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Illustrating qualitative research findings: the reflexive and epistemic potential of experimental visualization

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Abstract. Many social processes are characterized by multi-layered spatiotemporal dynamics. These dynamics cannot be visualized in the traditional cartographic way of locating social realities within the Cartesian coordinate system. Drawing on the insights from critical cartography and the debates on diagrammatic reasoning in the arts, this article discusses different ways of visualizing qualitative research. In qualitative research, there has been reluctance to engage in visualization practices. While visualizations provide evidence for research and serve as visual proof, they also reify social relations, naturalize certain perspectives on research objects, and thereby establish and legitimize specific ways of interpreting field data. Despite this important critique, visualizations can also serve as epistemic instruments that help us to think about, illustrate, represent, and assert research findings in different ways. Understanding visualizations as epistemic instruments allows us to shift our focus from visualizing as a technique of representation to visualizing as a research technique and a medium to reflect on and articulate ambiguous and nuanced field experience. Drawing on our auto-ethnographically documented experimental visualization practices, we suggest that visualization should be considered more systematically as a method that bears self-reflexive and epistemic potential within qualitative research processes. Visualizations can inspire and complement qualitative research processes in three ways. First, depicting research results in graphic formats, such as diagrams, forces us to think about qualitative research in more-abstract terms and requires us to formulate arguments in more-straightforward ways. Second, visualization practices challenge us to reflexively question and re-engage with our findings and to revisit pre-formulated interpretations and representations from a visual perspective. Third, by offering a different perspective, visual representations inspire further insights and allow for a multidimensional creative and self-reflexive (re-)engagement with qualitative data.

1 Introduction

Discussing research data and their interpretation with research participants, colleagues, and broader audiences is crucial to gain new insights and perspectives on findings. In such reflective processes, it can be helpful to communicate findings visually to complement verbal and written articulations. On a methodological level, at least three visual communication practices can be distinguished: (1) the production of visual material as part of the data analysis, (2) the presentation of visual material in the context of communication within research communities, and (3) the circulation of visual material in wider research-related contexts (Rose, 2016). This article focuses on visualizations that were produced for the purpose of communicating research within academic contexts and were thus originally used as representational means. However, as we will show, visualization practices can also engender reflexive and epistemic potentials for the interpretation of field data. Inspired by our own empirical experience, in this paper we take a systematic look at visualization as a method that bears self-reflexive and epistemic potential within qualitative research processes.

While visualizations provide evidence for research and serve as visual proof, they also reify social relations, naturalize certain perspectives on research objects (for examples from the history of geography, see Michel, 2015), and thereby establish and legitimize specific ways of interpret-

ing field data. In the introduction of their edited volume on visual geographies, Schlottmann and Miggelbrink point out that visualizations are still frequently approached as representations of "realities" in both everyday life and research (Schlottmann and Miggelbrink, 2015:15). For this reason, within qualitative research, there has been a reluctance to engage in visualization practices (Crang, 2003). This reluctance specifically concerns maps as the most prominent form of visualization in geography (Halder and Michel, 2018:13). Despite this important critique, visualizations can also serve as epistemic instruments that help us to think about, illustrate, represent, and assert research findings in different ways (Geise, 2019:314; Reichertz, 2007:283). Understanding visualizations as epistemic instruments allows us to shift our focus from visualizing as a technique of representation to visualizing as a research technique and a medium to reflect on and articulate ambiguous and nuanced field experience (Pink, 2006:5, 16; Flusser, 1993).

In this article, we present our experience with visualizations by drawing on the insights we gained from visualizing the results of the research project "Land imaginations: the repositioning of farming, productivity, and sovereignty in Australia" as part of the Collaborative Research Centre (CRC) 1199 "Processes of Spatialization under the Global Condition" at the University of Leipzig. We discuss one example of our collaborative visualization work in particular, namely, the different kinds of investment logic of Chinese companies and financial actors in Australian agriculture. The data used for this visualization were generated through an exploratory qualitative–interpretative research design, which focused on the specific, situated meanings and meaning-making practices of actors in a given context (Schwartz-Shea and Yanow, 2012:1). Originally produced for academic communication, we picked a graphic design format widely used in the relevant literature for our visualization: the commodity chain diagram. The commodity chain diagram is an established format to illustrate the relationships between firms and their corporate strategies within the global economy. Our intention was to create a visualization that aligns with this type of diagram but surpasses its linear and simplistic nature in order to provide a more tailored and specific image to reflect our key findings. Beyond this initial concern, our auto-ethnographically documented workflow shows that our experimental visualization practices were also of epistemic significance. During our visualization work – in which we experimented with possibilities of depiction and reflected on the potentials, limits, and implications of different modes of visualization – we repeatedly experienced the visual practice serving us as a means of thinking. In order to visualize our results, we were forced to generalize complex findings and, by doing so, gained additional perspectives and new insights into our research. Visualizing thus became a valuable means of reflection on the empirical material, its interpretation, and previous forms of visual and textual representation.

Based on this experience, we argue that visualization should be considered more systematically as a method offering self-reflexive and epistemic potential for qualitative research. Visualizations can inspire and complement qualitative research processes in three ways. First, depicting research results in graphic formats, such as diagrams, forces us to think about qualitative research in more abstract terms and requires us to formulate arguments in more-straightforward ways. Second, visualization practices challenge us to reflexively question and re-engage with our findings and to revisit pre-formulated interpretations and representations from a visual perspective. Third, by offering a different perspective, visual representations inspire further insights and allow for a multidimensional creative and self-reflexive (re-)engagement with qualitative data. Having said this, the structure and logic of visual argumentation, the connotation and use of graphic design, and the inherent evidence produced by visualizations require continuous reflection and (re-)positioning.

In the following, we first present two strands of research in the field of reflexive visualization that we draw on in our visualization practice. We then share the process of our own visualization work and discuss three key moments, which we perceive to be epistemically, creatively, and communicatively important. We conclude that the reflexive and epistemic potentials of visualizing qualitative data are currently underexplored and suggest that experimental visualization should be more systematically employed in qualitative research processes.

2 Visualizations as an epistemic means and method of reflection: critical cartography and diagrammatic reasoning

This section outlines two strands of debate within the field of reflexive visualization that are relevant for our visualization practice. Firstly, we present the debates on mapping beyond conventional cartography as they have been articulated in the fields of critical cartography and critical engagements with geographic information systems (GIS). These debates explore the processes, practices, and emancipatory potential of transferring the complexity of field experience and qualitative data into rather abstract visualizations. Although our visualization does not take the form of a map, we draw on some of the crucial points made by critical cartography and GIS scholars. Secondly, we introduce the field of diagrammatic visualization and the debates surrounding the epistemic qualities of visual modes of articulation within this field. The insights we gained from these debates have helped us to conceptually frame what we experienced in our visualization practice, namely that sketching things out opens up further avenues for interpreting qualitative research data.

2.1 Critical cartography

Maps reduce complexity in order to facilitate quick and simultaneous comprehension. But in highlighting specific aspects, other details recede into the background (Westerholt et al., 2018:1). Since the 1970s, cartography has been critiqued for reducing geographic phenomena to points, lines, and polygons by critical cartography (Wood, 1978; Harley and Woodward, 1987) and critical GIS scholars (see among others Thatcher et al., 2016; Schuurman, 1999; Pickles, 1995) who have called for and explored more-complex visual spatial representations. While aims, struggles, and experiences differ, all these debates have in common the fact that they engage in alternative forms of mapping. Considering maps as spatial narratives, Bodenhamer et al. (2015) underline the potential of these new forms of mapping in contrast to conventional cartography. They point out that in the humanities "it will be necessary to replace this more limited quantitative representation of space with a view that emphasizes the intangible and socially constructed world and not simply the world that can be measured" (Bodenhamer et al., 2015:10). Capturing complexity in the form of map-based narrations thus requires a double shift, from written towards visual modes of narration and from mapping out quantitative towards mapping out qualitative data. This dual transition implies experimenting with and challenging the limits of visual forms of articulation.

A major challenge in developing more-qualitative map-based narrations is the restricted capacity of mapping tools and GIS to organize "ambiguous, incomplete, nuanced sources about people, places, and events" (Westerveld and Knowles, 2021:2109), as the prescribed structures of these visualization forms and tools limit the comprehensive and contextually nuanced examination, interpretation, and representation of data. In this sense, while conventional maps work well at showing overall spatial patterning in a particular indicator, they can "obscure the data and stories behind them in search of a totalizing surface [and too often] end up conflating *place*-based differences with Cartesian geographic *space*" (Mogel and Stallmann, in Wood et al., 2018:330, emphasis in original). As a result, maps tend to hide the "histories of exclusion, oppression and resistance, which have much more to do with particular racialized bodies and particular physical structures in place than they have to do with the latitude and longitude" (Mogel and Stallmann, in Wood et al., 2018:330). Despite these critiques, maps are still a widespread and commonly accepted mode of knowledge representation – not least due to the historically rooted societal acceptance of maps (Wood and Fels, 2008:7). This often results in a lack of critical distance from the selectivity and biases within map designing, as "maps are needed in a rush, and people end up following the conventions they would usually criticize or strive to go beyond" (Harvey, in Wood et al., 2018:330).

