



What Is Driving the Water-Energy-Food Nexus? Discourses, Knowledge, and Politics of an Emerging Resource Governance Concept

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In the context of accelerated global socio-environmental change, the Water-Energy-Food Nexus has received increasing attention within science and international politics by promoting integrated resource governance. This study explores the scientific nexus debates from a discourse analytical perspective to reveal knowledge and power relations as well as geographical settings of nexus research. We also investigate approaches to socio-nature relations that influence nexus research and subsequent political implications. Our findings suggest that the leading nexus discourse is dominated by natural scientific perspectives and a neo-Malthusian framing of environmental challenges. Accordingly, the promoted cross-sectoral nexus approach to resource governance emphasizes efficiency, security, future sustainability, and poverty reduction. Water, energy, and food are conceived as global trade goods that require close monitoring, management and control, to be achieved via quantitative assessments and technological interventions. Within the less visible discourse, social scientific perspectives engage with the social, political, and normative elements of the Water-Energy-Food Nexus. These perspectives criticize the dominant nexus representation for its managerial, neoliberal, and utilitarian approach to resource governance. The managerial framing is critiqued for masking power relations and social inequalities, while alternative framings acknowledge the political nature of resource governance and socio-nature relations. The spatial dimensions of the nexus debate are also discussed. Notably, the nexus is largely shaped by western knowledge, yet applied mainly in specific regions of the Global South. In order for the nexus to achieve integrative solutions for sustainability, the debate needs to overcome its current discursive and spatial separations. To this end, we need to engage more closely with alternative nexus discourses, embrace epistemic pluralism and encourage multi-perspective debates about the socio-nature relations we actually intend to promote.

Keywords: discourse analysis, geography of knowledge, resource governance, socio-nature relations, sustainability

INTRODUCTION

In recent years, the Water-Energy-Food Nexus approach has attracted growing attention within international politics, academia and other areas of society. Originally, the concept emerged within the realms of international politics under the influence of the World Economic Forum and related policy makers. Cairns and Krzywoszynska (2016), for instance, trace the nexus back to the year 2008, where business leaders of the World Economic Forum issued a call to engage with nexus issues between economic growth and water, energy, food resource systems. The Bonn2011 Nexus conference marks an additional milestone, which gained prominence through its influential background paper: “Understanding the Nexus: Background paper for the Bonn2011 Nexus Conference” (Hoff, 2011). The World Economic Forum, simultaneously, published another leading report on “Water-Security: The Water-Food-Energy -Climate Nexus” (World Economic Forum). By arguing that an integrative approach to water, energy and food may enhance resource security, efficiency, poverty reduction and better resource governance across sectors, these documents set the tone for future debates.

The overarching nexus debate is shaped by many different societal domains and the significant influence of development actors. Hence, a large part of the nexus literature consists of policy reports, position papers, working papers or strategy documents compiled by international agencies, national ministries, NGOs, consultancies, transdisciplinary networks, or financial institutions like the World Bank. As the Water-Energy-Food Nexus debate gains traction, it progressively influences international development and resource governance approaches. The United Nations (UN) and EU Commission, for instance, seek to adopt a nexus perspective to implement the UN Sustainable Development Goals (SDGs; The Nexus Dialogue Programme, 2015). The nexus also acts as international development agenda, which diffuses into regional policy programs across multiple scales, mainly from north to south (Middleton et al., 2015). International non-governmental organizations such as IUCN and WWF highlight the need for a nexus approach to achieve resource security (IUCN, 2013; WWF and SAB Miller, 2014). Although research organizations like the Stockholm Environment Institute were involved in organizing the Bonn2011 Nexus conference, the concept only later became the focus of scientific investigation. Consequently, various academic nexus platforms emerged, as the nexus frames research agendas and provides growing funding opportunities for scientists.

Despite this growing prominence, the nexus in its nascent form is still ambiguous and serves multiple purposes. First, it is employed as analytical perspective to describe and better understand the interlinkages between water, energy, and food resource systems (e.g., El Gafy et al., 2017; Martinez-Hernandez et al., 2017). Second, it serves as *boundary concept* to facilitate discussion between the academia and politics concerning resource governance and sustainable development (e.g., Bazilian et al., 2011; Hernandez et al., 2014; Abdullaev and Rakhmatullaev, 2016; Brouwer et al., 2018). Third, the nexus

acts as governance concept, aiming to integrate resource sectors across policies and infrastructures to promote sustainability and better resource allocation (e.g., Rasul, 2014; Laurentiis et al., 2016; Karan et al., 2018). To achieve these goals, the nexus approach highlights the need for technological innovations, recycling, and the reduction of waste. Moreover, the concept advertises knowledge integration via inter- and transdisciplinary research approaches and collaborative decision-making (e.g., Ringler et al., 2013; Hernandez et al., 2014; Allouche et al., 2015; Conway et al., 2015; Laurentiis et al., 2016).

Though international guiding concepts, like the Water-Energy-Food Nexus, may become very influential in shaping policy programs, and scientific funding schemes, critical engagement with these concepts is often limited or neglected. Within the leading political and (natural) scientific debates, the nexus is rarely questioned but described as neutral and apolitical concept. This represents an important misconception, as “[i]nfluential concepts in policy making are not merely neutral or scientific; they do not emerge by chance but, rather, are the emanation of complex webs of interests, ideologies, and power” (Molle, 2008: p. 132). Hence, we deem it necessary to critically investigate the nexus approach before further endorsing it as analytical or resource governance framework. Timely reflexivity is important, as opening up such concepts to critical investigation can be very difficult, once they are established as social, political or scientific facts. The ambiguity of concepts like the nexus make them susceptible to processes of appropriation by powerful actors to suit particular agendas (Cairns and Krzywoszynska, 2016).

While critical investigation of the Water-Energy-Food Nexus concept is limited, several studies exist that review the nexus from a social scientific perspective. These contributions mainly challenge the nexus concept for neglecting socio-political aspects of resource use and allocation. They argue that the prevailing technical-managerial nexus framing is inadequate for addressing social aspects like poverty reduction, distributional justice, or power asymmetries in resource governance (e.g., Allouche et al., 2015; Benson et al., 2015; Foran, 2015; Leese and Meisch, 2015; Middleton et al., 2015; Mdee, 2017). Although this critical research provides important insights into actor interests and power relations, most of these papers are conceptual or theoretical in nature. Empirical studies exist but often focus on particular aspects of the nexus or specific geographical locations, which hinders an overarching generalization of research results. Mdee (2017), for instance, analyzes two case studies in Tanzania and concludes that, here, the nexus does not sufficiently disaggregate the political nature of water allocation. Cairns and Krzywoszynska (2016) identify the nexus as contested “buzzword” (ibid. p. 164) but solely focus on UK natural resource debates, which may differ from international ones.

In order to address these shortcomings, we investigate the academic nexus debate from a meta-level perspective. To overcome the methodological restrictions of most social scientific nexus research, we also aim to provide a strong empirical foundation for our argument. To reveal overarching knowledge and power relations, we take a discourse analytical approach to study the international scientific nexus debates. First, we explore various discursive formations of the WEF-Nexus. Can

we identify dominant or marginalized discourses and, if so, what knowledge and power relations are at work? This relates to the questions of who produces nexus knowledge and what knowledge is seen as more legitimate or authoritarian. We also focus on the geographical context of these knowledge and power relations by analyzing the stem of nexus knowledge and its destination. Second, we examine central discursive elements of the scientific WEF-Nexus by referring to the way environmental problems are framed and what solutions are legitimized to solve these problems. Are there different socio-nature relations shaping nexus discourses and what (political) implications emerge from this?

