

Chapter 4

Demographic Change and Land Use



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Abstract Demographic change is increasingly being described as one of the central factors of human influence on land-use change. But do changes in population size and composition directly effect changes in land use? These reflections prompted the author and two colleagues to conduct a study aimed at (a) finding answers to the questions of whether and to what degree clear correlations between demographic change and observable land-use changes could be found in the existing literature, and (b) establishing what this means for regional studies and regional development policies. After presenting the methodological approach, the current state of knowledge regarding correlations between demographic change and land-use change is reflected and will finally be followed by conclusions and the need for further research.

Keywords Land use · Demographic change · Impact

4.1 Does Demographic Change Cause Changes in Land Use?

Aside from natural processes, it is the many and varied demands that people make on land that lead to changes in land cover and land use. The drivers of change in land cover and land use are wide-ranging, complex, and overlapping, as are the effects of those changes. Drivers vary depending on the location, time frame, and institutional architecture of the human–environment system under observation. Some drivers have long-term impacts that unfold slowly while others trigger rapid and visible changes. (McNeill et al. 1994; Lambin et al. 2001; Lambin and Geist 2006).

According to Lambin et al. (2001), the debate on drivers of land-use change is dominated by simplifications and even myths that affect concepts, values, and decisions in politics and policies shaping land use.

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A distinction is made between biophysical drivers, i.e., natural influences, and socio-economic drivers, i.e., drivers of anthropogenic use (Schininger 2008; Cortesi and Hepperle 2011). The latter category is sometimes divided or broadened to include socio-economic, political, technological, and cultural factors. (Bürgi et al. 2004; Schneeberger et al. 2007).

Demographic change is increasingly being described as one of the central factors of human influence on land-use change (Hersperger and Bürgi 2009; EEA 2010; Moorfeld 2011). But does demographic change really contribute directly to land-use change? Do changes in population size and composition directly effect changes in land use (see remarks made in studies such as EEA 2010; BfN and BBSR 2011, 8; Milbert 2013, 45)? These reflections prompted the author and two colleagues to conduct a study aimed at (a) finding answers to the questions of whether and to what degree clear correlations between demographic change and observable land-use changes could be found in the existing literature, and (b) establishing what this means for regional studies and regional development policies.

4.2 Methodological Approach

The study was, at its core, an extensive literature review. No original empirical research or other inquiries were conducted. The findings were rigorously debated at two expert workshops and subsequently summarized in a review paper (Behrens et al. 2012¹).

One of the first steps was to define the two terms “demographic change” and “land use”:

Demographic change refers to changes in the composition of a population (Hoßmann and Münz, n.d.). This includes not just changes in population size, and in age and sex structures, but also changes in ethnic composition, regional distribution, and lifestyle (BMI 2011, 11). Demographic change cannot be characterized as a single, coherent phenomenon. It is shaped by preexisting social processes and takes very different regional and local forms (Demuth et al. 2010, 26).

The concept of land use was based largely on Spitzer’s definition. He uses the category “direct land use” (*direkte Landnutzung*) to group together types of land use that visibly cover the surface of the land (Spitzer 1991, 161). Then there are various forms of “indirect land use” (*indirekte Landnutzung*), for example nature conservation, which may be included in multiple-use scenarios alongside the principal land-use types (Spitzer 1991, 172). Data on direct land use is recorded in Germany’s official land-use statistics.

The catalog of land-use types used by the Working Committee of the Surveying Authorities of the Länder of the Federal Republic of Germany (AdV and AK LK

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2011) was adopted in order to establish a connection to official statistics. The land-use classifications contained in the catalog were tied to activity sectors with the goal of obtaining a problem-and-action-oriented overview of the issues.

The following activity sectors were established: agriculture, forestry, tourism, settlement expansion,² transportation, and water management. In addition, although it is not included in the AdV's catalog of use types, the sector of nature conservation was defined within the category of indirect land use. In addition to research aimed at specific sectors, the review looked at studies into overlapping sectors, in particular those with a focus on rural areas.

