Rethinking Nexus: Water Energy and Food Security

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The International Energy Agency's (IEA) warning that water demand would outstrip energy demands two-fold highlighted the scale of water-energy nexus. But the reality is more complex. Critically, a global population expansion to 9 billion people by 2050, coupled with increased economic growth, will intensify competition for water, as well as increasing the need for food and energy, creating a trilemma for 21st century society to resolve.

Traditional water-energy nexus thinking highlights the mutual importance of water and conventional energy. Energy is fundamental to collect, transport, distribute and treat water. Water is essential to extract process and refine fossil fuels. The onset of climate change further exacerbates the interconnectivity of the energy-water nexus.

A global water gap of 40 per cent between demand and accessible water by 2030 and that water consumption is set to rise from 4,500 billion cubic metres to 6,900 billion cubic metres with no change to business as usual practices and policies, such as improved 'crop per drop' irrigation and rain-fed measures.

Agriculture accounts for 71 per cent of current total global water withdrawals. A 50 per cent population increase will exponentially increase agricultural output, requiring more water and energy through fertilizers, harvesting and processing. India could double water consumption through to 2030 to 1.5 trillion cubic metres, leaving the country with a 50 per cent water gap. Anticipating any substantially positive impact of genetically modified organisms (GMOs) in developing plants that combine higher energy content with reduced water consumption is difficult.

A call was raised for awareness of the nexus between water, food and energy security, as well as climate change. A serious water crisis ahead has been realized as many groundwater resources are depleted, while demand for food and energy is increasing. By 2030, the world's population and economic growth are expected to lead to a 40 per cent increase in energy and water demand, and *a 50 per cent increase in food demand. Meanwhile, climate change puts additional strain on agriculture.*

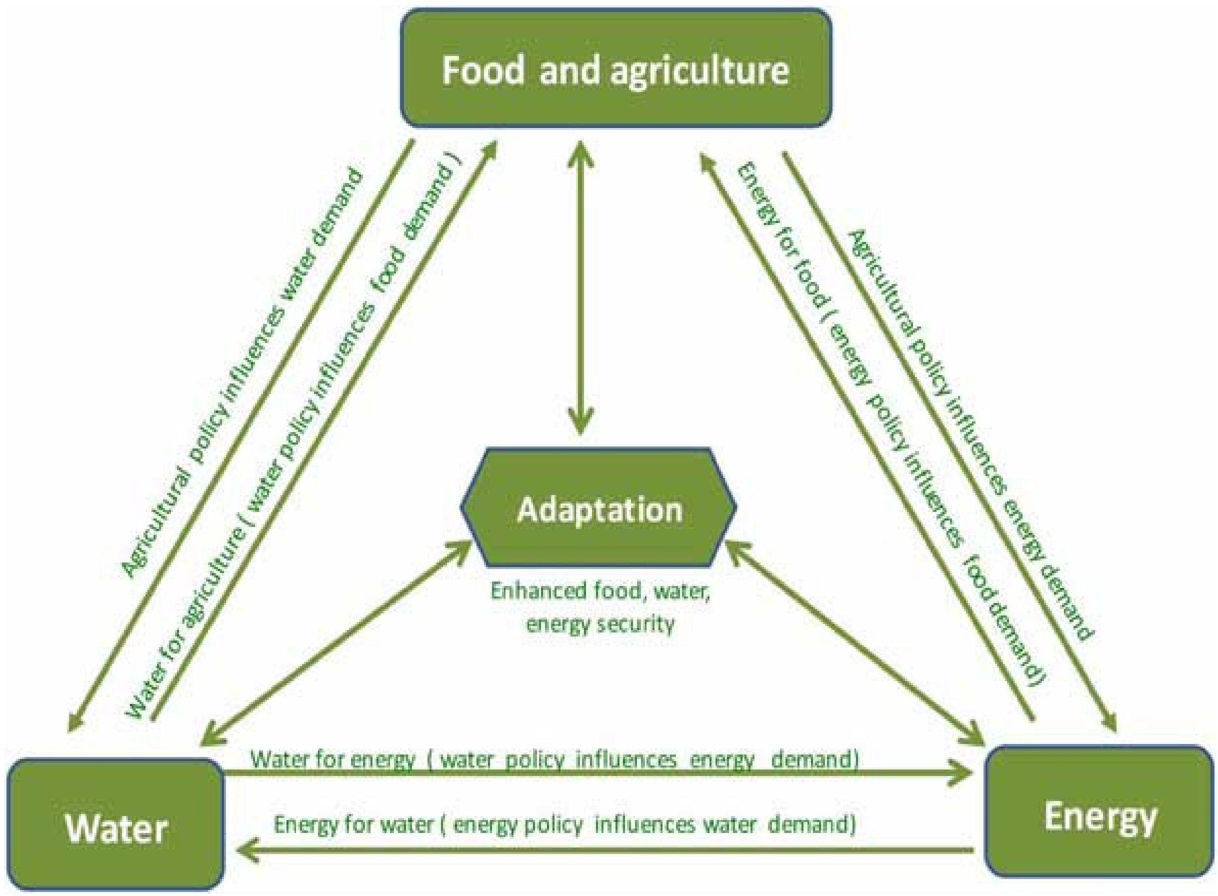
The increases in food prices in the recent past too have been closely linked to rising energy and oil prices, with serious economic implications. The poor are particularly affected by high food prices as they spend a high proportion of income on food. Worryingly, the triple food, fuel and financial crisis of recent years may be a taste of things to come.

