

# GAPS AND INNOVATIONS IN THE PRODUCTION ON GENDER AND GEOSPATIAL INDICATORS



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**Gaps and innovations in the production on gender and geospatial indicators.**

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# 1

## INTRODUCTION



The adoption of the 2030 Agenda and the Sustainable Development Goals (SDGs) made it possible to advance the gender agenda by making its mainstreaming and centrality visible in order to move towards a more equitable and lasting development model. Unlike the Millennium Goals (MDGs), the SDGs and the 2030 Agenda present a perspective that diversifies the topics covered from a gender perspective. This translates into 54 gender-sensitive indicators, which cover diverse topics such as poverty, food security, health, education and access and preservation of natural resources. However, the monitoring of these indicators presents greater challenges in terms of the collection and availability of information, the harmonization of data sources, as well as the disparities in the coverage of gender statistics between countries and over time (UN Women 2018).

Precisely one of the areas of opportunity to advance the rights of women and girls is found in the construction of spatial gender indicators. On the one hand, a key element of the gender agenda of the SDGs requires disaggregating goals and indicators not only by sex but also with the highest spatial and temporal resolution, in order to better visualize gender disparities in the territory and contribute to direct interventions and monitor their effectiveness. On the other hand, the increase in georeferenced data from multiple sources -censuses, remote sensors, big data, administrative records- makes it increasingly viable to collect the data to generate indicators that are more comprehensive in terms of the social dimensions, and at the same time allow small-scale estimates to be made.

Despite the demand and potential for information, there is still a significant lag in the definition and use of spatial indicators in monitoring the progress of women. Although there is a growing push for the construction of gender indicators at the subnational level, their coverage is still scarce. Furthermore, it is the limited use of other dimensions and spatial data that keeps us from seeing gender disparities. This report aims to make an overall assessment of the presence of the spatial dimension in international gender statistics, while offering an overview of the potential of this perspective, presenting the tradition of existing studies in the field, as well as recent methodological innovations. In order to make the study viable, the study concentrates on two themes: women's participation in paid work and care work.

These two themes make it possible to clearly illustrate both the conceptual and methodological discussions in studies on the geography of gender inequalities, and both are central to the UN Women Report "Progress of the World's Women 2019-2020." This confirms the importance of women's labour participation for their economic empowerment, but also points out the great territorial disparity that exists in this indicator. In addition, the report shows that women continue to do most of the unpaid domestic and care work and points to the centrality of the provision of social security to reduce the gender gap in care and in women's inclusion in the labour market. Additionally, this delimitation will allow better linkage with the other components that are being developed in the project of El Colegio de México.



## Objectives and Report Design

### Objectives

The study systematizes the conceptual discussion and innovative methodologies for the construction of geospatial gender indicators, concentrating on the discussion on women's paid work and care. On the one hand, the document takes stock of the contemporary discussion on the processes and mechanisms of the geographical construction of gender inequalities. On the other, it reviews the spatial indicators used and the georeferenced information that supports them. By focusing on the literature on women's labour participation and women's care work, this paper will examine central aspects of gender inequality, for which there is a robust set of indicators and databases. For this reason, the discussion of the spatial perspective and its georeferenced data requirements will be particularly illustrative of the potential of this approach for other areas of gender statistics.

### Specific objectives

- a) Synthesize the discussion on the spatial construction of gender inequalities, with particular attention to identifying spatial attributes that condition gender inequality (distance, territorial distribution, accessibility, territorial segregation, etc.).
- b) Examine the construction of the spatial indicators used to account for gender inequalities, with particular attention to the type of data and methodologies that allow the integration of data, as well as improve the temporal and spatial resolution of the indicators.
- c) Identify gaps and potentialities in international gender indicators in terms of incorporating the spatial dimension.

### Methodology

The study was based on a bibliographic review and on indicator systems that intersect the gender and spatial perspective. We searched for studies published in the two themes of the report (care and paid work), which focused on those studies that, on the one hand, explicitly discussed gender disparities and the role that space plays in their production. And, on the other, the review of those empirical works of a quantitative nature was favoured. At the same time, the minimum list of gender indicators of the United Nations Statistics Division and the UN Women indicator system were reviewed. As well as international initiatives for systematization and production of spatial information (PopGrid, Worldpop, IPUMS-Terra) in order to weigh the methodologies and information by sex offered by each of them. Of course, the scale of this project made a review of the national initiatives that might exist in this area unfeasible, a recommended task to be carried out in subsequent evaluations.

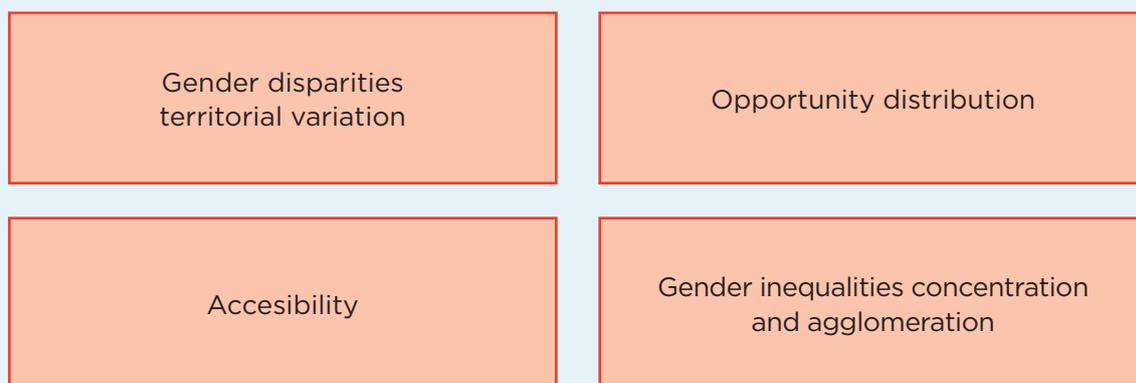
Throughout this document we will show that the construction of gender inequalities occurs in and across space, that is, not only are territorial disparities observed in key indicators, but the way in which the territory is appropriated, mobilized and perceived also contributes to produce these gender differences. This report identifies four thematic areas where gender spatial statistics can advance. Each of them is associated with a different set of indicators and favours different methodological approaches (see Table 1).



First, we will point out the importance of being able to document territorial variations in gender disparities on the international agenda and the centrality of having standardized indicators at different scales. Although this has been the aspect where most progress has been made in recent years, there is still a long way to go due to the diversity of the sources and the statistical representativeness of the sources responsible for collecting information, as well as the diversity of geographic units with which they work.

In addition to the need to construct the gender indicators that are shown today in the System of United Nations at different scales, this proposal argues the need to consider spatial dimension as an axis that informs how these inequalities are generated. For this, it suggests considering three aspects: a) inequalities in the territorial distribution of opportunities for women and girls, such as employment, education, health services or care services; b) accessibility to these opportunities in terms of the distance from the areas of residence or employment, or connectivity and access to means of transport and, c) the concentration or agglomeration of disadvantages, such as areas of concentration of poverty, low female labour force participation or high inequality in burdens; this dynamic adds to the individual experience of these conditions by pointing out the existence of social and institutional spheres that perpetuate gender inequality. Throughout the text, we show the relevance of these themes to understand women’s labour participation and care disparities, as well as pointing to some advances some advances in understanding how to account for spatial dynamics.

**Table 1.** Thematic axes of geospatial statistics on paid work and caregiving



**Source:** Prepared by the authors.

This document is organized as follows. The first section briefly presents the discussion on how space influences the production and reproduction of gender disparities, with special emphasis on labour participation and care work. The second section starts from the review of the United Nations System’s gender indicators to illustrate the potential of the spatial perspective to respond to some of the challenges identified in the report “Turning promises into action” (UN Women, 2018). A third section reviews the progress in the construction of geospatial indicators in the four themes previously mentioned, taking stock of the most commonly used approaches and some innovations in the field. The document concludes by briefly stating some recommendations to advance in the construction of gender spatial statistics in conceptual terms, data infrastructure and human capacities.



# 2

## SPACE AND GENDER



The conceptual framework on gender and geography goes over the fundamental discussion about how gender construction has changed over time, to incorporate questions about how the meanings of the categories “man” and “woman” vary in context and place, as well as assigned roles, standards of regulation of sexual behaviour, symbolic structures that affected people’s lives and practices (Scott, 2010). In other words, it analyzes the ways in which gender roles and relationships, as well as their consequences, are manifested geographically (McDowell, 1999). In order to identify the peculiarity of the spatial perspective, a brief synthesis of the non-spatial mechanisms through which gender disparities occur is first presented. This allows us to underline the contributions of the geographical perspective in the second part of the text.



## 2.1 INEQUALITIES OF WOMEN IN PAID WORK AND CARE

Gender is mutually constructed through a series of social relationships, including the workplace and household — which are also workspaces. The advantages and disadvantages conferred by masculinity and femininity vary in space and time, as they intersect with class relations, change in the labour market and place-specific geographic relations, including forms of regulation (McDowell, 2016). In order to show the contributions of this spatial perspective, in this first moment the discussion about care and its interrelations with the labour participation of women is synthesized. The second section shows which aspects are put on the table by the geography of gender inequalities.

Caring for people is a fundamental daily activity in any society. As it was carried out in private and domestic spheres, it was invisible, without recognition, and the fundamental contribution that this work represents for the sustainability of society as a whole has been overlooked (Boyer, 2003; Elizalde-San Miguel, 2018). Care practices are rooted in gender ideologies and hegemonic conceptions of family and care that circulate through public discourse, as well as in spaces of social interaction (Herrera, 2012). Thus, care work has been considered as a feminized activity, lacking economic and social value.

The devaluation of domestic work is part of a social construction based on the sexual division of labour, a situation that leads women to be the main historical support of this task. The invisibility of domestic work lies in the production of the subsistence of others, which transcends economic value, since it is also social and affective (Esparza Zamarripa *et al.*, 2017)<sup>1</sup>.

1 The terms “unpaid work” and “care work” [unpaid] have some degree of overlap, but should not be used interchangeably. The first encompasses activities that do not receive direct compensation such as work on the household plot, collecting water or firewood, and domestic chores such as cooking and cleaning. Unpaid care work includes direct care, or care of people without thereby receiving an explicit monetary reward. It is often seen as separate from the other activities that make caregiving possible, such as preparing meals, shopping, or cleaning. However, these limits are arbitrary, especially considering that people who need care are often unable to carry out these tasks on their own (UN Women, 2018).



Care does not only apply to dependent people, but ends up encompassing all the members of a family group, whether or not they are in a situation of dependency (Jirón & Gómez, 2018). In 2015, there were 2.1 billion people in the world in need of care: 1.9 billion girls and boys under 15 years of age, 200 million elderly who had reached or exceeded healthy life expectancy. By 2030, the number of people with care needs is projected to reach 2.3 billion, including 110 to 190 million people with severe disabilities who may need care or assistance throughout their lives (ILO, 2018).

Care activities are seldom shared equally between people, between families, between men and women, between women of different social classes and, with globalization, between nations. More precisely, international statistics coincide in pointing out that women continue to do most of this work throughout the various countries, although the gap in men's and women's care work decreases as in terms of income and age of children (UN Women 2019, Chapter 5), inequality intensifies in families where there are dependent children and older adults (Herrera, 2012; Esparza Zamarripa *et al.*, 2017).

In addition, women's entry into the workplace has not been translated into a proportional reduction in their care work, but they continue to take care of it, as well as of domestic work (Jirón & Gómez, 2018). However, some studies document certain changes in chores in which males participate. For example, in Costa Rica, male heads of the household, along with sons and daughters under 12 years of age spend, on average, more time on activities such as playing, reading stories, comforting and pampering, while women bear the weight of more routine tasks such as bathing, dressing, grooming, changing diapers, or transferring the girls to other personal care activities (Espinosa Herrera, 2016).

In countries with low coverage of public services for children and the disabled, families need time transfers from their relatives for care activities. In middle or low income households, it is other women who carry out care work and enable young women with children to enter paid work despite the lack of preschool and childcare services (Durán Heras, 2005). In countries where neither public services nor men assume responsibility for the provision of care, women in the highest income quintiles tend to resolve this tension -between the obligation to care and their wishes for work and personal development -by hiring care services from third parties.

Throughout the world, domestic work is a feminized sector and constitutes an important source of employment for women (Molano, Robert García, 2012). In more developed countries, these processes have given rise to "global care chains" by having a replacement of women who are relatives of the caregiver with migrants, who in turn have left their families in their countries of origin under the care of other women (Hochschild, 2000). This underlines inequalities in care not only between men and women, but also as a juxtaposition to gender inequalities of those of socioeconomic status, race, ethnicity and immigration status (England & Folbre, 1999; Neysmith & Aronson, 1997).

