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*A collection of data and information on the Water-Energy-
Food Security Nexus*

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Introduction

The World Economic Forum brought the issue of risk correlation between water, energy and food (WEF) securities to full political attention at the Davos Summit through the *Global Risks 2011 report*.

- A rapidly rising global population and growing prosperity are putting unsustainable pressures on resources. Demand for water, food and energy is expected to rise by 30-50% in the next two decades
- Economic disparities incentivize short-term responses in production and consumption that undermine long-term sustainability.
- Shortages could cause social and political instability, geopolitical conflict and irreparable environmental damage. (World Economic Forum, 2011)

**Security is about understanding and managing risks (and uncertainty),
tradeoffs and synergies**

Physical, economic and reliable access to required quantity/quality of WFE (for health, livelihood and production) with acceptable level of risks to individuals, environment and society

What is the NEXUS?

- Consumption of food, water and energy — directly or indirectly — impacts ecosystems and natural resources that society depends on for its survival.
- Recent events tell us that no longer food, water and energy systems can be viewed in isolation.
- We must understand how and where these three systems intersect — **the nexus**
- Nexus is an approach to ensure equity between generations and between segments of society, it is not an end in itself

3

Water, Energy, and Food security: the nexus approach

(WEF) Nexus approach aims at understanding how each of these three sectors relates to the other two and how this understanding can be used to make policy decisions that promote sustainable development and poverty reduction.

- The nexus approach is more than technological advances; it requires collaboration across ministry different levels of government and international cooperation.
- Reliable and effective governance is critical to the nexus approach a crucial aspect of effective governance is the engagement of participatory approaches including stakeholders.

4

Examples of E-W-F Nexus

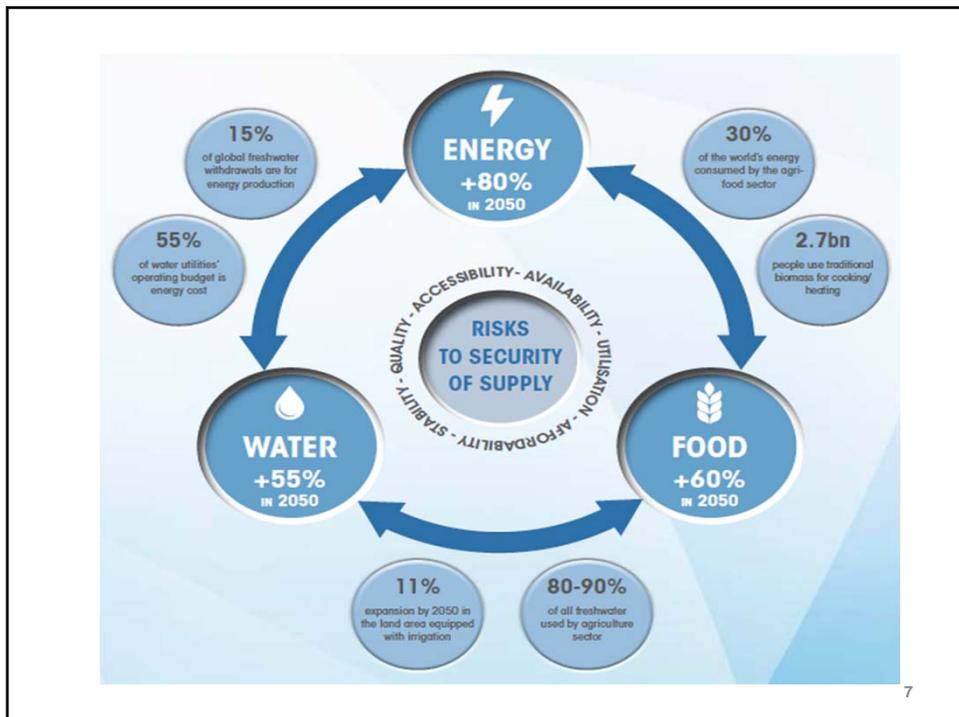
- Energy is required to treat water, wastewater, and transport drinking water;
- Water is required to make electricity and produce transportation fuels;
- Energy and water are required to grow food;
- Water quality can be adversely impacted by food and energy production.

