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Environment, Nature Conservation  
and Nuclear Safety

Federal Ministry  
for Economic Cooperation  
and Development



**Bonn2011 Conference**  
**The Water, Energy and**  
**Food Security Nexus**  
Solutions for the Green Economy  
16 – 18 November 2011

# Conference Synopsis

**BONN PERSPECTIVES**  
A FRESH LOOK AT SUSTAINABILITY



**RIO+20**  
United Nations  
Conference on  
Sustainable  
Development

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## Introduction

On November 16-18, 2011, more than 550 people gathered in Bonn, Germany, to explore a visionary method of achieving sustainability through a groundbreaking conference called “The Water, Energy and Food Security Nexus – Solutions for the Green Economy”. In our interconnected world, sectoral “silos” are no longer acceptable ways to approach our targets, because solutions based only on one sector or discipline will unavoidably affect other sectors, whether by design or accident. Nowhere are the interconnections more evident – and critical – than in the water, energy and food sectors, because each is not only connected to, but is also dependent on, the others. As humanity looks to the June 2012 United Nations Conference on Sustainable Development (Rio+20) for guidance and inspiration, the water-energy-food security nexus must be given a prominent role if viable and practical solutions are to be produced.

### What is the “Green Economy”?

The concept of a ‘Green Economy’ is yet to be clearly defined. According to UNEP, a Green Economy is an economy that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. Its carbon output and pollutions levels are low, and its resource use efficiency is high. In a Green Economy natural capital is valued as a critical economic asset and as a provider of benefits for the poor. The Green Economy approach “seeks, in principle, to unite under a single banner the entire suite of economic policies...of relevance to sustainable development”. Hence the Green Economy itself is the nexus approach par excellence. To succeed, a Green Economy must go beyond sectoral solutions and actively address the water, energy and food security nexus, in-line with human rights-based approaches.

Well aware of the profound importance of including consideration of the nexus in any credible discussion of sustainability, the German government convened the Bonn2011 Nexus Conference, bringing together key stakeholders in each of the water, energy and food sectors to collaborate and brainstorm solutions to their collective and complex problems. As Angela Merkel, Chancellor of the Federal Republic of Germany and patron of the conference, stated in the address that she submitted to the conference participants, “The goal of a lasting and reliable water, energy and food supply is a truly ambitious one. But it is up to us as the international community to live up to this goal. That is why it is so important that the Bonn2011 Nexus Conference has for the first time at an international level gathered decision-makers and experts from these three areas to work out the next steps together.”<sup>1</sup>

## Powerful partners on the Road to Rio+20

Even the organization of the conference reflected a unified, nexus approach. Led by the German Federal Ministries for the Environment, Nature Conservation and Nuclear Safety (BMU) and for Economic Cooperation and Development (BMZ), and designed on their behalf by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the conference had three strategic partners: the International Food Policy Research Institute IFPRI, the World Economic Forum WEF and the WWF, as well as more than 50 contributing partners from around the world. The city of Bonn, which is the home for UN organizations focused on environmental and sustainability policy, was a natural choice to host this gathering. Together with BMZ, Bonn created the “Bonn Perspectives” as a platform for international debate on fair and green growth to contribute to the Rio+20 process, and the Bonn2011 Nexus Conference provided the first key milestone for the Bonn Perspectives initiative.

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In the closing plenary session, Peter Brabeck-Letmathe, Chairman of the Board of the Nestlé Group, was blunt in his assessment of what happened after the 1992 Earth Summit in Rio. “The first Rio in 1992 developed and delivered the first message of sustainable development, which included the three pillars of environmental protection, social development and economic development, but unfortunately its delivery was a failure.” Klaus Topfer, Executive Director of the Institute for Advanced Sustainability Studies in Germany, agreed and called for a return to the nexus process of problem-solving, saying, “The original Rio conference discussed environment and development together in a sort of nexus way; however, after Rio we lost a little of this feeling and the nexus faded away. Now, 20 years later, we must reinvigorate this message of sustainable development through a nexus approach.” With Rio+20 only months away, the need for clear communication and coordinated action among water, energy and food sectors is more important and more timely than ever.

A pre-conference event on the evening of November 15 at the adjacent Wasserwerk, the 10<sup>th</sup> Bonn Dialogues event on Global Environmental Change, foreshadowed the themes that would resound throughout the conference. As Dr. Fritz Holzwarth, Deputy Director General for Water Management, stated on behalf of the conveners: “Unless the populace and the politicians are made aware of the interdependencies of water, energy and food, a Green Economy will be difficult to secure, and unsustainable practices are destined to continue. Thus, a strong signal must be sent to Rio+20 that fragmentation of the sectors can no longer be maintained, especially as the world evolves to greater urbanization.”

In the official opening of the conference, Sha Zukang, UN Secretary-General of Rio+20, outlined the goals of Rio+20: “We must first integrate the economic, social and environmental pillars of sustainable development. Second, we must implement a full agenda of sustainability. Third, we must achieve a coherence of objectives.” In the same opening plenary, Han Seung-Soo, Chairman of the Governing Board of the Global Green Growth Institute in the Republic of Korea, echoed Sha Zukang by saying that “the key word – nexus – signifies the challenge of Rio, which is to connect the dots between financial, social and environmental aspects of sustainable development.”

*“Governments need to be driven by civil society.”*

*Manfred Konukiewitz,  
Deputy Director General,  
Global and Sectoral Policies,  
German Federal Ministry for Economic  
Cooperation and Development*

In a supportive convergence of events, on the opening day of the Bonn2011 Nexus Conference the UN Environment Programme UNEP released its 626-page flagship report, *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*,<sup>2</sup> that highlighted ways to achieve the sustainable Green Economy, which was the underlying goal of the Nexus conference and the topic of many of the formal and informal discussions.

## Highlighting the Issues

As the conference began, speakers highlighted the issues that have caused the nexus approach to become both urgent and obvious. In developing countries population is increasing and in both developing and developed countries consumption patterns are changing and becoming more resource-intensive. Both of these phenomena present major challenges. Dirk Niebel, German Federal Minister for Economic Cooperation and Development, explained that “if we continue as we are going with business as usual, hu-

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manity will need two or three earths. There is enough water, energy and food for everyone but not if we continue on the path we are currently following.” As Robynne Anderson, main representative to the United Nations of the World Farmers Organization (WFO) explained in Bonn, “Increasing food production by 70% to meet the surging population demands puts tremendous pressure on farmers, who are highly adaptable but are limited by water and energy supplies”. Margaret Catley-Carlson, Member of the United Nations Secretary General’s Advisory Board on Water and Sanitation (UNSGAB) pointed out: “Yield increases are now flattening, so the world may have passed peak food production and may also be passing peak water. Clearly, the balance of the elements of the nexus may change from year to year and region to region, but proper balances must be found. Consumers have a key role to play, as the choices that each person makes in consumption patterns and habits make a significant impact on their local communities and on the global community as a whole, with dietary choices being a major factor.”

However, as noted by Alexander Müller, Assistant Director-General for Natural Resources of the Food and Agriculture Organization, although increasing population is putting a strain on natural resources, “Stopping growth in developing countries is not an acceptable solution, so we must all move towards a Green Economy that will support sustainable development. The Green Economy cannot be achieved without coordination and communication among all sectors and stakeholders.”

Clearly, the Green Economy is a vital component of the nexus solution, but achieving this new structure will require support and investment from the financial sector. Richard Taylor, Executive Director, International Hydropower Association, clarified the challenge: “Since 85% of future development will come from the private sector, methods

must be found to encourage financial investment to achieve the change of direction that will be necessary to arrive at a Green Economy.”

## How the Conference Was Structured

To present the conference topics in a fashion that would foment understanding and encourage active participation and discussion, the three conference days progressed in a logical manner, with the first day’s plenaries and stakeholder discussions in the “Nexus Café” and “Global Plenary” sessions providing an explanation of the interdependencies of the nexus elements. The plenary sessions on the second day guided nexus problems from challenge to solution and provided strategies for operationalizing the three action fields of sustainable development:

1. The social dimension: Accelerating Access, integrating the bottom of the pyramid
2. The economic dimension: Creating more with less
3. The ecologic dimension: Investing to sustain ecosystem services

Specific issues were discussed in more depth in the “Hot Topic Sessions” while the “Nexus Solutions in Practice” events showcased successful, nexus-related projects from across the globe. On the third day the plenaries identified enabling conditions needed to facilitate the transition to a greener economy, as well as the coordinated policy environment and incentives necessary to achieving the required change. The findings and recommendations were summarized by the Co-chairs of the conference – Dr. Uschi Eid, Germany, and Dr. Albert Butare, Rwanda – in the “Reflections of the Co-chairs”, which can be found on the Conference website.