Care work is not just the responsibility of the family or the market. In countries with broader welfare states, the issue appears on the public agenda as a service with the potential to reap social and economic benefits. However, the focus has been on child-care through stays and nurseries as a means for mothers to access and reintegrate into the labour market (Gallagher, 2013). The policy package to reconcile work and family life varies substantially between countries, including actions from paid parental



leave, shorter workweeks, protections for part-time and reduced-time workers, and affordable child and senior care services. Globally, the Nordic countries have the largest number of policies that aim at conciliation. Sweden is the most representative case for this group (Meyers & Gornick, 2004).

There is a consensus that unequal burdens in domestic and care work and, more generally, the gender roles and stereotypes associated with these limit women's labour insertion. In 2018, the global rate of female participation in the labour market was 48.5 percent, 26.5 percentage points lower than that of men. The gap in participation rates between women and men is narrowing in developing and developed countries, but continues to widen in emerging countries. This difference in participation is particularly large in North Africa, South Asia and the Arab States, where no change in trends is expected due to cultural and gender patterns. In developed countries, female participation rates are approaching that of men, where the gap is currently 15.6 percentage points, although it remains broad especially in Southern Europe. The smallest gaps are in emerging countries, with only 11.8 percentage points difference (ILO, 2018).

At the macro level, the increased participation of women at the national level relates to the country's economic conditions. The countries with the lowest poverty rates are those with the highest participation of women in out-of-home jobs. In addition, it is also associated with better institutional capacities in employment and care, as well as favourable working environments for women. Studies in OECD countries show that the variation in female labour participation also depends on public policies that shape women's decision to enter—or return—into the labour market and paid activities (Gornick *et al.*, 1997). Such family policies include direct monetary transfers, paid maternity and paternity leave, provision of childcare services, medical expense insurance, among others.

At the micro level, female labour participation is associated both with earning potentials, that is, educational level, work experience or occupation, but also with restrictions linked to domestic and care work (Van Ham & Büchel, 2006; Gornick *et al.*, 1997). This double tension means that women have a lower participation or that they do so in part-time positions, flexible schedules and short commutes (Sparreboom, 2014; Esparza Zamarripa *et al.*, 2017).

In addition, women face the conditions in the job offer both in terms of the availability of jobs that fit their searches and needs (working time, schedules, closeness, etc.) (England, 1992; Hegewisch & Gornick, 2011), as in terms of employer recruitment practices. In addition to the management and separation in employment positions that occupational segregation by sex entails, studies on employment discrimination by gender indicate that employers do not hire women when they are mothers (Gatrell, 2011), as they are associated with longer absence times. It is argued that discriminatory behaviour focuses mainly on highly qualified positions, as employers perceive their temporary and/or intermittent absences as the most difficult to manage (Hegewisch & Gornick, 2011). Labour regulation of part-time contracts, scale and entry to occupations affects the degree of gender discrimination in labour markets (Reskin, 1991; Hegewisch & Gornick, 2011; Gatrell, 2011; Byron & Roscigno, 2014). This discrimination is accentuated when considering factors such as race or migration status. Black women have been found to be associated with a role of single mothers, increasing their chances of being problematic for the white employer, so they are only assigned low-responsibility and low-training positions (Kenelly, 1999).



However, women in seeking better jobs are driving individual and collective changes that defy their exclusion from predominantly female jobs (Reskin, 1991). For example, entrepreneurs are changing opportunity structures by compensating for the needs of their families and communities. As employers, they offer other opportunities and working conditions for those male-led businesses. They challenge gender stereotypes and discriminatory structures (Hanson, 2009).

Globally, women are estimated to make 77 percent of what men earn. Since gender pay disparities can only be reliably calculated for those working under the wage regime, these figures underestimate the true extent of income gaps in many contexts, especially in countries where there is a high incidence of informal self-employment (UN Women, 2018). Although the pay gap has been closed, differences can be seen in how it continues to affect women around the world differently. The pay gap is more pronounced in South Korea, which has a 37 percentage points difference in men's and women's pay. The United States and Canada have a disparity of about 18 percentage points, while Luxembourg ranks at the lower end of the scale, with a pay gap of 3 percentage points (World Bank World Development Indicators, OECD, 2016).

The difference in pay can be explained because women have lower human capital than men, although they have also been shown to have lower return for the same capital (Gangl & Ziefle, 2009) and because women tend to have temporary jobs and prolonged breaks in the labour force (Kalleberg, Reskin & Hudson, 2000). In addition, mothers have been shown to generate less money than childless women, and married mothers are even more penalized (Budig and England, 2001).

The role that governments play is critical to encouraging or discouraging women's labour participation. The adoption of anti-discrimination or employment regulation laws have allowed women to enter traditionally male spaces (Reskin, 1991). Over the past decade, governments, together with employers, workers and collective organizations, have taken a number of steps to solve the problems facing women in the world of labour (ILO, 2018).

Family and gender policies include direct monetary transfers, paid maternity and paternity leave, provision of childcare services, medical expense insurance (Gornick *et al.*, 1997). These institutional supports shape female labour participation, although they have had the unsought effect of strengthening occupational segregation by not seriously challenging the traditional distribution of family responsibilities between men and women (Gallagher, 2013; Sparreboom, 2014). Within the role of governments, the issue of the provision of public care services for children as a policy to facilitate women's participation by freeing them, at least partially, from their care burdens has been particularly important (Gallagher, 2013). This is part of the initiatives that seek to eliminate unequal demands on women to reduce gender gaps in the labour market (ILO, 2018).



## 2.2 A SPATIAL VIEW OF GENDER INEQUALITIES

The conceptual framework on gender and geography takes up the fundamental discussion about how gender construction has changed over time, to incorporate questions about how the meanings of the categories “man” and “woman” vary in context and place, as well as assigned roles, norms of regulation of sexual behaviour, symbolic structures that affected people’s lives and practices (Scott, 2010).<sup>2</sup> In other words, it analyzes the ways in which gender roles and relationships, as well as their consequences, are manifested geographically (McDowell, 1999).

In particular, studies have raised the question about the territorial determinants of female labour participation, both in terms of the distribution of jobs, the determinants of work commute, gender norms that restrict job search distances or accessibility to care and social provision services (Pratt & Hanson, 1988; Kwan, 1999; Borker, 2017). Likewise, the geography of care has been studied in relation to the domestic burdens that condition women’s mobility, the places where care is demanded, as well as the movements and activities of women between home, work and spaces of care, showing the difficulties in reconciling the demands between these three places (Yantzi & Skinner 2009; Milligan & Power 2010; Van Ham & Mulder 2005).

In analytical terms it is possible to identify different mechanisms through which space creates inequalities. This is why this document aims to show how the construction of gender inequalities occurs in and across space, that is, not only are territorial disparities observed in key indicators, but the way in which the territory is appropriated, mobilized and perceived also contributes to produce these gender differences. In this sense, throughout this apparatus we will seek to show the specific ways in which these spatial gender inequalities are constructed from basic geographic concepts: distribution, accessibility and concentration and agglomeration (see Table 1).

A fundamental element is understanding that social inequalities vary across the territory and occur at different scales. In a specific sense, the scale refers to the level of aggregation in which a social phenomenon occurs and the spatial unit at which the indicators are generated, for example, at the neighbourhood, municipal, state, regional or national scale. Territorial variations can occur in gender inequality and at the same scale, for example, when comparing the participation rate among countries (national scale) or analyzing its variations among states. Of course, gender inequalities also occur at different geographic scales and account for different processes that occur at them. This is because the geographical scale is not only the territorial delimitation of a space on the globe, but it is delimited by power relations established within it, as well as by historical differences in the configuration of norms and expectations gender (Hanson & Pratt, 1995; Massey, 1994; McDowell, 1997, 1999). Thus, for example, the programmes available for the care of families with young children vary by levels of government (municipalities, states or national government), as well as the own institutional

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2 In a fundamental sense, at the center of the sexual division of labor is a spatial separation between the public space defined as masculine and the domestic space characterized as feminine.



capacity of governments to implement them and the political actors who support or oppose these programmes. In such a way that the coverage and effectiveness of these programmes may differ and, therefore, also inequalities in care.

Accounting for territorial variations and differences between scales is essential to shed light on the disparate advances in achieving the rights of women and girls, as well as to identify vulnerabilities experienced by population subgroups. Furthermore, recognizing where these lags are can help guide public policy interventions and increase their effectiveness. Thus, studies show not only high variations in the rate of female labour participation between countries but also within them. Various works expose profound disparities in the levels of female labour participation at the sub-national level, as well as their evolution in recent decades. Sakanishi (2015) finds that the greatest regional differences in women's economic participation rate are observed between married women and the ages of young children, suggesting the importance of locating care services to balance participation rates. For their part, various studies such as those by McLafferty & Preston (2019) and Wylie (1996) show that small-scale estimates at the neighbourhood level in cities can illuminate spaces of high job vulnerability of ethnic and racial minorities and guide public policy interventions.

In addition to territorial differences in the various gender indicators, it is central to understand to what extent territorial differentials contribute to generating gender inequalities. That is, to what extent the distribution of jobs, goods or services offers a different geography of opportunities for its residents (Briggs, 2005; Galster & Sharkey, 2017). This geography of opportunities is not neutral, it reflects pre-existing social inequalities, but it also contributes to producing a territorial stratification in terms of housing supply, local habitability conditions, security, availability of health and education services or jobs. These local elements play a central role in the growth and social mobility of individuals and their families (Chetty *et al.* 2014), but these conditions are more important for women as they face restrictions on their geographical mobility that makes it necessary to assess the conditions in their close contexts. From this perspective, achieving the rights of women and girls requires evaluating a spatial justice component: “who” gets “what”, “where” and “how” in a territory. It is therefore necessary to prioritize “where” as a reflection of an understanding of living standards and access to various elements of daily life with respect to people's residential location (England, 1996).

Due to the roles assigned to women, they are usually more geographically constrained, which is observed in the configuration of their daily practices, but also by the location and provision of services, particularly care (England, 1996). Women's daily life is structured according to the assigned gender roles. In these chores, care work of children, the elderly and partner not only demand a substantial part of their time, but also structures their mobility in the city Scheiner & Holz-Rau (2017), which becomes more complex when women enter the labour market<sup>3</sup>. Women build their daily lives based on their double or triple workload, this leads them to be “trapped” in local spaces, such as home or the neighbourhood. Men and women have been shown to make use of everyday space based on this inequality in workloads (Cooke, 1997). The spatial restriction of women is associated with the traditional roles of caring for the home and children. In contrast, women have been shown to take shorter trips, seeking to work closer to

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3 The study by Baum & Mitchell (2010) indicates that 0 percent of men in Australia consider the difficulty of finding childcare or elderly care as a factor in their job searches, as well as evaluating other family responsibilities, while for women they are.



their homes or to childcare sites or schools. This emphasizes the differences in commute time to work for men and women, the latter being those who seek to be closer to home. International studies report that this trend continues in European, North American and Asian countries. Among the factors that women point out when considering work is the time it takes them to commute to work. That is, women prefer to travel less daily, compensating for this commuting time with lower wages or part-time jobs (Liu, 2019; McLafferty & Preston, 1996; Shearmur, 2006; Sparreboom, 2014). On the other hand, men are not constrained to local spaces for their search and work exercise. It has been shown in multiple studies that they take longer trips to work compared to women (Baum & Mitchell, 2010; Camstra, 1996).

Furthermore, poor and segregated neighbourhoods in cities spatially constrain the kinds of jobs that women can access (England, 1993). In these cases, women work in low-paid, informal, or altruistic activities (Parks, 2004). Another mechanism that women follow in these spaces is self-employment (Biles, 2008; Poon *et al.*, 2012). An example of this is the cataloguing strategies that women carry out in their closest environments, both spatially and emotionally (Cahn, 2007). The other side of the coin is experienced by women who work in high-ranking jobs or linked to technological services, who rather seek to relocate their residence based on their employment and care services in order to balance the multiple demands. However, this flexibility is not possible for many women (Wright *et al.*, 2017).

In least developed countries, spatial entrapment is also observed in rural spaces, where women are inserted in informality or in precarious positions due, in part, to their low mobility. For example, in Kenya female heads of household must be self-employed in informal activities in rural centres (Aspaas, 1998). Women in non-urban areas experience a very similar situation in Vietnam (Poon *et al.*, 2012). In Mexico and Central America, the location of maquiladoras favoured occupational segregation by sex, as well as the feminization of employment in broad territorial textile sweatshops. Although it also contributed to the increase in women's labour participation in areas where these companies were established (Grijalva-Monteverde & Covarrubias-Valdenebro, 2004).

