MANAGING COMPLEXITY FOR SUSTAINABILITY. EXPERIENCE FROM GOVERNANCE OF WATER-FOOD-ENERGY NEXUS

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ABSTRACT

The 2030 Agenda and the Sustainable Development Goals have given strong impetus to the debate on the interdependencies between multiple sectors and have illuminated the practical need for greater cross-sectoral coordination and policy coherence to achieve sustainable development. A Nexus approach has been promoted by researchers and development agencies as a tool for policy makers to better understand and frame linkages between relevant sectors, with the ambition to align policies and integrate management across sectors and scales in support to both resource efficiency and people’s livelihoods. Water-food-energy (WFE) together form a highly complex and intertwined nexus. While the debate about the WFE nexus was helpful in attracting attention on sustainability challenges and the interdependencies between the three systems, addressing governance of the nexus proved challenging. Relatively little is said about the political and institutional changes that are necessary to lead a major transformation in the present water resources, agriculture and energy development paradigms, which could accelerate progress towards sustainable development. Using examples from Jordan and Morocco, where FAO is supporting governments using a nexus approach, this paper reflects on some of the complex WFE interlinkages and related governance challenges and discusses potential innovative mechanisms experimented to tackle complexity and governance at the heart of nexus. This paper suggests that despite its limitations, a nexus concept offers a good starting point to address complexity of integrated decision making and implementation. There is a need for improvement in the nexus scope; increased focus on power relations, institutional fragmentation and stakeholders’ interests; and the readiness to question structural inequalities and existing more dominant technocratic and administrative solutions.

Keywords: Nexus, water, food, energy, food security, sustainability, governance, cross-sectoral coordination, power relations.

INTRODUCTION

Many challenges we face today such as climate change, natural resources scarcity and degradation, and food insecurity, are complex, characterized by high levels of uncertainty, different perspectives and multiple interlinkages. The interdependencies among natural resources, water, food and energy are intensifying as demand for resources increases with growth in both population and incomes, changing consumption patterns, and low management efficiencies in both supply and demand in different sectors. Climate change exacerbates the pressure on all natural resources and makes millions of people more vulnerable to insecurity in their availability (Conway, et al. 2015; Scott, 2017).

The Sustainable Development Goals (SDGs) and Agenda 2030 call upon the nations of the world to improve conditions related to water, energy, food security and nutrition, terrestrial and aquatic ecosystems and global climate change. At the same time, they

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call for reducing poverty, doubling farmers’ productivity and incomes, and promoting economic growth, industry and infrastructure. Finding a balance between these objectives and achieving them in a sustainable and equitable way that leaves no one behind is not an easy task. It calls for better understanding of complex interactions and holistic approaches. Nexus is rapidly expanding as an approach that can help decision makers in developing integrated policies for sustainable resources management and development.

The idea of “nexus” seems to have brought together wide range of organizations around a common discourse in support of sustainable resources management and agriculture and a host of multilateral and bilateral donors and certain non-governmental organizations (Blake, 2015). Nexus has been formulated as a framework and a tool allowing us to better understand how sectors are interlinked, identify trade-offs, and guide development of cross-sectoral policies that can maximize the social and economic benefits. Over the last ten years, WFE nexus has been featured in numerous articles, research studies and reports, as well as conferences and seminars all over the world (SEI, 2018). At the same time, questions have been raised as to whether this new way of thinking can effectively lead to the improvement of resources management and use, and improved livelihoods. What proved difficult in practice is to find a way to deal with governance of nexus that supports development of socially and politically feasible policies.

To familiarize the readers with the concept of nexus, the paper first provides a short overview of the existing debate on the concept. Using experience from FAO work in Jordan and Morocco, the paper then moves to discuss the WFE nexus issues in the two countries and the mechanisms used to tackle governance challenges at the heart of the nexus: How do WFE policies impact each other? How can they be better coordinated and aligned? What factors can motivate stakeholders to collaborate? The last section discusses the limitations of a nexus approach and gives some suggestions for further research and discussion.

