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Research Briefs

KEI

Construction of a Historical Map Database as a Basis for Analyzing Land-Use and Land-Cover Changes, Exemplified by the Korean Demilitarized Zone and Inner-German Green Belt (Part 1)

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The **Korean Demilitarized Zone (DMZ)** has attracted global attention due to its unique history of human and natural interaction. Various cities and counties used to inhabit the **DMZ**, some of them fairly well developed and populous. However, after the Korean War, when the region became a no-man's land, it turned into an important refuge for flora and fauna. By studying such a rare transitional site of human–nature interaction such as the **DMZ**, researchers have the opportunity to explore how humans and nature can coexist in a sustainable way. In short, the **DMZ** is a living laboratory for sustainability science.

◆ **Germany's Green Belt** (*Grünes Band*, hereafter **GB**) shares a similar history to Korea's DMZ and exemplifies a promising future. Before the reunification of Germany, the **GB** was the border region between East and West Germany, and a so-called "Death Strip". Accessibility was highly limited due to the heavy military presence. Over many decades, the region unexpectedly developed a rich biodiversity due to the unique opportunity for nature to thrive largely undisturbed. After reunification, this unique landscape has been gradually and systematically protected. The **Green Belt** was created at the instigation of the BUND (*Bund für Umwelt und Naturschutz Deutschland e.V.*,

also known as Friends of the Earth Germany) as well as other non-government organizations and initiatives for nature protection, and it is supported by the German federal government. Today **Germany's GB** is considered to be the most well-preserved part of the European Green Belt, which runs along the former Iron Curtain.

- The **Korean DMZ** was designated in 1953 under the Armistice Agreement signed by the United Nations Command and the armies of **North Korea** and China. Most existing research on the **DMZ** landscape has focused on the period from the 1970s onwards. This is largely because such research relies on satellite imagery, yet it was only in the 1970s that satellite images began to be used to analyze landscapes, land use, and changes in land cover. Such a research gap is problematic because of its considerable length, i.e. from the 1950s to the 1970s.

- **Historical maps** not only include various topographical features such as roads, railways and other infrastructure but also elements of the historical and cultural heritage. Therefore, such sources of information must be used when researching the **DMZ** landscape. By analyzing **historical maps**, it is possible to determine how people previously utilized nature before the creation of the **DMZ**. Such research must be conducted as a first step. Subsequently, it is possible to investigate how the natural environment recovered within the **DMZ** after access became restricted, providing a basis upon which to make decisions about conservation and future sustainable forms of use when people are once again allowed into the **DMZ**.

- Since 2015, the Korea Environment Institute (KEI) and the Leibniz Institute of Ecological Urban and Regional Development (*IÖR* in German; IOER in English) have exchanged knowledge and experience through joint workshops and conferences. These discussions encouraged the two renowned research institutes to conduct a joint research project comparing the **Korean DMZ** and the **German GB**. The intention was for the study findings to promote the sustainable use of the **Korean DMZ** in the years to come.

- The KEI–IOER joint research to compare the **Korean DMZ** and the **German GB** analyzes study areas in each country by overlaying historical topographic maps with recent land-cover maps. Through the analysis, we aim to identify how land-use and land-cover changes in Germany's former inner-border region occurred over time—specifically, before and after reunification—and to comprehend the implications of these changes so that lessons learned can promote the sustainable use and conservation of the **DMZ**, for example as a protected area.

◆ In the original report, we address three research questions: (1) Can any **land-use and land-cover changes** be identified in the **DMZ** region since 1953, based on land-cover maps from 1916, 1951, and 2015? (2) Which part of divided Germany (i.e. East or West) underwent more changes in terms of land use and land cover before reunification, based on land-cover maps from 1937, 1956, and 1990? (3) How do the two case studies differ and what can we learn by comparing the two? If these questions can be answered adequately, then it is expected that the research outcome will reveal the likely development pathway of the **DMZ**.

