Chapter 10
The Role of Geographic Technologies in the Measure of Spatial Equity. Twenty-First Century Solutions for Old Geographical Issues

María D. Pitarch-Garrido

Abstract In Western societies, the development of the Welfare State has been accompanied by the proposal of different models of spatial organisation that help to improve spatial equity, this being a priority object of all public policy because it clearly contributes to the achievement of a greater social cohesion. Geography has contributed, from Christaller to the present, to propose territorial models that help to optimise the location of activities and services, using spatial statistics and digital cartography. At present, the study of spatial equity is again receiving the attention of the academy, in particular as regards the provision of public services and facilities in urban and metropolitan areas linked to the development of new technologies and GIS that have given applied geography a new opportunity to advance in its contribution to society. Progress in this regard is linked not only to technological applications, but also to the idea of guaranteeing equity in all areas and ensuring that the provision of public services is adequate for all citizens, particularly those likely to be excluded. This is of great importance, not only because it demonstrates the usefulness of geographical science, but also because social concern for justice is reflected in an environment that generates inequalities that, because of the social pact, are not tolerable, since the objective is to ensure an adequate quality of life for all.

Keywords Geospatial technologies · Spatial equity · Geographical issues · GIS

10.1 Introduction

For geography, technological change has meant a fundamental advance for a simple reason, although it is not the only one: it has allowed an incredible qualitative improvement of its main form of transmission of information and results: the maps. Elements such as location accuracy, extensive detailed demographic, social,

M. D. Pitarch-Garrido (✉)
Departament of Geography, Inter-University Institute of Local Development, University of Valencia, Valencia, Spain
e-mail: maria.pitarch@uv.es

K. Koutsopoulos et al. (eds.), *Geospatial Challenges in the 21st Century*, Key Challenges in Geography, https://doi.org/10.1007/978-3-030-04750-4_10

economic and environmental information, the reliability of the data and their usefulness combine to find a form of expression that generates an integral and efficient product in geographic technologies.

For not many years, some authors talk about the 'spatial turn' (*le tournant spatial*) to refer to the importance that space or place have acquired in social and humanistic analysis and studies when they try to explain human interaction, its identity and organisation, among other topics. This term is related to key concepts that were always the object of study of geography and that other disciplines, governments, civil organisations and the public in general, have incorporated in their daily life since the 1990s with the generalisation of the use of geographic technologies, particularly the Geographic Information Systems (GIS). The ability to analyse huge amounts of information in a differentiated and, at the same time, integrated manner meant that geography attracted the attention of other disciplines. The recognition by non-geographers is significant since it has made it possible to make research and study subjects that were always of the interest of the geographers visible.

It would be an exaggeration to say that the incorporation of the technologies associated with GIS has meant a radical change in geographical science and its study subjects. However, it is indisputable that it has opened new possibilities for progress in subjects considered classic objectives of geography, and at the same time it has allowed us to expand our recently developed field of study, almost always in collaboration with other disciplines.

One of these interdisciplinary fields is social equity. Its geographical aspect has come to be known as spatial equity. It is true that one does not exist without the other and geographical studies have been carried out on this subject since the 1960s. Harvey (1973) was one of the first geographers to define the term *spatial equity* or also referred to as *spatial justice*. Spatial justice must pursue the following objectives: respond to the needs of people in each territory, allocate resources in a way that maximises the spatial multiplier effects and allocate extra resources to help overcome the problems caused by the physical and social environment.

The question is whether this research topic, linked to spatial planning, is still a current problem for the geographers of the twenty-first century and, above all, if the geographical technologies have contributed to increased understanding about the aspects linked to this issue. The answer is linked to the reality and the practical application of geography. Even today, space introduces inequalities, therefore, there is still a wide margin for action and spatial planning. The GIS have significantly contributed to keeping the subject alive, because with the introduction of this technology, geography is in a good position to contribute to the improvement of the quality of life of people through the analysis of the territorial conditions that explain inequality, advanced location models and the consequent mapping of results. In the twenty-first century, applied geography has experienced a new impetus along with technological innovations.

This chapter aims to analyse the contributions that Geographic Information Systems and other related technologies have made in the area of spatial equity. As already pointed out, the question is old, but we are going to focus only on the contributions made in this century. The studies published on territorial (territorial) or spatial

(in)equity have been developed in two large dimensions: spatial management and planning (location of public services, accessibility, transport, urban development, tourism, etc.), and theorisation on the problems related with equity (socio-spatial imbalances, mobility, territorial structure, etc.). The first one is directly linked to territorial management and strategic planning, and can be classified as applied geography, while the second contributes powerfully to scientific progress in this area and to the definition of the major spatial problems that still concern society today, such as quality of life, sustainability, governance and cohesion.

In order to develop this analysis, we have identified the articles published in the main international scientific geography journals that consider spatial equity (or synonyms such as space justice) as the main topic dealt with. We have worked with journals indexed in the Scopus database,[1] the majority are in English, but not all. The time period that has interested us the most is from the year 2000 until 2018.

The chapter has been divided into four subsections. The first section explains what is meant by spatial equity and its role in current geography. The second section briefly presents the most important innovations and changes that technologies have introduced in geographical theory. In the third section, both equity and geographic technologies in the twenty-first century are related, from the scientific articles published on the subject. Finally, some conclusions with special emphasis on the future of these type of studies before the acceleration of the incorporation of GIS in everyday life (internet of things, mobile technologies, etc.) and, of course, in academia (the so-called neogeography).

10.2 Is Spatial Equity a Subject of Study for Geography Today?

The term justice in geography refers to the impartiality of the geographical distribution of social benefits (Gregory et al. 2009). Justice only becomes a problem when there is a conflict of interests, and what is more, even though those involved are not the generators of the conflict. According to the Oxford Dictionary of Human Geography (Catree et al. 2013), space justice, unlike social justice, focuses on the disparities between places. Given the unequal spatial distribution of resources and rights (some places are better served than others), spatial justice seeks a better distribution or redistribution in order to ensure that those territories that present the greatest problems due to harmful social and economic practices can improve their relative position with respect to others.

From political science, Fainstein (2017) points out that justice incorporates in its own definition, the values of democracy, diversity and equity. This last concept goes back to the time of the Enlightenment, but more recently to Marxist, neo-Marxists,

[1] Scopus is a bibliographic database of the Elsevier publishing house, which includes some 18,000 titles of journals and scientific documents of more than 5000 international publishers. It is accessible by subscription.

critical and even liberal geography theories. Therefore, it is evident that the ethical or simply human principles to resolve possible conflicts are of a different nature and this is what defines the meaning of social justice.