Addressing these questions is important, as certain understandings of environmental issues gain dominance and emerge as truths through specific knowledge and power effects (Hajer, 1995; see section Analytical Framework). The way environmental problems are defined is important for how these problems are dealt with politically. Particular understanding of environmental challenges may also reflect in physical or material effects (Feindt and Oels, 2005). In this sense, academia plays an important part, as science currently holds the “monopoly on knowledge claims” (Hajer, 1995: p. 281) in western societies. Science is actively engaged in shaping ideas, concepts and categorizations that have significant political implications. While the nexus debate is influenced by many different sectors, science plays a prominent role in defining and legitimizing the nexus as a resource governance concept to be implemented by policy makers. We focus on analyzing the scientific nexus discourse, as scientists are also increasingly called upon as experts in environmental governance processes, where they play an important (political) part (Castree, 2015). During the Bonn2011 Nexus conference, for instance, international scientists and research organizations like the Stockholm Environment Institute took very active roles. In this sense, the nexus represents a *hybrid* concept, which renders the distinction between scientific and non-scientific contributions difficult.

This hybridization becomes particularly obvious in global environmental politics, where the boundaries between science and non-science are increasingly blurred (e.g., Demeritt, 2001; Grundmann, 2007). When regarding the nexus as a hybrid, the conventional view of science as independent of the political or ideological realm becomes untenable. Science does not provide neutral or objective evidence for rational decision-making. Instead, we need to recognize the dynamic interactions or intrinsic connections between knowledge production and decision-making (Grundmann, 2007; Wesselink et al., 2013; Benessia and Funtowicz, 2016). Amidst this difficult distinction, we demarcate the scientific contributions to the nexus debate by focusing our analysis exclusively on peer reviewed journal articles (see section Research Methodology). A discourse analysis of the academic literature allows us to identify the underlying socio-political and geographical contexts of nexus research, different discursive formations, competing interpretations of environmental issues and promoted solutions to these problems. By exposing these discursive formations and elements, discourse analysis is

able to shift marginalized positions closer to the center of attention in order to promote alternative interpretations or policy options (Feindt and Oels, 2005; Glasze and Matissek, 2015).

In this article, we first outline our analytical framework and discourse theoretical approach. In the following sections, we present our research methodology and results. We then discuss our findings in terms of discursive formations, elements, and context of nexus research. The article concludes with some wider implications and reflections on our findings.

ANALYTICAL FRAMEWORK

Discourse analysis presents a well-established interpretative research approach within social sciences and human geography. The primary aim of social scientific discourse analysis is to identify ideas, concepts and categorizations through which we understand and give meaning to the world (Waite, 2010). For the purpose of this paper, we define these ideas, concepts and categorizations as discourses that arise from a particular social context (Hajer, 1995). Discourse analysis in geography questions how spatially or environmentally relevant concepts are established through language and social practices. Through discourse analysis, geographical notions like “the Orient” (Said, 1978) or “national borders” (Newman, 2000) are identified as discursive entities that shape our social realities (beliefs, values, norms, practices) and vice versa. Who is involved in the constitution of these ideas, concepts and categorizations? What meaning is associated with them for what purpose? What social and spatial effects result from these particular discourses and who is to be addressed?

Discourse theory is based on the assumption that discourses manifest in talk, texts, social practices and institutional settings. A discourse theoretical perspective emphasizes that social and natural phenomena can only be observed, perceived, and interpreted through language, texts, and within discourses (Dingler, 2005). Language and texts are not seen as a neutral medium through which information, events or reality are communicated in a transparent way. Instead, language, and texts are argued to form social meaning and establish social facts (Tonkiss, 2004). From a discourse theoretical standpoint, it is impossible to access reality directly in an objective and neutral way, as the perception of reality always takes place within a discursive framework (Dingler, 2005). However, discourse theory does not minimize the existence of physical processes. Instead, environmental issues like climate change or the WEF-Nexus are established as social facts through expert language, specific concepts and research practices. Environmental issues are interpreted as social and discursive entities despite referring to apparently natural phenomena (Feindt and Oels, 2005).

According to Foucauldian discourse theory, the establishment of discursive entities as social facts is deeply embedded in socio-temporal contexts. Ideas that become dominant common-sense knowledge are (re)produced, maintained and circulated within social and institutional settings, while alternative interpretations of the world are marginalized (Waite, 2010). Discourse analysis

situates and interprets environmental accounts within their historical, cultural, and political settings instead of treating them as universally true knowledge claims (Dingler, 2005; Hajer and Versteeg, 2005). From a discourse theoretical perspective, environmental issues are not seen as naturally given problems but, rather, as being shaped by multiple competing interpretations (Feindt and Oels, 2005). By establishing the WEF-Nexus as environmental governance concept various actors are likely to hold different perceptions of what the problem *really* is and what solutions are to be legitimized (Hajer, 1995). These struggles about the correct interpretation of environmental issues are intrinsic to environmental discourses or political conflict and can be revealed through discourse analysis (Feindt and Oels, 2005).

Discourse analysis in the realms of environmental politics pursues several objectives. First, discourse analysis aims to identify why a particular understanding of environmental issues gains dominance, while other understandings are discredited. Hence, environmental discourse analysis helps to reveal multiple competing interpretations of environmental issues and their manifestation within leading or marginalized discourses. Discourse analysis may reveal the intrinsically political nature of what is presented as apolitical and objectively true knowledge claims (Hajer, 1995; Feindt and Oels, 2005). For instance, although the WEF-Nexus is often presented as “unarguably true” (Cairns and Krzywoszynska, 2016: p. 166), a discourse analytical approach to the nexus may expose political dynamics and several competing interpretations. Second, discourse analysis closely engages with knowledge production and power effects within discourses. Competing interpretations of environmental issues are often based on different forms of knowledge. When a particular understanding of environmental issues gains dominance, its associated form of knowledge production is legitimized as more authoritative, while other ways of knowing are sidelined (Hajer, 1995; Waitt, 2010). According to discourse theory, particular environmental accounts and forms of knowledge are established as dominant and more legitimate by exercising power within discourses (Dingler, 2005). For instance, a discourse perspective can illustrate how dominant interpretations of the nexus emerge from particular knowledge and power relations that operate within the nexus discourse.

The way environmental issues are constituted through discourses, knowledge and power relations shapes if and how a problem is dealt with politically. The interpretation of environmental issues that gains dominance enables or constrains particular policy options. It also defines the range of actors that are legitimized for the resolution of these issues. Hence, by revealing marginalized discourse, discourse analysis may offer alternative policy options and solutions. Apart from shaping political action, environmental discourses also manifest in material and physical effects, as they are closely linked with social practices, institutional capacities and technologies (Feindt and Oels, 2005).

Our analytical approach is based on the Sociology of Knowledge Approach to Discourse (Keller, 2005, 2011, 2013), which combines Foucauldian discourse theory with the Peter Berger and Thomas Luckmann sociology of knowledge tradition.

RESEARCH METHODOLOGY

Data Selection and Corpus Compilation

Discourse analysis is based on social scientific approaches, as textual data are studied via qualitative research methods within their social, historical and geographical context (Tonkiss, 2004). During discourse analysis, linguistic and textual data gather in large text corpora that are compiled in accordance to selection criteria reflecting the research goal (Waitt, 2010; Keller, 2013). As we aim to analyze the scientific nexus discourse, we assorted our text corpus in line with criteria allowing us to detect discursive structures within the academic nexus literature (Table 1). Our final text corpus comprises 352 academic documents which were subjected to further analysis (see Table S1).

Scientific publications for our corpus were selected from the Web of Science online database (last accessed 17.04.2018). International scientific discourses manifest in English and various text formats including peer-reviewed articles, conference materials, scientific books, dissertations or working papers, which can all be studied as data (Keller, 2013). However, to ensure data coherence, comparability and quality we only included peer-reviewed articles, proceeding papers and special issue editorial contributions into our text corpus.