◆ Identical criteria were applied to the Korean and German cases when selecting the study areas. First, an area had to be worth protecting in view of its well-preserved nature, endangered wildlife, and/or cultural heritage. Second, an area must have a certain development perspective; that is, the area must possess a transportation network likely to be extended or be adjacent to large cities. Third, data availability must be secured. Furthermore, it was critical that the Korean study area did not encroach on any national security issues because, technically, South Korea and **North Korea** are still at war.

◆ The Korean study area includes the following: **Kaesong** downtown, **Kaesong Industrial Complex**, and a sub-area of the **DMZ** under the jurisdiction of **North Korea** and China. **Kaesong** is the largest North Korean city in the vicinity of the **DMZ**; it is also the nearest large city to Seoul, the capital city of South Korea. **Kaesong** is adjacent to the Yellow Sea and also lies close to two major rivers, the Han and the Imjin. In view of these geographical factors, it is likely that **Kaesong** will come under considerable development pressure when relations between the two Koreas thaw. The city also has a valuable natural and cultural heritage. Endangered species such as the red-crowned crane (*Grus japonensis*), the whitenaped crane (*Grus vipio*), and the black-faced spoonbill (*Platalea minor*) nest in this area. As **Kaesong** used to be the capital of an ancient Korean dynasty, there are numerous archeological historical sites such as palace/fortress walls and gates. Hence, the city must be protected not only in view of its valuable environment and ecology but also its history and culture. Through a literature review and process of consultation, we ensured that the study area was not likely to encroach on any national security issues. The raw maps were acquired through academic libraries and online databases.

◆ The **Eichsfeld** region was selected as the German study area. It is situated in the center of the country, near the city of *Göttingen*, at the intersection of the states of Thuringia (which formerly belonged to East Germany) as well as Lower Saxony and Hesse

(formerly belonging to West Germany). After reunification, the **Eichsfeld** region became an important national transport hub; a new highway (*Autobahn*) was constructed across the region as one of the so-called German Unity Transport Projects. The region has a thriving agricultural sector due to its fertile loess soils. At the same time, the **Eichsfeld** region is part of an important ecological corridor—the so-called **Green Belt**—that connects the *Harz* Mountains (north of **Eichsfeld**) and the *Werra* River Valley to the south. Hence, large parts of the region are protected. The raw maps needed to analyze this study area were acquired from several map archives and German surveying agencies.

- In the case of the two Koreas, topographic maps produced by the so-called Chosen Government General (CGG) were used to retrieve land-cover information for Korea in the 1910s. CGG refers to the Japanese Government General of Korea ("Chosen" is the Japanese pronunciation of the ancient Korean dynasty of *Chosun*). Military maps drawn up by the United States Army Map Services (AMS) were used to retrieve data for the 1950s. Remotely sensed data of the Korea Multi-Purpose Satellite (KOMPSAT) and digital topographic maps produced by the National Geographic Information Institute (NGII) were used to produce a land-cover map of the study area for the year 2015. In the case of Germany, historical topographic maps had been produced by each state and later collected and managed by the Federal Archives (for former regions of East Germany) as well as the respective surveying agencies. The Authoritative Topographic-Cartographic Information System, Digital Landscape Model (ATKIS-DLM) provides recent land-use information for Germany and was used as a reference for back-editing techniques.

- Our three primary research findings, associated with the aforementioned three research questions, were as follows:

First, we identified anthropogenic changes within the **North DMZ** even though all forms of development are generally forbidden there. Specifically, a river channel has been straightened and widened, and agricultural lands have been expanded (similarly, agricultural use can also be found in parts of the **South DMZ**). Based on these facts, it is fair to conclude that the area inside the **North DMZ** has been developed for some time and might be still under development. In addition, palace/fortress walls of the ancient *Goryeo* dynasty appear to have been severely damaged due to **Kaesong**'s urban sprawl, leaving only a small part untouched.