In line with data feminism, which asserts that "data are not neutral or objective [but] products of unequal social relations" (D'Ignazio and Klein, 2020:18), scholars in visual anthropology, critical cartography, and critical GIS emphasize "reveal[ing] the very processes by which the positionality of researcher and informant were constituted and through which knowledge was produced during the fieldwork" (Pink, 2006:35). Ignoring these processes would mean enabling "those in power to make decisions without involving local communities" (Pavlovskaya, 2009:16). Data feminists claim to (a) carefully reflect within the process of visualization on *how*, by *whom*, and by means of *which* visual formats and tools ambiguous, multidimensional, heterogenous field experience becomes translated into data categories and rather abstract visual design elements. Data feminism further rejects selective modes and formats of knowledge production and claims that "the most complete knowledge comes from synthesizing multiple perspectives, with priority given to local, Indigenous, and experiential ways of knowing" (D'Ignazio and Klein, 2020:18). In line with this and the abovementioned critique of maps, critical, participatory, and feminist GIS, scholars have put forth a call to (b) "incorporate multiple meanings and to provide texture and context" (Sui, 2015:6) in order to facilitate a stronger and more nuanced social and spatial understanding (Jung and Elwood, 2019; Cope and Elwood, 2009).

Instead of or in addition to using traditional techniques of mapping and GIS, critical visualization scholars have explored geonarratives and qualitative and mixed methods, as well as storytelling (Sui, 2015:1; see also Kwan and Knigge, 2006; Wilson, 2009; Bodenhamer et al., 2015, and see for examples Taylor et al., 2020; Westerveld and Knowles, 2021); community based, collective, tactical, creative, and emancipatory ways of engaging with GIS (Elwood, 2006; Elwood and Mitchell, 2013); and "platial", place-based, user-generated geospatial datasets to represent and analyze how people relate to places in everyday life (Goodchild, 2011; Klippel, 2020; Westerholt et al., 2018; Quesnot and Roche, 2015). Some approaches utilize GIS as a means to analyze and overlay diverse spatial datasets in order to understand past infrastructural developments and use immersive technologies to create embodied experience and offer a more intuitive feeling of places (Gregory and Healy, 2007; Terrone et al., 2020). Other approaches advocate developing "geographical imagination systems" (gis instead of GIS software) that prioritize a "creative process of tool making and conversation, rendering previously artisanal techniques more broadly accessible" (Bergmann and Lally, 2021:32). Alternatively, counter-mapping projects mostly abstain from GIS and use topological, non-Cartesian forms of visualization to unveil and subvert power relations conveyed through conventional cartography (Harris and Hazen, 2005:115). Instead of depicting place as a relation of latitude and longitude, these projects aim to map out how socio-spatial relations are powerfully constructed within established cartographical practices.

To sum up, all these approaches are grounded in (a) reflections on how heterogenous space-related field experience can be visualized and thus (b) face the challenge of engaging with mapping as a means to visualize multiple meanings and to take part in complex, situated, and inherently open-ended socio-spatial learning processes (Halder and Michel, 2018; Dammann and Michel, 2022).

2.2 Diagrammatic reasoning

The insights from critical cartography and GIS can be fruitfully combined with similar arguments that have been made in the field of diagrammatic reasoning in the arts since the 1960s (Holert, 2012; Leeb, 2012). Engagement with diagrammatic reasoning goes back to Charles Sanders Peirce's semiotic understanding of diagrams as a means to schematically visualize the structuring of analytical thinking – much as conventional cartography builds on the structure of the Cartesian grid (Holert, 2012:149; Bauer and Ernst, 2010:98). Similar to cartography, diagrams – in all their multifaceted intermediate forms (Wentz, 2013:202) – serve to generate, describe, and translate relationships, structures, and orders (Wittmann, 2020:415). In this process, they abstract, concretize, supplement, and exclude (Wittmann, 2020:416; for similar observations on infographics see Wintzer, 2015, and Geise, 2019). Diagrams follow a topological concept of space as a spatially situated relationship of points, individuals, and objects that is not placed in a pre-fabricated, absolute, topographical space (Leeb, 2012). In the quantitative–theoretical geography of the 1950s and 1960s, techno-scientific diagrams became the guiding models for spatial planning (Michel, 2015).

In some of these approaches, however, schematic diagrammatic formats also serve as a medium to further reflect research results. Diagrammatic reasoning emphasizes a mode of visualizing that focuses on the epistemic process that unfolds between established graphic formats, the empirical material, and the researcher.

Following Wittmann (2020:432), diagrams can be understood as abstractions that transform the concrete into concepts, schemata, and regularities. At the same time, diagrams give abstract relations and concepts a concrete form. In a conjunction of matter and semiotics, the outlines of diagrams provide order and stability and can be a means to mark or cross out, to destabilize, and to discover "new spatial imaginations" (Wittmann, 2020:416). In this sense, visualizing research on the basis of established graphic formats ideally also includes a continuous redesign of symbols that reflect the field experience. Diagrammatic practice can thus destabilize both the subject of analysis and the tool of analysis and in this way helps to pluralize perspectives. As Wittmann writes, diagrammatic practice facilitates an illustrative, exploratory, and tactile mode of thought. This diagrammatic reasoning oscillates between text and image, without striving for complete alignment between the visible

and linguistic (Wittmann, 2020:432). The idea of using diagrammatic practice as a method to stimulate creative thinking and engage in abductive reasoning was first formulated by Peirce (1993:76ff.). In his perspective, iconic signs facilitate the emergence of abductive thinking: taking up certain graphic formats and experimentally redesigning them allows for new relationships and qualities within field research to be discovered (Reichertz, 2007:282). Diagrammatic reasoning can thus help us to render pre-existing assumptions visible and to thoroughly reflect on these assumptions (Treude and Freyberg, 2012:6).

Diagrammatic reasoning can further profit from artistic practices, which apply inventive methods (Wildner, 2015) or provide methodologies (Bauer and Nöthen, 2021) to systematically explore and playfully engage with multi-layered, sensual, and cognitive modes of approaching empirical experience. In these artistic processes, new relationships between empirical aspects are constantly being discovered, while established interpretations and conventions are not necessarily circumvented or avoided. Instead, they are brought into new constellations, while graphic elements are re-imagined accordingly. This experimental practice can potentially disrupt fixed perspectives; open up new questions; and reveal the powerful, interest-driven, legitimizing, and naturalizing character of pre-existing forms of visualization. In this way, artistic practices offer multifaceted associative links and provoke us to deeply reflect and constantly question the construction of knowledge. The goal of such visual experimentation is not to establish research results and deliver unambiguous statements but rather to make complex empirical experience tangible and to offer points of departure for reflection.

Despite the increase in critical, experimental mapping projects and the use of mapping as a reflexive practice (Michel, 2022), the epistemic quality of playing with established visualization formats is still underexplored within geography. In particular, the debates on diagrammatic reasoning outlined above are helpful for understanding cartography (and other visualizations of socio-spatial relations) as not only a means of representation but also a tool for reflection. Dávila (2019) makes some initial connections between map-related and diagrammatic reasoning in his introduction to the book *Diagrams of Power. Visualizing, Mapping and Performing Resistance*. Another example of map-related-reasoning is the work of Streule, who uses mapping as a tool for assembling and reflecting heterogenous types of data (Streule, 2020). Map-related reasoning is also part of the "C/Artographies of Positionality", a visual practice developed by the working group "Critical Geographies of Global Inequalities" (2018). This group seeks to collectively think about situated research practices in order to uncover implicit colonialism and to challenge pre-existing assumptions within a research unit of critical geographers. In the next section, we discuss our visualization practice in regard to the perspectives of critical cartography and GIS as well as the diagrammatic reasoning outlined so far.

3 Putting reflexive visualization into practice

Below, we first describe our auto-ethnographic method and reflect on our respective positions and interests within the visualization work. We then place the purpose of our visualization in the larger research context of the CRC 1199. Following this, we present three key moments within our visualization work that we experienced as particularly insightful and inspirational. We discuss our reflections upon these moments, as well as the decisions made throughout this process.

3.1 Auto-ethnographic method and self-positioning

Documenting thoughts and practices during the visualization process is a first step to becoming aware of the decision-making processes of abstracting, condensing, and emphasizing certain aspects of research results that are part of visualization work. Documenting this process further helps to trace the choice and development of symbols as well as the implicit decisions made regarding the structuring of the argument and gaze-directing principles, allowing researchers to uncover how knowledge is constructed and naturalized by visual means. The auto-ethnographic documentation of our visualization work was inspired by Ellis et al. (2010:345), who define auto-ethnography as a research approach that seeks to document and describe personal experience (i.e., auto) and to systematically describe this experience (graphic) in order to understand, present, and communicate cultural experiences (ethno). Our aim was to describe the production and use of our visualization by means of field notes and to document all preliminary sketches, intermediate steps, and reflections within this process as detailed and comprehensibly as possible. Another aim of auto-ethnography is to provide "thick descriptions" (Geertz, 1973). Such thick descriptions enable a reflection of the complexity of the researched phenomena – in our case the complexity of experiences during visualization work. Thick descriptions offer further insights into the positionality and situatedness within which visualizations take place.

We situate our auto-ethnography at the intersection of reflexive ethnography, confessional tales, and layered accounts (Ellis et al., 2010:349f.). Reflexive ethnography emphasizes how researchers' interpretations and positions change through their fieldwork. Here, we ask how our analysis and reflection of the qualitative research changed during the visualization process. Confessional tales intend to make the ethnographic research behind the scenes visible. To situate the story behind our visualization, we sought to shed light on and retell the processes of visual production and reflection. Lastly, such a reflexive ethnography can produce layered accounts, which highlight the procedural nature of research and focus on the reciprocity of data collection and analysis. For this purpose, we documented how the visual and textual representation of the research results interacted and mutually evolved in the course of the visualization work.