The search for sources focused on the Federal Republic of Germany, that is, the review looked for findings regarding the impacts of demographic change on land use that could be observed in Germany or that were held to be relevant for Germany. A time frame of 2005–2012 was chosen.³

The search for sources turned up a total of 222 publications (research reports, monographs, multi-author volumes, and periodical articles) whose titles or subtitles indicated that they addressed the issues under review. The sources were then examined to determine if they contained findings on the relationship between demographic change and the selected sectors that were tangible and susceptible of analysis. This resulted in the number of sources subjected to detailed examination being reduced to 133 (for detailed information on these sources, see Behrens et al. 2012, 99–110). With respect to the sources as a whole, it can be said that although there is now an abundance of sources on the topics of demographics and population trends, those numbers are greatly reduced when the field is narrowed down to the impacts of demographic change on land use and even smaller when we look at specific land-use types. Upon closer examination of the sources, moreover, it was found that the studies frequently promised more in their titles than they actually delivered in substance.

The 133 sources that constituted the final selection were then assessed with respect to the following three points: (1) general effects of demographic change per sector, (2) effects of demographic change on land use per sector, and (3) ways to control or respond to these effects.

²Settlement expansion refers to the expansion of human settlements, including residential, commercial, industrial and recreational areas.

³The decision to restrict the review to Germany was made in order to be able to analyze the findings within a single legal and administrative framework. The time frame was selected so that the review could address current topics of interest, i.e., debates going back approximately ten years.

A second survey undertaken in early 2017 revealed that virtually no new studies on the issues under review had been published since 2012. Isolated studies on settlement expansion were found. Most noteworthy among them was the Environmental Report 2016 of the German Advisory Council on the Environment, in particular the chapter titled “Land consumption and demographic change” (SRU 2016).

The findings of the review can therefore still be seen as reflecting the current state of knowledge.

4.3 Current State of Knowledge Regarding Correlations Between Demographic Change and Land-Use Change

4.3.1 *Impacts of Demographic Change on Agriculture, Forestry, and Nature Conservation*

Shrinking populations in rural areas do not automatically result in reductions in the amount of land used for agriculture and forestry. The dominance of agriculture and forestry among land-use types is primarily a matter of agricultural/energy policy and economics, and is not determined by demographic factors. Unless this changes, there is no reason to expect agriculture's share of land use to decrease (Demuth et al. 2010; for an opposing opinion, see Wolf and Appel-Kummer 2005). What is more, agriculture and forestry trends are affected to a great extent by global interdependencies in the production, distribution, and consumption of resources. Thus in forestry, too, demographic change is not seen as a significant factor in trends regarding forest use. The possible consequences of demographic change at a national level that are identified in the studies—*a decrease in the demand for wood, forests reverting to a state of relative wilderness, a reduction in the use of local natural areas for recreation* (Wurz 2007)—lose their significance when global realities are factored into the equation.

One of the consequences of generally increasing competition for land use is that larger-scale areas will not be available for nature conservation in the future and that wilderness areas will therefore not be a large-scale option for nature conservation. This is not to say that there may not be small-scale, positive developments in nature conservation that can be traced back directly or indirectly to demographic change. In certain regions, abandoned city neighborhoods and districts may present expanded opportunities for nature conservation. Especially where protected areas and landscapes are on the rural–urban fringe and difficult to access, there are (limited) chances for a reduction in the intensity of use. It is expected that these areas will experience less recreational use by regional and local populations.

4.3.2 *Impacts of Demographic Change on Transportation, Tourism, and Settlement Expansion*

Parallel processes of growth and decline are expected with regard to trends in transportation and tourism infrastructure. In growing regions, steady or growing demand will result in greater pressure on infrastructure, eventually to the point that supply is expanded. In declining regions, pressure on infrastructure will decrease, leading to a reduction in supply (Grimm et al. 2009a; Canzler 2007; among others). In particular with respect to transportation, the sources conclude that, at least in the short term, declining areas cannot do without existing infrastructure. This means that as demand stagnates or even shrinks over the long term, infrastructure will tend to continue to

grow (FGSV 2006). Congestion and bottlenecks will be seen in growth regions and highly traveled transport corridors. In these cases, investments aimed at expanding existing infrastructure and efforts to increase its efficiency should be made early on. Additional investments in transportation infrastructure should only be made if sufficient demand is expected in the medium and long term (Knie and Canzler 2009, 177 f.).

With regard to the tourism sector, demographic change—and in particular, the *aging of the population*—will cause far-reaching changes on the supply side. The shift in age structure—at least in the short and medium term—is considered to be more serious than the potential decrease in demand as a whole (Petermann et al. 2006; Schröder et al. 2007). In terms of demand volume, a decrease in domestic travel with overnight accommodation is anticipated. This will result in poorer utilization not only of tourism infrastructure but also of associated regional infrastructure. In terms of demand structure, a reversal in market share is expected as demand shifts to older age groups. Tourism among older people will be an engine for growth in the tourism sector, at least in the medium term (until 2030) (Grimm et al. 2009a). Concrete, empirically substantiated predictions of whether and to what degree a change in tourism demand will impact land consumption for tourism infrastructure cannot be found in the literature.