Second, during the analyzed time period of 1937 to 1990, more changes can be identified in the East German border region than that of the West (note: while Germany was divided from 1949 until 1989, the maps were available for the named longer time

period). This can be attributed to the different political contexts, planning systems, and the ownership structures, i.e. private property in the West versus collective ownership in the East. The West German border region (called the German Zonal Border Area or *Zonenrandgebiet*) was mostly decoupled from economic development due to its isolated location at this impervious line of demarcation. The primary economic goal of the East German authorities was industrialization. Numerous changes are thus related to activities of agricultural industrialization such as collectivization, intensification, mechanization, and drainage, as well as the separation of arable and livestock farming. In short, the analysis shows that changes in land use and land cover under a system of socialist or communist planning can actually be more wide-ranging and radical than those under a market-based, capitalist system.

Third, comparison of the Korean and German case studies offers two important insights: (1) Agricultural expansion and intensification were the primary drivers of **land-use and land-cover changes** in **North Korea** and East Germany, with such activities affecting the landscape of both countries. In the Korean case study, even land inside the **DMZ** has been cultivated. From these findings, we infer that socialist or communist regimes place great emphasis on food production and food security; (2) **Land-use and land-cover changes** are more intensive in the Korean border region than was the case in divided Germany, and it is crucial to note that these changes are/were driven by different historical and political settings. On the one hand, the shift in land use and land cover in **North Korea** was caused by Japanese colonization in the 1910s, by the Korean War in 1950s, and, since the division of the peninsula, by the land-use policies of the North Korean socialist system. On the other hand, the changes in East Germany mainly resulted from the impact of World War II and the land-use policies of the East German socialist government following the partitioning of Germany. Although there may be some difficulties in comparing the **historical maps** (due to the diverse map legends serving different topographical purposes) as well as cartographic errors, the Korean case study shows more change than the German one.

- Given that we have identified a greater shift in land use and land cover in the Korean case, it is reasonable to conclude that in the years to come the **DMZ** as well as **North Korea** will go through more drastic change than that experienced in Germany. This is one critical finding of our report. While here we only analyze changes during the period of division of the two Korean and two German states, it is not unreasonable to suppose that changes will become more radical under the circumstance of an improved inter-Korean relationship.

◆ Any long-lasting improvement in the inter-Korean relationship requires a decisive shift in the political and societal climate. Such a transformation will have an impact on **land-use and land-cover changes** on the Korean Peninsula, including the **DMZ**. Furthermore, inter-Korean cooperation on economic development will certainly lead to increased development pressures, including those affecting the **DMZ**. This will serve to undermine conservation of the **DMZ**.

