

STE Preprint

20/2017

Märker, Carolin, Venghaus, Sandra, Hake, Jürgen-Friedrich

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Institut für Energie- und Klimaforschung
Systemforschung und Technologische Entwicklung (IEK-STE)

Integrated governance for the food-energy and water nexus – an application of the Management and Transition Framework

Carolin Märker¹⁾, Sandra Venghaus¹⁾, Jürgen-Friedrich Hake¹⁾

1) Forschungszentrum Jülich, Institute of Energy and Climate Research - Systems Analysis and Technology Evaluation (IEK-STE), D-52425 Jülich, Germany

Executive Summary

Despite a major, policy-driven increase in research on the food-energy-water-(FEW-) nexus in recent years, research addressing the required change in policy structures and processes necessary for an effective, integrated governance of the FEW-nexus resources is still in its infancy. This paper adapts the Management and Transition Framework (MTF) to the requirements and challenges of FEW-nexus governance and sets a special focus on action situations, actors and institutions. Two different conceptual FEW-nexus frameworks are developed, which span the spectrum of possible integration options. The first one can be seen as a maximal integration framework that defines the FEW-nexus as a single system consisting of three sub-systems. The second one largely rests on existing structures and a reframing of the present institutional setting. The two hypothetical frameworks are analyzed with respect to their strengths and weaknesses in governing the FEW-nexus. The analysis thus contributes to the debate about the practicality and benefits of a comprehensive FEW-nexus policy approach.

Keywords

Policy integration, integrated governance, food-energy-water-nexus, institutions, nexus governance

Contribution to 12th Dubrovnik Conference

I Introduction

Factors like population growth, urbanization and the impacts of climate change put major pressures on our planet's natural resources, especially on water, food and energy carriers. Nevertheless, the poor access to these resources is often more a governance problem than a problem of availability [Pahl-Wostl, 2009] and can occur because of reasons like corruption, over-regulation or sectoral fragmentation [Knieper et al., 2010]. The adoption of the Sustainable Development Goals (SDGs) by the United Nations or the prominent concept of 'Green Economy' are results of an ongoing debate in science and policy to deal with global changes and address resource scarcities within planetary boundaries. The emergence of the food-energy-water (FEW-) nexus can also be seen as an outcome of this debate [Al-Saidi & Elagib, 2016]. Its main goal is thus to manage the three resources in an integrated manner. The FEW-nexus doesn't set its focus on the sectors themselves but on the interlinkages between them in order to create or benefit from synergies and to avoid trade-offs [Stein et al., 2014]. Therefore, the nexus approach could provide a more coordinated and structured way of integrating food, energy and water concerns [Gain et al., 2015]. Nevertheless, originally influenced by sector driven concepts such as Integrated Water Resources Management (IWRM) the nexus approach is still mostly water-centered and has not yet found its way into concepts of food or energy policy [Al-Saidi & Elagib, 2016].

In recent years there has been a major, policy-driven increase in research on the FEW-nexus. To date, however, little research has sufficiently addressed required changes in policy structures and processes necessary for an effective, integrated governance of the nexus resources [Al-Saidi & Elagib, 2016]. Even if the nexus approach gained international recognition by now the three sectors of water, energy and food are still mostly managed separately in 'silos' [Al-Saidi & Elagib, 2016] what often leads to trade-offs and isolated policies neglecting the overall goal of sustainability [Bhaduri et al., 2015]. To successfully reach FEW-nexus governance adaptive solutions and practical implications are necessary [Stein et al., 2014]. So far, suitable institutional arrangements haven't been developed [Al-Saidi & Elagib, 2016]. As Al-Saidi and Elagib [2016] point out: "Nexus governance is the missing link in the nexus debate." The main research questions of this paper are thus: How could an integrated FEW-nexus governance framework be developed? And how could policy integration within the FEW-nexus approach look like?

To answer these questions the Management and Transition Framework (MTF) is applied. Originally developed for the analysis of water systems, the MTF depicts how complex resource government systems work and change over time. What makes the MTF of special interest for the research questions mentioned above is that it includes the ecological as well as the social system by focusing on the role of actors, actor networks and institutions. Since the FEW-nexus consists of three of such resource systems the MTF needs to be expanded by the energy and food sector.

Actually, the idea of the nexus approach isn't new. Some of the interlinkages between the three systems are well-known for a long time. What's new about the nexus is the focus on these interconnections and the fact that all three systems are treated equally [Al-Saidi & Elagib, 2016]. So, to come up with a FEW-nexus governance framework it is important to analyze which actors, actor networks and institutions need to be addressed by such a framework. One promising way of identifying relevant actors and institutions is by analyzing past decisions and development trajectories that determined the current state of the system. The MTF uses this approach and provides an assessment of the current state of the water system against the background of its historical development. Only by understanding the historical context as well as current conditions of a resource system suitable future solutions can be developed. By applying the MTF to the FEW-nexus it can be analyzed if, what and how interlinkages were considered in the past, what actors and institutions are crucial to the FEW-nexus and what needs to be changed to reach an effective FEW-nexus governance. Therefore, the paper applies and expands the MTF to the challenges of the FEW-nexus and shows how a novel FEW-nexus framework could look like.