A part of that justice is related to the territory. In reality, it is not about analysing social justice, but about injustice, that is, the inequality of opportunities. The concept, and therefore the problem, is very broad, but a considerable part has to do with location. There is talk of inequality in the distribution of income and other sources of satisfaction of the basic needs of the population. In this sense, it is necessary to consider, on the one hand, that personal differences (race, family, intellect, etc.) should not determine the happiness of individuals since they are fortuitous, and therefore, irrelevant to determine their rights; and on the other hand, that all this happens somewhere, that is, people are located in the territory, permanently or not and whatever their characteristics. Therefore, the place where a person lives should also not determine their right to equal opportunities above their contributions to the common good and their different needs, although the latter is the subject of discussion mainly by political theorists. Spatial equity, understood as the search for equal rights of the entire population, whatever their place of residence. We will focus on the definition of Soja (2010), which indicates that society produces injustice with reflection on space at the same time that space (location) is a source of injustice. In addition, territorial diversity is not opposed to justice or spatial equity. All this has been the subject of study in geography and among the specialised academics, it has generated a consensus regarding the need to guarantee the human rights of the entire population regardless of the characteristics of the territory that hosts them, therefore, a transformation of the territory and, with it, of society.

Geography has developed territorial models that help to reach adequate levels of territorial equity with greater or lesser success, in particular from the optimisation of the location of activities and services, for which it has used spatial statistics and cartography. Currently, the study of spatial equity is again receiving the attention of academia (Vadrevu and Kanjilal 2016; Stanley et al. 2016; Tan and Samsudin 2017; Jang et al. 2017; Livert and Gainza 2017; Pitarch-Garrido 2018).

This interest is linked to the development of new technologies and GIS that have given applied geography a new opportunity to advance its contribution to society. Progress in this regard is linked not only to technological applications, but also to the idea of guaranteeing equity in all areas and ensuring that the supply of public goods and services is adequate for all citizens, in particular for those susceptible to be excluded. Spatial planning constitutes an indispensable instrument to achieve an adequate level of equity. This is of great importance not only for evidencing the usefulness of geography, but also because it reflects the social concern for justice in an environment that generates inequalities that are not tolerable (remember that the degree of tolerance depends on the acceptance of a series of ethical principles) with a trend towards a change that makes us better as a global society. Thus, the development of the welfare state in many countries has been accompanied by the proposal of different spatial organisation models that help to improve spatial equity, this being a priority of all public policy as it clearly contributes to the achievement of greater social cohesion.

An aspect of great interest is to know how the research on spatial equity in geography has been oriented, in particular from what criteria is measured as a first step for the proposal of strategic improvement actions. Spatial equity is the key concept that lies at the base of the location models of economic activities. These models which have been developed since the 1950s try to find an optimal location to achieve maximum profitability of the offer, for example public services, however, the reality is sometimes much more complex than the one considered by them. Political factors associated with local decision-making or with very different public priorities, explain the creation of a supply network of the main well-being services (health, education and social services) that does not always respond to this optimal location, objective of the classic models in search of spatial equity.

Since the 70s, the measurement of equity has been carried out with more emphasis based on accessibility (Garner 1971; Domanski 1979). The main research question in this topic was how to achieve greater spatial equity without necessarily implying a reduction in economic efficiency. On multiple occasions, accessibility has been the basis of the models and explanations that try to shed some light on the implications of locating public services in the territory. Different types of models have been proposed, from very centralist ones to those that favour extreme dispersion, from the most theoretical to the most applied, but almost all with the common characteristic of maximising the amount of population served by those services, equipment, programmes or public actions that are offered by the government. One way to achieve this goal is to improve accessibility through public transport, so very soon, studies on public and private transport networks multiplied.

The location of economic activities, particularly that of the supply of public and private services, is not unrelated to the structure of the territory, both from the physical point of view (transport network, equipment, etc.) and social (location of the population, average income, location of workplaces and residences, etc.), which places it at the centre of the interest in geography. However, the analyses carried out clearly differ according to the level of work, and, as we will see later, the role of geographic technologies, particularly GIS, will be much more decisive on the local scale, that of applied geography, territorial strategic planning.

Inequality exists at all levels. Throughout history, human beings have created a network of tangible and intangible socio-economic relations based on unequal exchanges. For years economic geography has been explaining, from different theories, such as unequal development or the centre–periphery among others, the current global spatial structure as a consequence of a process, or set of processes, that have led us to conformation of the global world at present, with its fundamental geographical characteristic that is inequality.

The scale of global analysis has led to studies on equity which is not considered as such, although they are the fundamental idea in their background. Many of the authors who currently work on the issue of justice take up the critical conception from the 1970s, especially from the current crisis, and relate the spatial injustice to the different forms of oppression generated by the capitalist system (Brennetot 2011). In the context of globalisation, there are several issues that are directly related to locational aspects, and one of them has to do with the options of locating different

services to companies, but also to the consumer. New forms of marginality and polarisation appear in this global environment. According to Sassen (1991), 'the evidence, for the case of the United States, Western Europe and Japan, suggests that government action and policy will be necessary to reduce new forms of spatial and social inequality.' (p. 8). The concept of justice and spatial equity acquires an enormous pluralism and is clearly linked to postmodernism from an epistemological and theoretical point of view.

As Beder (2000) points out, the main ethical principle behind sustainable development is equity. According to this author, 'equity means that there should be a minimum level of income and environmental quality below which nobody falls. Within a community it usually also means that everyone should have equal access to community resources and opportunities, and that no individuals or groups of people should be asked to carry a greater environmental burden than the rest of the community as a result of government actions. It is generally agreed that equity implies a need for fairness (not necessarily equality) in the distribution of gains and losses, and the entitlement of everyone to an acceptable quality and standard of living' (p. 227). Thus, social, environmental and economic inequalities exist internationally and, in order to achieve sustainable development for all, the fight against poverty and inequality is essential at the global level. Like other sciences, geography incorporates the concept of equity in the broader sustainable development to analyse inequality on a global scale.

