Crawford Fund FOR A FOOD SECURE WORLD

WEATHERING THE 'PERFECT STORM'

Addressing the Agriculture, Energy, Water, Climate Change Nexus

The Crawford Fund
2019 ANNUAL CONFERENCE
Parliament House, Canberra, Australia

12–13 August 2019

Editor Ann Milligan

Circular food systems and solutions: addressing the nexus issues in South Asia

Dr Aditi Mukherji
International Water Management Institute

Abstract

The Water–Energy–Food (WEF) nexus concept has emerged as a powerful analytical tool for understanding the complex interactions among different sectors. In this paper, I propose that we now need to move beyond analysis to explore how the WEF nexus can be used to solve real-world water, energy and food issues. I use the example of India's WEF nexus to show how solutions for the water sector, especially the groundwater sector, can often be found in either the energy or the food sector. I also argue that policies that use a nexus thinking framework are more likely to solve interconnected nexus problems. The agriculture, groundwater and electricity sectors in India are bound in an unsustainable nexus of mutual interdependence. Growth in the agriculture sector is often reliant on unsustainable practices in the groundwater and electricity sectors. Likewise, policies and practices in one sector affect outcomes in all three sectors. The institutions undergirding India's WEF nexus were shaped by the imperative to make India food-secure at a time when hunger and starvation seemed imminent. While the Green Revolution led to an expansion in India's food production, the de-metering of the agricultural electricity supply in late 1970s–early 1980s led to a WEF nexus that has become untenable in India today. While many accounts of India's rapid groundwater decline do not differentiate across contexts, my work shows that there is wide variation across states in the functioning and outcomes of the WEF nexus that leads to distinctly different outcomes with respect to sustainable development. In this talk, through three state-level case studies, I will demonstrate that variation in the WEF nexus is caused not only by the physical characteristics of groundwater endowments and rainfall-recharge in each state, but also by variation in both institutional policies and in political exigencies. It follows that policies to improve the sustainability of the WEF nexus must take into account this inter-state variation and that a sustainability solution for one sector might as well lie in other related sectors. I make a call for using the WEF nexus concept for finding solutions to the nexus problem.

Two IPCC reports have come out recently (IPCC 2018, 2019), about the global mean temperature rise. The more recent one (IPCC 2019) shows that in most places we could reach 1.5°C above the preindustrial level, anytime between 2027 and 2045. Already almost 20–40% of global human populations live in regions where temperatures have reached 1.5°C above the global mean in at least one season. This really readable report (among IPCC reports) says that to limit all warming to 1.5°C, CO_2 emissions need to be zero by 2050. To achieve that would require fundamental changes in the way we take every decision – in everyday life and in agriculture, in industry, in everything – and deep emission cuts in all sectors and by all stakeholders.

This paper has been prepared from a transcript and the illustrative slides of the presentation.

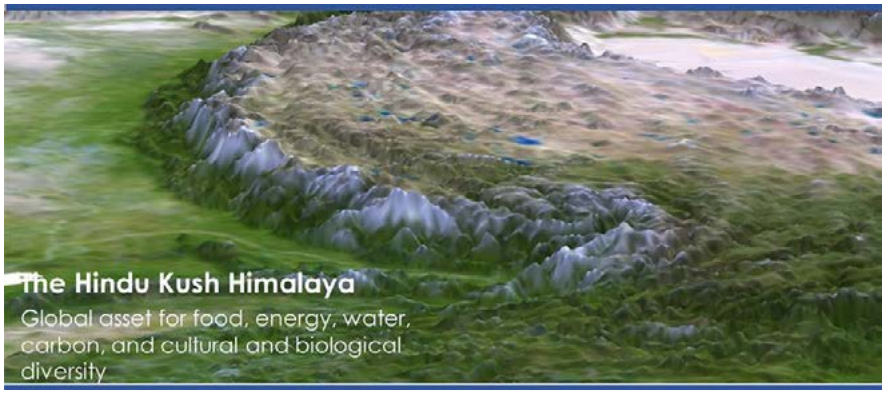

Figure 1.

For South Asia I postulate that current and future risks to water resources result from both climatic and non-climatic drivers. That is, the melting of glaciers, and their impacts on and risks to mountain people and downstream, are attributable to human-induced climate change. However, groundwater over-exploitation and its impacts on agriculture and cities, though exacerbated by climate change, is largely a result of poor policies.

Each now needs different actions: to save our glaciers the global community needs to adhere to their climate pledges; meanwhile, sustainable use of groundwater needs more national and local action.

The Hindu Kush Himalayan region (Figures 1, 2), comprising eight countries, would need to put pressure on the international global community to live up to their climate pledges. In a '1.5 degree' world, Hindu Kush Himalaya would already be losing one third of its glaciers; in a '2 degree' world that becomes 50% of the glaciers. Even 1.5°C is too hot for the Hindu Kush Himalaya because of elevation-dependent warming (Wester et al. 2019; Kraaijenbrink et al. 2017).

What do these changes mean for the region's water resources? Certainly the region would not run out of water. People living close to the glaciers, in Ladakh,

Figure 2.

in Karakoram, who directly depend on glaciers, would be affected. Also, because climate change is expected to increase runoff, at least initially, the downstream flood magnitudes will increase. When I was doing field work in places like Ladakh, farmers often asked us what they can do when their irrigation sources are no longer secure. The sad answer is there is nothing they can do.

