

Governing the Water-Energy-Food Nexus

Approach for Creating Synergies and Managing Trade-offs

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Key messages

- *The Asia-Pacific region is facing the challenges of securing water, energy and food. These challenges are intensifying due to economic growth and transformation, population growth, unsustainable land and resource use, changing lifestyles and climate change. As they are interconnected, to avoid major trade-offs these challenges need to be addressed through a nexus approach that considers water, energy and food as an integrated system.*
- *The water-energy-food nexus (WEFN) approach can play an important role in harnessing the synergies that exist between Sustainable Development Goals (SDGs) 2, 6 and 7, securing win-win solutions where possible, as well as in minimising potential trade-offs. To fulfil this role, better understanding based on scientific evidence of the linkages between SDG 2, SDG 6 and SDG 7, and their targets, is required.*
- *A number of common issues related to water, energy and food security have been identified in developing Asian countries. In the case of Bangladesh, India and Vietnam, these include: (i) inefficient use of water resources for irrigation, mainly driven by subsidised energy supply for irrigation water pumping; (ii) high dependency on thermal power plants, leading to increasing demand for water as a coolant by the energy sector; (iii) deteriorating water quality due to the discharge of untreated domestic and industrial wastewater, which threatens food safety and security, and rising costs and energy inputs for water treatment. Each of these issues affects more than one sector and can best be addressed through a WEFN approach.*
- *In developing Asian countries, the introduction and operationalisation of the WEFN approach faces many challenges including: (i) absence of institutional coordination; (ii) influence of political priorities on decisions rather than use of scientific knowledge to shape the decisions; (iii) lack of capacity to understand interlinkages between sectors; (iv) lack of multi-stakeholder engagement in planning and decision-making processes; and (v) lack of incentive mechanisms and adequate finance to support the approach.*
- *There is a strong need to establish enabling frameworks for promoting and governing the WEFN. These frameworks should be based on a continuous back-and-forth cycle between the generation of scientific evidence-based knowledge, the preparation of strategic guidelines, the identification of the means of implementation and practical nexus-oriented actions.*

1. Why is water-energy-food nexus thinking important for the Asia-Pacific region?

Water, energy and food are essential resources for human wellbeing and sustainable development. In Asia, home to nearly two thirds of the world's population and the largest regional contributor to global economic growth, the demand for these resources is immense. Asia is facing increasing difficulties in meeting its water, energy and food needs. Developing Asia, in particular, faces significant challenges. In the region, about 280 million people lack adequate access to safe water (ADB 2017), nearly 421 million people have no access to electricity (The Asian and Pacific Energy Forum and United Nations Economic and Social Commission for Asia and the Pacific 2017), and about 12% of people are chronically undernourished (FAO, IFAD, UNICEF 2017). It is likely that demand for water, energy and food will increase

further in the coming years due to a number of pressures, including rapid population growth and mobility, urbanisation, changing lifestyles, economic development and the impacts of climate change.

Water, energy and food security are inherently inter-linked and interdependent (Fig. 1). For example, about 4% of the world's total energy consumption is accounted for by water deliver (International Energy Agency 2016). The energy sector needs water for fuel extraction, cooling, and hydropower generation. This is clearly evident in India, where energy sector water demand will reach 90 billion cubic meters (BCM), which is about 8% of total usable water, if thermal power plants are cooled with conventional systems (Bhattacharya and Mitra 2013). Water and energy are also critical inputs for food security. India's agriculture sector consumes about 83% of total water withdrawals and 18% of total electricity consumption (Dewan 2017). These figures highlight the importance of managing water, energy and food in an integrated manner for realisation of the UN SDGs in Asian developing countries.

