EVALUATION OF SOCIAL COST OF LOW-INCOME HOUSING
AVALIAÇÃO DO CUSTO SOCIAL DA HABITAÇÃO DE BAIXA RENDA

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ABSTRACT

Brazilian Social Housing (SH) programmes have a positive effect on reducing habitational deficits, however, often fail to mitigate social segregation. In addition, SHs present a minimal, or inadequate comfort, and environment quality with adverse consequences on the quality of life and well-being of users. The negative impacts of housing conditions and the built environment may imply in Social Costs (SCs) incurred on society. There is a gap related to SCs associated with Brazilian SH, and how to estimate these. Our research aims to evaluate potential SCs related to SH. The study was developed in 3 stages: evaluation of SCs components, estimation of a SC model, and identification of SCs in a specific SH example. Visual observations, questionnaires, photos, mapping, and documents to analyse SCs were applied in a specific case study. Furthermore, our research highlights a participatory process, placing the residents as protagonists to define their housing. Understanding how social issues are associated with housing conditions and their surroundings and creating mechanisms to reduce SCs may enable the development and implementation of new housing design solutions. Also, fundamental are future scenarios where sustainability, quality of life, and well-being guide the production of housing and the resulting built environment.

Keywords: Built Environment; Environmental quality; Social Cost; Impacts; Social Housing.

RESUMO

Os programas de Habitação de Interesse Social (HIS) no Brasil têm um efeito positivo na redução do déficit habitacional, porém muitas vezes falham na mitigação da segregação social. Além disso, as HIS apresentam conforto e qualidade ambiental mínimos, ou inadequados, com consequências adversas na qualidade de vida e bem-estar dos usuários. Os impactos negativos das condições habitacionais e do ambiente construído podem implicar em Custos Sociais (CSs) incorridos na sociedade. Existe uma lacuna relacionada aos CSs associados à HIS brasileira, e em como calculá-los. Nossa pesquisa visa avaliar CSs relacionados com a HIS. O estudo foi desenvolvido em 3 etapas: avaliação dos componentes de CSs, estimativa de um modelo de CS, e identificação de CSs em um estudo de caso específico de HIS. Técnicas como observação visual, questionários, fotos, mapeamento e documentos foram aplicadas para analisar os CSs. Além disso, nossa pesquisa destaca um processo participativo, colocando os residentes como protagonistas para definir sua moradia. Compreender como as questões sociais estão associadas às condições habitacionais e seu entorno, e criar mecanismos para reduzir CSs, pode permitir o desenvolvimento e a implementação de novas soluções de projeto habitacional. É fundamental a consideração de cenários futuros onde sustentabilidade, qualidade de vida e bem-estar orientam a produção de moradias e o ambiente construído resultante.

Palavras-chave: Ambiente construído; Qualidade ambiental; Custo social; Impactos; Habitação Social.

1. INTRODUCTION

Worldwide, mass housing production has provided affordable housing for people through speedy production processes. In several countries, this type of production is developed by Social Housing (SH) programmes. Such programmes are important to provide adequate housing to low-income populations, especially those living in risk areas, as they may reduce a country's housing deficit and the vulnerability of people. However, in many countries these programmes produce only minimal standard housing and often create spatial exclusion which reinforces economic and social segregation between SH residents and the rest of society (DJAFRI et al., 2020; KOWALTOWSKI et al., 2019). SH productions also often fail in providing environmental comfort and neighbourhood quality, which may affect the quality of life and well-being of residents (MUIANGA et al., 2021). The negative impacts of housing conditions and surroundings, on the short and long-run may imply in Social Costs (SCs) incurred on society, either directly, as indirectly (MATTHEWS; ALLOUCHE; STERLING, 2015; PEVALIN et al., 2017; AGARWAL; BRYDGES, 2018).

