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

Bonn2011 Conference: The Water, Energy and Food Security Nexus – Solutions for a Green Economy*

Policy Recommendations

This document is the result of a broad participatory stakeholder process which started during the preparation for the conference and includes feedback from participants during and in the follow-up to the conference

13 February 2012

Bonn2011 considers that achieving water, energy and food security, and consequently reducing hunger and eradicating poverty, is a central future challenge that is possible even under difficult and challenging global economic conditions.

The first imperative is to achieve water, energy and food security for the poorest of the poor. It emphasizes the human dimension and fulfilment of basic human rights. Global demand and supply assessments predict significant shortfalls in water and food in the future, but this should not mask the reality that universal access to minimum standards of water, energy and food can be achieved and sustained within planetary boundaries provided there is political commitment and an appropriate enabling environment.

Second, more sustainable development and growth beyond poverty eradication can be achieved by better management of the world's ecosystems and a more informed and optimal use of water, land and other natural resources. It is an approach fully consistent with the Green Economy that aims to bring a broader perspective into decision-making and where '*growth in income and employment is driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services'.*[1]

This realisation forms the rationale for Bonn2011 and an approach that addresses the interdependency between water, energy and food security and the underlying natural resources - water, soil and land and related ecosystems. Bonn2011 has opened up a global debate on the importance of the nexus on water, energy and food security and the need for interlinked thinking and action. For further information on the background document, the Co-Chair's reflections, key messages, details of the conference sessions, nexus solutions and follow up, see http://www.water-energy-food.org/en/conference.html

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* convened by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the German Federal Ministry for Economic Cooperation and Development (BMZ)

[1] Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication. Water Chapter - http://www.unep.org/pdf/water/WAT-Water_KB_17.08_PRINT_EDITION.2011.pdf

1. Nexus challenge: beyond conventional decision-making

Central to a human rights approach is the achievement of water, energy and food security for the poorest of the poor. Many commitments have been made to contribute to this objective, including the Millennium Development Goals. With a view to contributing to sustainable development in general they have been complemented by a drive towards renewable energy sources, adoption of the concept of integrated water resources management, and moves taken towards more sustainable and efficient agricultural practices. Much is also being done by governments, within communities and in business to achieve more productive, resource efficient equitable and sustainable outcomes.

In spite of this significant progress, security of water, energy and food supplies remain far from being achieved globally. Basic services are not available to a large proportion of the world's population; about 0.9 billion are without adequate access to water for their basic needs and for many more the water is not safe for consumption, 2.6 million lack access to safe sanitation, close to 1 billion are undernourished, and at least 1.5 billion are without access to modern forms of energy. People thereby remain deprived of their human rights and are constrained in their opportunities for development. And for many others, the system does not yet offer the conditions needed to raise their livelihoods and emerge from poverty.

With 70% of the expected global population of 9.2 billion people living in cities by 2050 and with economic growth continuing on current paths, demands for water, energy and food will increase exponentially; there are projections of a 70% increase in agricultural demand by 2050 and energy demand increase of 40% by 2030. Water demand projections to satisfy agriculture and energy production are a similar order of magnitude.

At the same time, the world is reaching, and in some cases has already exceeded, the sustainable limit of resource availability and is at risk to trespass planetary boundaries. Therefore there is a need to build on more innovative solutions to achieve sustainable growth.

While global demand and supply assessments predict significant shortfalls in water and food in the future, this should not mask the conviction of Bonn2011 that universal access to minimum standards of water, energy and food can be achieved and sustained within planetary boundaries provided there is political commitment and an appropriate enabling environment. However the current situation shows as well that the effectiveness of conventional planning and decision-making is reaching its limits and compromises prospects for sustainable development including economic growth and poverty eradication.

Failing to recognize the consequences of one sector on another can lead to notable inefficiencies in the system. For example, decisions on the type of energy generation can significantly influence water demand and in the case of biofuels, compete over land for food production; the way water is sourced, treated, priced and distributed can raise or lower energy requirements; and the choices made on food and diet influence both water and energy needs.

Weak governance systems, limited awareness, distortions from perverse subsidies and unsustainable investments can exacerbate a set of unintended consequences and contradictory

outcomes. The result is sub-optimal allocation of resources and an inability to meet accepted norms of water, energy and food security.

A new nexus oriented approach is needed to address unsustainable patterns of growth and impending resource constraints and, in doing so, promote security of access to basic services. It is an approach that better understands the interlinkages between water, energy and food sectors as well as the influence of trade, investment and climate policies.

A nexus perspective helps to identify mutually beneficial responses and provides an informed and transparent framework for determining trade-offs to meet demand without compromising sustainability and exceeding environmental tipping points. It aims to bring economic benefits through more efficient utilization of resources, productivity gains and reduced waste. This is a particular challenge in today's economic climate, yet the consequences of inaction would become increasingly severe on people's welfare, economic growth, jobs, and the environment.

2. Guiding directions: focusing on an interlinked approach

Setting the nexus framework for an informed and interlinked approach to optimize resource use, balance allocation between competing uses and stimulate economic growth starts by reaffirming a set of well-established objectives. Bonn2011 aims to contribute to eradicating poverty; ensuring water, energy and food security for all; upholding basic human rights; achieving sustainable and equitable development; maintaining productive and resilient ecosystems; and reducing vulnerability to climate variability and change.

The three dimensions of sustainable development – social, economic and environmental – provide entry points from which opportunities to apply the nexus were subsequently identified. Their relevance to Bonn2011 is characterized by:

Access to basic services: Meeting minimum standards of access to safe water, adequate sanitation, healthy food and clean sustainable energy is a pre-requisite for human development and dignity. It starts with addressing the human rights to water and sanitation as well as food for more than a billion people, but goes further than safe drinking water and minimum nutrition standards to raise livelihoods for a far larger number. Improving access to basic services, including investments in agriculture particularly to benefit smallholder farmers, can yield significant returns for people's health, household income and the broader economy through higher productivity. Embedding a gender perspective will further accelerate achievement of these gains.

Productivity of resource use: There is a growing recognition that reducing waste, limiting over-use and increasing overall economic productivity is not only essential as demand on the world's resources increase, but also makes sound economic and business sense. Numerous examples of efficiency gains, demand management and re-use exist and can achieve multiple results; for example by lowering resource use and costs for industry, by saving the energy and water used to produce goods that would otherwise be thrown away and by reducing the consequences of pollution. Water and energy thus saved can be reallocated to other uses. As poverty reduces, expectations and demand also increase, making a stronger case for more innovative policies on resource efficiency beyond the current supply-dominated paradigm.

