



# Operationalizing the Water, Energy and Food Nexus Through the Law

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**Abstract.** The prevailing system of governance of the water, energy and food sectors is characterized by siloed law, policy and institutional structures, frustrating the transition to a more sustainable approach to resource governance. The past decade saw the emergence of the Water, Energy and Food Nexus (‘WEF Nexus’), an approach promoting the coordinated management and governance across sectors and scales, thereby responding directly to the complex and inseparable interactions and interdependencies between water, energy and food systems. Achieving coordinated governance of WEF resources is a challenging undertaking, one that cannot be effectively operationalized if it not endorsed and implemented through law and policy. Yet, as this paper shows, the law and the legal discipline have, until now, been largely absent from consideration within the WEF Nexus literature. Without understanding what characteristics require reflection within the legal and policy framework to support its operationalization, the WEF Nexus shall remain but a theoretical ideal.

Through a structured literature review of 39 records, this paper identifies the necessary characteristics of a regulatory framework that supports the operationalization of the WEF Nexus. An approach to mapping existing water, energy and food regulatory systems is then designed such that the researcher may determine the extent to which an existing regulatory system reflects the nexus characteristics.

This paper thus argues that the WEF Nexus cannot mature as a concept without taking bold steps towards reaching an understanding of how the Nexus can be applied in practice, which in turn requires the consideration of existing regulatory frameworks. By identifying common characteristics of a nexused governance framework as discerned from existing literature, this research takes a first step towards developing a shared understanding of how the WEF Nexus can be operationalized through the law.

**Keywords:** WEF Nexus · Law · Coordinated governance · Resource management

## 1 Introduction

The Water, Energy and Food Nexus (‘WEF Nexus’), though having previously gained some degree of scholarly interest [6, 12, 18], burst onto the academic stage in earnest

in 2011 following *The Water Energy and Food Security Nexus—Solutions for the Green Economy* conference held in Bonn [4, 15]. The widely cited background paper to the conference introduced the WEF Nexus as an approach that ‘integrates management and governance across [WEF] sectors and scales’, thereby moving away from the conventional siloed approach [7]. The potential of the WEF Nexus therefore lies in its promotion of coordinated governance frameworks, which respond directly to the complex and inseparable interactions and interdependencies between water, energy and food. To understand the potential value of the Nexus, these interdependencies are broadly outlined here.

In the most simplistic sense: the generation of electricity and the production of food both utilize large quantities of water, with agriculture utilizing 70% of the world's fresh water supply [5]. Energy is, in turn, required to transport and treat drinking water and to filter wastewater for reuse or safe release into the environment [5]. Simultaneously, climate change places additional stress on food and water supply, which is further exacerbated by the excessive use of carbon fuels in energy production [5]. As such, the actions of, and the constraints imposed within, one sector (energy, water or food) directly impact the other sector(s) owing to cross-sectoral interdependence.

This interdependence is equally reflected at policy level: the policy objectives in one sector are either the preconditions for the realization of another sector's objectives or, alternatively, the policies of one sector constrain or impose conditions on what may be achieved in another sector [15, 19]. In WEF Nexus terms this amounts to a manifestation of cross-sectoral interdependence within the policy realm.

As such, when viewed as an analytical framework, academics involved in the development of the WEF Nexus view it as a lens through which we may identify and understand synergies and trade-offs within both physical WEF systems and WEF related policy. The WEF Nexus thereby aids in improving the governance of WEF resources towards achieving more resilient systems. The WEF Nexus has, however, been criticized for being nothing more than a buzzword, absent of practical applicability [3]. However, in moving from theoretical ideal to implementable framework, law and policy must be considered within nexus discourse. This is because the provision of water, energy and food constitutes a policy realm that is firmly entrenched within existing governing legal texts of statutes and sectoral regulations. Furthermore, the management of water, energy and food systems – particularly when striving for greater coordination in the face of perceived siloism – is nuanced and complex, largely because it involves multiple actors spanning different governance scales.

As such, informal social norms, though powerful, cannot sufficiently ensure appropriate degrees of coordination as is required by the WEF Nexus approach, nor can social norms adequately confront the challenges associated therewith. Though to a lesser extent, official policy proclamations can also not perform the task of hard law. After proceeding on a similar line of analysis, albeit in a different but related theoretical context, Ruhl argues that-

no new theory of how to do things in environmental and natural resources management, particularly one that challenges entrenched ways of doing things and the interests aligned around them, is likely to gain traction in practice if it cannot gain

traction in the form of endorsement and implementation through specific laws and regulations [14].

