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The Nexus perspective and climate change

Global challenges

Despite substantial progress more than one billion people remain without secure access to food, water, sanitation or energy. At the same time, population growth, urbanisation, changing consumption patterns and climate change increase the pressure on energy, water and food demands causing trade-offs among these three development goals.

> Until 2030, global demand for water and energy is expected to rise by 40% and demand for food by 50%. (ERD 2012)

The Nexus perspective

There are numerous ways in which the water, energy, and food sectors are interconnected, and they depend on the same resources. Consequently, activities in one sector often help or harm the other two. For example, increased energy production benefits water supply and agriculture by making pumping systems more reliable. In turn, increasing the amount of water used in agriculture or energy generation can reduce the amount of water available. A Nexus approach pays attention to the shared challenges and potential synergies between water, energy and food provision and integrates management of resources across sectors and scales. The overall goal is to achive water, energy and food security for all, in the context of limited, vulnerable and interconnected resources.

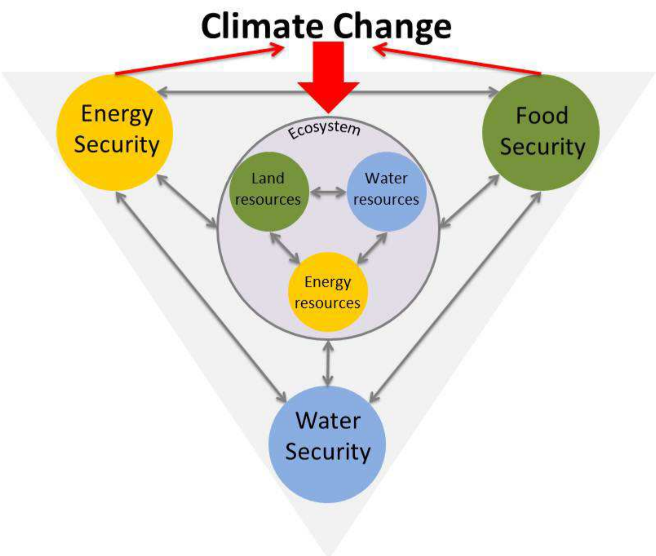

Fig.1: Contributions to and effects of climate change.

The Nexus and climate change

The water, agriculture and energy sector all contribute to and are strongly affected by climate change. Energy production and agriculture alone account for 42% of global greenhouse gas emissions. Agriculture and water in turn are highly climate-vulnerable sectors and subject to impacts such as reduced or increased precipitation and runoff, sea level rise, loss of glacier water storage, or more (severe) extreme events.

Mitigation and adaptation strategies thus need to integrate a Nexus perspective to avoid negative externalities. *Mitigation* measures, such as the expansion of biofuels or hydropower, can create significant pressure on water resources through new water demands and changes in the use of the resource. Climate change *adaptation* can be very energy intensive due to increased energy demand for irrigation, desalination or groundwater pumping.

Nexus solutions in practice

In the following section some of the most promising options for improving water, energy and food security through a Nexus approach considering impacts of climate change are presented.

Governance, institutions and policy coherence

Cross-sectoral and multi-level coordination of governmental institutions is crucial to develop complementary policies for water, agriculture and energy. While independent Nexus-oriented institutions may help, capacity development of existing institutions is more important so they can build new links across sectors and deal with the additional uncertainty and complexity when integrating a range of sectors and stakeholders.

> One must reshape institutions so they can take up the challenge – we can´t solve new problems with old institutions. We have to reshape our own thinking to a culture that sees water and wastewater as resources. (Uschi Eid, 2011)

Integrated Water Resources Management (IWRM)
Integrated approaches are already known from a water perspective: IWRM focuses on multi-sectoral and multi-stakeholder planning processes for use of water and water-related resources in order to balance economic and social development while maintaining ecosystem functions. IWRM

also reaches out of the water sector and is thus a key aspect of the Nexus approach. However, the Nexus addresses externalities across sectors to improve overall resource use efficiency and thus goes beyond the water-centric nature of IWRM.

Water stewardship

Sustainable water management, which prevents allocation and usage conflicts, can only be achieved by collective action of all water users. Water stewardship refers to the socially, environmentally and economically sustainable use of water, achieved collective action between the private sector, civil society and public institutions. Private enterprises, particularly those with a high water demand, must be included in water management and given incentives to invest in resource use efficiency and maintaining ecosystem functions and services, which in turn increases water, energy and food security for all stakeholders.

> Through increased energy efficiency in water pumping the Water Authority of Jordan could reduce the energy consumption by 35%.

Energy efficient water supply and sanitation

Energy security, reliable water supply and climate change mitigation are closely interlinked. Use of renewable energy, particularly from wind or solar, in water provision and treatment contributes to energy and water security, as well as climate change mitigation. In desalination processes, which are ten times more energy intensive compared to provision of local freshwater, shifting to electricity from renewable energy sources is particularly important. Water can also be saved by replacing water-intensive fossil energy or unsustainable hydropower plants, which also contributes towards climate change adaptation.

Water availability for energy production

Water is essential to operate and maintain some forms of energy production, for example cooling power plants or cleaning solar panels. Consequently, the energy sector is highly dependent on the quantity of water, but also on its quality: The water demand of thermal power plant rises with with increasing temperatures of rivers. Vice versa, the production of energy affects the quality of water: The return of used water from cooling systems raises the temperature of the water and influences the ecosystem.

Multi-use reservoirs and dams

Dams can serve various purposes: As waterstorage for agricultural production, domestic use and industry, as contributor to energy security and climate change mitigation for hydropower, as a control-mechanism to compensate for higher runoff variability, and as a floodcontrol. Multi-use reservoirs can combine these single purposes to increase water productivity and thus water, food and energy security. A Nexus approach is also key to mitigate to negative effects of dam construction.

Efficient irrigation systems

Efficient irrigation technologies enable both water and electricity savings as well as higher yield of crops. This increases security in all three relevant sectors and contributes to both climate change mitigation and adaptation. The installation of solar powered water pumps offers an integrated solution that allows access to solar energy which is then used to provide water.

Sustainable Agriculture

Different measures of sustainable agriculture increase production by improving soil fertility and minimizing harmful effects on climate, soil, water, air and biodiversity. It is essential for food security and can produce bioenergy. At the same time sustainable agriculture minimizes the use of non-renewable energy and the use of water. It therefore reduces the pressure on the ressources of the water-energy-food- -Nexus by sustainable intensification.

Sustainable biofuel production

Biofuels can compete with food production for water and land, expand into other ecosystems, and lower the resilience of food production systems. However, when integrated in multi-use systems, grown on marginal land or in rotation with other crops, biofuels can reduce overall pressure on resources.

Waste as a resource in multi-use systems

Multi-use systems can help to reduce losses along the supply chain: Wastes, residues and by-products can be turned into a resource for other products and services. Example of the recycling of nutrients or water can be achieved through productive sanitation and the reuse of wastewater or sludge. Further examples of the reuse of waste include multifunctional agriculture, agro-forestry, crop-livestock systems, land recycling and “closed-loop economy”.

> A Nexus approach is needed to help climate mitigation measures be more 'water smart', adaptation measures to be less energy intensive, and to avoid damaging consequences for food production and other ecosystem services.
> (Hoff H., 2011)

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