According to Kapp (1970), the costs shifted to society in an attempt by businesses to increase profits may be called SCs. Such costs may reflect the overall impacts of economic activities on society's welfare (FIELD, 1997; BAKER et al., 2013). In relation to the built environment, SCs may be linked to the economic losses due to annoyances of living in a specific place, or because of inadequate housing conditions (GILCHRIST; ALLOUCHE, 2005 ÇELIK; KAMALI; ARAYICI, 2017). Location and urban, as well as building design, and construction elements affect dwellers' well-being as indicators of their quality of life, not only on an individual level, but regarding societal issues and social progress (SWOPE; HERNÁNDEZ, 2019; FIELD, 1997; McKIM, 1997).

Concerning housing, specific reflections of SCs are yet few, but necessary (MUIANGA; KOWALTOWSKI; CASTRO, 2022). SCs take many forms, including loss of revenue, productivity and time, and consumption of non-renewable resources. SCs may be incurred through health problems caused by inadequate comfort and dysfunctional, and insalubrious conditions (MUIANGA et al., 2021). Fuel poverty, social exclusion, family conflict, and urban violence also create SCs (WATSON et al., 2016). Those costs are mostly studied through Post Occupancy Evaluations (POEs) of buildings, however often without adequate means to measure these and to find ways to remediate them (HUANG; DU, 2015; ONO et al., 2018). This complexity is attributed to the difficulty associated with quantifying SCs using standard estimating methods and the fact that these costs are borne by the community rather than contractual parties, as for instance found in construction projects (GILCHRIST; ALLOUCHE, 2005; ÇELIK; ARAYICI; BUDAYAN, 2019).

Studies on SCs of SH gauge the impacts of urban, neighbourhood and individual home conditions. There is a gap in SH research in relation to SCs (MUIANGA et al., 2021). The identification of SC causes should contribute to improving SH programmes (MUIANGA et al., 2022; MUIANGA; KOWALTOWSKI, 2022). This research is concentrated on Brazilian SH, structured by two questions: what are the main and recurrent social impacts associated with Brazilian SH? What are the main SCs for a specific SH example in Brazil?

2. OBJECTIVE

Our main objective is to develop a new approach to assess SH in terms of SCs, as well as contribute with knowledge on SH impacts, and present information to guide SCs mitigation. Thus, we considered previous literature reviews on impacts of SH in Brazil; evaluations of potential SCs; and analysis of SC in a specific SH case. The study builds an understanding of how social issues are associated with housing conditions and their surroundings and guide the analysis of SCs associated with SH for the development of future upgrading.

3. METHOD

The study was developed through 3 stages as strategies to analyse SCs for SH. In stage 1, the potential SCs were identified through a previous literature review analysis on four scales of the built environment. In stage 2, the study evaluated SCs components using information of stage 1, through brainstorming, and a SC estimation model was developed, consequently. In stage 3, strategies such as: visual observations, questionnaires, photos, mapping, and documents, were applied to analyse SCs in a case study.

3.1. IDENTIFICATION OF POTENTIAL SOCIAL COSTS

A previous study (MUIANGA et al., 2021) was developed through a systematic literature review. This study identified research on SH impacts to understand the concepts involved in SC. Quality of life and its components of social, health, economic and environmental conditions were analysed. The second study evaluated SCs in Brazilian SH with the need for transformations of units and surroundings during the Covid-19 pandemic (KOWALTOWSKI et al., 2021; MUIANGA et al., 2022; MUIANGA; KOWALTOWSKI; CASTRO, 2022). Another study categorised issues related to SH studies in general, and identified and assessed SH shortcomings, primarily in Brazil (MUIANGA; KOWALTOWSKI, 2022). Through a synthesis of these studies drivers for SCs were identified and assessed on four scales of built environment: "Social cost per Housing Unit"; "Social cost in Housing"; "Social cost on the Neighbourhood scale"; and "Social cost on the Urban scale".

3.2. IDENTIFICATION OF SC COMPONENTS VIA BRAINSTORMING - SC ESTIMATION MODEL

The residential unit, the building and immediate surroundings or neighbourhood and urban design conditions relate to SCs. Based on literature evidence, the association of SCs factors, consequences and impacts were identified. The evaluation of a variety of determinants, including physical and psychological well-being and feeling of belonging (related to the connections of people with the physical environment of units, workplace, neighbourhood, school and community) were determined with the participation of (uVital project)[1] researchers, through a brainstorming process. Factors for each dimension of the built environment were structured to compose the necessity (component) to overcome them. Figure 1 presents occurrences or events, followed by impacts, and cost components.

