Sustainable Energy Handbook

Module 2.4

Water-Energy-Food Nexus

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1 General introduction and background

This handbook has been designed to provide a brief overview of DEVCO activities on the water-energy-food nexus and how this approach will be increasingly used and implemented across a number of thematic units. It is also designed to be a useful summary on the concept itself, with explaination on how it will be operationalised at a global level not only by DEVCO but in conjunction by other EU Member States, international organisations and NGOs.

Water, energy and food are essential for human well-being and poverty reduction. Global projections indicate that demand for freshwater, energy and food will increase significantly over the next decades under the pressure of significant population growth (notably in Sub-Saharan Africa), increasing mobility, economic development, international trade, urbanisation, diversifying diets, cultural and technological changes, and climate change (Hoff 2011).

60% more food will need to be produced in order to feed the world's population (expected 9.7 billion) in 2050. Global energy consumption is projected to grow by up to 50% by 2035 (International Energy Agency, IEA, 2012). Total global water withdrawals for irrigation are projected to increase by 10% by 2050 (FAO 2011).

As demand grows, there will be increasing competition for resources: water, energy, agriculture, fisheries, livestock, forestry, mining, transport and other sectors, with unpredictable effects on livelihoods and the environment.

In this context, the Water-Energy-Food Nexus has emerged as a key policy narrative to support the goals of sustainable development. It has done this by supporting an inter-sectoral analysis of complex food, energy and water tradeoffs and synergies impacting on resource security and risks to society. It has also promoted a more coordinated and integrated management of natural resources use across sectors and scales to identify and manage trade-offs and build synergies through our responses, allowing for more integrated and cost-effective planning, decision-making, implementation, monitoring and evaluation (FAO 2014b).

In summary, the nexus concept is being used to understand the risk of not applying a nexus approach to these three main sectors and that concrete examples around the world demonstrate that the nexus applies equally to water-abundant and water-scarce regions.

The Water-Energy-Food Nexus discourse was given its baptism at the Bonn 2011 Conference: "The Water, Energy and Food Security Nexus: Solutions for the Green Economy" and its acclaimed research paper presented initial evidence on how a nexus approach could enhance water, energy and food security. “A nexus approach can support a transition to sustainability, by reducing trade-offs and generating additional benefits that outweigh the transaction costs associated with stronger integration across sectors.”

In May 2012, the 2011/2012 EU Development Report[i] (ERD) "Confronting scarcity: Managing water, energy and land for inclusive and sustainable growth" was launched ahead of the Rio+20 Conference. The Report urged the international community to radically transform approaches to managing water, energy and land[ii] (WEL) in order to support inclusive and sustainable growth in the poorest developing countries. This radical transformation was needed to satisfy the growing demand for water, food and energy without transgressing environmental limits or tipping points.[iii]

To this end, the authors advocated an ambitious integrated "WEL nexus" approach and "recommended that the EU review its development cooperation policies to ensure a nexus-wide approach was consistently followed to avoid perverse outcomes and maximise opportunities." The Rio+20 Conference also made gender equality and women's empowerment, water security and sustainable water management, food security and agricultural development priorities for sustainable development.iv

Bonn 2011 paved the way for "Berlin 2013: Realizing the Water, Energy and Food Security Nexus" which took stock of progress made in the conceptual development and the implementation of the nexus perspective and discussed new ways of anchoring the water, energy and food security nexus in global, regional and national policies. One of the main findings of the Policy Forum was the relevance of regional cross-sectorial dialogue processes led by regional organisations and the need to focus on specific policy issues in order to tackle cross-sectorial bottlenecks.

Importantly, as natural resource endowment is not uniform across the globe, the water-energy-food nexus is being understood and applied to specific and often unique regional and sub-regional conditions. Policy-makers and the academic community underline that much is still to be learnt and understood by applying a nexus approach to policy and programming but that if it serves to strengthen technical and political dialogue it should be used.Two initial applications of the Nexus approach will be rolled out:

A) Under the Umbrella of the Sustainable Energy for All Initiative (SE4ALL)[v] a High Impact Opportunity (HIO) on the Water-Energy-Food Nexus has been established. The overall goal of the Water-Energy-Food (WEF) Nexus HIO is *"to contribute to the achievement of the SE4ALL objectives through better use of the WEF nexus perspective and by fostering synergies between the different sectors".* This includes the consideration of the WEF nexus perspective at policy and implementation level in order to ensure improved energy access and energy efficiency, as well as augmented use of renewable energies. Further details are laid out in Section 6.