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## Understanding the Nexus<sup>3</sup>

What is meant by the water, energy and food security nexus, and why was it so important to convene a conference to craft nexus messages for Rio+20?

The short answer is that, through observation, extrapolation and projection, experts and practitioners from many disciplines have become keenly aware that the water, energy and food sectors are inextricably linked, and that actions in one area more often than not have impacts in one or both of the others. These linkages have always been present, but as the world's population hurtles towards 8 billion with increasing demands for basic services and growing desires for higher living standards, the need for more conscious stewardship of the vital resources required to achieve those services and desires has become both obvious and urgent.

*“It is important to note that no single actor is able to successfully and sustainably implement the nexus requirements all alone especially in a society that is inclusive.”*

*Albert Butare,  
Conference Co-Chair*

For both practical and ethical reasons, the old paradigm where each sector operated in its own silo – uninformed and unconcerned about its effect on the others – can no longer be allowed to exist, and business as usual can no longer be the status quo. To understand the urgency and importance of a nexus approach, one must first be aware of some of the challenges facing the water, energy and food sectors and the interdependencies among them.

## The Problems Presented by Population Growth

At the present moment, as the world has just welcomed its seven billionth human being, approximately one-seventh of our fellow humans (the “bottom billion”) do not have secure food supplies and have limited access to clean water, sanitation and modern sources of energy. Nearly 1 billion people lack access to

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### Understanding the Nexus

Business leaders at the World Economic Forum Annual Meeting in 2008 set out a Call to Action on Water, to raise awareness and develop a better understanding of how water is linked to economic growth across a nexus of issues and to make clear the water security challenge we face if a business as usual approach to water management is maintained. The report “Water Security: The Water-Food-Energy-Climate Nexus” published by the World Economic Forum in 2009 captures the ongoing debate and sets out the challenge we face if nothing is done to improve water management in the next two decades. It can be downloaded from [www.weforum.org/issues/water](http://www.weforum.org/issues/water)

‘Understanding the Nexus’, the Conference Background paper for the Bonn2011 Nexus Conference, was published in November 2011. It presents initial evidence for how a nexus approach can enhance water, energy and food security in a green economy by increasing efficiency, reducing trade-offs, and building synergies across sectors. The development of ‘Understanding the Nexus’ has been coordinated and led by the Stockholm Environment Institute (SEI). It can be downloaded from [www.water-energy-food.org/understanding-the-nexus](http://www.water-energy-food.org/understanding-the-nexus)

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safe water, 2.5 billion lack access to sustainable sanitation, 1 billion suffer from hunger, and 2.5 billion lack access to modern forms of energy.<sup>4</sup> There is considerable overlap among these figures, so that those who are lacking in one element are almost certainly deprived of one or more of the others. Over half of the global population now lives in cities, and a large proportion of urban dwellers – nearing one billion – lives in slums with basic water, food and energy needs barely met; their numbers are projected to swell in the next few decades.

While the bottom billion struggles daily to secure life's necessities of water, food and shelter, many others are living well above the poverty line and have begun to enjoy lifestyles that consume more energy, more water and a different mix of food that has a higher energy and water impact than ever before. Given these trends and the anticipated increase in population to 8 billion by 2030 and 9 billion by 2050, experts contributing to the SEI Conference Background paper "Understanding the Nexus" project that unless current patterns change, 50% more energy will have to be available by 2035, and the agriculture sector will have to produce 70% more food – with the consequence that agriculture will require at least 20% more water and 10% more land by 2050. All in all these combined pressures threaten to drive ecological and social systems beyond critical thresholds and to undermine the resilience of these systems in the face of societal and environmental crises.

## Interactions Among the Sectors

The interactions among water, energy and food are numerous and substantial. Water is used for extraction, mining, processing, refining, and residue disposal of fossil fuels, as well as for growing feedstock for biofuels and for generating electricity. Water intensity varies in the energy sector, with oil and gas production requiring much less

water than oil from tar sands or biofuels. Choosing biofuels for energy production should require a careful balancing of priorities, since water that has been used to grow feedstock for biofuels could also have been used to grow food. Many forms of energy production through fossil fuels are highly polluting in addition to being water intensive, especially extraction from tar sands and shale and extraction through hydraulic fracturing. Further, return flows from power plants to rivers are warmer than the water that was taken in and/or are highly polluted and can consequently compromise other downstream usage, including ecosystems.

Conversely, energy is needed for extracting, transporting, distributing and treating water. Energy intensity for accessing a cubic meter of water varies: logically, accessing local surface water requires far less energy than pumping groundwater, reclaiming wastewater or desalinating seawater. Irrigation is more energy intensive than rain-fed agriculture, and drip irrigation is more intensive yet since the water must be pressurized.

Food production is by far the largest consumer of global fresh water supplies. Globally, agriculture is responsible for an average of 70%, of fresh water consumption by humans; in some countries that figure jumps to 80-90%. Agriculture is therefore also responsible for much of fresh water over-exploitation. Food production further impacts the water sector through land degradation, changes in runoff, disruption of groundwater discharge, water quality and availability of water and land for other purposes such as natural habitat.

The increased yields that have resulted from mechanization and other modern measures have come at a high energy price, as the full food and supply chain claims approximately 30% of total global energy demand. Energy fuels land



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preparation, fertilizer production, irrigation and the sowing, harvesting and transportation of crops. The links between food and energy have become quite apparent in recent years as increases in the price of oil lead very quickly to increases in the price of food at our markets. The energy sector can have other negative impacts on the food sector when mining for fossil fuels and deforestation for biofuels reduce land for agriculture, ecosystems and other uses.

## Climate Change Compounds the Problems

Nexus challenges can be expected to be compounded as climate change causes temperatures to rise, soils to parch, storms to intensify and glaciers critical to water flows to shrink. Obviously, production of food and electricity, particularly hydroelectricity, are highly vulnerable to the droughts that are expected to accompany climate change. In addition to being affected by climate change, the energy and food sectors are also contributing factors to greenhouse gases that are flowing into the atmosphere.

## A Coordinated Effort

A nexus approach to managing and achieving security in the water, energy, food and environment sectors will support a transition to sustainability by reducing trade-offs and generating additional benefits that outweigh the transaction costs associated with a paradigm shift to stronger integration across sectors. The nexus focus is on system efficiency, rather than on productivity of isolated sectors, and the benefits and efficiencies it produces for society as a whole and for the marginalized in particular will quickly become evident. New approaches must be developed and implemented: the time for action has arrived and the costs of inaction will doubtless be higher than the costs of pro-active adaptation. More integrated policy-making and decision-making that ac-

### Energy and Food Produce Greenhouse Gas Emissions

Production of energy and food contributes a surprising proportion of greenhouse gas emissions. Electricity and heat production contribute 27% of global greenhouse gas emissions. Agriculture contributes to greenhouse gas emissions through a variety of activities. Fifteen percent of global emissions come from agricultural energy use, methane emissions (from livestock and rice cultivation), and nitrous oxide emissions (from fertilized soils). Land use changes for energy and food contribute a further 14%.

count for external costs across sectors will have to complement conventional approaches aimed at only improving sectoral resource productivity, and the result will be improved overall resource use efficiency, sustainable resource management and equitable benefit sharing. The SEI Conference Background paper “Understanding the Nexus” argues that a coordinated and harmonized nexus knowledge-base, which would include database indicators and metrics that cover all relevant spatial and temporal scales and planning horizons, and full life-cycle analyses across the nexus, should ideally underpin new decision-making and policy-making in a Green Economy framework.

To achieve such a dramatic change from the current dynamic, a radical shift in attitudes must be accomplished across the spectrum of human attitudes and actions. A shift is required from reducing environmental pressures from production to reducing global life-cycle environmental pressures from consumption; from protecting only the local environment to protecting the global environment; from viewing technology as the solution to viewing technology and behavioral change as the twin solutions; from seeing

public authorities as the sole responsible parties to seeing shared responsibility in implementing the necessary changes.<sup>5</sup> A toolkit of policy instruments will be necessary for such a transformation, including growth-conducive tax structures; policies to encourage innovation and green investment; environmental taxes and charges, emission trading schemes, and subsidy reform; regulations, standards, information-based measures, voluntary approaches, and labor and product market policies facilitating entry, exit and reallocation.<sup>6</sup>

The nexus approach has three guiding principles that underlie all discussions and recommendations and will be discussed further below. First, access for the poor to water, energy and food must be accelerated. Secondly, the world must learn to create more output with less impact on the planet. Finally, vital ecosystems and their services must be sustained through focused investment of financial and labor resources.