The value of ecosystem services and biodiversity: The contribution of ecosystems and biodiversity to human wellbeing and the economy is considerable. The services provided by ecosystems include freshwater, food including crops, fish and other aquatic products, timber and fibre production, biofuels, climate regulation and tourism. In some cases, the benefit relates to a cost of avoidance such as carbon sequestration and watershed protection. Conservation of biodiversity has long been an objective and is central to the provision of ecosystem services. Cultural and spiritual values and benefits are more difficult to quantify but equally of value. Most ecosystem services beyond food and biofuel

production have not been well monetized, regulation is weak and hence investments to sustain them have been limited resulting in deforestation, loss of wetlands, over-exploited rivers and degraded soils. Sufficient evidence exists to justify the use of innovative financing and regulatory tools to protect and sustain ecosystems taking into account their local, regional and global importance.

Taking a more interlinked and *nexus-aware* approach can largely be achieved within existing organizational structures although changes to procedures and processes will be necessary. In summary what is needed is 'policy coherence for sectoral implementation and management'. This requires active leadership supported by the requisite enabling frameworks and incentives to encourage interlinked thinking at policy, strategy and planning levels from which implementation in the sectors will follow. Benefits will be seen through water, energy and food security, poverty reduction, better health, more sustainable growth, new jobs through adoption of new technologies and avoidance of inefficiency and counterproductive investment.

3. Policy recommendations: opportunities to make a difference

As the nexus approach to addressing water, energy and food security gained momentum in the preparations for Bonn2011, the three entry points of increasing access, raising resource productivity and sustaining ecosystems became central to developing the policy recommendations. Even taking into account the challenges of population growth, urbanization, industrial expansion and climate change, a confidence emerged that water, energy and food security can be attained as part of a wider green growth agenda.

Six specific 'Nexus Opportunity Areas' resulted from the process. They support sustainable growth and achievement of water, energy and food security by cutting across interlinked decision spaces and identifying win-win solutions. They address the often competing tensions between sectoral objectives and the consequential 'push-pull' pressures on the water resource and associated land and natural resources.

The **'Nexus Opportunity Areas'** are:

Increase policy coherence
by ensuring that synergies and trade-offs among water, energy and food are identified both in design and implementation of policies, plans and investments. And by incentivizing co-operation and coordination for mutually beneficial approaches, multiple benefits and fewer unintended or adverse consequences.

Accelerate access
by progressively realizing – in a more coordinated way – the human rights obligations related to water, sanitation, energy and food to reap the resulting health, productivity and development benefits. And by prioritizing access for the poor and the marginalized in sector strategies, planning and investments.

Create more with less
by increasing resource productivity establishing mechanisms to identify the optimal allocation of scarce resources for productive purposes and sustainably intensifying the use of land and water to achieve equitable social, economic and environmentally sound development.

End waste and minimize losses
by reducing waste and losses along supply chains to capture significant economic and environmental gains within and across sectors and reduce demands on water, land and energy. And by changing mindsets and incentivizing technological development to turn waste into a resource and manage it for multiple uses.

Value natural infrastructure
by investing to secure, improve and restore the considerable multi-functional value of biodiversity and ecosystems to provide food and energy, conserve water, sustain livelihoods

and contribute to a green economy while strengthening the basic role that nature plays in supporting life, well-being and cultures.

Mobilize consumer influence
by acknowledging and actively utilizing the catalyzing role that individuals have in choosing consumption patterns on water, energy and other resource footprints and improving efficiency of resource use both through their direct actions and in influencing the way business is done.

For each of the 'Nexus Opportunity Areas', there is a set of policy recommendations that provide the basis to build momentum for a more coherent approach; develop enabling policy frameworks; provide economic incentives and establish market instruments; re-orient regulatory, planning and institutional setups; stimulate good governance; and build capacity.

There is no single approach or blueprint for nexus considerations. Regional, national and local diversity requires that these recommendations are viewed as a generic framework that can be moulded and adapted to suit local circumstances.

3.1 Increase policy coherence

Achievement of water, energy and food security, optimum use of natural resources, effective demand management and efficient use of increasingly limited financial resources require a coordinated and interlinked approach to decision-making. It is an approach that looks for synergies both horizontally across the three sectors and the broader policy environment including climate change and urban development, and vertically between international, regional, national and local levels. Similarly it embraces the principles of the Green Economy in decoupling growth from resource depletion. Achieving mutually beneficial approaches, multiple benefits and fewer unintended consequences requires political commitment and coherent policies to:

Ensure that development pathways explicitly account for the inter-dependency between water, energy and food. Energy provision and food supply options utilize water and land to varying extents and similarly water supply requires energy at differing scales and intensities. In prioritizing water, energy and food security and its contribution to poverty reduction, any trade-offs between alternative choices on resource utilization, technology, regulatory frameworks, incentive structures, fiscal and trade policy should be made on the basis of an integrated 'nexus assessment, review and strategy.' It would provide an open and full understanding of the implications of one choice on the other options as well as consequent requirements placed on natural resources and the risks of degradation. Multiple benefits and efficiency gains can be achieved by looking beyond single issue approaches.

Encourage cooperative structures and procedural mechanisms for implementation of a more interlinked 'nexus' perspective at international, national and local levels. The objectives of greater interlinkage in policy formulation, planning, management and monitoring processes can be achieved by targeted cooperation, cross-sectoral relations, improved procedures and regulatory measures while concentrating on the fundamental need to improve sector performance. Within sectors, financial incentives are required for innovation and replicating successful initiatives. Cooperation is needed at the national level through strategic planning and

functional linkages to coordinate sectoral ministries and other stakeholders including civil society; in business through strengthened incentives, public-private partnerships and improved corporate responsibility programs; at the local level in ensuring access to basic services; and at the international level, for example through more effective coordination in implementing existing multilateral environment agreements and Green Economy considerations. Similarly greater cooperation applies in formulating strategies to enhance resilience to natural disasters and improve adaptive capacities.

Promote sustainable development opportunities through a collaborative trans-boundary and basin-wide approach to development decisions that cross borders. In an increasingly globalised world, decisions taken in one continent can affect resource allocation in another. This gives rise to use opportunities of regional integration to enhance markets, trade and financing to promote optimal resource use, more equitable distribution and sustainable outcomes. Similarly, in shared river basins and aquifers interventions can change the amount of water available, alter flow regimes or affect water quality thereby limiting or expanding the available options upstream or downstream. Coming to cooperative arrangements for managing shared water resources is paramount for the nexus. It is linked to the principles of integrated water resources management that provide a recognized framework for cooperation but which in practice needs to be expanded to effectively influence responses to food and energy drivers and the wider political economy. A more inclusive and interlinked analysis across the spectrum of development options will provide a basis for coordinated planning and management in a trans-boundary context.

