

Research Article

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Co-Optimizing Solutions for Water and Food – Scoping the Nexus Challenges in the Agro-Sector and finding Scalable Business Solutions

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Abstract: The Water-Energy-Food (WEF) Nexus approach has an opportunity to create sustainable business solutions, especially in the agricultural sector. This report provides a clear understanding of challenges for the most promising and scalable solutions to the interconnected water, energy and food/feed/fiber problems, allowing combined co-optimization. Searching solutions for nexus challenges, a model based assessment of WEF nexus at global scale and a theoretical perspective of integrating economic and ecological objectives are presented. This study explores the opportunities for the global community to develop robust partnerships and cross sector collaboration to foster water security and increase resource use efficiency, particularly in agriculture and food industry, as part of corporate environmental and financial performance goals.

Keywords: Nexus; business solutions; co-optimization; agricultural sector

One of the innovative dimensions of the Water-Energy-Food (WEF) Nexus approach [1] compared to existing management approaches e.g., integrated water resources management [2,3] is that it has the opportunity to create sustainable business solutions, especially in the agricultural sector [4]. The private sector is an important part of the solution to water-energy-food security crisis.

The report provides a clear understanding about: (i) WEF nexus challenges; (ii) theoretical perspective of co-optimizing economic and ecological objectives contributing to solutions for nexus challenges; (iii) model based assessment of WEF nexus at global scale; (iv) scalable solutions to the interconnected water, energy and food/feed/fiber challenges, (v) combined co-optimization and challenges in the agricultural supply chain for business solutions.

Sustainability, synergies and trade-offs are the key issues for WEF Nexus challenges. Global agendas initiated by several international institutions such as climate change by United Nations Framework Convention on Climate Change (UNFCCC), biodiversity by Convention on Biological Diversity (CBD) and food security by World Summit on Food Security (WSFS) can be interlinked within nexus approach at both national and local level. Major challenge for nexus is that global demands for water, energy and food have increased enormously in the past few decades as a result of rising population, changing income levels and lifestyles and food consumption patterns and are expected to increase in the future must faster than the rate at which supplies to meet the demands are increasing [1,4]. The nexus approach can be demonstrated when analyzing the production of biomass. Growing demand for biomass to produce food, feed, fuel and fiber will not only increase the competition among these products over water and land but also have an impact on natural resources and ecosystems. Similarly, an assessment of food waste (more than 1.3 billion ton/annum) can be another way of looking at the nexus in reality. Food waste as a country would rank as 3rd top carbon emitter and 1st in terms of water footprint for agriculture products.

Managing natural resources is one of the key challenges for business companies and has been one of the core issues of sustainability research and practice for decades. For managing natural resources, linkages between corporate environmental performance (CEP) and corporate financial performance (CFP) through theoretical explanations,

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empirical results on resource use and water use efficiency, role of management and accounting are important [5]. Empirical results on resource and water efficiency demonstrate that CEP is more positively influenced by certain measures e.g., strategic performance, surveys and operational performance. Management at different levels i.e., stakeholder, strategic and operation level do matter for linking CEP and CFP. Similarly, the accounting can be used in data accumulation and data presentation to aid society in its attempt to internalize economic externalities through changing company's private costs or benefits.

The WBCSD Nexus model [6] is an integrated model to enhance business understanding of the water-energy-food security linkages at global scale through a quantitative analysis of (i) water demand for energy production; (ii) water demand for agricultural production; (iii) energy demand for water supply (only agriculture water excluding industrial and domestic water) and (iv) energy demand for food production. Geographically the model offers a wide spectrum of information from global to as small as a 25 sq. km area (approximately 5X5 km grid). In particular, it provides answers to the questions: (i) What are the constraints? (ii) Which geographical regions can be considered hotspots today and in future (2030, 2050)? The major sources of input data in the model are: Global Water System Project (GWSP), FAOSTAT, Water Footprint Network (WFN), Land Use and Global Environment (LUGE). Some of the insights it offers force us to revisit prevailing theories and rethink policies. For instance higher water efficiency in crop production may not necessarily mean an energy efficient production, and hence, the model guides towards co-management of resources. With new and updated data (e.g. latest crop data, energy use for water treatment systems) the model will increasingly offer more realistic scenario encompassing energy demand for domestic and industrial water supplies.

Scalable solutions for increasing agriculture production with less energy and water refer a large part of the options at hand to address the co-management challenges [7] – meeting the inevitable demand for food, fodder and fiber, yet remaining within the limits of water and energy availability, with minimum or zero environmental impact. Scalable Business Solutions is a group of motivated professionals working together to help companies quickly address the challenges and opportunities of the current business environment. An array of “smart” solutions exist and are being developed to usher us towards agricultural production that is knowledge-intensive, more precise and less wasteful, and which utilizes such innovations as smart seeds, clever crop agronomy, zero-energy farms, and integrated

logistical systems. These solutions are already available and can be implemented with multiple benefits on yields, energy, water, carbon emissions and land. Many of these solutions can be “co-managed” to reinforce each other and deliver multiple synchronized benefits of energy and water savings while increasing yields and creating better quality products at the same time.

Water is essential for manufacturing facilities, for communities, and for the agricultural supply chain [8]. The success of business depends on the agricultural supply chain. For optimizing water use benefits, each aspect of WEF nexus needs to be considered: (i) increased water availability, (ii) reducing water intensity of crop production; (iii) production of healthier crops (containing favorable biological, physical and chemical properties), and (iv) reduction of energy use and GHG emissions. Robust partnerships contribute to understand how to move forward towards increased water security and resource efficiency. For example, partnerships with farmers help in identifying problems with practical considerations, while partnerships with researchers can help in selecting appropriate technology through rigorous analysis. Sometimes, simpler solution can be found, e.g., use of low-cost tensiometers (traditional technology) in India, for monitoring soil moisture, which enables providing timely irrigation to crops. Research can, for instance, help developing mechanisms/techniques which ensure right amount of water at the right time.

Water, energy and food (WEF) nexus are important for sustainable development in the agriculture sector. Future agriculture will be more precise and more location specific, using more of improved natural processes. The interconnections of the WEF nexus enable complementary solutions for optimizing water use resulting in energy savings and healthy plants. The complementary solutions lead to creative approaches through partnerships with business leaders, researchers and farmers.

This report is based on the Session D03 at the International Conference *Sustainability in the Water-Energy-Food Nexus. Synergies and Tradeoffs: Governance and Tools at Various Scales* held in Bonn, Germany, on 19th and 20th of May 2014.

Session Chair: Joppe Cramwinckel, World Business Council for a Sustainable World

Speakers:

- “Water, Food and Energy Nexus Challenges” presented by: Alexander Müller, Institute for Advanced Sustainability Studies
- “Co-optimizing economic and ecological goals – how

- can companies contribute to the Nexus challenge” presented by: Edeltraud Günther, Technical University of Dresden, Germany
- “The WBCSD Nexus model” presented by: Ankit Patel, Resourcematics Ltd, UK
 - “Focus on key co-optimising solutions” presented by: Frank van Steenberg, MetaMeta, the Netherlands
 - “Addressing the Sustainability Challenge in the Agricultural Supply Chain” presented by: Liese Dallbauman, Water Stewardship Director PepsiCo

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