## Accelerating Access

“The global community has recognized that every human being has a right of access to water, energy and food and that no one will be fully secure unless and until everyone is secure. The poor must be at the center of the nexus, and for them it is immaterial if the economy is green, blue or purple – they simply need food and water”, stated Martin Dahinden, Director-General of the Swiss Agency for Development and Cooperation SDC at the Bonn2011 Nexus Conference. As His Royal High-

*“Global food security is under stress. More than one billion people are suffering from lack of access to energy and lack of calories in their diet, and more than two billion people are suffering from lack of micro nutrients like vitamins, which are very important for their health, for their productivity and for their livelihood.”*

*Shenggen Fan,  
Director General-IFPRI*

ness the Prince of Orange noted in the opening plenary session of the Bonn2011 Nexus Conference, “The world is at a tipping point. If we don’t commit to a sustainable path, what kind of world are we leaving for future generations? We know how insecure our youth is about their future, and Rio+20 must focus on their dreams. Although fewer people live in poverty and the number of people infected with AIDS has decreased, we are intolerably off track in providing universal access to water and sanitation and must focus more efforts on those key aspects of human existence.” Norbert Röttgen, German Federal Minister for the Environment, Nature Conservation and Nuclear Safety, agreed, stating that “there is a problem of debt – both fiscal and ecological. The current generation is living by consuming resources that rightfully belong to the future generations and we are therefore living at their expense. The winners of the old system will not be the winners of the new system of a Green Economy. A humane world can only be created if all elements are considered, so achieving the nexus approach is very important.”

As pathways to provide access to essential resources and services for the bottom billion are explored, synergies can be built and positive feedbacks generated while improving living conditions and livelihood opportunities for the most unfortunate. Clearly, human and environmental health are closely linked. Access to clean water is a strong determinant of human health, and healthy people contribute more to economic development. Access to clean, affordable and reliable

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ble energy is crucial to the fight against poverty. Secure access to resources also leads to more sustainable use of natural capital. Hence, investment and innovation that accelerate equitable access and benefits for the poor can have high rates of return in terms of development and environmental sustainability. The poor can therefore become effective and efficient actors in a nexus approach. Development has accelerated rapidly but the benefits of development have been unevenly distributed between and within countries. As the SEI Conference Background paper makes clear, the poor have been left behind in much of the recent development, and we must ensure that, in using resources to meet the demands of the increasingly numerous and wealthy middle class, we do not disadvantage the poor even more.

## Focus on Agriculture

Strategies for protecting the poor from further deprivation and accelerating their access to resources are varied and must be evaluated through the Nexus Perspective in order to achieve sustainable development. Much of the emphasis in providing water, energy and food will be placed on agriculture, both because food is such a vital commodity and also because the agricultural sector is such an enormous consumer of fresh water. Strategies for achieving sustainable agriculture must take into account not only current needs but also projections for future demands which are expected to produce an increase of 70% in the global food demand by 2050.<sup>7</sup> Demographic pressures, climate change and increased competition for land and water are likely to increase vulnerability

to food insecurity in the interim, especially in Africa and Asia. Unless current practices change, providing enough food for the growing population will come at an unbearably high cost of natural resource depletion and increased energy consumption to achieve the necessary agricultural intensification. Even now, the rate of growth for agricultural production and yields is beginning to diminish, calling for more creative means to achieve food security.<sup>8</sup>

Although irrigated agriculture uses 70% of all fresh water withdrawn from aquifers, streams and lakes, rain-fed agriculture still accounts for a large majority of cultivated land. Current productivity for rain-fed agriculture is about half its potential, and only 20% in the poorest countries. Yields of irrigated cereal in developing countries are 60% higher than rain-fed yields, and yield improvement schemes therefore generally focus on improving or expanding access to irrigation, often in combination with fertilizers and improved seeds.<sup>9</sup> Rice intensification currently being used in the Philippines and Vietnam has been effective in increasing resource productivity by using less water to generate higher yields.

Growth in agriculture employment, especially in the smallholder sector, is twice as effective in benefiting the poorest as non-agricultural growth. Most of the poor in developing countries live in rural areas, where farmers use rain-fed agriculture and suffer from low crop yields and lack modern means. Simply increasing food production is not enough to achieve food security; policies that enhance access to food by creating employment and income opportunities or

*In particular, women, who produce 80% and more of food in developing countries, must be engaged in the development and implementation of any solutions if those solutions are to have any chance of succeeding.*

*H.E. Paul Kagame,  
President of the Republic of Rwanda,  
in his speech at the Official Opening  
of the Bonn2011 Nexus Conference*

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## **India: NEXUS leads to 9.6% annual green GDP growth**

Irrigation has been a major driver behind India's green revolution, providing food and income to large parts of the population. India strongly relies on groundwater for agriculture because rainfall is only available about four months a year and river discharge is highly variable. This has led to severe over-exploitation of several aquifers. Also, irrigation pumping is very energy intensive: about 20 percent of India's electricity use and more than half of India's hydropower production goes into pumping groundwater. This over-exploitation is only possible due to flat and free power tariffs. These power subsidies are now difficult to reduce, given the dependence of India's rural population on this groundwater economy.

In Gujarat, the state government has introduced innovative win-win strategies involving support for massive rainwater harvesting, micro-irrigation and groundwater recharge schemes. In particular, the government has introduced an innovative 'Jyotigram' scheme, which is based on redistributing electrical power and 'intelligent rationing', and covers more than 90 percent of Gujarat's villages. The scheme has 're-wired' the state with thousands of kilometers of new power lines and has separated electricity supplies for villagers from supplies for irrigation tubewells. Villages now rely on 24 hours of constant electricity, and farmers were offered a reliable and predictable supply of eight hours of uninterrupted full voltage power along a strictly scheduled roster. This change has had a number of positive effects. Helped by a succession of good monsoons, the groundwater levels throughout Gujarat are recovering; consumption of electricity for pumping groundwater and electricity subsidies have declined; the gap in livelihoods between rural villages and cities has narrowed; and enterprises such as mills, tailoring, welding and many others have a reliable power supply – vital for creating new jobs. Farmers have embarked on ambitious new cropping schemes made possible by a reliable supply of water during critical periods. Gujarat has recorded 9.6 percent annual growth in agricultural GDP, as a result of the new rural power system, other infrastructure development, revitalized agricultural extension systems, reforms in agricultural marketing institutions, and new public and private investments. Key success factors were the early involvement of senior policy-makers, who saw the benefits for their constituencies, and the support of farming communities, who were convinced by promotion of the scheme as an intervention to provide continuous power supply to uplift the rural population.

by establishing effective safety net programs are also needed,<sup>10</sup> and policies and mandates that undermine security must be eliminated. Other proposals for increasing employment and standards of living among the rural poor include integrating poverty alleviation and green growth, and increasing capacity building and awareness training.<sup>11</sup>

## **Impacts of bioenergy**

The growing reliance on bioenergy as a means to increase energy security and independence and to mitigate climate change has fostered much debate within all of the nexus sectors, since producing feedstock for biofuels requires allocation of land and water resources while it contributes to meeting certain energy needs. The impact of the burgeoning bioenergy industry on food prices has been remarkable. Studies have shown that between 2000 and 2007 bioenergy added 30% to

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the weighted average price of cereal during the period, an increase of 39% to the price of maize, 21% to the price of rice and 22% to the price of wheat. These price increases for staples contributed to the food riots in 2008. China is the third largest ethanol producer after the US and Brazil, but China has limited bioethanol production in response to anxieties about the impact on food.<sup>12</sup> There are also concerns about “land grabbing”, where land is being purchased for production of biofuel from landholders who are not adequately informed of the consequences to them or to the surrounding ecosystems. Foreign acquisition of land and water resources by large-scale, agro-industrial enterprises, especially for food and biofuels, often includes explicit or implicit guarantees of access to water from river systems or aquifers, which can have serious consequences for local residents and ecosystems.<sup>13</sup> Growing biomass for bioenergy can not only impact food prices and land ownership but can also impact economic growth, deforestation and land use.

