# The SEI Initiative on the Water, Energy and Food Nexus

## 1. Introduction

The world has made great strides in lifting people out of poverty, easing hunger and raising living standards, but rapid population growth, increasing consumption, and climate change are pushing the planet's limits and depleting key resources. To ensure that development is socially and environmentally sustainable, we need to manage resources and ecosystems more effectively.

An important step in meeting this challenge is to understand how the water, energy, and agriculture sectors depend on each other and how resource use in each sector affects the others. The new SEI Initiative on the Water, Energy and Food Nexus investigates cross sector links between water, energy, and food to support those who govern and manage these systems to work together to meet human aspirations sustainably.

Resource scarcity and climate change pose formidable challenges, and robust evidence-based methodologies built on the nexus framework and applied jointly with stakeholders can be valuable tools in efforts to meet them.

## 2. Background

Following the Bonn Conference on the Water-Energy-Food Nexus in 2011, there have been a great many nexus conferences, white papers and initiatives. It is testament to the apparent need for greater integration of management and decision making across water, energy, and food production systems that the nexus approach has captured the attention of so many actors at various levels of governance, across economic sectors, and within different types of institutions.

But in some respects the nexus is nothing new. Water managers and water users have long considered the energy implications of some of their actions, partly because energy costs can be a major component of their bottom lines. Energy managers must always consider where they will get the water they need to use along the energy production chain, from fuel extraction and processing to transforming fuel into energy. Food producers rely on both water and energy as inputs, and this reliance is most strong in irrigated, market-oriented food-production systems.

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While Zambia's targets for agriculture align with efforts to halt the rate of deforestation, they can impact on fisheries and water use. SEI is using a nexus approach to support efforts to align development plans.

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The road ahead: Myanmar is at a crucial stage of development that will impact on demand for food, water and energy. Nexus thinking can promote a sustainable path for the country and its river basins.

However, where the nexus approach is different – and where its strength lies – is that it formalizes these links and explicitly considers them, taking human aspirations as the starting point and placing stakeholders at the centre of the process, rather than setting out from a traditional focus on allocation of natural resources (see Figure 1). We believe that applying a nexus framework can change for the better the ways in which decisions are made, resources are managed and ecosystems and communities are supported.

## 3. Objectives

The initiative will apply analytical tools and analysis in a set of case studies (see box) to be of real use to decision-makers and managers in the areas of water, energy, food production and ecosystems. The research will be flexible and respond to risks and opportunities.

Implementing the nexus framework is not easy, because decisions about energy, water, food, and ecosystems are often made in disconnected institutions that operate across different scales in response to distinct imperatives. This is a critical point, because nexus thinking asks resource managers, analysts and users to expand the scope of their engagement on the issues they confront. It must be clear to them that it is worth the effort in terms of generating outcomes that are meaningful to them.

## 4. What we will do: the three themes

The initiative is structured around three broad themes: governing the nexus, understanding the nexus, and implementing the nexus. These themes will be applied in case studies in Myanmar, Zambia and Colombia (see box).

Understanding the nexus will build on two decades of SEI's work developing analytical and planning tools for water and