In order to explain developments in the consumption of land for settlement (i.e., residential, commercial, industrial, and recreational areas) and transportation, a complex collection of variables must be brought to bear. While interdependencies between demographic change and land consumption for settlement and transportation were reasonably clear in the 1990s, cause and effect are no longer easy to identify today. Trends in land use for settlement and transportation are not tied to economic or even demographic factors in the way that they once were. Though demographic trends continue to be relevant to land consumption, the nature of that relationship is no longer clear and other factors are gaining in significance. Planning approval for new developments of single-family homes was long considered to be one of the principal drivers of new land consumption while the construction of high-rise buildings was not expected to contribute greatly to overall demand for housing land (BMVBS and BBSR 2009). This is starting to change, however: thanks to positive economic growth and continuing in-migration into urban areas, the number of approvals granted to high-rise apartments is considerably higher than those granted to single-family homes (SRU 2016). Other important factors will probably continue to contribute to land consumption, however. These include exaggerated growth expectations on the part of municipal administrations and resultant supply planning, low building density, and what Germans call the *Remanenzeffekt* (the “staying-put” effect), i.e., the phenomenon of elderly people staying in their apartments or houses, resulting in a rise in living space per person in regions with shrinking populations (BMVBS and BBSR 2009).

4.3.3 Impacts of Demographic Change in Multicausal Models

In addition to sources that dealt with specific sectors individually, the review identified and analyzed a number of sources that looked at multiple (parallel or overlapping) sectors and examined possible impacts of demographic change in qualitative terms (BMVBS and BBSR 2009; Rudolph et al. 2007; Siedentop et al. 2011). They did not reveal any findings beyond those offered by studies on single sectors, however.

There are only a few quantitative studies on the relationship between demographic change and land-use patterns (including Schaldach and Priess 2008; Murray-Rust et al. 2013; Wyman and Stein 2010). The quantitative study undertaken by Kroll and Haase looked at this relationship in counties in Germany. The results of the study, for the purpose of the review at any rate, can be summed up in the following key points (Kroll and Haase 2010, 730–737):

- With respect to regions in eastern Germany, the data show that land-use variables do not correlate with demographic variables. Economic trends tend to play a greater role in land-use change in these regions.
- In contrast, western Germany was found to exhibit high correlations between population trends and migration on the one hand and changes in settlement and transportation areas on the other. The increase in settlement and transportation areas in turn affects the amount of agricultural land, which consequently decreases.

4.3.4 Recommendations on Guiding Land-Use Impacts

Recommendations for guiding impacts on land-use sectors are just as unsubstantiated and imprecise as the findings regarding the impacts on land use. Neither for those sectors in which use is directly linked to the land, i.e., agriculture and forestry, nor for nature conservation, do the sources provide suggestions for new or improved approaches to guiding land-use patterns with respect to either the type or intensity of land use.

For sectors such as tourism and transportation, which are tied to land use indirectly through infrastructure, the principal challenge is managing simultaneous growth and decline. In view of this new situation, it is necessary to reexamine conventional models, legal regulations and standards created as part of infrastructure policies, and societal objectives such as creating equal living conditions. Investments in infrastructure should be made only in regions with sufficient demand over the medium and long term. Better coordination among sectors and more strongly integrated approaches—in terms of both perspective and action—are needed (Knie and Canzler 2009; FGSV 2006; among others).

The settlement expansion sector boasts a relatively sophisticated range of control mechanisms, created in part with the aim of achieving the German federal government's target of 30 ha per day (Die Bundesregierung 2002). A reduction in the

amount of new land zoned for settlement areas is recommended, alongside measures to increase the availability of unused urban spaces. The sources contain numerous recommendations for sustainable land management (at local and regional levels) and for management tools and incentives (Dosch and Bergmann 2005; Bürkner et al. 2007; BMVBS and BBSR 2009; Weith 2009; BBSR 2011; Bock et al. 2011).