Global agriculture is also highly dependent on energy from fossil fuel-burning for many processes, from on-farm mechanization, to fertilizer production, to food processing and transportation. The price of oil is also closely correlated with the price of fertilizer. Energy is crucial for production and transport of food, from the 'farm to fork'. The food sector currently accounts for around 30 per cent of the world's total energy consumption and over 20 per cent of greenhouse gas emissions. The emerging biofuels market increases interdependencies between food and energy prices, since feed and fodder commodities are being used for biofuels, and also because a higher oil price increases demand for biofuels. The Stockholm Environment Institute (SEI) has found that growing bio-fuels from crops is extremely water-intensive, as well as being a practice which puts pressure on food crops. According to the FAO, it takes 2,500 litres of water to produce one litre of biofuels for transportation. New legislation may be needed to address the impact of biofuels mandates on food and water security.

Energy and water are both absolutely essential for food. This is especially true because irrigation is used for the production of roughly 40 per cent of global food. In this way, agriculture accounts for about 70 per cent of all freshwater withdrawal. Inefficiency in one area can also lead to inefficiency in another. For example, subsidized electricity for irrigation can lead to over-pumping, which contributes to groundwater depletion. Where water is extremely scarce, desalination – which is highly energy-intensive – is used.

As conventional fossil-fuel sources become depleted, we have seen a shift to processes like hydraulic fracturing ("fracking") which are even more water-intensive. Extraction and processing of oil sands uses about 100-1000 litres of water per gigajoule (GJ), compared to 10-100 litres for conventional oil and gas. According to the World Resources Institute (WRI), 79 per cent of new planned power capacity in India will be built in water-stressed areas. Use of Carbon Capture and Storage (CCS) technology also increases water consumption.

Renewable energy has brought new challenges. Hydropower, already the world's dominant source of renewable energy, is a prime example of a technology that must be carefully managed to avoid negative impacts. Dams can affect biodiversity, fish migration and have impacts on downstream food *security. We must start to think about the 'water productivity' of energy. Solar power, for example, hardly uses any water.*



In the long-term, it will be necessary for our food to be produced using sustainable energy resources and this is likely to require a transformation in agricultural systems. At the moment, we are seeing the opposite occur: food crops such as maize and soy are being used to fuel energy-consuming transport. This issue must be tackled. Otherwise, there is a risk that food prices will continue to sky-rocket.

