Technical Note

DIMENSIONS, COSTS, IMPACTS OF HOUSING INADEQUACIES AND RELATIONS WITH THE SUSTAINABLE DEVELOPMENT GOALS: SUBSIDIES FOR A NATIONAL HOUSING IMPROVEMENT PROGRAM IN BRAZIL

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1 INTRODUCTION

This technical note aims to identify the relationships between housing improvements and the Sustainable Development Goals (SDGs). This exercise allows to identify the link between indicators already used for monitoring and evaluating the SDGs in Brazil, and the actions of what could become a comprehensive and integrated public policy for housing improvements in Brazil.

The link between the impacts of housing improvements and the SDGs reveals to decision-makers and public managers their potential to transform the worst socio-spatial conditions that Brazilian society faces. This political innovation, especially those directly impact involves changing the lives of residents of precarious settlements and inadequate housing.

This technical note presents the current methodological and analytical effort undertaken by Ipea to qualify and quantify housing inadequacies and estimate the costs to eradicate them in Brazil. The linking of these two research themes is justified by the larger goal of producing indicators that can support decision-making and be used as baselines and references for the evaluation of ongoing actions. This is particularly relevant in the context of the new policy that should be established with the regulation of the MCMV[1] housing improvements modality.

Data from the João Pinheiro Foundation (FJP) reveal that, in 2019, more than 24 million urban households[2] had at least one component of precariousness, whether related to urban surroundings, to the building itself, or to land tenure conditions (FJP, 2021). This research is usually used as a benchmark for the definition of housing and urban development policies. Nevertheless, it can and should be improved.

The building inadequacies measured by the FJP assess eight types of inadequacies, while the experiences of public policies for housing improvements analyzed by Ipea address at least eleven other types of inadequacies. This 19-set reveals a programmatic understanding of the actions to be foreseen in a housing improvement program. It is used here as an initial experience of qualifying and quantifying the ensemble of improvements to be carried out to overcome building inadequacies in the country.

The database used to measure the inadequacies is the Single Register for Social Programs of the Federal Government (Cadastro Único, 2019), with a universe of 28,884,000 families in urban and rural households.[3] Ipea and partner institutions have proposed new methodologies to extract data on the topic of housing inadequacies from Cadastro Único.

The decision to use this source of data is due to several factors. For example, it allows for municipal disaggregation; offers higher frequency of updating and employs active search procedures to gather information on families in the worst living conditions. In addition, as we will discuss later, there are recent limitations on the Brazilian Institute of Geography and Statistics (IBGE) surveys, the National Household Sample Survey (PNAD) and the Demographic Census. Finally, there is an ongoing effort, resumed in 2023, to improve that data base as the main registry used by the social policies of the federal government, including housing policies. This involves geocoding the Cadastro Único addresses and linking the data base with the existing municipal georeferenced administrative records.

2 PRESENTATION

This technical note is divided into five sections following this presentation. The first section aims to briefly state what is understood by housing improvements. Next, the impacts of housing improvements are discussed. The third section presents a table that relates actions and impacts of housing improvements to the SDGs,

1. Refers to the National Housing Program called My House, My Life (Minha Casa, Minha Vida, in the original version).

2. This number represents 39.8% of the total of urban durable permanent owner-occupied households. Improvised and rustic households are not considered, and rooms are also excluded, as they constitute part of the housing deficit (FJP, 2021).

3. Of this total there are 116,332 families with incomplete information, making it impossible to specify the location (urban/rural).

their targets and their indicators. The fourth section provides methodological notes and outlines the goals of quantifying and qualifying precariousness. It offers initial totals of inadequacies and costs, and highlights the necessity to improve data (through the search for adapted and measurable indicators). It ends with the fifth section, which summarizes how a specific programmatic structure for a housing improvement policy could contribute to the transversality of urban, social, economic, and environmental agendas, corroborating with the achievement of the goals agreed upon in the context of the 2030 Agenda.

The research presented here is associated with the efforts of partner institutions in developing and proposing a federal public policy for housing improvements. These efforts, notably those of CAU/Brasil and of CAU/UF[4] in each of the 27 states and the Federal District, are grounded not only in the knowledge of the realities of Brazilian cities, which are largely self-built by their residents, but also in the right to free Technical Assistance and Support for Social Housing (Athis) – as stipulated in Law No. 11.888/2008. In this sense, the Ipea's mission to advise the State in the development and improvement of public policy is reinforced.

Ipea future plans are to continue this effort, especially through the fruitful partnership with CAU/Brasil.[5] In addition to assessing housing inadequacy, we aim to select and develop indicators for monitoring and evaluating housing improvement policies. The impact evaluation may look at a broader view, including quality of life, the economy, and human development.

3 WHAT ARE HOUSING IMPROVEMENTS?

Here, we aim to provide a brief understanding of what housing improvements are. To do so, it is necessary to understand some other related terms and concepts used in this technical note. Therefore, we chose to present these terms as a kind of glossary, thus ensuring that access to this contribution is as objective and comprehensive as possible.

3.1 Urban inadequacy or precariousness

Inadequate or precarious urban or infrastructure conditions occur when there is a lack of or issues related to services such as electricity, water supply, sanitation, and waste collection, which in turn require urban improvements (FJP, 2021). Intermittent services are also considered inadequacies. In this case, housing improvement is associated with the ability of families to adapt to this condition in different contexts (urban, peri-urban, rural etc.). In the metropolitan context, in settlements with high density, the eradication of this form of precariousness depends on the infrastructure that is the responsibility of the public authorities or concessionary companies and similar – again, housing improvements are taken here as basic palliatives.

3.2 Inadequate or precarious building conditions

Inadequate or precarious building conditions correspond to housing problems related to: the lack of an exclusive bathroom (domestic sanitary unit); the lack of water storage; inadequate floor and roof situations; in addition to excessive crowding of residents in the household (FJP, 2021). Added to the inadequacies calculated by this institute are the following situations that already make up the range of items that can be financed (as "kits") recognized by the current federal policy of housing improvements – Land Regularization and Housing Improvement Program (REG MEL Program):[6] high degree of deterioration; unsanitary

4. CAU/Brasil is the Brazilian Council of Architecture and Urbanism. CAU/UF refers to the state representations of CAU/Brasil. UF refers to federal unit.

5. For the first joint research report by Ipea-CAU/Brasil, see Balbim et al. (2023).

6. Established by Resolution of the Social Development Fund Board (CCFDS) No. 225, of December 17, 2020. With the aim of promoting the right to adequate housing for low-income people through the granting of financing, under special subsidy conditions, for the execution of works and services aimed at the land regularization of informal urban areas and housing improvements, the program serves families with monthly income of up to R$ 2,000.

conditions; structural integrity issues; the lack of the minimum building and habitability standard defined by municipal regulations; and the need for accessibility for people with disabilities.

3.3 Inadequate land access and tenure insecurity[7]

Inadequate land access and tenure insecurity refers to the existence of housing, settlements, or properties on public or private land that do not have their legal situation related to land ownership recognized under a variety of possible instruments that guarantee land tenure, hence the right to housing (FJP, 2021).

3.4 Housing improvement

Housing improvement refers to interventions made in existing households that aim to guarantee the habitability of that built space, for example by expanding the built area of homes that are too small for the needs of the family; improving natural lighting and ventilation conditions; installing and/or improving sanitary facilities (sinks, toilets etc.); among other interventions that also seek to solve building and urban precariousness, improving the "habitat health" (Balbim et al., 2023) and the inhabitants' quality of life (Gomes, 2014; Balbim et al., 2023).