2. UNDERSTANDING NEXUS: CONCEPTUAL FRAMEWORK AND ISSUES

Sectoral integration is not a new question, and there is no shortage of approaches related to cross-sectoral coordination in planning and decision-making. Ever since 1992 Rio Summit on Sustainable Development, systems thinking and coordination across sectors and actors have been promoted as the most appropriate way to address complex resources and development challenges. Different approaches have been put in place, including: watershed management, integrated rural development, territorial approaches, integrated water resources management and socio-ecological systems approach (FAO, 2017). At the local level, integrated approaches have been practised for many years (Leck et al., 2015). However, progress on both outcomes and processes for policy coordination and coherence has been slow (Bréthaut et al., 2019). Despite improved understanding about interrelationships between the elements of WFE systems, policy, planning and management decisions for each sector are typically made in isolation without full consideration of tradeoffs and interactions.

The concept of “nexus” emerged in response to siloed thinking and policy making focused on a single resource. The principal aim of much of the nexus research is to develop tools to: a) assess and communicate the connections and interdependencies between the three systems (WFE, but also others); b) identify synergies and tradeoffs that arise from their management, and potential areas of conflict; c) propose integrated policy solutions and actions to reduce negative impacts, minimize tradeoffs and maximize synergies; and d) ensure coordination across sectors and
stakeholders (adapted from De Laurentis et al., 2014; Scott, 2017; Rasul and Sharma, 2016).

There exist many analytical frameworks and tools for WFE nexus that vary in terms of conceptual and methodological sophistication. In terms of methods, most include quantitative hydro-economic sophisticated modelling scenarios; value chain analyses and qualitative resource accounting (SEI, 2018; ACCWaM, 2017; Albrecht et al., 2018) or a combination of them. Some nexus approaches also point to social linkages, governance and power dynamics within different sectors and their influence on implementing integrated policy options (FAO, 2014; Allouche et al., 2015; SEI, 2018; Albrecht et al., 2018).

3. THE WFE NEXUS IN JORDAN AND MOROCCO

The interdependency among water, food and energy in Jordan and Morocco is particularly strong and expected to be intensified with population growth, changing consumption patterns and geopolitical developments. The WFE nexus is driven by many natural, demographic, socio-economic and political factors that do not only intensify the interlinkages but also increase the risk of negative impacts on each other. FAO is currently supporting the two countries in using a nexus approach to identify priority issues in WFE nexus and to develop socially and politically feasible options to address them.

3.1 Jordan

Jordan has the lowest water availability per capita. Groundwater is the major source of water. The changing demographic landscape, high levels of population growth partly due to an increasing number of refugees due to instability in the region, in particular the Syrian war, urbanization, climate change and increased water demand from various economic activities put further pressure on scarce resources. The interdependency among WFE sectors is intensifying as demand for resources increases (see Figure 1).

![Figure 1. Trade-offs and risks between the tree sectors in Jordan](source: Presentation by the Ministry of Water and Irrigation of Jordan, Technical Session on Policy Coherence and Cross-Sectoral Coordination, Land and Water Days, 31 March-4 April 2019, Cairo, Egypt)

3 This section largely builds on FAO work on water governance and WFE nexus in the two countries, and information provided by Morocco and Jordan delegations during Land and Water Days 2019.
The fact that 97 percent of Jordan’s energy is imported constitutes a major challenge to its economic growth. Water supply accounts for 25 percent of Jordan’s total electricity demand. To solve the country’s pressing energy issues, the National Energy Strategy (2007-2020) aims at diversifying energy resources, increasing local energy resources, reducing dependency on imported oil, and enhancing environment protection. The Strategy has been recently complemented with a dedicated policy on “Energy Efficiency and Renewable Energy in the Water Sector”, which can have different consequences in practice. For example, while the prospects of introducing solar energy in rural areas are positive as a cheap energy source that will improve livelihoods, this could also have unintended negative consequences if the use for illegal wells and groundwater extraction for irrigated agriculture goes unchecked.

