Introducing the Nexus concept to better manage and adapt large-rivers basins: example from the Upper-Rhine

Introduction du concept de Nexus pour une meilleure gestion et adaptation des grands bassins versants : l'exemple du Rhin supérieur

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RÉSUMÉ

Le concept de Nexus a émergé lors de la conférence de Bonn en 2011, introduisant un changement fondamental en passant d'approches thématiques vers des solutions d'avantage intégrées, cohérentes et multi-sectorielles. Le concept de Nexus met en lumière les liens (synergies et conflits) entre les politiques de l'eau, l'énergie, l'alimentation, le sol et le climat ainsi que leurs implications en termes d'efficacité d'usage des ressources, de développement économique et social. Nous explorons dans cet article les différences entre la GIRE – Gestion Intégrée des Ressources en Eau – et le Nexus à travers un exemple sur le Rhin-supérieur. Ce travail est conduit dans le cadre du projet de recherche SIM4Nexus qui utilise une modélisation dynamique des systèmes, développe un jeu sérieux pour faciliter la compréhension des interactions entre politiques, et implique les acteurs locaux pour assurer une bonne appropriation des résultats du projet. Le bassin transfrontalier du Rhin-supérieur est confronté à des enjeux liés aux écosystèmes aquatiques, à la qualité de l'eau et au risque inondation. La coopération transnationale y est forte autour des problématiques liées à l'eau, depuis des années. Cependant, cette coopération reste limitée avec les autres secteurs, en particulier le climat ou la transition énergétique. Nous analysons, sur ce territoire, les potentialités offertes par l'approche Nexus pour améliorer les politiques sectorielles dans un contexte de changements globaux.

ABSTRACT

The Nexus concept emerged since the 2011 Bonn conference and is introducing a fundamental shift from sectoral approaches to cross-sectoral, integrated and coherent solutions. The Nexus highlights the interdependencies (both synergies and trade-offs) between achieving water, energy, food security, land and climate policies, and their implications for human well-being, economic development and resource efficiency. Through this presentation, we explore the differences between the IWRM - Integrated Water Resources Management - approach and the Nexus approach on the Upper-Rhine region. This work is carried-out under the SIM4Nexus research project which builds on Systems Dynamic Modeling to integrate outputs of thematic models, Serious Gaming to facilitate the understanding of integrated policies and Stakeholders engagement processes to ensure appropriation of the project's results. The Upper-Rhine region is characterized by a transboundary river facing aquatic ecosystem issues, water quality problems and flood hazards. Transnational cooperation is strong on water issues and solutions are implemented for many years. However, cooperation is limited with the other sectors and policies, especially climate-mitigation and energy-transition. On the Upper-Rhine case, we analyze room for improvements of the sectoral policies and offer solutions to achieve Nexus-compliance in the face of global changes.

KEYWORDS

Climate, energy, Nexus, Rhine, SIM4Nexus

1 INTRODUCING THE NEW CONCEPT OF NEXUS

1.1 Definition of the Nexus

The Nexus approach provides a framework for designing and implementing policies that are coherent in their goals among all **Nexus dimensions: water, energy, food, land and climate.** Any policy addressing the resources relevant for the Nexus may have unintended positive or negative consequences across different sectors. This means decisions taken in these sectors or, for example, on economic investments, trade, development, biodiversity protection, innovation and research may have the effect of either reinforcing or counteracting impacts on other sectors. Consequently, policy coherence is important, and refers to the systematic effort to reduce conflict, manage trade-offs and promote synergy between policies within and across the Nexus.

1.2 Implementing the Nexus concept: the SIM4Nexus project

SIM4NEXUS is a European research project [2016-2020] supported by the H2020 fund and combining the expertise from research organizations, NGOs and practitioners from all across the EU. It addresses Nexus challenges by:

- developing a **Serious Game**: a cloud-based, integrated resource-use and policy assessment tool that will provide an immersive experience to the user. It is designed to be used primarily by authorities and policymakers at all levels (regional, national, continental and global). It will allow them to identify critical areas of the Nexus, to evaluate and quantify the effects on resource levels of new policies, subsidies, technological and social innovations, new investments and interventions;
- using well-established, scientifically sound and widely used **thematic models** (E3ME-FTT, CAPRI, MAGNET, IMAGE/GLOBIO, OSeMOSYS, SWIM, MAGPIE-LPJmL). The models will provide results for 2010 (Base Line), 2020, 2030, 2040 and 2050 and will run under the new scenario framework for climate change research, meaning the combination of SSPs (shared socioeconomic pathways) and RCPs (representative concentration pathways);
- combining model results through **complexity science tools** (System Dynamics Modeling-SDM), in which all sectors of the Nexus are brought together, and the complex web of their interlinkages is quantified;
- engaging local stakeholders through **12 case studies** covering a large span of Nexus challenges and policy settings.