A second element that entraps women in local spaces is job segregation in female-dominated activities. In this sense, studies have shown that women work close to their homes and they are typically assigned in activities such as jobs in personal services, care or services, and other low-skilled professions, including chores such as cleaning or food preparation. But this entrapment is not only due to women's preferences, but also to employers' strategies. Thus, previous studies have documented "pink-collar jobs" regarding the relocation of jobs aimed at feminized occupations (care, personal services or certain manufacturing branches) (England, 1993). Employers may consider women's travel restrictions either as a mechanism of discrimination in the labour market so as not to assign them higher positions, or by locating their establishments to take advantage of these restrictions and offer lower wages given the lack of opportunities, which contributes to spatial segregation and entrapment (Hanson & Pratt, 1995).

Another factor that influences spatial restriction in women's daily life is dependence on public transport. While middle-class men tend to use the car more and take longer trips to work (Scheiner and Holz-Rau, 2012), women confront gender stereotypes regarding car ownership and driving (Ndlovu, 2014). At the same time, it has been widely



documented how sexual violence that women experience in public transport restricts their movements (Mejía-Dorantes & Soto Villagrán, 2020) and can negatively affect their educational and labour insertion.

Restrictions on mobility that women experience tend to reinforce inequalities that they face in other spaces. If their job searches are more geographically restricted, their job opportunities will be, too, both in terms of salary and working conditions. Furthermore, geographical and social entrapment also conditions that women's networks are likely to be more local and family-friendly than those of men, which also limits their activities to nearby spaces (Hanson & Pratt, 1991; Pratt & Hanson, 1988; Sparreboom, 2014).

Under these conditions, the provision of care shapes women's daily life. On the one hand, the search for jobs close to home is influenced by family structure and the availability of community networks. Women can take longer trips to paid work due to the availability of other caregivers in their homes (such as grandparents or close relatives, usually women), or neighbours. This is generally the case in poor or spatially and racially segregated localities (Cooke, 1997; McLafferty & Preston, 2019; Parks, 2004). A more egalitarian division of labour between couples contributes, but, in general, it has been found that not only do women do most of the domestic and care work, but it also has a greater impact on women's commutes than in that of men (Carta & Philippis, 2018; Gimenez-Nadal & Molina, 2016).

Beyond family and community care, the provision of care services is a fundamental element for gender equality and the equitable location of these services is essential to achieve it. In this regard, England (1996) points out that concern for care services must be addressed from different geographical scales, since disparities often become more evident on smaller scales. Thus, while in rural settings the provision of care services is practically non-existent, in urban settings the location of these services crosses other social dimensions. For example, in cities in North America the location of day care centres is concentrated in middle class areas. This leads to greater coverage and, potentially, a differentiated impact on the well-being of women and their families. Hence the need for indicators on the provision of this type of service in different contexts and at different scales.

There are two determinants in the spatial study of care services: their location and accessibility. Although studies of care have grown rapidly in the past decade, there are still few that include a geographic perspective, either by identifying the distance between family or community members exchanging care or by examining the location of public and private care services. On the other hand, accessibility accounts for the spatial ease with which care can be accessed, both for family and paid care services. Rainer and Siedler (2012) show how family support and distance configure the number of times a family cares for its older adults. The authors also find that in countries with public policies for elderly's care, family agreements are less likely to occur to pay for their care. It is important to consider accessibility in conjunction with location because a care service can be located very close to the household or workplace and be difficult to access due to natural or built barriers. In this sense, works such as those by Van Ham & Büchel (2006), Van Ham & Mulder (2005) and Langford *et al.* (2019) point out that accessibility to care services is directly determined by the socioeconomic class of the neighbourhoods. Similarly, such accessibility offers women greater possibilities of entering the labour market.



Finally, the role of the State is important in shaping the geography of the provision of services. The State is a fundamental actor for the provision and location of this type of services, either because it constitutes itself as a direct provider of them, because it regulates the provision from the market or because it relegates it to families (Fincher, 1996). In this sense, there is an important variation in the provision of care between and within countries, which reflects the policies for the development of the care system and the place assigned to it in the search for gender equality and the protection of lower income sectors (Schwanen, 2007; Fraga, 2019).

In addition to variations in behaviour, the distribution of goods and services, as well as their accessibility, space also plays a role in terms of promoting interactions between nearby towns or populations, leading to the spread or “contagion” of common behaviours. Thus, for example, units close to each other would tend to resemble each other in their socioeconomic indicators, while more distant units would resemble each other less (Anselin, 2005). This gives rise to the emergence of agglomerations of disadvantages or social advantages in the territory, in such a way that in certain areas you can see corridors of poverty, concentration of high infant mortality or, on the contrary, agglomerations of high school performance. The territorial concentration of disadvantages reinforces inequalities as residents must face not only their own levels of poverty but also the conditions of their neighbourhood or community, as well as those of the region. The territorial concentration of disadvantages would generate poverty traps by deepening both the lack of public services and institutional and organizational weakness, as well as by favouring the emergence of behaviours or social practices that contribute to the reproduction of inequalities (e.g. poor school performance, violence, etc.) (Sampson & Morenoff, 2004; Wilson, 1996).

Territorial agglomeration of units with similar socioeconomic profiles reflects, to a large extent, that these units share similar economic structures and social trajectories, however, they can also emerge through diffusion processes among them: imitation of the behaviour of their inhabitants, public policies that spread among municipalities, movement of actors or populations between neighbouring municipalities, among other mechanisms (Sampson & Morenoff, 2004). Thus, Weeks *et al.* (2000) show how the spread of contraceptive use among adjacent rural communities contributed to the decline in fertility in Egypt. Sundaram and Vanneman (2008) also find that spatial clustering of low literacy rates in India among girls is associated with high rates of female labour participation, suggesting that in certain regions this has been achieved precisely by incorporating minors to the labour force. The analysis of these clusters can shed light on where to guide public policy territorially, while identifying that the areas where disadvantages are accumulated could be a sign of both failures in the implementation of public policies and programmes (Tickamyer, 2000), and of areas where it is necessary to re-examine the assumptions under which we design them.

In summary, the previous discussion shows that space matters in multiple ways. First, it is necessary to examine the territorial variations that make it possible to better visualize the degree of progress in achieving the rights of women and girls while identifying particularly vulnerable subpopulations. The variations in the rate of labour participation between and within countries clearly illustrates the need for disaggregated indicators of higher spatial and population resolution. Second, the distribution of employment, services and goods is essential in the construction of a geography



of opportunities that allows progress to be made precisely in guaranteeing these rights. Therefore, indicators are required to conceptualize and operationalize which public and private assets affect the well-being of women and girls. Previous studies point out in the field of work and care, the importance not only that there are jobs and public care offered, but also how these are distributed in the space. Third, in this same sense, accessibility to these services, in terms of physical proximity but also connectivity to transport networks, needs to be evaluated as a spatial component that will affect the effective access that women have to care alternatives. Fourth, it is necessary to examine the extent to which clusters or agglomerations of disadvantage (or advantage) are formed in monitoring indicators, as these offer indications of priority intervention areas. In this sense, a territorial analysis of the performance of the indicators can contribute to the objective set forth in the UN Women report (2018) regarding the need to identify areas and subpopulations of high vulnerability.



3

GENDER-SENSITIVE  
INDICATORS OF THE  
UNITED NATIONS:  
HOW CAN A  
SPATIAL APPROACH  
CONTRIBUTE?



**Gender indicators have the special function of signalling social changes in gender relations over time. Its usefulness focuses on pointing out variations in the status and role of women and men at different times. And, therefore, to measure if equal opportunities are being achieved through planned actions (Dávila, 2004). Initially, the concern in the design of indicators had focused on the creation of quantitative indicators.**

Progressively, all the organizations pointed out the need to use perception measurement instruments to get closer to the experiences and realities of women (Dávila, 2004). In 2006, the Inter-agency and Expert Group on Gender Statistics emerged in an effort to renew and guide gender statistics programmes around the world (UN-ESC, 2010). Subsequently, the minimum set of gender indicators was created, consisting of 54 quantitative and 11 qualitative indicators that address issues relevant to gender equality and female empowerment. However, many of these vary significantly in their characteristics - structure, orientation, scope and production (UN, 2010).

The Global Action Plan for Sustainable Development Data calls for a “data revolution” that expands the volume, speed and types of data produced. It must include specific solutions to obtain higher quality gender statistics. The gaps that exist in gender statistics, widespread in both developed and emerging countries, are also due to the fact that the collection of these data has not been a priority (UN Women, 2018). Achieving regular data collection for gender-specific indicators ensuring quality and comparability will require increased technical and financial resources in national statistical systems. Gender statistics, in particular, lack sufficient investment and an adequate approach (UN Women, 2018). It should not be forgotten that international donors and public policy makers use the data to guide their government investments and priorities. When data is not available or does not adequately capture the reality of people’s lives, resources are allocated inefficiently and policies do not meet people’s needs (Fuentes & Cookson, 2019).

In an effort to remedy the lack of information to monitor the goals, which was a problem with the Millennium Development Goals, the indicator framework for the Sustainable Development Goals (SDGs) is made up of 232 indicators, of which 52 are sensitive to gender. Indicator reports will provide useful data for monitoring progress, weaknesses and challenges during implementation at the global and regional levels.

In terms of gender statistics, monitoring of the SDGs is restricted by three main challenges (UN Women, 2018). First, there is uneven coverage of the indicators, with the absence of readily available data and indicators focused on women and girls or capable of capturing gender inequalities. In addition, the aggregate indicators focus on analysis at the national level, which makes it possible to compare between countries, but not between population subgroups within countries. Second, gender-specific indicators are often based on data collection mechanisms ad hoc or on isolated exercises that are not integrated into national statistical plans and strategies (UN Women, 2018). This is reflected in the fact that few of the gender-sensitive indicators are level I, according to the classification of the Inter-Agency and Expert Group on Sustainable Development Goals Indicators. This level assumes conceptual clarity, established methodology, availability of standards for its elaboration and regularity in the production of the necessary data. Third, differences in sources, definitions,



concepts, population survey samples, and methods used jeopardize comparability of data between countries and periods. Tracking progress on gender equality in the SDGs requires access to quality gender data that is collected frequently and at regular intervals.

By April 2019, 34 of the 54 gender-specific indicators are produced regularly enough for the Inter-Agency and Expert Group on Sustainable Development Goals Indicators to classify them as level 1, that is, they can be followed up on a reliable way worldwide (UN Women, 2018). Another 13 indicators, although they have established methodologies, have insufficient and irregular national coverage to allow global supervision (level 2). Four other gender-specific indicators still require some degree of conceptual elaboration or methodological development in order to start producing data (level 3). The missing indicator has elements of level I and II. While this poses a challenge in measuring change and being used for monitoring, at least in the short term, it also offers an opportunity to improve the availability and quality of gender statistics (UN Women, 2018).

Limitations in the development of international standards also pose a challenge to national statistical systems, which in parallel are developing their own SDG monitoring plans and need this information to properly align their initiatives with global processes and ensure international data comparability (UN Women, 2018). Another crucial challenge is obtaining data that is not only disaggregated by sex and age but also according to other dimensions, including race, ethnicity, immigration status, disability, income, and other characteristics.

Tables 2 and 3 summarize the indicators available for the themes of economic empowerment and domestic work and unpaid care available at the United Nations Statistics Division (UNSD) and UN Women. They describe the indicator, the agency responsible for its compilation and the level of quality of the indicator, in terms of the specificity of its methodology, the regularity of its production and its conceptual clarity. The first table groups indicators that aim to measure female participation in the labour market. In addition to the basic indicators of labour participation rates, the inclusion of indicators that seek to measure it in different types of employment (self-employed, employers), as well as in different sectors of the economy, is observed. In addition, some agencies also recommend mediating participation by marital status and its degree of insertion in the informal sector of the economy. Additionally, the empowerment of women is also estimated based on their salary levels, inheritance rights, the presence of women in managerial positions or the institutional framework that promotes equality and family-work balance. Most of these indicators belong to level 1 of development, especially those linked to the measurement of women's labour participation, demonstrating that it is an area with a long tradition in international statistics.