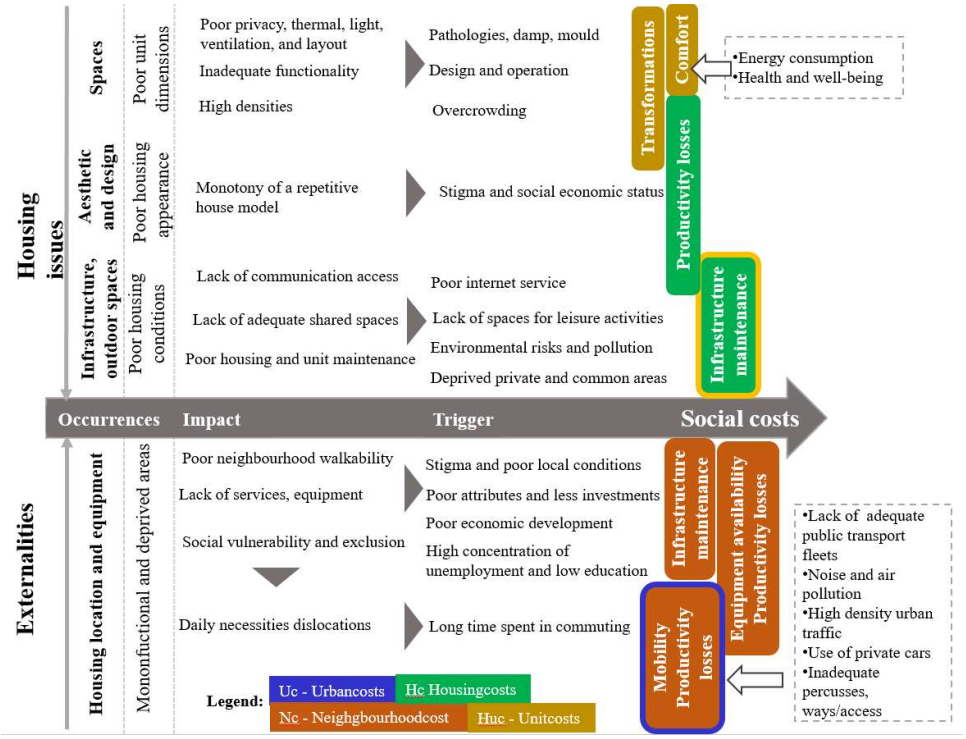

Figure 1: SCs events. Source: The authors

The quantification of SCs needs a set of procedures to assess the cost of adverse impacts of a built environment. Three preliminary studies define the SC equation. Gilchrist; Allouche (2005) and Matthews, Allouche, & Sterling (2015) considers that communities close to an operating construction site often find themselves subjected to negative impacts such as annoyances and economic losses. Construction costs include direct and indirect costs, while SCs are the costs of impacts related to construction projects in urban environments, such as: traffic, delays, safety, economic activities, pollution, and ecological/ social/health. Çelik; Kamali; Arayici (2017) analysed Sc associated with construction projects that generate serious adverse environmental impacts on the adjacent residents. SCs were evaluated through social impacts which affect residents of a place, in terms of neighbourhood, households, and house impacts, considering the sub-

[1] uVital - User-Valued Innovations for Social Housing Upgrading through Trans-Atlantic Living Labs

components.

For this research, SCs associated to housing and its surroundings are considered through:

$$\mathbf{Social_{Costs} = Urban_{costs} + Neighgbourhood_{costs} + Housing_{costs} + Unit_{costs}}$$

$$\mathbf{SCs = U_C + N_C + H_C + HU_C}$$

Equation 1

WHERE:
SCs (Social cost related to a specific local);
U_C (Social cost at Urban scale);
N_C (Social cost at Neighbourhood scale);
H_C (Social cost at Housing scale);
HU_C (Social cost at Housing Unit scale).