At first the MTF and its key features are introduced. Afterwards the MTF is applied to the FEW-nexus and major related problems and challenges are highlighted. Then, two different FEW-nexus frameworks are developed which span the spectrum of possible integration options. In the following discussion the two frameworks are compared and analyzed regarding their practicability.

II Management and Transition Framework

The Management and Transition Framework (MTF) was developed to depict and analyze complex resource governance systems, namely water systems [Pahl-Wostl et al., 2008]. According to Pahl-Wostl et al. [2010] it "is an interdisciplinary conceptual and methodological framework that supports the understanding of water systems and management regimes and transition processes towards more adaptive management." Within the MTF the three approaches of adaptive management, social learning and action situations were combined. Whereas adaptive management and social learning processes are considered as key elements for institutional change [Pahl-Wostl, 2009] action situations were included to stress the role of actors and institutions [Pahl-Wostl et al., 2010]. These three approaches will be explained in the next sections.

The MTF works by identifying decisive action situations and thus provides an evolutionary understanding of societal and systemic change in order to identify drivers of and barriers to change. Using the trajectory concept to analyze social processes and reveal social behavior [Riemann & Schütze, 1991], the MTF presents past transformative systems and processes. An action situation can be defined as a structured context of social interaction that produces a specific outcome in form of an operational outcome, increased knowledge or a new institution [Knieper et al., 2010]. A special feature about the MTF is that it captures formal policy as well as

informal learning processes [Pahl-Wostl et al., 2010]. Action situations can thus be assigned either to be part of the formal policy or the informal learning process [Pahl-Wostl et al., 2013].

In order to start with the MTF-analysis all relevant elements of the water system that need to be included were defined as well as their relations to each other. To visualize the water system a so-called class-diagram was created (Figure 1) [Pahl-Wostl et al., 2010] that depicts all these elements as interrelated classes. These classes are defined by a number of specific attributes. The diagram presents a holistic view on the water system including classes containing the societal system as well as the ecological system. Nevertheless, particular attention is spent on the interplay between actors and institutions within action situations [Knieper et al., 2010]. For this reason the class containing the action situation is positioned in the center of the diagram whereas all other classes are placed around it [Knieper et al., 2010]. The class diagram was created using UML [Pahl-Wostl et al., 2008]. All relevant data regarding the case studies as well as related information about the societal and environmental settings were saved in a comprehensive 'Total System Database' (TSD) using Windows Access. A MTF-analysis helps to get a better understanding of how governance in complex resource systems works and it provides a structured and standardized analysis enabling comparative case studies [Knieper et al., 2010]. Hence, the MTF also offers a valuable conceptual approach analyzing the FEW-nexus resource systems.

Figure 1: MTF class diagram

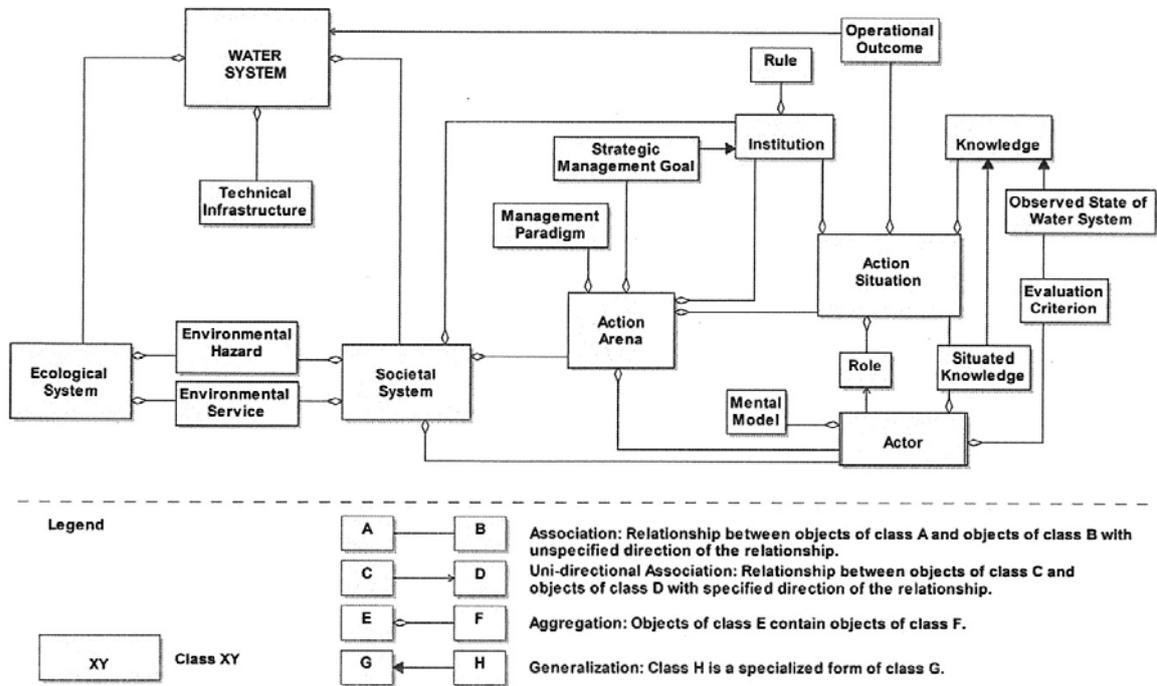


Fig. 1 – MTF class diagram. Attributes of the classes are not shown to simplify the representation. Regarding links an arrow denotes a generalization ('is a' link – e.g. observed state of water system is a kind of knowledge), an open diamond denotes an aggregation ('has a' link – e.g. an actor has a mental model) and a simple line denotes an association without specific kind.