**Table 2:** List of indicators of women's economic empowerment.  
United Nations System

Indicator	Custodian	Level
Participation rate in the labour force of people between 15 and 24 years, by sex	ILO	1
Participation rate in the labour force of people older than 15 years, by sex	UNSD	1
Participation rate in the labour force by sex and marital status*	UN Women	2
Proportion of self-employed workers, by sex	ILO	1
Proportion of working population who are employers, by sex	UNSD	1
Percentage of firms owned by women	UNSD	3
Percentage of the adult population that are entrepreneurs, by sex	ILO	3
Percentage distribution of the working population by sector, by sex	ILO	1
Percentage distribution of the working population in the agricultural sector, by sex	UNSD	1
Percentage distribution of the working population in the industrial sector, by sex	UNSD	1
Percentage distribution of the working population in the services sector, by sex	UNSD	1
Proportion of informal employment in the non-agricultural sector, by sex	UNSD	2
Proportion of total agricultural population with guaranteed property or rights to agricultural land, by sex	FAO	2
Proportion of the working population working part-time, by sex	ILO	2
Working population below the international poverty line, by sex, age *	UN Women / World Bank	2
Unemployment rate, by sex, age and persons with disabilities	ILO	1
Gender gap in wages, by occupation, age and people with disabilities	ILO	2
Equal right for sons and daughters to inherit property*	UN Women	2
Surviving spouses have the same right to inherit property*	UN Women	2
Participation of women in teaching positions	IPU	1 and 2
Proportion of women in management positions	ILO	1
Scope of the country's commitment to gender equality in employment	ILO	1
Maternity leave extension	ILO / UNSD	1

**Source:** Prepared by the authors, with information from 2018 from the Statistics Division of the United Nations and UN Women.

**Note:** for those indicators marked with a star, the level was estimated by the authors based on the United Nations criteria and the available methodological information. In the other cases, it comes from the agency involved.



Table 3 summarizes the indicators available for monitoring care activities and unpaid domestic work. Most of them focus on measuring the time spent on care and domestic work, distinguishing by age and location of women’s residence, while seeking to make an (indirect) estimate of their effects on paid work when calculating the time spent on it and the employment rate in the presence of young children. Likewise, indicators provide insight about care provision, both in terms of the number of children in formal care, and the extent of transfers to children and families. Unlike the indicators of economic empowerment, the indicators related to care are not produced regularly by the countries and, in several cases, there is still an ongoing discussion about how to measure them.

**Table 3.** Indicators of unpaid domestic work and care.  
United Nations System

Indicator	Custodian	Level
• Average hours invested in domestic and care work, by sex, age and location	UNSD / UN women	2
• Average hours invested in unpaid domestic work, by sex, age and location	UNSD / UN women	2
• Average hours invested in unpaid care work, by sex, age and location	UNSD / UN women	2
• Total average hours invested in work, by sex	UNSD	2
• Employment rate of people aged 25-49 with a child under 3 years of age living in the household and of households without children, by sex	UNSD	3
• Scope of the country’s commitment to support the reconciliation of work and family life	ILO	1
• Proportion of girls and boys under 3 years of age in formal care	OECD	3
• Proportion of households with children receiving cash transfers, by sex *	UN Women / ILO	1
• Proportion of mothers with new-borns receiving maternity benefits in form of monetary transfers *	UN Women / ILO	1

**Source:** prepared by the authors, with information from 2018 from the Statistics Division of the United Nations and UN Women.

**Note:** for those indicators marked with a star, the level was estimated by the authors based on the United Nations criteria and the available methodological information. In the other cases, it comes from the involved agency.



A weakness repeatedly pointed out in gender statistics is the disaggregation of information that makes it possible to make visible the differences between women's groups and better understand the multidimensionality of the difficulties they face (UN Women 2018; UN-IEAG 2014). The production of spatial gender statistics is an opportunity to advance in the consolidation of the system of gender indicators by shedding light on a dimension from where inequalities originate and by offering a technical approach to their estimation. On the one hand, a spatial look at gender indicators introduces the notion that it is necessary to account for the scale and territorial diversity of gender indicators as well as the distribution and accessibility of the conditions that affect the inequalities that women and girls experience. Likewise, it is also necessary to monitor the processes of concentration of disadvantages or advantages. On the other hand, the georeferencing of a greater volume of information offers the possibility of linking different data sources -traditional and non-traditional- as well as employing methods that explicitly use georeferencing of the information and allow the construction of multidimensional and smaller-scale indicators.

However, progress still needs to be made in this regard. Precisely because of the difficulties faced by gender statistics in terms of their completeness, periodicity and coverage, there is still a need to advance in the construction of geospatial indicators. These indicators would contribute not only to highlight the differences in conditions that women face, but also to a better understanding of how these inequalities are generated. Table 4 illustrates this point, while summarizing the recommendations of UN Women to advance SDG target 5.4. The suggestions point to the need to ensure that unpaid work is accounted for in surveys and to explore ways to distinguish between care and domestic work. It is recommended to show the differences between men and women in unpaid work, and also to disaggregate the differences between them. This points to the need for statistics with a greater territorial breakdown and by social categories (race, ethnicity, caste, economic position). In addition, it aims to document the infrastructure and services that increase or decrease domestic and care workloads. Although these can be approximated in surveys, it is also possible to take advantage of georeferenced information to construct indicators of their availability. The expansion of global data sources and computational methods of processing massive information makes it possible to consider this possibility even for areas where surveys are not possible.

**Table 4.** Sustainable Development Goals that frame this research

SDG 5. Achieve gender equality and empower all women and girls
SDG 5.4 Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate.
<ul style="list-style-type: none"><li>• Time use surveys are of great value in making unpaid domestic and care work visible in the statistics. Understanding the differences in the time use between women and men and within the diverse groups of women is the first step in reducing the heavier forms of care and in distributing care more equitably.</li><li>• The data should show the infrastructure aimed at reducing the burden of domestic work and unpaid care: access to running water, safe and decent sanitation services, less polluting kitchens, and efficient public transport, schools, health centres, residence for seniors.</li><li>• Care often overlaps with domestic work, making it difficult to accurately record statistics on face-to-face care.</li></ul>
SDG 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
<ul style="list-style-type: none"><li>• Gender inequalities in the labour market persist, and not only are women less likely to participate in it, but they are also more likely to focus on unstable, unprotected or poorly protected and low-paying jobs. Labour segregation and the gender pay gap persist in a generalized manner, everywhere. Gender equality in employment and women's access to decent work are essential for inclusive growth.</li><li>• The usual labour force surveys do not generally include the employment of women, which is more likely to be seasonal, informal and unpaid than that of men.</li></ul>

**Source:** prepared by the authors, based on the report Making promises come true from UN Women, 2018.

Derived from the ratification of declarations on gender equality on the international scene, such as the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW), the Beijing Platform for Action and the SDGs, many countries are making efforts to incorporate the gender dimension in the production and use of statistics. This is important, as unless this perspective is integrated into national statistical strategies and given priority in regular data collection processes, gender data shortages and gaps will persist. This means that one of the aspirations of the data revolution should be to provide greater political, technical and financial support to the entities responsible for producing official statistics (UN Women, 2018).

However, there are significant challenges for countries' ability to collect, analyze and disseminate gender statistics (Uganda Bureau of Statistics, 2018), as well as in terms of estimating and disseminating estimates at sub-national scales and expanding coverage



for groups that are difficult to measure and are currently invisible in national statistics (UN Women, 2018). This is evidenced by the fact that the indicators presented in Tables 2 and 3 are estimated at the level of the major regions of the world (Europe, North America, Latin America, etc.) or at the national level, but standardized indicators are hardly available and comparable to smaller geographic scales.

In addition to the difficulties in disaggregating information at smaller scales to make diversity visible in the progress of women and girls, the proposed indicators do not account for the spatial and temporal contexts that women experience. Thus, for example, references to women's mobility and commuting times are omitted, an element that would limit the realization of the gender spatial data revolution (Fuentes & Cookson, 2019).

The rapid expansion of georeferenced data makes it feasible to consider the need to extend the dimensions of gender inequality that are analyzed, as long as it is possible to integrate diverse sources based on the geolocation of the data. The geographical reference offers the opportunity to integrate multidisciplinary information (different themes and institutions) and at different scales (by administrative jurisdictions, times or temporal granularities) (Ballari *et al.*, 2013).

The most important obstacle to developing gender-sensitive Geographic Information Systems (GIS) has been the lack of gender-specific data sources. Although almost all countries have census data, the extent of gender-specific data tends to be very limited, in addition to the fact that the quality and quantity of the information varies among countries. Furthermore, data collected is often simply not tailored to women's problems, or addresses women's problems directly but not in ways that can be used in GIS, as is often the case in data collected by the Program of Demographic and Health Surveys (Bosak & Schroeder, 2005).

But this presents specific challenges linked to the nature of spatial data and the conditions of the infrastructure available in that field (UN-GGIM 2019). Efforts to strengthen the infrastructure on spatial data are aimed at reducing duplication of efforts between governments, by avoiding unnecessary repetition of data collection, and promoting the harmonization, dissemination and use of data (Tonchovska, Stanley & De Martino, 2012). It is required to have an institution or authority responsible for adopting international standards and developing a national strategy. The harmonization of standards for exchange of information, data content and technical solutions is also necessary; as well as promoting harmonization of geospatial data models within countries (Tonchovska, Stanley & De Martino, 2012). For all this, it underlines the need for adequate institutional and human capacity, as well as cooperation between various agencies and actors.



# 4

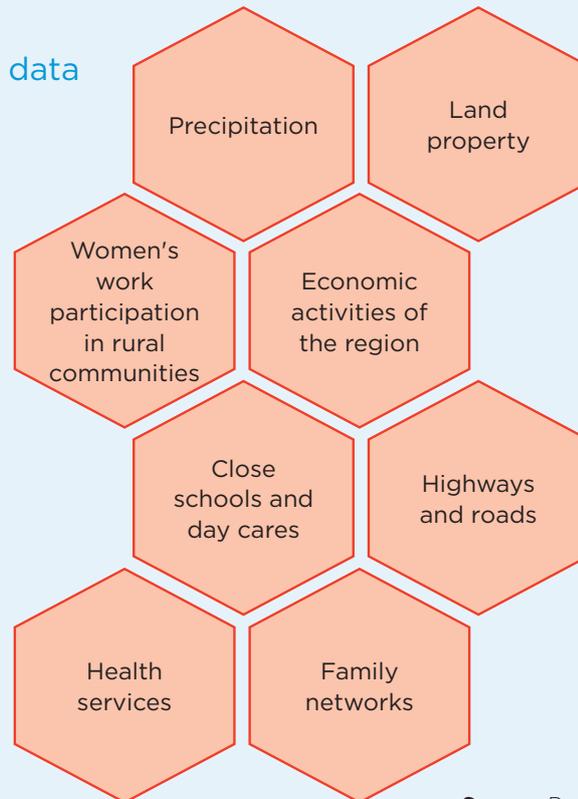
ADVANCES AND  
POSSIBILITIES FOR  
THE CONSTRUCTION  
OF GEOSPATIAL  
GENDER INDICATORS



The construction of spatial gender indicators involves not only an analytical perspective, but also mobilizing specific data and techniques. What makes these techniques different is that they explicitly use their location (X, Y coordinates), while specifying the spatial relationship or interaction with other units. That is, they ask about the distribution or spatial arrangement as a whole (Fothering, Brunsdon & Charlton, 2000; Haining, 2003). This involves using GIS and spatial analysis methods and techniques that precisely examine and use data location.

This opens up new possibilities for the construction of indicators, especially in the face of the rapid expansion of georeferenced information. The alternatives are expanded with the promise of using data location as the key to integrate information of a different nature. As Figure 1 illustrates, spatial data integration allows information from various sources, types and scales to be combined making it possible to construct multidimensional monitoring indicators. For example, women's labour participation in rural communities can be examined by integrating information on climatic conditions, household land ownership, labour markets and economic activities 25km around, available schools and on roads and means of transportation that connect women to schools and available jobs. This information is generated by different instances, is usually stored in different formats<sup>4</sup> and can have different periodicities, but it will be possible to integrate them if all these data are georeferenced and, therefore, it will allow the construction of multidimensional indicators for inequalities faced by women in an area.

**Figure 1.**  
Spatial integration of data



Source: Prepared by the authors.

4 Demographic and economic data are often available for areas (polygons), soil and environmental information is often available in layers of continuous information (raster), while that of schools or hospitals are usually point data and representation of roads is usually by means of polylines.



Of course, using data and spatial analysis techniques also implies challenges in terms of building the required georeferenced data infrastructure, formulating methods that allow integrating information from different sources, resolutions and formats, and developing the technical capacities to use this information in the various gender statistics offices. In addition, spatial integration of data requires solving not only problems related to the differences in the definitions and methods of collection and estimation between countries, but also those related to the borders and scale of the areas of analysis, the spatial precision of data, differences in the classification of spatial objects and territorial differences in data coverage (Sánchez & Adamo 2020).