Estimating SCs requires the identification of impacts of a specific built environment and its subcomponents. Variables of components and subcomponents that compose the costs were analysed, Table 1, details events presented in Figure 1.

Table 1: Components, sub-components, and variables

Components	Sub-components	Variables		
U_C; N_C	Mobility (Transport)	Pollution: emission and noise	Accident risks	Private and public transport
U_C; N_C	Productivity loss	Dislocations		
N_C	Neighbourhood Infrastructure	Pollution	Inadequate conditions	Security and services
N_C	Community facilities	Facilities installation	Daily private and public services	Health and social assistance
N_C	Loss of housing value	Depreciation: Local investments	local economy status	Job and education opportunities
H_C	Housing Infrastructure	Outdoor spaces maintenance	Common areas improvements	Sewage, refuse disposal
H_C	Productivity loss	Communication: access to internet	Housing conditions (layout, spaces)	
H_C	Loss of housing value	Depreciation: stigma and monotony		
HU_C	Housing Infrastructure	Indoor maintenance	Structural elements	Hydro and electrical installation
HU_C	Comfort	Energy consumption	Health and well-being	Environmental
HU_C	Transformation	spaces, finishes, privacy	Preferences	

Source: The Authors

3.3. CASE STUDY

To evaluate SCs in a specific SH case in Brazil, an analysis was conducted in the Residential Quilombo (Figure 2). The Residential Quilombo was developed through the *Programa de Aceleração do Crescimento* (PAC), located at *Rua Estrada Municipal José Sedano*, 1550 - *Vila San Martin, CEP* 13069-387, in the northern region of the city of Campinas, known as *Região dos Amarais*. Ninety-six (96) families from risk areas were moved to the Residential Quilombo in 2013. The income level of the families living in Quilombo are within the SH programme Faixa 1 (income up to R$1,800.00, which USD 345,91, values converted on 03-03-2023 (1 Real/BRL=0,192171USD).

2013, Source: Cohab-Campinas

2022, Source: The Authors

2022, Source: Google maps

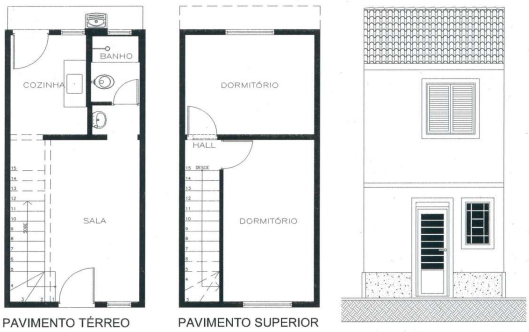

Figure 2: Images of Quilombo post-occupancy (2013-2022), Source: Cohab-Campinas

The design typology consists of 93 (ninety-three) two-storey houses, and 3 (three) one-storey houses for users with mobility problems. The development is divided into two dead-end streets considered condominiums. Each street gained a gate, a fence and a separate children's playground.

4. RESULTS

To conduct the case study at the Residential Quilombo, an interaction with users through questionnaires, workshops, also visual observations, photos, mapping, and documents as well as urban insertion analyses were applied. Also, contacts with the *Secretaria Municipal de Habitação* (SEHAB) and *Companhia de Habitação Popular de Campinas* (COHAB) were established. Each method, tool, and approach has been structured, with specific materials and application protocols that include ethical concerns. This research was carried out with the authorization of *Comitê de Ética em Pesquisa* (CEP) of UNICAMP and Plataforma Brasil, CAAE number: 36778720.0.0000.8142.

A questionnaire was applied with Quilombo residents. Twenty-six families responded. The questionnaire contained 6 topics: local, housing and infrastructure improvements; house transformations; comfort conditions; productivity gains or loss; installation of equipment; and cost of mobility. Detailed information on comfort conditions (thermal, acoustic and lighting), functionality and environmental psychology (privacy, space availability, dimensions, safety, layout, crowding), outdoor, common areas and surrounding, as well as well-being, behaviour, was obtained.