So, what experiences, motivations, and interests did we bring with us when setting out on our qualitative visualization work, considering that scientific socialization includes specific ways of thinking, ways of handling and interpreting images, and modes of visual perception (Geise, 2019:326)? To start with, we both have an interdisciplinary background that integrates human geography, anthropology, area studies, and cartography. Given our different research interests – Lea focuses on visual geography and Sarah focuses on critical agrarian and agri-food studies – we worked together in our different roles and with different interests in our visualization projects. Lea engaged in this project as a freelance cartographer and graphic designer and brought over 15 years of experience with visualizations with her. Her interest in experimental visual geographies is rooted in critical cartography. Sarah conducts critical, qualitative, and ethnographic research on complex global dynamics. She has a strong interest in visual forms of knowledge production and communication, which she approaches in intuitive and exploratory ways. Both of us regularly use visual methods to structure our work and processes of thinking. Our visualization work usually started by Sarah approaching Lea with an initial sketch and a draft text or verbal explanation of a specific argument from her research. This usually led to productive exchange about these arguments and the collaborative development of first visualization ideas. These experimental attempts at developing visual articulations often gave us the experience of engaging with research findings in more diverse and creative ways.

3.2 Positioning our visualization

The visualization presented in this paper was produced to illustrate Sarah's research project findings, which was funded within the framework of CRC 1199 from 2016 to 2023. The project focused on the diverse and sometimes conflicting imaginaries of farmland, which Sarah, together with her collaborator Michaela Böhme, investigated by looking at various forms of land investment in Australia. The project specifically focused on the investments of financial actors and their interlinks with land investments by the Arab Gulf states and China. To investigate these issues, Sarah and Michaela conducted extensive empirical research in Australia and China over several years.

The visualization of the project results was an important objective of the CRC 1199 in order to exchange, discuss, and communicate research results. Sarah presented her initial ideas for visualizing the project results at the CRC research seminar in 2018. For this purpose, she distinguished four conceptual dimensions: the visualization of (1) (temporal) processes (e.g., how has the export of agricultural goods from Australia to China changed?), (2) connections (e.g., how are companies organized internally?), (3) mechanisms (e.g., which interests and logics do investments follow?), and (4) imaginations (e.g., how is land represented

Processes
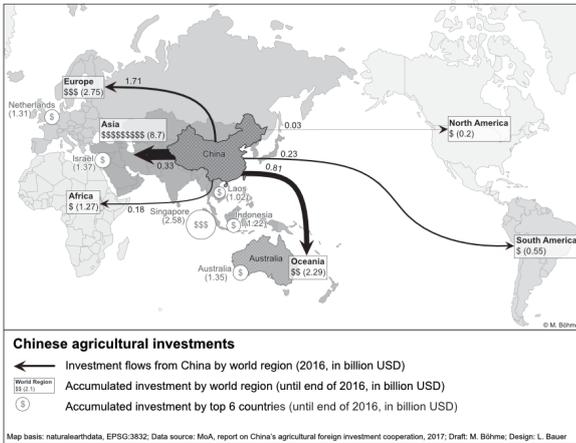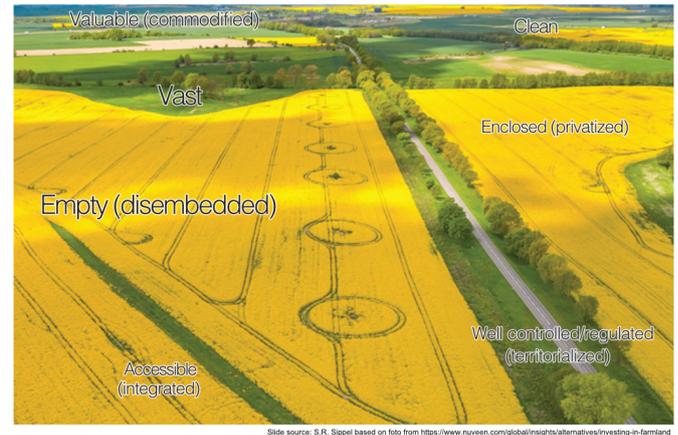
Connections
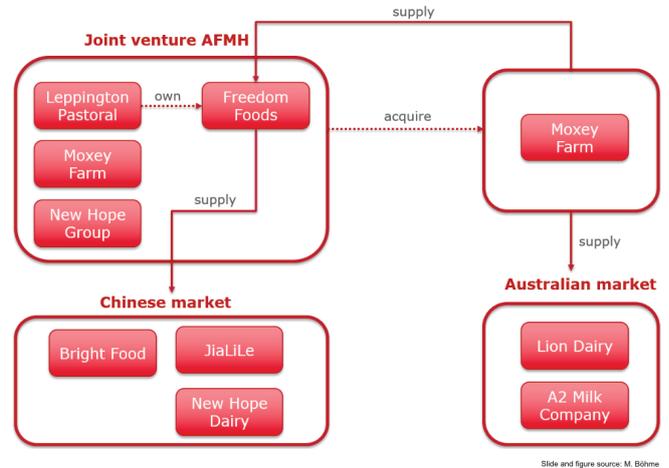
Mechanisms

Imaginations

Figure 1. Project results and first ideas for the visualization (sources from top-left to bottom-right are unpublished conference slides by Michaela Böhme and an unpublished conference slide by Sarah Ruth Sippel based on a photo from Nuveen LLC, 2024).

in brochures for investors?). While classic maps or diagrams were more suitable for visualizing processes and connections, the visualization of mechanisms and imagination posed a greater challenge (see Fig. 1). How can we visualize the interests of actors and different investment logic? On which design conventions can we draw for this purpose, and which new, experimental, and unconventional forms of visual design could be added? We will address these questions in the following sections. Before that, we briefly outline the core idea of the argumentation – the mechanism to be depicted – for a better understanding of the visualization. It is worth noting that the presentation of the argument below is already a result of the visualization work, as it did not exist in this form prior to the visualization.

3.3   The argument

As mentioned above, our visualization aimed to illustrate one specific finding of the research project, namely that Chinese companies and actors in the financial sector pursued different kinds of investment logic within their investment activities in Australia. In both the land rush debate and the (predominantly Australian) debate on foreign investment in farmland in Australia, these different investment objectives and their associated investment logic were hardly considered and often blurred. Sarah and her collaborator Michaela therefore decided to write an article to point out these different kinds of investment logic (Sippel and Böhme, 2019). Based on her research on Chinese corporate investments, Michaela argued that Chinese actors aimed at integrating farms into a company's larger agribusiness strategy and the associated commodity chain. The acquired land and agricultural produc-

tion thus become part of a comprehensive strategy by China to supply the Chinese market with food ("feeding China"). Chinese investors, she concluded, pursue a strategy of vertical integration in which agricultural enterprises are integrated into larger corporate structures. Sarah, who focused on the investments of financial actors in Australian agriculture argued that financial investors seek to disentangle the farm elements (mostly land but also water, livestock, etc.) that they believe will generate returns in order to enable individual investments in these assets. In a nutshell, the argument was that this disentanglement of agricultural elements by financial actors sharply contrasts with the Chinese investment logic, which aims to integrate agricultural enterprises into corporate structures.

3.4 The first draft

The first attempt to visualize this argument was made by Sarah and aimed at presenting two central aspects: the interventions in existing commodity chains by Chinese investments and financial investments and their respective structural influence on agro-economic processes.[1] To present these two dynamics in a contrasting way, the idea was to visualize the commodity chain and the ensemble of agro-economic processes "before" and "after" both types of investments respectively.

Figure 2, top-left, illustrates the different elements – production, marketing, transport, processing, etc. – and their rather loose coexistence before the investment of Chinese actors. The bottom-left, in turn, shows the agricultural elements (framed in red) of land, water, plants, livestock, etc., which are closely intertwined before the investment of financial actors and which can only be thought of and operated together. The right side of Fig. 2 illustrates the respective situations after the investments. The top-right illustration shows that the Chinese investments have a merging effect. Different units of this commodity chain, which previously acted separately from one another, were brought into one context (framed in red) – for example, they were integrated into a corporate structure and are now centrally organized and coordinated by the respective company. Below is an illustration of how the agricultural elements are organized after the investment by financial actors: they have been decoupled from each other, and it is now possible to invest in them and generate income flows from these elements individually (framed in red).

Sarah sent her first draft of the visualization of this investment logic to Lea, along with a first draft of the article. In preparation for the first meeting, Lea read through the draft and took notes with follow-up questions about both the text and the draft illustration. We developed the visualization during two personal meetings and their preparation and follow-

ups. We also discussed the textual argumentation and its further development. During each meeting, we drew sketches and developed first drafts for further discussion (see Fig. 3). To reveal the relevance these visualization experiments had for the research process, in what follows we present and discuss three central moments of reflection and decision-making within our visualization work.

3.5 Deconstruction of the first draft and refinement of the project findings

The discussion of the first draft materials inspired a number of crucial epistemic insights. While Sarah could (naturally) make sense of her visual draft, Lea's impression was that the design lacked explanatory power and was somewhat inconsistent in its graphic style. This required Sarah to explain to Lea precisely what the argument entailed, what specific mechanisms she wanted to illustrate, and which ideas she had used to develop her first draft. In doing so, she not only had to rethink her illustration but also needed to pin down her argument. Inspired by the first visual draft, it became clear that Sarah and Michaela's argument of opposing investment mechanisms referred to separate units of analysis. While Michaela referred to dynamics within the commodity chain, Sarah looked primarily at changes at the farm level. However, while they had been aware of these different units of analysis in developing their argument, the illustration – where Sarah had ironically used the same graphic symbols for the two units of analysis – blurred this distinction.