Although spatial equity is probably only a small part of sustainability, it is a solid part, with concrete proposals for action and that at local and regional level has had, and will continue to have, concrete impacts (Zuindeau 2006; Dempsey et al. 2011; Pitarch-Garrido 2017). In this concept, spatial equity intersects sustainability and geography, presenting great potential for scientific and political development. Spatial equity has the great advantage of incorporating aspects not only of enormous interest for the real life of people, and therefore clearly influencing their quality of life, but it also has a clear practical interest in the sense that these variables are quantifiable and, therefore, help to delimit the concept of social sustainability as well as to put it into practice. These are relatively simple variables to measure, even more so with current computer techniques and the existence of very complete information sources (official statistics, big data, etc.). This leads directly to the change from global to local level. In recent decades, geography has made its main contributions on the local level.

Currently, the use of the concept of spatial justice is understood from different perspectives or approaches to geography, as well as from different scales (Gervais-Lambony and Dufaux 2009). Most of the research that expressly incorporates the term spatial equity is at the local level, that is, it is case studies that allow the use of new techniques and lead to the definition of new analysis methodologies. The standard tool for measuring equity has traditionally been the rate of variation of demand inputs (for example, students per teacher, doctors per thousand inhabitants, etc.); However, this measure has little to do with accessibility measures, which clearly contribute to measuring efficiency and equity in the location of public services. The balance between two factors, which we can call size and distance, helps to delimit

equity in the access to the service and the efficiency in its use to be able to serve a certain demand. The issue is especially relevant in urban and metropolitan areas with a high concentration of population in certain spaces and a notable dispersion in others.

In this regard, it should be noted that the so-called intelligent urban growth considers sustainability as the basis for urban planning, and although its main orientation is towards the management of growth taking into account environmental aspects, the problems of social equity and the quality of life of people are no less important. In this sense, the closeness to the supply of public services is consolidated as one of the aspects that is most valued and that best guarantees the sustainability of the territory and, therefore, spatial equity (Dempsey et al. 2011).

The various current processes related to increased mobility of people, the suburbanisation of jobs and rapid real estate growth have led to a change in regional and urban planning. The governance of the territory must adapt to its complexity in order to be more effective and more adequately respond to the new problems and realities that emanate from it.

Current studies are more oriented to the practice for decision-making help. The idea of spatial justice, according to Soja (2010), is not based only on external processes such as globalisation (Harvey 2003), but also develops from endogenous decision-making processes at the local level. One of the ways that this author proposes to reflect on the spatial aspects of injustice is based on geographical studies on inequality and social welfare.

To try to achieve a fairer distribution over space, geographers continue to work on the development or improvement of localisation models that incorporate criteria such as public utility (number of people using the service), travel costs and means of transportation (Moreno Jiménez 2015; Geurs et al. 2016; Saghapour et al. 2016; El-Geneidy et al. 2016; Farber and Fu 2017; Ruiz et al. 2017). The current reality is that new technologies have powerfully contributed to favour the development of spatial models as tools for planning.

10.3 The Role of Geographic Information Systems in the Renewal of the Geography of the Twenty-First Century

The postmodern society is characterised by being the information society. Like all sciences, geography has sought to improve the knowledge of previous stages in a constant advance to better understand the territorial problems and, with them, the social, economic and environmental ones. This objective has been constant throughout the history of geography, what has varied has been the technical means to achieve it. Technological advances are the basis of new ways of thinking about geographical reality, of interpreting it.

It is necessary to continue with geography's commitment to the usefulness of its knowledge, that is to say, a geography committed to the time and the society in which it is developed. It is an old idea that was already developed in the time of Hettner in his work *Die Geographie, ihre Geschichte, ihr Wesenundihre Methoden* (1927) and which has been reflected by later authors, among others in the work of Unwin, *The Place of Geography* (1992). The geographer must be able to analyse the territorial reality and propose alternatives and priorities to clearly contribute to the improvement of the quality of life of people. This is possible, or at least more effective, based on good training in applied subjects and new techniques, including computer technology, which has become part of the central structure that underpins the new geography in recent years.

Territorial issues have acquired great social relevance. The reality is constantly changing and geography is currently experiencing a process of renewal that, according to Marchand (2001), is based on three factors: historical heritage, social culture and technological progress. Of them, we now focus on the role of third parties.

The incorporation of computer technology has developed the practical application of geography, facilitating the application of spatial planning processes more than in other historical moments, in particular, as we will see, of local environments, which have been able to take advantage of technological advantages more quickly and in a better way for the study of territorial problems (Taylor and Lange 2016).

But before continuing with this, it should be noted from a more theoretical point of view that on occasion, studies based on the application of computer techniques have been accused of excessive instrumentalists. The interest for the establishment of a technical control over the environment is understood as such. Given that it is the result that matters, the theory loses its relevance and it is the methods (based on advanced technologies) that gain prominence to make the appropriate predictions from the observable data. It is a philosophy of science that was already developed in the quantitative revolution (1960s and 1970s of the twentieth century), and now seems to be taking centre stage before the generalisation of methodologies based on the new contributions of the GIS and the big data, among others. However, while for some it seems to be a criticism, for others it is nothing more than the verification of being on the right track and the advantages in terms of application of the geographical technologies developed since the late twentieth century and now widespread in the studies of both geographers as well as other related sciences whose goal is to be useful to society.

Since the end of the 1990s, the interest that the role of computer technology and other advances linked to the generalisation of the internet in geographical studies has aroused is reflected in the appearance of monographs on the subject in large prestigious geographical journals, such as *Geojournal*. Number 45 of this journal in 1998 was entitled 'The Globalization of Geography', *Environment and Planning, B*, number 28, in 2001 on 'Cyber Geography', *Urban Studies*, number 38, in 2002, entitled 'The knowledge Based City', among other journals that have increasingly incorporated articles focused on the use of GIS and other technologies in geography, such as *Cartographica*, with its number 39 of 2004 practically being a monograph on GIS from critical geography. In addition, an increasing number of specific journals on

this subject have been consolidated in the scientific panorama, among which we can highlight *International Journal of Geographical Information Science*, *Transaction in GIS*, *Cartography and Geographical Information Science*, *Geofocus*, among others.