4.3.5 General Effects of Demographic Change in the Activity Sectors

In addition to the specific impacts of demographic change on land use in the activity sectors targeted by the review, the sources also describe the general effects of demographic change in these sectors. The following key effects were observed (Heiland et al. 2004; Wiener et al. 2004; Heiland et al. 2005; FGSV 2006; Petermann et al. 2006; TLL 2006; Oeltze et al. 2007; Rudolph et al. 2007; Schröder et al. 2007; Wurzbach 2007; Grimm et al. 2009a; Knie and Canzler 2009; Thoroe 2009; IG BAU 2014):

- changes in demand for agricultural, forestry, and tourism products (extent, structure, and quality) and changes in transportation-related demand (extent, structure, and distribution over space and time) as a result of decreasing population sizes and changing population structures
- labor and skills shortages as a result of decreasing population sizes and changing population structures
- regionally differentiated changes in core concepts and values (for example, guiding principles in forest management and nature conservation, or principles of spatial planning such as equal living conditions)
- diminishing public funds, associated with a diminishing scope for control and guidance.

A common feature of all the findings and recommendations is that they provide no—or only very vague—indications of whether the type and intensity of land use will change at some further, future stage, and if so, what form that change might take.

The following approaches regarding the management of or response to general effects can be found in the literature (Wiener et al. 2004; TLL 2006; TLL 2007; Grimm et al. 2009b; BMELV 2011; IG BAU 2014):

- rationalization and improvement of labor productivity
- marketing and PR work aimed at developing new markets and positioning products and services in the context of new challenges
- training and retraining programs as a counter-strategy to labor and skills shortages
- cooperation and cross-sector approaches to action.

4.4 Conclusions and the Need for Further Research

An analysis of the literature revealed that there are virtually no sources that contained findings or allowed conclusions to be derived regarding the direct impacts of demographic change on land-use change. This is especially true of the agriculture, forestry, tourism, and nature conservation sectors. The one exception was settlement and transportation areas, since research (including some empirical studies) has been conducted on the correlation between population trends and settlement expansion. Otherwise, findings regarding the impacts of demographic change on land use were based on more or less substantiated analytical arguments. It is possible that this finding is due to a time lag, i.e., that demographic changes already in progress have not yet made a sufficiently visible or tangible impact on certain land-use groups or types for society (or the literature, in this case) to have become aware of them.

In view of the complexity of spatial dynamics, it is difficult to isolate and examine individually the components of demographic change that are causal factors in land-use change. Clear cause-and-effect relationships cannot be established with any great certainty. Demographic factors have nonspecific effects and overlap with other influences on land use, such as economic trends, climate change, scarcity of resources, or institutional influences such as policy objectives. These influences may strengthen, neutralize, or even reverse the impacts of demographic change. In many cases, it would appear that other factors have—and will continue to have—a considerably stronger influence on developments in land-use patterns than will demographic factors.

In light of this fact, the findings of the literature under review do not support, or only marginally support, oversimplified conclusions such as those below (see remarks made in studies including EEA 2010; BfN and BBSR 2011, 8; Milbert 2013, 45):

- Shrinking populations lead to lower land-use intensities and/or to reduced land use in certain areas, which in turn opens up options for new or different land-use types.
- The combination of an aging population and greater cultural diversity causes changes in demand structures that lead to different land-use types and/or changes in land-use intensity.

The literature review and the subsequent discussion of its findings at two expert workshops came to the following conclusions regarding the need for further research:

Lack of empirical data: the absence of empirical evidence for assertions regarding the impacts of demographic change on land-use sectors proved to be a major shortcoming, as became clear over the course of the review. Above all, there is a lack of empirically substantiated, spatially differentiated studies on the correlation between demographic change and land use.

Comparative, regional case studies: the effects of demographic change vary from region to region. When combined with other trends and processes, a highly differentiated spatial structure emerges which is characterized by the coexistence, on regional and local levels, of both sprawl and decline. Thus research is needed that

takes regional variation into account and that is conducted over time periods which permit the effects of a region-specific combination of causes to be identified in their entirety.

Inclusion of demographic indicators in land-use statistics: the collection of land-use data should be improved so that it factors in demographic information, thus expanding the knowledge base for impacts of demographic change on land use. Correlations between population trends and land-use dynamics should be examined in long-term, comparative studies that focus on relatively small areas; these studies would have to tie data collected for land-use statistics to population data. An appropriate methodology for such studies has yet to be developed.