Based on this insight, Michaela and Sarah felt the need to reconsider their argument. After careful reflection, they came to the conclusion that the argument was convincing and important. However, they found that their written analysis needed to clarify that the opposing investment dynamics did not refer to the same units of analysis but rather to opposing socio-spatial restructuring processes within the agri-food system more generally. To achieve this, they strengthened the spatial lens in the text, which allowed them to interpret the types of investment logic of the two groups of actors as projects of (re-)spatialization, while emphasizing the different effects on established and institutionalized forms of spatialization ("spatial formats") and their formation to spatial orders. For the visual presentation, we developed a new design that reflected the two different units of analysis visually using different graphic elements (see Sect. 3.6).

The clear and pointed argumentation the visualization required forced Sarah and Michaela to also reflect on the juxtaposition of the two groups of investors in their article. As mentioned above, the objective of the chapter was to argue for a stronger differentiation between these two groups of actors and their investment logic within the land rush debate. The juxtaposition of the opposing investment logic itself, however, required a certain generalization of the empirical observations. For example, Michaela had also met Chinese actors who were involved with financial actors and thus, to a

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[1]The first visualization was based on an illustration Michaela created for a joint presentation in Cologne in 2017.
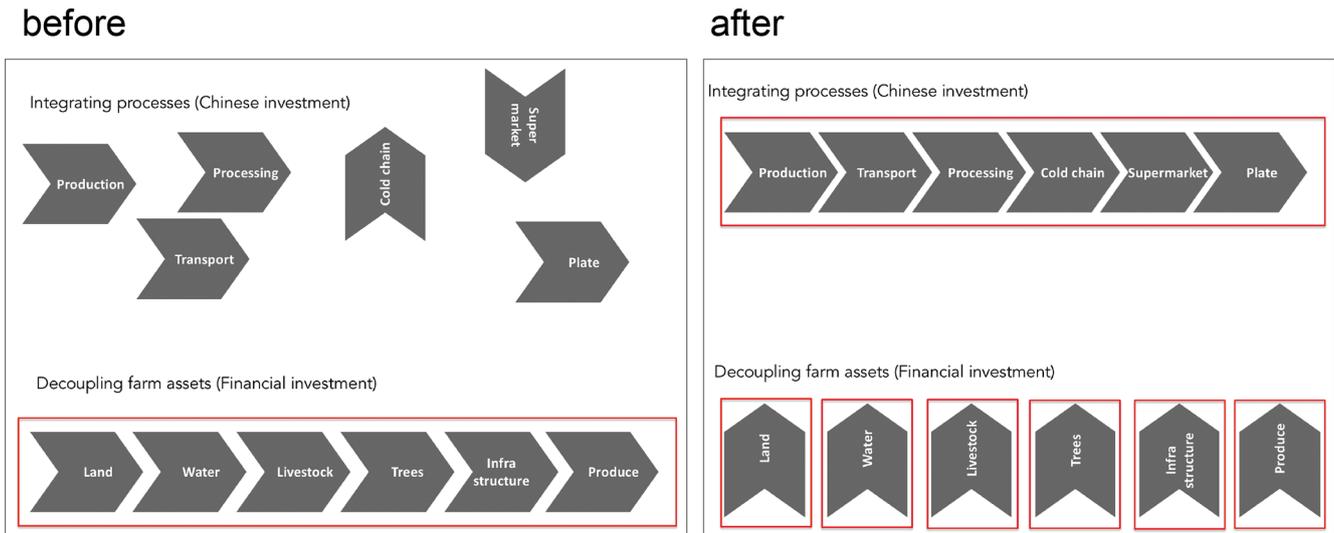
Figure 2. First draft illustrating the different investment logic.

certain extent, could also be considered financial actors. Similarly, the financial actors that Sarah studied did not all pursue the same strategy of decoupling farm elements. While all aimed at generating income flows ("assetization"), some constructed this income flow on the basis of the farm as a whole (rather than its individual elements). While these differentiations could be elaborated on in the text and positioned with respect to the broader goal of the argument, the visualization did not offer the same degree of differentiation. Rather, Sarah and Michaela had to decide whether they were willing to accept this simplified and highly generalized form of presenting their argument. In favor of further exploring this visualization experiment, they deliberately accepted this risk. The visualization, however, also included a second risk as it started to develop its own epistemic life, which is discussed below. Before that, we present how additional decisions influenced the graphic design and the implementation of spatial references in the visualization.

3.6   Graphic design and spatial references

In their first sketch, Sarah and Michaela depicted commodity chains using the graphic design established in economic geography and sociology. Here, commodity chains are usually represented by aligned, mostly horizontal polygons (see Fig. 4). These polygons are intended to represent sub-sections or sub-processes within commodity chains, often placed in relation to each other by arrows, thereby constructing a certain temporal and process-related logic. Sometimes, different proportions, color gradations, and variations in shape are used to more precisely depict complex processes within commodity chains and their segments. In terms of its graphic connotation, this visualization suggests that com-

modity chains are clearly defined, one-directional processes composed of equally definable and distinct elements.

Whereas Michaela had initially adopted the graphic design of the commodity chain rather intuitively, we decided to keep the design as unilateral and directed commodity chain segments. This decision was not without ambivalence, as we were aware of the suggestive power of this graphic design, which rendered the investment logic along the commodity chain much more ordered, rigid, and directed than our data suggested. However, we also saw this as an opportunity to refer to the established ways of visually depicting commodity chains. Moreover, we were curious to see if we would be able to at least partially disrupt the rigidity of this graphic design – and use it to productively overcome the skepticism towards visualization practices as reducing complexity and constructing static and one-dimensional representations of the world.

In order to visually construct the opposing types of investment logic as different ordering principles of the decoupling of units in the commodity chain segment – and thereby assert them rhetorically – we finally decided to go for a diagram (see Fig. 5). Our illustration depicts a "neutral" and a "normal state" of a commodity chain in the middle. This commodity chain consists of delimited, exemplarily labeled sub-processes, each of which consists of undefined units (e.g., plants, companies) and undefined spaces in between. Above and below this "reference state", we depict the two types of investment logic as different ways of decoupling and linking commodity chain segments. In the upper part of the visualization, we focus on the integration of certain units into the commodity chain. Below, a different mechanism is visualized, namely the generation of returns through the investment practices of financial actors (with corresponding income flows or outflows of capital). Here, we disrupted the notion of the closed, one-dimensional commodity chain by
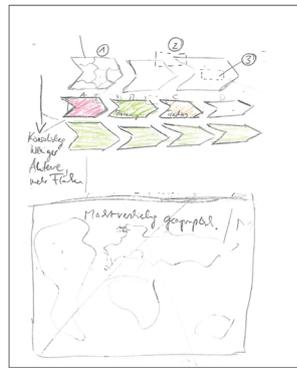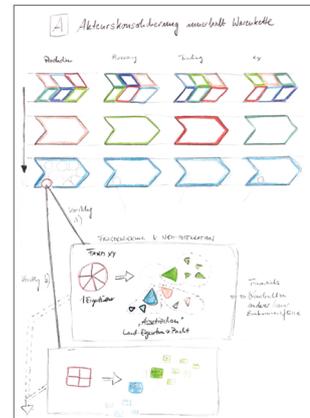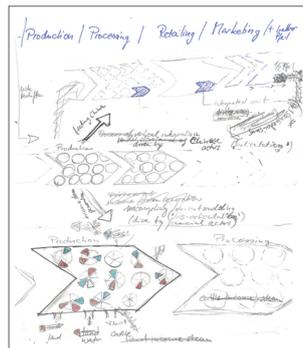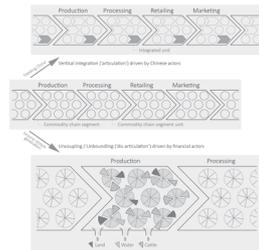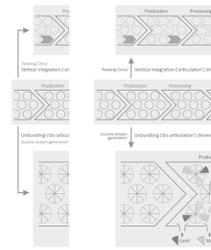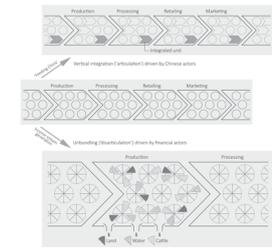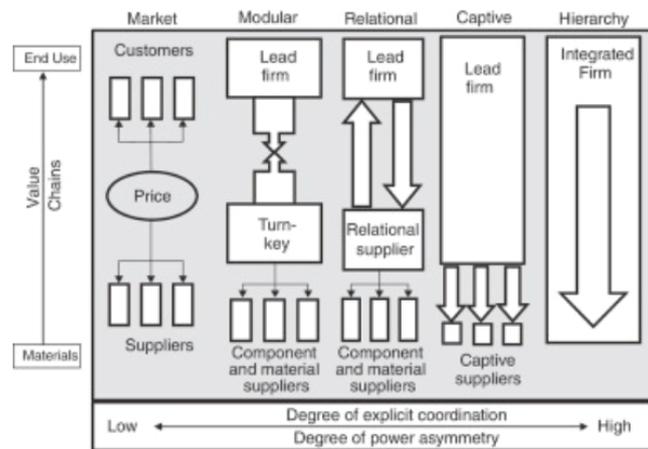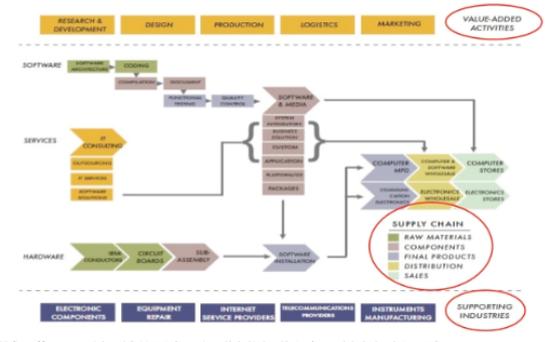
Figure 3. Design chronology.