Source: [Pahl-Wostl et al., 2010]

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II. 1 Adaptive management

The aforementioned current 'silo-thinking' often resulted from historically evolved responsibilities of ministries, organizations and administration. While, in fact, ensuring the system's performance on the one hand they can also generate inefficient results on the other [Pahl-Wostl et al., 2013]. Since the transaction costs resulting from institutional change can be really high, institutions and processes tend to develop along a certain path. This is often expressed in a certain inertia regarding the adaptation to changing environmental, political and economic contexts [Pahl-Wostl, 2009]. Therefore, the historical context and conditions of emergence need to be taken into account when analyzing institutions and potentials of change [Gagliardi, 2008]. Regarding this path dependency uncertainties within the management of the FEW-nexus resources are a major problem for political systems [Acheson, 2006]. Such uncertainties can be natural disasters like droughts or floods as well as military or distributional disruptions. But not only external events hold risks, also the complex interconnections within the FEW-nexus system among various actors, actor networks and decision outcomes are unpredictable. Surprising events and collapse thus need to be taken into account; especially

increasing impacts of climate change can contradict management paradigms developed under the assumption of stability and constancy [Dyball et al., 2005].

To deal with this kind of uncertainties political systems need to have the ability to adaptive management [Pahl-Wostl et al., 2010]. “Adaptive management is here defined as a systematic process for improving management policies and practices by systemic learning from the outcomes of implemented management strategies and by taking into account changes in external factors in a pro-active manner.” [Pahl-Wostl et al., 2010] Especially regarding the FEW-nexus governance system that crosses the line between ecological and socio-economic systems high levels of adaptive management are necessary [Bleischwitz et al., 2014]. This approach tries to keep the process open to deal with unpredictable events and stresses the contextual and time dependence of recent predictions of future developments [Kuklicke & Demeritt, 2016]. Adaptive systems thus require resilient institutions which have the ability to deal with these uncertainties [Bleischwitz et al., 2014].

II. 2 Social learning processes

To reach a higher level of adaptive management changes in the institutional setting and the processes of policy making are critical. Within the MTF institutional change is defined as social learning processes [Pahl-Wostl et al., 2010] that “refer to capacity of all stakeholders to deal with different interests and points of view and to collectively manage resources in a sustainable way.” [Pahl-Wostl et al., 2008] The MTF sets its main focus on the outcomes of these processes and how they can pave the way towards sustainable development [Siebenhüner et al., 2016]. To analyze these processes relevant actors need to be identified and the system’s boundaries need to be set [Dyball et al., 2005]. The probability of social learning highly depends on the quality of the particular system. For example, it is assumed that factors like centralization, inflexible bureaucracy or unavailable public information are barriers to social learning [Pahl-Wostl, 2009].

The MTF captures different levels of learning that “are addressed in the concept of triple-loop learning.” [Pahl-Wostl et al., 2010] Whereas single-loop learning is defined by an advancement of established processes without reassessing policies in place, double-loop learning requires a reframing of leading principles behind these processes. In processes of triple-loop learning, however, basic structures are changed as well as values and norms can be transformed. This kind of learning leads to changes in actors and actor groups involved, in balances of power as well as in political structures. The three stages of single-, double- and triple-loop learning often occur in an iterative manner [Pahl-Wostl, 2009].

Hence, to achieve structural change towards more adaptive management and integrated governance within the FEW-nexus higher levels of learning, e.g. double- and triple-loop learning, are necessary. It is assumed that these levels of learning can only be reached by the involvement of informal processes that need to be entangled to the formal policy process, especially in the beginning phase of developing change processes [Pahl-Wostl, 2009]. Also

regarding the FEW-nexus resource systems informal and non-state actors play a crucial role [Hoff, 2011]. Informal processes offer platforms for pilot projects and experiments that can influence current patterns of behavior and policy paradigms. Formal processes, however, are needed to implement the outcomes of learning and to reach widely accepted policy decisions [Pahl-Wostl et al., 2013].