B) A Nexus Project ('the Nexus Dialogues') to strengthen nexus political and technical dialogue within regional organisations in the following areas: Neighbourhood East and Neighbourhood South, Central Asia, Sub-Saharan Africa (Nile, Niger and in South Africa), Latin America and in South Asia. Further details are laid out in section 7.

2 General principles of the Water-Energy-Food Nexus

The interlinkage between the water, energy and food supply systems is a major consideration in countries' sustainable development strategies.

The ability of existing water, energy and food systems to meet the growing demand is constrained given the competing needs for limited resources and the challenge is further compounded by climate change impacts.

The nexus affects the extent to which water, energy and food security objectives can be simultaneously achieved as illustrated in the diagram below.

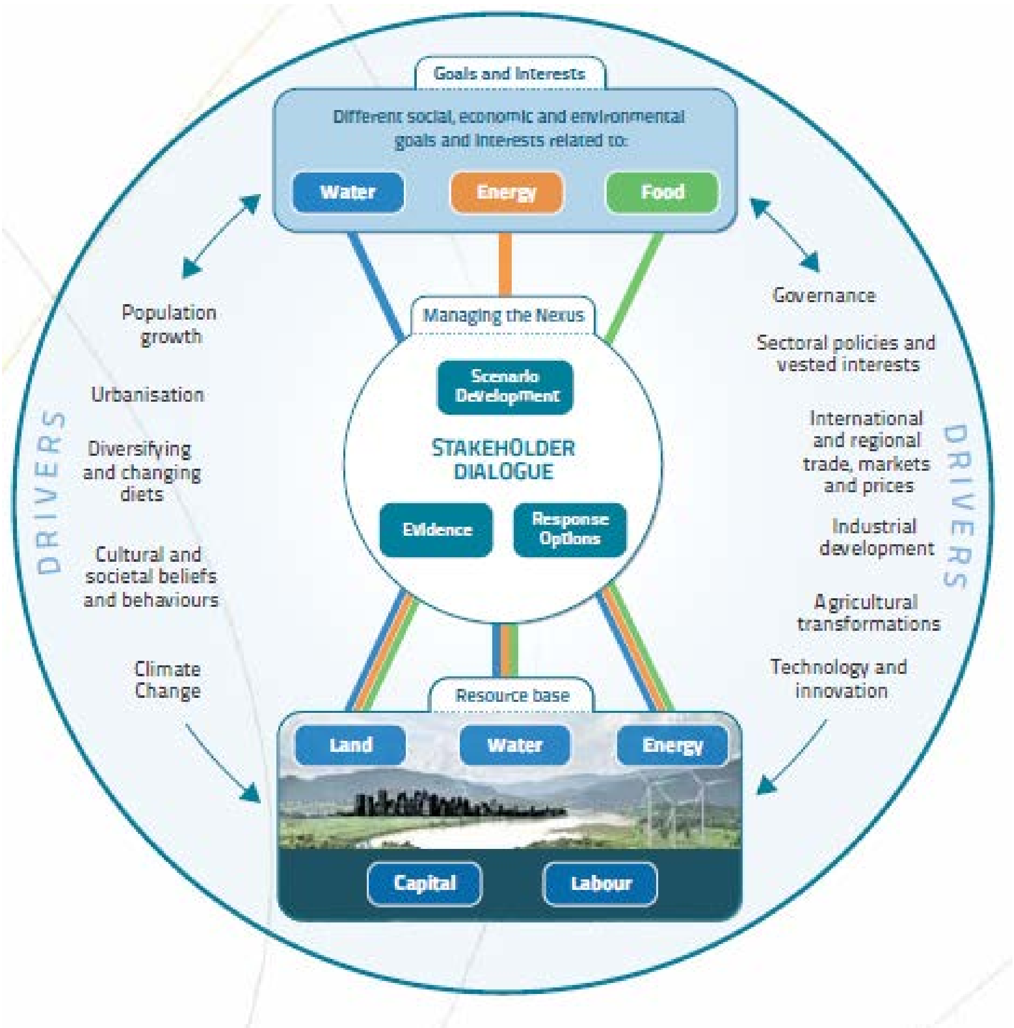

Figure - The FAO approach to the Water-Energy-Food nexus (FAO 2014)

Water is required for extracting and processing fossil fuels as well as for generating electricity from various sources. *Energy supply presently accounts for nearly 15% of global freshwater withdrawals annually*. As a consequence, the availability and accessibility of water resources for fuel extraction, processing and power generation represent a key determinant for energy security. Conversely, disruptions in the provision of energy services, which are essential for water treatment, production and distribution, also have direct implications for water security. At global level energy is required for productive and recreational activities including for meeting basic human needs. It is also needed to produce, transport and distribute food as well as to extract, pump, transport and treat water. A large amount of this energy is needed for food production and consumption, with around 30 % of total end-use energy is used directly or indirectly for the agro-food chain (FAO, 2011a).