Similarly, as illustrated by Allan et al., implementing new approaches aimed at ensuring sustainability and/or resilience of resource systems is only effective where supported by adequate regulatory regimes [1]. Thus, without adequate procedural, rights-based or other legal mechanisms for enforcing implementation, the operationalization of the particular framework or approach will stall. Without taking legal considerations into account, there is little hope for the WEF Nexus approach to effectively move from the realm of academic theory to that of practice.

Of further importance in this regard is the need to tailor the translation from theory to law to the political, social and legal culture of the jurisdiction within which the WEF Nexus is being operationalized. Without a thorough understanding of the content, scope and operation of the applicable statutes and regulations within a particular jurisdiction, the existing regulatory barriers to WEF Nexus implementation cannot be foreseen and resolved. This understanding is best achieved by mapping the legal regime regulating WEF resources of a particular jurisdiction to identify the existing barriers and untapped capacities that have the potential to hinder or promote WEF Nexus operationalization.

However, prior to mapping a legal regime, it is necessary to understand what characteristics the WEF Nexus requires reflected therein to promote coordination across sectors. To this end, a structured literature review is conducted to extract the necessary characteristics of a “nexused” regulatory framework that supports coordination across WEF sectors. An approach to mapping existing water, energy and food regulatory systems is then proposed such that the later research may apply this methodology to determine the potential in law to reflect a coordinated approach to WEF resource management.

## 2 Methodology

As a starting point, this review draws on previous work that I completed alongside Buijze and Malan [2] in which a systematic literature review was conducted based on the PRISMA Statement methodology developed by Moher and others [13]. The primary aim of PRISMA is to ensure that the systematic literature review is conducted objectively, with each decision taken by researchers made explicit, such that the review can be replicated and thus may be checked for validity and reliability.

The aim of the review was to collect and review the top 20% of literature (determined by citation number) published in the English language within peer reviewed journals on the Google Scholar database from 2011 (being the year of the seminal “*The Water Energy and Food Security Nexus—Solutions for the Green Economy*” conference) up to and including June 2021 (being the month immediately prior to the literature being collected) [2]. The Google Scholar database was searched using the key words “water”, “energy”, “food” and “nexus” in all possible combinations, resulting in 3634 records being collected. Duplicates were then removed and screening and eligibility criteria were applied.

Screening criteria required that the record be in the English language, and published in a peer reviewed journal from 2011 up to and including 2021. Eligibility criteria

required that all three spheres of the nexus be addressed in the record, thus those records focusing for example only on a “water energy nexus” or on a “water, energy, food and coal nexus” were excluded. Following screening, 208 records were included in the review. These 208 records thus represent the top 20% of WEF Nexus studies published between 2011 and 2021 judged according to citation number (Fig. 1).

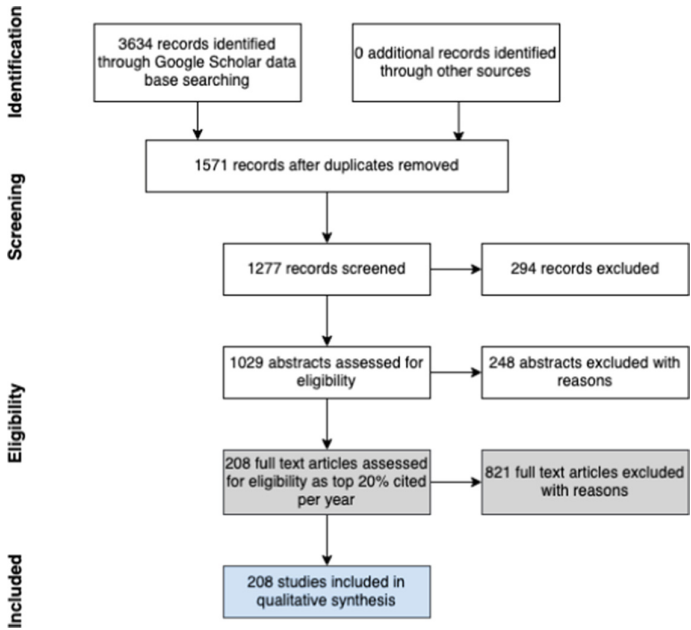


Fig. 1. Results of record collection and screening process according to PRISMA methodology