Review and redress distorting subsidies. Subsidies designed to support food, water and energy security have often had adverse consequences tending to disproportionately benefit the non-poor, reduce resource use efficiency (of water, energy and land), distort relative comparative advantage, displace investments in R&D and innovation, and pose burdens on limited government budgets. For example, energy subsidies have led to over-exploitation of groundwater whereas in other areas there are diverging opinions, for example more study is needed on the extent to which encouraging biofuels has exacerbated food shortages and price rises. An integrated and comprehensive assessment of the economic, environmental and welfare cost of subsidies and the political will to address them and turn them into incentives is needed as part of the drive to increase food, water, and energy security.

Adopt a rights-based and participatory approach to land-use policy and related investments. Productive land is increasingly under pressure from population and urbanization, more intensive agricultural practices, infrastructure development and foreign investment. Remaining forest land and freshwater ecosystems are under growing threat. Land management plays a fundamental role in providing basic water supply, food security and livelihoods to local communities and the wider population. Good practice guidance to strengthen governance of land tenure and related resources is being developed. Decisions influencing access to land and its management also require consideration of the rights and access to water and the rights of indigenous peoples. Provisions are needed to recognize people's rights, including consultation and meaningful participation, to avoid actions that would lead to impoverishment and to share the benefits through revenue sharing or equity arrangements.

Mainstream climate change mitigation and adaptation policy and strategies to reinforce considerations of water, energy and food security and the local environment. Minimizing the risks from climate change impacts to water, energy and food security needs to be incorporated in national development strategies. This involves adapting existing systems and incorporating resilience into new systems. Conversely, there needs to be a recognition that climate change policies and strategies to reduce greenhouse gas emissions may influence positively or negatively water and food security and ecosystems, whether through offset arrangements (e.g. reforestation) or direct investment (bioenergy, hydropower or other renewable energies). Similarly adaptation measures can be energy intensive (e.g. pumped irrigation and desalination). The choice of mitigation and adaptation options needs to assess and reflect on these consequences through a process of open and multi-dimensional analysis and dialogue.

3.2 Accelerate Access

Narrowing the gap in provision of basic services recognizes the importance of rights of access and the benefits that will accrue through increasing productive capacity. Potential is currently locked up in individuals who spend more time struggling to survive than being creative and productive, and in systems that fall short of targets due to unsustainable resource management practices, lack of innovation and poor governance. Similarly, poor water quality leads to poor health, loss of productivity and additional costs. As the limit to sustainable resource use is reached or exceeded, the challenge of meeting the gap in basic water, food and energy services while protecting the natural capital of ecosystems will increasingly require new approaches. Meeting growth targets will similarly require more optimal allocation and redistribution of scarce resources for productive uses and sustaining natural systems that currently support livelihoods. The opportunity exists to unlock that potential and to take a new look at systems in one sector that place an unsustainable demand on resources of another. Increasing access and unlocking productive potential requires innovation, ingenuity and policies that:

Achieve access to safe water, sanitation, food and energy for human survival and dignity, poverty reduction and sustainable development. Lack of access is generally not an issue of scarcity but one of commitment and enabling environment. Water and sanitation are a human right and access is essential for human development as well as economic development. The scale of resources needed to provide these basic services is relatively low, yet hunger and malnutrition continue. Prioritization in sector strategies and planning and explicit investment are needed to target the most vulnerable. According to the UNEP Green Economy report, these basic services are a pre-requisite for achieving further economic gains. A range of approaches are needed for urban, peri-urban and rural areas and for economies at different stages of development.

Apply an integrated approach to the provision of reliable, affordable and clean energy. The gap in access to reliable and clean cooking and heating stoves in developing countries, including adequate fuels and electricity supply, needs tailor-made solutions. They include off-grid and mini-grid renewable energy systems in rural areas and improved on-grid access and reliability for the urban poor. Reliable, affordable and clean energy access needs to be linked with use of energy efficient appliances, requiring attention at policy and project levels. Energy poverty has

been dealt with successfully in some developing countries through grass-roots organizations and small to medium sized enterprises. In more developed countries, there are opportunities to increase capacity of existing systems through new generation technology, optimization and efficiency gains.

Promote access, productivity gains and more equitable sharing of benefits through explicit commitments to transparency and integrity systems. Corruption takes many forms and can be widespread in major infrastructure projects and management systems resulting in economic and financial losses and distortions in decision-making, including in relation to utilization of resources. High level support for efforts to respect ethical behaviour, reduce corruption and enhance integrity, transparency and accountability needs to be followed through the system at all levels, and across and within sectors, with awareness raising, the adoption of available good practice tools and more effective enforcement.

Increase the contribution of water storage and its role in reducing vulnerability to short and long term climate variability and change. Water storage comes in many forms ranging from groundwater aquifers, soil moisture, rainwater harvesting systems, lakes, wetlands and small to large dams. Increasingly storage is seen as important to reduce vulnerability to climate variability and change although this depends on the duration of drought conditions. Some new storage will be required. A comprehensive options assessment is required to assess the most suitable alternative for any given situation and this can be built into a strategic, rather than project-by-project, approach to planning. In the case of dams, the social and environmental footprint can be extensive. International good practice exists for considering sustainability from early stages of planning through to implementation and for optimizing the management of existing dams to meet multi-purposes. Peoples' rights need to be respected and consent gained for decisions affecting their lives and livelihoods. Projects with multiple objectives can potentially broaden the benefit stream, but past experience shows that new approaches are needed to balance any competing uses and address institutional complexities.

3.3 Create more with less

Increasing efficiency of resource use in manufacturing and processing yields significant economic, financial and environmental gains. There is a strong business case for identifying inefficient infrastructure, equipment and processes in water supply for municipal and industrial systems, in energy generation and manufacturing and in both rainfed and irrigated agriculture. Savings in one sector can have spin-off benefits in others. The private sector is already working with international organizations to identify, implement and disseminate win-win solutions through water accounting and water stewardship programs. As a cost-effective strategy, demand management will play an increasingly important role in reducing the overall pressures on scarce resources. Creating more with less builds on existing experiences and will require more widespread adoption of policy frameworks to:

Further raise awareness among the public and in industry of resource use in manufacturing and production processes and publicize innovations and good practice for demand management, increasing efficiency and raising productivity. More widespread assessment and the further development and application of standard reporting practices are needed to

compare resource use in manufacturing, processing and production and to inform the assessment of development options. Demand management plans are seen as an essential part planning processes and assessing development options.

Encourage savings in industrial and agricultural sectors, electricity generation and transmission and in urban utilities by adopting innovative ways to raise efficiency and productivity and to reduce water, energy and carbon footprints. Many initiatives are being sponsored by business, international organizations and governments to promote savings of water and energy thereby reducing pressure on resources and allowing re-allocation to other sectoral uses and the environment. Such measures need to be accelerated and smart incentives provided for efficiency gains, particularly in agriculture which is the dominant user of water. Scope exists to raise productivity at various steps in the food supply chain. Appropriate pricing regimes and subsidy reform are part of a broader mix of measures and a life cycle approach is needed that examines the full value chain.