4.1. LOCAL AND HOUSING INFRASTRUCTURE, IMPROVEMENTS AND MAINTENANCE

The historical data of the SH case was obtained from SEHAB and COHAB of Campinas. A documental analysis of recurrent SHs problems in Campinas, including those of Residential Quilombo were developed, and our analysis aimed to respond the questions:

- What were the recurrent problems in common areas and private areas?
- What interventions were developed by residents, SEHAB, or construction companies responsible for the construction? How much did they cost?

From SEHAB's data some improvements developed by PAC projects could be identified as shown in Table 2.

Table 2: Interventions develop through PAC

Improvements		**Description**
Included in PAC-7 (PAC Quilombo - Residential Quilombo 1 e Residential Quilombo 2)	Sanitation	Rainwater network - implementation of guides, gutters, paving and drainage of the bus route
	Road and lighting	Electricity (public and private lighting)

Source: The Authors, based on SEHAB and COHAB data

Residents were asked about daily necessities in the neighbourhood and the housing unit (Table 3). Problems were identified mostly on the neighbourhood scale rather than the housing and private units.

Table 3: Unit and neighbourhood issues - Quilombo

Scale	**Details**	**Necessary (%)**
Unit	Individual activity spaces	23%
	Private social spaces	15%
Neighbourhood	Parks	77%
	Secure sidewalk with signalisation	85%
	Public furniture and corners	100%
	Public illumination	100%
	Maintenance	100%

Source: The Authors

PAC-7 provided interventions surrounding the Quilombo region, in order to improve the quality of life of people allocated there. However, some issues were not solved, such as the lack of secure sidewalks, effective public illumination, public furniture along sidewalks, and maintenance of open public spaces. Investments to improve those spaces are still necessary to reduce impacts on the quality of life of residents of Quilombo and other nearby SH developments. Specific necessities for residential unit spaces were also identified by residents. However, the cost of such infrastructure is variable and depends on previous evaluations of needs.

4.2. LAYOUT FUNCTIONALITY AND PERSONALIZATION: TRANSFORMATIONS

Many house transformations have been implemented in Quilombo. From data, and observational analysis, mapping, photos, and questionnaires, these alterations were identified as shown in Figure 3. From our analysis,

all of the 96 units of *Quilombo* have been transformed to some degree.

Figure 3: Transformations in Quilombo in 2022 (post-occupancy). Source: The authors

After the unit's occupation, SEHAB met with the families of Quilombo and informed them about alteration restrictions, especially in relation to structural issues, since the houses were built with structural concrete blocks. However, transformations were developed by owner families, without technical assistance. According to the data collected, from the questionnaire (Table 4), the most common transformations were in the form of increasing space (kitchen and living room); the construction of one or two more bedrooms and bathrooms, and a balcony; construction of garages and leisure areas; sidewalk alterations; exchange of finishes (painting and tiles); and new openings (door and windows).

Table 4: "Transformation set" costs.

Area	**Type of transformation**	**Details**	**%**
External	Garages	Coverage that usually comes from the added room	92%
	Gates and wall	Front wall and gate construction	85%
	Laundry / services	Covered area with floor	62%
	Tree, plants	On the sidewalk or in the rear outdoor area	38%
	sidewalk	Paving	23%
	Barbecue	Front or back area	23%
Indoor	Finishes	Painting, floor, stairs	85%
	Windows and doors	Changes	85%
	Fixtures	Fixed furniture, faucets, lighting, sockets	85%
	Balcony	Linked to the bedroom	85%
	Add rooms and spaces	2 floor or near the kitchen	54%
	Add bathrooms	Between rooms	31%
Transformation costs			
Costs (thousand of R$)	**Details**		
> 100	Addition of bedroom, bathroom, garages, change of finishes and doors and windows, gate and front wall, steakhouse, laundry, sidewalk		
50-80	Addition of bedroom, bathroom, garages, change of finishes and doors and windows, gate		
30-50	Addition of bedroom, bathroom, garages, gate and front wall		
20-30	Addition of room, garages		
10-20	Finishes and fixtures, doors and windows		

Source: The Authors

Families spent on average of more than 100 thousand *reais* (R$) on invasive interventions and up to 10 thousand R$ on low impact interventions to transform their units and meet specific desires and needs. One of the main reasons concerning dissatisfaction with the houses is related to the size of families, considering that several families have more than 4 members, being a couple with two or more children. Also, cultural issues were pointed out, such as demand for more indoor space all together. In addition, residents showed dissatisfaction with the construction quality of the units, as houses were delivered without any interior finishing. The quality of the windows and doors was also a subject of complaints. Residents had to spend on finishing of their units, including kitchen and bathroom fixtures.