In this section, we briefly present an evaluation of methodological and conceptual innovations to develop geospatial gender indicators, with an emphasis on the efforts that have been made in terms of monitoring women's labour participation and care. Likewise, we present some of the challenges that are observed to achieve it. This review is organized around the four analytical axes previously identified: a) estimates of territorial variations and disaggregated indicators on a smaller scale; b) distribution; c) accessibility, d) analysis of concentrations and agglomerations of disadvantages.



## 4.1 ESTIMATES FOR DIFFERENT AREAS AND AT DIFFERENT SCALES

As mentioned, when seeking to document territorial variations in gender indicators, it is necessary to distinguish between seeking to compare them between areas (on the same scale) or seeking to produce at smaller scales. Although both objectives involve evaluating the availability and consistency of the information between the sources, the second one also requires considering statistical representativeness of the available samples.

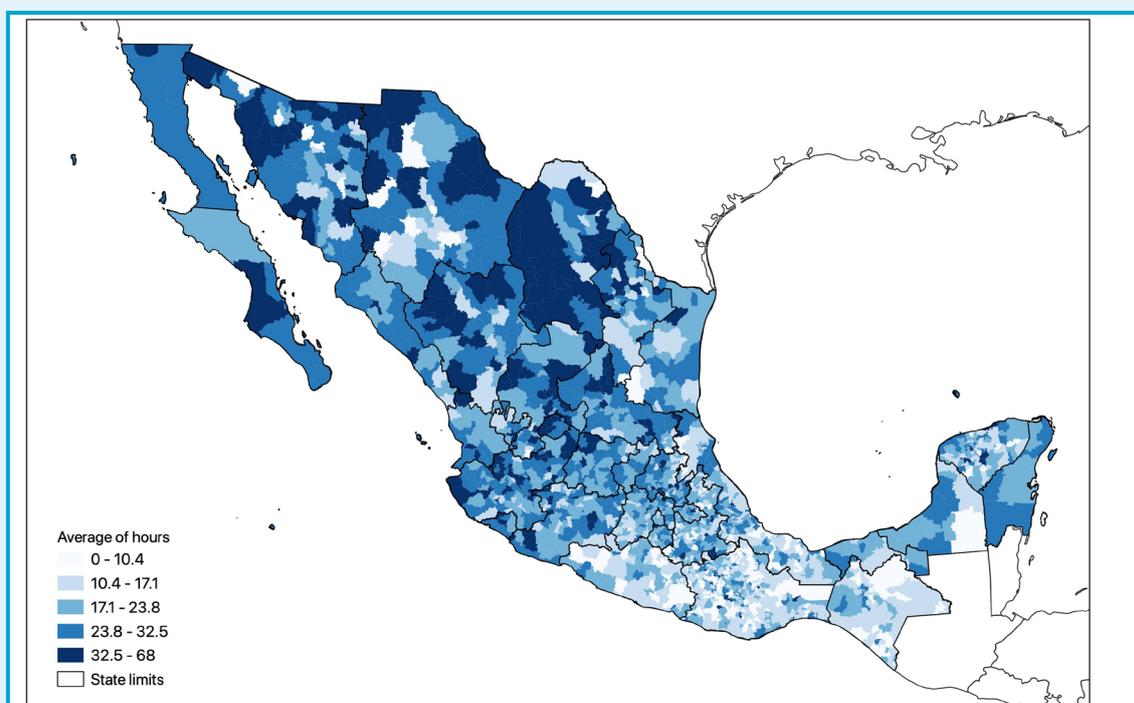
In general terms, various balances on gender statistics coincide in pointing out that the lack of disaggregation of indicators is important to be able to adequately monitor the achievements regarding the rights of women and girls (Buvinic *et al.* 2014; UN Women 2018). This disaggregation refers, first, to greater thematic and population specificity, in such a way that information on a small scale could be available, for example, informal women's employment or women's participation rates from ethnic minorities. A second type of disaggregation refers to the production of United Nations gender indicators (Tables 2 and 3) or other similar indicators, but at the sub-national level, preferably at the municipal (or county) or lower level (intra-urban divisions or rural communities, for example).

To a large extent, the efforts that have been made in recent years have been oriented to account for this variation and to produce estimates with higher territorial resolution. On the one hand, in the search for the consolidation of gender statistics and in the follow-up of the SDGs, we have sought to establish a common framework in the measurement of indicators that allow comparing results between countries and over time. This has also allowed progress in estimating indicators at the sub-national level.



In the two topics of our interest, it should be noted that female labour participation rates are among the most widely available standard indicators across countries and for which there is usually more data on smaller scales. Even so, they have difficulties in capturing women's paid work in informal work or as employers (Buvinic *et al.*, 2014). In contrast, data on care are scarcer at smaller scales, as most of them are collected through national surveys without representation at the sub-national level. Therefore, core indicators of hours of care are often provided only at the national level. As map 1 shows, this limitation is important. This shows the average number of care hours by women 14 years and older in the municipalities of Mexico. A high heterogeneity is observed in this indicator, highlighting those areas of the west and north with averages well above the municipal mean.

**Map 1.** Average hours spent by women in care work according to municipalities, 2015



**Source:** Prepared by the authors with data from the Intercensal Survey 2015, Mexico, taken from IPUMS 2015.

The geographic benchmark has become central in most national statistical offices, both in terms of data collection, processing, storage and dissemination (DESASD-UN, 2014). But we cannot forget that the geographic data infrastructure is still under development. For a significant number of countries, it is necessary to move forward with integrating population and socioeconomic information with the geographic unit and geolocation of it (DESASD-UN, 2014), as well as requiring best practices in the harmonization of definition of the geographic units, the precision and reliability of the geolocation and the territorial coverage of the data (Sánchez & Adamo 2020).



Despite these limitations, georeferenced information has grown by leaps and bounds, making it soon more feasible to incorporate it into gender statistics. In fact, these efforts can be enhanced by building on existing georeferenced data initiatives that would facilitate national offices and international agencies to generate harmonized indicators both in terms of the treatment of social variables and geographic units themselves. Next, we discuss some of these projects<sup>5</sup>.

In recent years, there have been various efforts to make accessible the information that census or administrative offices produce at the sub-national level. These efforts include IPUMS International, which systematizes information from censuses and population counts from nearly 98 countries in the world, offering harmonized variables that facilitate comparison over time and between countries. In addition to offering access to microdata from 443 census samples, IPUMS developed a geographic information subsystem where census estimates can be linked to digital cartographies of the first and second administrative level in the vast majority of countries<sup>6</sup>. Census indicators, of course, allow estimating a large number of gender indicators linked to the SDGs. In addition, IPUMS has another series of initiatives that include georeferenced information (IPUMS-TERRA, IPUMS-DHS).

Similarly, initial efforts made by WorldPop systematize cartographies and census information available across countries<sup>7</sup>. This work greatly facilitates mapping and examining territorial differences between and within countries, while eliminating difficulties in accessing, standardizing, and producing digital maps that are ready to use and accessible in repositories open to the public. Of course, these efforts are limited by the granularity of the available census data. In other words, while a country, the second-level geographical units may be districts of an average size of 250km, in others these same units may be 50km.

Other efforts have sought to produce socioeconomic and demographic estimates beyond census data. However, producing such estimates at the subnational level is highly data demanding. The social surveys most frequently used to assess the well-being of the population are usually national, urban / rural or, in some cases, regional. Hence, estimates at the sub-national scale are usually restricted to using census data or administrative records (civil, educational records). These sources have less thematic coverage and their periodicity is greater, given the difficulty and high costs of their collection.

Without intending to replace census data or administrative records, in recent years a series of methods have been proposed that seek to estimate smaller-scale sociodemographic indicators, making use of georeferenced information from various sources. These efforts are of great importance, in the first instance, because they allow countries with limited infrastructure to have more up-to-date and accurate information on the evolution of the population in specific territories. In addition, the estimation of population in small areas is one of the most demanded statistical inputs for sustainable development indicators, since the monitoring of these depends on the availability of counts of basic populations for the definition of care objectives (Leyk *et al.* , 2019).

5 A common problem is deciding what to do when unit boundaries change over time or the number of units increases or decreases (and boundaries change accordingly), for example, when new municipalities are created.

6 For a description of the available information see [https://international.ipums.org/international/geography\\_variables.shtml](https://international.ipums.org/international/geography_variables.shtml)

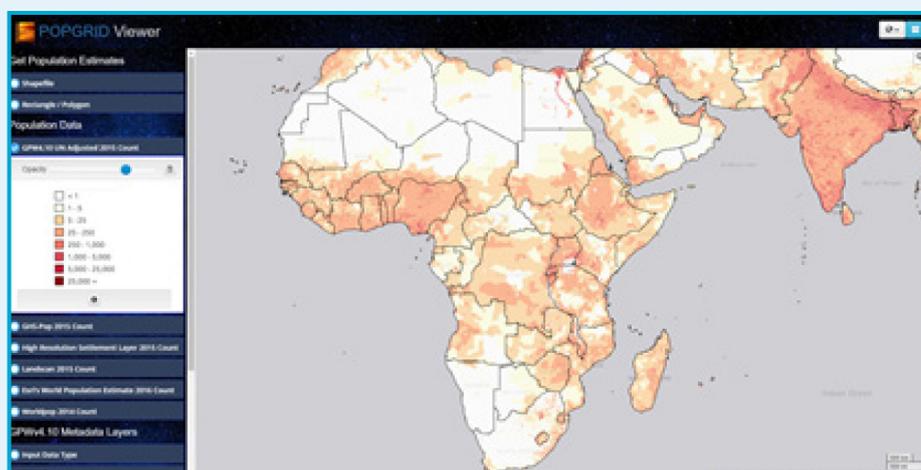
7 <https://www.worldpop.org/project/categories?id=17>



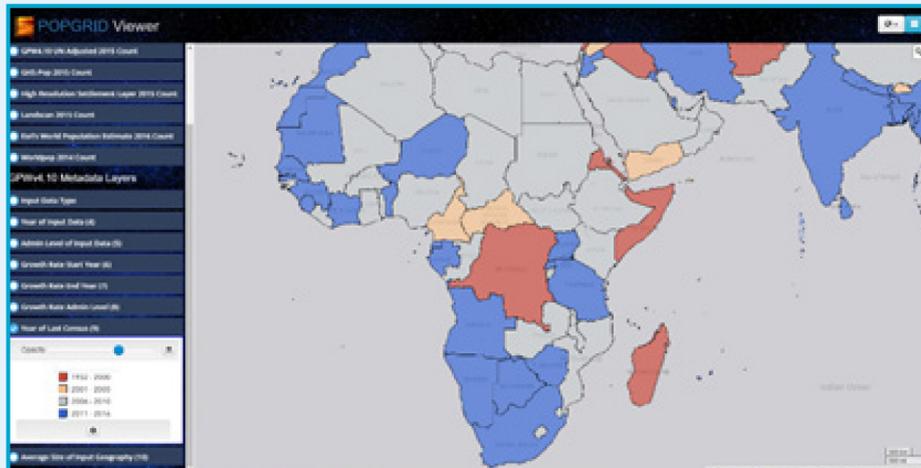
Two types of efforts stand out, on the one hand, those that generate “grids” or continuous population layers that offer present or future population counts on a small scale. On the other hand, there are those who, starting from that base, generate a socioeconomic or demographic characterization of it. The former are fundamentally based on combining census information with other sources of information (e.g. satellite images of urban settlements, infrastructure, land use, etc.) and employ models to distribute the population in the territory in a more realistic way (PopGrid, 2019) (see Appendix 1). That is, instead of having the total population (a single data point) at the municipal level, these exercises produce estimates for each cell in the geographical area (for example, one kilometre per one kilometre), calculating the distribution of the population in the territory depending on other attributes (proximity to roads, constructed area, etc.). These types of efforts include Global Urban Rural Project (GURP), Gridded Population of the World; Landscan Global Population Data Base or World Population Estimates. A detailed comparison of the characteristics, available data and differences can be found in PopGrid (see Appendix 1) and Leyk *et al.* (2019).

The following images show the gains of having a continuous population count. Figure 1.a shows the estimates of the GP4 model-Adjusted by the United Nations population estimates and projections that has a resolution of 1km. Redder shades denote pixels with a larger population. The small scale of estimates illustrates the high heterogeneity in the distribution of the population in Africa, between countries, but also within them. This greater granularity of information makes it possible to design more territorially focused public actions. On the other hand, Figure 1.b shows the year of the last census and illustrates the disparities in information’s temporality; in fact, four countries do not have information since 2000 or earlier. Spatial population projections help fill these gaps by using other sources of information to better estimate where population growth may have occurred. Figure 1.c shows the geographic scale available in original census data in each country. It is possible to observe that while in countries such as South Africa there is information on a small scale (0 to 25km) throughout its territory, in countries such as Nigeria or Algeria the information is available at highly aggregated geographic scales, making it less useful for punctual monitoring of SDG indicators. In these cases, the production of continuous layers contributes to correct some of these differences and make the information between countries more comparable in terms of their spatial resolution.