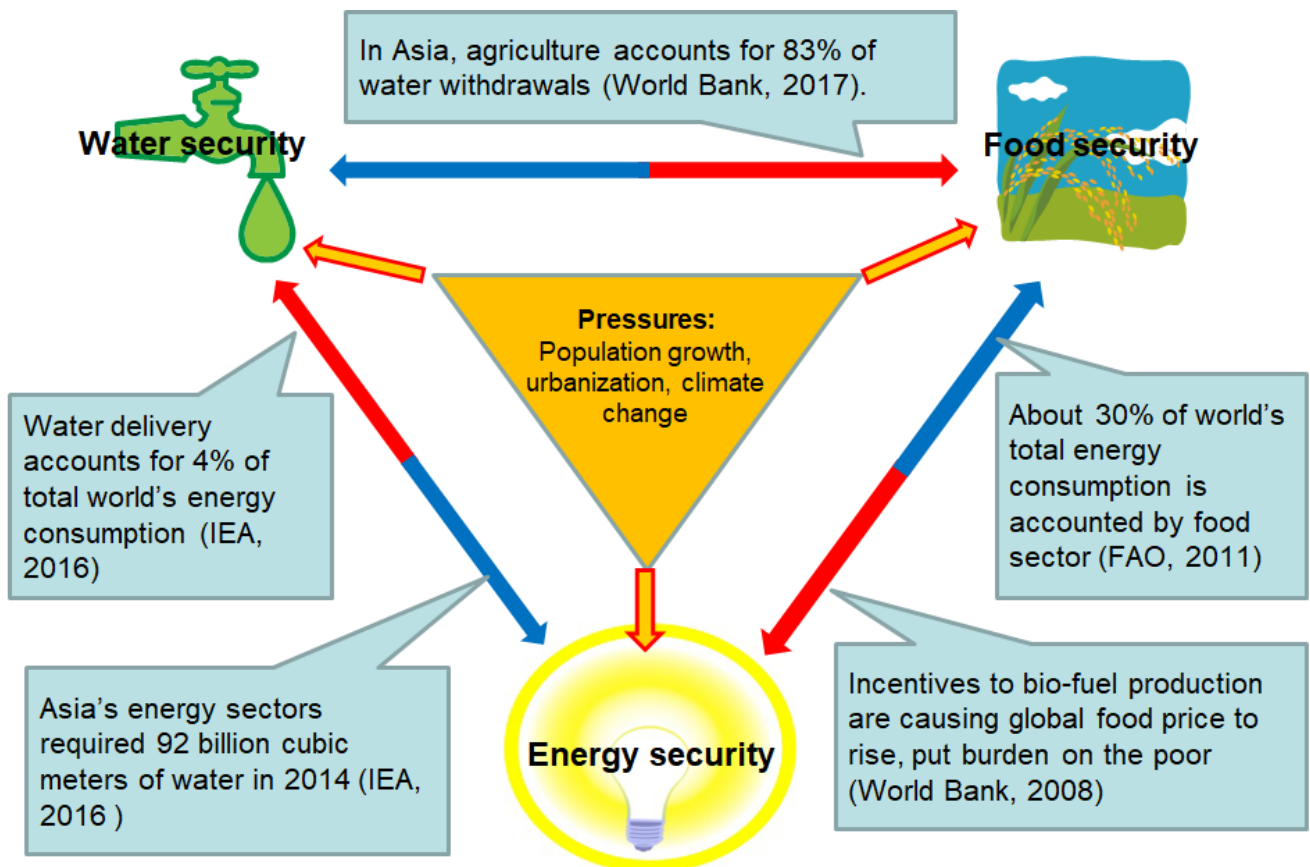


Figure 1. Observed interlinkages between water, food and energy

Recognition of the growing trade-offs for water, energy and food security arising from single-sector approaches has elevated nexus thinking in both academic and policy domains.

2. What are the differences between WEFN and other integrated approaches?

Discussions on integrated approaches for natural resource have been ongoing for several decades. The importance of integrated approaches for planning and management of natural resources has clearly been recognised in concepts such as integrated water resources management (IWRM), the ecosystems approach, integrated coastal zone management, integrated natural resources management, and forest landscape restoration. The foundations for the philosophy of IWRM were laid by the Spanish River Basin Organisation, which was established in 1926. More recently, various groups have proposed integrated approaches to address specific sets of issues. The concept of integrated natural resources management was developed by agricultural scientists and aims at the integrated management of land, water, forest and biological resources for sustainable agricultural productivity. IWRM also addresses a set of issues defined by a particular interest group. In recent decades, the IWRM concept has been elaborated by water professionals with the aim of promoting changes in practice to improve water resource management (Table 1). A shortcoming of these approaches is that they are largely influenced by specific sector interests, and while promoting integration may fail to reflect the concerns of all related sectors.