Provide an enabling framework for innovation and shortcutting development pathways. Extensive research and development is being undertaken by business, international organizations and governments to improve technology and service delivery. The costs and resource demands of new technology are reducing rapidly, making it affordable for developing and emerging economies to bypass the inefficiencies experienced by developed economies and achieve potential through innovation. Prior to major water or energy infrastructure development, a first step is to evaluate demand-side options, optimize the performance of existing assets and embrace lessons learnt from past projects in the planning, design and implementation.

Conserve and increase the long term productivity of land and soil through adoption of sustainable agricultural management practices. Increasing land degradation, drought and desertification and adverse impacts of climate change all present major constraints to livelihoods, the future productivity of arable lands and ecosystem services. The recently launched initiative on the economics of land degradation[2] demonstrates the consequences of inaction. Emphasis is required on adoption of more sustainable land, water and soil management practices, more productive rainfed agriculture, a reduction in land contamination from industry, realization of the potential for integrated food-energy systems, and the expansion of saline tolerant crops in coastal areas. Farmers are the agents of change but require the right knowledge, incentives and tools to respond.

3.4 End waste and minimize losses

Reducing waste along supply and consumption chains is a priority across all sectors, but there are practical and economic limits and so concerted efforts are required to engender a culture of viewing any residual waste as a resource, including coordinated planning of collection, treatment and re-use systems. Although easier for new developments such as rapidly expanding urban areas, examples of

[2] The European Commission, the German Government and the Secretariat of the UN Convention to Combat Desertification (UNCCD) have launched the Economics of Land Degradation (ELD) initiative in September 2011

retrofitting do exist. Recycling of solid waste has gained momentum in many countries through formal and informal systems. Apart from a few notable examples, the safe re-use of wastewater is less widespread yet can offer cost effective supplies of appropriate quality water for a range of uses including drinking, the household, agriculture particularly in peri-urban areas, industry and the environment. Similarly there is considerable potential for the use of waste for energy generation. Minimizing waste, reusing waste, recycling and extending the lifecycles of products will require policy encouragement to:

Promote a 'minimum' waste policy at national and local levels. Interest is growing in a 'green' cities agenda covering a range of linked initiatives by local authorities including reduction in waste. It can have multiplier benefits in terms of reducing demands on water and energy. Similarly reduction in losses along the food value chain including post-harvest losses is one area that contributes to more efficient agricultural systems, reduces use of resources and can relieve pressure on food prices. Improvements are needed in markets, knowledge management, technology and rural infrastructure. Water supply, energy and agriculture sectors are encouraged to target resource efficiency and minimum waste through appropriate sets of policies and incentives. Implementation of a minimum waste policy will require a long term perspective and institutional cooperation across a wide range of agencies, business, farmers, communities, and the media.

Encourage effective regulatory and planning frameworks for the re-use of waste and address environmental and human health concerns and cultural sensitivities. Opportunities for re-use of solid waste exist but policies are needed to encourage 'clean waste' that can be re-used fully as opposed to 'mixed waste' that creates residues and can lead to hygiene concerns and require considerable energy to separate. Coordinated urban planning can yield multiple benefits by lowering energy demand, reducing waste and levels of pollution and using innovative ways to generate electricity. Informed municipalities and utilities are moving ahead rapidly with new initiatives and these provide a knowledge base to be used as models for replication.

Create a culture of innovation for re-use of wastewater. The technology for re-use of wastewater exists and is proven but no single approach will suit all situations and cultures. It needs a change of mindset to see wastewater as a resource. Regulatory systems to cover wastewater re-use and ensure the appropriate standard of water quality need to be put in place, (e.g. for human consumption, industrial use, agriculture, aquifer recharge and environmental flows). Proactive support for research and development will be required to develop a new generation of more effective and efficient projects. Awareness of the benefits and safeguards needs to be raised and the capacity built at all levels for a more coherent approach.

Ensure options for re-using waste are considered objectively prior to exploiting new resources. Unfamiliar technologies often require incentives to gain acceptance even where the financial case appears strong. Policy encouragement and development assistance may be needed to cross the threshold of acceptability of re-use projects. Life cycle analysis will ensure externalities are incorporated and any perverse subsidies that favour natural resource exploitation over re-use are recognized and can be debated. In the case of energy production, multiple benefits may be achieved by promoting second generation technology bioenergy but

need to be viewed in the context of the agricultural system as a whole. Avoiding redundancy in product design and extending serviceability can also make a contribution to reducing waste and lowering demand.

Encourage and maintain momentum for recycling. Formal and informal recycling schemes exist across the world. The drivers for recycling include addressing environmental concerns, limited availability of landfill sites and financial incentives. The economic and nexus rationale for recycling exists yet improvements are needed to promote it further and safeguard the health and safety of those involved. A transition to more institutionalized and regulated recycling systems is needed as countries develop, including incentives to encourage consumer behaviour towards recycling.

3.5 Value natural infrastructure

The value of natural assets and ecosystems to economies, people's livelihoods and society in general is routinely under-valued in development decision-making. There is a spectrum of ecosystems ranging from highly diverse natural systems to intensively developed agricultural systems. Society benefits to varying degrees both in direct economic and financial terms and in the sense of broader factors such as the water cycle, climate regulation, human well-being, as well as culture and natural heritage. The Green Economy sees a transition to a set of policy and administrative arrangements that supports future growth while neither degrading the environment nor imposing unacceptably high costs on sections of society. To further realize and maintain the benefits already provided from ecosystems and biodiversity, a policy framework needs to:

Assess and acknowledge the value of ecosystem services directly and indirectly for water, food and energy security and their contribution to local and national economies. Terrestrial, aquatic and agricultural ecosystems and their habitats play a significant part in providing food, energy, supporting livelihoods, sequestering carbon, providing water treatment, flood protection, conserving water for productive purposes downstream, supporting biodiversity and generating tourism revenues. Broader understanding and application of common analytic tools are required to assess the full value of these. Human interventions need to be in balance with ecosystem functions and co-managed to keep them healthy and resilient to external challenges and supportive of the ecosystem adaptation capacity of the environment.

Encourage conservation and use of natural capital through a framework of economic analysis and incentives. Economic analysis of development options needs to internalize the value of natural capital in the assessment of alternatives at an early stage of planning and explore the options to generate multiple benefits of land rehabilitation. Any perverse incentives or subsidies that lead to its degradation would need to be removed unless fully justified through open and transparent processes.