All this interest in technological applications has been developed along with the evolution of GIS and other communication technologies and cartographic representation. In the last decade, in-depth analyses have multiplied on the intrinsic nature of GIS, its ability to analyse physical and social reality, its place at the centre of geography as a discipline or just as a technique applicable to various objects of study in the social sciences, etc. The controversy is still seen in different contributions from different methodological and epistemological approaches. However, in what seems to be more or less explicit agreement is to consider the technological advances associated with information technology, especially GIS, and the revolution in communications, particularly the Internet and, with it, the so-called digital geography, as an undeniable advance for the professional and practical projection of geography. The most important impact has been on cartography, which, thanks to the incorporation of information technology, has faced new challenges and opportunities for the representation of geographical reality and, above all, has become widespread among scientists and popularised among the general population. The technological applications in geography have made the cooperation between different disciplines possible (inside and outside of it), which has contributed to an enrichment of the most traditional approaches (Crampton 2001). According to Chuvieco et al. (2005) GIS have meant an epistemological split not only in the field of geographic communication (through maps), but also in the visualisation of information on the spatial relationships between the various factors that make up the territories. The reality is that the application of GIS to the more traditional problems addressed by geography and that until now had not had techniques that facilitated analysis with high precision, has been and is a usual and highly successful practice in applied geography. This has allowed us to deal with very varied territorial problems and open up new work possibilities for geographers.

In the same way that the spatial turn of the social sciences has been pointed out before, it should be noted that geography also talks about other turns: the political turn, the cultural turn and the digital or technological turn. In reality, all of them are related and do nothing but show that as a science, geography is in a good stage of production and, above all, of contribution to society. Without entering into the discussion about whether or not geotechnology is a nuclear or peripheral part of geography, what is evident from the above and from the evidence regarding production capacity is that technology has marked a new era of modern geography. The technological turn has been very profound (Ash et al. 2018). Digital geographies are discussed in order to include everything that has contributed to technological development under this umbrella, from digital cartography to geo-positioning websites. More than considering digital as something extraneous, or as a different subdiscipline, Ash et al. (2018) propose the consideration that digital covers all the action areas of geography and that it clearly contributes to changing and improving the production of geographic knowledge. These authors point out in their conclusion: 'As the proliferation, commercialization and popularisation of geolocation technologies are itself engendering

the flourishing of spatial ontologies and epistemologies, we encourage geographers to adopt and embrace an epistemological, ontological, and methodological openness in their engagements with the digital.' (p. 38).

Part of this new phase of the history of geography is the so-called GIS-2, which was already referred to in the 1990s. It is a term that emerged in the conference entitled 'GIS and Society', organised by the NCGIA[2] (National Center for Geographic Information and Analysis) of the University of California in 1996. The GIS itself became an object of study of geography, and still remains one today. When considering what it is for and what its limits are, geographers wanted to grant it a greater entity than mere cartographic representation. GIS-2 is an environment which generates knowledge and increases the emphasis on participation for the creation of information, incorporates the equitable representation of the different ways of understanding the world, it can redefine its parameters to adapt to the standards and objectives of the participants (incorporates subjectivity), it is able to incorporate the time variable and is able to manage all the components of a theoretical or applied research. In short, it supposes a proposal for growth for the GIS, on the way by which to develop, overcoming an only technological definition and incorporating greater creativity and adaptation to real problems for which it may be necessary to have the participation of citizens, their individual or collective narratives, new methods of analysis, etc.

Years later, geographers still need to address the development of GIS (Sieber 2004; Miller 2006; O'Sullivan 2006; Radil and Anderson 2018). GIS is a powerful tool and a body of knowledge which, oddly enough, includes both characteristics that have been evolving towards online geospatial applications that, for some, are the beginning of a democratic GIS, which favours the incorporation of diverse social groups, non-profit organisations, etc., despite accessibility problems for certain groups or sectors of the population linked to the interests of large private companies. The demand for a free, equitable and democratic GIS-2 or 3 is still alive today.

In this context, it arises in the concept of neogeography, which responds to the above, and even delves into the concept of geography as a social phenomenon that implies a new relationship with territories and with freedom as its main characteristic. Following Turner (2006), 'Neogeography means ‹new geography› and consists of a set of techniques and tools that fall outside the realm of traditional GIS, Geographic Information Systems. Where historically a professional cartographer might use ArcGIS, talk of Mercator versus Mollweide projections, and resolve land area disputes, a neogeographer uses a mapping API like Google Maps, talks about GPX versus KML, and geotags his photos to make a map of his summer vacation' (p. 2).

The separation between scientific and popular contribution, between the expert and the volunteer, has traditionally been made to bring complex scientific concepts to the non-expert population. However, in the case of geography, it may suppose some recently developed problems such as the lack of rigour over the information processed and generated. However, GPS, web and open-source GIS have reduced the cost of entry to geographic knowledge, at least in the mind of neogeographers

[2] http://www.ncgia.ucsb.edu/; http://www.ncgia.ucsb.edu/research/initiatives.html.

(Goodchild 2007, 2008). Without entering into an argument, it is interesting to note the weight of technology not only in the production of scientific or pseudoscientific knowledge, but in the greater proximity of geography to society, which deals with cartographic knowledge, at least, with greater familiarity than in the last century.

In conclusion, the contribution of geotechnology to the improvement of scientific and applied analyses carried out by geographers, and also by other specialists has meant a clear improvement in obtaining more realistic and useful results for society. The future is more open than ever and changes are happening faster than in previous years. The education of our young geographers must change in line with the new reality, as well as the ongoing training of the older ones. The knowledge that we are able to contribute, explain and translate into current communication formats (maps, applications, websites, etc.) should not be isolated in academia, but applied to the real problems of people to improve the global society and the place where we live. As we indicated in the title of this chapter, they are new solutions to old problems that still exist and can be improved, when not solvable. Geography, which is a science as old as human beings who have knowledge about where they are and about the territory in which they inhabit as one of their main desires, still has much to contribute, and technology clearly contributes to it.

10.4 Geographic Information Systems and Spatial Equity in the Twenty-First Century

Up to this point, the importance of geography studies in the twenty-first century with the idea of a search fund for spatial equity on different scales have been expressed, above all, on the most direct and effective level of public action: the local level. Therefore, there is no doubt that equity and/or spatial justice is still a subject of interest for geographers and that they are immersed in a global world in which technology is part of our lives and, therefore, of the research methodologies. They have substantially advanced towards more precise forms of measurement and more accurate analysis, capable of considering a greater number of variables, responding to territorially complex situations.

10.4.1 Methodology

In order to identify the most recent research on the issues of spatial equity made by geographers, a bibliometric analysis of geography journals indexed in the Scopus database has been carried out. The selected articles are those published since 2000, although reference will be made to others within the same theme published prior to this date (see Annex).