5

Nexus Discussions on Global Levels

- **Bonn conference (2011)** focused on **interdependency of water, energy, and food security** to “explicitly identified in decision making”.
- **Rio+20** highlighted the linkages between water, food security and nutrition and sustainable agriculture; sustainable cities; health; biodiversity; desertification etc.
- **UNFCCC Executive Secretary during COP18** described the **food-water-energy nexus** as the “human face” and **solution to climate change** (WMO, 2012).
- **UN Secretary General** highlighted the use of a **nexus approach** and urged the inclusion of environmental, social and economic dimensions (GIZ, 2012).

6



The Nexus: Its high relevance in the Mediterranean



The Nexus approach is important for the Mediterranean countries:

- many of them greatly rely on agricultural production
- demand for energy is increasing with improvement of life standards
- water shortages are increasing, including due to climate impacts

- The Arab Spring was triggered by increasing poverty including food prices



8

Nexus is just a tool to deal with interconnectedness

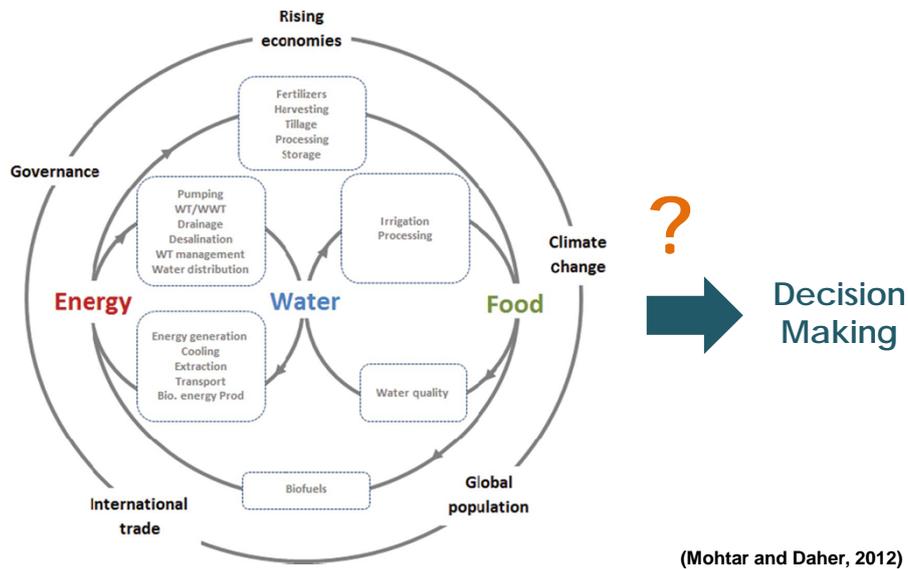
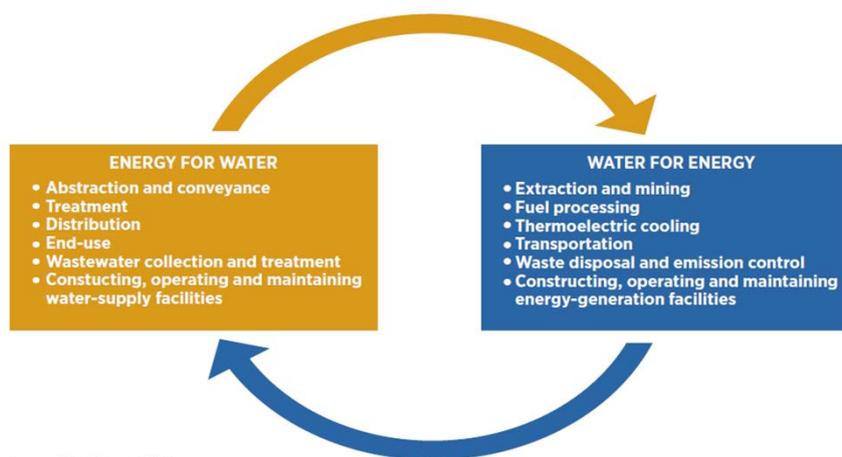


Illustration of the water-energy nexus



Water food energy nexus security the question: where are we now?