Develop and adapt sustainable financing mechanisms to maintain ecosystems services. Evidence has shown that ecosystems services are subject to significant development pressures unless sustainable forms of finance are available for their maintenance. A wide range of schemes and mechanisms are now available to finance necessary long term support activities, such as payment for environment services (PES), benefit sharing regimes, REDD+, ecotourism

projects, etc., and can be tailored to local circumstances. Successes at project level need to be broadened into more programmatic funding approaches.

Strengthen measures to protect critically important ecosystems and biodiversity. The inherent value of biodiversity and natural ecosystems is recognized through a range of multilateral and national agreements and commitments yet implementation often remains weak. A concerted effort is needed to turn these commitments into practice through wider use of sustainable financing mechanisms, more effective coordination across sectors and administrative levels, and unambiguous signals of support from the highest levels of government in support of implementation.

Reduce sources of pollution to water bodies, soil and air. In addition to the environmental benefits, reducing pollution loads at source will cut the costs of treatment (both financial and energy costs), the incidence of health impacts including water-borne diseases and respiratory problems and the accumulation of toxic contaminants. Lowering levels of pollutants in rivers and aquifers minimizes the need to release water for dilution, the saved water then being available for other productive purposes. Reducing pollution loads and increasing the provision of sanitation services and sewage treatment can complement efforts to provide cleaner water for household use beyond the minimum supply for safe drinking water. Co-location of synergistic production processes can turn waste streams from one into input streams for another, thereby also reducing the waste being discharged to water, land, and air.

Recover and maintain a balance between productive ecosystems and intensive farming systems. Economic growth and changing demographics are among the key drivers of change from subsistence agriculture to more commercial and intensive forms of agriculture. Foreign direct investment in agricultural land for export markets is also rising fast and has implications not only for local people, but also for water demand. Commercial agriculture can be more efficient in water and energy use, yet the relationship with the land and ecosystem changes, often involving higher levels of fertilizer and pesticide use. A balance is needed to limit additional water demand, explore options for protein production requiring lower levels of water and energy inputs, promote sustainable farming practices, maintain the diversity of production from agricultural systems and soil fertility and minimize the risk of pest outbreaks. Land tenure and customary rights of local people need to be fully recognized.

3.6 Mobilize consumer influence

Societal and personal choices on lifestyle and behaviour drive demand whether as a result of convention or aspiration. They are based on frames of reference and values entrenched in a wide range of cultural systems across the world, but are increasingly converging as a result of globalization. The consequences of such choices are not always fully apparent to those making them. At the same time, globalization has demonstrated the influence that consumers can have on manufacturers, suppliers as well as on government policy in taking a more responsible stance towards sustainable production and consumption. This in turn has demonstrated financial returns, new job opportunities and has reduced resource utilization. These advances can be further consolidated and replicated through policies that:

Provide access to knowledge and raise awareness of nexus interactions and resource utilization. Informed choice of consumers for more sustainable products and services requires reliable information about the resources used in their production and that of alternatives, including the extent of environmental and social impacts. Thinking globally and acting locally requires reliable, independent and meaningful information in a form that is readily accessible. Considerable advances in knowledge of water, energy and carbon footprints of various products exist and efforts are underway to standardize reporting conventions. More is needed to make this information prominent in the public domain and openings exist to use modern social media and target youth in addressing the nexus. Lessons can be learnt from application of existing certification schemes. These need to be broadened to include nexus and lifecycle considerations covering a wider set of products so that consumers can express individual preferences towards sustainable production.

Promote behavioural change and preference towards responsible resource use. Exerting consumer influence through purchasing power can be an effective stimulus for other manufactures to follow those companies taking a lead in efficient resource use and sustainable production. Particularly relevant to developed economies, such consumer preference can similarly have a major influence in many emerging and middle income economies. Workforces intimately familiar with production processes are in a unique position to identify effective and productive innovations. Similarly those companies already benefitting from more responsible production can act as examples to others in identifying win-win solutions.

Encourage local community involvement in dynamic conservation of natural resources and management of national heritage. Financing conservation areas and natural heritage through centralized government programs has long been problematic. Although new mechanisms are emerging, these tend to be constrained to situations where a market exists – for example a carbon market or sustainable business case. For natural resources and natural heritage management where there is no direct financial flow, including biodiversity conservation and areas providing cultural and spiritual value, co-management with local groups and indigenous communities can offer both local and national benefits.

Publicize measures of quality of life and sustainable use of resources to complement existing measures of economic well-being. Headline reporting of a country's health typically uses indicators of the size of its economy, its growth rate, balance of payments, poverty rate and levels of employment. Additional social, well-being and environmental indicators such as the Human Development Index, status of natural capital, biodiversity and other measures can be utilized to help raise support for investment priorities, including meeting water, energy and food security targets.

Establish a monitoring, evaluation and information system for assessing the added value of integrated nexus planning and nature of beneficial outcomes. Encouraging further expansion of integrated approaches to policy development, planning and implementation requires strong evidence that its value outweighs its costs. Contributors to the knowledge base will come from all stakeholder groups and regions and so an institutional home is required for a coordinated platform of nexus solutions that builds on the initial evidence presented in the background paper for the Bonn2011 Conference.

4. Taking action: scope, roles and responsibilities

Bonn2011 was the beginning of a process to understand and address the complexity of the nexus challenges. Moving on from policy-level recommendations to implementation, this section sets out the type of actions that stakeholders can take to promote a more interlinked and coherent approach. It distinguishes between:

- those areas where *nexus thinking* needs to be stressed and the externalities related to other sectors considered in more depth, and
- what can be achieved through strengthening *sectoral planning and implementation* within a more coordinated policy framework.

It should be possible to identify an investment agenda focusing both on the 'soft' elements of policy and regulatory reform, planning and capacity development and for the ensuing 'hard' investments needed to deliver on reaffirmed commitments for water, energy and food security. In taking this forward, there will inevitably be a diversity of situations and responses to be considered depending on a country's specific challenges and pressures, its culture and its development status. The following sections outline some of the actions that can be taken by different stakeholder groups:

National governments and parliamentarians

Governments are responsible for setting the policy framework, regulating markets and providing enabling conditions. Although scarcity of resources is a recurring issue, examples from around the world demonstrate how those resources can be better utilized provided that the commitment and enabling environment exist. Taking the 'Nexus Opportunities Areas' forward presents a number of challenges and will involve choices and trade-offs, both for decisions on investment in infrastructure as well as the 'softer' instruments needed to guide development thinking and market and consumer behaviour. The aim is to generate local benefits and minimize the risk of unintended consequences. The nexus does not replace working in sectors, but is an essential lens within which to focus new interlinked thinking. Actions for national governments to consider include:

Make the sectors work for the poor: Facilitate, and finance access for more than one billion people to adequate levels of food and nutrition, water, sanitation and energy so that they can lead healthy and productive lives. Assess and adopt the most effective delivery mechanisms to achieve this through both centralized and decentralized approaches, involving civil society, recognizing the importance of a gender perspective, and monitor progressive realization of peoples' rights to water, food and energy.