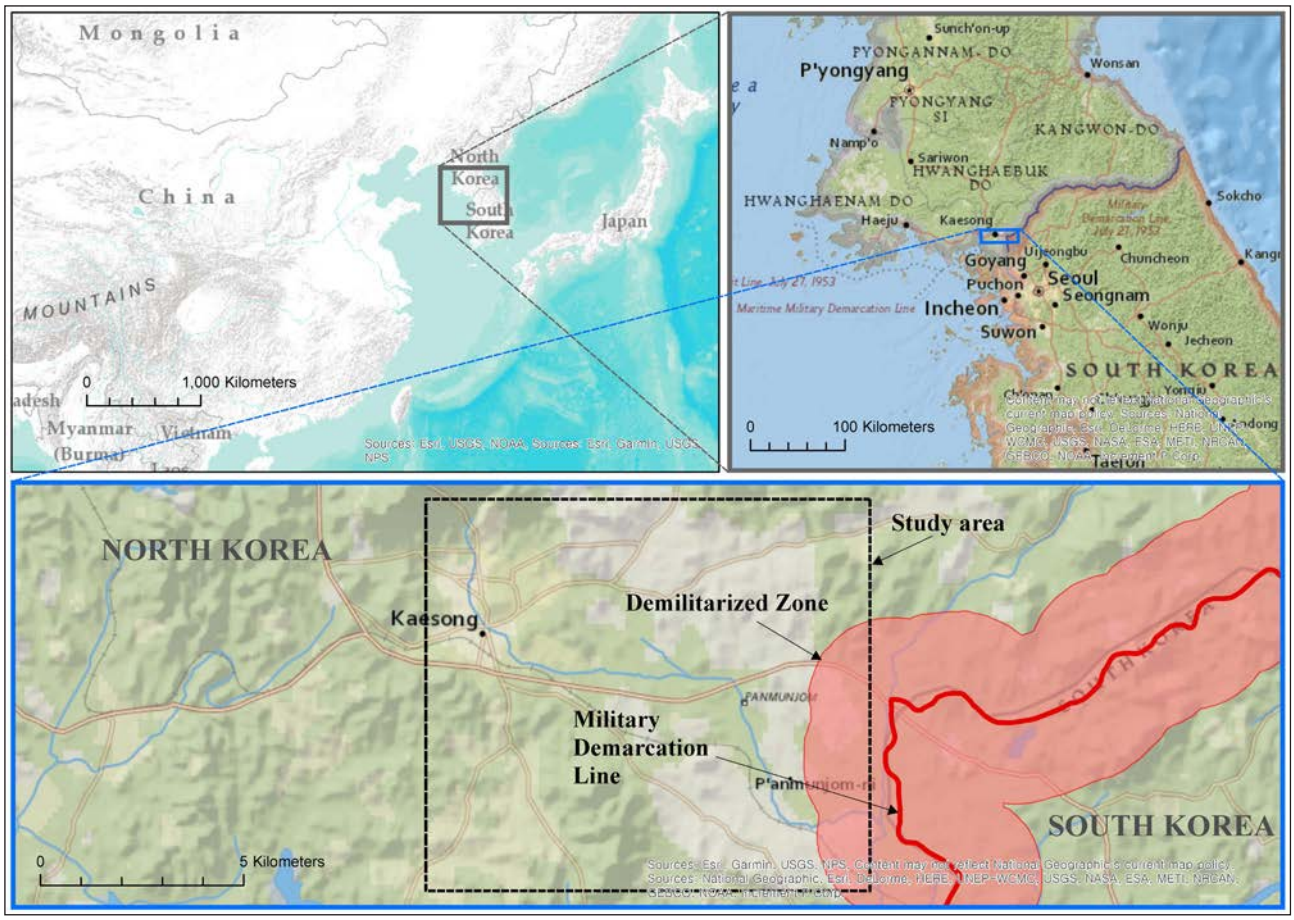
◆ Our comparative research is subject to the following limitations: First, the Korean case does not include the South Korean border region due to security reasons. In order to include both South and North Korean lands it is mandated to include the inner-border as well as the Joint Security Area, which was not allowed. Besides, the existing literature largely focuses on the South Korean border region, whereas very little in the literature deals with the North Korean border region; hence, we concluded that it is more meaningful to work on a North Korean case study instead of a South Korean one. This is in contrast to the German case, which includes both the former East and West German border regions. In future research, we plan to extend the study area to compare South Korea and North Korea. Second, as all of the **historical maps** were produced by different entities for their own purposes, the associated map legends and land categories are variously defined. For this reason, research outcomes must be interpreted with a degree of caution. Furthermore, data on the Korean and German study areas are related to somewhat divergent time periods and spatial extents.