- Do we have enough data points to catalyze action?
- How are organizations tackling interconnected resources challenges?
- Valuing natural capital can help accelerate nexus thinking and policy making?

11

The Current Situation

- Policies and legislation rarely account for interconnections in any combination among food, water or energy.
- Most governments have separate agencies to oversee water, energy, and agricultural food production with separate policies and plans for each sector.
- Consequences are resource depletion and environmental degradation with serious socio-economic implications.

12

Problem Statement

- Decision makers, in general, do not have access to comprehensive tools that:
 1. Quantify relationship between water, energy, and food
 2. Define their interconnectivity
 3. Develop a strategy that allows integrative management and planning for the future of these resources

This poses a threat to socioeconomic sustainability and resilience of national resources.

13

WFE Nexus: The needs

- Nexus requires governance, capacities, institutions, policies, solid RfD
- Nexus needs to be promoted at two parallel tracks, regional and national policy and and at two levels: governance and implementation
- Need for a regional platform for knowledge exchange
- Need to pilot and scale up
- Need for a regional roadmap to guide and streamline the scattered efforts: Convergence and synergy creation

14

WFE Nexus: The needs

- An integrated planning and management approach for water, energy and agriculture is required for guaranteeing sustainability
- A knowledge gap on the water-energy nexus in numerous countries around the world need to be bridged by concentrated research
- Academic and research programmes focussed on understanding the nexus as well as renewable energies (solar) and desalination.

15

WEF frameworks

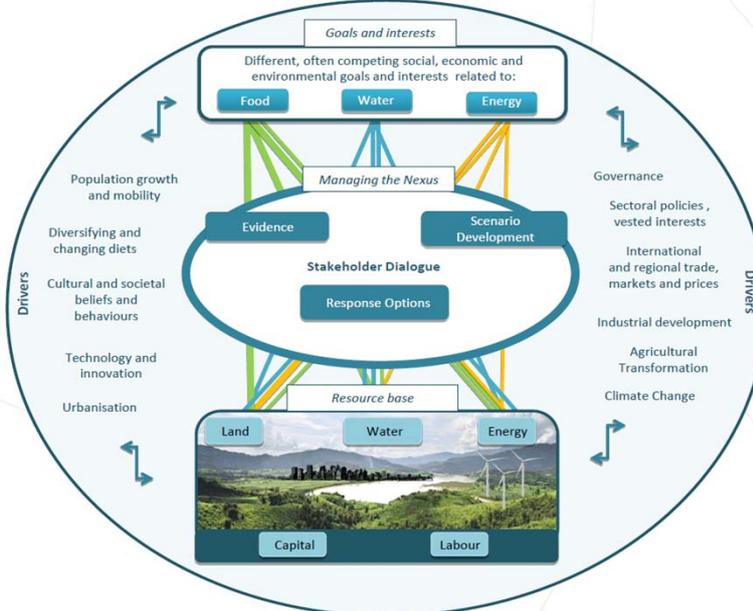
The following frameworks aim to provide an informed and transparent approach that builds on the system perspective, enables trade-off assessments and aims to promote transition to sustainability.

Key elements: they all focus on promoting security and consider involving different domains: society, by changing human behaviours; economy, by using different approaches to economic growth; and environment, by promoting ecosystem services.

The ultimate focus of these frameworks is to promote action by providing policy entry points to reduce trade-offs, explore synergies and promote the transition to a more sustainable future