Assess the potential for a more interlinked approach by preparing a medium to long-term "Nexus Strategy" based on cross-sectoral knowledge base - a National Water, Energy and Food "Outlook": The diversity of situations and challenges requires an interlinked strategic national and sub-national approach to:

- identify the scale and complexity of the nexus, raise awareness and increase the understanding of concepts of sustainable development,

- scope out solutions to develop a medium to long-term vision for water, sanitation, energy and food security and set measurable targets,
- assess institutional and procedural constraints particularly related to achieving water, energy and food security,
- identify policy priorities,
- address actors and their responsibilities, and
- formulate a roadmap covering each of the nexus opportunity areas and initiate a regular monitoring program for assessing achievements.

Key objectives of such strategies are to promote management change and technological and social innovation; show Green Economy-related win-win options for water, energy and food security, for the environment, and for the economy; place particular importance on reducing vulnerability to climate variability and change; and show a long-term perspective for water, energy and food security as an important cross-cutting aspect of sustainable development.

An inclusive Nexus Outlook report would follow broad guidelines developed by a task group from relevant international organizations and set the baseline for reporting on access (including equity of access) and include natural resources indicators in addition to more conventional economic indicators. Not all countries are faced with resource scarcity and so a short scoping assessment would be a first step to determine whether a full analysis and report is necessary. It would also assess how the Nexus Outlook could be combined with other reporting initiatives to reduce additional cost and effort, for example by linking it with post-Rio2012 initiatives, including taking the Green Economy forward.

Establish an enabling framework for policy dialogue and coherence across sectors. Set up procedures as part of the planning system to analyse and disseminate the interconnectivity between sector policies, trade policy, climate change policy, land management policy (including promoting tenure security), and disaster management. Raise awareness on the consequences of alternative development pathways on water, energy and food security, including trade-offs between and within sectors. Determining what policy considerations need to be integrated and what can be handled within sectors will be important for efficient realization of a more coherent approach. To meet the primary nexus objective, water, energy and food strategies need to articulate a plan for security of supply and sustainable access to basic services taking into account the implications on other sectors.

Build coherence in regulatory, planning and management frameworks and incentivize nexus outcomes: Ensure interlinkages and consequences for other sectors are explicit in regulatory processes and market instruments and encourage more efficient and equitable resource allocation and use through strategic planning processes and by removing or reducing perverse subsidies or incentives. Similarly promote fiscal instruments to provide incentives for sustainable use of finite resources. Develop innovative, synergistic environmental policy measures and instruments which concurrently respond to several environmental challenges and minimize trade-offs. Regulatory tools include licenses and concession agreements, pricing, land titling, impact assessments (SEA, EIA etc.), guidance for planning permissions and building control etc.

Sector-based actions based around the dimensions of policy, institutions and finance: Parallel initiatives to address lack of access and stimulate sustainable growth are required. Preliminary suggestions include assessing nexus and trade-offs in a broad range of areas related to:

- pro-poor tariff structures,
- national food and nutrition strategies that take into account consequences for water and energy,
- bioenergy and food production, strengthened land governance and integrated land use management for effective use of bioenergy by the poor,
- ensuring foreign direct investment in land meets objective of resources use efficiency, equity in access and environmental conservation,
- environmental services and food production including multi-functional agricultural systems,
- water and carbon footprints of energy generation options as one of a number of criteria in addition to environmental and social externalities,
- water and energy savings and reducing non-revenue water and electricity,
- scope for productivity increases (e.g. 'crop per drop', 'field to fork', raising nutritional value),
- sustainable management of groundwater,
- use of salt tolerant food crops, fodder crops and biofuels in coastal areas and saline affected land,
- reduction in pollutants of water bodies and land including by toxic materials,
- managing complexities of multi-purpose dams,
- reducing vulnerability to natural disasters.

Adopt conventional and innovative financing arrangements to achieve water, energy and food security and implement a nexus approach that also reflects the value and services provided by the natural environment. Assess opportunities to deliver on commitments including those through reallocation of budgetary priorities, redirecting subsidies, reducing non-revenue collection, raising levies on non-renewable energy, adopting new instruments such as output based aid and existing ones such as risk guarantees to leverage private funding.

Improve governance arrangements through more open, participatory processes, recognition of human rights and adoption of accountability and monitoring mechanisms. Strengthen application of meaningful stakeholder participation particularly of marginalized and vulnerable groups from the early stages of policy and strategy development when formative decisions on resource use and development options are taken, for example affecting people's rights in relation to land management or infrastructure development. Promote good governance including enhanced transparency and disclosure of information on investments related to land and water. Further develop a strategy and action plan to combat corruption and promote application of a range of accountability and integrity tools.

Consider the trans-national consequences and externalities of trade policy on water, energy and food security: Collect data that describes the extent that export and import of food and other products utilizes natural resources and their availability for other economic purposes

and impinges on sustainable extraction limits and access by local communities. One part of this approach is reporting on water, energy and land use footprints. Further develop instruments which promote sustainable production and reduce shifting of environmental burdens (e.g. certification schemes).

Adopt both a regional and a basin-wide perspective reflecting the principles of integrated water resources management and influences that go beyond the boundaries of a river basin. Extend current water resources management approaches to more effectively engage with energy and food sectors and take into account contemporary challenges such as regional power trading, foreign direct investment in land and agriculture and the increasing pressure on productive ecosystems and biodiversity. For international basins, review and make an informed decision on ratification of the 1997 UN Convention on Non-navigational Uses of Trans-boundary Watercourses and go beyond considerations of water sharing to incorporate benefit sharing.

Provide the learning and knowledge management opportunities necessary to create a cadre of leaders to think interlinked. Review and adjust curricula of institutionalized and in-service training to encourage more inter-connected thinking, innovation and networking across sectors and a capability to drive change through the system.

Establish monitoring systems to comprehensively track and monitor food security, water, energy and carbon movements and nexus indicators so policy development is based on sound evidence.

International organizations and development organizations[3]

International and other development organizations play a fundamental role in raising public awareness of global threats and trends, setting the global agenda, establishing and implementing multilateral policies and agreements, supporting national policy making and achievement of development plans, and monitoring key indicators of development and sustainability. A harmonized approach to development assistance will enable promotion of nexus-thinking both through directly funded projects and the influence that development agencies have on a country's economic, social and environmental policy making and the investment climate for the private sector. As with government agencies, the compartmentalization of mandates and roles can lead to unintended outcomes. The role of international and development organizations includes:

Further develop the evidence base for the nexus – Global 'Nexus' Outlook Report on Water, Energy and Food. Explore a multi-agency cooperation involving groups responsible for global assessment reports such as the World Water Development Report, World Energy Outlook, Agricultural Outlook, World Economic Outlook and Global Environmental Outlook among others. It will take forward the initial findings of the Conference background paper to the next stage. New metrics or headline indicators will be required for monitoring and reporting nexus

[3] Includes UN organisations, inter-governmental organisations, multi-lateral development banks, bilateral development agencies, foundations, development NGOs etc.

aspects of productivity, social well-being, natural resource resilience, etc. Guidance is needed for common approaches to the national 'nexus' reports, including analytical frameworks, harmonization of data, benchmarking and establishment of baselines.