3.5 Athis

Athis was defined by Law No. 11.888/2008, which legally ensures this public policy, which aims to guarantee the provision of "free public technical assistance for the design and construction of social housing for their own household" (Brazil, 2008). It is part of the social right to housing provided for in the Brazilian Constitution of 1988, aiming at the right to decent housing for families with monthly income of up to three minimum wages (Brazil, 2008; Balbim et al., 2023). According to Law No. 11.888/2008, technical assistance within the scope of Athis "covers all work of design, monitoring and execution of the work by professionals in the areas of architecture, urban planning and engineering necessary for the construction, renovation, expansion or land regularization of the household". In addition to the right to housing, the technical assistance service also seeks to: make better use of "the built space and its surroundings"; formalize the construction or renovation of the household with the public authorities; "avoid the occupation of areas at risk and of environmental interest"; and ensure that the occupation of urban land is in line with the relevant legislation, notably urban and environmental (Brazil, 2008).

3.6 Technical consultancy

This is a term commonly used to refer to non-profit organizations formed by architects, social workers, engineers, lawyers and other professionals with the purpose of providing technical consultancy to social movements struggling for guaranteeing their right for housing, communities and organized groups seeking access to housing production, whether or not with state participation, and other social policies. The development of these entities dates back to the state-sponsored promotion of self-management mechanisms. The so-called Technical Consultancy (Assessoria Técnica in Portuguese) has developed mainly from São Paulo, and today is mostly present in the southern and southeastern regions of the country. More recently, and with emphasis on the support and promotion of the CAU system, in addition to the initiatives of residency (postgraduate training) in architecture and urbanism of universities, the northeastern region is also experiencing a significant increase in the number of technical consultancies.[8]

7. Land tenure regularization can be an important complement to housing and urban improvements in order to consolidate human settlements and guarantee decent housing. However, this policy will not be discussed here because it deals with actions of a different nature than housing improvements (legal, administrative, notarial etc.).

8. For more information, see Fórum de Assessoria Técnica Popular do Nordeste (2022) and Rede Moradia-Assessoria (available at: https://www.moradiaassessoria.org.br/mapa).

3.7 Habitat health[9]

> The notion of habitat health encompasses the building, sanitary, environmental, and landscape conditions related to housing and the urban setting that guarantee the quality and adequacy of the internal and external environment of the house, ensuring the dignity of the lives of its residents and the appreciation of the place of life (Balbim et al., 2023, p. 41).

3.8 Social production of housing

> Social production of housing refers to the various forms of housing production, which involve, to varying degrees, formal circuits of the economy, whether public or private, but which keep the organization of the process and the definition of the main guidelines of the project and post-occupancy in the hands and in the mechanisms of collective organization of the residents themselves (Balbim and Krause, 2014, p. 190).

In the field of public housing policies, the actions already developed in Brazil related to the social production of housing, including housing improvements, have always had the status of "alternative programs". Consequently, there is a huge housing stock in precarious settlements throughout the country, with various inadequacies and, still, devoid of specialized technical work in its production (Balbim et al., 2023).

3.9 Self-management

Self-management can be understood as a means of productive and social organization, a concept used since the beginning of the 19th century, when it emerged as an alternative mode of production to the prevailing capitalist model. Equality among people constitutes the maxim that underlies self-management, and self-management associations seek to collectively overcome vulnerabilities by addressing gaps produced by the lack of public policies or even in association with policies to encourage self-management. The first comprehensive experience of self-managed housing production in Brazil took place in São Paulo, under the administration of Luiza Erundina from 1988 to 1992, in the context of the Assistance Fund for the Population Living in Substandard Housing (Program Funaps Comunitário), which consolidated previous community experiences, some of which were even fostered in the last years of the National Housing Bank (BNH), which was extinguished in 1986. In 2004, the creation of the Crédito Solidário Program by the first government of President Lula da Silva had associations and cooperatives as operators of the process, with freedom to manage the resources allocated to the production of their own homes. This modality, from 2009 on, becomes part of the MCMV program, an axis called *Entities* (Guillerm and Bourdet, 1976; Lefebvre, 1969; Moreira, 2009; Balbim et al., 2023).

4 HOUSING IMPROVEMENTS IMPACTS

Studies point to the difficulty of assessing the impacts of housing improvements on society and the environment, or even of individualizing them, due to their non-linearity, subjectivity, and potential or accomplished "cascading" or spillover effects (Balbim et al., 2012; Balbim and Krause, 2019; Frediani, Cociña and Roche, 2023). For example, in the programmatic structuring of housing improvements promoted by the CAU/Brasil system, through Athis, at least 116 causes and 125 consequences of the problem faced could be listed (Balbim et al., 2023).

9. The notion of habitat health was developed from collective discussions for the design of the programmatic modeling for Athis, more specifically in the context of the Ipea-CAU/Brasil partnership. The definition of this broad term is part of the objective of an Athis program. This definition, as well as others associated with it, can be found in the ***Research report: project 'Logical modeling for programmatic structuring of Technical Assistance and Support for Social Housing (Athis)'*** (Balbim et al., 2023).

Another shortcoming in the assessment of the impacts of housing improvements is the fact that it is not always possible to forecast how individuals' lives would have unfolded in a scenario without housing improvements, as there are multiple factors involved in such projections. In other words, what is known in impact assessment as "counterfactual" is difficult to replicate in habitat policy topics.

Finally, the lack and difficulty of producing data on precarious settlements and housing inadequacies also make it difficult to measure and assess the impacts of improvements (Denaldi, 2022).

At the same time that difficulties arise in measuring the impacts of improvements that are diverse, complex, and subjective, these characteristics contribute to the transversality of the theme of housing improvements in relation to the SDGs and in helping to achieve the 2030 Agenda.

In this perspective, several studies seek to measure and suggest methodologies that allow for an approximation of the measurement of these impacts, in order to present concrete data regarding the benefits of investment in housing and, more specifically, in housing improvements. This section presents a brief overview of this literature, in order to exemplify in a broad way the impacts that housing improvements can promote.

Based on the findings of the Ipea-CAU/Brasil research (Balbim et al., 2023) and the literature review cited here, it can be said that housing improvements have direct impacts on the entire economy and on the conditions for achieving full citizenship.

Here we list the main economic sectors and aspects of everyday life impacted by housing improvements, for which there is some degree of evidence of these impacts. Below we present related studies so that they can be analyzed and measured. They are: i) gross domestic product (GDP) growth and reduction of inequalities; ii) local and solidary economy; iii) job creation; iv) decent work; v) community life; vi) women's empowerment and gender policies; vii) environment; viii) food security; ix) safe water access; x) sanitation access; xi) family health; xii) community health; xiii) mental health; xiv) health system and policy; xv) human dignity and basic hygiene, especially for women; xvi) access to transportation, access to electrification and other services; xvii) education, especially early childhood education; xviii) security; xix) happiness; xx) access to rights; xxi) environmental resilience; xxii) climate conditions of the living environment; and xxiii) land tenure security.

Thus, as will be further detailed, it is observed that investing in housing improvements can meet or even exceed the targets and indicators set for SDG 11. It is therefore relevant to analyze in greater depth the relationship between these interventions and the other SDGs in order to contribute to greater articulation, integration, and transversality of this agenda.

A recent report published by the non-governmental organization (NGO) Habitat for Humanity (Frediani, Cociña and Roche, 2023) shows that the eradication of inadequacies effect in terms of income can generate a direct impact of up to 10.5 percentage points on GDP over the years. It also points out that the economic growth and improvement of living standards in precarious settlements would have an economic impact greater than the cost of ensuring adequate housing for many countries.

The Economic Commission for Latin America and the Caribbean (ECLAC) estimates that the construction sector not only has the potential to drive a country's economy, but can be key to the resumption of economic growth, such that for every 1% growth in the construction sector, the GDP growth rate can increase by up to 0.07% (Housing..., 2022). In Brazil, the Growth Acceleration Program (PAC), initiated in 2007, was an example of how the construction sector can contribute to boosting the economy.