On the other hand, biomass can be used for biofuels that provide heat, power and transportation. According to some proponents of bioenergy, the food-fuel debate relates mostly to first generation biofuels, which compete directly with food for land and water. The water requirements for second generation biofuel crops like switchgrass are lower than the requirements for first generation crops but are still higher than for fossil fuels, especially when the crops for biofuel feedstock are irrigated. The bioenergy sector can create new markets for developing countries and offer job opportunities for the poor, while reducing national dependence on fossil fuels. Hence, bioenergy has been placed high on the policy agendas of some developing countries, in spite of the possibility that biofuels could displace export crops like cotton, tobacco and coffee and despite the fact that switching from fossil fuels to biofuels will increase water use substantially. Developing countries that are considering bioenergy

must therefore consider all factors and consequences, such as land suitability, water availability, competitiveness, socio-economic costs and benefits, food security, economic growth and poverty reduction.<sup>14</sup>

## Water, Sanitation and Hygiene – WASH

No discussion of accelerating access for the poor to all the elements of the nexus would be complete without reference to WASH – Water, Sanitation and Hygiene. Access to water and sanitation are human rights and the cornerstones of development, underpinning every one of the Millennium Development Goals. Every day 4000 children die from dirty water or poor hygiene. Water scarcity, poor water quality and inadequate sanitation negatively affect food security, livelihood choices and educational opportunities for poor families across the developing world. WASH issues have impacts on health, economy, the environment and gender. Unfortunately, sewage systems and wastewater treatment plants are very costly and can generally only be afforded if long-term, low-interest funding is available. However, shifting from disposal of water to reuse of wastewater and solid refuse is critical if WASH issues are to be ameliorated, and cities can then be viewed as hot spots for resource recovery. WASH challenges must therefore be turned into business opportunities in order to activate the private sector and stimulate innovation. To address the problems fully, current WASH initiatives must be scaled up to touch greater numbers of people, which may require development and implementation of multi-level governance.<sup>15</sup>

The conference presenters proposed other methods for accelerating access to water, energy and food for the poor. Institutions must be forced to respond to natural resource scarcity in more adaptive and collaborative ways than in the past and must ensure collaboration between inte-

grated water resource management (IWRM) and other actions. Governments can develop new policy and fiscal instruments, provide more information and monitoring of data and trends, and engage in innovative planning to increase water and land productivity and combat degradation.<sup>16</sup> Clear national food and nutritional policies that take into account consequences for water and energy will be required, and harmful subsidies for water, energy and food must be eliminated. Focused and strengthened research into crop and agriculture science will engender new ideas for food and water security, and resource-use-efficient technology development and dissemination, especially for the poor, must be supported. Synergies and complementarities between public and private stakeholders in provision of water, energy and food must be found, and markets and trade solutions to ensure least-cost input flow for

farmers and consumers must be created.<sup>17</sup> With this basket of solutions, the poor may finally be admitted to a world where they have access to adequate quantities of water, energy and food.

## Creating More With Less

Continuing to practice business as usual to meet the water, energy and food needs of 9 billion increasingly wealthy people will put an unbearable strain on the environment, to the detriment of all living creatures on the planet. A seismic shift in attitudes and habits must begin now in order to increase the efficiency of resource use and change consumption patterns. In this way, we can provide more water, energy and food to more people with less impact on the environment and its resources. This goal can only be accomplished if demands for water, energy and food are met with the water-energy-

*“One must reshape institutions so they can take up the challenge – we can’t solve new problems with old institutions. We have to reshape our own thinking to a culture that sees water and wastewater as resources.”*

*Uschi Eid,  
Conference Co-Chair*

### **New Seawater Greenhouse Technology Replenishes Irrigation**

There are currently over 1 million hectares of greenhouses worldwide of which some 200,000 hectares are in the Mediterranean region. Seawater greenhouses are unique from the standard greenhouse system, because they use the saltwater to increase humidity inside the greenhouse. This humidity condenses at the backside of greenhouse, where there is cooler temperatures, and forms freshwater that runs down the wall and into the irrigation system. By using these greenhouses to create freshwater, they turn an extractive model of agriculture into a restorative one – and grow more with less.

The “seawater greenhouse” technology is not a “hot house” but a “cool house” constructed of corrugated cardboard which can grow delicate crops. Due to slightly higher humidity and slightly cooler temperatures the need for water is reduced. In Saudi Arabia, a 500-watt pump evaporates water for the greenhouse. The goal is a greenhouse that serves multiple restorative functions – it can produce salt that can be sold and other minerals that can be added to soil or added back to water for agricultural purposes. Economies of scale have not yet been reached in the systems currently operating (which are not big enough to be economically viable).

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food nexus as the central theme for provision of goods, services and resources.

## Increasing Productivity and Efficiency

The Green Economy has the concept of “creating more with less” as a central theme and guiding principle, because it depends on increased efficiency from sectoral resources and from overall resource use. In order to create more with less and achieve optimal resource and use efficiency, productivity must increase in all sectors. Productivity is defined as output – such as kilograms of biomass, kilocalories of food or kilowatts of electricity – per unit of resource consumed or utilized, such as water, land or energy. Water productivity in agriculture depends on various factors such as the type of vegetation or feedstock grown, local and regional climate, land and water management practices, and the extent of land degradation. The potential for increasing productivity of agriculture is especially high in sub-Saharan Africa and south Asia, but increasing

productivity does not always require high technology solutions or large capital investments.

Rainwater harvesting and supplementary irrigation are two techniques that are relatively simple to implement and do not have high capital requirements. If changes in practice and behavior and new investments are made with the nexus in mind, productivity will not be negatively affected, and the efficiency of overall resource use can increase dramatically. Reducing wastage along the production and supply chains generally reduces pressure on resources and mitigates other looming scarcities, such as the alarmingly dwindling supplies of phosphorus.<sup>18</sup>

*“Our vision is to copy the success story of labor productivity, which has increased twentyfold over a 150 years, this time with resource productivity.”*

*Ernst Ulrich von Weizsäcker,  
former dean of the Donald Bren School of  
Environmental Science and Management at  
the University of California, Santa Barbara;  
member of the Club of Rome*

As we explore ways to increase efficiency and productivity along the nexus, we can see that there are many similarities among the three sectors. All three have rapidly grow-

ing global demand; all are impacted by international trade; all suffer resource constraints leading to rivalry, conflict and war; all have strong interdependence with each other and with climate change and the environment; all have deep secu-

### Jordan Finds a Valuable Resource in Sewage

Jordan is one of the world’s most water-scarce countries. And with the water table falling by more than a meter each year, the kingdom cannot afford to let any resources go to waste. That’s why it is turning to reclaimed water, under a project supported by KfW Entwicklungsbank (German development bank) on behalf of the German Federal Ministry for Economic Cooperation and Development BMZ. The project takes sewage from Irbid and other urban areas in northern Jordan and treats it at three plants. Then the water flows via pipeline to the Jordan Valley, where it is used to irrigate fields. This means that more clean water will be available for drinking and household use, but the benefits go much further. It will prevent pollution by ensuring sewage gets treated, it will generate hydroelectricity as the treated water is piped downhill to the Jordan Valley, and the phosphorous- and nitrogen-rich treated wastewater will reduce farmers’ need for commercial fertilizers.

rity issues; all are fundamental to the functioning of society, and all have heavily regulated markets.<sup>19</sup> One study has analyzed all three sectors, looking for ways to economize and increase efficiency and found that overall demand can be reduced by 30%, with the most effective places for savings being energy for buildings, large-scale farms, food waste, and municipal water leakage.

## Reducing and Eliminating Waste

In seeking ways to optimize efficiency, the low hanging fruit – those issues that are obvious,

*“We can begin by reducing the amount of wastage in our system. A third of the food that we actually produce is just lost. It rots in the field, it rots on the way to the markets, and it rots in the market.”*

*Charles Iceland,  
Senior Associate,  
World Resources Institute*

that global food waste represents 1.5% of the total energy demand and 20-30% of total land and water use.<sup>20</sup> Food wasted annually in rich countries is almost equal to the entire net food production of sub-Saharan Africa. In developed countries, food waste is caused by consumer behavior, standards for beauty and aesthetics, and trade and food labeling legislation, such as labels indicating a best-by or sell-by date. In devel-

easiest to change and have the largest impact – should be the starting point. Food waste is an obvious candidate for attention and action. Shockingly, one-third of all food produced for humans is lost or wasted. It has been estimated

### **Linking water and sanitation provision to energy saving and food security in Durban, South Africa**

German non-profit BORDA (Bremen Overseas Research and Development Association) is collaborating with the Municipal Water and Sanitation utility and the University of KwaZulu-Natal to design and build a decentralized wastewater treatment system (DEWATS). The DEWATS at the “Newlands-Mashu-Permaculture Learning Center” follows an innovative sanitation approach. It serves as an individual household sanitation solution, like latrines, and can be used where a connection to the public sewer system is economically unfeasible due to distance, topography or limits of the sewer network and/or the receiving treatment works.

The system receives up to 40 cubic meters/day of domestic wastewater from 85 households in a residential area. It is a gravity system that requires no machinery or energy inputs. Biogas is collected from the system, which can be used for cooking. The gravity system reduces energy consumption, and biogas contributes to energy security; wastewater treatment reduces freshwater pollution and reduces the need for bulk water treatment and reticulation. The city partnered with the private sector for some of the project, which came about when eThekweni municipality (which includes Durban) had to incorporate slum areas and some rural areas. Dry sanitation is used in some rural areas, while decentralized water-borne sanitation is used in others. The area has a one-home-one-garden policy aimed at food security, and the municipality has begun planting food rather than ornamentals like flowers in green areas of the city, such as public parks and medians. The food thus grown can be used by residents who want to harvest it.



