backlogs of the mentioned infrastructures. The transition or fault line where slopes become steeper than the 20 degrees is between the yellow and purple blocks. Ate municipality is investing heavily in the installation of stairs to connect the high residential areas with the lower ones. A staircase should also serve as an escape route in case of a natural disaster. In doing so, Lima and the district municipalities have actually opted to legalize these informal residential areas on the mountain slopes in the long run.

Steps on the slopes in Huaycán

Source: municipality of Ate

In the development of Huaycán, much attention was paid to economic activities. One example is Industrial Park No. 1, where there are many smaller and medium-sized enterprises producing, for example, furniture, metal products and clothes. Due to the general lack of land for development in Huaycán, industrial areas can hardly expand, which is disadvantageous to entrepreneurs and employment.

▪ Nuevo Pachacútec, Ventanilla, Lima North

Ciudad Pachacútec is part of Lima's northern development axis along the Pacific. The area belongs to the municipality of Ventanilla and the province of Callao. Back in the 1960s, Ventanilla was designated as a satellite town of Lima and Callao, about 20 km north of the capital. From 1988, the first residents settled in this remote desert area north of Ventanilla that was designated as the 'Pachacútec Special Urban Project'. Implementation of the first phase was slow. At one point, half of the plots had been officially sold to families and the other half occupied illegally. Throughout Pachacútec, residents in their self-built homes are vulnerable given the risks of earthquakes.

Pachacútec as a whole

Nuevo (new) Pachacútec is an extension of Ciudad Pachacútec and was developed from the year 2000 by the Lima and Callao governments, initially to solve problems with a group of migrant families in VES. There, families had occupied land designated for agricultural use. The national government decided in 2000 to relocate more than 7,000 families from VES to Pachacútec, a distance of 50 kilometers. This led to the substantial expansion of Pachacútec north-westwards in 2001 and 2002, which was called the 'New Pachacútec Pilot Project' (PPNP). The government also launched the 'National Family and Community Health Training Program' (PROFAM) which enabled funding and implementation. Other government agencies were also involved including COFOPRI, which issued title deeds of plots. In 2004, the Ventanilla municipality became involved in the management of Ciudad Pachacútec, including the PPNP.

Ventanilla with Ciudad Pachacútec

Source: municipality of Ventanilla

Planning area New Pachacútec

Source: Gov. Callao

New Pachacútec was designed as a sites-and-services project, with minimal infrastructure and basic amenities. First, 10,000 plots were realized for housing self-construction. Then the houses were built with wood and thatched mats. These shelters were very basic. In 2002, basic amenities were limited; for instance, drinking water was supplied by tankers. Later, drinking water systems were installed with storage tanks on the hills, networks of pipes and collective water taps in the residential streets. Initially, there was no sewerage and residents had to dig a latrine on their own plots. Access roads were not paved and residential streets not covered. Electricity supply had just started. In 2020, there are still many low-quality houses and public safety is limited. New Pachacútec is divided into five sectors (A, B, C, D and E), each with an elected council. The sectors consist of neighborhood units with about 300 houses, each with its own board. Shops and amenities are concentrated in a few neighborhood centers.

Pachacútec was further expanded in 2006/2007 with an adjacent area known as 'El Mirador'. Some 1,500 plots of modest starter homes were sold to families here.

Residential solution in 2004. *Sub-center in 2022.*

Source: Sánchez Hurtado

The MiVivienda fund made it possible for low-income groups to get loans or a mortgage. These options were also available to families in the El Mirador sub-center. The price of a starter home (core house) in El Mirador at that time was US$4000 (2009 to 2011). Some households could get loans for building materials from the building materials bank 'BANMAT'. Since 2002, the poorest families could access housing finance through the 'Casa Bonita' programs for home improvement and 'Mi Casita' for housing construction on their own plots. Allocation of plots with starter homes to households was done by banks. Some neighborhoods were organized as housing cooperatives.

The growth of New Pachacútec

The development of New Pachacútec boomed. In the early stages, the area's sand dunes were still clearly visible. Now New Pachacútec is almost completely built-up. The main roads are mostly paved and connections to the older parts of Pachacútec and Ventanilla are good. Southbound road connections towards Lima are crucial in case groups of residents need to be evacuated. This area has hills with slight to steep slopes, which requires good planning and research into soil stability. The landscape shows houses in the sandy and gently sloping landscape. In most houses, wooden facades were replaced by masonry walls. Retaining walls are being built on the slopes, which was also done earlier in El Mirador. The Callao regional government thinks it is time for Pachacútec as a whole to become a separate district municipality and wants to separate it administratively from Ventanilla.

Housing development in the sand (2022)

Source: Marilu Sánchez Hurtado

The Pachacútec area has security risks. Theft is common in everyday life. Other forms of crime include drug trafficking, violent robberies, youth gangs and the illegal buying and selling of plots. Residents' sense of security is low and every family tries to secure their own homes. Although the police

patrol the main routes twice a day, residents still have little confidence in them, which has led to residents sometimes arming themselves and forming surveillance groups. Insecurity is mainly a problem on the edges of New Pachacútec. Accessibility by public transport there is low, especially at night. Another aspect of insecurity is that New Pachacútec is in an area of high seismic risk. Traditional masonry is still common, as a replacement for the thatched mats of the early phase. However, traditional masonry is not always earthquake resistant.

In 2015, 200,000 people were already living in the whole of Pachacútec, made possible in part by the construction of roads, public lighting, retaining walls, drinking water supply, sewerage, schools, health posts, sports and recreational parks and internal connections.