The main question addressed by SIM4Nexus is how to identify and decide upon pathways to achieve the below 2°C target in a balanced way as well as a more resource-efficient Europe. **The energy transition in the Rhine river region** is an example at the heart of the EU new climate agenda.

2 APPLYING THE NEXUS CONCEPT TO LARGE RIVER BASINS

2.1 The Upper Rhine transboundary case study

The transboundary France-Germany case study is situated in the Upper Rhine region and covers the federal state of Baden-Württemberg on the German side and the newly formed Grand Est Region on the French side, with the Upper Rhine playing the role of physical and administrative border in its middle. The area along the Rhine is one of the most densely populated and highly industrialized area of the European continent. The case study focuses on the links and synergies between energy policy and the transition to a low-carbon economy on one side, and the management of natural resources (in particular water) and ecosystems on the other side. Because of its transboundary character, it investigates also the links between policy development and implementation on both sides of the Rhine, and whether there would be opportunities for enhancing cooperation and policy coherence for achieving jointly set policy objectives in a more cost-effective manner.

The Upper Rhine is known as one of the best practice examples in integrated water resource management and transnational cooperation in decision making. This is shown by a variety of legal transnational entities and their policies, as well as initiatives and projects across borders. Both sides of the river are historically intertwined and cooperation beyond borders is the norm in particular in the field of water management as illustrated by the activities of the International Commission for the Protection of the Rhine (ICPR).

2.2 Identifying Nexus challenges in the Upper Rhine region

The frame of the case study is set by the **river Rhine** and its adjacent river basins.

The Rhine river underwent heavy straightening of the watercourses in the 19th and 20th century which cut off old meanders in order to alleviate flood problems and to develop water transport. In the late 1950ies, the Rhine canal was built between Basel and Breisach. It runs parallel to the Rhine, is 50km long and is used for the generation of electricity through **hydropower**. Over the years the straightening led to a lower groundwater table declining by two to seven meters in the lowlands on the both sides of the Upper Rhine. At the moment, there are ten hydroelectric stations and one nuclear power plant which receives cooling water from the canal. Increasing the renewable energy production rate in the region would require sufficient river discharges throughout the year, which is under threat from **climate change** (modified rainfall patterns and stronger snow melt).

The Rhine aquifer is one of the biggest in Central Europe and an important source of drinking water: the area between Basel and Strasbourg receives three-quarters of its drinking water from this aquifer. The development of the **population** is therefore strongly linked to the availability and quality of this water resource. Half of the industrial demand is also met in this highly industrialized region by the 45 billion m^3 aquifer. In the rift valley, the groundwater table is relatively close to the surface, therefore vulnerable to pollution from anthropogenic sources: agriculture (fertilizers and pesticides), industry, sanitation. Climate changes and **urbanization** are clear threat to the efficient recharge of the aquifer and its overall quantitative balance.

The Integrated Rhine Programme for **flood prevention** was established by the federal state parliament in 2010 after more than 20 years of transboundary cooperation between France and Germany on the topic. It entails 13 polders that used to be former alluvial floodplains alongside the German border of the Rhine in Baden-Württemberg between Basel and Mannheim. The programme integrates **ecological** concerns into extensive flood prevention and fosters cooperation in between two federal states on the German side and the Alsace region on the French side.

This area is a model region regarding energy transition. The goals set are a fourfold split of its greenhouse gas (GHG) emissions in 2050 compared to its 1990 emissions, with an intermediate goal of 40% reduction in GHG emissions by 2030. The share of renewable energy should be of 32% in the final energy consumption in 2030. For example, the increase of **biofuel production** is a particularly problematic objective as it has many potentially negative interactions in the Nexus. The current EU proposal for a revised Renewable Energy Directive addresses these impacts with strict rules for land use but not for water use. However, the expansion and intensification of energy crops may affect water quality and quantity, the hydrological cycle, as well as local microclimate.

All these interlinkages and feedback loops between the different sectors are being investigated through the System Dynamics Modeling and a conceptual representation is under development.

3 CONCLUSION ON DIFFERENCES BETWEEN IWRM AND NEXUS APPROACHES

Even though the concept of the integrated management of water resources (IWRM) has been in use for years, the complex interlinkages and interdependencies amongst all other natural resources (including energy, land, food, biodiversity) has not been given due importance. As a result, **responding to a challenge in the management of one resource often creates challenges for the management of others**. The Nexus approach also necessitates a better understanding of the factors that determine the entanglement of flows in the supply and demand of water, energy, food and other materials in our economy, as well as of the role that the interlinkage over these flows plays in the stabilization of socioeconomic and ecological processes across different scales.

BIBLIOGRAPHIE

SIM4Nexus project : www.sim4nexus.eu