II. 3 Action situations

The notion of action situations was developed by Elinor Ostrom and can be seen as the central part of her Institutional and Analysis and Development Framework (IAD). Originally, the IAD is used to analyze “the role of institutions in collective choice processes.” [Pahl-Wostl et al., 2010] Therefore, decisive action situations are identified [Ostrom, 2011]. The concept of action situations was included in the MTF to stress the meaning of institutions and actors in complex governance systems and to provide a *modus operandi* [Pahl-Wostl et al., 2008]. Within the MTF the main focus isn't set on the activities within an action situation itself but on its outcome and how it affects other action situations. Like this action situations can be linked by their outcomes [McGinnis, 2011]. The MTF thus depicts processes “as sequences or networks of action situations” [Pahl-Wostl et al., 2010] that can show the temporal development of a specific water system [Pahl-Wostl et al., 2013].

Possible outcomes of action situations which are captured by the MTF are knowledge, operational outcomes or institutions [Pahl-Wostl et al., 2013], whereas the latter gains special attention within the framework. Using the definition by North, institutions are defined as “humanly devised constraints that structure political, economic and social interaction. They consist of both informal constraints, and formal rules. Throughout history, institutions have been devised by human beings to create order and reduce uncertainty in exchange.” [North, 1991] Institutions are thus needed to organize human behavior in a structured way and to stabilize the societal system. However, currently this doesn't always happen in the most efficient or sustainable way [Gagliardi, 2008].

The decision on what can be described as an action situation and what level of aggregation is best suited highly depends on the specific FEW-nexus case study [Pahl-Wostl et al., 2013]. Action situations themselves are embedded in action arenas that can be defined as “issue specific political arenas” [Pahl-Wostl et al., 2008] within a resource system. On the one hand they are influenced by the ‘management paradigm’ which describes preferred solutions and strategies. On the other hand they are characterized by the ‘strategic goal’ that reflects the defined future targets [Pahl-Wostl et al., 2010].

III Application of the MTF to the FEW-nexus

III. 1 Problems and challenges

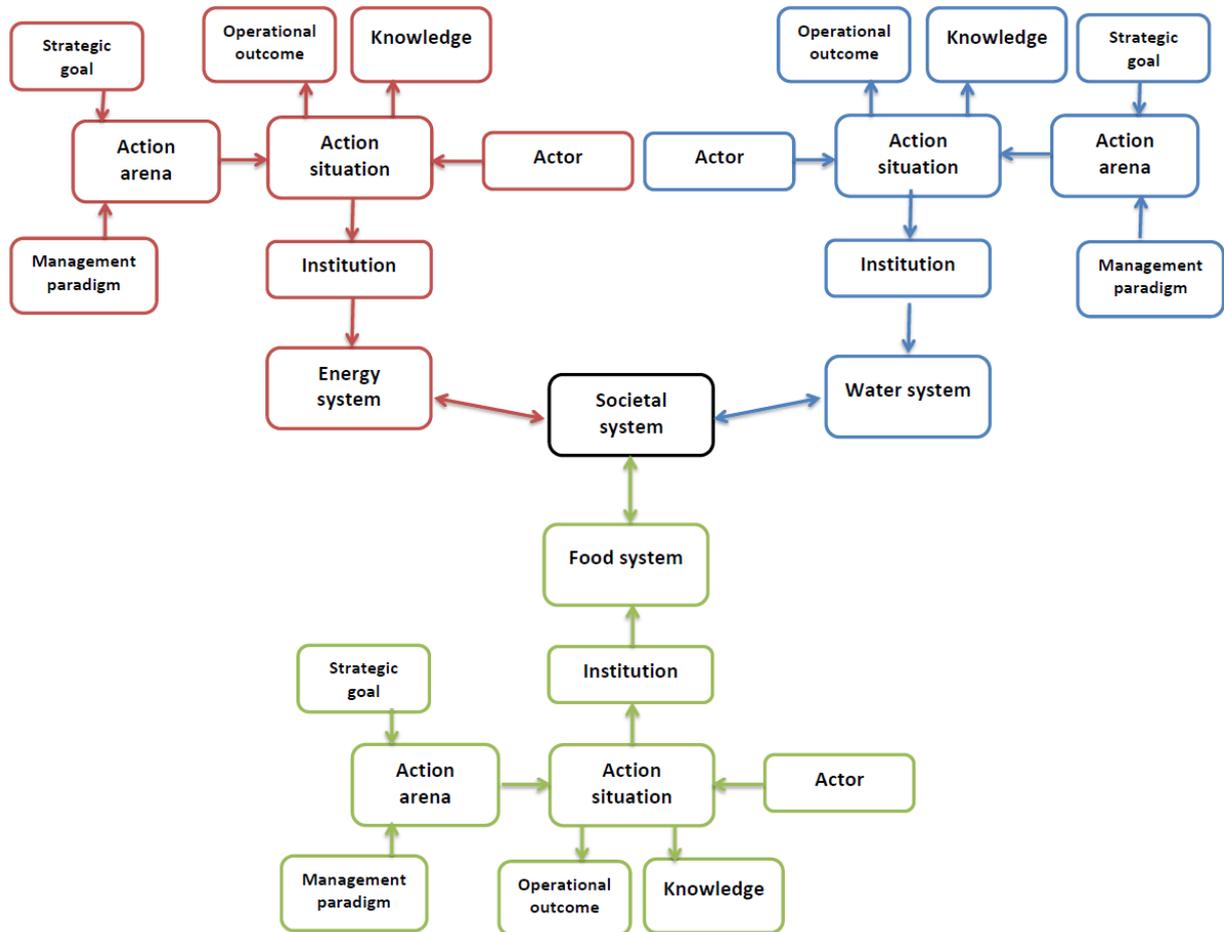
The FEW-nexus sets its main focus on the interconnections between the water, energy and food sectors and requires an integrated governance framework. But neither is there a common way of integrating these sectors nor is there a common definition of what integration actually means [Al-Saidi & Elagib, 2016]. As Stein et al. [2014] point out: “What should be integrated, by whom, for whom and how?” The recent nexus literature gives relatively few implications on how integration can be reached but gives many overlapping or opposing concepts instead [Benson et al., 2015]. Gain et al. [2015] therefore propose a minimal understanding of policy integration as comprehensiveness, aggregation and consistency. But what does this imply for the spatial dimension of integration, namely vertical or horizontal? Since the MTF originally was designed to analyze water systems like river basins, policy integration was mainly defined as vertical integration between the European, national and local level [Pahl-Wostl et al., 2010]. This means that each action situation happens within one of these spatial scales [Pahl-Wostl et al., 2013]. The actual integration process happens by interconnecting the outcomes of these action situations. Outcomes achieved at one spatial level can have a significant influence on an action situation operating at a different level. But not only outcomes also actors participating in more than one action situation can be a form of integration [Knieper et al., 2010]. The MTF thus provides a structured and comprehensive way of representing vertical policy integration. This is also of great importance for the FEW-nexus since many nexus related problems that occur at one specific spatial level, like locally or regionally, are influenced by national sector policies [Hoff, 2011].