Figure 4. Visualization of commodity chains in economic geography and sociology (based on figures Gereffi et al., 2005, Fig. 1, and Gereffi, 2012, slide 5).
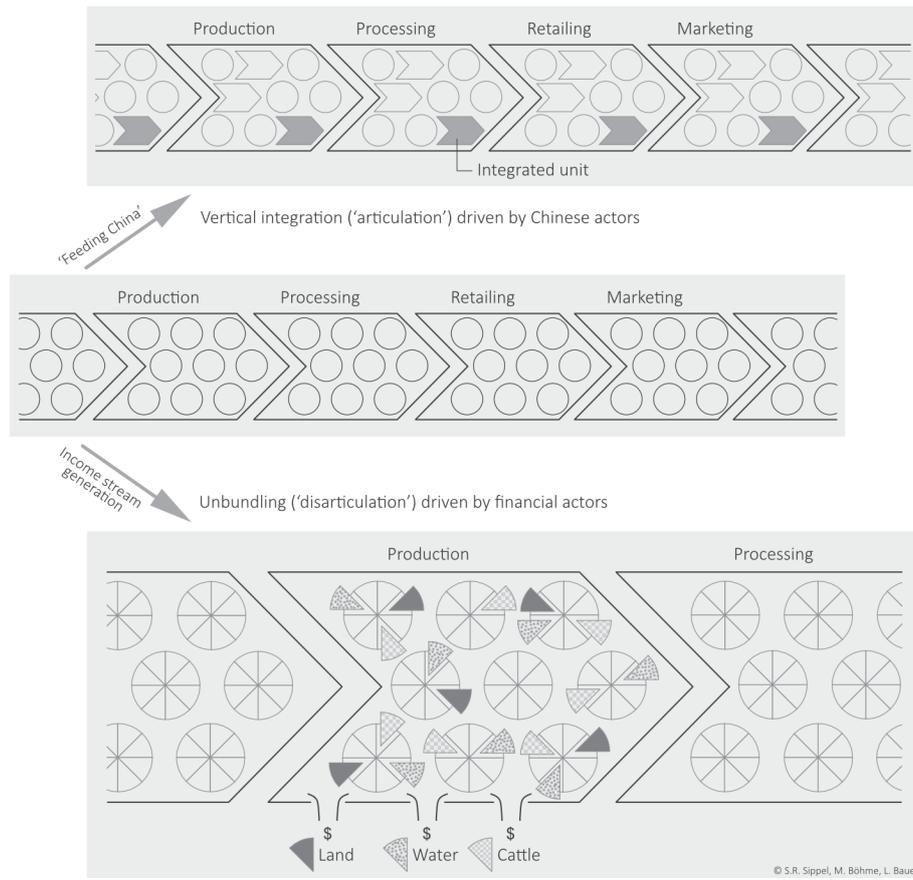
Figure 5. Final visualization.

integrating the flow of financial returns, which – by adding an additional layer of capital flows – steps out of the usual linear presentation of flows within commodity chains.

Similar to the social acceptance of maps to visualize space, commodity chain diagrams represent the accepted way of visualizing inter-firm relationships in economic geography and sociology. Such a recurrent use of specific visual forms within academic disciplines establishes a "viscourse" (Knorr Cetina, 2001; Poferl and Keller, 2017:305; Geise, 2019:321), an ongoing communicative visual discourse between the subject of research, the process of visualization, and pre-existing academic debates. We originally aligned our visual design with pre-existing commodity chain diagrams in order to playfully connect to this existing viscourse. In the course of the visualization, we also started to subtly subvert this viscourse by seeking to provide a more nuanced picture of corporate strategies and how they disentangle farm elements.

In the production segment below, the pie charts and their split up units are the result of further experimental visualization, where we intended to find a visual expression for the disassembling, separation, or removal of previously inseparable units (here, farms) for the generation of income streams. While we first played around with more naturalistically inspired pictorial forms of visualization (see Fig. 6), we eventually decided to use pie charts in line with our focus on the conceptual and institutional fragmentation of agricultural elements as part of their assetization. The pie chart seemed appropriate to illustrate these dynamics in a rather schematic way and allowed us to highlight, separate, and differentiate individual (circle) elements. While the visualization of integration processes within commodity chains (Fig. 5 above) clearly refers to established graphical conventions, to our knowledge the process of financial assetization has not yet been visualized. We were thus challenged to experimentally find our own visual expression.

This is not to say that pie charts do not entail their own graphic connotations. Pie charts are a standard means of depicting quantitative data. In recent years, however, this conventional use has been increasingly subverted in a playful way, for instance in journalistic infographics. We use the static, self-contained, and conventionalized graphic connotation of the pie chart specifically as a symbol for quantified relationships, suitable to depict the mechanism of financialization (which to a large extent relies on the quantification of "almost everything"). The pie chart also served us to visu-
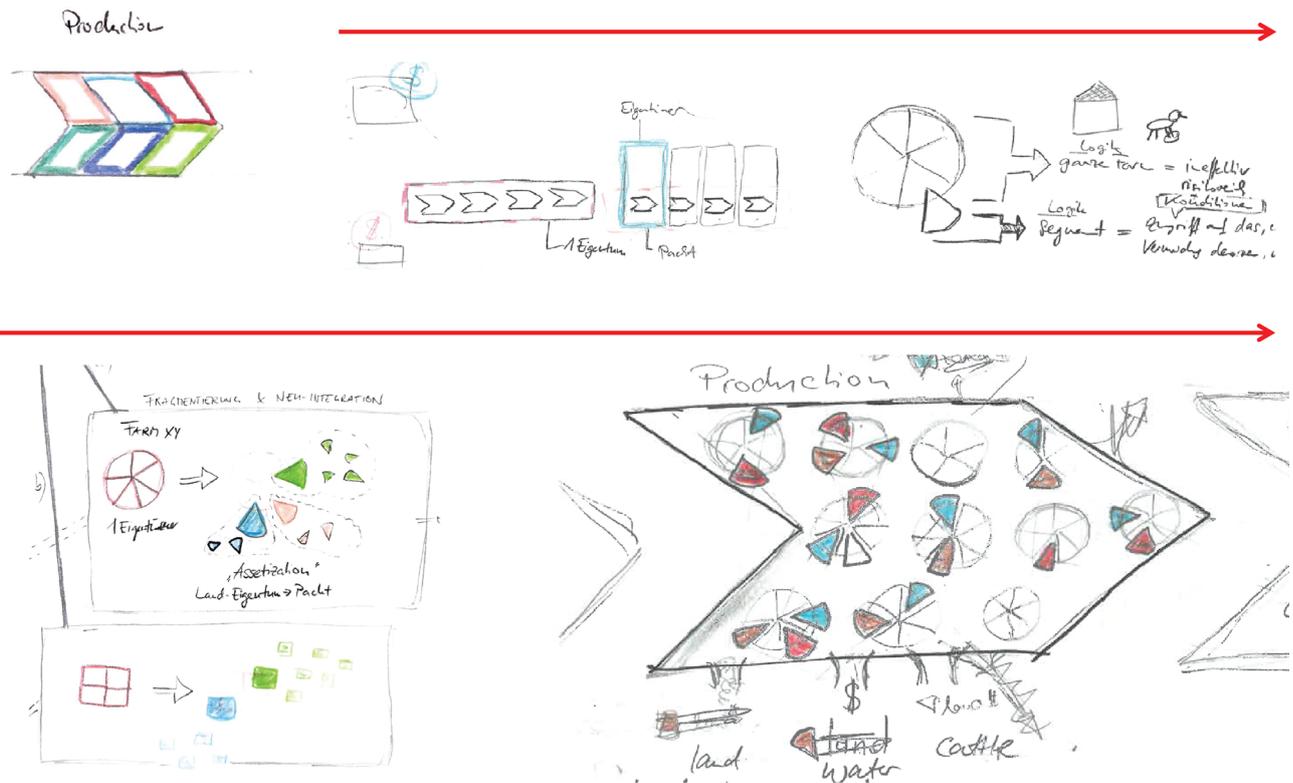
Figure 6. Processes of decoupling: different steps in the visual re-construction of investment strategies.

ally assert a "unity" of farms before the financial investment in a graphically pointed way. At the same time, we again intended to playfully challenge the round and closed symbolism of the pie chart by graphically highlighting and taking out some of its parts, as both a condition and result of the construction of financial assets. While we found these experimentations with graphic conventions and their creative disruption fruitful and inspiring, we also discussed whether the subtleties and nuances of our graphic language would indeed provoke the intended associations for our audience, or whether they predominantly helped to inspire our own reflections and sharpening of our argument.