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oping countries, food waste occurs through inadequate post-harvest technologies, poor infrastructure such as roads, storage and processing facilities, inappropriate packaging, inefficient means of transportation, border delays and difficult climatic conditions.<sup>21</sup>

To reduce food waste, focus should be placed on educating small holders about food waste, with a special emphasis on farmers and women farmers, who should be at the center of the nexus. Investments in rural storage facilities and rural electrification for those storage facilities would also be helpful. Additional proposals for solutions include improving the quality and availability of data; supporting farmers in capacity development and investments in infrastructure; creating awareness in consumers; prohibiting food ex-

ports at dumping prices; phasing out harmful food subsidies; and establishing an integrated food and water waste management system.<sup>22</sup>

Water has its own form of waste. Stormwater and gray water produced by domestic and commercial users are discarded as wastewater, and clean potable water is used for flushing toilets and irrigation.<sup>23</sup> Some forms of irrigation are more water-intensive than others: drip irrigation saves water, lowers energy demand for pumping and increases crop yields. Implementation of rainwater harvesting would lower demand for water for irrigation.<sup>24</sup> Urban sewage and wastewater is an untapped resource with tremendous potential to be re-used for agriculture after treatment. Indeed, wastewater treatment plants can not only produce reclaimed water for irrigation, they can

### **Water-spreading weirs refresh Sahel river valleys**

On behalf of the German Federal Ministry BMZ, KfW and GIZ have implemented a project during the past 12 years that brings water to degraded dry valleys in Burkina Faso, Niger and Chad. Supplementing retention basins, small impoundment dams and microweirs, the water-spreading weirs use a simple but effective technology to intensify agricultural production. While not intended to create reservoirs, the weirs are well-suited for large-scale rehabilitation of wide, shallow dry valleys that have been seriously degraded and where severe erosion prevents the normal smaller-scale flooding that would spread water slowly and naturally over the land.

Since the eroded, barren valleys enable floodwaters to accumulate and flow rapidly, fertile sediments are no longer deposited in those valleys, and aquifers cannot be replenished. The abutments and wing walls of water-spreading weirs correct the sedimentation and runoff problems by slowing and spreading the waters enough to allow for the more natural flows to return. To maximize the area of land that is ameliorated, the weirs are usually built in series.

Local communities are deeply involved in the project, by identifying suitable valleys and submitting requests for funding that describe both the suitability of the location and the willingness of the villagers to participate. Villagers perform the intensive labor to construct the weir, and local craftsmen are trained to maintain the structures. An optimum series of weirs allows crops to grow in larger areas and can also provide for post-rainy season and irrigated crops as well. Since more water is available for agriculture, for drinking and for watering livestock, the workload of women decreases, and poverty is reduced. The weirs thus serve the Nexus aspect by enhancing food security, increasing surface and groundwater availability, and reducing the energy required to pump water from deeper aquifers.

also serve as sources of energy from biogas, and their biosolids can be used for fertilizers. To address water waste, better means of measuring water must be found, and water productivity must be raised, including through sustainable intensification of agriculture. Pricing water to reflect its value would doubtless result in more efficient water use.

*“If economy is not subservient to ecology, we will self-destruct.”*

*Shanta Sheela Nair,  
Outcome Ambassador  
and Vice-Chair,  
State Planning Commission,  
Development of Tamil Nadu, India*

then added two more goals for 2030: doubling the rate of improvements in energy efficiency and doubling the share of renewable energy. Two strong levers for increasing energy efficiency can be found by imposing sus-

tainable urban design and by implementing some form of emissions regulation or carbon pricing.<sup>25</sup> In the time of cheap energy and ignorance of carbon’s effect on climate change, both commercial and domestic structures were designed without energy efficiency as a main goal. Without a clear signal through carbon pricing that unchecked emissions will no longer be tolerated, business as usual will be allowed – and even encouraged – to continue.

## Energy Efficiency Goals

The United Nations has proclaimed 2012 as the International Year of Sustainable Energy for All, with a goal of ensuring universal access to modern energy services by 2030. Well aware of the need to create more energy with less, the UN

### **Ecosystem Services a Priority on Kenya’s Tana River**

Payments for ecosystem services (PES) typify the Green Economy and the nexus approach. The goal of PES is to provide enabling conditions for more sustainable resource use and pro-poor benefits, while maintaining or restoring natural capital. At the global scale, REDD+ is one such payment mechanism, which promotes enhanced carbon sequestration through better land management. At the basin scale, various PES schemes have been established around the world, to support improved land and water management in upstream catchments to boost water yields, improve water quality and reduce erosion and sedimentation.

One such scheme is Green Water Credits, a financial mechanism that offers incentives for farmers upstream in Kenya’s Tana River to improve land and water management. Various soil and water conservation measures in the headwaters of the Tana River have been assessed to determine their potential to sustainably increase local productivity and water availability and, at the same time, to alleviate stress on downstream reservoirs. These reservoirs are especially important because Nairobi’s water supply, most of Kenya’s electricity supply, and several large irrigation schemes depend on them. A number of powerful economic actors, such as water and power companies and export producers, have come forward to support this ecosystem approach as an alternative to a conventional end-of-pipe solution, which in this case would be to build another reservoir once the old one has silted up. The Green Water Credits scheme in Kenya has brought on board Kenya’s Water Resources Management Authority as the coordinating institution, as well as a local bank to handle the financial transactions.

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## Investing to Sustain Ecosystem Services

The UN Environmental Program defines ecosystem services as the “contribution of ecosystems to human well-being”, with particular importance for the livelihoods of the poor. Preserving ecosystems and reducing ecological scarcity are central to the Green Economy, which in turn is central to achieving the nexus approach. Ecosystems are vital to the well-being of humans and other forms of life by delivering a long list of vital services that we often take for granted: nutrient cycling and recycling, soil formation, food, fuel, fresh water, feed for livestock, and sources of bio-fuels, wood and fiber, in addition to assisting with carbon sequestration, climate and water regulation, disease regulation and water purifi-

cation. Further, ecosystems support various cultural aspects of human existence, providing aesthetic value, spiritual significance, education opportunities and recreational enjoyment.<sup>26</sup> In spite of the vital and often overlooked services they bring, the health of ecosystems is facing severe and increasing threats from deforestation, expansions of high intensity agriculture and cattle ranching, expansion of hydropower, installation of new infrastructure such as roads, mining for minerals and fossil fuels, navigation through sensitive areas, climate change and flooding.<sup>27</sup>

With respect to water, ecosystems serve as a natural water infrastructure, often providing services such as improved water quality more efficiently than man-made “hard” infrastructures. Man-

### Resource Efficiency Systems Tested in China’s Dry Ningxia Region

Ningxia has very low water availability: just 200 cubic meters per capita, or about 15 percent of China’s average. Water availability is further decreasing due to climate change and pollution – 90 percent of China’s aquifers under major cities are polluted. More severe drought in recent times and desertification has compromised land and water productivity. Afforestation can help to rehabilitate land, but comes at a cost: throughout China new forests are increasingly depleting local water supplies due to the high water demand of trees. Water demands are growing rapidly, in part as a result of changing diets. The Yellow River provides most of the irrigation water in Ningxia, with projected higher water availability as a result of the large south-north transfer project, which will eventually deliver 45 cubic kilometers annually to the north of China. Given that pumping across such large distances is very energy intensive, alternative agricultural water supply and demand measures are currently being tested in the Ningxia region, including drip irrigation, zero tillage, shifting to less water intensive crops, etc. The Ningxia region is close to China’s main coal-mining region, so its energy mix is dominated by coal. Because of the water intensity of generating electricity from coal and its high greenhouse gas emissions, planners are seeking and testing energy savings and alternative energy sources. Ningxia is rich in solar energy and wind and there is further potential for diversifying energy sources, including in biogas production linked to pig farming and sanitation. Pilot programs run by the Ningxia Center for Environment and Poverty Alleviation achieved a 30 percent reduction in household coal use. Biofuels may locally also provide new opportunities for cleaner energy access and improved rural livelihoods. However, its overall resource use efficiency and risks for food security need to be assessed further. Nationwide, China has recently moved away from maize to other feedstocks due to national food security concerns. Shifting water to economically more efficient uses in industry is encouraged by granting additional water rights to companies that install water saving measures.

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made infrastructures often have negative consequences for the environment such as reduced biodiversity and diminished ecosystem diversity and services. Investment in natural capital needs to go beyond terrestrial ecosystems and include aquatic ecosystems and wetlands, such as peat wetlands, which store 30% of all global soil carbon. Higher priority must therefore be given to the water requirements of these aquatic systems when balancing their needs against other water and lands uses.