But these sector policies point to the fact that within the FEW-nexus integration is not only necessary across different vertical scales but also across sectoral scales [Knieper et al., 2010]. By applying the MTF to the FEW-nexus an inclusion of two additional resource systems besides the water system becomes necessary what means adding the horizontal integration dimension as well. Therefore, interactions between formal and informal actors as well as institutions across administrative and sectoral levels need to be captured [Hoff, 2011]. Holistic FEW-nexus governance would thus consist of several interacting governance systems [Knieper et al., 2010]. This actually demands new forms of policy integration across various vertical and horizontal scales what could be described as ‘diagonal’ integration. Since the problems and challenges of the FEW-nexus are highly case specific, the biggest challenge will be to develop a structured governance framework that facilitates comparative analysis by staying open to case-specific conditions at the same time [Stein et al., 2014]. Nevertheless, an applied MTF can help to develop a nexus framework that not only accounts for vertical but also horizontal scales and that facilitates a structured historical analysis and a current assessment of a FEW-nexus system.

In a first step of our analysis we used the MTF class-diagram to develop a simplified diagram of the FEW-nexus under the assumption of the current criticism of ‘silo-thinking’ (Figure 2) in order

to bring the three sectors together in the simplest way. We thus represent a system that doesn't account for interlinkages between the sectors and therefore is assumed to lead to unintended results and unsustainable development pathways [Howells et al., 2013]. Since the main research focus is set on actors, action situations and institutions and to keep the diagram manageable in this stage of research, only the following classes of the original class-diagram were included: action situation, action arena, strategic goal, management paradigm, actor, operational outcome, knowledge, institution and water system. Because the FEW-nexus consists of three sectors, these classes were also used to represent the energy and food systems. A common societal system connects the three systems. In this first step the arrows only simplify one dimension of possible relations between the different classes. Since the classes concerning the ecological system would also need to be related to each of the three systems at the same time, they were excluded in this diagram in order to reduce complexity. These classes will be included again when the framework is applied and a case-study specific class-diagram will be created. Even this simplified diagram already shows the high level of complexity when dealing with the FEW-nexus.

Figure 2: FEW-nexus under the assumption of ‘silo-thinking’



Source: IEK-STE

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The question is now: How to integrate these sectors in order to reach FEW-nexus governance? Since the MTF focuses on identifying decisive action situations to analyze transformative change, the action situation, the action arena it is embedded in, as well as the actors engaged in it should be starting points of any integration within a FEW-nexus framework. The possibilities of institutional change highly depend on the actors' perceptions and mental models about the system and their specific role within it [Levänen & Hukkinen, 2013]. Furthermore, their behavior is embedded in an existing institutional setting that again influences their preferences and decisions [McGinnis, 2011]. That's why a nexus approach needs to set the actors in the center of any analysis [Rodriguez et al., 2015]. By focusing on the role of actors specific nexus problems perceived by those involved can be identified what facilitates developing solutions proper to the specific context [Stein et al., 2014]. To get an idea of how the three sectors could be integrated