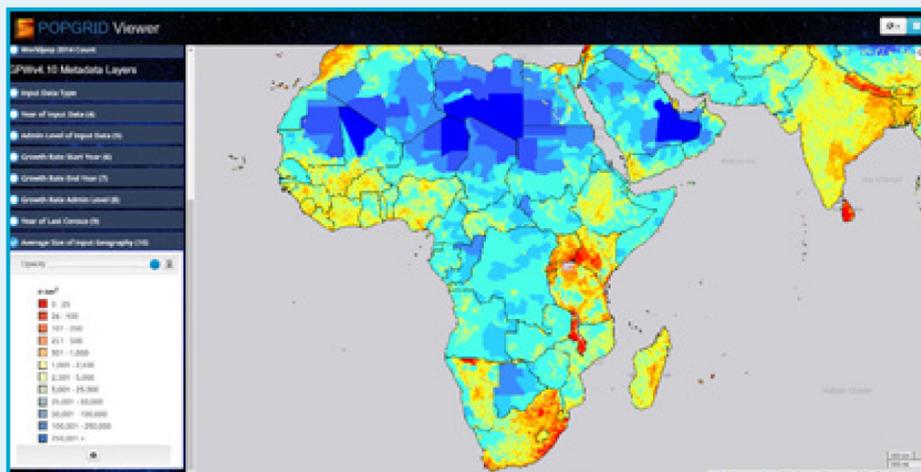
**Figure 1a.** Population count. GPA-UN population grid



**Figure 1.b** Year of the last census survey.



**Figure 1.c.** Size of the geographic unit available in census information



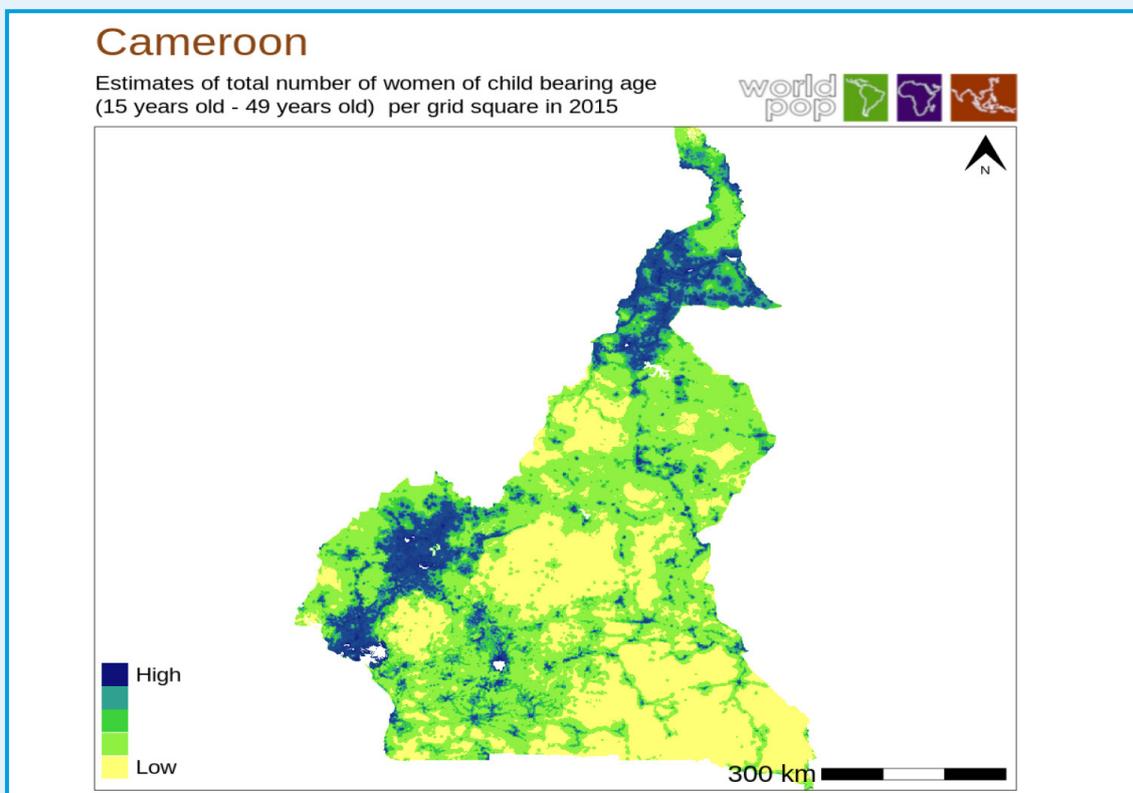
Source: Prepared by the authors with data from popgrid.org

Despite the great utility of these exercises, it should be remembered that they do not substitute census surveys or civil registries to account for the demographic dynamics itself (PopGrid, 2019). Furthermore, due to the diversity of methods they use to integrate census information, make population projections, and the specific methods they use to distribute the population throughout the territory, these exercises may differ substantially in their population estimates in certain areas and vary in their accuracy across the globe (Leyk *et al.*, 2019).

Furthermore, the vast majority of these exercises produce a population count or population densities to define urban and rural areas, but do not directly produce estimates by sex. Only a second group of more recent initiatives, seeking to build spatial sociodemographic bases that allow estimating the composition by sex, age and some other social characteristics on a small scale (Tatem *et al.* 2012). These initiatives mostly resort

to census and survey data, supplemented by other georeferenced layers and geospatial models to produce small area estimates. Those who produce distributions by sex and age tend to resort mainly to censuses and surveys to estimate such distributions on a fine scale (Puzzelo *et al.* 2017), a useful exercise for those countries with little data infrastructure. The following Figure (2) shows WorldPop (spatial demographics project) estimates for the number of women of reproductive age per square kilometre in Cameroon. This shows the strong territorial disparities in these volumes and, therefore, the differences in the demands on reproductive health care that this entails.

**Figure 2.** Estimate of the total number of women of reproductive age. Cameroon



**Source:** Worldpop ([www.worldpop.org](http://www.worldpop.org)). School of Geography and Environmental Science, University of Southampton; Department of Geography and Geosciences, University of Louisville; Department de Géographie, University de Namur) and Center for the International Earth Science Information Network (CIESIN), Columbia University (2018). Global High-Resolution Population Denominators Project. Funded by the Bill and Melinda Gates Foundation (OPP 1134076).



In addition to these more disaggregated demographic estimates, other initiatives have also sought to calculate small-scale socioeconomic variables. Following the methodological proposal of the “poverty maps” (Elbers, Lanjouw & Lanjouw, 2002) to extrapolate the information of the sociodemographic profile of the households from the surveys to certain areas with similar characteristics, some current proposals seek to identify a series of spatial covariates with attributes collected in surveys. For example, Bosco *et al.* (2017) seeks to identify gender inequalities in literacy, malnutrition and contraceptive use rates by combining data from the Demographic and Health Surveys (where these indicators are directly measured) with information on travel times, distance to schools, health centres, roads, weather conditions, agricultural production, environmental conditions and demographic characteristics of the area. These characteristics are associated in the territory with the three indicators of interest, so it is expected that this information can be used to produce more frequent estimates of them and with higher spatial resolution.



## 4.2 DISTRIBUTION OF JOBS, GOODS AND SERVICES

Although most of the works have concentrated on analyzing territorial differences in gender indicators or on producing the bases for sociodemographic estimates on a smaller scale, there are other areas that would benefit from incorporating the spatial dimension and that the greater availability of data makes feasible. These refer mainly to the distribution of opportunities in the territory in terms of jobs, but also goods and services that families use for care. It is important to examine to what extent this distribution is more or less equitable in the territory and to what extent areas with low coverage can be identified. This same logic can be expanded to other themes, such as access to health services, clean water or arable land.

Few studies use a geographical perspective in care studies (see Box 1). Those who do so often focus on paid care from a supply and demand approach. In this sense, what has mattered to geographic studies of service provision is the ratio of supply to demand for services. In other words, how many places of care exist for each household with children or older adults (Langford *et al.*, 2019).



## Box 1. Spatial Care Indicators

The allocation of time is the empirical dimension par excellence in the subject of care and unpaid work. This dimension has been measured by the proportion of time dedicated to any of the tasks in relation to the total time available for women or compared to that performed by men. Time allocation indicators are helpful in observing variations in women's time spent relative to men's. These indicators have been differentiated by demographic characteristics of the caregivers and who they are cared for (age, sex, relationship, marital status, life cycle of the household, etc.).

To these indicators of individuals and households, we add those linked to the provision of the State. The most used variables are the existing establishments, the public expenditure made in the provision of childcare or day-stay services and the number of maternity/paternity permits granted. These indicators reflect the public and private nature of care. On the one hand, there are indicators linked to the home environment, this being the first unit of care work management, either in the division of workloads or the composition of the household. On the other hand, there is the governmental role external to the home that only focuses on the expenditure made in providing services related to care work.

From the territorial perspective, it is empirically approached by means of the territorial variation of the indicators and the spatial distribution and accessibility to both unpaid and paid care. Jobs with a spatial perspective, however, are few. The most frequent are those aimed at describing differences in care time between men and women between countries and at the sub-national level.

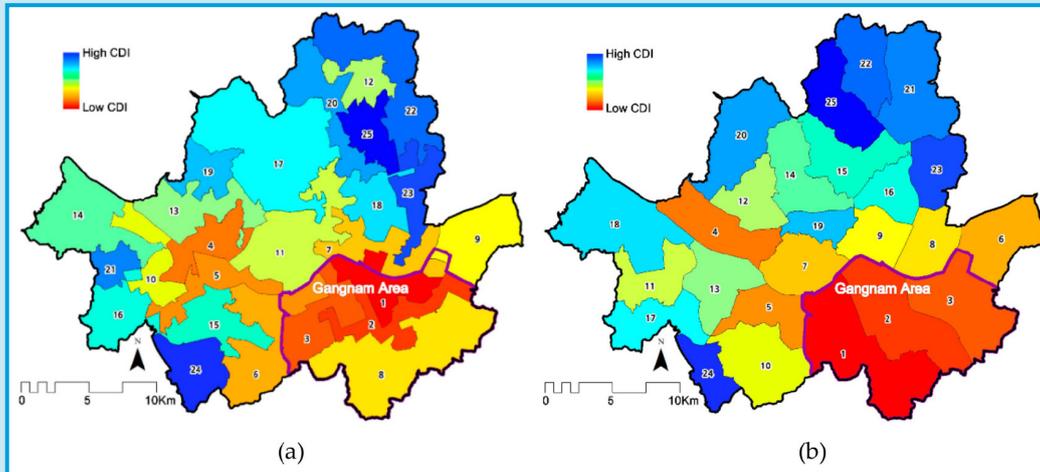
### Most widely used spatial indicators

- Hours of care for men and women at the national and sub-national levels, by care type.
- Gap in care work between men and women at sub-national level
- Hours of domestic work, at national and sub-national level
- Availability and use of public care policies at the sub-national level (maternity and paternity leave, supports for families with dependents, etc.)
- Availability of nurseries and care centers. Number per geo / population area
- Accessibility to nurseries. Distance to areas of residence. Distance to employment areas. Transfer times

Particular attention has been paid to the location of care centres. The spatial indicators used for this item are number and density of care centres, that is, the number of centres per each km<sup>2</sup>. Sometimes this measure is nuanced by the number of centres in a given area compared to the number of target population in the same area. This indicator gives an idea of the ability of out-of-home care centres to support demand. Kim & Wang, (2019) expose how in the City of Seoul in South Korea, the provision of care centres is not ubiquitous throughout the city. In particular, the authors show that the childcare service is located towards the peripheral areas of the city. On the other side, the Central Business District has a low presence of this type of services (see Box 2).



## Box 2. Index of availability of nurseries and preschools according to two different regionalizations



Source: Kim & Wang (2019, p. 9)

The figure shows the geographic patterns of the availability of nurseries and preschools in Seoul according to two regionalizations. Both show that it is markedly uneven in the territory, with the Central Business District standing out, which has the worst accessibility and where there is significant occupational segregation. However, figure (a) corresponds to smaller geographic divisions identified by the authors. This classification allows to observe a greater heterogeneity in availability.