Table 1. Various integrated approaches for natural resource management

Concept	Founding year	Main actors	Scale
Integrated Water Resource Management	1926*	Water professionals	Basin
Ecosystem Approach	1992	Ecologists	Ecosystem functioning zones
Integrated Coastal Zone Management	1992	Marine scientists	Coastal zone
Integrated Natural Resource Management	1992	Agricultural scientists	Landscape
Forest Landscape Restoration	2000	Foresters	Landscape
Water Energy Food Nexus Approach	2011	Water, energy, food, land, climate	Transboundary to local

Source: * Varis et al. (2008), and Stucki and Smith (2010)

The WEFN concept is relatively new. It gained significant attention after the Bonn 2011 Nexus Conference. This conference brought together over 500 people from governments, academia, the private sector and financing institutions to discuss the water, energy and food security nexus as a solution for the 'green economy.' The key principle of this concept is to treat water, energy and food sectors equally and in an integrated manner. It is concerned with identifying integrated policy solutions by understating scientific relationships across the system to minimise potential trade-offs and create synergies. The WEFN approach emphasises cross-sectoral coordination for policies and decision-making processes to improve social equity, enable sustainable growth and protect essential resources. The approach aims to shift policy and practice away from the management of resources through sector 'silos' or sector-based integrated approaches, towards cross-sectoral planning and management (Bizikova et al. 2013). The WEFN approach is garnering increasing attention and this can help generate the required momentum and political will for action, which has been lacking in previous approaches (Biswas, 2008; Liu et al., 2017).

3. Roles of WEFN in achieving the SDGs

The importance of food, water and energy for sustainable development is clearly acknowledged in SDG 2, SDG 6 and SDG 7, respectively. Water, energy and food security are interconnected, which explains why strong interlinkages can be observed between the targets under these three goals. Some of these interlinkages are mutually reinforcing/positive, while others are potentially conflicting. The main challenge is how to minimise the potential risk of conflicts between targets when working towards the SDGs. Scientific evidence on these interlinkages is needed for their effective management. Fig. 2 depicts the nature of interlinkages between water targets and other targets under different goals. It indicates that SDG target 6.3 has mutually reinforcing relationships with SDG targets 2.4 and 7.3, but also potential trade-off relationships with SDG targets 2.1, 2.3, 7.1 and 7.2.

approach has received increasing attention (Weitz et al. 2014). This can be seen in the statements and actions of international initiatives (e.g. Sustainable Energy for All (SE4All) and World Economic Forum), the research/academic sector (e.g. International Food Policy Research Institute (IFPRI), German Development Institute (DIE), Stockholm Environment Institute (SEI)), government (e.g. Germany, Colombia), the private sector (e.g. World Business Council for Sustainable Development (WBCSD), Anheuser-Busch InBev (AB InBev), Royal Dutch Shell, and Coca Cola), and international organisations (e.g. World Wildlife Fund (WWF), International Union for Conservation of Nature (IUCN), OPEC Fund for International Development (OFID), International Renewable Energy Agency (IRENA), United Nations Economic and Social Commission for Western Asia (UNESCWA), Food and Agriculture Organisation (FAO), and United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP).

After the adoption of the SDGs by the United Nations General Assembly in 2015, the WEFN