Keywords

- Korean Demilitarized Zone (DMZ)
- German Green Belt (*Grünes Band Deutschland)*
- Kaesong
- North Korea
- Eichsfeld
- Historical Map
- Land-use and Land-cover Changes
- Geographic information systems

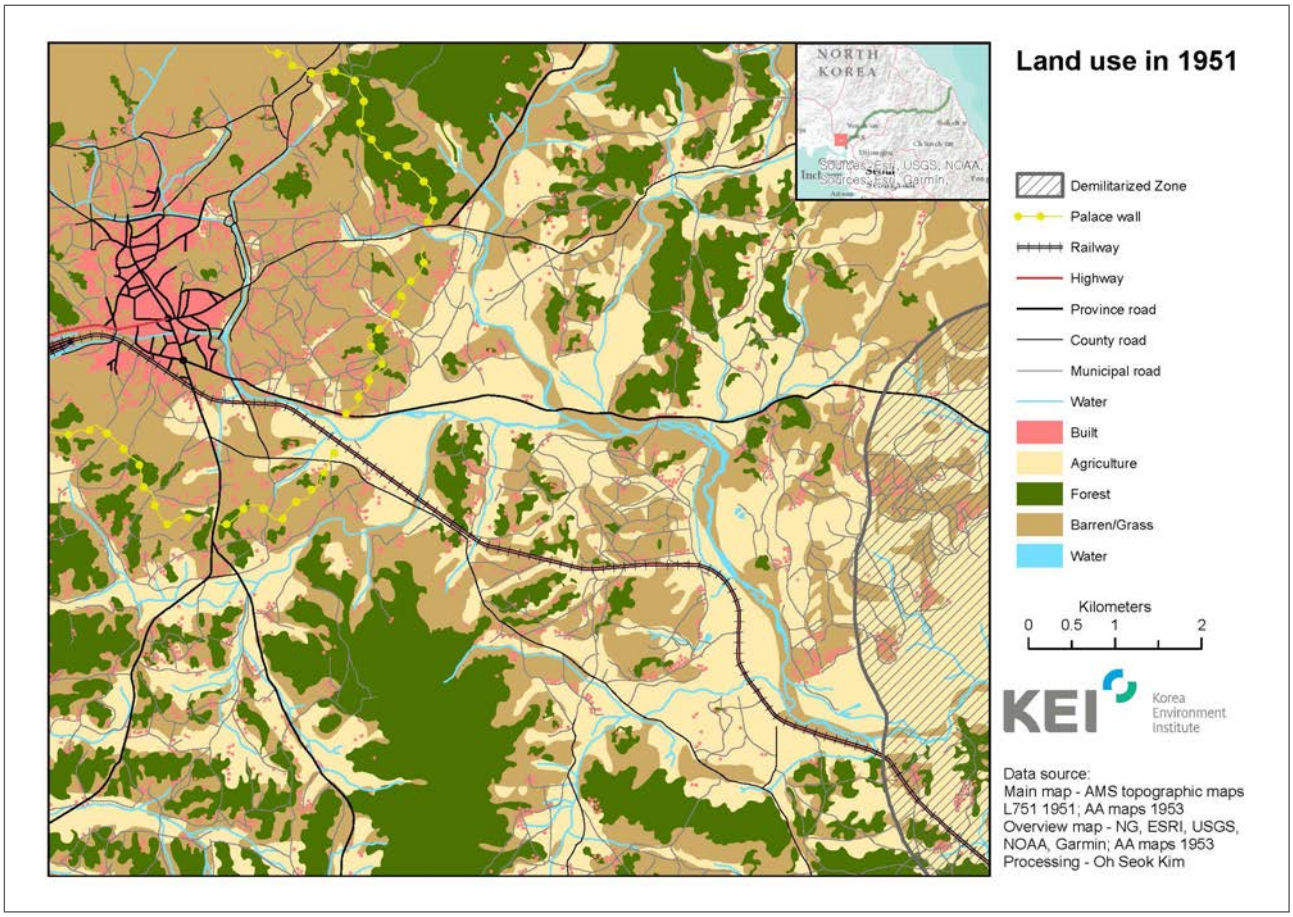
Note that this publication is based on the research report with the identical title, published by the Korea Environment Institute.