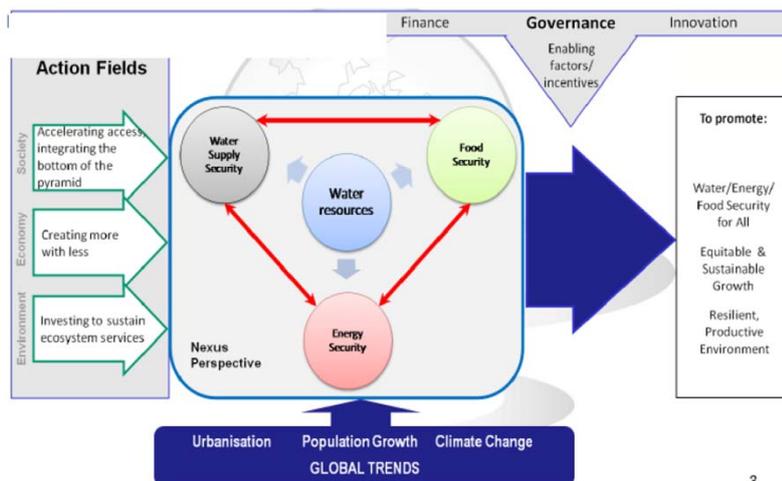
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The FAO approach to the Water-Energy-Food Nexus



17

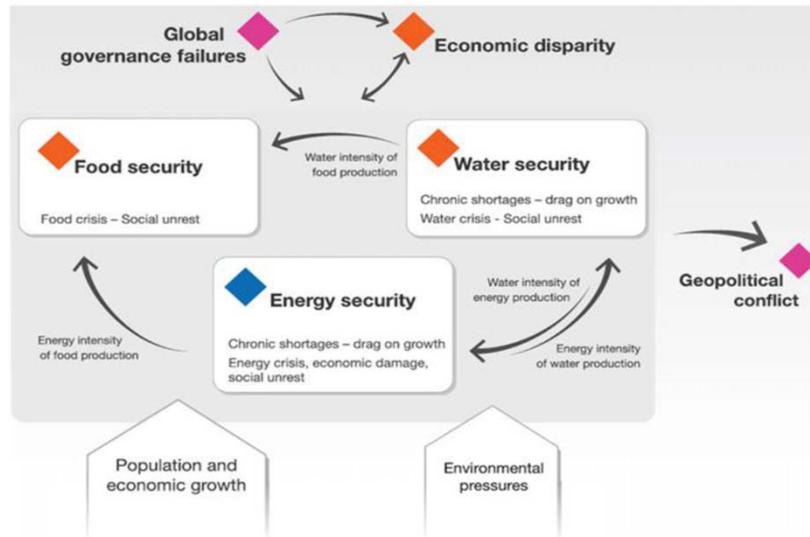
WEF Framework: Bonn2011 Nexus Conference



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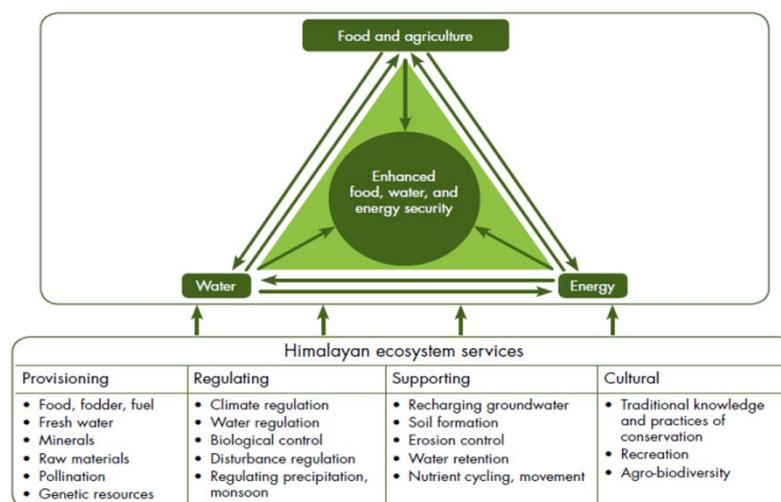
18

