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WATER, FOOD, ENERGY: NEXUS SOLUTIONS

The availability of water is central to the future security of food, energy, domestic and industrial water supply and the environment. This relationship is the 'nexus' between a set of competing demands and interactions. Producing more food and energy, and having sufficient water for our fast growing population—projected to reach 9.5 billion by 2050—means managing water, food and energy differently.

The proposed SDGs on water, food and energy security all include targets on increasing efficiencies. Yet the water–food–energy nexus has multiple dimensions that, if managed in isolation, will compromise a nation's ability to achieve the full portfolio of SDGs.

Climate change introduces additional uncertainties, further increasing tensions between sectors for access to water. Conventional energy and food production are emitters of greenhouse gases, but measures to reduce emissions—including renewable energy interventions, such as subsidies for biofuel production—can have adverse consequences on food prices.

Irrigation plays a central role in the nexus where improvements in one sector may involve trade-offs in another.

To achieve desirable and sustainable outcomes for water, food and energy requires investigating these elements as an integrated whole, across sectors and scales. The nexus approach is part of broader systems thinking; it features a pragmatic focus on the relatively limited number of policy choices that are constrained by political realities. This approach recognizes and minimizes trade-offs, builds synergies and increases resource use efficiencies.

REFLECTING MULTIPLE DIMENSIONS AND SCALES

A nexus approach means that when governments and industries determine policies in one sector—whether it is energy, agriculture or water—they take into account the implications in other sectors. Similarly, policy and planning processes within each sector would account for different scales, from local to transnational.

Nexus Interventions at Policy Level

In the food production chain, for example, irrigation plays a central role in the nexus where improvements in one sector may involve trade-offs in another. Introducing irrigation increases land productivity, but pumping water increases energy demand compared to rain-fed agriculture.

Groundwater irrigation is a classic nexus case. Underground water is extracted for agriculture production worldwide using millions of electric and diesel pumps that can compromise water availability in conventional shallow wells used for drinking and domestic purposes. Two contrasting cases from India, one of over-abstraction and the other of underuse, demonstrate the scope for solutions across sectors. In both cases, the advent of lower cost, more efficient solar pumps is adding new potential to groundwater irrigation.

CASE STUDY: Innovative Electricity Scheme Reduces Power Subsidy and Groundwater Use and Boosts Agricultural Production

Gujarat is one of India's driest states, and during the 1980s the government encouraged groundwater irrigation by subsidizing farm electricity supply. A common power line served all domestic, agricultural and commercial connections. During the peak irrigation season, theft of power by farmers was rampant, causing reduced voltage for homes, schools, businesses and hospitals. By the 1990s, groundwater supplies were heavily depleted, the state electricity board was nearly bankrupt and powerful agricultural lobbies resisted a metered electricity tariff. The removal of electricity subsidies, a policy intervention frequently promoted by development agencies, was politically untenable.

With involvement of IWMI researchers, the state government implemented a new policy in 2003 under a scheme called Jyotigram Yojana, or 'lighted village'. Electricity lines for agricultural and non-agricultural users were separated, allowing electricity supplies to farms to be rationed for eight hours a day while enabling continuous supply to domestic and industrial users. To overcome farmer resistance, researchers suggested supplying full voltage and uninterrupted power to farms during the rationed hours. Farmers could then keep to their irrigation schedules, conserve water, save on pump maintenance costs, use labour more efficiently and expand their irrigated agriculture rapidly.

Gujarat's agricultural GDP rose by almost 10%, the highest in India, in the seven years following the project's inception, due in part to Jyotigram Yojana. At the same time, groundwater levels are recovering. Now the national government is setting Gujarat's Jyotigram Yojana project as a flagship scheme to address burgeoning electricity demand, unsustainable water use and increasing demand for food.

CASE STUDY: Reformed Groundwater Policy Improves Smallholder Farm Production

In India, pumping groundwater aquifers for agriculture is growing at an astonishing rate. The country has an estimated 20 million tube wells, and a new one is dug every 15 seconds. Yet, in the Ganges Basin of eastern India where water is plentiful, groundwater is still under-used. In West Bengal, in the Ganges Basin, tanks and ponds are often dry by January, leaving little surface water available for crops until the June monsoon rain. Yet access to the plentiful groundwater that is recharged annually is often limited.