For the purposes of the present review, I then re-screened each of the 208 abstracts and applied additional eligibility criteria, selecting only those records that, at face value, examined the regulatory, governance, and/or political aspects of the WEF Nexus. This resulted in the selection of 55 records. I then embarked on a detailed and complete reading of each record, resulting in the further exclusion of 16 records for failing to meet the aforementioned eligibility criteria, 39 records thus being included in the final review.

In an EXCEL spreadsheet, the characteristics identified within each record were then recorded alongside the year of publication, updated citation number as of 1 October 2021, the field of study of the research, the definition of the WEF Nexus given, and the methodology adopted in the research. From this data, the ‘common characteristics’ – namely those characteristics identified by two or more records – were identified, the results of which are presented and discussed below.

### 3 Results

Of the 208 records screened for inclusion in this review, only two were from the field of law with research having been conducted that directly considered the legal aspects

**Table 1.** Summary of disciplinary field of articles included in review

Total No. of Articles per Field of Study	
Field of Study of Article	Total No. of Articles
Governance	12
Sustainability Studies	2
Environmental Science	12
Interdisciplinary/ Transdisciplinary	4
Law	2
Political Science	5
Critical Social Science*	1
*Article did not contribute characteristics but was kept in review for underlying governance insight.	
Uncategorised	1
<b>Total Articles</b>	<b>39</b>

of the WEF Nexus (*see* Table 1). Those records originating from a disciplinary field other than law either failed to consider or acknowledge legal aspects of the WEF Nexus altogether, or observed a need for legal considerations more generally [11] but did not further the enquiry beyond mere observation. This demonstrates the absence of legal considerations in prevailing WEF Nexus discourse.

This notwithstanding, the literature did sufficiently develop the Nexus from a governance perspective, identifying those characteristics necessary in promoting coordination in WEF systems of governance. Taking an interdisciplinary perspective, the legal field may draw on the characteristics identified as necessary for effective governance and translate this into applicable legal mechanisms. Where a legal mechanism reflects the characteristics that non-legal fields identify as necessary for promoting coordinated resource management, such legal mechanism should serve as an example of a means of promoting coordination through law. In this way the first step towards nexus operationalization is taken, by identifying the kinds of legal mechanisms that promote WEF coordination in the manner envisaged by WEF Nexus proponents.

With this in mind, the characteristics identified in this literature review can be presented. Table 2 gives an overview of the results of the review, including a specification of the number of records per disciplinary field that identified a particular characteristic. A total of twenty characteristics were identified within the literature. Though there was a degree of variance in the terminology used in describing the characteristics – for example “bridging mechanisms” versus “cross-cutting mechanisms” – the variance was small, and the terminology was largely consistent. The most prevalent characteristic identified was the requirement of horizontal/cross-sectoral coordination, which was considered a

necessary element of a nexused regulatory framework in 44% of the records reviewed. The least prevalent characteristics were (predictably) those directly referencing legislation with the requirement for consideration of inter-sectoral issues within legislation, and for localized over generalized legislation and planning identified in only 3 of the 39 records.

The nature of the characteristic(s) identified within a particular record depended largely on the nature and focus of the specific research. This serves as one explanation for why no single characteristic was identified by a majority of records within the review. A second explanation for this is that no record had as its primary aim the identification of the necessary characteristics of a nexused regulatory framework. Instead, such characteristics arose within the discussion of the particular research question explored within