Sometimes the inability of residents to invest in their housing can be an obstacle to improving their households and living conditions. This problem can be addressed through people-led or community-led initiatives – which can be supported by public policies, as has already occurred in Brazil – such as loans from cooperatives, community banks, and local currencies that help to stimulate the local economy without leaking money into the upper circuit of the economy (Santos, 1975; Moreno, 2022; Pupo, 2022).

Investments in housing improvements and the urbanization of precarious settlements (slum upgrading) contribute to fostering job creation[10] and decent work[11] in these spaces, especially in contexts of initiatives with people-led or community-led partnerships and self-construction, as demonstrated by the study by Smith and Brown (2019). In precarious settlements, self-construction is the norm, especially in the Global South, revealing great potential for the establishment of public-popular partnerships[12] in this area, with positive impacts on the social capital of communities.

It is important to note that job creation is primarily, but not exclusively, for the residents of precarious settlements. Taking as an example Athis (Law No. 11.888/2008) initiatives, interventions that result in housing improvements employ professionals in the fields of architecture and engineering, directly related to the construction sector, but also in the areas of health, social assistance, law, and others indirectly related.

On the same topic, Degert, Parikh and Kabir (2016) highlight the potential to create economic opportunities based on community empowerment, starting from housing conditions and initiatives associated with the local community. This would contribute to strengthening the lower circuit of the urban economy (Santos, 1975). Similar experiences have had positive impacts on strengthening community aspects in the context of the struggle for housing and the emancipation of women, emerging from initiatives promoted by community banks (Pupo, 2022).

Smith and Brown (2019) also assess that, beyond job creation, investments in housing improvements can sometimes promote changes in the livelihoods of residents of precarious settlements. In the case study conducted in Kenya by the authors, it was observed that the improvement of housing conditions – in this case, access to larger plots – led 90% of households to start developing activities related to urban agriculture.

This finding by Smith and Brown (2019) reveals the complexity and cascading or spillover impacts that investment in housing improvements can promote. In this case, there was an indirect boost to urban agriculture, which in turn has positive impacts on the environment, notably on the ecological footprint of cities, as well as on food security, the promotion of the local economy, and others.

When it comes to improvements associated with access to basic services, studies observe the direct impact of promoting access to water supply and sanitation on the health of residents (Degert, Parikh and Kabir, 2016). In this context, it is worth revisiting the World Health Organization (WHO) data that for every dollar invested in water and sanitation, there is a return of US$ 4.3 saved in the health system (Every..., 2014).

In addition to health, the lack of water supply in housing primarily impacts the lives of women and girls, as they are typically responsible for collecting water, facing challenges also related to sanitation and menstrual hygiene (AGUN, 2016). The lack of sanitation facilities in households also negatively impacts these realities, and initiatives such as the "Nenhuma Casa sem Banheiro" (No house without a bathroom) project from the Rio Grande do Sul Council of Architecture and Urbanism (CAU/RS) have a positive impact on the

10. It is important to note that studies that estimate the number of jobs created are based primarily on the construction of new homes, with no data available for jobs created by housing improvement projects.

11. The concept of decent work is central to the SDGs and the 2030 Agenda, and is understood as productive and quality work, in conditions of freedom, equity, security, and human dignity. More information available at: https://www.ilo.org/brasilia/temas/trabalho-decente/lang--pt/index.htm.

12. In recent years, the term "*public-popular partnerships*", or PPPop, has been used in a generic way to refer to partnerships with the organized civil society to enable and expand self-management initiatives and others, such as the case of housing improvements. In 2019, Bill No. 4517 was presented, which establishes the Public-Private Popular Partnership (PPPP), within the scope of the competence provided for in articles 24, item I, 25, 1st paragraph and article 182 of the Federal Constitution and in Federal Law No. 10.257, of July 10, 2001 – the Estatuto da Cidade (City Statute). Recently, an article was published in the Argentine newspaper Pagina 12 about similar partnerships specifically for housing improvements executed with resources from the tax on large fortunes (available at: https://www.pagina12.com.ar/572683-pala-pico-e-inclusion-el-plan-de-integracion-sociourbana-en-?ampOptimize=1).

dignity, health, quality of life and gender security of women living in precarious settlements (Somekh and Balbim, 2023; "Nenhuma…, 2020).

Considering the provision of basic services from both a quantitative and qualitative perspective, the positive impacts are multiplied. Samad and Zhang (2016) observed that access to electricity is associated with a 9.6% increase in the income of residents of precarious settlements. However, if the access is to a stable service, without interruptions or blackouts, the observed increase in income was 17%.

A similar situation was also observed during the covid-19 pandemic in Brazilian precarious settlements, as residents of these localities had difficulty complying with WHO hygiene recommendations due to interruptions and intermittent water supply (Rodrigues, 2021).

Irregularities in the provision of basic services can also lead to lost opportunities for work or education (Obolensky et al., 2019), for example in the case of problems with public transportation, or the difficulty of young girls attending school during their menstrual period (AGUN, 2016).

It is estimated that amounts between 0.1% and 0.2% of GDP are lost annually due to the provision of unreliable services to users – such as the aforementioned cases of blackouts, water shortages, and transportation disruptions (Obolensky et al., 2019).

In the case of education, housing improvements can increase the results of children's education, since aspects of housing that are improved, such as natural and electrical lighting and adequate natural ventilation, as well as space for activity, contribute to studying and carrying out educational tasks in the context of the home and can thus have an impact on education. Consequently, adults who have had their education interrupted will have greater difficulties in finding jobs and obtaining income (Cunningham and MacDonald, 2012). According to Frediani, Cociña and Roche (2023), the expected school attendance rate could increase by up to 28% in some countries. Globally, up to 41.6 million children and young people could be enrolled in primary and secondary education as a result of housing improvements, which is equivalent to 16.1% of the total number of children and young people who currently have no access to education (Frediani, Cociña and Roche, 2023).

In the health field, housing improvements have enormous potential not only in improving the health of the residents themselves, but also in the savings generated for the health system and in improving the environmental conditions associated with health (Henson et al., 2020; Gomes, 2021). As for life expectancy, the eradication of inadequacies could increase up to 4%, or 2.4 years more on the world's average, solely due to the direct effect of ensuring access to adequate housing in precarious settlements (Frediani, Cociña and Roche, 2023). On a global scale, up to 738,565 deaths could be avoided annually (Frediani, Cociña and Roche, 2023), a number greater than that resulting from the eradication of malaria.

Adebowale, Morakinyo and Ana (2017) found a correlation between households built with inadequate or precarious materials and the mortality of children under five years old in Nigeria. Cattaneo et al. (2009) observed a decrease in diseases caused by parasites, diarrhea, and anemia in young children after housing improvement actions that cemented the floors of the dwellings, previously made of earth. There was also an improvement in the cognitive development of these children.

In the field of mental health, an increase in stress has been observed in low-income groups for people who do not own their own homes (Bloze and Skak, 2012). At the same time, well-being and quality of life have increased with satisfaction with their housing, reducing levels of depression and stress (Cattaneo et al., 2009).

Another subjective impact was observed by Galiani et al. (2017). In this research, in Latin America, it was found that residents of households that were the focus of housing improvements were happier with their quality of life, observing in some cases a feeling of greater security and also an improvement in the health of children.

Soares (2007), Ferreira and Santana (2013), Silva and Burnett (2015), Albernaz et al. (2017), and Smith and Brown (2019) also observed that housing improvement initiatives with people's participation were able to establish a collective identity of communities, as well as improve the ability to defend their rights, being other subjective aspects of the impacts of improvements.

Considering environmental issues, housing improvements make dwellings and their residents – and, to a greater extent, settlements in general – more prepared for risks related to the climate crisis, through greater adaptability of structures that allow avoiding or reducing possible negative effects of disasters or environmental catastrophes (Satterthwaite et al., 2020).