WEF Framework: World Economic Forum 2011



19

WEF Framework: International Centre for Integrated Mountain Development, 2012



20

Promoting WFE Nexus Interventions Areas

- Engaging stakeholders to build awareness and capacities about the interconnected nature of the elements of the WEF nexus, share ways to minimize trade-offs, explore synergies and suggest actions for changing behaviours with regard to the nexus and with regard to other actors whose well-being relies on services and products associated with elements of the nexus.
- Improving policy development, coordination and harmonization to account for trade-offs and build on the increased interconnectedness of WEF. Part of this process is promoting, identifying and eliminating contradictory policies.
- Governance, and integrated and multistakeholder resource planning to promote cross-sectoral and cross-departmental approaches to planning and working with stakeholders at different levels to improve public sector-led governance, planning and information.
- Promoting innovation to identify technological choices and investments that explore WEF synergies and could be implemented to achieve desired changes on the ground.
- Influencing policies on trade, investment in environment/climate by focusing on improving ecosystem management to increase resource productivity, thus contributing to poverty alleviation and green growth.

21

Nexus tools for assessing tradeoffs and synergies

The Objectives:

- Development and deployment of an **integrated resource management tool** based on the water- energy-food nexus framework
- Implementation and evaluation of the tool over a wide range of climatic and socio-economic zones represented by different countries **in the arid and semi arid regions**.
- Avail, as a by-product, a standardized WEF-nexus optimum **institutionally coordinated database**
- Engage decision makers in **the process of improving current policies**, and strengthening relevant public-private collaboration through the use of the proposed tool.

22

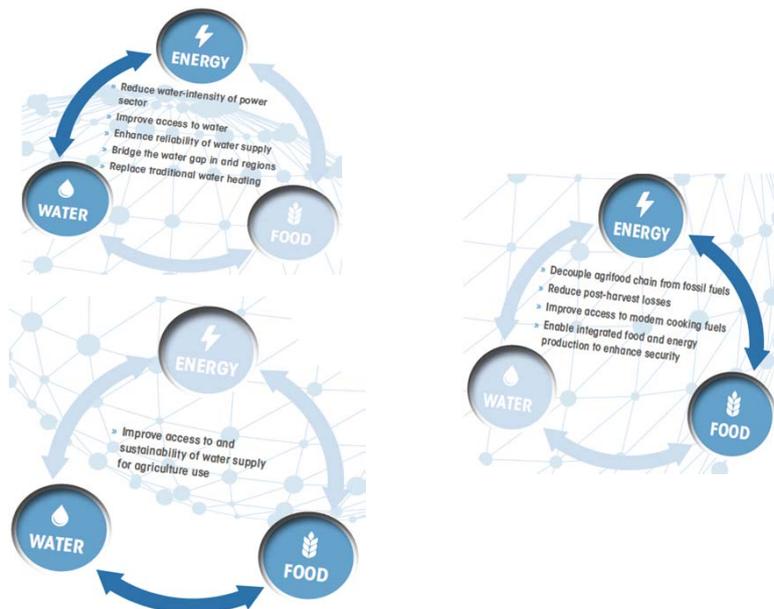
Renewable Energy and the Water, Energy and Food Nexus Initiative

In spite of the important role renewable energy could have on both water and food security nexus, yet the running project in this field is still very limited. Partnership between international, regional organizations and national scientific and research institutions should be established working together on effective programmes having the following objectives.

- **Develop an empirical energy-centric nexus tool** to provide qualitative estimates of the impact of renewable energy deployment on the different elements of the water, energy, and food nexus.
- **Support policy makers** in: optimizing the level of renewable energy that can be sustainably integrated into the national energy mix; and/or assessing the impact of existing renewable energy targets on other national resource needs.
- **Disseminate the key findings** from the study among different stakeholders through platforms such as the World Future Energy Summit 2014.

23

Renewable Energy Opportunities



24

Conclusion and recommendations

- The knowledge gap in the water-energy nexus in many development as well as developed countries need to be bridged by concentrated active research to identify
 - ❑ **Inter-dependencies(e.g., efficiency relationship in both resources)**
 - ❑ **Current and future challenges**
 - ❑ **Opportunities(e.g., potential of energy capture from wastewater treatment plants)**
 - ❑ **Appropriate and effective governance, institutional, and organizational frameworks**
- Exploring the options for **demand side management in both water and energy systems is more promising than the supply side management (including technological and behavioral)**
- Water and Energy are strongly interlinked and warrant close **cooperation / coordination in planning and management, even joint planning to achieve efficient management of both**
- Formulation of multi-sectoral policies and adopt development practices capable of achieving integrated and comprehensive planning and management in the areas of energy, water, and food security for current and future generations. A regional cooperation that involves Governments, universities, and public sector stakeholders can support the achievement of this goal.