## Protecting Water for Ecosystems

To protect the water that is the lifeblood of ecosystems, a number of recommendations were made at the conference. Global frameworks were suggested to address the efficiency of the urban water cycle, to provide advice on water uses for the urban, energy, agriculture and environmental sectors, and to establish guidelines for energy neutrality for water utilities, with a common definition of the energy and carbon footprint. In the meantime, the interactions of cities, industries, agriculture and ecosystem services need to be optimized, and an enabling environment must be created to maximize the economic benefits of water reuse, the cascading effect of water use and the recovery of energy and nutrients. Utilities should be encouraged to develop demonstration projects to entice investors to join a transition toward more efficient models.<sup>28</sup>

A precautionary approach that secures ecosystem services and maintains buffers against shocks and crises such as floods needs to avoid further ecosystem degradation and limit cropland expansion. Natural capital can attract more investment when it becomes part of national accounting. Payments for ecosystem services (PES) can provide economic incentives for sustainable ecosystem management. However, to date most

PES target only individual sector and services (water provisioning and carbon sequestration) and lack a nexus approach.

Benefits can be derived if the surge of foreign direct investment in agriculture and infrastructure in developing countries, and reengagement of donors into agriculture, could be directed to some extent toward natural capital. Green and conservation agriculture can provide additional benefits such as carbon sequestration and resilience to climate risks through improved moisture retention while also generating jobs and improved food security.<sup>29</sup>

## Urbanization and Ecosystems

When considering protection of ecosystems and the services they provide, the trend towards urbanization commands attention because of the impact that urbanization has on local environments. Cities occupy 2% of land, but they use 75% of resources. Cities and towns can be engines for decoupling agriculture from fossil fuels by bringing waste and nutrients – through municipal composting and urban waste water – back into the biological cycle. With climate change, water conservation in cities is a crucial issue. Cities can improve storm water drainage by increasing the extent and absorption capacity of their green areas. Adjacent wetlands that are protected and preserved can play an important function as buffers for storm water surges, as filters for pollutants and as supporters of wildlife communities. Strengthening urban and peri-urban agriculture and forestry, wetlands and biodiversity can play a central role in making cities more sustainable and resilient and allowing their adjacent ecosystems to thrive. Furthermore, producing fresh food close to cities contributes to reducing energy use and greenhouse gas emissions, and shrinks the ecological footprint of cities since less energy is needed for production, transport, cooling, storage, processing, and packaging of food. Climate change has

direct impacts on cities through more flooding and landslides, amplified “urban heat island” effect, worsening air and water quality, and growing water scarcity; cities are also highly vulnerable to disruption in food supplies. To manage growth sustainably cities must decouple the quality of life of urban dwellers from their ever-expanding extraction and over-use of resources (especially extraction of fresh water and over-use of fertile soil) their increasing consumption of energy, their rising generation of waste and the resulting deterioration of biodiversity and ecosystems.<sup>30</sup>

A variety of approaches have been suggested for increasing the viability of urban agriculture. For example, land mosaics can be created by interspersing developed areas with green spaces. Urban agriculture can be integrated into national policies by removing unjustified restrictions on urban agriculture, establishing municipal food programs and making funds available for co-financing of programs. Better data collection and analysis of the effects of urban agriculture and biodiversity protection will give policymakers the information they need to make rational decisions on urban agriculture. These policymakers should also work in collaboration with all relevant stakeholders to include urban agriculture, forestry and biodiversity in local climate change adaptation and disaster risk reduction strategies.<sup>31</sup>

## Protecting Soil for Ecosystems

Soil represents a critical component of ecosystems that is pivotal in the water and carbon cycle and in the provision of ecosystem services. Soils are major sinks for CO<sub>2</sub>, methane and nitrous oxide, so sustainable management is required for climate change mitigation. Soils provide a varie-

ty of ecosystem services, such as the provision of food, water and bioenergy; regulation of water quality; support of nutrient cycling, and primary production and conservation of biodiversity. Overexploitation of soil puts sustainable development at risk, hampers economic development and causes costly environmental damage, so sustainable management of soils is necessary to cope with urbanization, population growth and climate change. Declines in soil quality occur with land degradation processes such as erosion, depletion of soil organic matter and nutrients, salinization, compaction, crusting, acidification and water imbalance. Globally, 3.5 billion hectares have already been degraded by desertification, and 955 million hectares by have been affected by salinization. Urbanization will take another 7% of arable land by 2030, and cities that are located in prime habitats along rivers and

*“There needs to be strong leadership, not at the sector level – at the highest possible level of decision making.”*

*Letitia Obeng,  
Chair, GWP*

deltas occupy highly productive soils. Soil nutrients such as phosphorus and nitrogen are transported to rivers and lakes and must be replenished, often through excess application of fertilizers. Not surprisingly, 42% of the very poor live in degraded areas,

whereas only 15% of non-poor make their homes in areas where the soil has been degraded. Integrated soil management promotes management of soils and related resources such as water and forests through participatory processes to maximize resultant economic and social welfare in an equitable manner without compromising sustainability of vital ecosystems.<sup>32</sup>

## The Role of Dams

There has been much debate and discussion about the effect that dams have on their river basins and ecosystems. On the positive side, dams create reservoirs for multiple purposes, includ-

ing water storage and managed releases, flood protection, navigation, electricity generation and irrigation, so they can increase supply of water, energy and food. On the negative side, dams interrupt water flows and fish migration, impact siltation, displace people and ecosystems, and allow vast quantities of water to evaporate. A recent study performed a system and economic analysis of dams, looking at joint development options such as combining hydropower, irrigation, flood management and industrial uses. The economic portion of the study showed high rates of return for investors in such projects, and also showed that economic evaluations underestimate the soft benefits of dams, such as ecosystem services, flood control and future increased employment in the agricultural sector. Commonly

used economic analysis tools thus seem inadequate for properly comparing multi-purpose and long-term benefits of dams, showing that further in-depth analyses are necessary before drawing firm conclusions about dams. The study concluded by proposing a balanced approach to future dam development, including hydropower and irrigation development together with environmental flow

releases and flood protection.<sup>33</sup> Additional recommendations that were made by conference presenters include continuing to study multi-purpose dams and raising awareness of the enabling and limiting factors for dam management. Those who are planning dams were advised to reference the recently launched global Initiative on Existing Dams and the Hydropower Sustainability Assessment Protocol for identifying strengths and weaknesses of existing and new dams.<sup>34</sup>

## Making it Work and Moving Forward

Arriving at an integrated nexus approach will require significant financial investment, because many of the old patterns will have to be changed and much of the current infrastructure will have to be updated, altered or completely rebuilt. The costs of inaction will ultimately outweigh the costs of action, so investment now will reap benefits in the not-so-distant future. However, due to the magnitude of the financial investments that will be required, the challenges of arriving at a nexus-oriented system cannot be left to the public sector to solve alone – private finance will have to play a major role. Unfortunately, at this time both public and private financial institutions lack adequate analytical frameworks to value

nexus issues, and rating agencies do not incorporate nexus risks in their evaluations of securities. Policy makers can help encourage a shift in private-sector involvement by leveraging investor movement towards sustainable finance and responsible investment through regulations and incentives. Investments by pensions funds can be especially important as a balance to short-term speculative in-

vestments. To arrive at a collaboration of public and private funding of nexus solutions, public authorities and international institutions should consider offering investment guarantees, and policy makers and investors must collaborate to create new mechanisms and funds. A number of guidelines are already available to assist the financial sector in making the transition to a nexus-based world: the Equator Principles for banks; the UN Principles for Responsible Investment; the UNEP Finance Initiative; the Principles for Re-

*“Act Nexus smart – encourage business by stressing the cost of failure, build up consumer engagement, and never say PPP (for public-private partnerships). It has to be PPPP, because people must come first.”*

*David Nabarro,  
Special Representative of the  
United Nations Secretary-General  
on Food and Nutrition*

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sponsible Investment in Farmland; the Principles for Responsible Agricultural Investments; the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forest in the Context of National Food Security; the UN Global Compact's CEO Water Mandate, and the Carbon Disclosure Project (CDP) Water Disclosure Project.<sup>35</sup>

Implementation of a nexus perspective will not happen automatically. While the opportunities and their social, environmental and economic benefits are real, implementation requires the right policies and incentives, and leaders and institutions up to the task, as well as empowerment, information and education. Appropriate incentives to encourage these transitions must be established, such as identifying financing arrangements that encourage and reward implementing a nexus approach. Harmful subsidies for food, water and energy must be reviewed and removed, while still considering support mechanisms for the poor and smallholder farmers that are decoupled from resource use. At the same time, demand should be shifted to reflect scarcity of resources, such as by correctly pricing resource use either via the market or through government intervention. Regional integration can enhance regional markets and trade, which would have the result of allowing for optimal resource use in that region.