In this sense, we can cite households with greater thermal comfort that help residents withstand extreme temperature waves, drainage structures appropriate to the reality of each settlement, households that allow and preserve ecosystem functions, contributing to the reduction of disaster risk, mapping of areas with the highest geological and environmental risk to identify the need for relocations, and the installation of alert and evacuation systems for extreme cases (UNDRR, 2015; Satterthwaite et al., 2020).

However, it is important to note that environmental improvements are not always able, on their own, to prevent all types of environmental risks in precarious settlements. Some risks require integrated public policy actions, which may even go beyond the scope of the settlement, such as the need for comprehensive and integrated stormwater management programs to prevent flooding and inundation in settlements (Satterthwaite et al., 2020). One possible strategy for public policy is the definition of typologies that indicate the kind of intervention or action required, for example, in Local Plans for Social Housing (PLHIS) or in inter-municipal housing diagnoses (Denaldi, 2022).

Degert, Parikh and Kabir (2016) list air quality and biodiversity conservation as points that are usually not included in the scope of housing improvement projects or, as mentioned earlier, cases in which the necessary actions go beyond the scope of the project, requiring articulations between different public policies.

In this sense, Denaldi and Ferrara (2018) highlight the persistence of the challenge of articulating urban and environmental public policies, a challenge similar at the global scale (Frediani, Cociña and Roche, 2023), despite the advances observed in slum upgrading actions in Brazil (Balbim and Krause, 2019).

It is important to note that there have been advances and setbacks in this articulation. In the case of land regularization, the enactment of Law No. 13.465/2017 made it a predominantly bureaucratic practice in Brazilian housing policy, weakening the environmental aspects it previously carried in the repealed legal framework; and the re-edition of the MCMV program in 2023 did not reverse this change (Balbim, 2022; 2023).

On the other hand, the MCMV previously had initiatives – albeit limited – to install solar panels for the generation of sustainable electricity, with proven viability (Souza and Ferreira, 2019) and great social potential, as it is understood to improve the quality of life for families and communities (Melo et al., 2018). In this sense, the re-edition of the program in 2023 included a "green subsidy", which provides additional funding for projects that incorporate sustainable technologies (Balbim, 2023). These are issues that should be given greater prominence in the program's actions, seeking greater alignment and integration with the 2030 Agenda, the SDGs, as well as the sustainability, adaptability, and resilience of human settlements, particularly precarious settlements, from the perspective of "leaving no one behind".

5 HOUSING IMPROVEMENTS ACTIONS AND IMPACTS ON THE SDGS AND THEIR INDICATORS

Continuing the effort to formulate a structured program or policy for housing improvements based on evidence, we sought to relate the potential and expected impacts of actions and guidelines associated with housing improvements verified in the programmatic structuring under development in partnership with CAU/Brasil to each of the 17 SDGs.

The potential and expected impacts were classified as direct and indirect, and it was found that housing improvement actions, listed from the programmatic structuring, impact all 17 SDGs, 9 of them directly and 8 indirectly.

In addition to the analysis of potential impacts, we listed the national goals[13] and indicators of each SDG that were most closely related to these actions and guidelines for a housing improvement program.

In total, 27 national goals and 38 indicators related to housing improvements were listed, revealing the adherence of this policy to the broader framework of the SDGs and, above all, indicating the diversity of possibilities for evaluating the efforts that may be made by the State and society to overcome housing precariousness.

TABLE 1

Relationship between the SDGs, housing improvements and associated indicators

SDG	Type of housing improvement-related action	Impact	National goal	Indicator	Notes and comments
Goal 1 – No poverty: end poverty in all its forms everywhere	Guarantee of access to basic services, water supply, sanitation and electricity infrastructures. Land tenure regularization (supporting component). Training for the use of appropriate construction and renovation technologies.	Direct	1.4 – By 2030, ensure that all men and women, in particular the poor and vulnerable, have equal rights to economic resources, as well as *access to basic services*, *ownership and control over land* and other forms of property, inheritance, natural resources, *appropriate new technologies* and financial services, including microfinance.	1.4.1 – Proportion of the population living in households with access to basic services. 1.4.2 – Proportion of the total adult population with secure land tenure rights, with legally recognized documentation and who perceive their land rights as secure, by sex and by type of tenure.	Potential association with other SDGs in the area of training/capacity building and labor.
Goal 2 – Zero hunger: end hunger, achieve food security and improved nutrition and promote sustainable agriculture	Improvements that enable food preparation in households (access to safe water, energy, and a suitable cooking space). Associated family farming projects, especially urban ones, contribute to increasing food security.	Indirect	Not applicable	Not applicable	Actions related to family farming, whether urban or rural, are being considered because they promote cooperative association and self-management, which are important elements for interventions via housing improvements.
Goal 3 – Good health and well-being: ensure healthy lives and promote well-being for all at all ages	Guarantee of access to basic services, infrastructure – notably water supply and sanitation, but also waste collection and stormwater management. To provide housing with natural lighting and ventilation, and insulation or waterproofing of foundations and walls.	Direct	3.3 – By 2030, end the AIDS epidemics, *tuberculosis*, malaria and neglected tropical diseases (NTDs), and combat hepatitis, *waterborne diseases*, and other communicable diseases. 3.9 – By 2030, substantially reduce the number of deaths and diseases from hazardous chemicals, *air*, *water* and soil *pollution* and contamination.	3.3.2 – *Tuberculosis* incidence per 100,000 inhabitants. 3.3.5 – Number of people in need of interventions against NTDs. 3.9.1 – Mortality rate from *environmental air pollution* (external and *domestic*). 3.9.2 – Mortality rate attributed to *unsafe water sources*, *unsafe sanitation* and lack of hygiene.	Regarding NTDs,[1] some of them are directly related to housing and sanitation conditions, and in this sense, they are directly impacted by housing improvements.

(Continues)

13. The global targets were adapted to Brazil's priorities, taking into account national strategies, plans and programs and the country's challenges of the country. More information available at: https://repositorio.ipea.gov.br/bitstream/11058/8636/1/Agenda%202030%20ODS%20Metas%20Nac%20dos%20Obj%20de%20Desenv%20Susten%202018.pdf.