Agriculture also accounts for 70 % of total global freshwater withdrawals, making it the largest user of water. Water is used for agriculture production, forestry and fishery, along the entire agro-food supply chain, and it is used to produce, transport and use all forms of energy (FAO 2011b).

Vulnerabilities in water and energy supply also pose critical risks for food security, as severe droughts and fluctuations in energy prices can affect the availability, affordability, accessibility and utilisation of food over time. The agro-food supply chain accounts for 30% of the world's energy consumption and is the largest consumer of water resources, accounting for approximately 70% of all freshwater use. Such interlinkages are compelling governments, the private sector, communities, academia and other stakeholders to explore integrated solutions to ease the pressures and formulate development pathways based on sustainable and efficient use of limited resources.

The requirement of energy and water for food is expected to be exacerbated in the near future as 60% more food will be required to be produced in order to feed the world in 2050[1] and global energy consumption is projected to grow by close to 50 percent by 2035 (IEA 2012). In Africa a five-fold increase in power capacity is expected by 2040 (6% per annum is expected to sustain a continental annual average economic growth rate of 6.2% over this period and an annual energy demand growth rate of 5.7% taking into account the potential for energy efficiency gains) (African Union (UA) Commission and NEPAD 2012). For example just total global water withdrawals for irrigation are projected to increase by 10 percent (FAO 2011b) and water demand for agriculture at least by 20% by 2050, even in the presence of productivity technological development.

A major driver for increasing competition for land/food and water resources is energy. Water and land (the latter especially in case of bioenergy) are major input factors for energy production. By 2035, global energy demand will grow by one-third with respect to 2011 (IEA 2013). Energy demands and therefore the need of cooling power plants is increasing to face the increase in demand. Energy production from hydropower and other sources is projected to increase by an overall 60% globally by the year 2030 with respect to 2004, thus generating further pressure on water resources (WWAP 2009). Moreover, the production of bioenergy feedstock competes with food production not only on prime cultivated land, but also water consumption. The production of biofuel feed stocks currently occupies some 2-3% of the world's arable land (FAO 2013).

Land is also a resource that needs to be managed carefully as today about 25% of the world's land is highly degraded, 8% is moderately degraded and 36% is slowly degraded (FAO 2011) and an additional 47 million ha will be needed for food and animal feed production, 42-48 million ha for large-scale afforestation, and 18-44 million ha for producing biofuel feedstock by the year 2030 (European Report on Development 2012). However the amount of suitable land to bring under cultivation is quite limited, Cities, industry and other users, too, claim increasingly more water, energy and land resources, and at the same time, face problems of environmental degradation and in some cases, resource scarcity.

Finally, another important driver for an increased competition for energy, food/land and water resources is climate change, which is expected to modify precipitation patterns, evapotranspiration and temperature, while increasing the number and severity of extreme events (Bates et al. 2008). These changes will affect livelihoods and the agricultural sector especially in the developing world, where populations are far more dependent on farming and highly vulnerable to climate change due to the lack of social, technological and financial adaptation measures.

The above highlights that there are clear interlinkages between the management of energy, food and water, including international support to these three sectors. Specific interventions in one sector may result in synergies or trade-offs between sectors or interest groups. Traditional impact assessments for specific interventions (including new policies) take into account single sectorial outcomes while omitting the more complicated inter-linkages that arise due to the intertwined nature of reality.

These risks confront not just governments, but any stakeholder engaging in activities that are affected directly or indirectly by the availability, accessibility and affordability of water or energy. Consequently, they manifest at different levels – regional, national and local – causing governments, communities and businesses to increasingly consider the nexus as a key variable affecting the socio-economic sustainability of their operations and long-term objectives. The first step of the process of managing the water–energy nexus is to understand the entire spectrum of risks that are relevant for a specific country, business or community (IRENA, 2015).

[1] In developing countries, th eincrease will reach up to 100% by 2050, relative to 2009 levels (FAO 2011).

