Geophysical Research Abstracts
Vol. 21, EGU2019-14601-1, 2019
EGU General Assembly 2019

Trade-offs and synergies between ecosystem services within the water-energy-food-land-climate nexus in Sweden

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The world is facing many challenges regarding water, energy and food. In the past, these types of problems were often tackled with a sectoral approach. However, it has become evident that there are many complex interactions between different sectors, which need to be considered in decision-making processes. In an effort to better describe the complex interactions among multiple resources systems, the use of the "nexus" concept has been gaining increased attention in recent years, particularly in relation to the water (W), energy (E), and food (F) domains, i.e. WEF nexus, but also including the environmental domain and climate change impacts. The nexus perspective emphasizes the interconnections between the different components of a system and aims at recognizing the trade-offs and synergies between these components. The focus has initially been on the physical interactions between different nexus components, but with time developed into broader social issues, such as improvement of resource use efficiency, sustainable livelihoods or environmental security. Coherence on a political level between different sectors is getting more and more important, not only to avoid conflict, but also to discover and develop synergies between the sectors. The consequences of nexus policy interactions often become visible as a physical change in an ecosystem. Several processes can be affected, which leads to changes in the provisioning of ecosystem services, which are defined as the contributions of ecosystems to human well-being and are usually divided into four categories: supporting, regulating, provisioning and cultural services. Human societies commonly focus on increasing the direct benefits, or the provisioning services (food, drinking water, raw materials and energy products). However, ecosystem services are often bundled together and increasing one service can affect the provision of other services in any of the four categories.

In the present study, we applied the nexus approach to study the physical interactions between five sectors in Sweden. We went beyond water, energy and food sectors and also included land (forestry and agriculture) and climate sector. We focused particularly on ecosystem services related to these sectors and built a model of their trade-offs and synergies. A literature study of Swedish policy documents on ecosystem services was performed to identify the most important ecosystem services related to the five sectors. The effects of climate change on these services were assessed based on the information provided in policy documents and the scientific literature. Our study illustrates that there are numerous links between different sectors, which lead to both synergies and conflicts in the use of ecosystem services. Therefore, we argue that a more holistic view on the implementation of Swedish environmental policies is needed; one that engages different sectors and ensures the optimal delivery of these services.