Appendix A



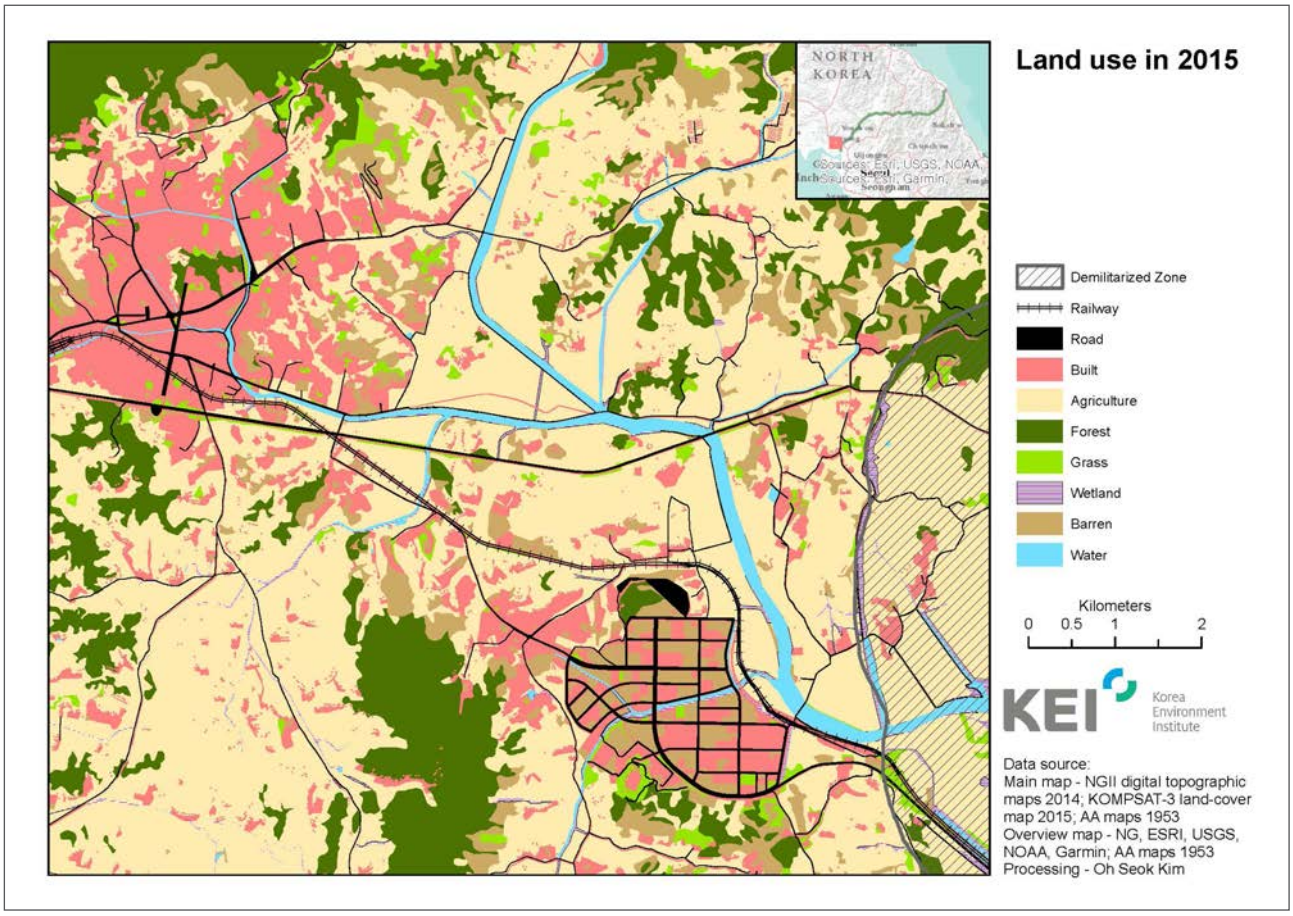
Appendix A. Location of the Korean study area (Oh Seok Kim and Marco Neubert, 2018, p.28)