3 The 2 main applications of the Nexus concept

In its broader understanding, managing the nexus means making an optimal use of the resource base available (which includes natural resources such as land, water and energy but also human resources such as capital and labour) in order to meet different and sometimes competing social, economic and environmental goals and interests of a society.

Two main applications of the nexus concept can be identified:

- **The nexus concept for policy-making and as a framework for inter-sectorial dialogue.** This is of particular importance for governments that want to increase their policy coherence and long term strategy, as well as for organizations in charge of maintaining and improving policy harmonization within and among governments. In fact most governments have separate agencies to oversee water, energy, and agricultural food production, and they set policies and plan for each sector separately. Inter-agency and stakeholder dialogues are important to:
    - Engage and bring together actors from different sectors and levels of governance
    - Develop a shared understanding of the national, regional and international context in which future interventions will be embedded and to ensure that these interventions are aligned with national needs and priorities
    - Directly link to ongoing and emerging decision-making processes
    - Create momentum to move from assessment outcomes to action, instilling a sense of ownership, leadership and mutual accountability.
- **The nexus concept as a systematic framework to assess and chose among different interventions**[2]. This is particularly interesting for donor organizations or in general for decision-makers, operating in a specific sector, and wanting to minimize unintended negative impacts in other sectors. A nexus assessment of this kind can be done at all levels of detail.

  Examples of nexus-related interventions or policy could be water desalination and biofuel production. A number of countries are increasingly relying on energy-intensive, fossil-fuelled desalination plants; others rely on energy-intensive inter-basin water transfers and groundwater pumping as solutions to water scarcity; and bioenergy development has, to a great extent, focused on water-and land-intensive fuels such as maize-based ethanol and palm-oil biodiesel, rather than pursuing more efficient and sustainable solutions, such as generating energy from agricultural residues and waste.

Recently the FAO proposed a nexus assessment methodology for specific interventions (FAO 2014a) which combines information about the sustainability of the context in which the intervention is going to be rolled out, and information about the performance of an intervention in terms of nexus resource use efficiency.

4 Nexus in the context of sustainable management of water resources

At present, energy production accounts for nearly 15% of global freshwater withdrawals – or 580 billion cubic metres (m^3) of water every year (IEA, 2012). This includes water use during primary energy production and electricity generation. Of this water withdrawn, nearly 66 billion m^3, or 11%,

[2] An intervention can be for example the construction of a new power plant (hardware intervention) as well as the introduction of a new policy or support scheme (software intervention).

is not returned to the source and therefore is deemed to be consumed (Lavelle and Grose, 2013). The share of water withdrawn and consumed for energy significantly varies at the national level.

Global energy demand is projected to increase 35% by 2035. Meeting this rising demand could increase water withdrawals in the energy sector by 20%, and water consumption in the sector by 85% (World Bank, 2013).

Energy demand for water services is set to increase. Global data on energy use in extracting, producing, treating and delivering water remain limited. This is primarily because of large variations in the energy intensity of delivering water due to differences in water source (such as groundwater or surface freshwater), water quality (high-salinity seawater is the most energy intensive to treat and use) and the efficiency of water delivery systems (IRENA, 2015).

As easily accessible freshwater resources are depleted, the use of energy-intensive technologies, such as desalination or more powerful groundwater pumps, is expected to expand rapidly (World Bank, 2013; WEF, 2011; Hoff, 2011).

Significant energy is used to heat water for domestic and industry applications. This energy is derived either directly from the combustion of fuels, such as natural gas and fuel oil, or indirectly through electricity. In the latter case, the risks posed by the nexus become more pronounced because of the destabilising impact that increased heating demand can have on the electricity system (IRENA, 2015).

The intensity of the water–energy nexus is a regional, national or sub-national characteristic, which depends on the energy mix, demand characteristics, resource availability and accessibility. For power production, for example, the choice of fuel and technologies holds significant impacts for the quantity of water required (World Bank, 2013; Farid and Lubega, 2014). Where water resources are limited, technologies that impose less strain on water resources may be preferable. Renewable energy technologies such as solar photovoltaics and wind consume little-to-no water during operation compared to fossil fuel-based plants that require large amounts of water during the different stages of energy production.

Water is a critical input for fuel extraction, power generation as well as food production. The **risks that the water sector presents to energy and food security** as well as the energy sector to water security have been summarised in the table below:

a) Shifts in water availability and quality, resulting in reduced reliability of supply.