The Web of Science online database was searched with a combination of the keywords *water*, *energy*, *food* and *nexus*. These keywords were selected, as the *Water-Energy-Food Nexus* designation is dominant within current scientific debates, although multiple other names exist. These include for example: the *Water, Energy and Food Security Nexus* (Hoff, 2011), the *water-energy nexus* (Siddiqi and Anadon, 2011) or the *water-food-energy-climate nexus* (Beck and Walker, 2013). By focusing explicitly on these content-related keywords, we sought to guarantee the data's immediate relevance for our research topic. Furthermore, comparative searches including the additional keywords *climate* or *security* did not result in a significantly different selection of documents.

The selection of texts was conducted with the Web of Science database, as it identifies scientific peer-reviewed material, while also allowing a systematic literature review and data analysis. Comparative searches with Google Scholar led to a similar selection of scientific publications but contained additional text formats such as book chapters, working papers, technical reports and student thesis that did not meet our selection criteria.

Although we compiled our text corpus in a controlled and transparent way, several limitations are associated with this approach. First, the Web of Science database is not free of bias and cannot represent a complete citation search or the entire range of scientific discourses within alternative text formats. Social sciences and humanities are also less likely to publish in peer-reviewed journals, which could result in an unintentional bias toward natural sciences. Older journals and scientific contributions are potentially underrepresented within the Web of Science database. By focusing solely on contributions in English, we are also unable to display discourses taking place in other languages. Despite these limitations, we argue that the controlled compilation of our extensive text corpus allows us to reconstruct discursive

TABLE 1 | Criteria guiding the selection of documents for the overall text corpus.

	Selection criteria	Justification
Database	Web of Science Core Collection (Indexes = SCI-EXPANDED, SSCI, A&HCI, ESCI)	WoS mainly comprises scientific text formats Allows systematic literature review and analysis of results Guarantees comparability of text formats within the final corpus Comparative Google Scholar searches did not result in a significantly different selection of scientific texts
Timeframe	All years	No time limitation imposed on the literature search, in order to map the emergence and historical development of the WEF-Nexus discourse
Language	English	Research focus on the international scientific nexus discourses, which is held in English. Restriction to one language to ensure data comparability and coherence during qualitative analysis
Keywords searched	Water; energy; food; nexus	Content-related selection of keywords based on our research goal to identify scientific discourses around the WEF-Nexus. Comparative searches with the additional keywords <i>security</i> or <i>climate</i> did not result in a significantly different selection of documents
Document types included (total 352)	Peer-reviewed articles; proceedings papers; special issue editorial material	Selection of documents according to scientific standards to ensure data comparability and coherence

formations and draw overarching conclusions on nexus discourses.

Discourse analysis presents an interpretative research approach during which a justified selection of texts or text extracts is analyzed in more detail. The selection of data for this in-depth analysis is an open and criteria-driven process, which consolidates the corpus material to represent the range of discourses and their structures. The selected texts need to traverse and record the breadth of the entire corpus material in a controlled way (Keller, 2013). Following these guidelines, we initially selected 22 documents from our corpus for an in depth analysis. These documents were chosen to outline the development of the scientific WEF-Nexus discourse(s) over time, illustrate the discursive structures and comprise major thematic priorities. Hence, we selected the 10 most cited articles and 12 additional texts, aiming to proportionally represent the distribution of publication years and most common article keywords within our corpus (see **Table S1**). However, by focusing on the most cited documents, a bias emerges, as older publications are cited more often. Focusing on most common article keywords will most likely result in a selection of texts that represent the dominant discourses. To overcome this bias and to also portray alternative or marginalizes nexus discourses, 5 additional texts were subjected to an in-depth analysis. These 5 texts were selected from the Water Alternatives journal, which presents one of the very few journals in our text corpus diverging from the mainstream nexus approach by taking a very critical perspective.

Data Analysis

As mentioned above, discourse analysis is concerned with what is being said as well as the social, historical and geographical context in which things are being said (Hajer, 1995). Hence, our data analysis occurred in two main steps as shown in **Figure 1**.

To gain a more detailed understanding of the social, historical and geographical context of WEF-Nexus discourses, the overall text corpus (352 publications) was subjected to several analytical

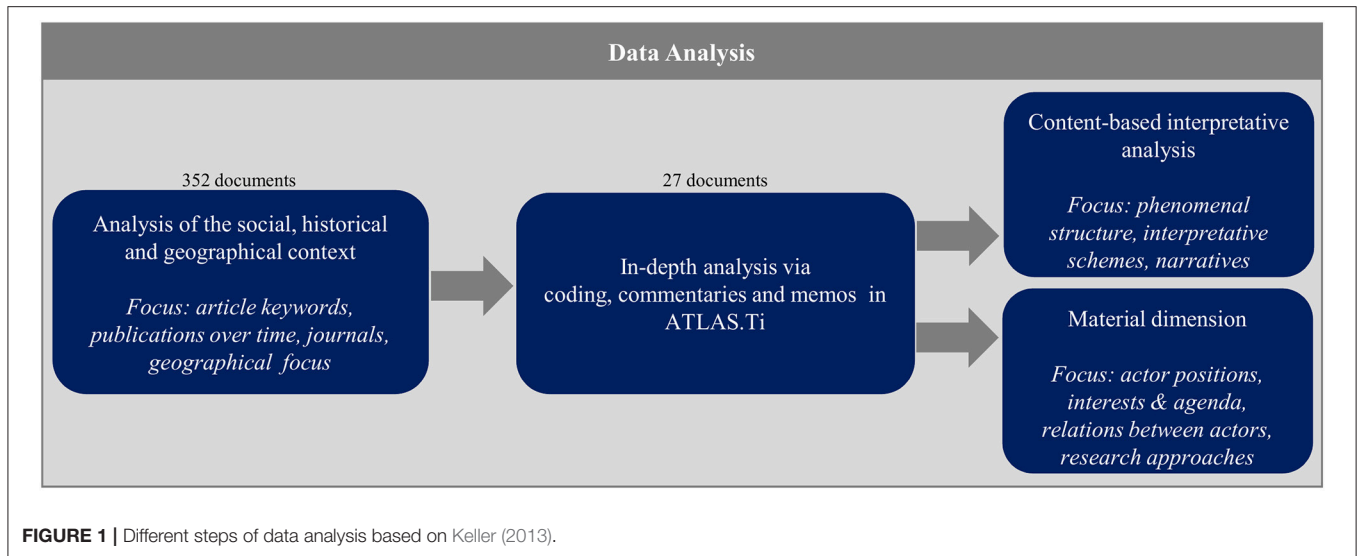
procedures. First, we identified the number of publications over time to trace the emergence and historical development of nexus discourses. Second, the most frequent article keywords and journals were extracted to investigate scientific communities, research approaches and thematic priorities around the nexus. Third, the location of nexus case-studies was derived from article keywords and texts themselves. This geographical focus of nexus research was then opposed to the location of knowledge production in terms of authors' countries of work (affiliation).

For the in-depth analysis of our 27 selected papers, we employed the methodological suggestions provided by Keller (2013) and his Sociology of Knowledge Approach to Discourse. As per Keller (2013), our analysis occurred along two lines, namely the material or context dimension and a content-based interpretative analysis. The analysis of both dimensions was conducted via coding, commentaries and memos within the qualitative software ATLAS.Ti.

