

# Bottom of the Pyramid Urban Logistics: Case Study of Goods Distribution in Slums

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## Abstract

In Latin America and the Caribbean region, 21% of urban population lives in slums. The access of goods and service are commonly hindered by the topography, lack of transportation infrastructure and safety. This paper evaluates the goods distribution in the slum Comuna 13, in Colombia, considering the dimensions of the analysis that interfere in the buying pattern: geography, resistance, adjacency, neighborhood, isolation, topography and individual. Interviews and field observation were conducted and spatial analysis confirmed that mobility is a huge problem faced by the slum population and affects the potential of delivering products, several types of products are not found in these areas and the prices are not competitive but also there is a relevant level of resilience and a strong sense of community by the slum residents where it was identified low level of complaints regarding goods distribution and a high level of sales between close neighborhoods and acquaintances.

*Keywords: Slum, goods distribution, spatial analysis, Comuna 13, consumer buying behavior*

## 1. Introduction

Currently, one in eight people across the world live in slums and projections indicate that by 2050, the population will reach 3 billion people. In Latin America and the Caribbean region, 105 million urban residents were living in these poor informal settlements in 2014, representing 21% of urban population (UN-HABITAT, 2016).

As a consequence, the volume and frequency of cargo to the slums raise, although there are many factors that hinder the goods delivery, such as: (i) lack of proper road infrastructure due to ladders, narrow or dead end streets that make it impossible to circulate cargo vehicles and, in some cases, any type of motorized vehicle; (ii) inadequate topography, since slums usually are settled in regions of rugged topography and hills; and (iii) physical security, where high rates of robbery and violence discourage companies from attending to these areas. In addition, slum consumers still face social and economic discrimination, reducing the supply of products to these areas.

This paper aims to present a case study considering the dimensions that interfere in the consumer buying behavior of slums residents and consequently, the goods distribution.

The methodology used was the study of a case using the seven dimensions of the analysis proposed by Bell (2016): geography, resistance, adjacency, neighborhood, isolation, topography and individual. The selected case was in Colombia (Comuna 13), where was applied interviews, field observations and spatial analysis.

As a result of this study, the challenges of supplying goods to unplanned areas are confirmed and data from the case study might help to develop solutions and studies to improve the flow of goods in slums.

## 2. Literature review

According to (Pratt, 2018), the peculiarities of each city where the logistics is inserted and the characteristics of the urban goods distribution vary according to interaction factors, degree of development, typology and social aspects.

At the context related to slums, the difficulties faced in these regions are reflected at the price paid by suppliers to delivery their products, which, in Brazil, is between 20 and 50% higher than any other region of the city (Duarte et al., 2019).

Few studies regarding goods distribution inside the slums were published (Hirakawa et al., 2018), showing opportunities to deepen research in this theme. The discussion of urban distribution in slums by Da Silva Costa (2015) and Koch&Nassi (2019) emphasizes that no universal solutions should be taken for problems related to precarious areas due to the economic and social differences of the inhabitants and the spatial differences of these regions, reinforcing the importance of researching their particularities.

Also, it is important to understand the context in which these different practices emerged, which according to Lima Jr. (2011) and Kahle et al. (2013) it emerges in different businesses to meet the needs of low-income consumers or Bottom of the Pyramid (BOP), usually representing a significant consumer market, through simple, cheap and efficient alternatives and technologies. According to Prahalad&Lieberthal (1999), effective strategies for BOP only can be built from the bottom up with the engagement of people at the local level.

### 3. Methods and procedures

The methodology consists of applying interviews, field observation and spatial analysis of Comuna 13, considering seven dimensions of the analysis that influence the consumption behavior, and consequently, the goods distribution.

#### Dimensions of the Analysis

Slum consumers are the focus of this investigation and the dimensions of the analysis were based on Bell (2016), who discusses how the place where the individual resides, interferes in their consumption behavior, considering the world demand for services and products on the Internet. The seven points discussed by the author were adapted to our investigation which focus on goods distribution (Table 1).