**Table 2.** Overview of characteristics necessary in promoting a nexused approach to WEF governance

Characteristic Identified in Literature	Field of Study of Article							Total
	Gov	SS	ES	I/T	Law	PS	UC	
horizontal / cross-sectoral coordination	5	2	4	2	1	3		17
incentives for nexused decision making and/or implementation of practices	5	1	5		1	2		14
policy coherence	4	1	4		1	2		12
inter-sectoral cooperation / information sharing	5	1	3		1	1		11
long-term planning (policy approach/objectives) with short term goals and (flexible) planning	3	1	5	2				11
multi-stakeholder engagement (more broadly stated - no specific moment designated)	3	1	3		1	2		10
integrated / inter-sectoral policy / policy making	3	1	3	1		1	1	10
effective institutional structure to facilitate coordination across sectors	3		4		1	1	1	10
public participation / participatory processes or mechanisms	5	1	1			2		9
reliable and consistent data collection in order to clarify interactions and design incentives / nexus approaches	4		3			1	1	9
constant monitoring (either of targets/goals or of impacts)	3		2		1	1		7
sufficient budgetary and financial planning to implement nexus initiatives	3		2	1				6
bridging / cross-cutting mechanisms	2		2	1	1			6
decentralized / localized decision making and nexus implementation	2		1	1	1	1		6
science-based policy making		1	2	1		1		5
flexibility in decision making		2	1	1				4
harmonization of sectoral goals / targets / objectives	3		1					4
clarify rights and responsibilities across sectors	1		1	1	1			4
consideration of inter-sectoral issues within legislation			2		1			3
localized over generalized legislation and planning			1		1	1		3

any given record, and this review extrapolated such characteristics from the general discussion. It is for this reason that a systematic literature review based on the PRISMA methodology was elected such that this review may be reproduced in case it is necessary to test for validity of results.

It should be borne in mind that these results serve as a first step towards formulating the common characteristics of a nexused regulatory framework. It is not the intention or submission of this research that the characteristics identified within this literature review constitute a conclusive, comprehensive and authoritative list. Given that this exercise is a novel one within the WEF Nexus literature, and further that legal and political considerations of the nexus remain in their infancy, it is hoped that this review may serve as inspiration for further research that aims to develop, in more concrete terms, how the Nexus may be applied to regulatory frameworks governing WEF sectors.

## **4 Discussion**

### **4.1 Analyzing the Characteristics Promoting a WEF Nexus Approach to Resources Management**

What becomes immediately clear upon a first reading of the identified characteristics is that they are broadly and normatively stated. This reflects the absence of concrete proposals within the existing literature on how the nexus can be applied to existing governing frameworks. Instead, the literature presents an almost idealized perspective in which the WEF Nexus is utilized as a means of constructing a ‘best case’ alternative to existing siloed governance structures, absent of practical proposals for ‘real-world’ implementation. However, this is not in and of itself problematic.

Instead, theorizing an ideal application of a WEF Nexus approach to WEF resource governance is a necessary initial process of academic and scientific creativity that becomes problematic only when it continues in such a vein *ad infinitum*. This initial process is particularly important where an alternative to the prevailing status quo is being sought, requiring innovative thinking theorizing the ideal governance structure. However, there must reach a point in which this innovatory theory is consolidated and translated into more realistic and practically applicable terms. Given that a decade has passed since the WEF Nexus conference in Bonn and the subsequent sharp uptake in focused research on the topic, the time for more practical translations of the Nexus has come.

This notwithstanding, given that the Nexus requires a jurisdictionally specific and tailored approach, the translation from theory to practice cannot necessarily be a singular endeavor with subsequent universal application. Instead, what is required is the consolidation of the characteristics of a nexused governance framework to serve as a guideline for the class of features required within the regulatory framework in order to operationalize the Nexus. Thereafter, research focused on a specific jurisdiction is necessary to determine more precisely what mechanisms are required in practice taking into account the regulatory and political landscape as well as the prevailing socio-economic realities shaping the extent to which certain mechanisms are realistically implementable.

Therefore, although the normatively framed characteristics require translation to practically implementable mechanisms, such a translation must be tailored to the context

in which the Nexus is being applied. This jurisdictional specificity required may also contribute an explanation as to why characteristics within the literature have, until now, remained broadly and normatively stated.

Beyond the normativity of the characteristics identified, it is also interesting to observe that the listed characteristics do not raise any entirely new ideas within the realm of governance research. In fact, strong similarities can be drawn with the characteristics of adaptive governance [9, 10], risk governance [21], good governance [17], and reflexive governance [20]. However, the existence of parallels does not necessitate the conclusion that the WEF Nexus approach to governance is not sufficiently novel to warrant consideration, nor that it is simply a reproduction of existing approaches wrapped in new terminology. Instead, such similarities represent a wider consensus within the Social Sciences on what is required within a governance framework in order to promote resilient and/or sustainable management of resources.