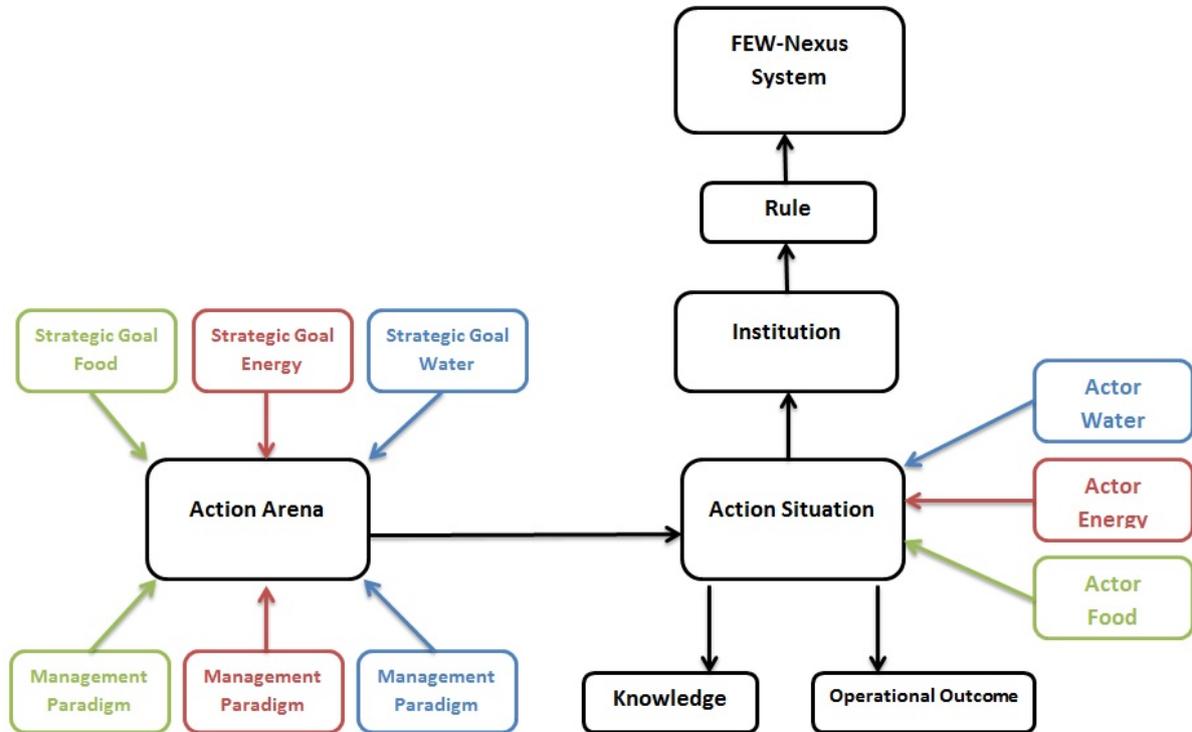
within the FEW-nexus two different hypothetical frameworks were developed showing different levels of policy integration.

III. 2 Holistic FEW-nexus framework

A maximum of policy integration within the FEW-nexus would be possible when leaving the structure of three separate governance systems behind and turning into one FEW-nexus system. To reach such a unified system all relevant actors from the three nexus sectors need to be gathered in one mutual action situation. This action situation is embedded in an action arena that comprises the management paradigms as well as the strategic goals of all the sectors. The idea behind this framework is that it would lead to fully integrated nexus outcomes. It offers a holistic view on the nexus sectors [Al-Saidi & Elagib, 2016] and captures a wide range of interconnections between them (Figure 3). Referring to the classification of policy integration by Al-Saidi and Elagib [2016] this framework could be described as incorporation. On the national level this kind of policy integration would lead to outcomes like national nexus strategies and plans or the inclusion of food, energy and water responsibilities within one department like a FEW-nexus ministry [Al-Saidi & Elagib, 2016]. Since resource flows don't stop at national borders but spread around the globe, a holistic, integrated nexus-framework could also be helpful at a global scale in order to analyze these flows and give implications for different countries to enhance their adaptive capacity [Bleischwitz et al., 2014].

Against the background of the current 'silo-thinking' and historically determined institutions, this kind of policy integration would often require a restructuring of the institutional setting [Allouche et al., 2015]. Due to the responsibilities of the three sectors divided among a wide range of ministries, organizations and institutional bodies such policy integration is hard to reach, especially on the national level [Howells et al., 2013]. Mostly ministries concerning energy, agriculture, economy and environment are engaged in this process, often with single sector-specific responsibilities [European Environment Agency, 2011]. To achieve an incorporated framework not only the biophysical, ecological, political and economic scales need to be integrated but also the different spatial and vertical scales [Madrid et al., 2013]. Even if such a holistic framework can be developed in theory it hasn't to be also well-suited for actual policy-making. Another problem could be the time frame of such an integrated framework. Common experience shows that policies don't change as fast as resource problems need to be solved [Howells et al., 2013]. For those reasons a second framework was developed that builds more on increasing cooperation than structural change.