Table 1: Dimensions of the Analysis applied to Goods Distribution in Slums

Dimension	Concept presented by Bell (2016)	Adaptation for Goods Distribution	Issues addressed in this study
Geography	Influence of the region on consumers	Influence of the region on consumers, mobility of people and goods, and information technology	Consumer behavior, technologies used to facilitate deliveries, problems faced for receiving goods and frequency of online shop
Resistance	Frictions that oppose the flow, which might be "search" frictions or "location" frictions. Also, commercial operations of physical products are limited by the distance between the actors involved, especially when the products are difficult to transport	Inclusion of topography (steeply sloping ground, ladders, ramps, dead-end streets, and alleys), lack of formal household address, and precarious security	Preferences, which consequently affect the way of transporting the acquired goods, delivery options offered by stores and the transport mode used when there is no delivery offered by the stores
Adjacency	Adjacency stimulates social interactions, creating behavioral patterns between individuals	Consumer habits influenced by access of goods and social interactions	Types of products offered in and around the slums and the dependence of informal trade
Neighborhood	Concept of neighborhood goes beyond physical proximity, it involves social proximity between individuals, resulting in demand by similarity	Same concept	Impact of neighborhoods' influence on consumption behavior
Isolation	Geographic isolation and isolation by preferences (related to small niche markets which usually have specific products hard to find)	Same concept	Actions when products are not found in the slums, road infrastructure to transport products to homes
Topography	How the topography influences the consumption behaviour	Same concept	Types of obstacles for the cargo transportation
Individual	Right of accessing goods and services	Same concept	The meaning of urban logistics and suggestions for improvement of the goods distribution

## Research Protocol

In Comuna 13, which had the infrastructure to carry out visitation and interviews with residents and local traders, 68 presentational interviews were carried out and complemented by field observation, between July 9<sup>th</sup> and 18<sup>th</sup>, 2018.

The questions were formulated according to the dimensions presented at Table 1 with the aim to understand: (i) the influence of the region in the consumption behavior and goods distribution; (ii) the frictions and challenges that oppose the goods movement; (iii) how social and economic interactions among residents work; (iv) what are the demands for similarities or similarities generated by the physical proximity of the residents; (v) what types of isolation interfere with or hamper the goods distribution; (vi) the relationship between topography and the goods distribution; and (vii) residents as agents of the distribution chains.

### Spatial Analysis

For Hillier&Hanson (1984), the relation between society and space goes beyond occupying regions of the terrestrial surface. Spaces create shape according to the way people, buildings, roads and zones move and connect, in this way, through the spatial order it is possible to recognize the social and cultural differences of societies.

Thus, spatial analyses were conducted with the objective of studying the road connectivity and level of integration of the slum street network.

Based on orthoimages, which are high resolution aerial images that represent the area in a single scale and display the objects in their real geolocation, it is possible to extract information such as distance, areas and positioning of elements (Habib et al., 2013) with high precision level. Using orthoimages of Comuna 13 and a Geographic Information System (GIS), the ArcGIS, it was possible to produce maps of the formal and informal roads of the slum. Also, a complementary spatial analysis was carried out with DepthMap software to identify the integration and local connectivity of the road network.

## 4. Results and Discussion

Considering the seven dimensions of the analysis and based on the data collected from the Comuna 13, the issues and characteristics that affect the distribution of goods are presented in Table 2.

Table 2: Issues and characteristics that affect the distribution of goods in Comuna 13

Dimension	Issues / characteristics of Communa 13
Geography	<ul style="list-style-type: none"><li>• Buyer prefer to pay on cash</li><li>• 16% had done online shopping at least once</li><li>• Most of respondent do not mention order delivery problems</li></ul>
Resistance	<ul style="list-style-type: none"><li>• Most of stores far from the slum offer delivery by motorcycle</li><li>• When there is no delivery service, usually the transport of the purchase is made on foot</li></ul>
Adjacency	<ul style="list-style-type: none"><li>• Most of purchases inside the slum are related to home meals</li><li>• Clothes, electronic devices, and household equipments are not found inside the slum</li><li>• 37% of respondents buy from informal sellers</li></ul>
Neighborhood	<ul style="list-style-type: none"><li>• 38% of respondents mentioned that ask for products recommendation to their neighbors</li></ul>
Isolation	<ul style="list-style-type: none"><li>• Some types of products are found only outside the slum</li><li>• Better prices are found far from the slum</li><li>• Conditions of the roads and identification of the houses are adequate only in the main corridors</li></ul>
Topography	<ul style="list-style-type: none"><li>• 59% of roads have ladders and 21% have ramps, and 63% have access only by motorcycle or bicycle</li></ul>
Individual	<ul style="list-style-type: none"><li>• Suggestion to improve the deliveries are to expand the access roads, to enhance the security to deliverymen, the delivery punctuality, and the identification of roads houses</li></ul>

The spatial analysis confirms the low level of road connectivity and demonstrate the mobility restriction, especially in the edges of the slum.

Figure 1 shows the orthoimage with the roads represented by lines in Comuna 13, where the red lines indicate the informal roads and the yellow lines the formal ones.