The interpretative analysis of our 27 selected papers was conducted in an open and iterative process that was closely linked to our data but also informed by our research goal (Keller, 2013). Several questions guided our initial evaluation including: What key ideas, concepts, categories and classifications mobilized in the documents (Waite, 2010)? What re-occurring themes, images and metaphors cluster around the nexus (Tonkiss, 2004)? Following this initial evaluation, we followed the three stages suggested by Keller (2013) for an interpretative dissection of text passages. These three stages comprise an in-depth analysis of (i) interpretative schemes, (ii) phenomenal structure, and (iii) narrative structures:

i. Interpretative schemes

Interpretative frames are considered socially and historically embedded devices for interpreting events and deriving possible actions. According to Keller (2013), for instance, the notion of risk presents an overarching modern frame which structures the perception and action toward certain phenomena like climate change.



ii. Phenomenal structure

The phenomenal structure refers to the way phenomena like the WEF-nexus are constituted within discourses in terms of key themes, problem structure, legitimization of certain actions and practices to deal with particular phenomena (Keller, 2013). Concretely, our analysis revolved around interpretations, metaphors, and normative claims concerning the nexus concept, problem and solution structures as well as conceptualizations of socio-environmental relations.

iii. Narratives

Narratives are story-lines that tie together various discursive elements into a coherent structure to explain who is doing what and why. According to Hajer (1995), narratives combine elements from different domains to provide actors with a set of symbolic reference that suggest a common understanding. These may be stories of progress, apocalypse, causalities, responsibilities, or dangers (Keller, 2013).

The material and context dimension was investigated with a focus on the role of particular actors within discourses, relations between actors, intended audiences and research approaches (e.g., natural or social sciences). By analyzing this material and context dimension of discourses, we can identify the social dynamics carried into the production of knowledge and texts (Waite, 2010).

Finally, results from our interpretative analysis and material dimension were aggregated into general statements about the discourses present in the overall corpus (Keller, 2013).

RESULTS

Social, Historical, and Geographical Context of Nexus Discourses

Since 2009, research interest in the Water-Energy-Food Nexus has increased almost exponentially (Figure 2) with the sharpest rise in the number of publications occurring between 2014 and 2015. We relate this increase to the adoption of the SDGs in 2015, in which the nexus is to play an important

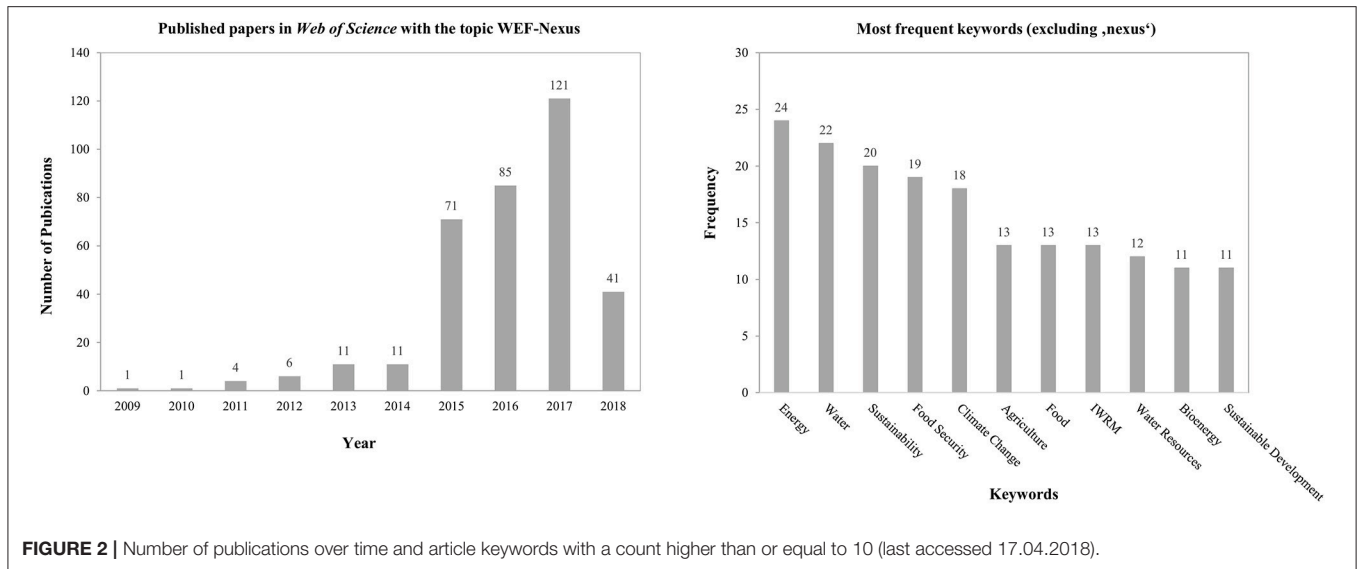
role (The Nexus Dialogue Programme, 2015). Naturally, water, energy and food present the most frequent article keywords within our text corpus. Additional thematic priorities around the nexus include sustainability, sustainable development, food security, agriculture, bioenergy, climate change, IWRM, and water resources (Figure 2).

The most prevalent journals in our text corpus are presented in Table 2. Regarding the scope and topics of these journals, dominant research approaches and topics clustering around the nexus become apparent. Most commonly, journals focus explicitly on resource management, environmental science topics, technology and sustainable development. Although some journals like *Environmental Science & Policy*, *Water International*, the *International Journal of Water Resources Development* or *Sustainability* present themselves as interdisciplinary platforms that purposefully include social and political aspects, we argue that *Water Alternatives* portrays one of the very few critical social scientific journal in Table 2 and our overall text corpus. Unlike other journals, *Water Alternative* explicitly challenges the narrow framing of and technical approach to water. The journal aims to focus more on the political dimensions of water resources development through constructive critiques and alternative approaches (Water Alternatives Journal, 2018).

The map presented in Figure 3 illustrates the geographical context of nexus research by comparing the places of nexus knowledge production to the location of nexus case-studies. Regarding individual countries and their frequency of occurrence, we detect that nexus knowledge is mainly produced in developed industrial countries of the Global North. Contrary to this, the nexus is mainly applied and researched in developing countries of the Global South with a strong focus on South-East Asia.

Interpretative Analysis

Based on our in-depth analysis, we identified two major discursive formations around the Water-Energy-Food Nexus which are characterized by different interpretative schemes,



phenomenal structures, narratives and material context. Although it may prove difficult to clearly assign individual documents to specific discourses, we associate 21 papers with the leading nexus discourse, while only 6 constitute an alternative formation. The main features of each discourse are presented below.

Most Influential Nexus Discourse

Based on our in-depth analysis of 21 papers, we derived overarching conclusions about the leading nexus discourse.

i. Interpretative schemes

Within the leading nexus discourse, we identified interwoven interpretative schemes. These include *risk and security*, an *economic rationale* and an overarching *ecological modernization frame* shaped by *techno-scientific approaches*. The security and risk frame is shaped by the notion of resource scarcity posing a risk to the global economy or humanity as a whole. Consequently, resources like water, energy and food need to be securitized. For example, Bazilian et al. (2011) state that water, energy and food “all have deep security issues as they are fundamental to the functioning of society” (ibid. p. 2). The techno-scientific rationale and ecological modernization frame aim to solve sustainability issues by increasing resource use efficiency via technological and scientific innovations. The economic rationale conceptualizes and frames the nexus in terms of resource demand, supply, consumption, input, output, trade-offs, volatility spill-overs, value chains, and economic efficiency.

ii. Phenomenal structure

Problem descriptions and promoted solutions within the leading discourse are strongly related to the interpretative schemes mentioned above. Problems are framed prominently in terms of global resource scarcity, constrains and over-exploitation. Global water, energy, and food resources are argued to become increasingly scarce in response to economic and

population growth, increasing standard of living, urbanization and environmental degradation. Climate change is interpreted as aggravating this situation also in terms of poverty and lack of access to resources. In the context of this worsening global resource crisis, the isolated development of water, energy, and food nurtures inefficient resource use and allocation. The sectoral approach to management practices, policies and institutional settings concerning water, energy and food is seen as major issue. Economic aspects are presented as additional challenge. Inefficient water use in agriculture, for example, is related to “[l]ow subsidized tariffs” (Abdullaev and Rakhmatullaev, 2016: p. 6) and the pricing of water below market value. Missing expert knowledge and data on the interconnections between water, energy and food systems is also seen as major disadvantage.