Lastly, a major focus of our internal debate was the inclusion of spatial references, given both the project's and the CRC 1199's focus on processes of spatialization and their visual representation. At first sight, our final illustration seems to leave the question of space unanswered. It reduces spatial references to two small and rather unimposing textual references. The visualization includes only two small hints at national, territorialized spaces – "feeding China" and "Chinese actors" – which seemed essential for its understanding. We made this decision after some experimentation with topographical modes of representation. In order to spatially locate the Chinese actors and the places of their extra-territorial agricultural practices, Lea first placed the commodity chain on a map (see Fig. 7). In doing so, Lea sought to geographi-

cally locate the implications of the investment logic for farms in Australia, along with associated power shifts in north–south dynamics, within the agri-food system as a whole. Sarah, however, argued that a map like this added little to the key argument regarding the contrasting socio-spatial implications of the two kinds of investment logic and groups of actors. A topographical representation of the investment strategies would have unnecessarily foregrounded and generalized their territorial affiliations and might even have distracted from the main argument. The emphasis of this argument was precisely not on where things were happening (i.e., the map) but on the changing socio-spatial relations within the agri-food system. Without further developing the possibilities of cartographic representation, we decided to include socio-spatial rather than topographical references in a minimalist way by means of labeled arrows. In this way, we marked the process of integration as a part of and result of a national strategy and its implementation by the group of Chinese actors. Apart from that, further spatial contextualization is only made in the accompanying parts of the illustration (i.e., the subtitle and the textual or verbal explanations).

3.7 Evidential effects and epistemic life of visualizations

Schlottmann and Miggelbrink (2015:21) point out that the use of images – such as visualizations for scientific communication – should always be accompanied by a reflection on
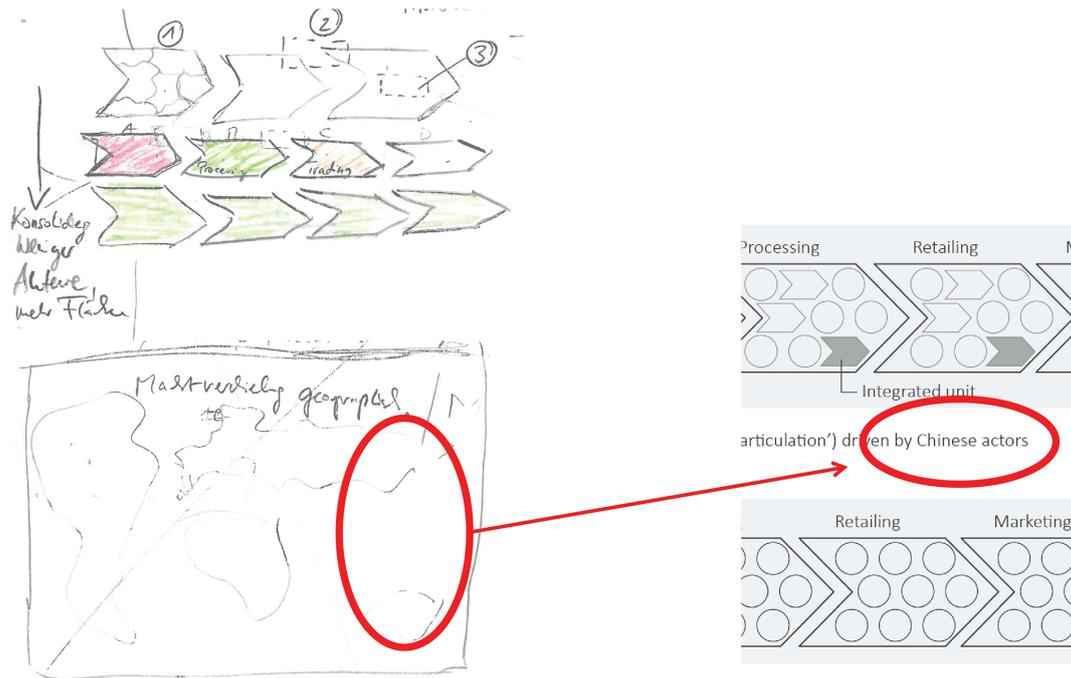
Figure 7. Integration of spatial references.

the evidence that visualizations produce and that is deeply anchored in our visual habits and cultures of representation. This requires not only explicitly positioning visual constructions as part of situated culture- and interest-specific contexts of knowledge production but also constant and critical reflection on the visual habits and cultures that we and our (professional) colleagues are part of. This section addresses some of the latter aspects. We reflect on how we used our final visualization as a means of providing evidence for our argumentation and describing how our visualization developed an epistemic life of its own.

The evaluation of the CRC 1199 along with its subprojects in June 2019 was an important event for the display of our visualization. As is usual in evaluations like this, all presenting researchers were encouraged to prepare visual representations of their work. Our project visualizations served as a first choice for the pitch-like short demonstrations of the evaluation. In particular, the visualization discussed in this article was helpful to present the project results, as it endowed our project results with visual authority. It boiled them down to two key mechanisms and allowed us to get the key points across within a few minutes. Sarah and Michaela strategically used the visual power of the visualization – while being aware of the performative character of these moments of research evaluation and trusting in the capacity of the reviewers to critically reflect on both the power of visualizations and the performativity of evaluations. The extensive reflection on the argument and its refinement as well as the deliberate graphic decisions made during the visualization work outlined above, gave them the intellectual confidence needed

for this very condensed presentation – possibly more so than they would have had they only written down the argument.

The final visualization was eventually published as part of the article "Dis/articulating agri-food spaces: the multifaceted logics of agro-investments" in the volume *Spatial Formats under the Global Condition*. The visualization has since been handed over to a wider academic (and possibly non-academic) audience – and from here might unfold an epistemic life of its own. In regard to our own engagement with the published visualization, for Sarah, the visualization process has highlighted the potential to strengthen memorization. Even compared to other visual elements she used in the past, such as maps, illustrative graphs, or tables, the diagram seems to be more visually dominant in her memory. This may, of course, be due to the intensive engagement with this visualization – not least in the context of this article. However, the stronger visual presence could also be a result of the argumentative capacity of the visualization. It does not merely locate empirical observations topographically or arrange numbers in a table in a well-arranged way but attempts to visually articulate key findings from qualitative research. Visualizations not only illustrate, they speak for themselves. In this way, the epistemic power of visualizations also affects those that created them; as the producers of these visualizations we are just as much subject to this epistemic power, no matter how much we reflect on or contextualize it in our presentations.

Visualization work can thus be understood as a continuous struggle with this epistemic power of the visual, as a struggle against the visual fixation of arguments and for a method-

ological approach that appreciates qualitative visualizations as an open-ended exploration of continuously emerging subject matters. In the case of this visualization, we have only partially communicated this struggle. Although our reflections in this article may contribute to a positioning and deeper reflection of the visualization, we did not make the process of creation and reflection transparent in the original article. This kind of uncommented use of visualizations is nothing new but nevertheless can be criticized in retrospect. We suggest that critical reflection of the context and decisions made during visualization work should become an indispensable component that accompanies visualizations, similar to the methodological reflections and positionality presented as part of qualitative research. This could be one first step towards overcoming the skepticism about visualization in the qualitative social sciences and could allow qualitative researchers to engage more productively with qualitative visualizations and their currently underused epistemic potentials.

4 Conclusion

The financialization of agriculture – the construction of agriculture as a financial asset class – is characterized by multilayered, spatiotemporal dynamics. These dynamics cannot be visualized in the traditional cartographic way of locating social realities within the Cartesian coordinate system. We therefore had to find different visualization strategies. To conclude, we want to sum up these strategies and discuss what can be learned from our experience for qualitative visualization projects. Our visualization work was inspired by the insights from critical cartography and the debates on diagrammatic reasoning in the arts in three main ways, which helped us to better understand the reflective and epistemic value of engaging with the visual in qualitative research.

1. *Making (some of) the invisible visible*. Drawing on data feminism, critical cartography, and GIS, we continuously reflected on how we translated ambiguous, multidimensional, and heterogenous empirical data into categories and rather abstract visual design elements and how this emphasized certain aspects of the research and excluded others. As our research did not include participatory methods, the possibility of involving multiple perspectives was limited. Our visualization practice is, however, in line with feminist, emancipatory, and counter-mapping approaches, as it strives to reveal processes of exploitation – in our case the financialization of agri-food. Specifically, we focused on rendering visible the local consequences of corporate practices – consequences that are usually concealed in conventional commodity chain diagrams. To depict these local implications as a consequence of linear investment logic, we represent local consequences within a diagram that overall reproduces the linear logic and only breaks it at a few small points. Reflecting the call for a pluralization

of perspectives, we furthermore contrasted two different financialization strategies by developing two ways of depicting commodity chains in relation to specifically arranged design elements: one that integrates farm units into larger investment strategies (as observed in Chinese firms) and another that disentangles farm units into a set of investment assets (as observed in Australian firms). This comparative approach helped us to not only revisit and rework our own interpretation of empirical data but also question and re-relate the seemingly natural and linear ways in which pre-existing commodity chain diagrams produce meaning.