Correlation between changes in lifestyle and land use: one topic of research that urgently needs to be investigated, and where much is currently unknown, is the correlation of changes in the lifestyles, leisure time activities, motivations, and attitudes of present and future generations to changes in land-use demands.

References

- AdV, & AK LK/Arbeitsgemeinschaft der Vermessungsverwaltungen der Länder der Bundesrepublik Deutschland; Arbeitskreis Liegenschaftskataster. (2011). Katalog der tatsächlichen Nutzungsarten im Liegenschaftskataster und ihrer Begriffsbestimmungen (AdV-Nutzungsartenkatalog). Stand: November 2011.
- BBSR/Bundesinstitut für Bau-, Stadt- und Raumforschung. (2011). Auf dem Weg, aber noch nicht am Ziel – Trends der Siedlungsflächenentwicklung. Bonn. = BBSR-Berichte KOMPAKT Nr. 10.
- Behrens, H., Dehne, P., & Hoffmann, J. (2012). Demografische Entwicklung und Landnutzung. Müncheberg. = Leibniz-Zentrum für Agrarlandschaftsforschung (ZALF) e.V., Nachhaltiges Landmanagement, Diskussionspapier Nr. 3.
- BfN and BBSR/Bundesamt für Naturschutz & Bundesinstitut für Bau-, Stadt- und Raumforschung (Hrsg.). (2011). Kulturlandschaften gestalten! Zum zukünftigen Umgang mit Transformationsprozessen in der Raum- und Landschaftsplanung. Bonn.
- BMELV/Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz (Hrsg.). (2011). Waldstrategie 2020. Nachhaltige Waldbewirtschaftung – eine gesellschaftliche Chance und Herausforderung. Berlin.
- BMI/Bundesministerium des Innern. (2011). Demografiebericht. Bericht der Bundesregierung zur demografischen Lage und künftigen Entwicklung des Landes. Berlin.
- BMVBS, & BBSR/Bundesministerium für Verkehr, Bau und Stadtentwicklung; Bundesinstitut für Bau-, Stadt- und Raumforschung (Hrsg.). (2009). Einflussfaktoren der Neuinanspruchnahme von Flächen. Bonn. = Schriftenreihe Forschung Heft 139.
- Bock, S., Hinzen, A., & Libbe, J. (Eds.). (2011). *Nachhaltiges Flächenmanagement – Ein Handbuch für die Praxis*. Berlin: Ergebnisse aus der REFINA-Forschung.
- Bürgi, M., Hersperger, A. M., & Schneeberger, N. (2004). Driving forces of landscape change—current and new directions. *Landscape Ecology*, 19, 857–868.
- Bürkner, H.-J., Berger, O., Luchmann, C., & Tenz, E. (2007). Der demografische Wandel und seine Konsequenzen für Wohnungsnachfrage, Städtebau und Flächennutzung. Erkner. = IRS Working Paper 36.
- Canzler, W. (2007). Verkehrsinfrastrukturpolitik in der schrumpfenden Gesellschaft. In O. Schöller, W. Canzler, A. Knie (Hrsg.). *Handbuch Verkehrspolitik*, 510–532. Wiesbaden.