25

Science recommendations

1. Identify and quantify linkages of the “Water System”: food and energy
2. Create a global **Water Knowledge Hub that is relevant, visible, credible and at low cost.**
3. Establish **“water value” as an economic, social and political good.**
4. Deploy **tools for managing and planning water resources and risk management strategies**
5. Deploy technologies to improve **water use efficiency at local and regional scales.**
6. Understand water physical and human systems for **improved science based decision making.**

26

Recommended reading

ADB (2013). Thinking About Water Differently: Managing the Water-Food-Energy Nexus. Asian Development Bank (ADB). Mandaluyong City, Philippines

Bizikova, L., Roy, D., Swanson, D.A., Venema, H.V. and McCandless, M. (2013). The Water- Energy-Food Security Nexus: Towards a Practical Planning and Decision Support Framework for Landscape Investment and Risk Management International Institute for Sustainable Development (IISD). Winnipeg, Canada

Bonn (2011). Messages from the Bonn 2011 Conference: The Water Energy and Food Security Nexus- Solutions for a Green Economy In: The water energy and food security nexus- Solutions for a green economy Bonn.

de Fraiture C., Giordano M., Liao Y. (2008): Biofuels and implications for agricultural water use: blue impacts of green energy, *Water Policy* 10, 67-81

de Fraiture C. et al. (2007): Looking ahead to 2050: scenarios of alternative investment approaches, in: *Water for food, water for live* (ed: Molden D.)

DHI (2010): P. Glennie, G. J. Lloyd, H. Larsen, *The Water-Energy Nexus: The water demands of renewable and non-renewable electricity sources*

FAO (2014). *The Water-Energy-Food Nexus. Concept Note.* FAO. Rome

FAO (2009): Growing more food, using less water, www.fao.org/fileadmin/user_upload/newsroom/docs/water_facts.pdf, accessed 29 August 2011

GAO (2010): Energy-Water Nexus: A Better and Coordinated Understanding of Water Resources Could Help Mitigate the Impacts of Potential Oil Shale Development; GAO-11-35. 70 United States Government Accountability Office (GAO), Washington, DC

German, L., Schoneveld, G., Skutch, M., Andriani, R., Obidzinski, K. and P. Pacheco (2010): The local social and environmental impacts of biofuel feedstock expansion. A synthesis of case studies from Asia, Africa and Latin America, *CIFOR Infobrief* 34

Gerten D., Heinke H., Hoff H., Biemans H., Fader M., Waha K. (2011): Global water availability and requirements for future food production, *Journal of Hydrometeorology*, 12, 885-899

Gleick P. (2003): Global freshwater resources: soft-path solutions for the 21st century, *Science*, 302, 5650: 1524-8

Godfray H.C.J.; Beddington J.R.; Crute I.R.; Haddad, L.; Lawrence, D.; Muir, J.F.; Pretty, J.; Robinson, S.; Thomas, S.M. and Toulmin, C. (2010) Food security: The challenge of feeding 9 billion people. *Science* 327, 812, DOI: 10.1126/science.1185383

Grey D., Sadoff C.W. (2007): Sink or swim? Water security for growth and development, *Water Policy*, 9, 545-571

Hellegers, P., Zilberman, D., Steduto, P. and McCornick, P.G. (2008). Interactions between Water, Energy, Food and Environment: Evolving Perspectives and Policy Issues., *Water Policy*, 10, (1-10).

Hoff, H. (2011). Understanding the Nexus. Background Paper for the Bonn2011 Conference. The Water, Energy and Food Security Nexus., Bonn. Stockholm Environment Institute, Stockholm

Hoff H. (2009): Global Water Resources and their Management, *Current Opinion in Environmental Sustainability*, 1:141–147

Hoogeveen, J., Faures, J.-M. and Van de Giessen, N. (2009): Increased biofuel production in the coming decade: to what extent will it affect global freshwater resources? *Irrigation and Drainage*, 58. Pp. 158–160, Wiley.