A search has been carried out using the following combined terms that may be present in the title, abstract or keywords: 'spatial equity' and 'GIS', 'spatial justice' and 'GIS', 'spatial' and 'equity' and 'GIS', 'spatial' and 'equity'. Starting with these last two terms searched as separate words, 249 documents appear since 1978. The years with the most articles are 2016, with 34 documents, and 2017, with 45 documents that meet this criterion. As it is evident, both terms 'spatial' and 'equity' do not appear in this first search related to computer technologies. It is interesting to know the enormous amount of articles on this subject, which increases as the century progresses. The most important journals are *Journal of Transport Geography*, with 12 articles in which both terms appear, *International Journal for Equity and Health*, with 10 articles, and *Landscape and Urban Planning*, with 8 articles. The spatial equity linked to transport turns out to be one of the aspects that geographers are most interested in.

However, when we incorporate the term 'GIS' into the previous search, the number of documents is drastically reduced. Only 34 meet that triple condition. The years 2014 and 2016 have the most articles, with 6 each. The most important journals are *Journal of Transport Geography*, as in the previous case, with 5 articles, *Cities*, with 4 and *Sustainability (Switzerland)* with 2.

The most precise combination of the terms 'spatial equity', jointly, and 'GIS' results in 24 documents, of which 3 correspond to conference proceedings and 1 to a revision of a book, therefore, in reality, it is about 20 scientific articles to be precise. 2014 includes more articles with these terms, with a total of 4, while 2016 and 2017 add 3 more each. In this case, the journal that leads the publications on the subject is *Cities*, with 4 articles, followed by *Journal of Transport Geography*, with 3 articles.

In the same way, the terms 'spatial justice' and 'GIS' add up to a total of 6 articles, all of them included in the previous search.

A search in other scientific journal databases results in a greater number of articles, and a broader search incorporate topics that are not directly related to what geography understands as spatial equity. Therefore, and to be specific, we will focus on the 20 scientific articles that, from geography, have entered into the study of spatial equity through GIS in the twenty-first century. It is worth noting that all of them have been published in English, except 2, 1 in Japanese (in the *Geographical Review of Japan* journal) and 1 in Spanish (in the journal *Investigaciones Geográficas*) which is the only 1 in open access.

10.4.2 Results

From the analysis of the selected articles, a first overview of the specific topics analysed can be offered. First, it should be noted that the objective of most of the research published in the journals indicated is to measure equity based on the location of different types of public services: parks or urban green areas, hospitals, family doctors, educational centres, social services, children's recreational services, services for the elderly, etc. From their location, the different authors develop either accessibility

models (with or without restrictions) or demand indices to measure the consumption capacity of said services by social groups with different economic characteristics.

Not all selected articles have been produced by geographers. Of the 20, there is only an author assigned to a clearly denominated department of geography in 7. This does not mean that other authors linked to departments such as Earth Sciences, Geoinformatics and Engineering, are not geographers, however, it gives us a clear idea of the current interdisciplinarity of the science and, also, of the interest from other disciplines on the subject of spatial equity and geographical analysis.

The most widely used technique is spatial statistics with results mapped through the GIS. Most articles use the analysis of accessibility to assess the degree of equity in a specific territory. This is related to multiple issues such as decisions on the allocation of resources, the location of the service or activity, information and even the quality of it. In short, it is the 'ease' with which the user can get the service they need, for which physical accessibility is important, but so is the measure of it in time. Travel time contributes enormously to the perception that citizens have about the quality of the supply of public services and, therefore, about the quality of life. Time is a measurement that links activities and places (May and Thrift 2001; Davouidi 2009).

The most widely used measurement of spatial equity has been accessibility to public services. To this end, interesting studies on public transport have been carried out since the 1990s, with very reliable results, despite not having the exact location of the demand (the population). This was compensated, in some way, with the correct location of the service offering centre. Currently, the use of GIS has made it easier for the real-time accessibility indicator to get closer to reality in complex areas such as urban and metropolitan areas, being able to reach conclusions that were not possible with a less precise technique.

From the establishment of different limits (in time of access), it is possible to characterise the different areas and municipalities according to their greater or lesser equity. The establishment of these limits is an important aspect when drawing up public policies at the local and regional level.

Another recurring theme for the analysis of spatial equity is transportation: public bus lines, toll roads, high-speed train, etc. Evidently, the structure of the public transport network determines the results of equity. The improvement of the transport network and/or the creation of new networks is fundamental today to integrate and order urban and metropolitan areas, in which dispersion and urban complexity is inevitable. The so-called intelligent urban growth considers sustainability as the basis for urban planning, however, its orientation towards the management of growth and environmental aspects seems to leave aside the problems of social equity. In the articles analysed, studies on transport are the only ones that go beyond the urban scope, focusing on the intermediate scale, the regional one.

On the other hand, it is worth noting the interest of a significant amount of research to characterise the population susceptible to demand public services from the socio-economic point of view. On the one hand, the study of the socio-economic and demographic characteristics of the resident population in the spaces with the lowest level of accessibility serves to delve into the real impact of spatial equity. On the

other hand, if we consider the characteristics of the population without linking it to their place of residence, it is possible to know the social implications of equity in the territory analysed as a whole. The GIS allows both types of analysis as evidenced in the articles presented.

Another feature common to research published on spatial equity is its local approach. The spaces analysed are, above all, cities such as: Changting (China), Palma de Mallorca (Spain), Hamadan (Iran), Zahedan (Iran), Cape Town (South Africa), Madrid (Spain), Edinburgh (United Kingdom), Tehran (Iran), Beijing (China), Tainan (Taiwan), Toronto (Canada), Chicago (USA) and Edmonton (Canada). And, a few regions such as Sundarbans (India) and England (United Kingdom), or countries such as Israel and Spain.

The city is the place where justice and equity are more clearly defined and where they can best be analysed. Both from the global point of view (its role in the international economy) and from a local perspective (centre of services provided to its own hinterland), the city is the most appropriate space to define the processes of improvement in equity and therefore, in the achievement of greater spatial justice at all levels. This explains the geographers' interest in using the case study as an analysis methodology and for this case to be a city.

A common element in almost all the analysed contributions, closely related to the previously described idea, is the explicit interest of the authors for their research to have a practical application in spatial or local politics. The public action can be twofold: on the location or relocation of the centres offering services, but also on the public transport network. An optimisation of the former and a broadening or territorial expansion of the latter in order to reach a greater part of the territory would considerably improve equity in a territory.