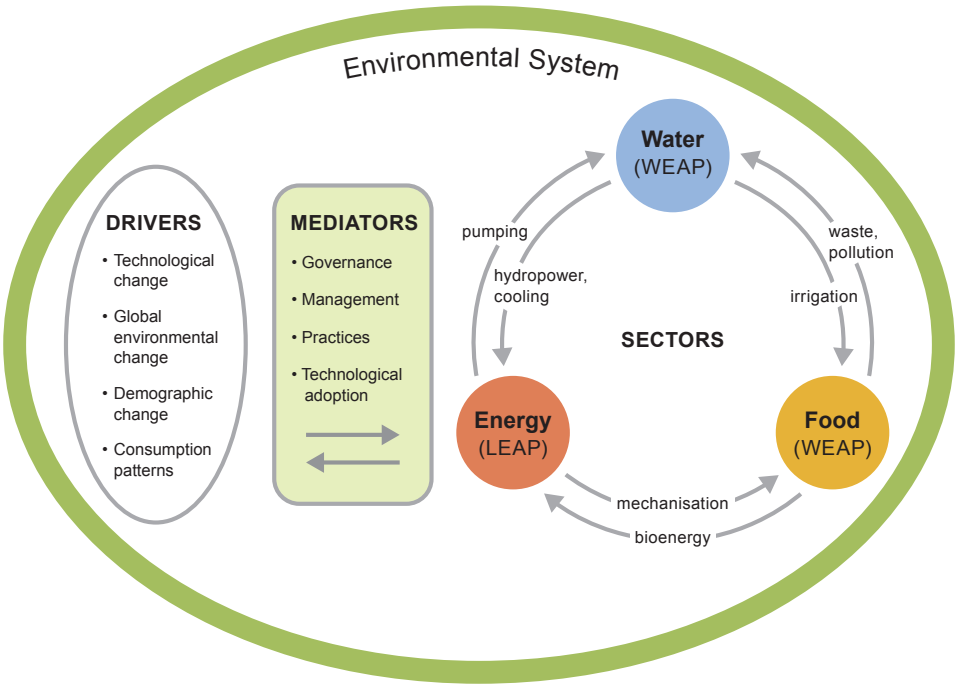


**Figure 1: A preliminary conceptual model of the water, energy and food (WEF) nexus. The model shows links between sectors and drivers and mediators of change. It also indicates where the SEI nexus toolkit (i.e. WEAP and LEAP) can be applied.**

energy that represent key features of energy, water, and food production systems. It will also build on recent efforts to link these tools together in new and innovative ways.

Activities under governing the nexus will draw on SEI's long experience in environmental governance, including critically examining institutions and proposing alternatives that better contribute to policy coherence and integration in support of sustainable development.

Implementing the nexus will work closely with stakeholders to identify which policies and institutional arrangements currently work well, as well as feasible options to better manage natural resources and for technical innovation in the allocation of resources and the processes at the interface of water, energy food and ecosystems.

Importantly, the themes and case studies will inform each other. As Figure 2 illustrates, lessons from each case study will feed back into the themes. Also, the themes will support learning across the case studies: for example, lessons drawn from Colombia, which has established mechanisms for cross-sector dialogue, can be useful for stakeholders in Myanmar or Zambia.

**Understanding the nexus**

This theme will focus on how to understand interactions between systems of food production, water flow and allocation, and energy production and consumption. To do this we will use our analytical tools for managing energy, water and food production systems – the Water Evaluation and Planning system (WEAP) and the Long-range Energy Alternatives Planning system (LEAP). These tools are used widely around the world to support policy and decision-making.

SEI has recently linked the two tools to form a "nexus toolkit" so that energy and agriculture production, water supply, and related environmental impacts can be jointly