	RISKS	IMPACTS
Water-related risks to energy security	Shifts in water availability and quality due to natural or human-made reasons (including regulatory restrictions on water use for energy production/ fuel extraction)	• Reduced reliability of supply and reliance on more expensive forms of generation • Possibility of economic pricing of water and therefore higher costs of energy production • Reduced availability of water for fuel extraction and processing stages, leading to reduced outputs
	Increase in energy demand for water production, treatment and distribution	Strains on the energy system and reduced efficiencies given the different demand profiles for water and energy
Energy-related risks to water security	• Limited or unreliable access to affordable energy necessary to extract water • Re-allocation of water resources from other end-uses to energy	• Disruption in water supply to end-users or diversion of resources away from other core activities such as agriculture • Changes in delivery cost of water due to fluctuating costs of energy inputs

Food-related risks to water security	Contamination of water resources due to energy extraction and transformation processes	Water resources, including for drinking purposes, rendered unsuitable due to contamination, often requiring additional treatment
	Impact of agricultural activities on water resources	Use of external inputs for agriculture and food production can lead to water pollution affecting downstream activities and aquatic life
	Poorly regulated agricultural foreign direct investments (e.g., international land leasing)	Increased agricultural land leasing, when poorly regulated, could lead to expanded use of local water resources, with negative local socio-economic impacts
	Water resource over-utilisation due to food security ambitions	Pursuit of food security ambitions can strain water resources, often leading to substantial depletion in freshwater reserves

Table - Summary of risks and impacts within the water nexus (adapted from IRENA, 2015)

5 Nexus in the context of food security

The relationship between water and food systems is among the most widely covered elements of the nexus. Historically, the accessibility and availability of water resources has greatly influenced the evolution of agricultural practices globally. The type of crops grown, the crop cycles and the irrigation method adopted all vary from arid to wet parts of the world. Today, the water–food nexus is symbolic of vulnerabilities on two fronts: *changing patterns of water supply that is influencing the reliability of water-intensive sectors including agriculture*, and *growing competition for limited water resources in meeting the projected increase in food demand* (IRENA, 2015).

By 2050, a projected 60% increase in agricultural production, will cause water consumption for irrigation to rise by 11% and withdrawal by 6%, despite accounting for modest gains in water efficiency and crop yields (FAO, 2009). Although a seemingly modest increase, much of it will occur in regions already suffering from water scarcity and witnessing intense competition with other sectors, including manufacturing, electricity production and domestic use. In the face of these competing demands, increasing allocation of water for irrigation will be challenging (OECD-FAO, 2012).

Irrigation will have to play an important role in increasing food production. Growth in agricultural production to feed a projected human population of over 9 billion in 2050 will come from 1) increasing crop yields, and 2) expanding arable land area, together with increases in cropping intensities (i.e., by increasing multiple cropping and/or shortening fallow periods). Yields of irrigated crops are well above those of rain-fed ones. To achieve increased production, the expansion of harvested irrigated land area is estimated to rise nearly 12% to 2050, compared to a 9% rise for rain-fed harvested land area (Alexandratos and Bruinsma, 2012).

Agriculture is both a cause and a victim of water pollution. Although the majority of the food produced is consumed domestically, trade in agricultural commodities continues to grow. Hence, quantifying the water–food nexus requires due consideration of the virtual (or embedded) water content of agriculture products. Virtual water refers to the total amount of water needed for food production which changes from country to country depending on agriculture practices (IRENA, 2015).

The **risks posed by the food sector on energy security as well as the energy and water security on food security**, have been summarised in the table below:

	RISKS	IMPACTS
Energy-related risks to food security	Dependence on fossil fuels increases volatility of food prices and affects economic access to food	• Fossil fuel dependency of upstream (e.g., production) and downstream (e.g., transport, storage, etc.) food supply chain • Price volatility and supply shortages of energy inputs introducing economic and physical risks in the food supply chain • Social, environmental and health impacts of traditional biomass cooking methods
	Potential trade-offs between bioenergy production and food crops	Allocation of agricultural products for bioenergy production with possible impacts on food prices & food production
	Risks of energy production on food availability	Possible negative impacts of energy technologies (e.g., hydropower, thermal power generation) on river and marine life
Food-related risks to energy security	Overall increase in food production and changing diets raises energy demand along the food supply chain	Rising demand for energy needs for agriculture can strain the energy system, particularly in regions with a potential to expand irrigated agriculture with pumped water
	Quality and affordability of energy supply can depend on feedstock availability	In energy mixes with bioenergy, quality and affordability of food-crop-based feedstock can affect energy supply
Water-related risks to food security	• Increased variability in water availability, particularly due to climate change • Regional concentration of food production and consumption	Changes in supply of food products, leading to higher price volatility, further compounded by regional concentration of food production activities
	Impact of water quality on food production and consumption	Utilisation of poor-quality water along different stages of the food supply chain can have negative impacts, including soil degradation and accumulation of contaminants within the food chain