The Nexus approach, though sharing many characteristics of alternative governance approaches, is distinguishable by its foregrounding of the interlinkages existing between WEF sectors and the need for the regulatory framework to not only account for but also reflect such interlinkages. This results in priority given to *coordination, cooperation and information sharing across WEF sectors* as core characteristics of the requisite governance framework.

Furthermore, the characteristics identified are to a large extent complementary. If read together they promote, as a best-case scenario, *a framework that prioritizes strong horizontal coordination between departments such that sectoral goals and incentives are aligned across departments and decision making is collaborative with open channels for information sharing across sectors and scales*. Importantly, a reading of these characteristics in this way does not necessarily imply a call for greater degree of *integration*. Instead, what is required is mechanisms *promoting inter-sectoral collaboration, coordination and cohesion*, the precise degree of which should be determined by the existing institutional and regulatory landscape of a particular jurisdiction.

By way of example, achieving a high level of coordination may be impractical in a Sub-Saharan African context where institutional capacity is limited, but a more realistic endeavor in a more developed western-European context. Thus, the degree of coordination encouraged by the nexused governance approach should be viewed as a sliding scale, the precise positioning on the scale between higher or lower levels of coordination being dependent on the jurisdictional and institutional realities of the region of application.

This systematic literature review has thus provided a first step towards formulating the common characteristics of a nexused regulatory framework. Additionally, the results and discussion thereof serve as a basis for which this research may move forward in mapping the existing law governing the WEF sectors.

As has been emphasized in the discussion herein, translation from theory to practice requires a jurisdictionally specific and tailored approach. It is for this reason that I have not at this stage proposed definitive mechanisms that may promote a nexused governance framework in a general sense. Instead, using the characteristics identified in this review as a *guideline*, the existing regulatory system of a particular jurisdiction can be analyzed to determine to what extent and in what way these characteristics are already reflected



within the jurisdiction, the converse of which gives insight into the aspects of that existing regulatory framework that may present barriers to achieving nexused governance of WEF sectors.

#### **4.2 A Methodology for Mapping the Potential for Existing Regulatory Frameworks to Promote the WEF Nexus Approach to Resource Governance**

**Methodological Design.** The difficulty in mapping the legal framework shaping the governance of WEF resources is the sheer volume of legal instruments that may fall within the scope of the review. The extent of the review will thus hinge on the capacity of a research project. As a minimum, however, the core or steering legislation within each WEF sector respectively should be analyzed.

As a general guideline, legislation and policy designating technical requirements, for example technical standards for water storage or food safety and labeling requirements, need not be included within the review. Priority should be given to legal instruments regulating the WEF sectors with potential to promote cross-sectoral coordination, namely instruments regulating decision-making within WEF sectors; WEF service delivery and end-use of the resource(s); and infrastructure planning and management of WEF resources. This is not to say that technical standards do not represent an area of law with the potential to promote coordination, but rather that given the breadth of legislation applicable to WEF sectoral regulation, certain scoping decisions may be necessary and technical specifications represents a class of legislation reasonably excludable.

Additionally, an analysis of sectoral legislation should be conducted against the backdrop of applicable overarching legislative frameworks, such as within the branches of administrative and constitutional law, which shape the exercise of public power. Other overarching areas of law that may be applicable include regulatory instruments providing for environmental conservation and/or environmental management, disaster management, and land use planning laws.

Once the legislation of the analyzed jurisdiction is selected, each document should be reviewed, identifying legal mechanisms that either reflect or have the effect of promoting one or more of the characteristics identified herein. In this way, the identified characteristics help to guide the researcher in recognizing untapped potential within the law to promote a nexused approach to WEF governance.

This methodology is applied to map the overarching administrative law applicable to the regulation of public powers in the South African legal context as a mini-case study analysis to illustrate how the identified characteristics may be useful in informing an enquiry into the extent to which existing legal frameworks facilitate the operationalization of the WEF Nexus. Indeed, the wider the legislative review, the more reflective the findings of the potential barriers and untapped capacities within the existing legal system. As such this mini-case study serves only to illustrate the application of this methodology and the of the characteristics identified within the above literature review.