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SDG	Type of housing improvement-related action	Impact	National goal	Indicator	Notes and comments
Goal 4 – Quality education: ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	Housing improvements that enable and provide opportunities for extra-curricular study	Indirect	4.a – Build and improve physical facilities for education that are appropriate for children and sensitive to disabilities and gender, and that provide safe, non-violent, inclusive and effective learning environments for all.	4.a.1 – Proportion of schools with access to: (a) *electricity*; (b) internet for pedagogical purposes; (c) computers for pedagogical purposes; (d) infrastructure and materials adapted for students with disabilities; (e) *drinking water*; (f) *separate sanitary facilities for each sex*; and (g) *basic handwashing facilities* (according to the definitions of the WASH indicators).[2]	Access to adequate housing can increase the expectation of school attendance (Frediani, Cociña and Roche, 2023). A finding of the research in partnership with CAU/Brasil was the link between school attendance and learning quality when there is a suitable study space in the household.
Goal 5 – Gender equality: achieve gender equality and empower all women and girls	Guarantee of basic services within the household, especially water supply.	Direct	5.2 – Eliminate all *forms of violence against all women and girls in public and private spheres*, including trafficking and sexual and other forms of exploitation. 5.4 – Recognize and value unpaid care and domestic work, through the *provision of public services*, *infrastructure* and social protection policies, as well as the promotion of shared responsibility within the home and family, in accordance with national contexts.	5.2.1 – Proportion of women and girls aged 15 years old and over who have experienced physical, sexual or psychological violence by an intimate partner, in the previous 12 months, by type of violence and by age. 5.4.1 – Proportion of time spent on unpaid domestic and care work, by sex, age and location.	Guaranteeing basic services within the household reduces the amount of time spent on domestic work, allowing for other activities such as education, and prevents harassment in public places (water fountains, sanitary facilities etc.).
	Expansion of the household in cases of excessive density or crowding.				The expansion of the household guarantees a safe and uncrowded environment, which contributes to reducing the occurrence of gender-based violence.
Goal 6 – Clean water and sanitation: ensure availability and sustainable management of water and sanitation for all	Improvements that promote access to water supply (without intermittency).	Direct	6.1 – By 2030, achieve *universal and equitable access to safe and clean drinking water* for all. 6.2 – By 2030, achieve *access to adequate and equitable sanitation and hygiene* for all, and end open defecation, with particular attention to the needs of women and girls and those in vulnerable situations. 6.b – Support and strengthen the participation of local communities to improve water and sanitation management.	6.1.1 – Proportion of the population using safely managed drinking water services. 6.2.1 – Proportion of population using (a) safely managed sanitation services and (b) handwashing facilities with soap and water. 6.b.1 – Participation of local communities in water and sanitation management.	As for target 6.b, it can also be applied to cases of condominium sanitary sewage, common in precarious settlements and rural communities (but the indicator would have to be refined, as it does not have this "disaggregation").
	Domestic sanitary improvements and others that promote access to hygiene facilities (non-shared bathroom).				
Goal 7 – Affordable and clean energy: ensure access to affordable, reliable, sustainable and modern energy for all	Access to electricity in households. Access to energy without service interruption/intermittency.	Direct	7.1 – By 2030, ensure *universal*, *reliable*, *modern* and affordable *access* to energy services.	7.1.1 – Percentage of the population with access to electricity. 7.1.2 – Percentage of the population with primary access to clean fuels and technologies.	–

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SDG	Type of housing improvement-related action	Impact	National goal	Indicator	Notes and comments
Goal 8 – Decent work and economic growth: promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Creation of jobs in the context of housing improvement.	Direct	8.3 – Promote development-oriented policies that support productive activities, *decent work generation*, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro, small and medium-sized enterprises, including through access to financial services. 8.5 – By 2030, achieve full and productive employment and decent work for all women and men, including for young people and people with disabilities, and equal pay for work of equal value. 8.6 – By 2020, substantially reduce the proportion of young people without employment, education or training.	8.3.1 – Proportion of workers employed in informal activities, by sector and sex. 8.5.1 – Average hourly wage of employees by sex, occupation, age and people with disabilities. 8.5.2 – Unemployment rate, by sex, age and people with disabilities. 8.6.1 – Percentage of young people (15-24) who are not in the labor force (employed and not employed), are not students and are not in job training.	–
	Housing improvements favor conditions for job search and access to employment (e.g. mobility).				
	Job creation in precarious settlements.				
	Promotion of small businesses, entrepreneurship, solidary and self-management economy and cooperative association.				
	Valuing women's work on self-managed construction sites.				
	Training for the design and execution of self-management interventions.				
	Valuing technical consultancy (architects, engineers, social workers etc.).				
	Valorization and formalization of housing self-promotion/self-management work.				
Goal 9 – Industry, innovation and infrastructure: build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	Innovation of materials and construction techniques used in housing improvements.	Indirect	9.3 – Increase *access for small industries* and other companies, particularly in developing countries, to financial services, including *affordable credit and fostering of their integration into value chains and markets*.	9.3.1 – Proportion of value added by "small-scale" companies in total industry value added. 9.3.2 – Proportion of micro-enterprises with loans or credit lines.	The target and indicators related to small industries were selected, as there is a greater chance that they will adhere to a large-scale housing improvement policy.
	Development of industrial technologies based on or adapted to community solutions.				
Goal 10 – Reduced inequalities: reduce inequality within and among countries	Real estate appreciation. Interiorization of housing improvements (to reduce regional inequalities).	Indirect	10.1 – By 2030, progressively achieve and sustain income growth for the poorest 40% of the population at a rate higher than the national average. 10.2 – By 2030, empower and promote social, economic and political inclusion of everyone, regardless of age, gender, disability, race, ethnicity, origin, religion, economic or other condition.	10.1.1 – Growth rate of household expenditure or per capita income between the 40% with the lowest income of the population and the total population. 10.2.1 – Proportion of people living below 50% of the median income, by sex, age and people with disabilities.	The findings of the research in partnership with CAU/Brasil revealed and made clear the need to interiorize technical assistance work, in order to reach urban and rural locations where the work of architects and urban planners does not normally reach, and which are also locations with little economic dynamics.

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SDG	Type of housing improvement-related action	Impact	National goal	Indicator	Notes and comments
Goal 11 – Sustainable cities and communities: make cities and human settlements inclusive, safe, resilient and sustainable	All actions related to housing improvement contribute to making cities and communities more inclusive, safe, resilient and sustainable, with special emphasis on: access to safe, adequate and affordable housing for all; maintaining the population in their homes, preventing urban sprawl; and reducing the risk of disasters and environmental injustice.	Direct	11.1 – By 2030, guarantee access for all to *safe, adequate and affordable housing and basic services and slum upgrading*. 11.3 – By 2030, increase *inclusive and sustainable urbanization*, and capacities for the planning and management of participatory, integrated and sustainable human settlements, in all countries. 11.5 – By 2030, significantly reduce the number of deaths and the number of people affected by disasters and substantially reduce the direct economic losses caused by them in relation to global GDP, including water-related disasters, with a focus on protecting poor and those in vulnerable situations.	11.1.1 – Proportion of urban population living in precarious settlements, informal settlements or inadequate households. 11.3.1 – Ratio of soil consumption rate to population growth rate. 11.5.1 – Number of deaths, missing people and directly affected people attributed to disasters per 100,000 inhabitants. 11.5.2 – Direct economic losses in relation to GDP, including damage caused by disasters to critical infrastructure and the interruption of basic services.	The incidence is higher in target 11.1 (and possibly also in 11.5, which is lower, as the elimination of risk situations must depend to a lesser extent on housing improvements, and more on (re)urbanization actions). Anyway, the great justification from the point of view of sustainability lies in trying to meet target 11.3, in order to avoid urban sprawl. By the way, this is one of the tier III indicators, which have not yet been developed.
Goal 12 – Responsible consumption and production: ensure sustainable consumption and production patterns	It is possible to encourage sustainable consumption and production through the materials and technologies used – such as pre-fabricated kits, using local and more sustainable materials – in addition to optimizing resources, already common in self-construction processes.	Direct	12.2 – By 2030, achieve sustainable management and *efficient use of natural resources*.	12.2.1 – Material footprint, material footprint per capita and material footprint as a percentage of GDP. 12.2.2 – Internal consumption of materials, internal consumption of materials per capita and internal consumption of materials per unit of GDP.	In terms of the target and indicators, the impact may be indirect, but the principle of reuse based on the qualification of a stock, which, in turn, avoids the production of new units, guarantees a direct impact on the goal itself.
	Economy of reuse.				
Goal 13 – Climate action: take urgent action to combat climate change and its impacts	Housing improvements in a broad sense contribute to increasing the resilience of cities and the prevention of disasters or the number of people directly affected by them.	Direct	13.1 – Strengthen resilience and adaptive capacity to climate-related risks and natural disasters in all countries.	13.1.1 – Number of deaths, missing people and directly affected people attributed to disasters per 100,000 inhabitants. 13.1.2 – Number of countries adopting and implementing national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030. 13.1.3 – Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies.	Disaster risk reduction is already included in SDG 11. Indicator 13.1.1 is identical to 11.5.1. The impact of housing improvements, although direct, varies depending on the risk, for example drought situations are clearly alleviated by water storage. Regarding traditional housing modes and practices, these also contribute to the resilience of households.