Agricultural sector consumes 58 percent of the available renewable water resources, whereas its share in the country’s GDP does not exceed 5 percent. There is a strong awareness in the sector of the need to improve water productivity, but challenges remain in implementing the required policy changes to improve both water and agricultural economic productivity in a coherent and socially sensitive manner. For example, the Law of Agriculture (LoA) encourages the expansion of irrigated agricultural production, which is at odds with water conservation efforts. Connected to this are land tenure issues. In line with the LoA, rangelands owned by the state can be converted to private ownership if lands are utilized under permanent irrigation. This has resulted in the expansion of irrigated lands, oftentimes prompting the drilling of illegal wells to cultivate the rangelands, which contributes to unsustainable groundwater extraction. Extension services have limited capacities and do not reach agricultural water users in certain areas of the country. Shortages in water are mainly caused by unsustainable groundwater extraction, including thousands of illegal private wells (Molle, et al., 2017). As a result, many communities in Jordan experience tensions over water scarcity. The arrival of Syrian refugees in the last five years has exacerbated the situation. The effects of groundwater over-extraction are particularly felt by the small farms, marginalized and needy communities, and women farmers.

### 3.2 Morocco

In the last two decades, Morocco has experienced significant social and economic changes. Agriculture played a key role in this change: it is a main source of income, employing 39 percent of the working population, and generating 13 percent of the country’s GDP in 2016. Water resources, which are relatively scarce and unevenly distributed within the country, have been critical for national economic development. However, the resources are becoming increasingly scarce due to both natural factors and effects of climate change, as well as the rapid increase in demand for water to meet domestic, touristic, industrial and agricultural needs. This makes achieving the security in one of the three sectors without addressing trade-offs with the other two extremely difficult (see Figure 2).

A strong legal architecture connects the WFE sectors in Morocco. The country is proceeding with a core economic growth path involving development activities in industry (Plan Emergence), agriculture (Plan Maroc Vert), tourism (Plan Azure) and energy (Renewable Energy Plan). The National Energy Strategy promotes investments in renewable energy, including support to its use in agriculture. The mobilization and rationalization of water resources management has been at the centre of the economic policies and investments in infrastructures with the aim of ensuring water security for all the sectors.
The coordination of water and related sectoral policies should be ensured at the national level by the National Council of Water and Climate, the Interministerial Commission of Water and the National Council of the Environment. However, these bodies have not held internal meetings for several years. Weaknesses in coordination between sectoral departments at the national level have been duplicated at the local level, contributing to fragmented implementation and disconnect between the WFE sectors.

The review of coherence of sectoral policies undertaken by FAO and the Moroccan Government found that some of the instruments for implementing sectoral policies indirectly encourage behaviour by water users and economic sectors that influence their growth in demand. In some areas of the country this contributed to overexploitation of water resources under conditions of scarcity or over-allocation (FAO, 2018). For example, Morocco currently subsidises butane gas for domestic use fixing its price for the next ten years at around 42 MAD for a 12kg bottle – compared to 90 MAD on the world market. These low prices contributed to the use of butane gas by farmers to power irrigation wells throughout the country (WB and FAO, 2017). Even if there are no official statistics, it is estimated that one third of diesel water pumps are converted by the farmers to use butane gas, because of its largely subsidised price (Doukkali and Grijzen, 2018). The Government is currently addressing the issue of butane subsidies and exploring options of support through renewable energy. However, given the experience of unintended consequences of the butane subsidies on water use illustrated above, introducing renewable energy subsidies or not, and the mechanisms for their implementation in practice have to be considered very carefully.

3.3 Discussion. Tackling the governance of nexus in the two countries

Underlying WFE nexus in both Jordan and Morocco are coordination issues and some inconsistencies in relevant sectoral policies, laws and strategies. Multiple actors play a role in WFE nexus at the national level, the governorate/provincial and basin level, and the municipality level. The interplay between critical economic sectors of activity lead to complex arbitrations regarding resources allocation modalities, equity or equality of access and the inclusion of diverse stakeholders in decisionmaking processes. While stakeholders actively engaged in WFE sectors do appreciate and agree with the rationale for nexus thinking, they stress practical limitations to implementing the concept. They each have a sectoral focus, guided by the specific function they serve (service provision, regulation, policy), their institutional legacies and objectives, and organizational cultures.
The two countries are currently exploring possible mechanisms to address governance at the heart of the complex WFE interrelationships, and to maximize synergies between the three sectors. While action regards both national and sub-national levels, focus is at a local scale and groundwater-agriculture linkages, aiming to develop understanding of inflection points where a change in the way resources are managed could result in improved future outcomes.