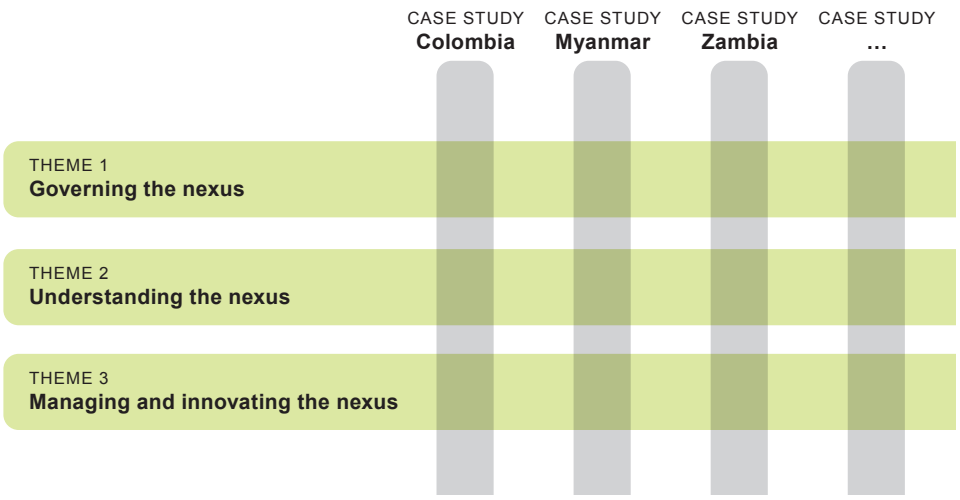


**Figure 2: The initiative is organized under three themes that run through a set of case studies. The case studies and the themes will inform each other in an iterative way. Further case studies are likely to be added as the initiative progresses.**

## Case studies

### Myanmar

Myanmar is undergoing an economic and political transition, substantially affecting demands for food, water and energy. This transition, while bringing welcome economic development, will also put pressure on the country's ecological resources, constraining its efforts to move towards sustainable development.

The energy sector is essential to Myanmar, as less than half the population today has access to electricity and the country has a goal to provide universal access to electricity by 2030. The country's hydropower potential far exceeds current requirements, so hydropower development, if it reaches its potential, can provide much needed income from exporting electricity while meeting domestic demands. However, dam development would displace thousands of households and may compromise ecosystems and associated livelihoods. Furthermore, the expansion of biofuel plantations could create tensions around food security and water allocation, since these plantations consume increasing amounts of water, change patterns of land use, and may also drive up the price of edible biofuel crops. Our view is that nexus-oriented multi-sector planning can support Myanmar to develop its river basins sustainably.

This case study aims to inform policy debate and analysis in Myanmar to include links between the water, food, and energy sectors, particularly between energy and water. SEI seeks to support Myanmar through institutional analysis, quantitative assessments of the water-energy-food nexus, evidence-based research, and participatory planning.

### Zambia

Analysis of Zambia's development plans outlined in its current national policy framework reveals some conflict between many of the targets for specific sectors. For instance, while developing intensified agricultural systems may be in line with targets for halting the alarming rate of deforestation, they are set against sustainable water use and fisheries. Although government Sector Advisory Groups do meet quarterly to collaborate across sectors, in general the groups appear to mainly react to new implementation projects rather than play a proactive, strategic role.

If Zambia is to reach its development goals, there is a need for integrated, quantitative assessments of potential development trajectories that account both for inter-linkages across sectors and competing demands for resources. In turn, this points to the need for improved cross-sector planning.

Right now there is a window of opportunity to bring about change because relevant policies are under revision. This case study aims to strengthen cross-sector collaboration and dialogue within the Sector Advisory Groups, and potentially other forums, with quantitative assessments of the water-energy-food nexus, in order to:

- support strategic planning in relevant sectors to implement the current policy framework
- guide the development of new policies, and
- advise on new investments in technical innovations.

The ultimate aim of our work in Zambia is to contribute to accelerated economic development combined with sustainable use of natural resources.

### Colombia

Our work in Colombia will build on SEI's three years of experience applying innovative, model-based, decision-support techniques to improve water management at various scales within the Magdalena-Cauca River basin, taking into account the challenge posed by climate change.

Under the initiative the geographic focus will shift to the Colombian Orinoco. This region is home to Colombia's most important petroleum reserves and a growing biofuels industry, as well as substantial livestock and irrigated agriculture systems that have enormous possibilities for intensification. The region also holds Colombia's most charismatic and unique biodiversity. National policy-makers in Bogota have developed ambitious, yet largely uncoordinated, plans for the development of Orinoquia, leaving local authorities, including the local Corporaciones Autonomas Regionales (CARS), scrambling to shape this development in a manner consistent with local objectives and aspirations.