Appendix B



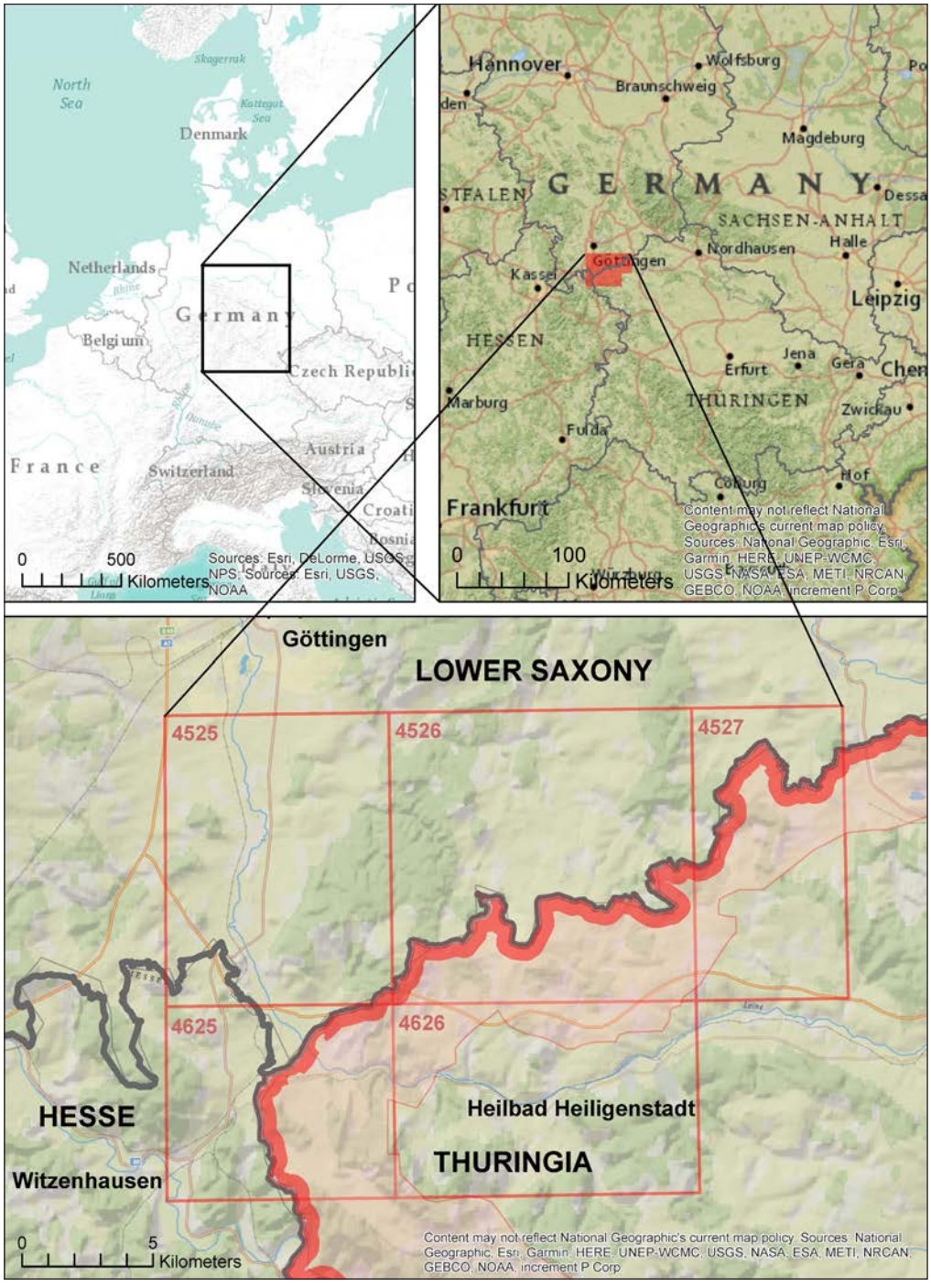
Appendix B. Land use in Kaesong in 1951 (Oh Seok Kim and Marco Neubert, 2018, p.59)