Establish a portal of good practice examples across the nexus. Identify a partnership of existing institutions to build on the initial steps in the Conference background paper and create an knowledge portal covering innovations and nexus-relevant examples of policy support, institutional and financing arrangements and project examples and provide guidance on learning from past examples to reduce transaction costs and make replication more cost and time effective. Develop standards and monitoring sustainable production and resource management.

Encourage cooperation between UN-Water and UN-Energy to address nexus issues. Positive steps were taken for inter-agency coordination with the establishment of UN- Water and UN-Energy. Together they are in a position to promote policy coherence, take forward a number of nexus initiatives and use their networks for outreach among other international organizations. They are key players in ensuring nexus perspectives are prominent in discussions on sustainability development goals and the implications of policies such as climate change or food subsidies on other sectors.

Facilitate countries in attaining water, energy and food security and adopting nexus approaches through financial support and capacity development. Assistance will be required for delivery of basic services, understanding nexus implications and response strategies, building capacity to look across sectoral processes and for financing of resulting investment portfolios.

Prepare voluntary guidance standards for land leasing. Further develop and facilitate implementation of FAO coordinated voluntary guidelines on Responsible Governance of Tenure of Land and Other Natural Resources.

Review and further develop guidelines on water quality for re-use in industry and agriculture and for aquatic ecosystems. Build on existing WHO guidelines for drinking water, FAO guidelines for wastewater re-use in agriculture and UNEPs work on environmental water quality to develop a compendium of guidance of appropriate water quality standards for the full range of wastewater and human waste re-use.

Improve global governance on trade. Prepare the ground for more effective and sustainable trade through the removal of trade barriers and subsidies (in particular in agriculture), and the progressive adoption of agreed sustainability criteria with respect to key water (including virtual water), nutrient and carbon cycles.

Encourage a coordinated approach to implementation of multi-lateral environmental agreements and other conventions. Develop linkages between the various global secretariats and guidance to encourage more effective implementation and coordinated reporting at national level thereby achieving co-benefits and reducing duplication and inefficiency.

Accelerate knowledge generation on ecosystem processes and their value. Apply knowledge-rich solutions and work towards universally accepted standards on ecosystem, valuation, management and conservation

Further encourage partnerships and tool development. Promote, improve and disseminate existing initiatives on life cycle analysis, foot-printing and stewardship, sustainable production, (e.g. for bioenergy production by implementing sustainability indicators pioneered by the G8-Initiative Global Bioenergy Partnership and for hydropower through existing and emerging sustainability assessment tools), and facilitate the extension of integrity initiatives from the water sector to the energy sector. Establish incentive funds to support promising innovations and application of new technology.

Promote trans-boundary cooperation. Intensify efforts to stimulate cooperation across administrative boundaries to identify mutual benefits for water, energy and food security and in resource use and to mitigate any trans-boundary shifting of environmental burdens. Scope exists within formal cross-border cooperation agreements and to stimulate emerging opportunities through less structured cooperative arrangements.

Local authorities and utilities

Considerable scope exists within municipalities and related utilities for thinking that cuts across sectoral boundaries. Cities are engines of growth, but also have high rates of poverty and low rates of service provision. This underlines the importance of a more interlinked and committed approach. With adequate regulation and the right incentives, the inherent innovation within business and research centres can provide solutions and attract finance, particularly in planning for rapidly emerging urban centres that do not yet have the congestion and complexity of established megacities. Actions include:

- Declare a minimum waste policy and prepare plans for water and wastewater utilities to become carbon neutral.
- Ensure coordination in planning processes responsible for waste management, water re-use, peri-urban agriculture, energy from waste, etc.
- Develop conceptual frameworks and plans that identify the synergies between urban water management and agriculture and create the enabling environment for implementation,
- Develop clear national and municipal roles and responsibilities and facilitate inter-sectoral cooperation to achieve more sustainable water, sanitation, health and food security impact and manage natural disasters,
- Address the externalities of urbanization on coastal waters and river systems, particularly related to water quality and productivity of aquatic ecosystems
- Stimulate urban planning and related regulatory framework to consider the benefits of and interlinkages between flood management, urban agriculture, climate protection and recreation,
- Prioritize capacity building for achieving water, energy and food security and related nexus considerations

- Ensure nexus considerations are taken into account by utilities in water supply and energy expansion programs and there is a proactive focus on measures to reach the poor, including use of social pricing and reduction in non-revenue supplies.
- Raise efficiencies of existing infrastructure through rehabilitation and technological advances including optimizing the performance of existing energy generation and distribution infrastructure (smart grids) and explore multiple benefits including social and environmental.
- Channel financing and create incentives for income generation in re-use of water, nutrients and energy.

Business and the private sector

Beyond responsiveness to market signals and government regulation, responsible business leaders have increasingly taken the lead in identifying innovative approaches and technological advances consistent with the interlinked perspective of the nexus. In many cases this has been done for commercial reasons of cost effectiveness and risk management. But this characterizes only a relatively small group and the trend will need to be accelerated and taken up more broadly among others in the business community. There is a sound business case and at the same time is consistent with principles of corporate sustainability encompassing a company's delivery of long-term value in financial, social, environmental and ethical terms. The UN Global Compact, World Business Council on Sustainable Development and World Economic Forum support this through work streams and specialized initiatives addressing water, food and energy issues from a nexus perspective. Initiatives for business and the private sector include:

Incorporate a nexus perspective in business planning including investing in and developing innovative technologies and systems and a business model that proactively considers water, energy and food security and natural resources utilization, takes a lifecycle approach to assess footprints and works towards a 'cradle to cradle' approach in which maximum re-use of materials and minimum waste is achieved.

Broaden water and energy stewardship and application of corporate sustainability. Evidence shows that businesses increasingly need to take an active interest in understanding and mitigating water-related risks facing their operations, supply chains and investments, risks that are often shared by communities and the environment. Voluntary and regulated measures are needed to ensure their activities do not compromise the water, energy and food security of others, especially the poor or ecosystems. Measures exist to reduce negative impacts and share benefits with local communities and thereby reduce both commercial and reputational risk. There is scope for progressive companies to share their knowledge and mentor others through communities of practice.