- Cortesi, F., & Hepperle, E. (2011). Impacts of megatrends on soils. A new approach to sustainable resource management. In E. Hepperle, R. W. Dixon-Gough, T. Kalbro, R. Mansberger, K. Meyer-Cech (Eds.), *Core themes of land use politics: Sustainability and balance of interests*. Zürich: 55–69.
- Demuth, B., Moorfeld, M., & Heiland, S. (2010). Demografischer Wandel und Naturschutz. Bonn-Bad Godesberg. = Bundesamt für Naturschutz, Naturschutz und Biologische Vielfalt 88.
- Die Bundesregierung. (2002). Perspektiven für Deutschland. Unsere Strategie für eine nachhaltige Entwicklung. Berlin.
- Dosch, F., & Bergmann, E. (2005). Schwerpunkt Flächeninanspruchnahme in der Nachhaltigkeitsstrategie – Trends, Strategien und Initiativen auf Bundesebene. In: Forum Stadt- und Regionalplanung (Hrsg.): *Das Flächensparbuch. Diskussion zu Flächenverbrauch und lokalem Bewusstsein*, 65–75. Berlin.
- EEA/European Environment Agency. (2010). The European environment—State and outlook 2010. Land use. Synthesis, Copenhagen. <https://www.eea.europa.eu/soer/europe/land-use> (Zugriff am April 11, 2014).
- FGSV/Forschungsgesellschaft für Straßen- und Verkehrswesen, Arbeitsgruppe Verkehrsplanung. (2006). Hinweise zu verkehrlichen Konsequenzen des demografischen Wandels. Köln.
- Grimm, B., Lohmann, M., Heinsohn, K., Richter, C., & Metzler, D. (2009a). Auswirkungen des demografischen Wandels auf den Tourismus und Schlussfolgerungen für die Tourismuspolitik. AP 2, Teil 1: Trend- und Folgenabschätzung für Deutschland. Berlin, Kiel, München.
- Grimm, B., Lohmann, M., Heinsohn, K., Richter, C., & Metzler, D. (2009b). Auswirkungen des demografischen Wandels auf den Tourismus und Schlussfolgerungen für die Tourismuspolitik. AP 4: Folgerungen. Berlin, Kiel, München.
- Heiland, S., Regener, M., & Stutzriemer, S. (2004). Endbericht zum Forschungs- und Entwicklungsvorhaben Folgewirkungen der demografischen Entwicklung in Sachsen im Geschäftsbereich des SMUL. Im Auftrag des Sächsischen Staatsministeriums für Umwelt und Landwirtschaft, vertreten durch das Sächsische Landesamt für Umwelt und Geologie. Dresden.
- Heiland, S., Regener, M., & Stutzriemer, S. (2005). Auswirkungen des demografischen Wandels auf Umwelt- und Naturschutz. *Blinder Fleck in Wissenschaft und Praxis. Raumforschung und Raumordnung*, 63 (3), 189–198.
- Hersperger, A. M., & Bürgi, M. (2009). Going beyond landscape change description: quantifying the importance of driving forces of landscape change in a Central Europe case study. *Land Use Policy*, 26, 640–648.
- Hoßmann, I., & Münz, R. (o. J.). Glossar. In: *Berlin-Institut für Bevölkerung und Entwicklung: Online-Handbuch Demografie*. Berlin. <https://www.berlin-institut.org/online-handbuchdemografie/glossar.html#c1400> (Zugriff am August 25, 2014)
- IG BAU/Industriegewerkschaft Bau-Agrar-Umwelt. (2014). Handlungsbedarf. Demographischer Wandel in der Landwirtschaft. Berlin, Frankfurt am Main.
- Knie, A., & Canzler, W. (2009). Forschungsvorhaben de.wi.mob.i.n. Demografische und wirtschaftsstrukturelle Auswirkungen auf die Mobilität in der Gesellschaft in den nächsten Jahrzehnten. Konsequenzen für die Verkehrsträger und die Zukunft staatlicher Daseinsvorsorge, Endbericht. Berlin.
- Kroll, F., & Haase, D. (2010). Does demographic change affect land use patterns? A case study from Germany.
- Lambin, E. F., Turner, B. L., Geist, H. J., et al. (2001). The causes of land-use and land-cover change: moving beyond the myths. *Global Environmental Change*, 11(4), 261–269.
- Lambin, E. F., & Geist, H.J. (Eds.). (2006). Land-use and land-cover change. In *Local processes and global impacts*, Berlin, Heidelberg.
- McNeill, J. et al. (1994). Toward a typology and regionalization of land-cover and land-use change: Report of working group B. In W. B. Meyer, B. L. Turner II (Eds.), *Changes in land use and land cover: A global perspective* (pp. 55–65), Cambridge.
- Milbert, A. (2013). Vom Konzept der Nachhaltigkeitsindikatoren zum System der regionalen Nachhaltigkeit. *Informationen zur Raumentwicklung*, 1, 37–50.