In Morocco, the issue of "convergence of public policies" is considered as one of the levers to accelerate the economic and social development of the country. Several institutions at the national level are currently working in this direction: the Economic, Social and Environmental Council, the National Observatory for Human Development, the High Commissioner for Planning, the Ministry of General Affairs and Governance (MAGG), the Ministry of Economy and Finance. The Government envisages the establishment of a permanent interministerial commission to ensure the coherence of public policies and an integrated information system for monitoring and evaluating their impact, supported by MAGG.

At the sub-national level, aquifer contracts are reconceived as a new mode of governance that encourages stakeholder participation and allows them to take responsibility within a negotiated contractual framework to regulate and improve groundwater management by addressing WFE nexus at the level of an aquifer system in a basin. This type of decentralized engagement is included within broader regional development plans and a river basin management framework to ensure consistency between the objectives and actions implemented across the different management levels. In Berrechid region, the Water Basin Agency (WBA) led the process of negotiation of the aquifer contract, which involved all relevant stakeholders from key sectors - agriculture and energy in primis. The WBA still has to deal with complex social dynamics and relationships between public and private actors from different sectors whose interests and actions diverge.

Despite the difficulties, things are moving forward. FAO is supporting the WBA in transforming the aquifer contract into a new form of alliance with and among all concerned stakeholders. The stakeholders are jointly exploring options to improve resource use efficiency and sustainability in selected water consuming food supply chains, including through economic incentives for farmers to reduce water consumption, e.g., agricultural diversification or value chain valorization and other support measures. These measures are complemented by support to collective action of water users, exchange of information, consultations and dialogue among different stakeholders and strengthening trust and collaboration between them. Although progress is slow, this process indicates a potential viable governance arrangement that can bring together different actors involved in WFE (or other sector) governance to jointly identify key problems at the level of the aquifer, develop an action plan and define investments and financing arrangements needed. The participatory process and the shared responsibility for the agreed action plan represent incentives for adherence and implementation. A lot still needs to be done however with regard to the attitudes and engagement of the relevant actors and water users during the implementation of the aquifer contracts.

Jordan is experimenting with a different approach. Unwilling to continue with 'carrots' in favor of agriculture, and unconvinced by the results of attempts at co-management in the Azraq basin—an area that has been one of the most affected by water scarcity and groundwater-agriculture trade-offs (Molle, et al., 2017), the government is combining a ‘stick-policy’ and collaborative approaches. At the national level, the Ministry of Planning and International Cooperation plays an important role in the coordination of sectoral policies and plans, as well as in project proposals and feasibility studies. It ensures alignment of the national planning process, including
alignment and implementation of Jordan's Vision 2025 "Resources Security and Management", which is seen as the bridge to link the three sectors. Vision 2025 explicitly addresses WFE nexus. Its Resource Security component calls, *inter alia*, for initiatives addressing the critical WFE-nexus interlinkages, such as creating an innovation fund on agriculture, WFE security to foster water-efficiency in agriculture; providing incentives for reducing overpumping of groundwater; improving energy efficiency in water utilities and introducing renewable forms of energy in the water sector. The 2016 National Water Strategy also reflects a focus on the SDGs and sets a path to work with stakeholders across sectors to develop a better understanding of the interdependence of WFE and climate resources.

At the aquifer level, the Government of Jordan has employed original, indirect tools to address groundwater-agriculture trade-offs, including the interconnection of ministerial computer systems, the reduction of the incentives to speculate on land and labour, the discontinuation of agricultural loans or credits to illegal well owners, the cutting off of electricity supplies, and 'naming and blaming' actions (Molle et al., 2017). Remote sensing based monitoring has been attempted to track illegal water use, an approach that decreases in success when users know they are being remotely monitored.