4.3. Perspective of minimal sustainability issues: comfort, energy consumption and sustainability

Quilombo does not have an energy-efficient design project. Thus, evaluating the project through observations,

and according to the questionnaire information, internal lighting is deficient. Lighting conditions were further deteriorated through obstructions due to additions and transformations, mainly in the front of the units, as shown in Figure 4. LED lamps to reduce energy consumption are recommended, since artificial lights need to be constantly on to provide sufficient internal light, for normal domestic activities. The installation of photovoltaic panels and solar water heating systems are also indicated to reduce the consumption of non-renewable natural resources. These, however, are not yet part of the Quilombo design model.

Figure 4: Images of internal spaces using artificial light to improve illumination. Source: The authors

Table 5: Comfort: Questionnaire results regarding ventilation, lighting, thermal and acoustic

Details	**Adequate**
Visual privacy (post wall and gates construction)	77%
External noise– voices, equipment, dislocations	54%
External noise – roads/highways	62%
Thermal comfort – winter and summer	85%
Ventilation	54%
Damp, mould, odours	100%
Natural light	50%
Equipment	**Use**
Use of heaters and air conditioners	10%
Fans	90%

Source: The Authors

Possibilities to improve the lighting conditions and energy efficiency measures were analysed. Additional openings or the inclusion of masonry glass blocks in external walls, installation of photovoltaic panels, LED lamps and solar water heating panels are options. Such new installations can reach a cost of R$ 32 thousand, according to the "composition tables"[2] to reduce energy consumption of each unit over time. However, energy efficiency is not a priority for Quilombo residents, as they obtain social taxes rates for both water consumption and electricity. However, for comfort reasons interventions in SH projects should be considered to improve natural lighting and ventilation conditions to also contribute to sustainability.

4.4. PRODUCTIVITY LOSSES

A resident of Quilombo, located 13.8 km from Campinas centre, spends an average of 48 minutes to 25 minutes for the routes shown in Figure 5, by bus, or by individual car/motorcycle, respectively.

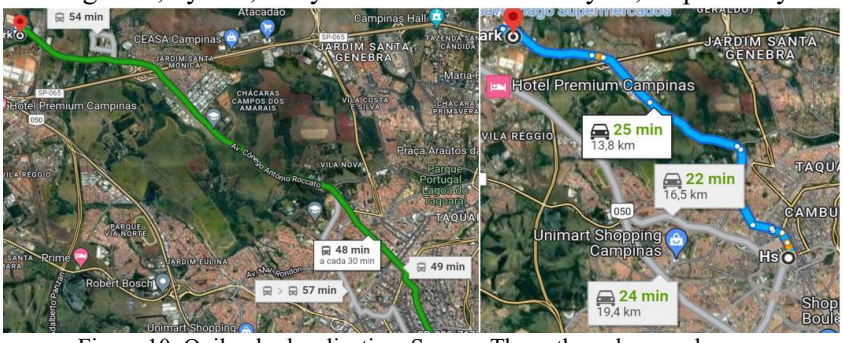

Figure 10: Quilombo localization. Source: The authors, by google maps

[2] https://www.cdhu.sp.gov.br/web/guest/licitacoes/tabelas-de-composicao

To evaluate the cost concerning productivity losses from travel time, parameters were defined. Thus, distances travelled per day and per year, and hours spent per day, and their costs were evaluated in relation to income. Residents travel on average 7,000 km per year commuting, considering 254 working days. Considering incomes of SH residents (R$ 1.800,00) the cost of productivity losses is R$ 4 thousand per year for the bus mode, and 2,8 thousand R$ per year for the motorcycle or car mode.