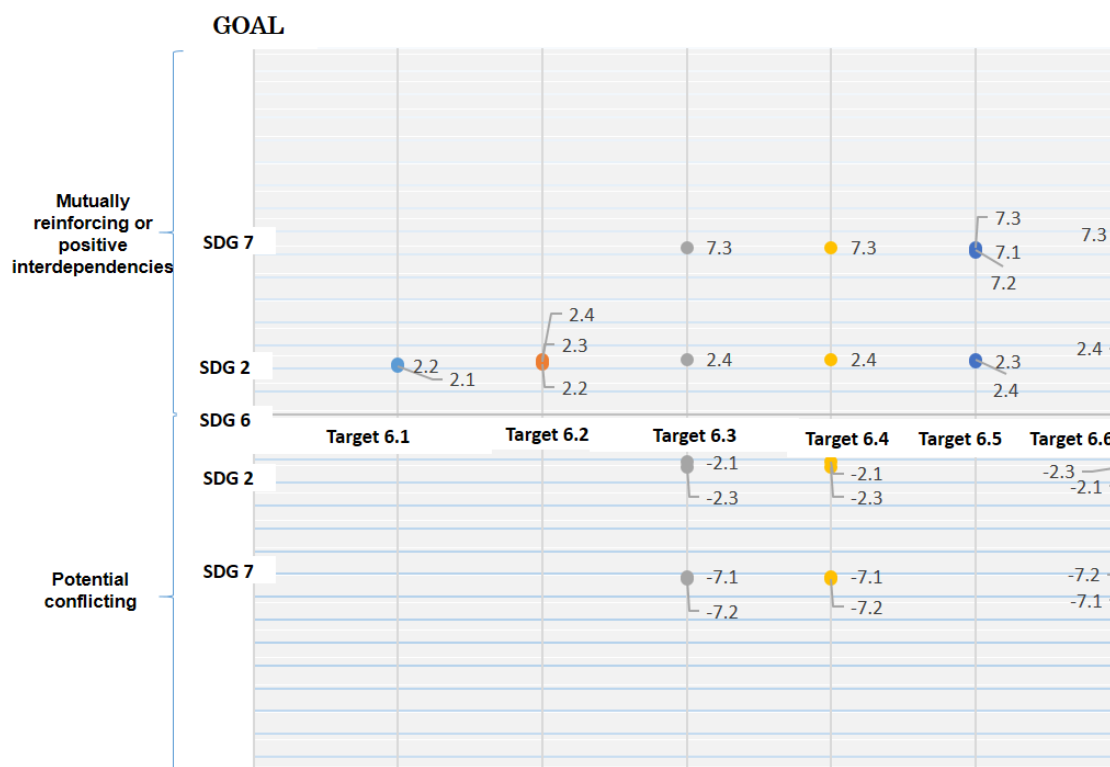


Figure 2. Type and nature of interlinkages between water targets and SDG 2 and SDG 7 targets

Note: Numbers on the x-axis indicate target 6.1... target 6.6, while numbers on the y-axis indicate Goal 2, Goal 6 and Goal 7. Negative values on the y-axis indicate that these targets may have some potential conflicts with relevant targets in SDG 6

4. Priority issues and challenges for WEFN approach in Asia

While Asian leaders have expressed commitment to working towards the SDGs, the region's economic growth patterns are degrading ecosystem services and contributing to climate change, which makes achieving

Table 2. Prioritised issues related to water, energy and food security in Bangladesh, India and Vietnam

Country	Prioritized issues related to water, energy and food security
Bangladesh	<ul style="list-style-type: none"> - Over-use of groundwater due to subsidised energy; results in groundwater depletion. - Policies to increase coal-based thermal power generation; increases pressure on water resources for cooling. - Water quality degradation due to untreated wastewater discharge.
India	<ul style="list-style-type: none"> - More frequent periods of water shortage; impacts agriculture and energy. - Decline of groundwater level due to subsidised electricity for irrigation water pumping; threatens food security. - Over dependency on water intensive thermal power plants; increases conflicts with other water users. - Lack of food storage facilities and poor distribution system means basic nutritional needs cannot be met. - Deterioration of water quality of major rivers.
Vietnam	<ul style="list-style-type: none"> - Agricultural sector accounts for nearly 95% of total annual freshwater withdrawals; puts huge pressure on water resources. - Construction of hydropower dams in upstream countries, including China and Lao PDR; threatens water and food security. - Deteriorating water quality due to untreated domestic and industrial wastewater discharges; leads to greater costs and energy use for treatment, and threatens food safety and security

Source: Consultation with national experts in Bangladesh, India and Vietnam

the SDGs all the more difficult. Based on a literature review and a survey of experts in three countries –

Bangladesh, India and Vietnam – this section highlights the issues in the region that can be addressed through the WEFN approach. The prioritised issues of these three countries are compiled in Table 2. Some of the highlighted issues are found in more than one country. An example is the over-use of water resources for irrigation due to subsidisation of electricity, which has contributed to water scarcity in both India and Bangladesh. Another priority issue is the high dependency of the energy sector on thermal power, which uses large amounts of water for cooling. Deterioration of water quality is also intensifying water scarcity in the region. All these issues require immediate attention employing WEFN-based resource planning. Despite significant progress in scientific research on the WEFN as well as the development of tools for quantifying relationships in the WEFN, the introduction of the WEFN approach into decision-making and planning processes faces many challenges (Table 3).