Related to these issues, the primary goals is to achieve global resource security through an integrative nexus approach to water, energy and food. Resource demand needs to be regulated, resource use optimized and consumption rendered more efficient. Water, energy and food policies, programs, and institutions are to be managed in a cooperative cross-sectoral way to advance sustainable development. As part of a nexus framework, resource use efficiency and optimization are achieved mainly via technological innovations and market instruments. Market mechanisms, in this case, often relate to water and energy pricing signals. For example, misguided water and energy subsidies are to be eliminated, in order to “introduce better pricing signals” (Bazilian et al., 2011: p. 4) and to encourage farmers to “invest in a more efficient irrigation technology” (Berardy and Chester, 2017: p. 8). Problems of access and distribution of resources are solved primarily via policy integration, management and planning. To solve resource challenges in an integrative nexus approach, inter- and transdisciplinary research is promoted.

The leading discourse is characterized by specific themes and ideas clustering around the nexus. First, the WEF-Nexus is employed as analytical concept to describe the interactions

TABLE 2 | Journals within the overall text corpus with a count higher than or equal to 10.

Journals	Nr. of publications in overall text corpus	Journal scope and topics
Water ISSN 2073-4441	21	Water science and technology; ecology; water resources management; water governance; hydrology; hydraulics; water scarcity; flood risk; water quality
Applied Energy ISSN 0306-2619	17	Energy conversion and conservation; optimization of energy processes; mitigation energy pollutants; sustainable energy; innovative technologies; modeling and forecasting; energy conservation strategies
Environmental Science & Policy ISSN: 14629011	15	Interdisciplinary research of policy relevance on environmental issues; climate change; biodiversity; environmental pollution and wastes; production; transport; consumption; growth; demographic changes; well-being; health
Water International ISSN: 0250-8060	15	Journal of the International Water Resources Association (IWRA), founded for the sustainable management of water resources around the world
International Journal of Water Resources Development ISSN: 0790-0627	13	Interdisciplinary policy and practice-oriented journal that covers all aspects of water resources; water resources and their economic, financial, social and environmental-related impacts; interdependences and inter-linkages between the water and the agricultural, energy, industrial and health sectors in both developed and developing countries
Journal of Cleaner Production ISSN: 0959-6526	13	Focusing on cleaner production, environmental, and sustainability research and practice; cleaner production and technical processes; sustainable development; sustainable consumption; environmental sustainability assessment; sustainable products and services
Environmental Science and Technology (Letters) ISSN: 0013-936X	11	Aim is to provide authoritative source of information for professionals in a wide range of environmental disciplines; advances, trends and challenges in environmental science, technology and policy
Sustainability ISSN 2071-1050	11	Forum for studies related to sustainability, experimental and theoretical research relating to natural sciences, social sciences and humanities; scientific predictions and impact assessments of global change and development; air pollution and climate change; water pollution and sanitation; misuse of land; desertification and drought; industrial development and energy crisis
Advances in Water Resources ISSN: 0309-1708	10	Theoretical, computational, or experimental approaches used to advance fundamental understanding of surface or subsurface water resources systems or the interaction between these systems; surface and subsurface hydrology; hydrodynamics and hydrometeorology; multiphase transport phenomena; modeling fluids
Environmental Progress & Sustainable Energy ISSN: 1944-7450	10	American Institute of Chemical Engineers reporting on critical issues of the environment, including remediation and treatment of solid or aqueous wastes, air pollution, sustainability, and sustainable energy; alternate energy technologies; biofuels; biorefineries
Water Alternatives ISSN 1965-0175	10	Aim is to challenge narrow framing of water problems and technical and engineering approach to water; focus more on political dimension of water resources development and management at all scales; journal is to provide space for creative and free thinking on water, fostering debate, eliciting innovative alternatives, promoting original analyses and constructive critiques

between water, energy and food. Interlinkages between water, energy, and food are conceptualized within a coupled systems approach characterized by feedbacks and interdependencies. The dominant perspective argues that a nexus approach will enable us to better understand or assess the complex dynamics between water, energy and food resource systems. Second, the WEF-Nexus is supposed to act as “boundary concept” (Abdullaev and Rakhmatullaev, 2016: p. 1) between science and policy. Indeed, authors often state that nexus research should support decision-making to allocate increasingly limited resources more effectively. Third, the WEF-Nexus is directly promoted as emerging resource governance concept to achieve and monitor sustainable development. From this leading perspective, the nexus is to reduce competition over resources, eliminate trade-offs, and maximize synergies between sectors. As the nexus concept allows to implement more efficient infrastructure and environmental policies, increasing global demand for water, energy, and food resource can be managed more effectively. The WEF-Nexus concept itself is rarely questioned and

critical points are only touched upon within the dominant discourse.

As shown in our Analytical Framework, discourses (re)produce particular nature-society relations. Within the leading nexus discourse, for instance, the environment is addressed in a *command and control* approach that follows a utilitarian logic and sees nature as economic resource. Environmental aspects need to be monitored and controlled for human use and benefit. Karan et al. (2018), for instance, state that “since dollars are the only measure common to food, energy, and water components, the changes in the sustainability are formulated in terms of dollars” (ibid. p.20). Ringler et al. (2013) argue that “natural resources are beginning to limit, to a substantial degree, economic growth and human well-being goals” (ibid. p. 617). Nature and society are predominantly conceptualized as two distinctly separate spheres; an approach which is often referred to as *Cartesian dualism* (Dingler, 2005). This *Cartesian dualism* manifests in the coupled-systems perspective which is typical for the dominant nexus approach.