4.5. ASSESSMENT OF FACILITIES AVAILABILITY FOR DAILY USE

4.5.1. EDUCATIONAL FACILITIES

To analyse costs related to the provision of schools, health clinics and other social services, information about the population of Campinas-SP was collected, based on IBGE data. In addition, a previous[3] evaluation study of Quilombo's urban insertion was carried out to analyse the necessities for social services and facilities for daily, occasional and sporadic use.

In order to analyse daily needs of facilities in Vila San Martin, which involves the Residential Quilombo, and also the Edivaldo Orsi Housing, of CDHU Campinas, an analysis of the number of units in each housing complex was established. The CDHU project comprises 2340 residential units and Quilombo has 96 houses, thus with a total of 2436 UH, and 8282 peoples or users. We worked with CDHU information since it was a new SH project delivered in 2013, as well as Quilombo, in the region, that demanded an analysis of the provision of services.

The demand for early childhood education units in San Martin is based on 244 children. Near Quilombo there is a School called *Professora Amélia Pires Palermo* that supports 326 children, aged from 0 to 5 years and 11 months, thus no further facilities are necessary. The demand for both levels of Public Elementary education is 504 children in the region. San Martin has an elementary school, for early years "*Maria de Lourdes Bordini Professora"* with a capacity for 523 students, with classes from 1st to 5th grade, and another elementary school, for final years "*Telemaco Paioli Melges Doutor"* exists. This school has a capacity for 643 students. Thus, according to the analysis of facilities for daily use relating to elementary education, there is no requirement for new schools.

4.5.2. UBS DEMANDS

The neighbourhood of the *Residencial Quilombo* and the *Edivaldo Orsi Housing* complex, of CDHU Campinas has a health centre called *Doctor Cássio Menezes Raposo do Amaral*, also called UBS 49, belonging to the north zone of the district, attending an area of 10,000 residents. Through interviews, Quilombo residents have fewer needs for hospital use, when asked about respiratory, physical and mental illnesses. Residents gave positive responses, stating not to suffer from related problems.

According to the questionnaire, residents use the UBS for basic health routines. However, some residents reported fear, and chose to isolate themselves due to security problems, thus some psychological support may be needed. Some of the residents' report that they do not feel safe living in the house because of the lack of a controlled entrance. Parents also fear exposing their children to insecurity and limit younger children from using outdoor spaces. On the other hand, residents feel satisfied to live in an organised community, when compared to the risk area where they came from. Evaluating the health state in relation to environmental comfort conditions of a unit is complex, since it requires a longer period of analysis and procedures under controlled research measurements and thus this was not specifically estimated here.

4.6. COST OF TRANSPORT

4.6.1. COMMUTING NEEDS AND GAS EMISSIONS

Quilombos' residents have daily commuting needs to the centre of the city for jobs and to access facilities and services not provided in the neighbourhood. A Quilombo resident would have to travel 13,8 km for each route per day and walks almost 0,5 km to access his or her final destination. According to data from the SIMOB (*Sistema de Informações de Mobilidade Urbana*), in municipalities with more than 1 million inhabitants, gas emissions are generated for motorised travel according Table 6, and thus emissions can be calculated for travels by Quilombo residents.

Table 6: Gas emission

	Grass/inhabitant/day	Local pollutants - per trip (grams)	GEE (CO_{2eq}) / inhabitant/day	GEE (CO_{2eq}) – per trip (grams)
Bus	3.9	5.7	421	618

[3]Study developed by the authors of urban insertion. In the evaluation process by a journal.

Car	1.2	3	714	1426
Motorcycle	0.3		30	

Source: The authors

4.6.2. SECURITY OF ROAD SYSTEMS- ACCIDENTS

In Campinas, accident data is provided by EMDEC. However, there is a lack of public data that detail impacts of accidents, noise, pollution and mobility issues in different modes of transportation for municipalities. Accident, pollution and noise impact costs can be obtained from SIMOB[4] data, updated to the year 2022 as shown in Table 7.