The future possibilities of geographic technologies, in particular GIS, are many and varied. One of the most interesting ones is to perform simulations to measure the consequences of new locations or closures, aspects so relevant in times of crisis. Possible closures of service supply centres (part of the public decision-making policy) do not have to be negative if the service is not reduced and its localisation is carried out effectively and, above all, taking into account territorial equity, even being able to improve it. Applied geography seems to be more relevant than ever in the twenty-first century, and in the old issue of fairness or spatial justice, it can still bring many surprises.

10.5 Conclusions

The impact of technology on geography as a science is indisputable. The emergence of new ways of doing geography has led to pioneering research, better communication of results, availability of material to contribute to decision-making in spatial planning processes at different scales, especially on a spatially local scale, etc. All of which has also generated challenges for future generations of geographers such as a greater need to acquire new technical skills, improve continuous training, interact

with other disciplines more closely, consider the use of other languages to communicate the results to a greater extent, such as audiovisual language, to address practical problems for the proposal of solutions to real situations, etc. The biggest challenge for geographers is to be able to show the importance of spatial analysis and the interaction of the human being with the environment (natural and artificial) on all scales, knowledge that we share with colleagues from other disciplines, without losing the essence that defines geographic knowledge and maintaining its usefulness.

Regarding the issue at hand, it should be noted that spatial equity and its analysis (and proposals) based on the incorporation of geotechnologies is not an exhausted issue, despite having been studied since the mid-twentieth century. The perspective has not changed much since then, which has meant that the use of GIS is a remarkable qualitative improvement. In recent years, and perhaps due to the variety and breadth of new topics for geography (some of them linked to new technological realities), and with its political implications, equity is of less interest. It remains a clear theme (it appears as a keyword) in countries such as China, Iran and Spain with a recent interest by their geographers to publish their results in international journals in English, thus becoming more visible, which does not mean that these older subjects have not traditionally been addressed in these countries. In addition, it is necessary to consider that the research developed by geography is not always classified with the basic keywords, but that related topics can lead to true applied analyses on the phenomenon of spatial equity, without being referred to in that way.

In any case, in this chapter, we have tried to give a general view of the technological applications for the proposal of actions that seek greater social and territorial equity based on an adequate location of public services and transport management. The future opens up many possibilities of work in this field, always associated with new technological developments and communication, some of them already present in the most advanced societies. The technical improvement of GIS, associated with the better qualification of future geographers, opens up new possibilities. The availability of a large amount of geolocated data, and in particular big data, opens a window of opportunity for more and more specific and reliable analyses. To this, we must add the enormous possibilities presented by the internet and social networks to gather qualitative information, that is, opinions, assessments, perceptions regarding public policies that affect citizens as a whole, quality of services, conservation status of equipment, etc. When all this is managed and screened, it can provide even more rigour than just quantitative information. In addition, networking with multidisciplinary teams and experts from many parts of the world will become much more common than today. GIS and other geoinformatic applications will undoubtedly contribute to facilitating the exchange of ideas and an increase in the understanding of territorial and social diversity. The realisation of proposals that can be applied with the aim of improving the quality of life of all people will remain in the hands of geographers and other scientists.

Annex

Title	Authors Affiliation	Journal	Keywords
A spatially accurate method for evaluating distributional effects of ecosystem services	Aliza Fleischer[a] Daniel Felsenstein[b] Micha Lichter[b] [a]Department of Environmental Economics and Management, The Centre for Agricultural Economics Research, Hebrew University of Jerusalem, Israel [b]Department of Geography, Hebrew University of Jerusalem, Israel	*Ecological Economics* Volume 145, March 2018, Pages 451–460	Ecosystem services Equity Welfare distribution Synthetic spatial microdata
Spatial equity measure on urban ecological space layout based on accessibility of socially vulnerable groups—a case study of Changting, China	Yanhua Yuan[1,2] Jiangang Xu[3,*] Zhenbo Wang[4,5,*] [1]School of Geographic and Oceanographic Sciences, Nanjing University, Nanjing, China [2]Nanjing Engineering Consulting Center, Nanjing, China [3]School of Architecture and Urban Planning, Nanjing University, Nanjing, China [4]Key Laboratory of Regional Sustainable Development Modeling, Chinese Academy of Sciences, Beijing, China [5]Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China	*Sustainability* 2017, *9*(9), 1552	National famous historical and cultural cities Public parks GIS spatial analysis Accessibility Spatial equity Socially vulnerable groups Mountainous city

(continued)

(continued)

Title	Authors Affiliation	Journal	Keywords
Improving bus service levels and social equity through bus frequency modelling	Maurici Ruiz[a] Joana Maria Segui-Pons[b] Jaume Mateu-LLadó[b] [a]GIS and Remote Sensing Service, University of the Balearic Islands, Palma de Mallorca, Spain [b]Geography Department, University of the Balearic Islands, Palma de Mallorca, Spain	*Journal of Transport Geography* Volume 58, January 2017, Pages 220–233	Public transport Bus headways optimization Social equity Spatial equity Simulation GIS-T
Measuring spatial equity and access to maternal health services using enhanced two step floating catchment area method (E2SFCA)—a case study of the Indian Sundarbans	LalithaVadrevu Barun Kanjilal IIHMR University, Sanganer, Jaipur, Rajasthan, India	*International Journal for Equity in Health*, 2016, 15:87	Maternal health Enhanced two step floating catchment area method Geographic information system Sundarbans Equity
Is inequality in the distribution of urban facilities inequitable? Exploring a method for identifying spatial inequity in an Iranian city	Hashem Dadashpoor[a] Faramarz Rostami[b] Bahram Alizadeh[c] [a]Department of Urban and Regional Planning Tarbiat Modares University, Tehran, Iran [b]Researcher of Urban and Regional Planning, Tehran, Iran [c]Tabriz Islamic Art University, Tabriz, Iran	*Cities* Volume 52, March 2016, Pages 159–172	Inequality Spatial inequity measurement Public facility distribution Enjoyment Hamadan city Iran

(continued)

(continued)