- Moorfeld, M. (2011). Landscapes in Eastern Germany at a turning point—linkages between population decline, ageing and land consumption.
- Murray-Rust, D., Rieser, V., Robinson, D. T., Milicic, V., & Rounsevell, M. (2013). Agent-based modelling of land use dynamics and residential quality of life for future scenarios. *Environmental Modelling & Software*, 46, 75–89.
- Oeltze, S., Bracher, T., Eichmann, V., Dreger, C., Ludwig, U., Lohse, D., Zimmermann, F., & Heller, J. (2007). Mobilität 2050. Szenarien der Mobilitätsentwicklung unter Berücksichtigung von Siedlungsstrukturen bis 2050. Berlin. = Deutsches Institut für Urbanistik, Edition Difu – Stadt Forschung Praxis, Band 1.
- Petermann, T., Revermann, C., & Scherz, C. (2006). Zukunftstrends im Tourismus. Studien des Büros für Technikfolgen-Abschätzung beim Deutschen Bundestag. Berlin.
- Rudolph, A., Regener, M., Müller, B., & Meyer-Künzel, M. (2007). Soziodemografischer Wandel in Städten und Regionen – Entwicklungsstrategien aus Umweltsicht. Dessau. = Umweltbundesamt. UBA-Texte 18/07.
- Schalldach, R., & Priess, J. A. (2008). Integrated models of the land system: A review of modelling approaches on the regional to global scale. *Living Reviews on Landscape Research*, 2, 1.
- Schininger, I. (2008). Globale Landnutzung. Externe Expertise für das WBGU-Hauptgutachten “Welt im Wandel: Zukunftsfähige Bioenergie und nachhaltige Landnutzung”, Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen, Materialien, Zürich, Berlin.
- Schneeberger, N., Bürgi, M., Hersperger, A. M., & Ewald, K. C. (2007). Driving forces and rates of landscape change as a promising combination for landscape change research—An Application on the northern fringe of the Swiss Alps. *Land Use Policy*, 24, 349–361.
- Schröder, A., Widmann, T., & Brittnier-Widmann, A. (2007). Wer soll in Zukunft eigentlich noch reisen? Tourismus in Deutschland zwischen Geburtenrückgang und Überalterung. In: C. Haehling von Lanzenauer, K. Klemm (Hrsg.). Demografischer Wandel und Tourismus. Zukünftige Grundlagen und Chancen für touristische Märkte, 57–89. Berlin. = Deutsche Gesellschaft für Tourismuswissenschaft e.V., Schriften zu Tourismus und Freizeit Band 7.
- Siedentop, S., Gornig, M., & Weis, M. (2011). Integrierte Szenarien der Raumentwicklung in Deutschland. Berlin = DIW Berlin, Politikberatung kompakt 60.
- Spitzer, H. (1991). Raumnutzungslehre, Stuttgart.
- SRU/Sachverständigenrat für Umweltfragen. (2016). Umweltgutachten 2016 Impulse für eine integrative Umweltpolitik. Berlin.
- Thoree, C. (2009): Wald im Wandel – gesellschaftliche Herausforderungen. In: B. Seintsch, M. Dieter (Hrsg.). Waldstrategie 2020. Tagungsband zum Symposium des BMELV, 10.-11. Dez. 2008, 5–9, Berlin. Braunschweig. = Johann Heinrich von Thünen-Institut, Landbauforschung – vTI Agriculture and Forestry Research Sonderheft 327.
- TLL/Thüringer Landesanstalt für Landwirtschaft. (2006). 1. Teilbericht Auswirkungen des demografischen Wandels auf die Thüringer Landwirtschaft. Jena.
- TLL/Thüringer Landesanstalt für Landwirtschaft. (2007). Auswirkungen des demografischen Wandels auf die Thüringer Landwirtschaft. Teilbericht Betriebsbefragung zur Personalentwicklung und Weiterbildung. Jena.
- Weith, T. (2009). Bausteine zur Nachhaltigkeit in Flächenpolitik und Flächenmanagement. In T. Weith (Hrsg.), Flächenmanagement im Wandel, 9–19. Berlin. = Zeitschrift für angewandte Umweltforschung, Sonderheft 16.
- Wiener, B., Richter, T., & Teichert, H. (2004). Abschätzung des Bedarfs landwirtschaftlicher Fachkräfte unter Berücksichtigung der demografischen Entwicklung (Schwerpunkt neue Bundesländer). Halle/Saale. = Forschungsberichte aus dem Zentrum für Sozialforschung Halle e. V.
- Wolf, A., & Appel-Kummer, E. (2005). Demografische Entwicklung und Naturschutz – Perspektiven bis 2015. Essen. = Bundesamt für Naturschutz, BfN-Skripten 196.
- Wurz, A. (2007): Waldzukünfte – Basispapier (Kurzfassung). Zukunftsfeld „Demografische Entwicklung“ im Rahmen des Projektes Zukünfte und Visionen Wald 2100. Freiburg.
- Wyman, M. S., & Stein, T. V. (2010). Modelling social and land-use/land-cover change data to assess drivers of smallholder deforestation in Belize. *Applied Geography*, 30(3), 329–342.

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