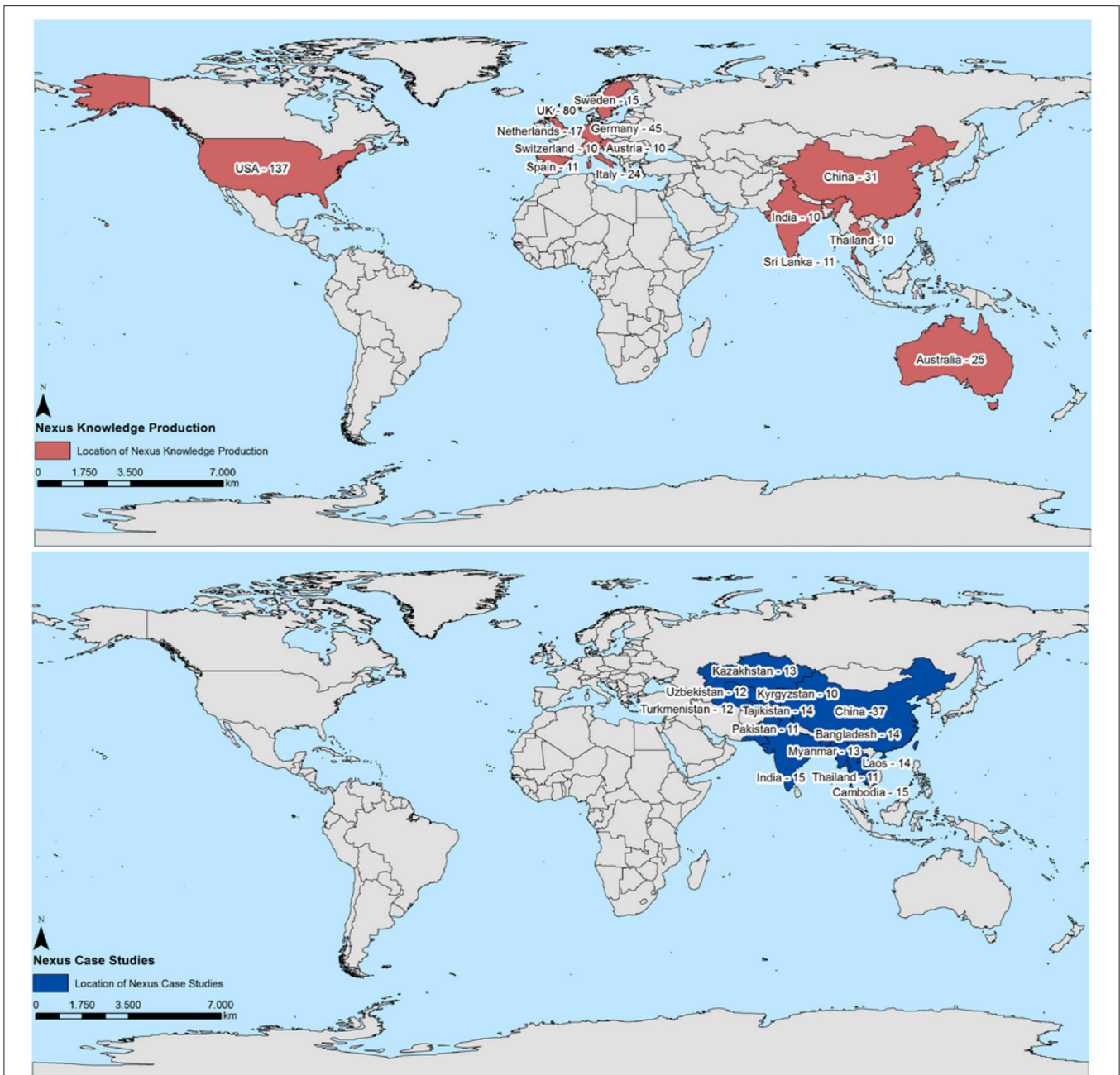


FIGURE 3 | Geographical focus of nexus research and spaces of nexus knowledge production. Map based on places with equal or more than 10 counts.

iii. *Narratives*

These various discursive elements consolidate into a dominant nexus narrative based on apocalyptic story-lines. According to this narrative, multiple global crises cumulate in resource scarcity that poses an ultimate threat to human existence. Researchers and decision-makers are called upon to urgently adopt an integrative approach to water, energy and food systems. Only a nexus approach, so the story goes, will help us prevent a global catastrophe. A nexus approach

promises to maximize synergies between resource systems, reduce trade-offs, optimize resource use, help us allocate limiting resources more effectively and promote sustainable development.

Alternative and Marginalized Nexus Discourse

Based on our in-depth analysis of 6 papers, we derived overarching conclusions about the alternative or marginalized nexus discourse.

i. *Interpretative schemes*

Contrary to the leading discourse, the alternative nexus discourse is characterized by a social constructivist interpretative scheme. For example, authors employ a “constructivist reading of security” (Leese and Meisch, 2015: p. 700). Others highlight the “constructed and political nature of global resource scarcity” (Allouche et al., 2015: p. 616). This indicates that nexus aspects like “global resource scarcity” are not seen as objectively true facts. Instead, it is argued that these notions are embedded in wider socio-political contexts, political dynamics, and that they are shaped by various actors and interests. As part of this social constructivist perspective, authors focus on nexus language, aim to “disaggregate narratives of water scarcity” (Mdee, 2017: p. 100) or analyze different interpretations of the nexus amongst international actors. These social constructivist approaches emphasize the “particular policy settings, [...] arenas of power and contestation” (Allouche et al., 2015: p. 616) surrounding the nexus approach.

ii. *Phenomenal structure*

Within this alternative discourse, the dominant techno-scientific nexus framing is defined as overarching problem. A primary critique focuses on the exclusion of socio-political dimensions within the leading discourse. It is argued that decisions concerning resources like water, energy, and food are not neutral but highly political. The allocation and distribution of resources take place within areas of unequal power and often lack transparency or public participation. For instance, Allouche et al. (2015) argue that the framing of the nexus as technical issue actively “hides its politics” (ibid. p. 610). By neglecting socio-political aspects, the current nexus framing may further powerful interests, and dominant worldviews. Powerful actors may easily adopt and appropriate the nexus to safeguard their interests, consolidate pre-established positions and marginalize subordinate actors. For example, framing the nexus in terms of security creates a sense of alarm or urgency and allows water, energy and food to be treated as economic goods in order to address an apparent economic emergency. By neglecting the politics of resource distribution or scarcity, the dominant nexus risks “marginalizing those who are least likely to be able to articulate their needs” (Mdee, 2017: p. 103). Furthermore, the current nexus is challenged for not being sufficiently pro-poor, as its techno-managerial approach overlooks the complex dynamics between “financial investment, the developmental states, different classes of people, and distributional outcomes on the ground” (Foran, 2015: p. 656).

The dominant nexus is also described as contested, controversial, immature and diffuse political project that is “far from unified” (Benson et al., 2015: p. 759). Essentially, the nexus itself is seen as socially constructed and normative concept. The alternative nexus discourse challenges the “normative primacy” (Leese and Meisch, 2015: p. 696) of the dominant nexus approach. It is argued that the nexus is not shaped by objective scientific evidence. Instead, statements concerning resource scarcity or ineffective resource allocation

are embedded within their historical context and prevalent political discourses. This context, however, is often neglected. For example, the dominant natural scientific nexus approach inadequately addresses the “social, productive and cultural values” (Mdee, 2017: p. 103) associated with resources like water. The reason for this disregard is argued to result from a lack of critical social sciences conceptualizations. By ignoring the social dimensions, “resource linkages remain thinly described and under-theorized” (Foran, 2015: p. 656). Finally, the integration of water, energy, and food sectors itself is seen as problematic. It is suggested to compare the nexus to existing governance frameworks before endorsing it as new paradigm. From this alternative perspective, it remains questionable, whether the nexus presents anything new, or may provide added value for resource governance.

To overcome these challenges, an alternative nexus framing is suggested that highlights the socio-political dimension of resource governance. This extended nexus approach recognizes the political nature of decisions concerning resource use and allocation. A more in-depth political analysis may be required to understand different assumptions already embedded in policy. This political analysis may also reveal the political nature of different narratives surrounding the nexus (e.g., scarcity). A more explicit focus on the socio-political dimensions will illuminate powerful interest and power asymmetries concerning the re-allocation of resources. Researchers need to pay closer attention to the politicized relationship between water, energy, and food governance systems in addition to the socio-political and historical context of nexus narratives. For instance, the alternative nexus also “recognizes that global priorities may not reflect local concerns” (Allouche et al., 2015: p. 618). A political perspective allows to assess whether the nexus centralizes or de-centralizes control and decision-making, reduce or increase inequality.

To this end, the alternative perspective suggests to engage more strongly with issues of social justice. To achieve poverty reduction, the nexus needs to focus more on the question of: Whose water, energy and food use is to be secured? Whose water, energy, and food use is termed inefficient? How are the needs of the marginalized prioritized? To promote sustainable development, the nexus needs to “address poverty and redress inequality and social justice” (Allouche et al., 2015: p. 619). Open and transparent decision-making are required to overcome the dispossession of the poor. Resource governance needs to be rendered more inclusive and collaborative. Additionally, the alternative nexus perspective highlights the need for interdisciplinary inquiry to foster a more holistic understanding of the resource nexus. The dominant approach is to be extended by social scientific perspectives to value plural approaches toward the nexus challenge. A social scientific perspective would focus more explicitly on power relations and asymmetries, implications for people and socio-spatial patterns of inequalities. Extending the current nexus by social scientific approaches would highlight the importance of local contexts, diverse ways of knowing and acknowledge the value of plural interpretations of resource issues. An extended nexus “may help us think through multiple scales

and interfaces of competing claims for water use” (Mdee, 2017: p. 104).