**South African Administrative Law as a Case Study.** I begin by selecting the applicable regulatory instrument to include within the review. The regulatory instrument's selection is then motivated, followed by a brief summary of the most important provisions

identified within, given that such provisions reflect one or more of the characteristics identified as promoting a WEF Nexus approach to resource governance.

Since South Africa is a constitutional democracy, the most important legislative instrument is the Constitution of South Africa [22] and is thus a clear starting point for the review. The Constitution establishes the overall framework for the exercise of public power, the most important sections in this regard being Sections 33 and 195. Section 33 establishes a right to just administrative action that is 'lawful, reasonable and procedurally fair' (Section 33(1)), and obligates government to enact legislation giving effect to this right (Section 33(3)). Section 195 sets out the basic values and principles governing public administration which includes requirements for the public administration to promote the '[e]fficient, economic and effective use of resources' (Section 195(1)(b)); the impartial, fair, equitable and unbiased provision of services (Section 195(1)(d)); and the participation of the public in policy-making (Section 195(1)(e)). Any legislation enacted that regulates public administration must, per Section 195(3), promote these principles and values.

The law giving effect to the Section 33 right, and that complies with the Section 195 principles and values, is the Promotion of Administrative Justice Act [24] ('PAJA'). Given that the Constitution requires its enactment, PAJA is clearly required within the legislative review.

PAJA is a law of general application. This means that it applies to and binds the entire government administration across all spheres (national, provincial and local), and further that it does not grant powers to administrators but instead provides *how* the powers given to administrators *by other laws* must be exercised. PAJA sets out in detail what steps must be taken by public officials for administrative action to be considered lawful, reasonable and procedurally fair (Sections 3 and 4). The Act further empowers individuals to take a public decision/action on review in court (Sections 6 and 7), and/or to request reasons for the public decision/action (Section 5).

Furthermore, for administrative action affecting the public to meet the threshold of procedural fairness, PAJA requires the public official hold a public enquiry and/or a notice and comment procedure thereby entrenching participatory process into the public decision-making procedure. This applies regardless of whether the applicable sectoral legislation requires participatory process or not. Procedural fairness is thus concerned with participation in decisions that affect an individual's rights and/or legitimate expectations [8].

The final legislative instruments selected for review were the Intergovernmental Relations Framework Act [23] ('IRF Act'), Intergovernmental Fiscal Relations Act [24] ('IFR Act'), and The Local Government: Municipal Systems Act [26] ('MS Act'). This trio of legislation was selected given that it collectively regulates and co-ordinates the relations across the three scales of government and promotes a system of cooperative government. The promotion of co-ordination across scales is directly relevant given that WEF sectors are differently organized across all levels of government. Co-ordination is promoted within this legislation through-

- mandated consultation across spheres and organs of government when conducting affairs and/or drafting and implementing legislation and policy (for example Sections 5(b), 5(e), and 36 of the IRF Act);
- established intergovernmental consultative forums or bodies (for example Sections 6 and 16 of the IRF Act, and Sections 2, 3 and 5 of the IFR Act), and the correlating legal obligation to actively participate in these intergovernmental structures (Section 5(f)(i) IRF Act);
- the legal obligation for co-ordination across government scales and departments when implementing legislation and/or policy (Section 5(c) IRF Act) in order to promote coherence in governance across spheres (Section 4(a) IRF Act);
- the legal obligation to cooperate with information sharing requests across government scales (Sections 5(e)(i) and (ii) IRF Act);
- the empowerment of organs of state to enter into an implementation protocol that defines ‘the roles and responsibilities of each organ of state in implementing policy, exercising the statutory power, performing the statutory function or providing the service’ (Sections 35 IRF Act); and
- the requirement that planning undertaken by a municipality be aligned with and complement ‘the development plans and strategies of other affected municipalities and other organs of state’ (Section 24(1) of the MS Act).

An important finding is thus made: the administrative law shaping the governance of WEF sectors in South Africa reflects a number of the nexus characteristics and the existing legal mechanisms hold potential to promote a coordinated governance approach. However, this coordinated approach is more strongly applied across scales than across sectors. Sectoral legislation thus needs to be examined to determine if sectoral coordination is promoted therein. Importantly, despite an presence of mechanisms actively promoting intersectoral coordination, no significant legal barriers were found in the administrative law framework that prevent this from being pursued. This represents an area of potential for future legal development. A more detailed discussion of this potential, however, must be deferred to a later extensive review, following the completion of the analysis of the sectoral legislation and policy.