Figure 3: Holistic FEW-nexus framework



Source: IEK-STE

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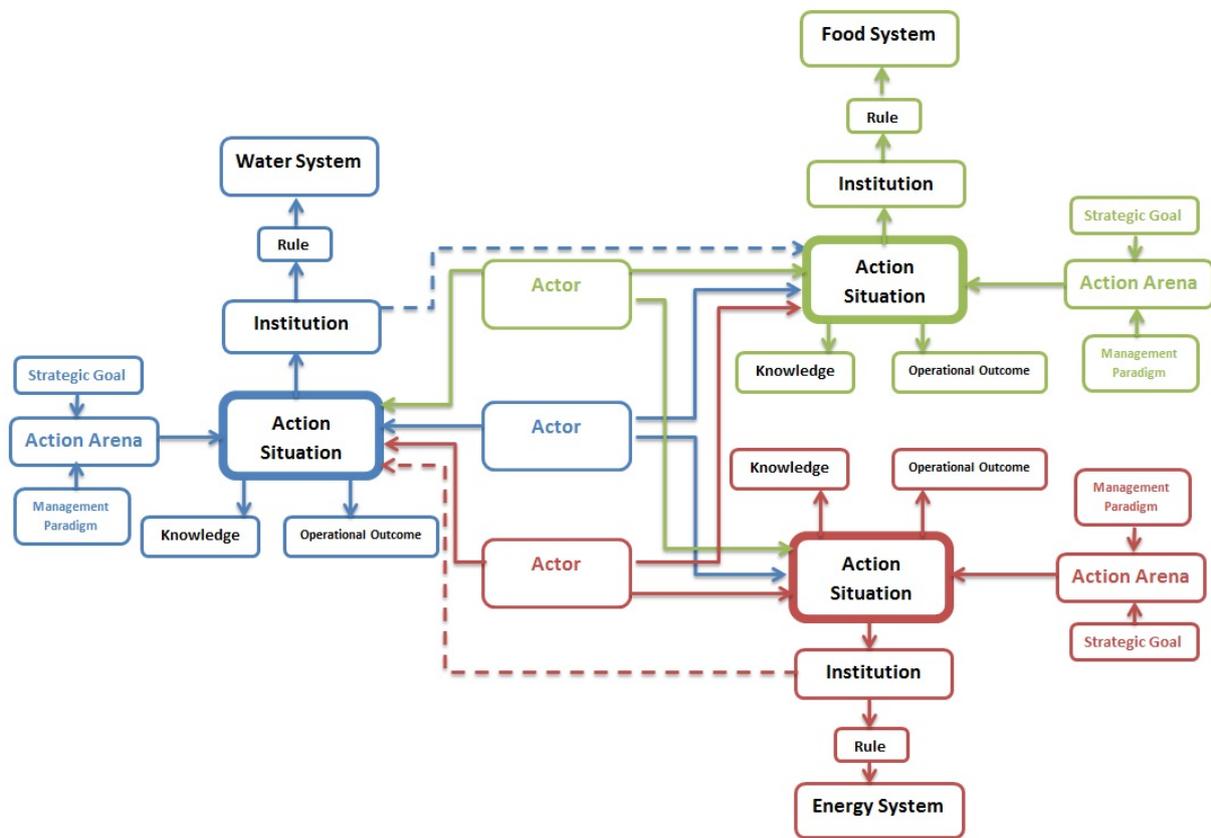
III. 3 FEW-nexus cooperation framework

Considering the problems mentioned above a higher level of policy coherence could already be a huge improvement [Rodriguez et al., 2015]. Regarding the complexity of three resource governance systems and the high number of participating actors, institutions and policies the nexus approach offers a wide range of possible enhancements and development opportunities even if a whole integrated nexus strategy wasn't developed so far [European Environment Agency, 2016]. As mentioned above most administrations and institutions are built around one specific sector. To gain a higher level of coherence cross-sectoral cooperation could start at the sector level [Bleischwitz et al., 2014]. The main idea behind this second FEW-nexus framework is to look through the lens of one sector while considering the interlinkages to the other two sectors [Al-Saidi & Elagib, 2016]. Improvement can thus be gained by using current knowledge as well as existing institutions instead of developing completely new ones. Like this, policies that are already in place could be enhanced, positive aspects could be highlighted and tradeoffs could be reduced [Stein et al., 2014]. This kind of policy integration thus sets its focus on cooperation and preservation of existing structures and institutions (Figure 4) [Bhaduri et al.,

2015]. Referring to Al-Saidi and Elagib [2016] it could be described as assimilation. According to Hoff [2011] it is “important to strengthen existing institutions so they can build new links across sectors and deal with the additional uncertainty, complexity and inertia when integrating a range of sectors and stakeholders. Strengthened institutions will also be able to better cope with the risks of marginalization and new disparities that are inherent to integrated approaches and collective action.”

In practice this would mean involving relevant actors from each of the three sectors into the decisions process within one sector. Like this, stakeholders together can identify trade-offs and synergies, place their ideas and agree on sector-specific solutions acceptable for everyone [Bhaduri et al., 2015]. But not only the actors’ perspectives need to be included in an action situation, also institutions concerning one sector can have an influence on action situations of the other sectors. One example for this can be seen in the current attempt to integrate the goals of the European Water Framework Directive into EU Common Agricultural Policy (CAP) [Europäischer Rechnungshof, 2014]. In the diagram this relation is represented exemplarily by dashed arrows. The outcome of this kind of policy integration could be nexus-smart sector policies [Al-Saidi & Elagib, 2016], e.g. a ‘water smart’ CAP [Europäischer Rechnungshof, 2014]. Sectoral policy-making can thus be seen as a precursor for cross-sectoral approaches [Beck & Villarroel Walker, 2013]. Instead of restructuring a governance system this kind of policy integration should first accompany and then replace sectoral approaches. Since institutional change often takes a long time while resource scarcities can further increase, assimilation could be a faster, more practical solution than incorporation. Current institutions could therefore be altered in order to be adaptable to those changes and to foster cross-sectoral cooperation [Hoff, 2011].