Both at the national and sub-national level, the Government of Jordan has also invested significant efforts in awareness raising and has succeeded in building a message of urgency on the WFE nexus, which is being intentionally disseminated to all levels of society, including judges, imams and MPs, and the message is starting to percolate (Molle et al., 2017).

Experience from WFE nexus issues in both Jordan and Morocco highlighted the difficulties in dealing with governance: one key lesson was realizing that having more information and data on interactions between the three sectors does not automatically imply a shared understanding of problems nor does it lead to policy changes without a strong political will to manage trade-offs and active engagement of the concerned stakeholders. Another lesson was realizing that the established cross-sectoral coordination mechanisms may not be effective as they need to be operationalized in practice.

The nexus is complex and difficult to resolve with existing solutions: multipurpose dams, desalination, renewable energy, formal cross-sectoral platforms and pricing may not be the silver bullets as they are sometimes thought to be. Available literature and FAO experience in the two countries indicate that institutional readiness to learn and assimilate knowledge on interlinkages, stakeholders' attitudes and perceptions of nexus and the level of trust among them are critical to adopt a holistic approach to address WFE issues, which can lead to a real change on the ground.

4. **NEXUS: A BUZZWORD OR A GLIMPSE OF THE SOLUTION FOR DEALING WITH COMPLEXITY?**

A wide array of conceptual models on WFE nexus have been produced by research and development agencies – each with its own perspective and agenda. This has led some authors to argue that "understandings and usage of the term nexus are plural, fragmented and ambiguous", having "something of a paradoxical quality, being simultaneously unarguably true at a simple descriptive level, and yet confusingly unintelligible or meaningless to actors unfamiliar with the discourse" (Cairns and Krzywoszynska, 2016). It has been termed a new buzzword that can generate "more linguistic heat than policy light" (Nature, 2016). It has also been observed that most approaches fail to provide applicable solutions or actionable cross-cutting insights,
which can actually improve resource management and governance outcomes (SEI, 2018; Albrecht et al., 2018; Hatfield-Dodds et al., 2015).

Despite its limitations, nexus is a concept with a scope for innovation, which can help identify leverage points to break path dependency and enable integrated decision-making in the face of uncertainty. What makes it innovative is the shift from a sector – or a resource-centric perspective to a multi-centric one. Furthermore, it does not provide a picture of an idealized scenario or image of what the sustainable and integrated resource management should look like, but emphasizes the need to understand the reality of the situation, behavior of different actors who are active in WFE systems, their relationships, and how they are influenced by existing policies, strategies and plans as well as by global trends and relevant international instruments.

Where the nexus approach needs further research and development is: i) its scope – the need to prioritize the most critical cross-sectoral linkages and potential conflicts; ii) the methods that incorporate social and political context of WFE sectors; and iii) engagement of stakeholders and decision-makers. This is critical because physical trade-offs between natural resources (e.g., water, land, ecosystems) and human activities (e.g., agriculture, industry, tourism, energy) are most often the consequence of governance challenges, such as overlaps in institutional mandates, lack of compatibility of geographical and political scales, differences in enforcement culture, power and information imbalances, pressures from interest groups, and the cumulative effects of history. Without capturing the full range of societal and governance challenges related to WFE interlinkages, decision-making processes and stakeholder behaviours, identified (technocentric and administrative) options risk remaining largely non-effective, and not leading to expected improvements in resource use efficiency, sustainability and equity.

5. CONCLUDING POINTS

The way that natural resources such as water and energy have been developed and consumed by society have not been shaped by the awareness of their scarcity or their value. Food, water and energy are deeply embedded in the social contract between society and those who govern (Allan et al., 2015). A nexus approach offers a potentially innovative way to address the inherent complexity of resources and development challenges. It can be better operationalized by integrating qualitative methods and transdisciplinary approaches, which can tackle the social, governance and political context at the heart of nexus. The literature and FAO experience indicate that this involves greater emphasis on the use of alliances and dialogue across actors and levels, bringing different knowledge systems and stakeholders together, as well as supporting change in perceptions and attitudes (FAO, 2018a).

6. REFERENCES


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