Within the marginalized nexus discourses, a non-dualistic view on nature and society is prevalent, as the relations between society and nature are conceptualized as co-constituted. Therefore, socio-nature need to be analyzed within their socio-political, institutional, and historical context.

iii. *Narrative*

These various discursive elements aggregate into a narrative opposing the dominant nexus story-line. The dominant techno-scientific nexus approach claims normative primacy but neglects to address the highly political nature of resource governance, use and allocation. The dominant nexus framework is unable to adequately address poverty or social justice, as power relation and asymmetries are neglected. To promote sustainable development and poverty eradication, the nexus needs to include social scientific political analysis and more collaborative decision-making.

Material Dimension

Two distinct research communities characterize the major discursive formations surrounding the Water-Energy-Food Nexus. The leading nexus discourse is shaped by natural scientific, engineering and economic perspectives, which is mirrored in the scope and topics of the most common journals (**Table 2**). Leading nexus research focuses on assessing the interlinkages, trade-offs, and synergies between water, energy and food systems via quantitative measurements and computer modeling. Papers associated with the leading nexus discourse are cited more often and prevail in terms of quantity. Many more researchers and authors contribute to the dominant nexus discourse.

The alternative and marginalized nexus discourse is characterized by a critical social sciences community. The alternative perspective takes a social constructivist and political approach to resource management. Papers are often conceptual and theoretical in nature. The marginalized discourse cumulates in the *Water Alternatives* journal, one of the very few critical journals found within our text corpus. Fewer authors shape the alternative discourse and papers associated with this alternative discourse are cited less frequently. They are, therefore, less influential in conceptualizing the nexus framework.

Interestingly, both discourses refer to similar actors, events and institutions, which are often part of the international political sphere. Important points of reference include for example the United Nations (e.g., FAO), the Rio+20 summit, the MDGs and SDGs and the IPCC platform. The World Economic Forum is identified as one of the major nexus promoters and the Bonn2011 Nexus conference is often named as major milestone in developing the nexus. The Bonn conference is referred to mostly in terms of its background paper provided by Hoff (2011). Indeed, the publications by Hoff (2011) and the World Economic Forum (2011) present very influential texts that are often mentioned and cited within our text corpus. The nexus is also sometimes compared to and associated with the Planetary

Boundary Concept (Rockström et al., 2009) and the Club of Rome’s Limits to Growth report (Meadows et al., 1972).

The two discourses have two distinctly separate intended audiences. Authors associated with the leading discourse aim to address and inform policy makers directly with their research results, in order to promote better and more sustainable decision-making. Contrary to this, the marginalized discourse addresses authors involved in the dominant nexus framing, in order to re-conceptualize the current nexus.

DISCUSSION

By taking a discourse analytical approach, our findings reveal a splintered WEF-Nexus, with one leading and one counter-discourse. This finding highlights that the nexus is not uniform but, rather, presents a contested concept that is shaped by competing interpretations. According to Hajer (1995), discursive structures and formations are not given but emerge from a continuous struggle over discursive dominance, which indicates that the leading nexus discourse is not closer to an objective truth. Instead, it establishes and maintains its leading position by exercising power in various ways (Dingler, 2005). For instance, compared to the alternative approach, many more authors are involved in (re)producing the prevalent nexus narrative. The leading nexus discourse is also more prominent in terms of number of publications, citations and range of scientific journals. Within the leading approach, the nexus itself is not questioned but handled as proven fact, while researchers focus on targeting policy makers with their research findings. By directly addressing policy makers, scientists contribute to establishing, and promoting the nexus concept further within the political realm. We assume that this strategy is often successful, as researchers and research organizations are called upon as advisors when designing meetings like the Bonn2011 Nexus conference.

Important consequences ensue from the leading nexus discourse continuously establishing and maintaining its dominant position and supremacy over its counterpart. As shown in our Analytical Framework, particular forms of knowledge production are legitimized and seen as more authoritarian, depending on what understanding of environmental issues gains dominance (Hajer, 1995). Based on our analysis, we showed that the leading nexus discourse is based on techno-scientific research approaches. In other words, natural scientific, economic, and engineering knowledge is seen as more legitimate and authoritarian when dealing with solutions surrounding the nexus than social scientific knowledge. This observation correlates with the powerful and persisting ideals of modernity: science and technology should merge to foster societal progress, unlimited wealth, economic prosperity, and control over nature (Benessia and Funtowicz, 2016).

Additional knowledge and power effects reflect in the geographical context of nexus research. As shown in **Figure 3**, the nexus is shaped by western knowledge, which is then diffused or exported across the Global South with a strong focus on South-East Asia. This observation is in line with the history of the

concept as traveling idea for development interventions. This is also supported by Middleton et al. (2015), who demonstrate that international organizations and high-income donor countries work with governments and politicians in South-East Asia to translate the nexus concept into national or regional policies. In mainland South-East Asia, aid funding shifts toward the nexus, as international organizations establish global nexus programs (e.g., UN agencies). The projection of the nexus onto South-East Asia exemplifies the regionalization of a global policy discourse and development agenda promoted through and beyond the Rio+20 conference or the World Economic Forum (Middleton et al., 2015).

This explicit regional focus of nexus research may have several reasons. First, the dominant discourse frames the need for a nexus approach in terms of global resource scarcity supposedly caused by rapid urbanization, changing lifestyles and economic growth. Currently, these three trends coalesce in South-East Asia. The geographical focus of nexus case studies largely corresponds with the region of the world exhibiting the highest density of fastest growing cities. Second, countries like India and China are experiencing population increases, economic growth and rising standards of living. Resource governance debates in China or India also highlight the need for resource securitization and the coordination of competing uses (e.g., Chen, 2007; Xue and Xiao, 2013). Additionally, major river basins transcend countries like China, India, Myanmar, or Cambodia. The Mekong River, for instance, is extensively managed, researched, and appears several times within our text corpus. Its long lasting development history, institutional context and management settings to coordinate water, energy, and food supplies for rapidly growing cities may provide a favorable platform for nexus research. We presume that the specific combination of these factors contribute to South-East Asia's particular popularity for nexus research.

By embedding our geographical observations in the geography of knowledge debate, we argue that the western idea of a single scientific rationality producing universally true knowledge is highly questionable, as science is spatially situated. As Livingstone (2003) illustrates: "What has been promoted as scientific objectivity, as the 'view from nowhere,' turns out to have always been a 'view from somewhere'" (ibid. p.184). The universal claim of western nexus knowledge has to be challenged with regard to Middleton et al. (2015) observing that many rural farmers, fishers or community groups in South-East Asia do not perceive water, energy, and food as separate entities in the first place. This local approach to water, energy, and food stands in contrast to the disciplinary fragmentation of knowledge occurring in the (western) world of scholars.

Apart from these overarching knowledge and power effects, our results also show that the two discursive formations are shaped by distinct actor groups that conceive socio-nature relations in very different ways. These differences are based on and reflected in the different forms of knowledge, interpretative schemes, competing problem definitions, and opposing solutions suggested to solve these problems. Within the leading nexus discourse, nature and society are interpreted as two separate but coupled systems, interlinked through dynamic feedback

processes. This coupled-system approach to nature emerges from the natural scientific, economic and engineering knowledge base aiming to control, monitor and manage nature. Nature is perceived as economic resource to be used and regulated for human benefit. Schmidt and Matthews (2018) even argue that the nexus concept serves to financialize nature, as it was deliberately developed by global financial networks to effect the transition from state-oriented to financialized approaches of water development and sustainability. This conceptualization of society-nature relations also underpins the security and risk frame, ecological modernization approach, and economic rationale. As mentioned above, the leading nexus narrative contends that population and economic growth, changing lifestyles, urbanization and climate change inevitably cumulate in a global resource scarcity that poses a threat to human existence. Suggested solutions for addressing these global risks are based on scientific or technological innovations and market incentives aiming at allocating limited resources more effectively.