## 5 Conclusion

The above analysis has clearly demonstrated an absence of legal considerations within prevailing WEF Nexus literature. Given that WEF governance is embedded within extensive regulatory frameworks, legal considerations within WEF Nexus discourse are necessary to enable its operationalization as an approach to resource governance. A first step in this regard is to acknowledge what characteristics require reflection within prevailing regulatory frameworks in order to promote a nexused approach to WEF governance. Having identified 20 characteristics within prevailing literature, it is important to map the regulatory regime shaping the governance of WEF resources in a particular jurisdiction to determine the extent to which such characteristics are already reflected. This in turn generates insight into what aspects of the prevailing legal system hold potential to promote a coordinated governance approach, and what aspects may present barriers to

implementing such an approach and thus require targeted legal reform. In this way, this paper has taken a first step towards developing a shared understanding of how the WEF Nexus can be operationalized through the law.

### Appendix: Articles included in systematic review (n = 39)

	<u>AUTHOR(S)</u>	<u>TITLE</u>	<u>YEAR</u>	<u>CITATION</u> 01/10/2021	Field of study
1	Allouche, J; Middleton, C; Gyawali, D	Technical Veil, Hidden Politics: Interrogating the Power Linkages behind the Nexus	2015	196	Political Science
2	Artioli, F; Acuto, M; Mcarthur, J	The water-energy-food nexus: An integration agenda and implications for urban governance	2017	89	Political Science
3	Bhaduri, A. and Others	Sustainability in the water-energy-food nexus	2015	97	Governance
4	Bréthaut, C.; Gallagher, L.; Dalton, J.; Allouche, J	Power dynamics and integration in the water-energy-food nexus: Learning lessons for transdisciplinary research in Cambodia	2019	26	Interdisciplinary
5	Cairns, R.; Krzywoszyńska, A	Anatomy of a buzzword: the emergence of 'the water-energy-food nexus' in UK natural resource debates	2016	217	Governance
6	Daher, B. and Others	Towards bridging the water gap in Texas: A water-energy-food nexus approach	2019	39	Governance
7	de Andrade, G. and Others	A literature-based study on the water-energy-food nexus for sustainable development	2021	20	Sustainability Studies

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	<u>AUTHOR(S)</u>	<u>TITLE</u>	<u>YEAR</u>	<u>CITATION</u> <u>01/10/2021</u>	Field of study
8	Foran, Tira	Node and Regime: Interdisciplinary Analysis of Water-Energy-Food Nexus in the Mekong Region	2015	110	Critical social sciences
9	Howarth, C.; Monasterolo, I	Opportunities for knowledge co-production across the energy-food-water nexus: Making interdisciplinary approaches work for better climate decision making	2017	84	Interdisciplinary
10	Howarth, C.; Monasterolo, I	Understanding barriers to decision making in the UK energy-food-water nexus: The added value of interdisciplinary approaches	2016	141	Governance
11	Kaddoura, S; El Khatib, S	Review of water-energy-food Nexus tools to improve the Nexus modelling approach for integrated policy making	2017	109	Uncategorized
12	Keskinen, M. and Others	The Water-Energy-Food Nexus and the Transboundary Context: Insights from Large Asian Rivers	2016	100	Political Science

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	<u>AUTHOR(S)</u>	<u>TITLE</u>	<u>YEAR</u>	<u>CITATION</u> <u>01/10/2021</u>	Field of study
13	Kurian, M	The water-energy-food nexus: trade-offs, thresholds and transdisciplinary approaches to sustainable development	2017	206	Governance
14	Kurian, M. and Others	One swallow does not make a summer: Siloes, trade-offs and synergies in the water-energy-food nexus	2019	26	Environmental Science
15	Larcom, S; van Gevelt, T	Regulating the water-energy-food nexus: Interdependencies, transaction costs and procedural justice	2017	37	Law
16	Leck, H; Conway, D; Bradshaw, M; Rees, J	Tracing the Water-Energy-Food Nexus: Description, Theory and Practice	2015	333	Environmental Science
17	Leese, M; Meisch, S	Securitising Sustainability? Questioning the 'Water, Energy and Food-Security Nexus'	2015	133	Political Science
18	Liu, J. and Others	Nexus approaches to global sustainable development	2018	254	Sustainability Studies
19	Mercure, J.F. and Others	System complexity and policy integration challenges: the Brazilian Energy-Water-Food Nexus	2019	79	Interdisciplinary