Pachacútec's economic development began with small-scale trade, mainly through shops and workshops. Now some neighborhood centers are present, with shops and services. In 2015, Pachacútec experienced economic development, thanks in part to the coordination of cluster and neighborhood leaders with the local government. NGOs World Vision, Coprodeli, Plan Internacional, Unicef, Alternativa, Estrategia and others were active there, working with the Ventanilla municipality. In 2017, drinking water and sewage systems were commissioned throughout Pachacútec, which was reported by the Ministry of Housing, Construction and Sanitation. To improve the drinking water and sewerage system, a water treatment plant was prepared for the third phase of Pachacútec.

Many houses have only one floor; occasionally there are also finished houses with a second floor. A considerable vertical growth of Pachacútec is therefore possible in the future. The construction materials used for the walls and partitions were mainly temporary. Materials made of wood were reused at a later stage. Building materials such as bricks, concrete blocks and reinforced concrete structures are now widely used. Facades are often plastered and painted. In the original construction, corrugated sheets ('zinc') are almost always used for the roof. The quality of architecture is variable, but generally low.

Earthquake-proof construction in Pachacútec

The risks of earthquakes and tsunamis in the municipality of Ventanilla - including Ciudad Pachacútec - are marked on maps; the western part of Pachacútec is marked as 'high risk', while the eastern part is marked as 'medium risk'. However, all of Pachacútec is vulnerable in the event of a high magnitude earthquake. The El Mirador area has steep slopes, sometimes of 20 per cent. Retaining walls were built in the area.

Overview of El Mirador with core houses (2010)

Source: Wybren Klaver

In the sandy residential areas, seismic waves can be amplified in the event of an earthquake. The subsoil is classified as sand to mud sand, which can be up to several meters deep. The compactness of this material that is superficially loose increases with depth, according to CENEPRED, the national center for natural disaster risk assessment. Attention should be paid to proper reinforced concrete foundations

and structures. Building safe houses requires technical assistance, which, however, is not always structurally available to self-builders.

In recent decades, there have been no devastating earthquakes along the Lima coast. To keep the population alert, a new approach is needed to bring construction knowledge to residents, including through communication and knowledge transfer. Evacuation routes and plans have already been implemented. The map of critical areas shows 'high risk' indication, while some parts are nemed 'very high risk'. The latter is the case in large parts of Ciudad Pachacútec.

The NGO Estrategia has experience in providing technical assistance to women's groups in Pachacútec working together to produce sustainable building materials and build their own homes. Estrategia has contributed to the improvement of the human settlement 'A.H. Los Olivos de la Paz' in Pachacútec Sector E, and in the settlement 'A.H. Costa Azul'. The first pilot program involved the construction of 10 houses of 40 m2 and a communal dining area. About 160 people were trained. Two groups of 40 people were trained intensively for 15 days. Later, groups of 60 people were trained. The housing units were built to show the population that they could build 'dignified houses' that could later be extended with an extra floor. A second housing project was started with 15 houses in Costa Azul. These were built with concrete blocks produced by residents who had first been trained.

Basic houses under construction in New Pachacútec

Source: Marilu Sánchez Hurtado

Epilogue

Villa el Salvador is a sizeable suburb of the Lima metropolis that was largely realized through individual self-construction. There are growth opportunities for businesses but limited opportunities for housing. Many individual houses can still be expanded vertically. Planned densification should be a priority, but this is still in the study phase.

The Huaycán suburb was also created by individual self-construction. Huaycán has about 160,000 inhabitants, while an unknown number of people live on the mountain slopes. Huaycán is on the road to consolidation, but this is not the case in the informal housing on the mountain slopes. The Ate municipal government did start integrating informal parts with existing residential areas.

Ciudad Pachacútec is a large satellite city in northern offshoot of Lima that was slowly developed from 1988. This suburb was also built by the residents themselves. Residents' groups became involved in housing programs run by the NGO 'Estrategia' and contributed to improving housing quality. This led to the establishment of family-run businesses engaged in the production of hollow concrete blocks and the sale of building materials, among others. These activities help in earthquake-proofing the houses. New Pachacútec is Lima's last new suburb with official self-build plots.

Earthquake-resistant construction is needed in practically all of Lima and therefore also in the three suburbs mentioned above. With the three urban extensions and many others, Lima has reached its physical limits. Further growth seems possible only if densification processes in the residential areas would de initiated. Most housing can be expanded in height, which so far only happens on individual

plots. The low housing densities in Lima's suburbs are partly due to the relatively low "1 family 1 plot system".

The three suburbs described are all planned residential areas that came about through self-build. The government provided land use planning and infrastructure, but later such tasks were taken over by municipal authorities. The authorities were often faced with invasions of poor people in peripheral areas or near city edges. Current policy goals include: improving socio-economic conditions and the quality of amenities, as well as integrating informal neighborhoods into a larger urban whole.

Justification

The author was in Peru several times between 2002 and 2012 for research conducted in collaboration with Liliana Miranda of Foro Ciudades para la Vida, Lima, and representatives of municipalities and NGOs. Interviews with the director Gustavo Ríofrio and sociologist Mario Zolessi of the NGO DESCO, as well as with the architect Jorge Burga Bartra, were very inspiring. During the same period, the author was in Peru several times as a consultant for the municipality of Piura in northern Peru, and in the municipality of San Borja, Lima, for PUM Dutch senior experts. The author further worked with researcher Ana-Maria Fernández-Maldonado, and architect Pablo Muñoz Unceta, both from TU Delft, and Wybren Klaver (New Pachacútec), then a student at Utrecht University. In 2021 and 2022, the author worked intensively with Luz Maria Sanchez Hurtado, architect-director of the NGO Estrategia in Lima on earthquake-resistant construction in Lima and its surroundings, and more specifically in the suburb of Pachacútec.

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