Table - Summary of risks and impacts within the food nexus (adapted from IRENA, 2015)

6 Nexus in the context of energy production & the SE4ALL initiative

The SE4ALL initiative has set challenging objectives for increasing the renewable energy uptake, increase the rate of efficiency improvement, and increase access to energy, globally. It is technically possible to meet the SE4ALL objectives by 2030, but it is difficult to foresee what this would entail in other sectors (e.g. a sharp increase of energy consumption as a consequence of access to electricity; a progressive decline of groundwater resources as a consequence to energy access for irrigation; a negative impact on food security as a consequence of increased biofuel production; etc.).

The energy-water linkages and the energy-food linkages mentioned in sections 4 and 5 above and in the two previous tables should certainly be considered if the SE4All objectives are to be met in a sustainable way and lead to sustainable development.

More specifically, the table below summarizes some synergies and trade-offs associated with specific types of interventions linked to sustainable energy, i.e. those kind of interventions that could be supported under EU cooperation frameworks or support instruments on energy, which have potentially important impacts outside the energy sector. Synergies and trade-offs with the water sector and the food sector, are highlighted in green and red respectively. This table is useful to get an initial indication about which main nexus issues require particular attention, on the basis of the intervention type.

This table mentions specifically some energy-water and energy-food linkages relevant in the context of the SE4ALL initiative and related sustainable energy interventions.

Access to modern energy objective	Energy efficiency objective	Renewable energy objective
Water pumping and groundwater management Access to modern energy facilitates the provision of water and sanitation services, for example through electricity (solar) pumping of groundwater resources. The depletion of underground aquifers due to access to energy for pumping can put food stability at risk in the long run Energy for clean drinking water Energy can be used to boil and sterilize water for drinking and cooking. Water desalination Water desalination can provide freshwater for agriculture and sanitation in costal dry countries. A large amount of energy (electricity) is needed to desalinate water resources. Water for power generation Thermal plants (including nuclear) consume large amounts of water, etc.	Energy efficient water technologies Energy can be saved and used more efficiently adopting technologies that also make efficient use of water resources. Irrigation systems Energy waste in irrigation due to Irrigation equipment, operations and maintenance problems. Irrigation systems can increase water-efficiency and energy-efficiency at the same time (e.g. drip irrigation) Management of water by utilities Reduction of water losses and management improvements in water utilities leads to less energy consumption to pump, lift and transport water Water productivity in agriculture By improving the productivity of rain-fed agriculture, energy-intensive irrigation can be limited or reduced.	Dams and hydropower Dams and hydropower projects can lead to non-equitable water entitlements and rights, particularly for downstream communities (e.g. water diversions, water use and access). Both large-scale and small-scale hydropower infrastructure may increase the risk of flooding and put additional stress on fisheries and ecosystems. Deforestation and accompanying infrastructure constructions (e.g. roads) will further alter watershed ecosystem and reduce their resilience to flood risks. Bioenergy Biofuel production, especially in developing countries, can lead to insecure and inequitable water entitlements (land and water grabs). Water is needed for biomass production for feed and energy. There might be competition over these water resources from other users. Production of bioenergy can contribute to water pollution.
Hydropower production Hydropower provides access to modern energy and when associated with storage in reservoirs, contributes to the stability of the electrical system by providing flexibility and grid services. Large-scale and small-scale hydropower infrastructure may significantly affect water flows (fluctuations and alterations), sediment load, nutrient flows and water quality.	Agricultural productivity There is the risk that energy efficiency in primary production is achieved at the expense of productivity Energy efficiency and economic return Reduction of use of non-renewable energy in agrifood systems has usually a positive effect on economic returns of food production in the long run	Food crops use for bioenergy compete for food availability (although they can have positive effects on food access) Damage of forest land can affect livelihoods of local populations therefore access to food Energy recovery from biomass, organic waste and wastewater and water quality
Irrigation systems Access to modern energy makes possible active water management through power irrigation, benefiting crop and livestock production and can lead to unsustainable water pumping Access to energy for irrigation can	Livestock production The use of animal waste and manure for biogas production increases the overall energy efficiency of meat production, while providing a low-cost source of fertilizers that can help increasing yields in a sustainable	Reducing the pollution potential of wastewater by converting oxygen demanding organic matter that could cause low oxygen levels in surface waters. Nutrients, like nitrogen and phosphorous, are conserved in biogas effluents and can be used to displace