2. *Connecting to a preexisting viscourse*. Our diagrammatic reasoning practice draws on experiences from critical cartography and GIS and makes them fruitful for another pre-existing graphic format, that is, commodity chain diagrams instead of cartography. We used existing commodity chain diagrams as a viscoursive starting point for our diagrammatic reasoning practice and thus questioned the ways in which these diagrams bring design elements into a certain relation to provide a condensed, highly schematic narration that describes and legitimizes economic value generation but veils their specific workings and local implications. As pictorial ways to refer to and frame perspectives on certain aspects of globalization, commodity chain diagrams take part in constructing space (Wittmann, 2020:416) and function as "visual worldings" (Hoggenmüller, 2022). They emphasize or exclude certain modes of global ordering and render them visible or invisible. Taking up the distinct format of commodity chain diagrams carries the risk of aligning with the paradigmatic perspectives of previous research on commodity chains, that is, to perpetuate complex socio-spatial relations and to take part in normalizing corporate commodification strategies. At the same time, and in line with counter-mapping practices, taking up commodity chain diagrams can be used as a way of unveiling and counteracting these strategies. The use of established visual formats and symbols in scientific communication can thus be valuable strategy, but it is important to be mindful of and critically engage with their historical roots and embeddedness within influential political practices that favor certain empirical aspects while marginalizing others. Also, it is important to reflect on the reasons for the often unconscious and hasty recourse to established graphic elements and symbols and how they frame, fixate, and align empirical complexities.

In our practice of diagrammatic and map-related reasoning, we sketched out first drafts of our diagram in a process where we moved "between the steps of reflection, imagination, visualization, and discussion over and over again" (Critical Geographies of Global Inequalities, 2018:295) in an inherently incomplete and

open-ended socio-spatial learning process. In this way we questioned, re-related, and re-shaped standard design elements of commodity chain diagrams given our analytical focus on land governance, the logics of financialization, and their consequences at the farm level. We also employed symbols that adhere to quantitative principles of data organization, such as pie charts. We intentionally used these charts to articulate a central aspect of financialization – its focus on numbers – while being aware that this decision reproduced the invisibility of those that are affected by financialization.

3. *Using visualization for reflection.* In the visualization process, we realized that the act of visual abstraction also helped us gain new perspectives on previously articulated research findings and discover new interpretations. In this paper, we thus aimed to thoroughly describe and consider these processes of abstraction in detail in order to demonstrate the epistemic potentials of visualizing. By highlighting the reflective and epistemic value of visualization practices, we want to encourage a more extensive and strategic use of experimental visualization in the context of qualitative research. Based on our auto-ethnographically documented visualization work, we acknowledge that visualizations always and inevitably reduce complexity while privileging some aspects and marginalizing others. Our plea for a more visual engagement and articulation of research findings is thus grounded in the awareness that every form of expression entails specific epistemic possibilities and challenges. In order to recognize these possibilities and challenges, the complexity-reducing aspects inherent to visualizations need to be continuously reflected upon and positioned. However, the need to simplify, generalize, and, to some extent, exaggerate in order to produce visualizations can also be a valuable and productive process that complements other forms of engagement with qualitative data, as long as the challenges and decisions made are deliberately reflected upon and addressed. These decision-making processes include (re-)considerations of the argument and the overall graphic design, as well as references to disruptions to or avoidance of visual conventions. Such decisions, as we have shown in this article, bring with them controversial and ambivalent effects that need to be acknowledged.

Moreover, viscoursive communication remains a challenge. Our case study has shown that visualization work can prepare us for a clear, concise, and confident formulation of arguments in presentations. However, researchers need not only be careful about the evidential and epistemic power of visualizations in communicating their findings, they must also take into account that these affect the researchers themselves and their future engagement with their own research. Research findings tend to become more one-dimensional and simplified through visualization than in the case of written or verbal communications. It is important to critically observe and continuously reflect on these implications and to position them in their respective contexts. We should thus understand visualization work less as producing completed, final products that stand and speak for themselves but more as experimental starting points for further and continually ongoing engagements with complex realities. Despite the challenges and ambivalences addressed in this paper, experimental visualization offers substantial reflexive and epistemic potential that currently remains underused within qualitative research. Our reflections presented in this article are a first step towards a more in-depth discussion about these possibilities and opportunities. Based on our fruitful and enriching experience with visualizations, we want to encourage qualitative researchers to engage in this discussion and to both creatively and critically embark on their own visualization adventure using visualization as a complementary method within their research.

References

Bauer, M. and Ernst, C.: Diagrammatik. Einführung in ein kultur- und medienwissenschaftliches Forschungsfeld, transcript, Bielefeld, https://doi.org/10.1515/9783839412978, 2010.

Bauer, L. and Nöthen, E.: Geographisch-künstlerische Stadtforschung. Ein Drei-Schritt-Verfahren zur Erschließung der Vielheit sozialräumlichen Wissens, sub\urban, 9, 169–190, https://doi.org/10.36900/suburban.v9i3/4.519, 2021.

Bergmann, L. and Lally, N.: For geographical imagination systems, Ann. Am. Assoc. Geogr., 111, 26–35, https://doi.org/10.1080/24694452.2020.1750941, 2021.

Bodenhamer, D. J., Corrigan, J., and Harris, T. M.: Deep Maps and Spatial Narratives, Indiana University, Bloomington, ISBN 9780253015679, 2015.

Cope, M. and Elwood, S. (Eds.): Qualitative GIS: A mixed methods approach, SAGE Publications, London, Thousand Oaks, New Delhi, Singapore, ISBN 9781412945660, 2009.

Crang, M.: Qualitative Methods: Touchy, Feely, Look-See?, Prog. Hum. Geogr., 27, 494–504, https://doi.org/10.1191/0309132503ph445pr, 2003.

Critical Geographies of Global Inequalities (KGGU): C/Artographies of Positionality. Or How We Try to Situate Ourselves as a Working Group in Academia, in: This Is Not an Atlas. A Global Collection of Counter Cartographies, edited by: kollektiv orangotango+, transcript, Bielefeld, 296–301, https://doi.org/10.1515/9783839445198-039, 2018.

Dammann, F. and Michel, B. (Eds.): Handbuch Kritisches Kartieren, transcript, Bielefeld, https://doi.org/10.1515/9783839459584, 2022.

Dávila, P. (Ed.): Visualizing, Mapping, and Performing Resistance, in: Diagrams of Power and Performing Resistance, onomatopee, Eindhoven, 4–9, ISBN 9789493148031, 2019.

D'Ignazio, C. and Klein, L. F.: Data feminism, MIT Press, Cambridge, London, ISBN 9780262547185, 2020.

Ellis, C., Adams, T. E., and Bochner, A. P.: Autoethnografie, in: Handbuch Qualitative Forschung in der Psychologie, edited by: Mey, G. and Mruck, K., VS Verlag für Sozialwissenschaften, Wiesbaden, 345–357, https://doi.org/10.1007/978-3-658-26887-9_43, 2010.

Elwood, S.: Critical Issues in Participatory GIS: Deconstructions, Reconstructions, and New Research Directions, Trans. GIS, 10, 693–708, https://doi.org/10.1111/j.1467-9671.2006.01023.x, 2006.

Elwood, S. and Mitchell, K.: Another politics is possible: Neogeographies, visual spatial tactics, and political formation, Cartographica, 48, 275–292, https://doi.org/10.3138/carto.48.4.1729, 2013.

Flusser, V.: Lob der Oberflächlichkeit. Für eine Phänomenologie der Medien, Bollmann, Bensheim, Düsseldorf, ISBN 3927901369, 1993.

Geertz, C. (Ed.): Thick Description. The Interpretation of Cultures, in: The Interpretation of Cultures: Selected Essays, Basic Books, New York, 3–32, ISBN 0465097197, 1973.

Geise, S.: Wissenschaftliche Bilder und die Visualisierung komplexer Daten in der Kommunikationsforschung, in: Handbuch Visuelle Kommunikationsforschung, edited by: Lobinger, K., Springer Fachmedien, Wiesbaden, 313–333, https://doi.org/10.1007/978-3-658-06508-9_21, 2019.

Gereffi, G.: Global Value Chains as a driver for upgrading and innovation, Local Economic Development 7– 8 March 2012, Slide 5, https://de.slideshare.net/slideshow/ gereffi-gary-gvc-upgrading-in-latin-america-11993151/ 11993151#5 (last access: 19 September 2024), 2012.

Gereffi, G., Humphrey, J., and Sturgeon, T.: The governance of global value chains, Rev. Int. Polit. Econ., 12, 78–104, https://doi.org/10.1080/09692290500049805, 2005.

Goodchild, M. F.: Formalizing Place in Geographic Information Systems, in: Communities, Neighborhoods, and Health, edited by: Burton, L. M., Matthews, S. A., Leung, M. C., Kemp, S. P., and Takeuchi, D. T., Springer, New York, 21–33, https://doi.org/10.1007/978-1-4419-7482-2_2, 2011.

Gregory, I. N. and Healy, G. R.: Historical GIS: Structuring, mapping and analysing geographies of the past, Prog. Hum. Geogr., 31, 638–653, https://doi.org/10.1177/0309132507081495, 2007.

Halder, S. and Michel, B.: This Is Not an Atlas. A Global Collection of Counter Cartographies, edited by: kollektiv orangotango+, transcript, Bielefeld, 11–21, https://doi.org/10.14361/9783839445198-001, 2018.

Harley, J. B. and Woodward, D.: Preface, in: The History of Cartography, Vol. 1, Cartography in Prehistoric, Ancient, and Medieval Europe and the Mediterranean, xi–xxi, edited by: Harley, J. B. and Woodward, D., University of Chicago Press, Chicago, ISBN 0226316335, 1987.

Harris, L. and Hazen, H.: Power of Maps: (Counter) Mapping for Conservation, ACME, 4, 99–130, https://doi.org/10.14288/acme.v4i1.730, 2005.

Hoggenmüller, S. W.: Globalität sehen: Zur visuellen Konstruktion von "Welt", Campus Verlag, Frankfurt, New York, https://doi.org/10.12907/978-3-593-44235-8, 2022.