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SDG	Type of housing improvement-related action	Impact	National goal	Indicator	Notes and comments
Goal 14 – Life below water: conserve and sustainably use the oceans, seas and marine resources for sustainable development	Spillover effect. Housing improvements result in households that have less impact on the environment, pollute less water and soil, thus contributing to ocean conservation.	Indirect		None	The promotion of housing improvements, especially related to urban planning and building inadequacies, helps to reduce or eliminate sources of water pollution which, thus, indirectly contribute to the conservation of the oceans.
Goal 15 – Life on land: protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	Spillover effect. Housing improvements result in households that have less impact on the environment, pollute less water and soil, and thus contribute to the conservation of terrestrial ecosystems.	Indirect	15.1 – By 2020, ensure the conservation, recovery and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and arid lands, in accordance with obligations arising from international agreements. 15.3 – By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world.	15.1.1 – Forest area as a proportion of the total area of the territory. 15.3.1 – Proportion of territory with degraded soil.	Promoting the requalification of the real estate stock instead of the production of new units prevents the expansion of the urban area and its possible advance into preserved areas.
Goal 16 – Peace, justice and strong institutions: promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	Spillover effect. A housing improvement policy stimulated by the state contributes not only to promoting social and environmental justice, but also to strengthening public institutions.	Indirect	16.1 – Significantly reduce all forms of violence and related mortality rates everywhere. 16.6 – Develop effective, accountable and transparent institutions at all levels.	16.1.1 – Number of victims of intentional homicide, per 100,000 inhabitants, by sex and age. 16.1.4 – Proportion of the population that feels safe when walking alone in the area where they live. 16.6.2 – Proportion of the population satisfied with their last experience with public services.	The impact depends on the organization of a public policy on access to justice and the strengthening of institutions.
Goal 17 – Partnerships for the goals: strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development	Spillover effect. In most initiatives related to housing improvements, partnerships are the foundation of the strategies developed, considering actors such as the community, social movements, professionals and technicians related to the process, public and private institutions and international organizations.	Indirect	17.3 – Mobilize additional financial resources for developing countries from multiple sources. 17.17 – Encourage and promote effective public, public-private and civil society partnerships, based on the experience of resource mobilization strategies in these partnerships.	17.3.1 – Foreign direct investment, official development assistance and South-South Cooperation, as a proportion of gross national income. 17.3.2 – Volume of remittances (in US dollars) as a proportion of total GDP.	Indirect impact, as "partnerships" here refer to international cooperation.

Authors' elaboration.

Notes: [1] For more information, see Doenças… (2022).

[2] Water, sanitation and hygiene indicators.

The table 1, the list of related indicators and the impacts identified in the literature on the subject underpin and illustrate the next research steps in the quest to define the scale of the problem according to each type of precariousness, the associated costs and the impacts, especially economic, that justify efforts to put this policy into effect.

6 MEASURING AND UNDERSTANDING THE NEED FOR HOUSING IMPROVEMENTS IN BRAZIL

There are several challenges to measuring the need for housing improvements around the world, as well as to the development of public policies and their necessary monitoring and evaluation.

In order to support the planning of this public policy in Brazil, based on evidence of the scale and multiplicity of the problem, we looked at administrative records for alternatives to census restrictions that would make it possible to qualify the inadequacies and produce indicators that are adherent, at least, to the municipal level.

In Brazil, the main indicator used to monitor housing needs is the sequence of studies on the housing deficit, produced by FJP (2021). This study highlights four components of the quantitative housing deficit, which represents the demand for a new household: precarious (or rustic) households, excessive density (crowding) of rented households, families sharing a housing unit and excessive urban rent burden.

Additionally, there is the so-called *qualitative* housing deficit, that is, the inadequacy of households, which reflects the portion of the population that lives in durable permanent housing, but with some type of building precariousness, urban precariousness (lack of utilities) or in a situation of land tenure insecurity, representing the demand for housing improvements, urban services and land tenure regularization.

The FJP study contemplates a municipal estimate every 10 years, based on the Demographic Census sample, and an aggregate estimate by state and metropolitan region in the intercensal period based on the PNAD.

The FJP methodology has undergone several adaptations since its first publication in 1990 (FJP, 2021). In the most recent publication, it started using administrative records from Cadastro Único to estimate improvised households, since the question referring to this component was not included in the Continuous PNAD, the IBGE survey that subsidized the estimate for the 2016-2019 period. In the next publication of the municipal housing deficit, the FJP's methodology will have to undergo yet another revision, as the 2022 Demographic Census sample questionnaire[14] did not include questions about the value of rent and access to electricity. Thus, there is the possibility that new models for measuring the housing deficit will be proposed in order to respond to the demands for improving public policies, as reported here.

6.1 Cadastro Único as a database for quantifying/qualifying inadequacies

Cadastro Único has been used as a data source to monitor the evolution of Espírito Santo state's housing situation by the Jones dos Santos Neves Institute (IJSN) since 2015. This made it possible to identify the municipal quantitative housing deficit annually and establish the deficit profile by the following categories of analysis: sex, race, age group, education, occupation and disability (IJSN, 2019). Taking the IJSN study in Espírito Santo as a reference, the Mauro Borges Institute (IMB) produced a similar study for the state of Goiás (Lima, Prado and Cardoso, 2018). The same methodology was adapted by Ipea to investigate the existence of a housing deficit in the previous housing situation of the families who moved to the MCMV program estates, in the country's 20 largest cities (CMAP, 2020; Krause et al., 2023).

14. Available at: https://censo2022.ibge.gov.br/np_download/censo2022/questionario_amostra_completo_CD2022_atualizado_20220906.pdf.

Due to the need to estimate the housing deficit and inadequacy at the municipal scale, Feitosa, Cunha and Rosemback (2023) also proposed a methodological approach for estimating the housing deficit with data from Cadastro Único. In this study, the qualitative housing deficit is also computed, referring to building and urban precariousness, a component that was not addressed in the IJSN and IMB methodologies.

6.2 What are the shortcomings of Cadastro Único and what can be improved?

Two initial considerations are in order here. It is important to highlight that the data contained in Cadastro Único are self-declared and it has therefore been recommended that the responsible ministry build a verification strategy, through sampling, which could improve the reliability of the data (CMAP, 2020).

Another caveat concerns the profile of the families enrolled in Cadastro Único. In general terms, Cadastro Único can register families with a monthly per capita family income of up to ½ minimum wage, or up to 3 minimum wages of total monthly family income, or who have an income above these, but are linked to or have an interest in some welfare program or benefit that uses Cadastro Único in its concessions. On the other hand, the main social programs that actively search and include families in the Register have lower income limits: in the case of Bolsa Família,[15] the limits are usually lower than ¼ of the minimum wage of per capita household income, which is also the income limit for families covered by the Continuous Cash Benefit Program (BPC).[16] Therefore, it is possible that potential beneficiaries of other programs and actions, such as Athis, have not necessarily been included in Cadastro Único through an active search. Therefore, registered families would correspond, in general, to the most vulnerable portion within the universe of families eligible for programs and actions that can also reach families with higher income – still within a low-income segment, roughly speaking (Krause et al., 2023).

Seen from another angle, these indications show a tendency to consider the families enrolled in Cadastro Único as that portion of the beneficiaries who have the highest priority for Athis and housing improvements, which is why we continue to use this cut-off. It is also reinforced that Cadastro Único has "an almost censitary coverage of the poor population and their living conditions, which allows diagnoses to be made in order to define and operationalize the country's social policies" (Direito, Koga and Licio, 2023, p. 45).

On the other hand, Cadastro Único has been heavily impacted by political issues in recent years, which is why we decided to use the 2019 database, which is considered to be more accurate.[17] The current scenario is one of improving the database, including new families via social programs, especially the MCMV, and the possibility of identifying their location through geocoding, which is fundamental for using the database in intra-urban analysis and for precision in defining the universe of beneficiaries of policies such as the housing improvements.