In this sense, the leading nexus discourse (re)produces a neo-Malthusian narrative: Giampietro (2018) even speaks of "the return of the Neo-Malthusians" (ibid. p. 2). This neo-Malthusian narrative locates the causes for resource scarcity in places that experience population and economic growth, changing lifestyles and urbanization. To date, these places are mainly located in countries of the Global South, which are implicitly made responsible for unsustainable development and environmental degradation. Hence, neo-Malthusian approaches are not neutral or objective but highly political. As Harvey (1974) argues, neo-Malthusian approaches may have important political implications by directing policies toward neo-imperialism abroad. Although this statement cannot be confirmed by our analysis and goes beyond the scope of this study, we illustrate that nexus implementation and application strongly focuses on the Global South. In particular, the nexus is projected onto South-East Asia, which currently experiences population and economic growth, changing lifestyles, and urbanization. By interpreting environmental problems through a security and risk frame, ecological modernization approach and an economic rationale, resource intensive (western) lifestyles, capitalist economies or utilitarian approaches to nature are not addressed as underlying problems. Hence, we argue that the leading nexus discourse presents a typical techno-scientific approach to sustainability that gears policies toward addressing environmental problems without dealing with deeper causes responsible for these problems (Harvey, 1974; Beck, 1992; Castree, 2001). The security and risk frame creates an additional sense of urgency for action, which may legitimize far reaching interventions to control an apparent emergency. Inclusive decision-making and alternative policy options may easily become suspended (Beck, 1992).

To the contrary, the alternative nexus discourse actively engages with the political nature of resource governance, allocation and scarcity. Nature-society relations are acknowledged to have political dimensions that must be investigated within their socio-political, institutional and historical contexts. The alternative nexus discourse suggests expanding the current nexus to focus more explicitly on power asymmetries, social justice and the socio-political or historical

context of resource allocation, in order to overcome poverty and social inequalities. More social scientific and political analysis are promoted in addition to more collaborative decision-making. However, this alternative nexus approach is less visible and influential within the overarching nexus discourse.

Our analysis demonstrates that the nexus discourse as a whole is shaped by distinctly separate discursive formations, knowledge bases, and limited geographical foci. Despite highlighting the need for integrative approaches, the leading nexus discourse takes place in a rather confined intellectual and geographical space. Instead of conceptualizing the nexus in a truly interdisciplinary way, social scientific knowledge seems to be less legitimate or authoritarian and plays a negligible role in shaping the overarching nexus idea. Additionally, the nexus is mainly informed by western knowledge, which is then exported to the Global South.

These distinctions then contrast with the definition of the term *nexus*, which refers to the “connection or series of connections linking two or more things” and “a connected group or series” (Oxford Dictionary, 2018). Both nexus discourses advertise integrative solutions via inter- and transdisciplinary research approaches and collaborative decision-making (Ringler et al., 2013; Hernandez et al., 2014; Allouche et al., 2015; Conway et al., 2015; Laurentiis et al., 2016). We attribute this divide between rhetoric and real collaboration to a misconception of *integration*. As shown by Hofer and Meisch (2018), narrowly framed and solution-oriented research often promotes a limited understanding of disciplinary *integration*. Instead of endorsing truly inter- and transdisciplinary exchange, genuine cooperation between scientific disciplines is actually limited. Research projects aiming to *integrate* different types of knowledge often reflect wider power imbalances between natural and social sciences. While such research projects are largely dominated by techno-scientific approaches, social scientists taking marginal positions are often required to subscribe to natural scientific analytical frames and are employed as “afterthoughts” (Strang, 2009: p. 6). However, genuine collaboration, multiple types of expertise, and truly integrative approaches are required to explain the complexities of environmental challenges (e.g., Strang, 2009; Gerlak and Mukhtarov, 2015).

In this sense, we do not oppose or refute the WEF-Nexus concept *per se*. Instead, we argue that the overarching nexus discourse needs to bridge the current gap between rhetoric and real collaboration by developing into a more holistic, inter-, and transdisciplinary concept that also moves beyond its current spatial constraints and scientific reductionism. The current nexus debate needs to overcome its limitations by endorsing epistemic pluralism and knowledge claims from various sources and places. For this purpose, the techno-managerial approach, on the one hand, needs to recognize and acknowledge the deeply political nature of resource use and governance. Indeed, any debate about the nexus “necessarily entails a political or ideological dimension that must be explicitly acknowledged” (Giampietro, 2018: p. 4). Social scientists, on the other hand, are called upon to become more future and action-oriented, by engaging in environmental debates early on and by moving beyond purely theoretical and conceptual approaches. Otherwise, it remains questionable whether the

nexus will be able to promote sustainable resource governance. Instead of creating emblematic issues shaped by techno-scientific approaches, we wish to see a wider debate around which nature and society relations actually intend to promote (Hajer, 1995).

Within the alternative nexus discourse, critical scholars argue along the same lines (e.g., Allouche et al., 2015). In this sense, we position this paper in the realms of what we termed the alternative nexus discourse. Discourse analysis cannot produce objectively true knowledge, as the researcher is an integral part of the analysis and may reproduce or contribute to particular discourses. Despite this intrinsic limitation, discourse analysis presents a valuable analytical perspective for environmental research. First, we illustrate the distinct discursive formations and the wider context of the nexus concept. Second, most social scientific contributions are conceptual or theoretical in nature and discourse analysis provides a strong empirical foundation for our argument. By exposing different discursive formations, various interpretations of environmental issues or possible solutions, we hope to emphasize and strengthen alternative nexus positions. This may also help to promote alternative interpretations or policy options (Feindt and Oels, 2005; Glasze and Matissek, 2015).

CONCLUSION

In this paper, we closely engaged with the Water-Energy-Food Nexus and showed that the concept in its current form is shaped by several fractures and lines of conflict. By employing a discourse analytical approach, we identified two distinct formations of the scientific nexus discourse. The leading discourse is based on natural scientific, economic, and engineering research approaches, frames problems in terms of resource scarcity or global crises and aims to solve these problems via technological innovations or market incentives. The leading discourse occupies much more space by establishing and maintaining its authoritative position in various ways. We argue that the leading techno-scientific nexus reproduces a neo-Malthusian narrative which directs policies toward addressing environmental issues without dealing with the root causes for these problems. Its counter-discourse is based on social scientific approaches, identifies the current techno-scientific nexus framing as major problem, and actively engages with the socio-political aspects of resource governance. We illustrate that this alternative nexus discourse is less influential and seen as less legitimate. A second line of separation runs between places of nexus knowledge production, located in Global North, and nexus application focusing mainly on South-East Asia. By referring to the geography of knowledge debate, we claim that the nexus as western concept cannot have universal aspiration.

We conclude that the current Water-Energy-Food Nexus represents a splintered concept that is shaped by separation rather than integrative approaches to resource governance. In order for the nexus to critically investigate solutions for future sustainability, it needs to overcome its discursive and spatial separations. By embracing epistemic pluralism and different forms of knowledge from different sources or places, the nexus can develop into a more holistic concept. We also suggest to

engage more closely with the geographies of nexus knowledge: What are local nexus approaches and conceptualizations of socio-nature relations in countries where western nexus knowledge is currently applied? To support more integrative and diverse discussions, we also encourage social scientists to engage sooner and more actively in ongoing environmental debates. As shown, environmental politics are often shaped by natural scientific and techno-scientific approaches to sustainability. Social scientists are called upon to engage and contribute to environmental discourses by becoming more future and action-oriented. To the contrary, natural scientists are encouraged to acknowledge and recognize the political nature of resource use and governance. Timely involvement of multiple perspectives could result in more fundamental debates about the nature and society we intend to promote instead of endorsing emblematic issues and concepts.

AUTHOR CONTRIBUTIONS

VW contributed to the conception and design of the study, conducted the study, organized the database, and wrote the first draft of the manuscript. AB supervised and contributed to the

conception and design of the study. All authors contributed to manuscript revision, read and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fenvs.2018.00128/full#supplementary-material>

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