Title	Authors Affiliation	Journal	Keywords
Distributional planning of educational places in developing cities with case studies	Abdol Aziz Shahraki[a] Issa Ebrahimzadeh[b] Diman Kashefidoost[b] [a]Royal Institute of Technology, The School of Architecture and the Built Environment, Department of Regional Studies, Stockholm, Sweden [b]University of Sistan and Baluchestan, Department of Urban planning and Geography, Zahedan, Iran	*Habitat International* Volume 51, February 2016, Pages 168–177	Iran Land use policy Educational spaces Distribution pattern Optimal distribution
Toward spatial justice: The spatial equity effects of a toll road in Cape Town, South Africa	Justin van Dijk Stephan Krygsman Stellenbosch Tom de Jong University Stellenbosch Utrecht University	*Journal of Transport and Land Use* Vol. 8, No. 3, 2015	Accessibility Toll road Spatial equity GIS South Africa
Designing a socio-spatial need indicator for urban social services analysis and decision-making. A case study [Diseño de un indicador de necesidad socio-espacial para el análisis y la formación de decisiones sobre servicios sociales urbanos. Un estudio de caso]	Jiménez, A.M. Universidad Autónoma de Madrid, Departamento de Geografía, Madrid, Spain	*Investigaciones Geográficas* Open Access Volume 87, 2015, Pages 102–117	GIS Local public policies Social indicator Social needs Social services
Accessibility modelling: Predicting the impact of planned transport infrastructure on accessibility patterns in Edinburgh, UK	Karou, S. Hull, A. School of the Built Environment, Heriot-Watt University, Edinburgh, United Kingdom	*Journal of Transport Geography* Volume 35, February 2014, Pages 1–11	Accessibility Edimbourg Tram GIS Spatial equity Transport Planning

(continued)

(continued)

Title	Authors Affiliation	Journal	Keywords
An integrated framework to evaluate the equity of urban public facilities using spatial multi-criteria analysis	Taleai, M.[a], Sliuzas, R.[b], Flacke, J.[b] [a]Center of Excellence for Geomatics Information Technology, Geomatics Faculty, K.N. Toosi University of Technology, Tehran, Iran [b]Faculty of Geo-Information Science and Earth Observation, University of Twente, Netherlands	*Cities* Volume 40, Issue PA, October 2014, Pages 56–69	GIS Linkage among land uses Multicriteria evaluation Multifunctional land uses Spatial equity
Using connectivity for measuring equity in transit provision	Kaplan, S.[a], Popoks, D.[a], Prato, C.G.[a], Ceder, A.[b] [a]Department of Transport, Technical University of Denmark, Bygningstorvet 116B, 2800 Kgs. Lyngby, Denmark [b]Department of Civil and Environmental Engineering, University of Auckland, 20 Symonds Street, 1010 Auckland, New Zealand	*Journal of Transport Geography* Volume 37, May 2014, Pages 82–92	Geographical Information Systems Intergenerational equity Spatial equity Transit connectivity Vertical equity
Assessing the location of public-and-community facilities for the elderly in Beijing, China	Zhou, S., Cheng, Y. Xiao, M. Bao, X. Beijing Normal University, Beijing, China	*GeoJournal* Volume 78, Issue 3, June 2013, Pages 539–551	Beijing Public-and-community facilities Spatial analysis Spatial equity The elderly

(continued)

(continued)

Title	Authors Affiliation	Journal	Keywords
Efficiency and spatial equity impacts of high-speed rail extensions in urban areas	Monzón, A. Ortega, E., López, E. TRANS y T-UPM Centro de Investigación del Transporte, Universidad Politécnica de Madrid, ETSI, Madrid, Spain	*Cities* Volume 30, Issue 1, February 2013, Pages 18–30	Accessibility indicators Efficiency impacts High-speed rail (HSR) Spatial Equity Urban areas
Estimating secondary school catchment areas and the spatial equity of access	Singleton, A.D.[a], Longley, P.A.[b] Allen, R.[c], O'Brien, O.[b] [a]Department of Civic Design, University of Liverpool, United Kingdom [b]Department of Geography and CASA, University College London, United Kingdom [c]Department of Quantitative Social Science, Institute of Education University of London, United Kingdom	*Computers, Environment and Urban Systems* Volume 35, Issue 3, May 2011, Pages 241–249	Catchment analysis Decision support system Education GIS Percent volume contour School
Exploring an integrated method for measuring the relative spatial equity in public facilities in the context of urban parks	Chang, H.-S. Liao, C.-H. Department of Urban Planning, National Cheng-Kung University, Taiwan	*Cities* Volume 28, Issue 5, October 2011, Pages 361–371	Accessibility Mobility Spatial equity Urban public facilities
Immigration, ethnicity, and accessibility to culturally diverse family physicians	Wang, L. Department of Geography, Ryerson University, Toronto, Canada	*Health and Place* Volume 13, Issue 3, September 2007, Pages 656–671	Accessibility Chinese immigrants Ethnicity Family physician

(continued)

(continued)

Title	Authors Affiliation	Journal	Keywords
Spatial equity in facilities providing low- or no-fee screening mammography in Chicago neighbourhoods	Zenk, S.N.[a] Tarlov, E.[b], Sun, J.[c] [a]Program in Cancer Control and Population Sciences, University of Illinois at Chicago, United States [b]Midwest Center for Health Services and Policy Research, Hines VA Hospital, United States [c]Department of Sociology and Criminal Justice, Texas A and M University-Commerce, United States	*Journal of Urban Health* Volume 83, Issue 2, March 2006, Pages 195–210	African-american GIS Health care access Mammography Neighbourhood Poverty Urban health
An accessibility-based integrated measure of relative spatial equity in urban public facilities	Tsou, K.-W. Hung, Y.-T. Chang, Y.-L. Department of Urban Planning, National Cheng-Kung University, Taiwan	*Cities* Volume 22, Issue 6, December 2005, Pages 424–435	Geographical Information Systems Integrated equity indices Spatial analysis models
Trends and issues in accessibility studies in the GIS Era	Tanaka, K. Faculty of Integrated Arts/Sciences, University of Tokushima, Tokushima, Japan	*Geographical Review of Japan* Volume 77, Issue 14, December 2004, Pages 977–996	Accessibility GIS Space-time measure
Spatial accessibility and equity of playgrounds in Edmonton, Canada	Smoyer-Tomic, K.E. Hewko, J.N. Hodgson, M.J. Department of Earth/Atmospheric Sci., University of Alberta, Canada	*Canadian Geographer* Volume 48, Issue 3, September 2004, Pages 287–302	Accessibility GIS Amenity Equity Spatial distribution Urban area

References

Ash J, Kitchin R, Leszczynski A (2018) Digital turn, digital geographies? Prog Hum Geogr 42(1):25–43