Access to modern energy objective	Energy efficiency objective	Renewable energy objective
lead to stress, runoff and erosion, hence reduced yields in the long run. Water pollution by fossil energy use Water for extraction, mining, processing, refining, and residue disposal of fossil fuels, as well as for growing biofuels and for generating electricity → competing uses over resources. Tar sands, shale gas, hydraulic fracturing are particularly water-intensive as well as polluting. Water contamination from oil.	manner Improved cooking efficiency Increase in efficient use of energy for cook stoves and technology for food preparation and conservation increases quality of food. New technologies and practices in agriculture New technologies and practices can reduce the use of non-renewable energy in agro-food systems while maintaining a stable food production	chemical fertilisers in crop production. Biogas produced from wastewater can be used in direct combustion (e.g. absorption heating and cooling, cooking, space and water heating, drying, and gas turbines) and in internal combustion engines and fuel cells for production of mechanical work and electricity. Recycled nutrients can be used as fertilisers instead of mineral fertilisers
Technologies for resilience to water-related disasters Increased access to energy services will most likely support economic development, which will have far-reaching impacts on ecosystems (e.g. the uptake of technologies for water purification and storage) Yield increase and income Access to modern energy leads to higher yields, therefore an increased food availability and often (but not always) incomes Increased yields on food prices Access to modern energy for farming can decrease food price to consumers due to increased yields Food processing technology Access to modern energy enables the introduction of mechanization and technologies that can reduce food losses and waste Cooking Access to modern energy decreases pressure on forest resources and forest damage Renewables uptake at household level Access to renewables at household level in off-grid areas allows better food conservation	Food transport Transporting food for long distance usually implies a less energy efficient food chain (with associated GHG emissions) but can help to mitigate domestic food price volatility	Fossil fuel pollutants Renewable energy, such as wind and solar power, leads to less water pollutants due to avoidance of fossil fuel burning. Some renewables such as geothermal can have negative impacts on water quantity and quality. Energy for irrigation systems Renewables can provide the energy needed for active water management through power irrigation (e.g. solar water pumping), especially in isolated rural locations, therefore making communities more resilient. Irrigation can also play an important role in mitigating the impacts of floods and droughts. Depending on the context, drainage of wetlands may increase the risk of flooding, and excessive irrigation (and lack of drainage) may promote soil salinization and desertification. Delinking the food and energy markets The uptake of renewable energy in agro-food systems helps to decouple agricultural production from the energy market Increase of renewables usually translates in a saving on the energy bill

Table: Fields of (sustainable energy) intervention with their synergies, trade-offs and risks from a nexus perspective (adapted from FAO 2014a)

7 The EU financed Nexus Dialogues

The "Nexus Dialogues" Phase I (2016-2018) EUR 6 170 000 budget proposes to strategically steer on-going and newly established demand-driven Nexus policy-dialogue approaches in five regions: Africa (Nile, Niger and SADC), Latin America (Andean region), Asia (Mekong Area), Central Asia (Aral Sea region) and the Neighbourhood (with particular focus on the Mediterranean region) with a view to achieving substantial outcomes, namely, Nexus policy recommendations and concrete endorsed Nexus action plans that can benefit from Phase II (project implementation can start from 2017 onwards when further funds would be mobilised for leveraging investment in larger-projects).

The project was presented by Commissioner Mimica at the 7th World Water Forum held in April 2015 demonstrating strong political commitment to the nexus agenda.

The German Development Agency are providing financing of EUR 1 170,000 and will lead the Secretariat of the initiative given their strong understanding of the topic in many regions across the world.

This action has been designed with a primary focus on dialogue to trigger the development of policy recommendations and action plans for future investment. The "Nexus Dialogues" is therefore targeted at all developing countries where there is strong evidence of demand-led "Nexus-awareness and Nexus-readiness".

This action builds on important early lessons learnt from water, energy and food security nexus discussions around the world over the last two and an half years.

As a result of this programme, governments and organisations are expected to make improvements to existing policy discourse and more efficient and inclusive long-term policy. The Nexus Dialogues should not mean a duplication of effort; the action should fit within existing regional programmes and platforms as appropriate and bring a stronger Nexus brief to on-going discussions.

This action will also finance support studies, building up teams of nexus experts from the countries/regions, small-pilot projects and an evaluation and a feasibility study to guide Phase II i.e. leveraging of investment projects.