Appendix C



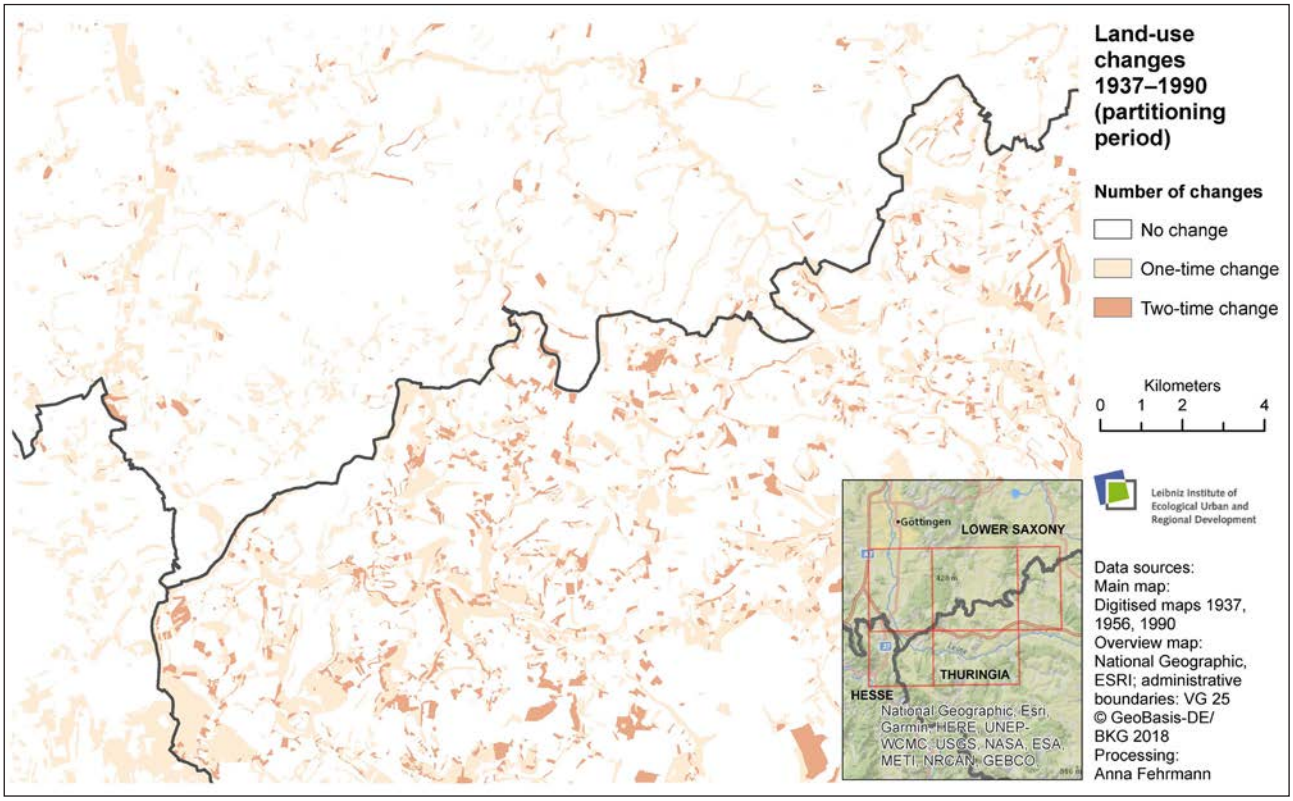
Appendix C. Land use in Kaesong in 2015 (Oh Seok Kim and Marco Neubert, 2018, p.61)

Appendix D



Appendix D. Location of the German study area (Oh Seok Kim and Marco Neubert, 2018, p.30)

Appendix E



Appendix E. Land-use changes in Eichsfeld from 1937 to 1990 (Oh Seok Kim and Marco Neubert,2018, p.75)

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