Benefit from resource efficiency and productivity gains that may have both single and multi-sector consequences including opportunities for increasing productivity in existing water and energy systems, increasing efficiency of supply chains and reducing waste including food waste. Subscribe to relevant voluntary accords, systems and standards such as the CEO Water Mandate.

Adopt financing schemes for sustainable production and natural resource management such as payment for environmental services including catchment management funds to protect watersheds of agricultural areas and water supplies, and benefit sharing mechanisms to respect the rights and roles of local communities.

Recognize the rights and needs of workers and the contribution they can make to productivity gains. Workers have a unique insight into production processes and procedures which is information that can be tapped to identify efficiency and productivity gains. Improved relationships between employers and workers, as espoused in the Decent Work campaign of the International Labour Organization, are needed in many areas particularly those with widespread poverty, to remove exploitation, recognize workers' rights and provide social protection systems to reduce their vulnerability. Fair transition schemes are required in both private and public sector if jobs are threatened by new working practices.

Extend product longevity. Adopt policy commitments to design more sustainable products, remove in-built redundancy and work towards recycling and re-use schemes.

Include a nexus perspective in corporate sustainability reporting. Identify actions taken and processes put in place for a more inter-connected approach to planning and strategy development and report on implications for the business.

Investors and financing agencies

Addressing nexus issues also requires an increase in private sector capital and innovative financing models from responsible investors. Actions are needed to:

- Increase collaboration between the public sector, business and finance, and civil society, including proactive and innovative financing arrangements to achieve water, energy and food security.
- Incorporate nexus considerations into existing initiatives such as the UNEP-Finance Initiative and UN-based Principles for Responsible Investment, and further support Water Disclosure such as through the Carbon Disclosure Project.
- Adopt international good practice for infrastructure development (e.g. energy generation, dams, waste treatment etc.), and foreign direct investment (e.g. commercial agriculture and forestry, biofuels) and recognize relevant sustainability guidelines, assessment tools and certification schemes.
- Leverage sustainable finance and responsible investments to place a premium on long-term investment horizons that incorporate environmental and social issues as a matter of risk-management and so are synergistic with a nexus approach.
- Adopt social and environmental safeguards in infrastructure projects including the Equator Principles.
- Reflect nexus thinking in corporate sustainability reporting of investment portfolios.

Civil society (communities, NGOs, media)

Community groups, individuals, mass organizations including those for youth and women, development and advocacy NGOs and the media all play critical roles in promoting more equitable and sustainable outcomes through outreach, development support and awareness raising. Actions include:

- Raise awareness of nexus solutions through local organizations and media campaigns and use of social media,
- Encourage communities to be more involved in the planning and management of water and energy systems including decentralized options.
- Undertake cooperative, stakeholder driven assessments of resource supply and demand to help inform policy makers and the public.
- Provide oversight for transparent and sustainable resource allocation and the fulfilment of the human right to food, water and sanitation

Farming community

Farmers are the agents of change for more efficient and productive agricultural outputs but need to have the knowledge, tools and incentives to adapt. Initiatives include:

- Raise awareness, develop capacity and respond to incentives for increasing productivity and reducing waste such as post-harvest losses, etc.,
- Support GIAHS program (Globally Important Agricultural Heritage Systems) and adoption of the Integrated Food Energy System (IFES)
- Adopt the System of Rice Intensification (SRI) and similar techniques to increase food production and productivity of water.

Research organizations

National and regional research institutes and universities have an essential role in developing improved management practices, new technologies and ideas, adapting ideas to local conditions and challenging conventional thinking. Proposed actions include:

- More in-depth analysis of the benefits of the nexus perspective, policy coherence on economies, jobs etc., and incentive systems that influence market and consumer behaviour.
- Applied research to address the management and institutional related aspects of addressing the nexus perspective, including arrangements for coordination and cross-sectoral policy formulation and initiatives to examine how existing research can be better used by the public and private sector in pursuit of nexus objectives,
- Develop 'nexus' indicators and baseline data required for monitoring and reporting nexus aspects of productivity, social well-being, natural resource resilience, etc.
- Build a knowledge base and applied R&D to support decision making, including: more drought and flood resistant and nutrient efficient crop varieties; lower water consuming

techniques including both modern and traditional agricultural technologies; new technologies and processes for efficiency improvement, e.g. promoting technical innovation to raise efficiency in the production and use of bioenergy, (second and third generation technologies, use of waste and ligno-cellulosic biomass); techniques to achieve 'clean' waste by separating chemicals including phosphorous; ways to bring down the costs (and consumptive requirements) of renewable energy and desalination; efficient application of water harvesting systems; and ecological sanitation systems.

- Undertake research to better understand ecosystems and further develop economic tools to incorporate externalities.
- Analyze inter-regional and global trade from a nexus perspective.
- Further develop hydrological tools and risk management strategies under conditions of climate change uncertainty to ascertain whether past records can still predict the future hydrology and how this influences design and the need for greater emphasis on risk management and adaptive management (for hydropower, irrigation, etc.).
- Improve communication between soil scientists and politicians to ensure solutions to prevent land degradation and improve soil fertility are implemented particularly in view of increasing pressures. The interlinkage between fertility of soils and food security, water quality and flow, green water availability in soils, as well as biodiversity needs to be considered in decision making processes.

Regional bodies

Existing institutional mechanisms for regional cooperation and integration can connect countries and people to promote nexus thinking. Many of the actions covered above are relevant for implementation within a regional perspective and include regional data sharing, trade opportunities and benefit sharing.

5. Moving forward: gaining momentum for a nexus approach

Bonn2011 has addressed three main objectives:

- to develop policy recommendations based on multi-stakeholder consultations and taking a nexus perspective,
- to position the water, energy and food security nexus perspective as an important dimension within the "Rio2012" process,
- to launch concrete initiatives to address the water, energy and food security nexus in a coherent and sustainable way.

The challenge of thinking in a nexus perspective is central to the Green Economy, to the themes of Rio2012 and the consideration of sustainability development goals. Bonn2011 provides a unique first platform for consideration across the three sectors in a multi-stakeholder process.

The messages from Bonn2011 will be taken forward through the preparatory process for Rio2012 so that the outcome of Rio can adequately reflect the interdependencies between water, energy and food as well as the underlying resources of water, land, ecosystems and soil. Relevance of the nexus policy recommendations will be further highlighted prior to Rio at a Ministerial Round Table at the 6th World Water Forum in mid-March 2012.

Bonn2011 aims to catalyze a gradual change of mindset and reflection of the nexus perspective. Outcome oriented indicators of achievement on specific areas will need to be formulated in conjunction with interested parties on a case by case basis as a follow up to Bonn2011.

Apart from the inter-governmental processes of the UN, there is already much that can be achieved by the broad range of stakeholders identified here in embracing nexus considerations and mainstreaming them into planning and development processes.