SEI convened a meeting to launch the initiative in Colombia, and presented a vision of how the initiative could support efforts to link scales and sectors, with a focus on the Rio Cravo Sur watershed. The meeting gathered all relevant institutions at the national level dealing with energy planning, water management, biodiversity conservation, food production and land reform, along with local authorities from the Casanare Region of Orinoquia. These institutions made commitments to participate in a process to find the proper balance for sustainable development in this watershed, with full consideration of its expected contribution to national goals. Implementing this process will be the focus of our activity in Colombia.

analyzed and assessed (see Figure 1). While energy and climate impact models have been linked with tools for biomass, land or water at global scale, and are sometimes connected at smaller scales on specific projects, there are few if any general tools that can be taken up and applied by practitioners. Therefore, SEI's nexus toolkit is unique in this regard, and lends itself to integrated, cross-sector analysis. Moreover, the tools can produce multiple scenarios (which are useful when working with policy analysis, stakeholder dialogue, and scenario narratives) to identify more robust solutions over the long term.

The nexus toolkit allows practitioners to quantify the outcomes of different development paths that result from choices

Photo © Claudia Strambo

Waste water treatment plant in the Llanos plains in Colombia's Orinoco region. The initiative is working with stakeholders to find the proper balance for sustainable development in the Rio Cravo Sur watershed.

made about current and new policies, as well as the impact of technical innovations.

**Governing the nexus**
Under this theme we will address major governance challenges related to coordinating and integrating the water, energy, and agriculture sectors.

We will explore the links between sector policies, identify synergies and trade-offs, and investigate how institutions might be arranged to maximise coordination and integration across sectors. This effort reflects connected but distinct challenges to the governance of the nexus, which are: policy coherence, institutional coordination, integration, and planning. We will follow this chain through a multidisciplinary effort, taking in political and institutional analysis, knowledge and models on the link between policy design and policy instruments, and the behaviour of economic sectors and individual actors in the "real world".

The nexus toolkit (see section above) will inform the work of the theme by allowing us to assess the coherence or otherwise of sector policies and propose and test new policy options, governance mechanisms and economic incentives, such as subsidies, tariffs and prices, which can play a role in increasing efficiency and sustainable use of resources.

Our research will set out from the proposition that there are optimal levels of governance and jurisdictional fragmentation that can be put in place without compromising currently effective sector governance mechanisms.

The work will be informed by SEI's history of research on environmental governance, including critically examining institutions and proposing alternatives that respond to emerging sustainable development challenges.

**Implementing the nexus approach**
Under this theme we will put the nexus approach into practice in a set of case studies (see box). A participatory process involving key stakeholders will be the starting point, allowing us to develop a rich picture of the water, energy and food nexus in each case study location and to identify and discuss issues and priorities that the people we work with consider important. By consulting closely with stakeholders we will determine the key factors and questions that need to be analysed so that the nexus toolkit is applied to suit their needs. To make the scenarios useful and relevant, the modelling effort will be improved through consultation with stakeholders, who will critique assumptions, data and results. The stakeholders will also co-create the scenario narratives with the research team.

The approach will support robust decision-making under conditions of political, economic, and climatic uncertainty, and enable stakeholders to recognize which policies and institutional arrangements currently work well, and to identify feasible options to better manage natural resources and for technical innovation. Scenarios will also help stakeholders to identify dilemmas linked to different development trajectories that will have to be accounted for in the planning and policy-making process.

We will also establish teams of local technical experts in each case study location, which will learn how to apply the nexus toolkit so that the work can continue after the studies have been completed.

**Published by:**
Stockholm Environment Institute
Linnégatan 87D, Box 24218
104 51 Stockholm
Sweden
Tel: +46 8 30 80 44

**Initiative co-leaders:**
Annette Huber-Lee
annette.huber-lee@sei-international.org
Eric Kemp-Benedict
eric.kemp-benedict@sei-international.org

**sei-international.org**
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**Twitter: @SEIresearch, @SEIclimate**