Figure 4: FEW-nexus cooperation framework



Source: IEK-STE

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IV Discussion

Starting with the representation of the current criticism of ‘silo-thinking’ the following developed FEW-nexus frameworks show two ways of how policy integration within the nexus could look like. The first framework depicts a whole FEW-nexus system treating all three sectors as sub-systems of equal importance. It uses a holistic nexus-perspective that in many cases would mean to restructure the current institutional setting and would require levels of triple-loop learning. Therefore, informal actors and institutions are of special importance for such a kind of policy integration. In practice, incorporation can rather be found on the national or supranational level in form of national strategies or plans [Al-Saidi & Elagib, 2016].

In comparison to the first framework the second one leaves the meta-perspective of a holistic system and aims at an increased level of policy coherence and cross-sectoral cooperation. It uses a ‘prism-view’ located at one sector but taking into account interlinkages to the other two sectors [Al-Saidi & Elagib, 2016]. This kind of policy integration would rather require levels of

double-loop learning since existing policies and institutions are preserved and altered or complemented by a nexus perspective. This would result in sector-policies that could be described as FEW-nexus smart. Table 1 again summarizes the main differences between both of the frameworks.

Table 1: Comparison between the holistic FEW-nexus framework and the FEW-nexus cooperation framework

	Aim	Outcomes	Levels of learning	Perspective
Holistic FEW-nexus framework	FEW-nexus system	National FEW-nexus strategies and plans, FEW-nexus ministry	Triple-loop learning	Holistic nexus-perspective
FEW-nexus cooperation framework	Increased policy coherence and cross-sectoral cooperation	FEW-nexus smart sector policies	Double-loop learning	Sector-perspective considering the other sectors

Source: IEK-STE

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In this paper policy integration could thus either be seen as creating a whole new governance system or as improving existing policies. The question is now: Which one is more promising to the actual goal of policy integration within a FEW-nexus perspective? According to Hoff [2011] strengthening existing institutions is assumed to be more promising in order to achieve sustainable development. Nevertheless, in some cases new institutions might need to be established [Hoff, 2011]. This means that the way of policy integration thus highly depends on the specific case study. Regarding different vertical scales, like locally, regionally or nationally, a certain tendency of appropriate integration designs can be recognized. Whereas at the local level case-specific solutions are needed that might rather be achieved through assimilation, at the national or supranational level holistic nexus strategies including long-term goals and binding targets are necessary to turn to sustainable future development pathways [Bhaduri et al., 2015].

To prove hypotheses like this case study analyses are needed. This paper shows that an MTF-based FEW-nexus framework can provide a promising way to do this because it captures policy integration across various spatial and sectoral scales and facilitates comparative analyses due to its structured but flexible possibilities of adaptation. Therefore, a case-specific class-diagram can be created [Pahl-Wostl et al., 2010] that builds on the conceptual frameworks developed in this paper. According to Al-Saidi and Elagib [2016] other integration paradigms like IWRM “failed

due to over-idealization as final remedies for integration.” The two FEW-nexus frameworks don’t aim at being a panacea to the general nexus-governance problem [Al-Saidi & Elagib, 2016] but they can help closing the existing research gap and transferring the FEW-nexus from a conceptual into a practical approach.

V Conclusion

This paper applies the MTF to the FEW-nexus in order to analyze how an integrated nexus framework could look like. It shows that the MTF, originally developed to analyze the water system, offers a valuable theoretical approach. The application to the FEW-nexus came along with various problems and challenges, first and foremost the high level of complexity arising from the expansion by two more sectors. It therefore requires new forms of integration across various spatial as well as sectoral scales. The two different nexus frameworks developed in this paper show different levels of integration. Whereas the first one describes a new holistic FEW-nexus system, the second one achieves policy integration by increasing cooperation among existing institutions and policies. The analysis has shown that the second type seems to be more promising regarding actual policy-making since the first type would often require a reframing of basic policy structures. Nevertheless, in some cases such structural changes are not only necessary but also achievable. Hence, the type of policy integration most suited is highly dependent on the specific case study. Therefore, both of the frameworks offer valuable approaches for future applications to case studies.

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Leitung/Head: Prof. Jürgen-Friedrich Hake

Forschungszentrum Jülich

Institute of Energy and Climate Research

IEK-STE: Systems Analysis and Technology Evaluation

52428 Jülich

Germany

Tel.: +49-2461-61-6363

Fax: +49-2461-61-2540,

Email: preprint-ste@fz-juelich.de

Web: www.fz-juelich.de/ste