6.3 Quantitative analysis of housing inadequacies from Cadastro Único

To analyze the demand for housing improvement policies, only permanent owner-occupied homes were considered. In other words, improvised, collective or rented homes were not considered. Furthermore, the address declared by the families was used to identify apartment-type homes that may not be eligible for some types of housing improvement.

15. Bolsa Família is Brazil's largest cash transfer program.

16. The BPC is a guarantee of one minimum wage per month to the elderly aged 65 or over or to people with disabilities of any age.

17. According to the analysis carried out by Direito, Koga and Licio (2023, p. 46) for the publication ***Desmonte e reconfiguração de políticas públicas***, "CadÚnico went through different expansion movements until 2016, when trends of retraction and demobilization or, even, redirection of capabilities began to be identified, presenting the risk of dismantling the institutional environment built until then". Despite this recent "dismantling", Cadastro Único has once again become a priority for the federal government and the methodology proposed here can be immediately used in the revised bases in 2023.

Rooming houses were considered, a reference to what are commonly called tenements.[18] This caveat is made because this is the only variable used that overlaps with the method used by the FJP to calculate the housing deficit.

There is also the exception of rustic households, which, although considered, are highlighted in the totals. Because they have inadequate wall materials, they would require partial or total reconstruction of the household, an item provided for in housing improvement policies such as the successful efforts of the Federal District Government's Housing Development Company (Codhab-DF). This universe will be computed and analyzed separately, due to its high cost and also because it is understood that the solution may involve new housing units.

In the case of households with building precariousness, the need for housing improvements can be read directly from the situation of inadequacy. For example, households without a bathroom require the construction of a new bathroom, either isolated or contiguous.

With regard to urban precariousness, the data source does not allow identifying whether it occurs due to the lack of public utilities' coverage or the lack of connection to them (water, sanitation and electricity). Once there is no sewage system, for example, it may be possible to connect to the general network (drainage) when available; otherwise, the installation of a septic tank can be considered, still a housing improvement, in contexts where their use is acceptable. In this sense, it was decided to encompass all the components on the understanding that, with or without the immediate possibility of connection to the service network, there is a need for housing improvements, or the installation of a water tank as an alternative to the non-existence or intermittency of the supply service.

Having made these initial considerations, table 2 lists the types of inadequacies, their description and the corresponding demand identified by Cadastro Único. The solutions presented on table 3 are based on the regulations of the federal government's REG MEL Program.[19]

TABLE 2
Quantitative housing inadequacies from Cadastro Único (2019)

Type of inadequacy	Description	Number of families (Cadastro Único, 2019)	
		Urban household	Rural household
Inadequate wall material (total reconstruction)	Families who live in a household where the predominant material of the external walls is reused wood, straw, or other material (except masonry, rustic wooden walls and adobe).	410,405	372,066
Inadequate wall material (external wall covering)	Families who live in a household where the predominant material of the external walls is adobe without plasterwork.	98,708	254,891
Excessive density with the possibility of housing improvement	Families who live in a household where 3 or more people sleep in one bedroom, excluding apartments.	2,767,963	850,727
Lack of bathroom	Families who live in a household without a bathroom or toilet, either in the household or on the property, excluding apartments.	381,457	978,445
Inadequate floor material	Families who live in a household where the predominant material of the floor is earth or reclaimed wood.	471,867	537,916
Lack of piped water	Families who live in a household without piped water in at least one room.	924,965	1,925,031
Lack of sewage	Families who live in a household without connection to a sewage or septic tank system, excluding apartment-type homes.	4,379,630	2,861,776
Absence of water supply by public network	Families who live in a household that is not connected to the general distribution network.	2,110,541	3,500,856
Lack of electricity in the household or rooms	Families who live in a household without an electricity meter.	1,264,080	738,442
Total number of families living in their own household with at least one type of inadequacy		**8,377,532**	**5,030,919**

Authors' elaboration.

18. Cortiços, in Portuguese.

19. The regulations for the REG MEL Program can be found in the publication: Casa Verde Amarela. Instruction manual. Land Regularization and Housing Improvement Program. 2021. 45p. In addition to this, the costing sheets for the housing improvement kits were also used to draw up and refine the inadequacies to be dimensioned.

Based on the demand for housing improvements from Cadastro Único and the individual costs of the solutions, an initial estimate of the overall cost of a program with this scope was made, which is shown in table 3. The individual costs used are those provided in the REG MEL Program normative, with the exception of the estimate for total reconstruction, which was obtained by using as reference the costs for building a single-family, ground-floor, 43.6 m² household used by the National Research System for Construction Costs and Indexes (Sinapi).[20] Individual costs vary by state, so the reference value presented is an average of the global costs divided by the demand.

TABLE 3
Number of families with inadequacies and respective solutions

Type of inadequacy	Housing improvement solution	Description	Number of families (Cadastro Único, 2019)		
			Urban	Rural	**Total**
Inappropriate wall material	Total reconstruction	Families who live in a household where the predominant material of the external walls is reused wood, straw, or other material (except masonry, rustic wooden walls and adobe).	410,405 (4.9%)	372,066 (7.4%)	**782,471 (5.8%)**
	Exterior wall cladding	Families who live in a household where the predominant material of the external walls is adobe without plasterwork.	98,708 (1.2%)	254,891 (5.1%)	**353,599 (2.6%)**
Excessive density with the possibility of housing improvement	New isolated/contiguous room	Families who live in a household where 3 or more people sleep in one bedroom, excluding apartments.	2,767,963 (33%)	850,727 (16.9%)	**3,618,690 (27%)**
Lack of bathroom	New isolated/contiguous bathroom	Families who live in a household without a bathroom or toilet, either in the household or on the property, excluding apartments.	381,457 (4.6%)	978,445 (19.4%)	**1,359,902 (10.1%)**
Inadequate floor material	Cement screed and ceramic tile flooring in a standard room	Families who live in a household where the predominant material of the floor is earth or reclaimed wood.	471,867 (5.6%)	537,916 (10.7%)	**1,009,783 (7.5%)**
Lack of piped water	Review/installation of plumbing and sanitary installations	Families who live in a household without piped water in at least one room.	924,965 (11%)	1,925,031 (38.3%)	**2,849,996 (21.3%)**
Lack of sewage	Septic tank and drainfield	Families who live in a household without connection to a sewage or septic tank system, excluding apartment-type homes.	4,379,630 (52.3%)	2,861,776 (56.9%)	**7,241,406 (54%)**
Absence of water supply by public network	Water tank	Families who live in a household that is not connected to the general distribution network.	2,110,541 (25.2%)	3,500,856 (69.6%)	**5,611,397 (41.8%)**
Lack of electricity in the household or rooms	Review/installation of internal electrical network	Families who live in a household without an electricity meter.	1,264,080 (15.1%)	738,442 (14.7%)	**2,002,522 (14.9%)**
Total number of families living in their own household with at least one type of inadequacy			**8,377,532 (36.8%)**	**5,030,919 (83.5%)**	**13,408,451 (46.6%)**
Total number of families registered in Cadastro Único			**22,742,536 (100%)**	**6,025,132 (100%)**	**28,767,668 (100%)**

Authors' elaboration.

TABLE 4
Individual costs of solutions and global costs of a housing improvement program

Type of inadequacy	Housing improvement solution	Average individual cost of the solution (R$)	Global costs of the Program (R$)
Inappropriate wall material	Total reconstruction	95,500.28	74,726,196,082.00
	Exterior wall cladding	7,368.87	2,605,624,470.00
Excessive density with the possibility of housing improvement	New contiguous room	14,372.66	52,010,190,238.00

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20. Information available at: https://www.caixa.gov.br/Downloads/sinapi-demonstracoes-de-uso-fichas-tecnicas/Ficha_Tecnica_13105.pdf.