Research is only just beginning to explore the complex issues in the food-energy-water nexus. What is clear is that better collaboration is needed between different sectors. Policy-makers must ensure that expansion of certain types of energy does not put a strain on other vital resources. Policy-makers often work in silos – for instance, there can be little cooperation between those working on reducing emissions and those on adapting to climate change. This may have led to the controversial issues created by biofuels expansion. It is clear a more *holistic outlook is needed in tackling these problems and managing increasing demands for energy, water*

This water gap presents the opportunity for water-rich countries, such as Canada, to address how to maximize its freshwater resources to provide 'virtual' water through intensive products and commodities to water scarce countries. Current energy trends exacerbate the trilemma. Average global temperature increases of 3.6°C are likely. The current global energy infrastructure will contribute 80 per cent of the greenhouse gas emissions necessary to reach a 2°C warming, the threshold of serious climate change predicted by the Intergovernmental Panel on Climate Change (IPCC). And the US Third National Climate Assessment suggested extreme scenarios could lead to a temperature increase of more than 5°C by the end of the century, causing cataclysmic climate change by IPCC projections. Moving from this current energy trend is problematic. Fossil fuels are projected to comprise 80 per cent of global energy demand to 2035 with current policies. A shifting of fossil fuel subsidies to renewable energy subsidies could see renewable energy supply over 60 per cent of demand.

From a water perspective, this energy shift could be advantageous. Energy's water dependency accounted for 15 per cent – 583 billion cubic metres – of global water withdrawals in 2010. While only 66 billion cubic metres are not returned to source, energy-related water withdrawals are anticipated to increase by 20 per cent by 2035, with a dramatic 85 per cent increase in consumption. The rate of water not returned to source would almost double to 120 billion cubic metres.

In contrast, the use of renewable energies to 2035 is predicted to increase water consumption by only 4 per cent although some technologies – such as concentrated solar power, which generates steam to drive turbines – would be more water intensive than others. Tackling climate change through measures such as carbon capture storage could also prove to be water intensive.

But energy is vital to humanity and development. Worldwide 1.3 billion people have no access to electricity, while 2.6 billion people use traditional biomass for cooking. Does the world need to rely on fossil-fuels to bridge this energy gap? Wind, water and sunlight can provide all new energy to 2030 and replace pre-existing energy sources by 2050. Society, industry, governments and investors have to wake up to the reality surrounding food, energy and water – and fast. There are alternatives to fossil fuels but there are no alternatives to food, or freshwater.

Nearly one-third of all food produced gets lost or wasted in production and consumption systems, according to the Food and Agricultural Organization. In a world of 7 billion people, set to grow to 9 billion by 2050, wasting food makes no sense – economically, environmentally and ethically. Small but simple actions by consumers and food retailers could dramatically cut the 1.3 bn tonnes of food *lost or wasted across the world each year. Requesting smaller portions at restaurants, freezing leftovers and donating to food banks can help make a difference, while retailers and supermarkets should be carrying out audits and working more closely with their suppliers to reduce waste.*

Together, we can reverse this unacceptable trend and improve lives. In industrialized regions, almost half of the total food squandered, around 300m tonnes annually, occur because producers, retailers and consumers discard food that is still fit for consumption. This is more than the total net food production of sub-Saharan Africa, and would be sufficient to feed the estimated 870 million people hungry in the world.

According to the FAO, 95 per cent of food waste in developing countries are unintentional losses at early stages of the food supply chain, caused by financial, managerial and technical limitations in harvesting techniques; storage and cooling facilities in difficult climatic conditions; infrastructure; packaging and marketing systems. But in the developed world, the end of the chain is far more significant. At the food manufacturing and retail level, large quantities of food are wasted because of inefficient practices, quality standards that over-emphasize appearance, confusion over date labels and consumers being quick to throw away edible food due to over-buying, inappropriate storage and preparing meals that are too large. Per capita waste by consumers is between 95 kg and 115 kg a year in Europe and North America/Oceania, while consumers in sub-Saharan Africa, south and south-eastern Asia each throw away 6 kg to 11 kg a year.