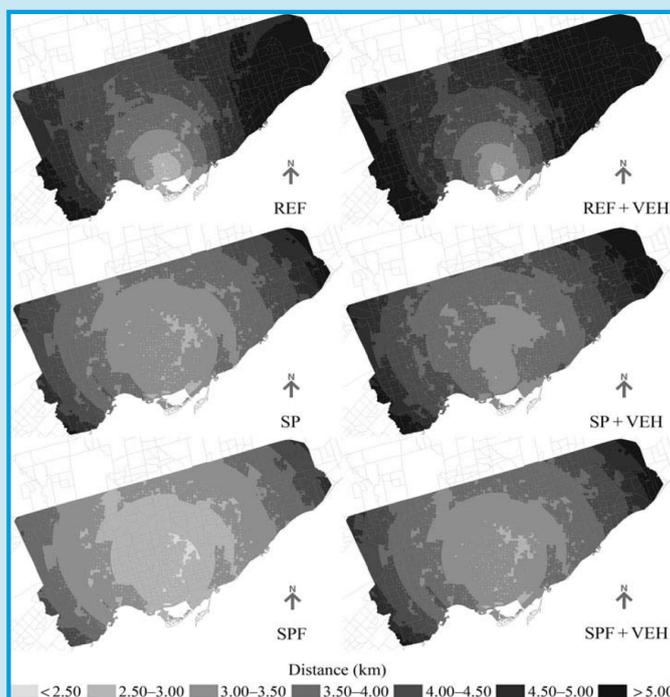
## 4.3 ACCESSIBILITY

Spatial accessibility is a fundamental factor in the daily life of women. This variable has been empirically approximated by the amount of time invested in daily commute, generally between work and home or home and care centres. Another way of considering spatial accessibility is the means of transport used by women, since it has been observed that, in several countries, women depend more on public transport and therefore increase their travel times (Kwan & Kotsev, 2015).

As noted, the accessibility factor is essential to analyze labour participation, since it has been found that women make shorter trips in time/distance compared to men, this due to the double burden at home. On the other side, men, having their own means of transport, make longer trips to work (see Box 3). This in turn conditions women to look for part-time jobs, for a job closer to home, establish community employment networks in the neighbourhoods or find spatially segregated jobs in their immediate environment (De Meester *et al.*, 2007; Joassart-Marcelli, 2014; Perle *et al.*, 2002).



### Box 3. Accessibility to work by sex and type of home



Source: Páez et al. (2013, p. 826)

The map of Páez et al. (2013) shows different scenarios of distances made daily to work by people living alone (REF), people living in single-parent homes (SP) and single-parent homes for women (SPF) and how distances are modified if they own a vehicle. The gray scale represents from the increase in the average distance made daily. Thus, the last ones at the bottom of the figure show how single-parent households for women travel shorter distances, with or without a vehicle.

It is important to mention that a large part of the specialized literature faced information problems for the construction of its indicators (see Box 4). In this sense, there are few works that study the territorial dynamics with georeferenced data, most of them use the information from surveys that ask for average transfer times or location of residence and employment. On the other hand, georeferenced data and Geographic Information Systems help to represent a large amount of data in a cartographic way, visualize the distribution and more accurately assess daily accessibility. However, in recent years in many countries, the sources of georeferenced information have expanded, both from the administrative records of the establishments as well as information from large data that allow knowing the location of employment establishments and those dedicated to care, at the same time that global systems such as GoogleEarth or OpenStreetMaps make it possible to assess connectivity to the urban layout. It should be noted that both types of information are complementary in that surveys can better account for the variability in the times experienced by women, while GIS can make specific measurements of the territorial distribution and accessibility of jobs and services.



The main advantage of recovering distances through travel surveys is the subjective perception of people in terms of their travel. Thus, people with greater difficulty in their displacements report greater time or distance. On the other hand, the measurement of transfer distances by means of GIS makes it possible to obtain robust and consistent measurements for population groups that inhabit the same area, in this way subjective discrepancies in distance perception can be controlled. Although each estimation method have different strengths, the discrepancy between the distances perceived and estimated by means of GIS has been shown to be not substantial (Stopher *et al.*, 2007; Witlox, 2007). This leads us to think about the need to combine both methods to obtain more accurate estimates.

#### **Box 4. Spatial indicators Women's labour participation**

The central indicators in the field of labour inequality refer to labour participation rates, the number of hours and the occupations where they are concentrated. These indicators reflect not only women's decisions but also the available job offer and the conditions that regulate their participation socially and institutionally. Another relevant indicator is the pay gap between men and women, the difference in wages between both sexes for the same work.

From studies with a territorial perspective, the territorial variation of the aforementioned variables and spatial accessibility have been examined. The studies show territorial differences in the rates of labour participation between countries, as well as within them. Urban areas tend to have higher participation rates than rural areas (Mansour, 2018; De Meester *et al.*, 2007; Duncan, 1991) and regional and inter-city variations are also observed. Territorial variations in the gender pay gap are also documented (Gittell, 2009, Hoffman, 2015). Furthermore, studies document differences in the distribution of jobs in feminized sectors (Sparreboom, 2014; Wright *et al.*, 2017; Wyly, 1996), as well as differences in travel times for the highest incomes (Shearmur, 2006).

#### **Most commonly used spatial indicators**

- Labour participation rates for different areas and scales
- Territorial differences in employment's position, different areas and scales
- Variations in levels of occupational segregation, different areas and scales
- Distribution of jobs, different areas and scales
- Concentration of feminized employment, different scales
- Accessibility to sources of employment. Line distance from home. Commute times



## 4.4 CONCENTRATION AND AGGLOMERATION OF DISADVANTAGES

This type of analysis builds on previous approaches as it examines the territorial distribution of gender indicators or the availability of employment or care services, but the analytical emphasis is on identifying the territorial agglomeration or concentration of gender disadvantages. This is usually done by mapping the variables of interest, or using territorial concentration indices or measures of exploratory analysis of spatial data (AEDE).

Among the more descriptive works are the analyzes of the differences in the rates of labour participation or type of occupation at the sub-national scale. Some studies have focused on examining the territorial concentration of the job offer for women. Some examples of these works examine relocation of companies linked to care services on the outskirts of cities (Hanson & Pratt, 1995), or the location of maquiladora activity in certain regions (Grijalva-Monteverde & Covarrubias-Valdenebro, 2004). In a similar vein, the studies by Grant (2013) and Hanson (2009) show that female self-employment tends to be concentrated in rural and impoverished urban areas, reflecting the adverse conditions of those environments.

Other works have sought to estimate the non-homogeneous territorial distribution of occupational segregation by sex, estimating the location quotient and the dissimilarity index<sup>8</sup> and with this they identify specific areas within cities where occupational segregation settlements by gender are located (Sparreboom, 2014; Wright *et al.*, 2017; Wyly, 1996). Similarly, other analyses examine the co-location between indicators of social disadvantage and the rates of labour participation of men and women. In this sense, some studies seek to identify to what extent high rates of residential segregation are associated with high rates of unemployment, underemployment or job insecurity (Carlson & Persky, 1999; Kwan, 1999; Wyly, 1996).

In addition to specific territorial indices, other literature mobilizes spatial statistics measures to examine how territorially concentrated or dispersed women's care or employment is. Some of these efforts are based on AEDE measures. In particular, a few subsets of techniques focus on visualizing and describing the spatial distribution of a variable, estimating the spatial association, identifying clusters and outliers, and suggesting regional differences in the data (Anselin, 1994; 1995). This approach uses visualization and estimation of spatial, local, and global autocorrelation measures, such as Moran's I or the Local Indicators of Spatial Association (LISA).

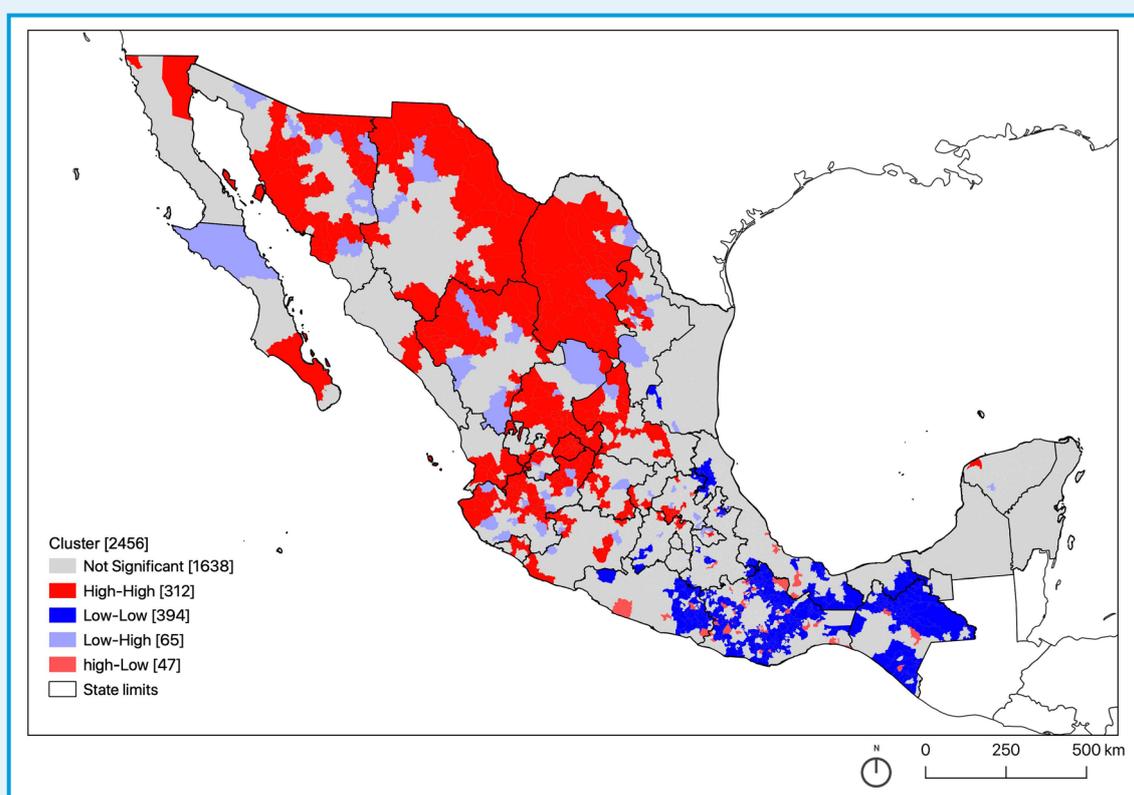
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8 The location quotient is a measure of territorial variation that indicates the relative concentration of a variable in a given geographic unit with respect to the total area of interest. While the Dissimilarity Index is a measure of the disparity in the distribution of population groups of interest throughout a territory. This indicator was generated in studies on racial segregation.



To illustrate this type of analysis, Map 2 shows the spatial grouping of the average number of hours spent caring for women aged 14 and over in Mexico at the municipal level. This type of analysis allows us to identify the existence of spatial clusters with similar values (red and deep blue) and dissimilar values (light blue and pink). It can be seen that large areas where the time dedicated to care in the municipality is high and is surrounded by other high-value municipalities, these high-high clusters tend to be located both in the high Jalisco region and in the north central area of the country. In contrast, territorial clusters with low care time values are few and of limited territorial extension. It highlights that both types of groupings of similar values are surrounded by municipalities where the average care times are different, which points to the need to explore the local conditions that explain the differences between these areas.

**Map 2.** Average number of hours dedicated to care by women 14 years and older at the level of municipalities in Mexico.



**Source:** Prepared by the authors with data from the Intercensal Survey 2015, data from IPUMS-International



Anselin, Sridharan & Gholston (2007, p. 305) suggest that this type of approach is useful in monitoring social indicators in various components:

- a) **Monitoring:** Develop a GIS to track indicators of interest over time.
- b) **Understand the context:** Implement the AEDE tools to study the spatial properties of the indicators of interest.
- c) **Identification:** Use exploratory spatial models to identify spatial units with 'outstanding patterns' of success or failure.
- d) **Communication:** Decision makers and planners are better able to communicate with local space unit decision makers and politicians with outstanding patterns to better understand the underlying local factors.
- e) **Diagnosis:** Joint work of authorities to explain the particular cases of success or lag identified
- f) **Respond and learn:** Guide interventions and verify results



## 4.5 NEW DATA SOURCES AND THE CHALLENGES THEY ENTAIL

In addition to the more conventional spatial data, there is an increasing type of information derived from the omnipresence of computation in contemporary societies: satellite images with high geographic resolution, environmental information in real time, information on purchasing patterns through the recording of transactions by card credit or social behaviour on social networking sites. These open up possibilities for reducing gaps in the generation and processing of information. In general, the information generated by Big Data is characterized by the speed, volume, granularity and variety of the information (Holmes, 2017). Granularity allows information to be obtained at very small scales, either from the individuals themselves or high-resolution spatial data (Kitchin & McArdle, 2016).