The policies that will be needed for the nexus transition will not arrive in a vacuum. An enabling framework must be created for policy dialogue and coherence across water, energy and food sectors not only in the public sector but also in the private sector and in civil society institutions. Establishing procedures as part of the planning system will help analyze and disseminate the interconnectivity between sector policies. The vertical coherence between international, national and local policies must be strengthened as the process takes form. During the planning stages, establish-

ing a medium to long-term "Nexus Strategy" based on national water, energy and food outlooks will provide measurable targets and policy priorities, address relevant actors and design a consistent monitoring program for assessing achievements. Above all, secure tenure and user rights to land and water resources, in particular for vulnerable groups, must be protected.

Policies and frameworks cannot be implemented adequately without supportive and empowered institutions. Institutional arrangements, particularly at the top of the national and international decision-making trees, must be adapted to cope better with cross-sector challenges and inter-linked problems. Existing cross-sector institutions, such as planning commissions, can be utilized to inform sectoral implementation. Public-private-civil-society partnerships can increase cooperation and enhance empowerment as joint solutions are identified and implemented across the nexus. The path from research to dissemination to early adoption and scaling up of appropriate nexus technologies and practices must be accelerated, and a level playing field for new approaches and technologies must be ensured. Better measures to monitor and evaluate nexus outcomes and results are critical and must be stimulated and invigorated. Natural disasters can have multiple impacts due to the interdependencies between water, energy and food, so institutions must develop and implement strategies and related arrangements to enhance resilience to natural disasters and enrich adaptive capacities.

Once the policies, frameworks and institutions are in place, education, information dissemination and empowerment can be more robust. Understanding the inter-linkages between water, energy and food is critical to the development of response strategies and investment portfolios within and across sectors. That understanding can only be developed through providing access to information and raising awareness of

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resource use among all stakeholders. Therefore, all sector actors must be trained and qualified to implement nexus approaches, and the young must be educated from an early age to think interlinked. In this way, everyone can play a role in promoting nexus approaches, through innovation, cooperation, experimentation and implementation.

While implementing the action items above, we must bear in mind certain goals that cannot be compromised. People and their basic human rights must be at the center of the nexus, especially women, who make important choices and decisions regarding water, energy, and food for household consumption. Synergies and trade-offs among water, energy, and food must be considered in all policies, plans, and investments. Good governance, a clear rule of law, lack of corruption, and secure rights to land and water resources must be supported and promoted. Fi-

nancing must be developed that rewards nexus approaches to complex challenges, and market mechanisms must ensure that they reflect the true value of water, energy and food as well as associated natural resources. Business is essential for driving change and getting to scale, so the business case for sustainability must be clearly and forcibly made. Regional integration can lead the way, and regional markets and trade should be encouraged through incentives and policies to achieve optimum resource use.<sup>36</sup>

Knowledge and the communication of that knowledge are essential to implementing the nexus approach. Therefore, research, knowledge and data must be created and communicated, and better measures to monitor and evaluate nexus outcomes and results must be developed and/or enhanced.



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## Conclusion

Access to adequate water, food and energy services can be ensured for everyone, but not if business as usual is allowed to continue on its current trajectory. Policies, practices, structures and attitudes must all change to incorporate a nexus approach to water, energy and food. To accomplish this dramatic shift in the current paradigms, stakeholders in all disciplines and at all levels must be consulted, engaged and empowered.

A nexus perspective increases the understanding of the interdependencies across the water, energy and food sectors and influences policies in other areas of concern such as climate and biodiversity. The nexus perspective helps to move beyond silos and ivory towers that preclude interdisciplinary solutions, thus increasing opportunities for mutually beneficial responses and enhancing the potential for cooperation between and among all sectors. Everyone in all disciplines needs to think and act from the perspective of being interlinked in order to realize the full impact of both direct and indirect synergies that can result.

A deep understanding of the nexus will provide the informed and transparent framework that is required to meet increasing global demands without compromising sustainability. The nexus approach will also allow decision-makers to develop appropriate policies, strategies and investments, to explore and exploit synergies, and to identify and mitigate trade-offs among the development goals related to water, energy and food security. Active participation by and among government agencies, the private sector and civ-

il society is critical to avoiding unintended adverse consequences. A true nexus approach can only be achieved through close collaboration of all actors from all sectors.

While the opportunities provided by the nexus perspective and the consequent social, environmental and economic benefits are real, implementation requires the right policies, incentives and encouragement, and institutions and leaders that are up to the task, as well as frameworks that encourage empowerment, research, information and education. Accelerating the involvement of the private sector through establishing and promoting the business case for both sustainability and the nexus is essential to driving change and getting to scale.

The Bonn2011 Nexus Conference has provided a first platform for consideration of the close interlinkages of water, energy and food security and the benefits of a nexus perspective in a multi-stakeholder process. The specific message from Bonn2011 is clear: outcomes of Rio+20 in June 2012 must acknowledge and address the interdependencies between water, energy and food and act upon the challenge to make the nexus work for the poor and for all of us. The nexus approach is very much at the heart of the overall challenge of transforming our consumption-based economies to green economies by changing growth patterns to become more sustainable.

It is thus vitally important to incorporate the nexus perspective in Rio+20 as well as in local, national and other international planning activities that focus on water, food, or energy.