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	<u>AUTHOR(S)</u>	<u>TITLE</u>	<u>YEAR</u>	<u>CITATION</u> <u>01/10/2021</u>	Field of study
20	Middleton, C; Allouche, J; Gyawali, D; Allen, S	The Rise and Implications of the Water-Energy-Food Nexus in Southeast Asia through an Environmental Justice Lens	2015	101	Environmental Sciences
21	Mohtar, R.H.; Daher, B	Water-Energy-Food Nexus Framework for facilitating multi-stakeholder dialogue	2016	84	Transdisciplinary
22	Newell, Joshua P.; Goldstein, B.; Foster, A	A 40-year review of food-energy-water nexus literature and its application to the urban scale	2019	57	Governance
23	Nhamo, L. and Others	The Water-Energy-Food Nexus: Climate Risks and Opportunities in Southern Africa	2018	89	Environmental Science
24	Olawuyi, D	Sustainable development and the water-energy-food nexus: Legal challenges and emerging solutions	2020	20	Law
25	Pahl-Wostl, C	Governance of the water-energy-food security nexus: A multi-level coordination challenge	2019	179	Environmental Science
26	Pardoe, J. and Others	Climate Policy Climate change and the water-energy-food nexus: insights from policy and practice in Tanzania	2018	71	Governance

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	<u>AUTHOR(S)</u>	<u>TITLE</u>	<u>YEAR</u>	<u>CITATION</u> <u>01/10/2021</u>	Field of study
27	Rasul, G	Managing the food, water, and energy nexus for achieving the Sustainable Development Goals in South Asia	2016	298	Environmental Science
28	Rasul, G.; Sharma, B	The nexus approach to water-energy-food security: an option for adaptation to climate change	2016	387	Governance
29	Salmoral, G. and Others	Water diplomacy and nexus governance in a transboundary context: In the search for complementarities	2019	19	Governance
30	Scott, C.A.; Kurian, M.; Wescoat, J.L	The Water-Energy-Food Nexus: Enhancing Adaptive Capacity to Complex Global Challenges	2015	180	Governance
31	Sharmina, M. and Others	A nexus perspective on competing land demands: Wider lessons from a UK policy case study	2016	57	Environmental Science
32	Smidt, S. J. and Others	Complex water management in modern agriculture: Trends in the water-energy-food nexus over the High Plains Aquifer	2016	89	Environmental Science
33	van Gevelt, T	The water-energy-food nexus: bridging the science-policy divide	2020	24	Political Science

*(continued)*



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	<u>AUTHOR(S)</u>	<u>TITLE</u>	<u>YEAR</u>	<u>CITATION</u> <u>01/10/2021</u>	Field of study
34	Venghaus, S; Hake, J.F	Nexus thinking in current EU policies – The interdependencies among food, energy and water resources	2018	56	Environmental Science
35	Weitz, N.; Strambo, C.; Kemp-Benedict, E; Nilsson, M	Closing the governance gaps in the water-energy-food nexus: Insights from integrative governance	2017	210	Governance
36	White, D.D. and Others	Stakeholder Analysis for the Food-Energy-Water Nexus in Phoenix, Arizona: Implications for Nexus Governance	2017	53	Governance
37	Wichelns, D	The water-energy-food nexus: Is the increasing attention warranted, from either a research or policy perspective?	2017	197	Environmental Science
38	Yung, L. and Others	How methods for navigating uncertainty connect science and policy at the water-energy-food nexus	2019	23	Environmental Science
39	Zhang, P. and Others	Food-energy-water (FEW) nexus for urban sustainability: A comprehensive review	2019	115	Environmental Science

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## **Legislation**

22. Constitution of the Republic of South Africa
23. Intergovernmental Relations Framework Act 13 of 2005
24. Intergovernmental Fiscal Relations Act 97 of 1997
25. Promotion of Administrative Justice Act 3 of 2000
26. The Local Government: Municipal Systems Act 32 of 2000