Beder S (2000) Costing the earth: equity, sustainable development and environmental economics. N Z J Environ Law 4(2000):227–243

Brennetot A (2011) Les géographeset la justice spatiale: Généalogie d'une relation compliquée. Ann Géographie 678:115–134

Catree N et al (2013) A diccionary of human geography. Oxford University Press, Oxford

Chuvieco E et al (2005) ¿Son las tecnologías de la información geográfica (TIG) parte del núcleo de la Geografía? Boletín Asoc Geógrafos Esp 40:35–55

Crampton JW (2001) Maps as social constructions: power, communication and visualization. Prog Hum Geogr 25(2):235–252

Davouidi S et al (2009) El desarrollo territorial: entre la perspectiva ambiental, la cohesión social y el crecimiento económico. In: Feria JM et al. (eds) Territorios, Sociedades y Políticas. Universidad Pablo de Olavide y AGE, Sevilla

Dempsey N, Bramley G, Power S, Brown C (2011) The social dimension of sustainable development: defining urban social sustainability. Sustain Dev 19:289–300

Domanski R (1979) Accesibility, efficiency and spatial organization. Environ Plan A 11(10):1189–1206

El-Geneidy A, Levinson D, Diab E, Boisjoly G, Verbich D, Loong C (2016) The cost of equity: assessing transit accessibility and social disparity using total travel cost. Transp Res Part A: Policy Pract 91:302–316

Fainstein (2017) Urban planning and social justice. In: Gunder M, Madanipour A, Watson V (eds) The Routledge handbook of planning theory. Routledge, pp 130–142

Farber S, Fu L (2017) Dynamic public transit accessibility using travel time cubes: Comparing the effects of infrastructure (dis) investments over time. Comput Environ Urban Syst 62:30–40

Garner BJ (1971) Modelos de Geografía Urbana y de localización de asentamientos. In: Chorley RJ, Haggett E (eds) La Geografía y los modelos socioeconómicos. IEAL, Madrid

Gervais-Lambony P, Dufaux F (2009) Justice… spatiale! Ann Géographie 665–666:3–15

Geurs KT, Patuelli R, Dentinho TP (eds) (2016) Accessibility, equity and efficiency: challenges for transport and public services. Edward Elgar Publishing

Goodchild MF (2007) Citizens as sensors: the world of volunteered geography. GeoJournal 69(4):211–221. Available at: http://www.springerlink.com/content/h013jk125081j628/. Accessed 21 Jan 2018

Goodchild MF (2008) Assertion and authority: the science of user-generated geographic content. Cite Seer. In: The proceedings of the colloquium for Andrew U Frank's 60th Birthday, GeoInfo 39, Department of Geoinformation and Cartography, Vienna University of Technology. http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.161.9211. Accessed 22 Jan 2018

Gregory D, Johnston R, Pratt G, Watts M, Whatmore S (eds) (2009) The dictionary of human geography. Wiley, New York

Harvey D (1973) Social justice and the city. McMillan, Londres

Harvey D (2003) The right to the city. Int J Urban Regional 27(4):939–941

Jang S, An Y, Yi C, Lee S (2017) Assessing the spatial equity of Seoul's public transportation using the Gini coefficient based on its accessibility. Int J Urban Sci 21(1):91–107

Livert F, Gainza X (2017) Distributive politics and spatial equity: the allocation of public investment in Chile. Reg Stud 1–13

Marchand P (2001) La géographie régionales à l'orée du IIIe millénaire. Ann Géographie 619:303–308

May J, Thrift NJ (eds) (2001) Timespaces. Geographies of temporality. Roudledge, London

Miller CC (2006) A beast in the field: the Google maps mashup as GIS/2. Cartographica 41(3):187–199

Moreno Jiménez A (2015) Diseño de un indicador de necesidad socio-espacial para el análisis y la formación de decisiones sobre servicios sociales urbanos. Un estudio de caso, *Investigaciones Geográficas*, 87, Instituto de Geografía, UNAM, México, pp 102–117. https://doi.org/10.14350/rig.43499

O'Sullivan D (2006) Geographical information science: critical GIS. Prog Hum Geogr 30(6):783–791

Pitarch-Garrido MD (2017) La accesibilidad a los servicios públicos como medida de la equidad espacial en las áreas metropolitanas. El caso del área metropolitana de Valencia. Pitarch-Garrido (ed) Estructura, vida y gobierno en territorios complejos: el área metropolitana de Valencia. Tirant lo Blanch, Valencia

Pitarch-Garrido MD (2018) Social sustainability in metropolitan areas: accessibility and equity in the case of the metropolitan area of Valencia (Spain). Sustainability 10:371

Radil SM, Anderson MB (2018) Rethinking PGIS: participatory or (post)political GIS? Prog Hum Geogr 1–19. https://doi.org/10.1177/0309132517750774

Ruiz M, Segui-Pons JM, Mateu-Lladó J (2017) Improving bus service levels and social equity through bus frequency modelling. J Transp Geogr 58:220–233

Saghapour T, Moridpour S, Thompson RG (2016) Public transport accessibility in metropolitan areas: a new approach incorporating population density. J Transp Geogr 54:273–285

Sassen S (1991) The Global City. New York, London, Tokyo, Princeton University Press: Princeton-New Jersey

Sieber R (2004) Rewiring for GIS/2. Cartographica 39(1):25–39

Soja EW (2010) Seeking spatial justice. University of Minnesota Press, Minneapolis

Stanley BW, Dennehy TJ, Smith ME, Stark BL, York AM, Cowgill GL, Ek J (2016) Service access in premodern cities: an exploratory comparison of spatial equity. J Urban Hist 42(1):121–144

Tan PY, Samsudin R (2017) Effects of spatial scale on assessment of spatial equity of urban park provision. Landsc Urban Plan 158:139–154

Taylor D, Lange J (2016) Social applications of geographical information systems: technical tools for social innovation. Aust Geogr 47(4):417–433

Turner A (2006) Introduction to neogeography. O'Reilly Media Inc.

Vadrevu L, Kanjilal B (2016) Measuring spatial equity and access to maternal health services using enhanced two step floating catchment area method (E2SFCA)—a case study of the Indian Sundarbans. Int J Equity Health 15(1):87

Zuindeau B (2006) Spatial approach to sustainable development: challenges of equity and efficacy. Reg Stud 40(5):459–470