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Type of inadequacy	Housing improvement solution	Average individual cost of the solution (R$)	Global costs of the Program (R$)
Lack of bathroom	New contiguous bathroom	11,230.32	15,272,133,692.00
Inadequate floor material	Cement screed and ceramic tile flooring in a standard room	992.05	1,001,754,361.00
Lack of piped water	Review/installation of plumbing and sanitary installations	2,624.06	7,478,569,544.00
Lack of sewage	Septic tank and drainfield	4,702.52	34,052,851,435.00
Absence of water supply by public network	Water tank	711.15	3,990,572,827.00
Lack of electricity in the household or rooms	Review/installation of internal electrical network	924.72	1,851,768,765.00
Global costs *without* total reconstruction			**118,263,465,332.00**
Global costs *with* total reconstruction			**192,989,661,414.00**

Authors' elaboration.

Of the 28,884,000 families registered in Cadastro Único in 2019, 28,767,688 had complete and consistent records and were therefore considered in the analysis. Thus, the proposed methodology indicates that at least 13,408,451 families (46.6%) of the total of 28,767,688 included in the analysis could benefit from a program of free technical assistance and housing improvements.

Based on this demand, it is estimated that an investment of over R$ 118 billion would be necessary in housing improvements, without considering cases of housing deficit (total reconstruction of rustic households). Considering total reconstruction, the global costs would be of R$ 192 billion.

It is important to highlight the limitations of the methodology applied. The number of beneficiaries and costs could be even higher, since, as already pointed out, not all low-income families are registered in Cadastro Único and there are other types of building inadequacies that are not registered by the questionnaire. On the other hand, it is not possible to state that the proposed solutions are applicable in all cases in which precariousness has been identified. It is possible that some households without public water supply already have a water tank, for example.

Therefore, the quantitative analysis of demand and global costs is a work in progress. The research foresees the inclusion of new data sources, which will be combined to obtain a more accurate estimate.

The REG MEL program proposed to invest resources through "housing improvement kits" for each type of inadequacy. It is understood that the Ministry of Regional Development (MDR) took as a basis for the elaboration of the kits suggestions and evaluations carried out by the Inter-American Development Bank (Eloy et al., 2021), in addition to the results of partnerships with the Federal Comptroller General's Office (CGU) and the Federal Court of Accounts (TCU).

The typology of inadequacies presented below was drawn up based on the Cadastro Único variables (tables 3 and 4 and solutions presented), the housing improvement kits of the REG MEL Program and the housing improvement kits developed by the Federal District Government (GDF) through the Codhab and, obviously, the identification of the type of inadequacy referring to each of these kits.

TABLE 5

Housing improvement services related to the different types of inadequacies

Type of inadequacy	Housing improvement (solution)
Rustic household, expressed in inadequate wall material	Partial reconstruction or wall cladding or total reconstruction
Excessive density with the possibility of renovation	New isolated/contiguous room
Lack of bathroom	New isolated/contiguous bathroom
Inadequate floor material	Cement screed and ceramic tile flooring in a standard room

(Continues)

(Continued)

Type of inadequacy	Housing improvement (solution)
Lack of piped water	Review/installation of plumbing and sanitary installations
Lack of sewage	Septic tank and drainfield
Absence of water supply by public network	Water tank
Lack of electricity in the household or rooms	Review/installation of internal electrical network
Inadequate coverage[1]	Total roof replacement without reuse of existing materials or partial roof replacement with reuse of existing materials
Inadequate bathroom[1]	Bathroom renovation
Inadequate household accessibility[1]	1 meter accessibility ramp module
Inadequate bathroom accessibility[1]	Adapted bathroom
Non-existent internal coating[1]	Internal coating (plasterwork) and painting with PVA latex for wall [cost per room]
Non-existent external coating[1]	External coating (plasterwork) and painting with acrylic PVA for a 42 m² household
Non-existent/inadequate door[1]	Door removal/installation
Non-existent/inadequate window[1]	Window removal/installation
Non-existent/inadequate roof insulation[1]	Roof insulation installation
Lack of ventilation in the room[2]	Construction of a ventilation shaft
Inadequate door and window structure[2]	Structural repair (beams/joists)

Authors' elaboration.
Notes: [1] Inadequacies incorporated from the REG MEL normative.
[2] Inadequacies incorporated from the Codhab-DF practices.

The forms of inadequacy presented are being used as variables in the Ipea-CAU/Brasil research, which is currently in the data collection phase. A research form was designed so that local governments, entities and organizations that carry out housing improvement actions can inform the dimension of the evidenced precariousness and their specific types of inadequacies. This next stage of research, together with the preliminary data presented here, was announced at the Housing Week of CAU/Brasil, held in the city of Aracaju, state of Sergipe, in the Northeast of Brazil from July 25 to 29, 2023, which celebrated the 15th anniversary of the Athis law.

Once this set of 19 types of inadequacies to be tackled by public policy has been defined, at first through kits, and knowing that only 8 types of inadequacies can be estimated by Cadastro Único, information is being sought regarding the surveys of the housing conditions of the dwellings that are the subject of already implemented housing improvement policies.

In this way, we hope to be able to infer the behavior of the variables not present in Cadastro Único by comparing them with the general picture observed from the data collected, coming from experiences on a sub-national scale – whether regional, state or local – in order to measure the demand for housing improvements or even for carrying them out.

Finally, the most auspicious initiative in the research to qualify and quantify the necessary housing improvements comes from the IAB, Maringá branch (IAB-Maringá), in partnership with the FJP and CAU/Brasil. The IAB-Maringá, together with the Municipal Health Secretariat, built a municipal housing diagnosis instrument that consists of a questionnaire applied by Community Health Agents (ACS) with a focus on sanitary and housing conditions that affect the health of citizens (Ferreira, 2022). The first data from this survey, as well as the questionnaire, were kindly provided to Ipea and used in the definition of the proposed methodology, as well as in previous analyses that corroborate the intention to "extrapolate" the inadequacy variables of Cadastro Único to the larger set of existing realities.

It is currently being evaluated, and the stage of analysis of the technical and state capabilities of this research will seek to show, that this initiative in Maringá is a kind of pilot for the most consistent and viable model for collecting data on the health of, their households and their living environment.

In the next steps of this research, the preliminary results of the survey in Maringá and practical intervention experiences gathered in partnership with CAU/Brasil and CAU/UF will be used to estimate the types of housing inadequacies that are often associated, as well as an average estimate of the costs of interventions.

7 CONCLUSIONS REGARDING THIS STAGE OF THE RESEARCH

This technical note sought to highlight the transversality of the theme of housing improvements in relation to the SDGs, pointing out the relationships between housing improvements and the SDGs and their potential in the accomplishment of the 2030 Agenda in Brazil.

It was identified that housing improvements are directly or indirectly related to all 17 SDGs, with 26 Brazilian indicators functional for the assessment of housing improvements, in addition to 12 indirectly related.

Additionally, it is important to highlight that housing improvements are directed primarily to the most vulnerable groups of the population, in line with the SDGs' "Leave no one behind" pillar and with the principles that rule the federal government's social policy based on Cadastro Único.

The links between SDGs and housing improvements reveal the centrality and potential of housing improvements, as a public policy, to act as an umbrella for sectoral policies that converge towards the 2030 Agenda.

In this sense, Ipea and partners, notably CAU/Brasil, have been developing efforts to define a programmatic structure for a housing improvements' public policy in Brazil, embodying this potential.

With the diagnosis in hand, which at the moment is an estimate of the existing inadequacies, the next step is to quantify technical and state capacities and to calculate the necessary investment volume to overcome these ailments and advance the country towards a less unequal society, with greater access to services and opportunities, sustainability, and resilience.

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