Table 3. Challenges to operationalising the WEFN approach

Challenges	Bangladesh	India	Vietnam
Absence of policy coherence	●	●	●
Few entry points for scientific knowledge in decision-making processes	●	●	●
Lack of capacity to interpret interlinkages	●	●	●
Lack of multi-stakeholder engagement	●	●	●
Lack of incentives for adopting efficient technologies	●	●	●
Lack of adequate finance	●	●	●

Common challenges to the WEFN approach in Bangladesh, India and Vietnam include absence of institutional coordination; the influence of political priorities on decisions and lack of processes for scientific knowledge to shape decisions; lack of capacity to understand interlinkages between sectors; lack of multi-stakeholder engagement in planning and decision-making processes; and lack of incentive mechanisms and adequate finance to support the approach.

5. Way forward

The WEFN approach aims for policy coherence with a view to careful management of resources for sustainable development. For this, good governance is essential, especially to ensure that processes are participatory and outcomes equitable. Until very recently, implementation focused primarily on technical solutions, whereas governance, i.e. the institutions and processes governing the WEF sectors, has not received much consideration. A key aspect of good governance of the WEFN is the creation of a framework of continuous back-and-forth cycles between scientific evidence-based knowledge generation processes, strategic guideline preparation, identification of the means of implementation and practical nexus-oriented actions (Fig. 3). The following measures are proposed for constructing this framework.

1. Identify key agency within the current institutional framework to coordinate relevant sectors: Agencies with approval authority for sectoral action plans or budgets (e.g. planning agency) should take the lead to develop strategic plans and guidance for operationalisation of the WEFN. These will serve as umbrella documents for integrated resource planning, and will facilitate coordination at both national and

sub-national levels. A nexus-based policymaking process requires horizontal integration across different ministries/departments and vertical integration across the different level of governments (national and sub-national level).

2. From sectoral to comprehensive development visions: A WEFN strategic plan and science-based decision support tools can be developed for sectors to share common visions for water, energy and food securities and to work towards win-win solutions.

3. Strengthening science-policy interactions: Strategic plans and actions should be based on science-based decision support tools. These should be easy for policymakers to understand and employ. To create such tools, new science-policy interfaces should be established and existing interfaces strengthened. Governments can create incentives and processes for scientists and research institutes to better understand and contribute to policy needs.

4. Awareness raising and capacity building for policymakers: Policymakers may lack knowledge and capacity to interpret scientific data on the relationships between water, energy and food systems. Capacity building programmes are needed to build their understanding of the linkages between the three sectors. This will help create the foundations for integrated development planning.