# Notes

- <sup>1</sup>The full text of Chancellor Merkel's opening address can be found at <http://www.water-energy-food.org/en/conference/welcome/merkel.html>
- <sup>2</sup><http://www.unep.org/greeneconomy/GreenEconomyReport/tabid/29846/Default.aspx>
- <sup>3</sup>Unless otherwise indicated, the information, data and figures in this section are taken from "Understanding the Nexus", the Background paper for the Bonn2011 Nexus Conference, whose development has been coordinated and led by the Stockholm Environment Institute (SEI), with contributions from various organizations. The full text can be found at [www.water-energy-food.org/understanding-the-nexus](http://www.water-energy-food.org/understanding-the-nexus)
- <sup>4</sup>"Accelerating Access – Integrating the Bottom of the Pyramid", Strategy Panel 1, Bonn2011 Nexus Conference, 16-18 November 2011. See [http://www.water-energy-food.org/en/conference/programme/show\\_17/accelerating\\_access\\_integrating\\_the\\_bottom\\_of\\_the\\_pyramid.html](http://www.water-energy-food.org/en/conference/programme/show_17/accelerating_access_integrating_the_bottom_of_the_pyramid.html)
- <sup>5</sup>Briefing paper on "Systemic Challenges – Systemic Solutions" prepared by Jacqueline McGlade, Executive Director of European Environment Agency (EEA) for "Enabling Environment and Incentives", Plenary 7, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_41/enabling\\_environment\\_and\\_incentives\\_for\\_nexus\\_solutions.html](http://www.water-energy-food.org/en/conference/programme/show_41/enabling_environment_and_incentives_for_nexus_solutions.html)
- <sup>6</sup>Briefing paper on "Green Growth & the Water-Food-Energy-Environment Nexus" prepared by Helen Mountford, Deputy Director, OECD Environment Directorate for "Enabling Environment and Incentives", Plenary 7, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_41/enabling\\_environment\\_and\\_incentives\\_for\\_nexus\\_solutions.html](http://www.water-energy-food.org/en/conference/programme/show_41/enabling_environment_and_incentives_for_nexus_solutions.html)
- <sup>7</sup>Briefing paper submitted for "Bioenergy, Food and Water Nexus: Developing Country Perspectives", Hot topic 4, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_19/the\\_bioenergy\\_food\\_and\\_water\\_nexus.html](http://www.water-energy-food.org/en/conference/programme/show_19/the_bioenergy_food_and_water_nexus.html)
- <sup>8</sup>Briefing paper submitted by the Global Water Partnership, the Food and Agricultural Organization of the United Nations and the International Land Coalition for "Integrate or Disintegrate: Tackling Competition on Water, Energy and Food Security", Hot Topic 9, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_26/integrate\\_or\\_disintegrate\\_tackling\\_competition\\_for\\_water\\_and\\_land.html](http://www.water-energy-food.org/en/conference/programme/show_26/integrate_or_disintegrate_tackling_competition_for_water_and_land.html)
- <sup>9</sup>Briefing paper submitted by Claudia Ringler, Zhenya Karelina and Rajul Pandya-Lorch of the International Food Policy Research Institute for "Emerging Country Strategies for Improving Food Security: Linkages and Tradeoffs for Water and Energy Security", Hot Topic 11, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_34/emerging\\_country\\_strategies\\_for\\_improving\\_food\\_security.html](http://www.water-energy-food.org/en/conference/programme/show_34/emerging_country_strategies_for_improving_food_security.html)
- <sup>10</sup>Briefing paper submitted for "Bioenergy, Food and Water Nexus: Developing Country Perspectives", Hot topic 4, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_19/the\\_bioenergy\\_food\\_and\\_water\\_nexus.html](http://www.water-energy-food.org/en/conference/programme/show_19/the_bioenergy_food_and_water_nexus.html)
- <sup>11</sup> See footnote 3 on "Understanding the Nexus"
- <sup>12</sup> See footnote 9
- <sup>13</sup> Briefing paper submitted for "Opportunities and Risks of Large-Scale Investments in Land and Irrigation Schemes", Hot Topic 10, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_27/opportunities\\_and\\_risks\\_of\\_large\\_scale\\_investments\\_in\\_land\\_and\\_irrigation\\_schemes.html](http://www.water-energy-food.org/en/conference/programme/show_27/opportunities_and_risks_of_large_scale_investments_in_land_and_irrigation_schemes.html)
- <sup>14</sup> Briefing paper submitted for "Bioenergy, Food and Water Nexus: Developing Country Perspectives", Hot topic 4, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_19/the\\_bioenergy\\_food\\_and\\_water\\_nexus.html](http://www.water-energy-food.org/en/conference/programme/show_19/the_bioenergy_food_and_water_nexus.html)
- <sup>15</sup> Briefing paper submitted by the German WASH Network, RUAF Foundation (International Network of Resource Centres on Urban Agriculture and Food Security) and the United Nations Secretary-General's Advisory Board on Water and Sanitation (UNSGAB) for "No Food and Nutrition Security Without Water, Sanitation and Hygiene", Hot Topic 7, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_21/no\\_food\\_and\\_nutrition\\_security\\_without\\_water\\_sanitation\\_and\\_hygiene.html](http://www.water-energy-food.org/en/conference/programme/show_21/no_food_and_nutrition_security_without_water_sanitation_and_hygiene.html)
- <sup>16</sup> Briefing paper submitted by the Global Water Partnership, the Food and Agricultural Organization of the United Nations and the International Land Coalition for "Integrate or Disintegrate: Tackling Competition on Water, Energy and Food Security", Hot Topic 9, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_26/integrate\\_or\\_disintegrate\\_tackling\\_competition\\_for\\_water\\_and\\_land.html](http://www.water-energy-food.org/en/conference/programme/show_26/integrate_or_disintegrate_tackling_competition_for_water_and_land.html)
- <sup>17</sup> See footnote 9
- <sup>18</sup> See footnote 3 on "Understanding the Nexus"
- <sup>19</sup> Briefing paper submitted by FAO, IAEA, IIASA, KTH, SEI, UN-DESA, UNIDO and WBCSD for "Sustainable Energy for All – What Does it Mean for Water and Food Energy?", Hot Topic 3, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_18/sustainable\\_energy\\_for\\_all!.html](http://www.water-energy-food.org/en/conference/programme/show_18/sustainable_energy_for_all!.html)
- <sup>20</sup> Briefing paper submitted by McKinsey and Co., the OECD and the World Economic Forum for "Managing the Nexus for Green Growth", Hot Topic 12, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_35/managing\\_the\\_nexus\\_for\\_green\\_growth.html](http://www.water-energy-food.org/en/conference/programme/show_35/managing_the_nexus_for_green_growth.html)
- <sup>21</sup> Briefing prepared by GIZ and the Stockholm International Water Institution for "Ending Food Waste From Field to Fork", Hot Topic 2, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_3/ending\\_food\\_waste\\_from\\_field\\_to\\_fork.html](http://www.water-energy-food.org/en/conference/programme/show_3/ending_food_waste_from_field_to_fork.html)
- <sup>22</sup> See footnote 16
- <sup>23</sup> "The Urban Challenge", prepared by Kalanithy Vairavamoorthy, Director, School of Sustainability Studies, University of South Florida, United States, for "The Urban Challenge: Optimising Water, Food and Energy Security in an Urbanising World", Hot Topic 5, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_20/the\\_urban\\_challenge\\_optimizing\\_water\\_food\\_and\\_energy\\_security\\_in\\_an\\_urbanizing\\_world.html](http://www.water-energy-food.org/en/conference/programme/show_20/the_urban_challenge_optimizing_water_food_and_energy_security_in_an_urbanizing_world.html)
- <sup>24</sup> See footnote 3 on "Understanding the Nexus"

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- <sup>25</sup> “The Nexus and Its Implications for Business” prepared by Allard Castelein, Vice President Environment, Shell, for “Sustainable Energy For All – What Does It Mean for Water and Food Security?”, Hot Topic 3 at Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_18/sustainable\\_energy\\_for\\_all.html](http://www.water-energy-food.org/en/conference/programme/show_18/sustainable_energy_for_all.html)
- <sup>26</sup> Presentation prepared by Haripriya Gundimeda, Associate Professor, IIT, Bombay, for “Investing to Sustain Ecosystem Services”, Strategy Panel 3, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_33/investing\\_to\\_sustain\\_ecosystem\\_services.html](http://www.water-energy-food.org/en/conference/programme/show_33/investing_to_sustain_ecosystem_services.html)
- <sup>27</sup> Presentation “Putting Nature in the Nexus”, prepared by Karin Krchnak, Director International Water Policy, The Nature Conservancy, for “Investing to Sustain Ecosystem Services”, Strategy Panel 3, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_33/investing\\_to\\_sustain\\_ecosystem\\_services.html](http://www.water-energy-food.org/en/conference/programme/show_33/investing_to_sustain_ecosystem_services.html)
- <sup>28</sup> Briefing paper prepared for “The Urban Challenge: Optimizing Water, Food, and Energy Security in an Urbanizing World”, Hot Topic 5, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_20/the\\_urban\\_challenge\\_optimizing\\_water\\_food\\_and\\_energy\\_security\\_in\\_an\\_urbanizing\\_world.html](http://www.water-energy-food.org/en/conference/programme/show_20/the_urban_challenge_optimizing_water_food_and_energy_security_in_an_urbanizing_world.html).
- <sup>29</sup> See footnote 3 on “Understanding the Nexus”
- <sup>30</sup> Briefing paper prepared by RUAF Foundation and ICLEI – Local Governments for Sustainability for “Urban Agriculture, Forestry and Biodiversity Protection – A Strategy for Urban Water, Energy and Food Security”, Hot Topic 1, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_2/urban\\_agriculture\\_forestry\\_and\\_biodiversity\\_protection.html](http://www.water-energy-food.org/en/conference/programme/show_2/urban_agriculture_forestry_and_biodiversity_protection.html)
- <sup>31</sup> See footnote 30
- <sup>32</sup> Briefing paper “Sustainable Soil Governance: Towards Integrated Soil Management for Water and Food Security” prepared for “Soils for Sustainable Development”, Hot Topic 6, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_28/soils\\_for\\_sustainable\\_development.html](http://www.water-energy-food.org/en/conference/programme/show_28/soils_for_sustainable_development.html)
- <sup>33</sup> Briefing paper submitted by the World Wildlife Fund, the International Hydropower Association and The World Bank for “Making Dams Work for the Nexus”, Hot Topic 8, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_25/making\\_dams\\_work\\_for\\_the\\_nexus.html](http://www.water-energy-food.org/en/conference/programme/show_25/making_dams_work_for_the_nexus.html).
- <sup>34</sup> See footnote 33
- <sup>35</sup> Briefing paper prepared by the UN Global Compact Office for “The Water-Energy-Food Security Nexus: Understanding the Risks and Opportunities for Private Finance”, Hot Topic 13, Bonn2011 Nexus Conference, 16-18 November 2011. Available at [http://www.water-energy-food.org/en/conference/programme/show\\_36/the\\_water-energy-food\\_security\\_nexus\\_understanding\\_the\\_risks\\_and\\_opportunities\\_for\\_private\\_finance.html](http://www.water-energy-food.org/en/conference/programme/show_36/the_water-energy-food_security_nexus_understanding_the_risks_and_opportunities_for_private_finance.html)
- <sup>36</sup> Reflections of the Co-chairs, Bonn2011 Nexus Conference, 16-18 November 2011. Available at <http://www.water-energy-food.org/en/conference/reflections.html>
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With its interactive and intersectoral approach the Bonn2011 Nexus Conference was the kick-off event for a novel series of dialogues and conferences on sustainability, the “Bonn Perspectives”. This new joint initiative of the German government and the City of Bonn aims at providing fresh ideas to the international debate on sustainability by offering opportunities for multidisciplinary and intersectoral dialogues on solutions for emerging global challenges.

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