Holert, T.: "A fine flair for the diagram", Wissensorganisation und Diagramm-Form in der Kunst der 1960er Jahre: Mel Bochner, Robert Smithson, Arakawa, in: Materialität der Diagramme. Kunst und Theorie, edited by: Leeb, S., b_books, Berlin, 135– 178, ISBN 9783942214230, 2012.

Jung, J. and Elwood, S.: Qualitative GIS and Spatial Research, in: SAGE Research Methods Foundations, edited by: Delamont, S., Cernat, A., Sakshaug, J. W., and Williams, R. A., SAGE, https://doi.org/10.4135/9781526421036818834, 2019.

Klippel, A.: From spatial to platial – the role and future of immersive technologies in the spatial sciences, J. Spat. Inform. Sci., 21, 33–45, https://doi.org/10.5311/JOSIS.2020.21.722, 2020.

Knorr Cetina, K.: 'Viskurse' der Physik: Konsensbildung und visuelle Darstellung, in: Mit dem Auge denken. Strategien der Sichtbarmachung in wissenschaftlichen und virtuellen Welten, edited by: Heintz, B. and Huber, J., Edition Voldemeer, Zurich, 305–320, ISBN 3211836357, 2001.

Kwan, M.-P. and Knigge, L.: Doing Qualitative Research Using GIS: An Oxymoronic Endeavor?, Environ. Plan. A, 38, 1999– 2002, https://doi.org/10.1068/a38462, 2006.

Leeb, S.: Einleitung, in: Materialität der Diagramme. Kunst und Theorie, edited by: Leeb, S., b_books, Berlin, 7–32, ISBN 9783942214230, 2012.

Michel, B.: Geographische Visualitätsregime zwischen Länderkunde und Quantitativer Revolution, in: Visuelle Geographien, edited by: Schlottmann, A. and Miggelbrink, J., transcript, Bielefeld, 209–224, https://doi.org/10.1515/9783839427200-016, 2015.

Michel, B., Kritisches Kartieren als reflexive Praxis qualitativer Forschung, Geogr. Helv. 77, 153–163, https://doi.org/10.5194/gh-77-153-2022, 2022.

Nuveen LLC: Investing in farmland, image on webpage, https://www.nuveen.com/global/insights/alternatives/investing-in-farmlandhttps://www.nuveen.com/global/insights/alternatives/investing-in-farmland (last access: 19 September 2024), 2024.

Pavlovskaya, M.: Feminism, Maps and GIS, in: International Encyclopedia of Human Geograph, edited by: Kitchin, R. and Thrift, N., Elsevier, Oxford, 37–43, https://doi.org/10.1016/B978-008044910-4.00025-0, 2009.

Peirce, C. S.: Semiotische Schriften, Band 3, Suhrkamp, Frankfurt am Main ISBN 9783518290811, 1993.

Pickles, J. (Ed.): Ground Truth. The Social Implications of Geographic Information Systems, The Guilford Press, New York, ISBN 9780898622959, 1995.

Pink, S.: The Future of Visual Anthropology: Engaging the Senses, Routledge, ISBN 9780415357654, 2006.

Poferl, A. and Keller, R.: Die Wahrheit der Bilder, in: Fotografie und Gesellschaft, edited by: Eberle, T. and Reichle, N., 305–316, https://doi.org/10.1515/9783839428610-016, 2017.

Quesnot, T. and Roche, S.: Platial or locational data? Toward the characterization of social location sharing, in: Proceedings of the 2015 48th Hawaii International Conference on System Sciences, 5–8 January 2015, Kauai, HI, USA, 1973–1982, https://doi.org/10.1109/HICSS.2015.236, 2015.

Reichertz, J.: Der marodierende Blick. Überlegungen zur Aneignung des Visuellen. sozialersinn, Zeitschrift für hermeneutische Sozialforschung, 8, 267–286, https://doi.org/10.1515/sosi-2007-0206, 2007.

Rose, G.: Visual methodologies: An introduction to researching with visual materials, SAGE, London, ISBN 9781473948891, 2016.

Schlottmann, A. and Miggelbrink, J.: Ausgangspunkte, in: Visuelle Geographien, edited by: Schlottmann, A. and Miggelbrink, J., transcript, Bielefeld, 13–26, https://doi.org/10.1515/9783839427200-001, 2015.

Schuurman, N.: Critical GIS: Theorizing an Emerging Science, Cartographica Monograph, 53, University of Toronto Press, Toronto, https://doi.org/10.14288/1.0089782, 1999.

Schwartz-Shea, P. and Yanow, D.: Interpretive research design: Concepts and processes, Routledge, London, New York, ISBN 0415878071, 2012.

Sippel, S. R. and Böhme, M.: Dis/Articulating Agri-Food Spaces: the Multi-Faceted Logics of Agro- Investments, in: Spatial Formats under the Global Condition, edited by: Marung, S. and Middell, M., Dialectics of the Global 1, Berlin, https://doi.org/10.1515/9783110643008-013, 2019.

Streule, M.: Doing mobile ethnography: Grounded, situated and comparative, Urban Stud., 57, 421–438, https://doi.org/10.1177/0042098018817418, 2020.

Sui, D.: Emerging GIS themes and the six senses of the new mind: is GIS becoming a liberation technology?, Ann. GIS, 21, 1–13, https://doi.org/10.1080/19475683.2014.992958, 2015.

Taylor, F. E., Millington, J. D. A., Jacob, E., Malamud, B. D., and Pelling, M.: Messy maps: Qualitative GIS representations of resilience, Landsc. Urban Plan., 198, 103771, https://doi.org/10.1016/j.landurbplan.2020.103771, 2020.

Terrone, M., Paliaga, G., Piana, P., and Faccini, F.: Coupling historical maps and Lidar data to recognize man-made landforms in urban areas, EGU General Assembly 2020, Online, 4–8 May 2020, EGU2020-7826, https://doi.org/10.5194/egusphere-egu2020-7826, 2020.

Thatcher, J., Bergmann, L., Ricker, B., Rose-Redwood, R., O'Sullivan, D., Barnes, T., Barnesmoore, L., Beltz Imaoka, L., Burns, R., Cinnamon, J., Dalton, C., Davis, C., Dunn, S., Harvey, F., Jung, J.-K., Kersten, E., Knigge, L., Lally, N., Lin, W., Mahmoudi, D., Martin, M., Payne, W., Sheikh, A., Shelton, T., Sheppard, E., Strother, C., Tarr, A., Wilson, M., and Young, J.: Revisiting critical GIS, Environ. Plan. A, 48, 815–824, https://doi.org/10.1177/0308518X15622208, 2016.

Treude, L. and Freyberg, S.: Diagrammatik und Wissensorganisation, LIBREAS. Library Ideas, 21: Bilder, Graphen, Visualisierungen, 3–15, https://doi.org/10.18452/9014, 2012.

Wentz, D.: Anschauen und Denken. Neue Perspektiven auf Materialität und Virtualität der Diagramme, ZfM Nr. 01/2013, Schwerpunkt Medienästhetik, Diaphanes, Berlin, 202—206, https://doi.org/10.25969/mediarep/831, 2013.

Westerholt, R., Mocnik, F.-B., and Zipf, A. (Eds.): On the Way to Platial Analysis: Can Geosocial Media Provide the Necessary Impetus?, Proceedings of the First Workshop on Platial Analysis (PLATIAL'18), Zenodo [data set], https://doi.org/10.5281/zenodo.1475269, 2018.

Westerveld, L. and Knowles, A. K.: Loosening the grid: topology as the basis for a more inclusive GIS, Int. J. Geogr. Inf. Syst., 35, 2108–2127, https://doi.org/10.1080/13658816.2020.1856854, 2021.

Wildner, K.: Inventive Methods: künstlerische Ansätze in der ethnographischen Stadtforschung, EthnoScripts, 17/1, 168–185, https://journals.sub.uni-hamburg.de/ethnoscripts/article/view/810 (last access: 15 November 2024), 2015.

Wilson, M. W.: Towards a genealogy of qualitative GIS, in: Qualitative GIS: A mixed methods approach, edited by: Cope, M. and Elwood, S., SAGE Publications, London, Thousand Oaks, New Delhi, Singapore, 156–170, https://doi.org/10.4135/9780857024541.n9, 2009.

Wintzer, J.: '… wie in der folgenden Abbildung zu sehen ist …', in: Visuelle Geographien, edited by: Schlottmann, A. and Miggelbrink, J., transcript, Bielefeld, 103–120, https://doi.org/10.1515/9783839427200-008, 2015.

Wittmann, M.: Visualisierungsstrategien: Das Diagramm, in: Handbuch Filmanalyse, edited by: Hagener, M. and Pantenburg, V., Springer VS, Wiesbaden, 415–433, https://doi.org/10.1007/978-3-658-13339-9_27, 2020.

Wood, D.: Introducing the Cartography of Reality, in: Humanistic Geography. Prospects and Problems, edited by: Ley, D. and Samuels, M., Maaroufa Press, Chicago, 207–223, ISBN 9781138992276, 1978.

Wood, D. and Fels, J.: The Natures of Maps: Cartographic Constructions of the Natural World, Chicago University Press, ISBN 9780226906041, 2008.

Wood, D., Mesquita, A., Harvey, F., Mogel, L., and Martín F.: Discussing Conter-Cartographies, in: This Is Not an Atlas. A Global Collection of Counter Cartographies, edited by: kollektiv orangotango+, transcript, Bielefeld, 327–335, https://doi.org/10.14361/9783839445198-044, 2018.