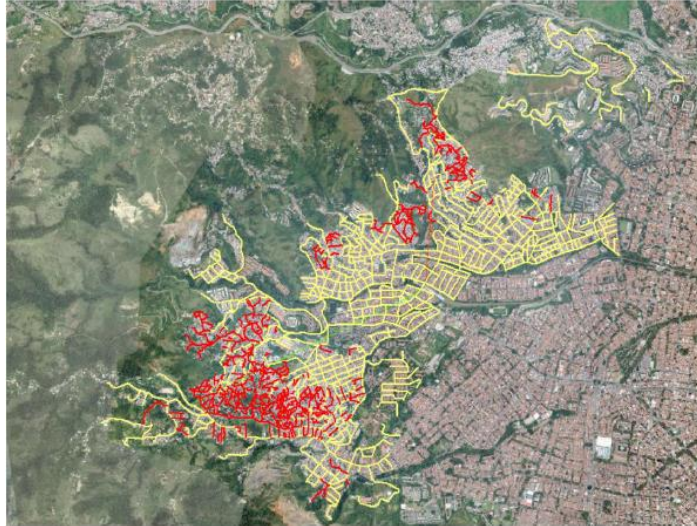


Figure 1: Orthoimage of Comuna 13 with informal and formal roads. Source: image generated in ArcGIS software by authors

For this study, levels of integration and distribution of roads, considering an integration index, were established. In a representation of integration, the red color represents the most integrated roads and at a downward rate, the orange, green, light blue and dark blue color variations, the less integrated roads. Integration index can be understood as the potential of going to a point, which refers to the easiness of going from one point to another of a specific region (Hillier, 2008).

Figure 2 illustrates the road integration index at Comuna 13, where it is possible to observe that the central and tourist area is classified as better integrated (red lines), where most of the local trades and tourist attractions are concentrated.

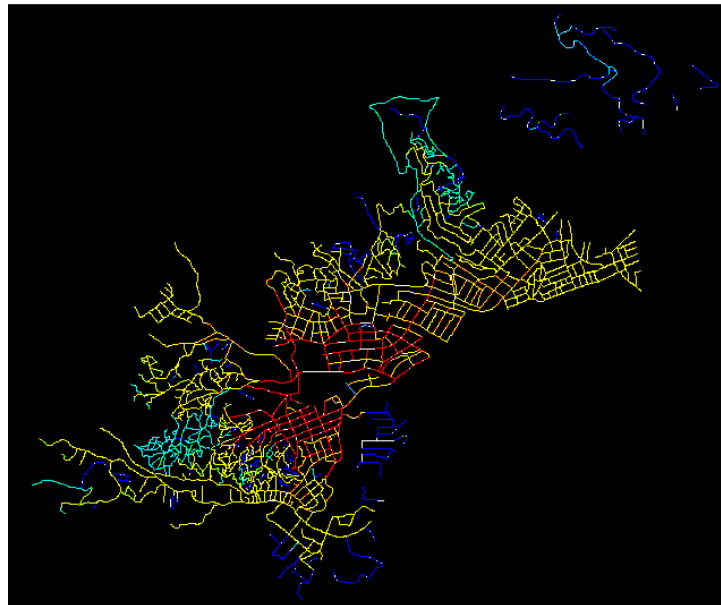


Figure 2: Road integration at Comuna 13. Source: image generated in DepthMap software by authors

Considering the interviews and field observation, there are opportunities to improve the goods distribution in Comuna 13 that might reduce the cost of distribution and leverage the access of products. The presented dimension of analysis (Table 2) might contribute to understand the local needs and lead to solutions that better meet the demand.

## 5. Conclusions and future research

The Geography, Adjacency, Isolation and Topography dimensions confirmed that road access is a huge problem faced by the slum population and also affects the potential of delivering products, where only 18% of interviews mentioned that there are no access limitations. Not all type of products is found inside

the slums, products' price is not competitive and the easy mobility from one point to another is restricted to specific parts of the slum, as demonstrated by the spatial analysis.

The Resistance and Individual dimensions demonstrated the relevant level of resilience, once most of interviewees does not complain about the delivery service, even though not all suppliers offer delivery service and during the field observation, several situations of people carrying large parcels on foot were registered.

The analysis of the neighborhood dimension showed a relevant level of neighbors' influence on purchasing recommendations.

Considering the spatial analysis, it was possible to conclude that Comuna 13 has better infrastructure in the central region of the slum, and concentration of informal roads in the borders (red lines in Figure 1) as well as the level of road integration (Figure 2).

It is recommended to consider the results of the dimensions of the analysis in order to develop and implement bottom up innovative solutions, with the participation of the local population and considering the restrictions and particularities of the region. Also, solutions that already are implemented in the slum might represent opportunities to replicate in other areas, as the use of funicular to transport cargo and the delivery service provided by motorcycle drivers.

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