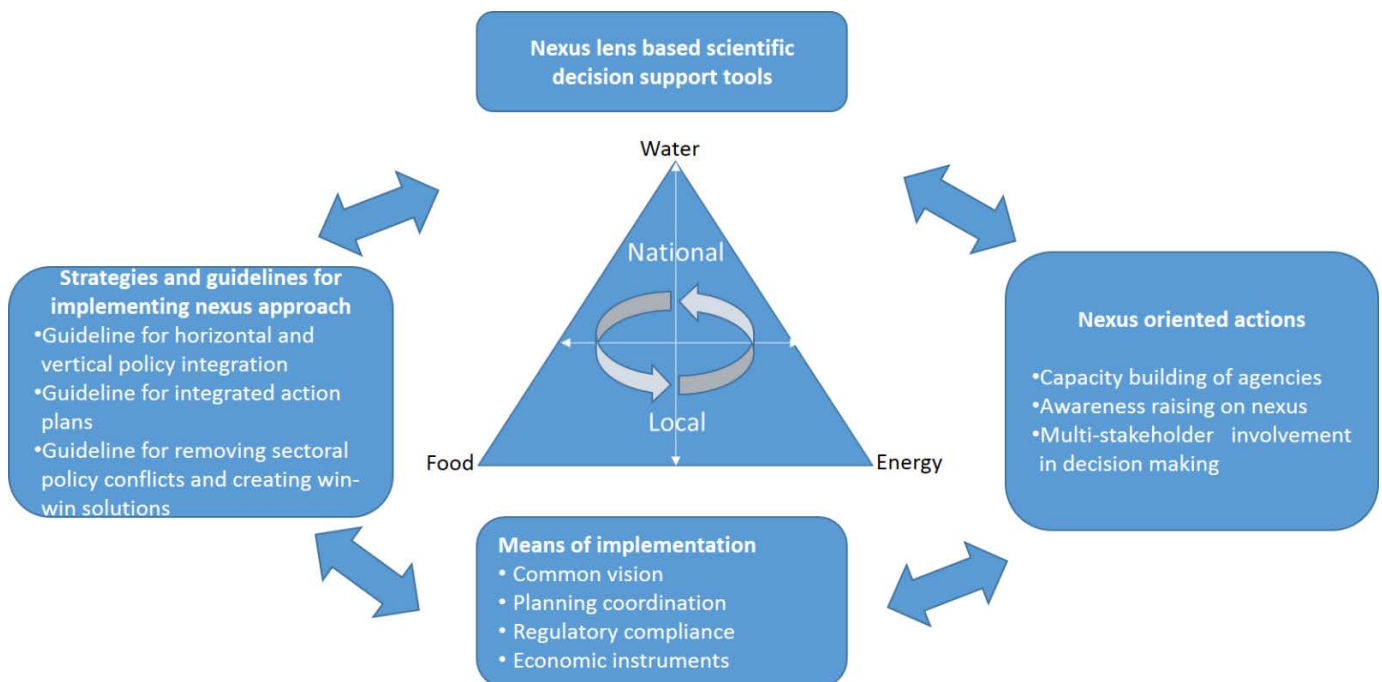


Figure 3. Enabling framework for WEFN governance

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References

- ADB. 2017. “Asia Infrastructure Needs Exceed \$1.7 Trillion Per Year, Double Previous Estimates.” 2017. <https://www.adb.org/news/asia-infrastructure-needs-exceed-17-trillion-year-double-previous-estimates>.
- Bhattacharya, Anindya, and Bijon Kumer Mitra. 2013. “Water Availability for Sustainable Energy Policy: Assessing Cases in South and South East Asia.” *IGES Policy Report*.
- Biswas, Asit K. 2008. “Integrated Water Resources Management: Is It Working?” *International Journal of Water Resources Development* 24, no. 1: 5–22. <https://doi.org/10.1080/07900620701871718>.
- Bizikova, Livia, Dimple Roy, Darren Swanson, Henry David Venema, and Matthew McCandless. 2013. “The Water–Energy–Food Security Nexus: Towards a Practical Planning and Decision-Support Framework for Landscape Investment and Risk Management,” no. February.
- Dewan, Vibha. 2017. “Water and Agriculture in India Background Paper for the South Asia Expert Panel during the Global Forum for Food and Agriculture.” https://www.oav.de/fileadmin/user_upload/5_Publikationen/5_Studien/170118_Study_Water_Agriculture_India.pdf.
- FAO, IFAD, UNICEF, WFP and WHO. 2017. “The State of Food Security and Nutrition in the World.” *Food and Agriculture Organization of the United Nations*. <http://www.fao.org/state-of-food-security-nutrition/en/>.
- International Energy Agency. 2016. “World Energy Outlook 2016.” *International Energy Agency*. https://doi.org/http://www.iea.org/publications/freepublications/publication/WEB_WorldEnergyOutlook2015ExecutiveSummaryEnglishFinal.pdf.
- Stucki, V., Smith, M. 2010. Integrated Approaches to Natural Resources Management in Practice: The Catalyzing Role of National Adaptation Programmes for Action. *Royal Swedish Academy of Sciences*. pp351-360.
- The Asian and Pacific Energy Forum, and United Nations Economic and Social Commission for Asia and the Pacific. 2017. *Asia-Pacific Progress in Sustainable Energy*.
- Varis, O., M.M. Rahaman, and V. Stucki. 2008. The rocky road from integrated plans to implementation: Lessons learned from the Mekong and Senegal River basins. *International Journal of Water Resources Development* 24(1): 103–121.
- Weitz, Nina, Annette Huber-Lee, Måns Nilsson, Marion Davis, and Holger Hoff. 2014. “Cross-Sectoral Integration in the Sustainable Development Goals: A Nexus Approach.” *Background Paper for the Independent Research Forum on a Post-2015 Sustainable Development Agenda*. *Development Agenda*. Stockholm. <https://doi.org/10.1371/journal.pmed.1002285>.