Table 7: Impact costs and Annual individual and public mobility costs per inhabitant, by mode of transport

	> 1 million of population by municipals	
	Impacts cost	Hundreds of R$ habitant/year
TC	TC - Pollution	R$ 4,45
	TC - Accidents	R$ 0,06
	TC - Noise	R$ 0,25
	Subtotal TC	R$ 4,8
TI	TI - Pollution	R$ 0,74
	TI - Accidents	R$ 8,6
	TI - Noise	R$ 0,4
	Subtotal TI	R$ 9,8

Costs per transport modal	**13.8 km/ trip**	**300 days (2 trips)**
	Thousands of R$ per habitant/year	R$ per habitant/day
Individual costs of public transport	R$ 3,1	R$ 10.30
Public cost of public transport	R$ 0,081	R$ 0.27
Total TC	R$ 3,2	R$ 10.57
Individual transportation costs	R$ 3,0	R$ 10,01
Public cost of individual transport	R$ 0,08	R$ 0.28
Total TI	R$ 3,08	R$ 10,29

Legend: Collective Transport (TC), Motorized Individual Transport (TI), Non-Motorized Transport (TNM)

Source: Authors based on SIMOB and EMDEC data

WHERE:

- ticket cost = R$ 5,15, days/year = 300 days (2022);
- Public cost, public cost of collective transport, and public cost of individual transport obtained from SIMOB.

A resident may spend 3 thousand R$ per year for transport. In addition, there is also a public cost in relation to accidents and pollution (air and noise). Providing places with walking accessibility, to give environmental sustainability, and reduce private and public costs in mobility is thus indicated.

4.7. GENERAL SC ANALYSIS

To evaluate which effective upgrading measures could be implemented within the Brazilian SH context, specifically for the Quilombo case, possible SH interventions and SCs associated were assessed. The results of priorities are shown in Table 8. They present the need for both housing transformations, in terms of private spaces and common areas, as well as neighbourhood improvement. In addition, the study conducted in this research with the participation of residents found that families desire better access to service facilities, improved mobility and increased safety. From this, general impacts and costs of living in Residential Quilombo are presented in Table 8. Those costs represent mobility, transformations and comfort improvements.

Table 8: Impacts and costs of living in Residential Quilombo

Issues evaluated	**Costs (per/year)** Thousands of R$	**Costs (per/project)** Thousands of R$
Transformations		R$ 50,00
Comfort		R$ 32,00
Productivity loss	R$ 4,0	
Private transport include impacts	R$ 4,0	
Public transport include impacts	R$ 3,7	
Total	R$ 8 or 7,7	R$ 82,00

Source: The authors

The impacts that may be mitigated through public investments for existing housing relate to improving access (providing more facilities in the neighbourhood) and the built environment of the surroundings to reduce depreciation, and providing access to jobs and local educational facilities, reducing displacement to reach the city centre and job opportunities and the use of motorised vehicles, avoiding productivity losses due to displacements, and increasing neighbourhood investments in general, to improve the quality of life.

[4] http://files.antp.org.br/simob/sistema-de-informacoes-da-mobilidade--simob--2018.pdf

In relation to the residential units, technical follow-ups should be carried out to support desired transformations and improve those already carried out. Environmental comfort and functionality problems may be avoided through better design development, and technical guidance. Introducing financial incentives or projects to improve sustainability is important, as well, for energy efficiency on a longer time horizon.

5. CONCLUSIONS

This research was conducted with information from previous studies developed by the authors. Preliminary studies were essential for knowledge and information analysis data for this research. Literature reviews on SH and SC, on several levels, the analysis of the urban insertion of housing projects, as well as the possibility of actions for housing improvements allowed us to gain broad knowledge on social impacts, and on possible guidelines for their mitigation. Thus, SH conditions impacts and the SCs associated with them were analysed.

Our research highlights the importance to consider SCs in the production of SH projects. Also, participation, placing the resident as the protagonist, in the definition of their housing needs and the type of place where they will live is essential. Identifying possibilities of improving existing housing and applying the information to new projects is fundamental supporting continuous improvements as well. Crucial also is that future scenarios are assessed concerning environmental sustainability, quality of life and well-being of people for the production of low-income housing.

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