Big data with applications in high-resolution geographic estimates has two main facets. The first of these is the use of satellite images, for example, NASA images and remote sensors, such as drones, which make it possible to make estimates on soil, humidity and geological characteristics with great spatio-temporal precision. That is, at very small scales and practically in real time (Karmas *et al.*, 2016). The second application is called Volunteered Geographic Information (VGI). This aspect of Big Data refers to the enormous and varied information that all people with access to mobile devices and the Internet generate daily. Examples of this are the Open Street Maps or Google Earth platforms that feed on user contributions to these platforms. Another case of VGI is information collected from social media sites such as Facebook, Twitter, or Instagram. This type of database allows to know the behaviour trends of its users in real time and with excellent geographical precision (Goodchild, 2015).



Data generated by digital devices can be a tool to reduce the data generation gap with a gender perspective. Information from digital devices can help generate data with high statistical and geographic granularity. It is enough to think that mobile phones can help to understand the behaviour of gender inequalities in places of difficult access, or to accurately account for women's daily activities (Buvinic *et al.*, 2014; UN-IEAG, 2014). Research in spatial data infrastructure has become a viable option for dynamic, real-time data collection by miniaturizing sensors, reducing their costs, and integrating with mobile devices and wireless technologies. In addition, with the advancement of web 2.0, smartphones and mobile applications, citizens take on a more active role in the production of information (Ballari *et al.*, 2013).

Some examples illustrate this point. Big Data has been useful to more quickly identify the spread of autoimmune diseases in women (Ramos-Casals *et al.*, 2015). The information obtained on Twitter has been used to identify population structures, not in order to replace the general population census, but to obtain updates in the intercensal periods (Sloan *et al.*, 2013). Another use of big data has been the identification of geographical areas of danger for women, as well as an approximation of their political participation (Elwood, 2008).

Finally, although Big Data offers a window of opportunity, it also implies challenges and limitations. In the first instance, the information from the Internet is biased, since not all the population has access to this technology. Likewise, the information that can be analyzed is a reflection of cultural, political and social biases that may imply discrimination due to racism or gender. In this sense, gender is also a category for the study of this type of information (Elwood, 2008; Leszczynski & Elwood, 2015). Another challenge of Big Data is its private nature, since much of the information generated on the Internet is owned by private entities and these restrict access to them. In this scenario, an alternative is to generate hybrid assemblies of information where public, private, local and international efforts are combined to achieve a better data infrastructure (Singleton & Longley, 2019).

Although the Big Data paradigm offers possibilities to reduce the gap in gender spatial information, it also carries several challenges. The first of these is the digital gap, since there is still a trend for the use of technologies by men. At the same time, Big Data also implies the standardization of methods for measuring gender inequalities. This is due to the unstructured nature of its data and the private nature of its producers (Buvinic *et al.*, 2014). Likewise, it is necessary to establish guarantees to maintain quality and integrity and ensure confidentiality. Governments must ensure that data abides by these standards and principles at all times (UN Women, 2018).

Although new space technologies and initiatives that facilitate greater participation within social groups do not in themselves encourage female participation in them, nor do they eliminate the ways in which gender or other characteristics shape the processes and results of these creative efforts, contribution and curation of data (Leszczynski and Elwood, 2015). Furthermore, although the spatial information agenda has expanded, it has lacked the explicit incorporation of the gender dimension, in terms of asking about what spatial information priorities should be, what data infrastructure is required, and the indicators to be defined and mapped (Gilbert & Masucci, 2006; Pavlovskya, 2009). In this sense, it is essential to advance in a proposal that recovers the extensive discussion on the geography of gender inequalities and the advances in the generation of information.



Large databases are georeferenced natively. This is because all digital devices have the Global Positioning System (GPS). This feature makes it possible to access the geographic coordinates of the information collected digitally (Goodchild, 2015). However, the availability of use of the geographic dimension of the data faces limitations in terms of openness of the data. On the one hand, big data is open access and available for use within GIS. In this area, there are platforms that combine different types of information, from populational, meteorological or satellite information. Examples of large georeferenced open data are those produced by NASA, for meteorological information, or Worldpop, which generates higher geographic population resolution and some of its characteristics using different databases.

On the other hand, there are georeferenced big data that are not open, either because of their payment for access or because of the need for data science specialists and their georeference. At this point, databases from the Internet and telecommunications can be mentioned, for example, the recording of mobile phone calls or bank movements through credit cards. This type of information is confidential and can become dangerous if ethical and anonymity preservation measures are not followed. In this same item of large non-open databases, the information emanating from social networks on the Internet is found. Some of the social media platforms allow access to a small sample of data in an open way, however, in order to access this information, the intervention of data scientists is necessary to access and manage said databases. On the other hand, full access to the bases implies monetary costs.

As mentioned, the big data revolution means great opportunities for monitoring the SDGs. One of the advantages of using big data to reduce gender gaps is the ability to recover women's subjective dimensions in real time and with high geographic resolution (D'Ignazio & Klein, 2019). However, big data is not yet directly constituted from a gender perspective.



# 5

## RECOMMENDATIONS



Statistics on gender inequalities have advanced significantly in recent decades, in terms of the number of countries that collect information, thematic coverage and the precision and conceptual harmonization between the agencies involved, although there is still a long way to go in these aspects (UN Women 2018; Buvinic *et al.*, 2014). The construction of geospatial indicators can contribute to improving gender statistics by mobilizing the potential of georeferenced data that allows generating multidimensional and smaller-scale indicators, as well as illuminating aspects of the production of gender inequalities that facilitate public interventions to attend to them.

The previous review shows the potential of spatial data to document gender disparities. First, in order to achieve the gender equality goals advanced in the Sustainable Development Goals, it is essential to document territorial disparities in the progress of women and girls, as well as disaggregate the estimates at smaller scales in order to identify differences in the vulnerability faced by various groups of women and girls. Second, to better understand the differences in needs and progress, it is necessary to examine the geography of opportunities that confront them, in terms of the availability of jobs and care alternatives and services, among others. Third, accessibility and mobility of women to connect residential areas with productive and care spaces is essential to understand the possibilities they have to take advantage of that geography. Fourth, it is necessary to examine the concentration and agglomeration of social disadvantages, as these account for territories with the greatest backwardness and disparities in the achievement of women and girls' rights. Concentrations that also allow identifying areas of interest for monitoring public interventions.

In order to improve geospatial statistics, it is recommended to make progress on the following tasks:

- 1 Continue efforts to strengthen national statistical systems, both at the level of national offices and the different statistical production entities so that they adopt new data practices (SDSN TRENDS 2019). Specifically, it is necessary to identify the spatial data infrastructure as a fundamental part of this task and to recognize the centrality of georeferencing in the integration of data from different sources and scales. In the definition of national agendas on this subject, it is required to specifically define the challenges that are faced to advance in the georeferencing of gender information.
- 2 It is necessary to consolidate the national geospatial infrastructures that involve defining, standardizing and disseminating among the practical agencies on the georeferencing of the data, the definition of borders, the directory of units or spatial objects, and, more generally, space information management practices (WGGIIA-EGSDGI, 2020). For agencies producing gender statistics, this implies reviewing and, where appropriate, updating their production and data storage practices to make them compatible with this new framework. Special discussion requires topics such as the guarantee of data confidentiality, while georeferencing poses specific challenges for it.
- 3 Promote the estimation of gender statistics at the sub-national level. A greater territorial and population disaggregation is essential for monitoring the SDGs. Depending on the data infrastructure of each country, this may involve different methodological strategies, either by improving its current instruments or by resorting to indirect estimation methods.



- 4 Promote initiatives and methods that allow the combination of survey data, census and other spatial data for the production of smaller-scale indicators by sex, as well as indicators associated with gender disparities. Although these methods do not replace direct records or measurements, they are an alternative in conditions where these records are not available, or more frequent or updated measurements are required.
- 5 Promote georeferencing data of administrative systems and its opening. In addition to the civil registries that are central to various gender statistics, there is great potential in the registries of public programmes, transportation, or health services, among others. This information allows examining the demand and territorial coverage of these services and their disparity, central axes in various SDG goals.
- 6 Incorporate indicators linked to the distribution of opportunities and the accessibility of employment and care to gender statistics. Current records allow many countries to build indicators of other dimensions of territorial inequality using information from open sources such as GoogleEarth or OpenStreet. In the immediate term, you can seek to estimate the times of commuting to work and care, seeking to incorporate indicators into the employment and mobility surveys.
- 7 Promote the analysis of the concentration of gender disparities through the use of spatial gender statistics, particularly exploratory measures of spatial autocorrelation.
- 8 The greater availability of geospatial information does not automatically imply greater capacities for its use. Specific efforts are required to build technical capacities in both statistical offices and gender statistics generation offices. Due to the low proportion of women in STEM education, where many of the disciplines related to spatial data processing and generation are included, it is necessary to pay particular attention to the incorporation of women in this field, both at a technical and managerial level.



# 6

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# 7

## APPENDIX



## I. POPGRID Data Collaborative

POPGRID repository aims to advance the use and impact of population data and geospatial infrastructure by bringing together and expanding the international community of data providers, users, and stakeholders from public and private sectors to accelerate the development and use of high quality of georeferenced data on population, human settlements and infrastructure.

As such, it gathers information from various efforts to generate continuous layers of information at the global level, which employ different estimation methods and produce information with different resolution as described below.

Database	Resolution	Years	Repository	Data source	Access
Gridded Population of the World (GPW)	1 km (30 arc-sec)	2000, 2005, 2010, 2015, 2020	CIESIN Columbia University	Two types a) National population censuses b) Population estimates and projections of the United Nations Population Division	Open
Global Rural-Urban Mapping Project (GRUMP)	1 km (30 arc-sec)	1990, 1995, 2000	*CIESIN- Columbia University *IFPRI *CIAT-WB	Population estimates and projections of the UNDP (United Nations Development Program)	Open
LandScan Global Population database	1 km (30 arc-sec)	Annual releases 2000 - 2016 (current version)	ORNL	Census Bureau.	Commercial / Open for research
Global Human Settlement Layer - Population (GHS-POP)	*1 km (30 arc-sec) *250 m <sup>2</sup> (7.5 arc-min)	1975, 1990, 2000, 2015	*JRC *CIESIN- Columbia University	Population estimates and projections of the UNDP	Open
World Population Estimate	150m	2013, 2015, 2016 2017	ESRI	134 national population censuses processed by Michael Bauer Research GmbH	Commercial / Open ArcGIS users
World pop	100 m (3 arc-sec)	2000- 2020 global and national for specific years	World pop	Two types a) National population censuses b) Population estimates and projections of the United Nations Population Division	Open

Source: <https://www.popgrid.org/data-docs-table1>



## II. Worldpop

Worldpop is one of the international projects that offers geographic products of open-access, high-resolution contemporary human population distributions. This allows the measurement of small-scale demographic indicators, such as distribution and population composition, characteristics, population dynamics. In particular, Worldpop offers estimates in a resolution of 100 m<sup>2</sup> of indicators such as the population composition by sex for all low and middle income countries in South and Central America, Africa and Asia. The following table describes the main products available through this project.

Database	Description	Temporality	Geographic resolution	Continent
Population	They involve different types of databases on population count grids	2000-2020	National - 100m	Global
Births	Integrates small area data on the number of live-born infants and abortions considering women of reproductive age	No Data	National - 1km	Africa, Asia, Latin America, and the Caribbean, and Oceania
Pregnancies	Integrates small area data on the number of pregnancies considering women of reproductive age	No Data	National - 1km	Africa, Asia, Latin America, and the Caribbean, and Oceania
Urban changes	Indicators of urban change based on comparable methodologies, satellite images, human settlements of 1000 people and more	No Data	National - 1km	Asia - Oceania
Age structure	Population count with high geographic resolution for all countries of the world according to sex and five-year group	No Data	National - 100m	Africa
Women of reproductive age	Estimate the total of women of reproductive age (15 and 49 years)	2015	National - 1km	Africa, Asia, Latin America, and the Caribbean, and Oceania
Growth Indicators	Includes some small-scale SDG indicators related to poverty, literacy, maternal and child health, coverage of contraceptive use, and vaccination	2006, 2009, 2011, 2013-2016	300m, 1 km, 3 km	Africa, Asia
Internal migration flows	Maps on internal migration of all low and middle-income countries	No Data	1km	Africa, Asia, Latin America, and the Caribbean, and Oceania

**Source:** Prepared by the authors based on worldpop.org