For further information on the Nexus Dialogues project please contact the DEVCO HQ Water team.

8 List of key questions

The following questions can be used by DEVCO HQ and Delegation staff when preparing in particular infrastructure, water, energy, and food security projects, but also when considering trade, security, human rights, decentralisation projects and programming

Governance, legal basis and institutional organisation

- Which legal basis are applied to the management of water, energy and land?
- Which institutions (modern and traditional ones) are in charge of water, energy and land management?
- Are there any institutional mechanisms in place to ensure inter-ministerial and inter-sectorial dialogues on cross-cutting issues? The start of the discussion is the common points between the sectors. That is the nexus.
- Is resource availability (data) and resource management accessible and transparent to all sectors?
- What incentives can be put in place to encourage cross-sectoral dialogue?
- Have potential trade-offs between bioenergy production and food crops been discussed and identified among relevant stakeholders and national agencies?

- What would nexus success look like?
- Who is responsible for the nexus?

Water management

- What is the country strategy and policy in the field of water management?
- Which ways of operating dams sustain wetland fisheries?
- Which technologies make irrigation more water efficient?
- Which are the water storage options available for farmers?
- What are energy efficient water treatment technologies?
- How does watershed management help hydropower?
- Are there legal/regulatory restrictions on water use for energy production?
- Is there a shift in water availability (changing precipitation patterns) and quality (pollution or salinity)?
- Is there increasing energy demand for water production, treatment and distribution?
- Is there a shift in water availability affecting traditional generation, requiring expensive back-up supply?
- Is the target region affected by increased variability in water availability for food production, particularly due to climate change?
- Are there disruption in food supply due to local water variability, given geographic concentration of food production and consumption?
- What is the impact of food production and consumption on water quality?
- Is climate change impacting availability of water resources in the long term?
- Is access to energy necessary to extract, transport and treat water limited or unreliable?
- Is water being reallocated between energy and other end-uses? How?
- Is management of dams for hydropower considering the flood risk management?
- Is there any contamination of water resources due to energy extraction and transformation?
- Are there important fluctuating costs of water supply due to variability in prices of energy inputs?

Food security and land management

- What is the country strategy and policy in the field of land management?
- Is there a lack of energy availability which hinders food processing and irrigation?
- Is water resource over-utilisation impacting food security ambitions?
- Are food production and processing activities contaminating groundwater or surface run-off water?
- Is water contamination leading to increased water supply costs?
- Is increased food production and changing diets raising energy demand along the supply chain?
- Are there important variations in crop-based bioenergy feedstock prices?
- To what extent is the food supply chain dependent on fossil fuels in the different steps?
- What amount of agricultural products are allocated to bioenergy production?
- Which are the local social, environmental and health impacts of traditional biomass cooking methods?
- Are energy inputs highly volatile (economically and physically)?
- Is lack of access to energy leading to increased food wastage (e.g. lost productivity, or high processing losses)?
- What are the risks around the virtual nexus i.e. the risks resulting from the exportation of certain types of products grown in developing countries on their economies?

Investments

- Are foreign direct investments in the energy, water or land sector (e.g. international land leasing) poorly regulated?

Emerging questions:

- What would nexus success look like?
- Who is responsible for the nexus? Who governs the nexus? – activating all sectors/parts of governance, activating polycentric governance
- Who do we make accountable for making the nexus work?
- What behaviours do we expect from key players?

9 Useful references and links

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For a **collation of specific tools that could be used to assess nexus impacts and to draw scenari**o, see

- Annex 3 of the FAO report Walking the Nexus Talk: Assessing the Water-Energy-Food Nexus in the Context of the SE4All Initiative: http://www.fao.org/3/a-i3959e.pdf, or
- http://www.water-energy-food.org/en/practice/assessment.html

[i] http://www.erd-report.eu/erd/report_2011/

[ii] Land tenure – the EU is currently supporting the implementation of the VGGT under the thematic instruments: FSTP and now the GPGC. This is an important DEVCO topic.

[iii] By 2030, demand for water and energy is expected to rise by 40% by 2030 and while food demand is expected to rise 50% by 2030…*"It is becoming ever more difficult to provide universal access to water and energy and achieve food security in a sustainable way. Close to 1 billion people are undernourished, 0.9 billion lack access to safe water and 1.5 billion have no sourceof electricity."*

[iv] http://www.unwomen.org/en/news/stories/2012/8/gender-perspectives-on-water-and-food-security

[v] http://www.se4all.org/