IEA (2009): *World Energy Outlook 2009*, International Energy Agency

IPCC (2011). Special Report on Renewable Energy Sources and Climate Change Mitigation Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Seyboth, K., Matschoss, P., Kadner, S., Zwickel, T., Eickemeier, P., Hansen, G., Schlömer, S., von Stechow, C. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA

KahrI F., Roland-Holst D. (2008): China's water-energy nexus, *Water Policy*, 10, 51-65

Karlberg, L. and Hoff, H. (2013). Using a Nexus Approach to Support Development and Environmental Planning in Ethiopia. SEI Discussion Brief. Stockholm Environment Institute. [<http://www.sei-international.org/publications?pid=2374> Accessed on 17/05/2014]

Lloyd, G & Larsen, H (2007); Report for Vestas: A Water For Energy Crisis?

McCornick P.G., Awulachew S.B. and Abebe M. (2008): Water-food-energy-environment synergies and tradeoffs: major issues and case studies, *Water Policy*, 10: 23-36

Mohtar, R.H. and Daher, B. (2012). *Water, Energy, and Food: The Ultimate Nexus Encyclopedia of Agricultural, Food, and Biological Engineering*, Second Edition

OECD (2011, forthcoming): Water, Energy and Agriculture: Meeting the Nexus Challenge, OECD, Paris

OECD (2011). Water, Energy and Agriculture: Meeting the Nexus Challenge, OECD, Paris.

Pimentel D. (2009): Energy Inputs in Food Crop Production in Developing and Developed Nations, *Energies*, 2, 1-24

SOER (2010): State of the Environment, Cross-sectoral assessment of the agriculture, energy, forestry and transport sectors, EEA

Stein, C. (2013). How Understanding Social Networks Can Help to Govern the Nexus: A Case from the Blue Nile Basin. SEI discussion brief. Stockholm Environment Institute. [<http://www.sei-international.org/publications?pid=2394> Accessed on 20/05/2014]

Stone et al. (2010): The potential impact of biomass production on water resource availability, *Bioresource Technology*, 101, 2014-2025

UN-WWDR (2014). Water and Energy. The United Nations- World Water Development Report.

UN-ESCAP (2013). Water, Food and Energy Nexus in Asia and the Pacific. Discussion Paper. UN-ESCAP. Bangkok.

UNECE (2014). Workshop on Water-Food-Energy-Ecosystems Nexus Assessment in the Sava River Basin. Unece Water Convention Draft Methodology.

UNEP (2011c): Cities – Investing in energy and resource efficiency, www.unep.org/greeneconomy/Portals/88/documents/ger/GER_12_Cities.pdf accessed 29 August 2011

UNEP / IWMI (2011): An ecosystem services approach to water and food security, United Nations Environment Programme and International Water Management Institute, Nairobi & Colombo

WBCSD (2009): Water, Energy and Climate Change. A contribution from the business community, Geneva

Webber M. (2008): Water versus Energy, *Scientific American*, Earth 3.0., 1 Oc, t34-41

WEF (2011): Water Security: The Water-Food-Energy-Climate Nexus, Island Press

Weitz, N., Nilsson, M., Huber-Lee, A., Davis, M. and Hoff, H. (2014). Cross-Sectoral Integration in the Sustainable Development Goals: A Nexus Approach. . SEI discussion brief. Stockholm Environment Institute. [<http://www.seiinternational.org/publications?pid=2474> Accessed on 27/05/2014]

World Policy Institute (2011): The Water-Energy Nexus: Adding Water to the Energy Agenda. Diana Glassman, Michele Wucker, Tanushree Isaacman, and Corinne Champilou. New York: World Policy Institute and EBG Capital, March 2011.

WWDR (2009): World Water Development Report 3: Water in a Changing World, World Water Assessment Programme, Earthscan, London, UK