In 2004, the West Bengal State Government legislated for farmers to apply for permits to use tube well pumps, with a view to sustainable groundwater use. However, applying for an abstraction permit and getting an electricity connection was costly and time consuming. As a result, poor farmers were forced to hire expensive diesel pumps for irrigation. Agricultural growth in the state slumped from 6% per year in the 1990s to just under 2%.

IWMI researchers analyzed the economics of smallholdings, farmer behavior and the costs and benefits of the various options for providing groundwater to small farms. Based on IWMI's advice in September 2011, the state government scrapped small pump licenses in districts with renewable and safe groundwater resources and introduced a flat connection fee.

This policy reform is improving smallholder farmer access to water. IWMI is now researching the effects the new policy has had on the power sector and on groundwater levels.

TAKING A RIVER BASIN APPROACH TO MANAGING WATER ACROSS NATIONAL BOUNDARIES

At the transnational scale, the growing pressure on water resources in many river basins is complicating the trade-offs between upstream and downstream uses. The rising cost of fuel and the effects of climate change are putting a complex array of pressures on water and food systems. Increasing the use of renewable sources to generate energy—such as water for hydropower and biomass for bioenergy—can have positive economic and mitigation benefits. But it can also negatively affect already stressed water and food supplies, especially where nations share natural resources. Innovative solutions to resolve hydropower and irrigation conflicts though the underground storage of water are being explored in Central Asia.

CASE STUDY: Pilot Study on Underground 'Water Banking' in Central Asia's Fergana Valley

The Fergana valley basin spans Kyrgyzstan, Uzbekistan and Tajikistan and has long been the population and agricultural heartland of Central Asia. It forms part of the catchment of the Syr Darya River—the longest river in Central Asia—that runs through all three countries.

The natural flow of the river is high in summer and low in winter. However, upstream–downstream issues emerged in the 1960s when irrigation water withdrawals more than doubled in the basin and reservoirs were constructed to regulate and divert the flow. The biggest change was in the winter of 1992–93, when an upstream reservoir shifted from providing summer irrigation water to generating hydropower to satisfy increased demands for power, particularly in the winter.

Hydropower production in the upstream increased by 30%, but cotton yields downstream plummeted by 46%, and some of the land was taken out of production due to shortages of irrigation water and increasing salinity.

IWMI researchers conducted pilot field experiments in Uzbekistan's Fergana Valley to 'bank' the winter flows released for hydropower from upstream Kyrgyzstan into underground aquifers and then extract the stored water for irrigation in the summer months. Depending on the hydrogeological conditions, developing such groundwater management strategies can be a feasible practice for dealing with competing sector demands for energy and food.

An important nexus dimension is the choice of energy generation technologies in response to climate emission targets, as this can impact both water demand and food production.

INTRODUCING NEXUS THINKING IN ACHIEVING THE SDGS

Nexus thinking is useful for setting SDG targets and implementing programs that span a number of SDGs, for example, programs that:

- ensure access to energy for all and year-round access to food for all while ensuring sustainable levels of freshwater abstraction and integrating biodiversity conservation measures, including for wetlands
- double the share of renewable energy while ensuring food security
- improve water quality while sustaining economic growth and encouraging industrial development.

The proposed SDGs target for efficiency of water and energy are clearly interlinked: savings in energy generation can result in water savings and reduction in greenhouse gases. An important nexus dimension for countries is the choice of energy generation technologies in response to climate emission targets, as this can impact both water demand and food production, as in the case of increased biofuel production.

Expected targets to improve wastewater management and increase recycling and reuse can lead to other nexus benefits, such as reduced energy required to produce and transport chemical fertilizers and the recovery of nutrients that would otherwise be dumped.

In the next phase of the SDG process, the focus will be on selecting indicators and setting national targets. Programs to achieve the SDGs will be developed and implemented. Selecting appropriate indicators to measure nexus-friendly goals for energy, agriculture and industry sectors could encourage more integrated and effective outcomes.