Unsustainable groundwater use in India

In India, the Green Revolution looked like a silver bullet. We had millions of people at the risk of imminent hunger and the Green Revolution enabled food production to be increased. But it left behind a legacy of unsustainable groundwater use, unsustainable energy use.

Why such growth in groundwater? Three things: small land-holding, high population density, and the need to grow two to three crops in a year. Groundwater served the purpose, which canal or tank water did not. Not only the area irrigated but also the number of wells and tubewells has increased markedly since 1970. According to the latest survey, there are now around 20.5 million wells and tubewells across India (Figure 3).

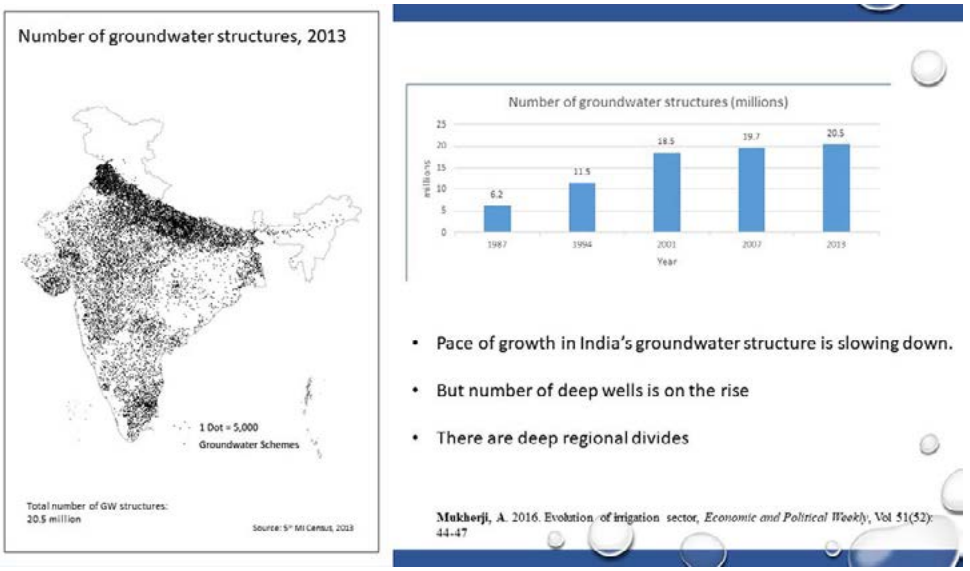

Figure 3.

Groundwater has enabled production of rice, wheat, and dairy. But now there is scarcity of groundwater because of over-extraction – as shown by the red dots on the map in Figure 4 – except in eastern India.

Irrigated rice and wheat are now the biggest consumers of electricity: it is estimated there has been a 12-fold increase in overall electricity demand in India, from 1950, around the time India became independent, to 2010, but a *25-fold increase in electricity consumption in agriculture*. Farmers get free or highly subsidised electricity in most states, and are therefore blamed for the poor financial status of the states' electricity utilities. But farmers also receive very poor quality service.

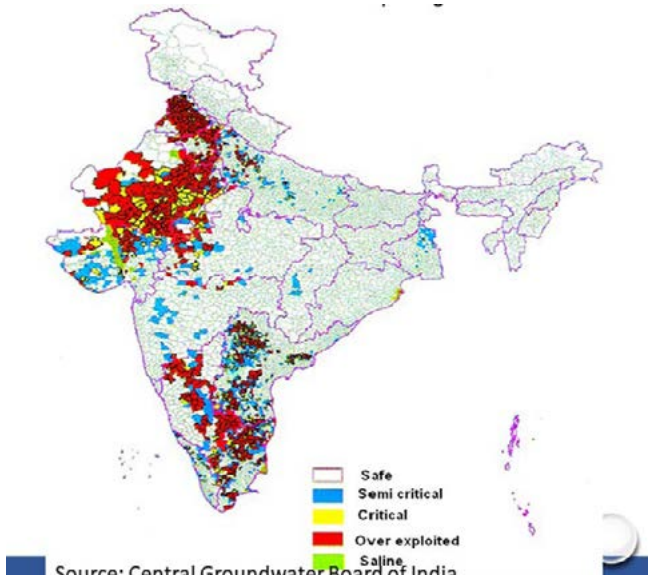

Figure 4. Status of groundwater across India. *Source*: Central Groundwater Board of India.

However, India is a big country. That electricity situation holds true largely for western and northern and southern India, while the entire eastern India depends on diesel pumps.

Some of the work that we have been doing at the International Water Management Institute (IWMI) shows that different groundwater electricity regimes require different solutions: places where groundwater is under-developed can potentially become the future food basket for the nation, with solar-driven irrigation instead of diesel pumps.

Solar irrigation and groundwater sustainability

Promoting grid-connected solar irrigation can help farmers in areas where groundwater has been over-exploited to reduce groundwater pumping, and sell solar electricity back to the grid. This is a win–win solution, reducing groundwater extraction without compromising incomes. In effect, solar power becomes a remunerative 'crop', offering farmers an additional climate-proof income source, and incentivising them to become water and energy efficient.

Selling back to the grid:

- improves the financial viability of power-distribution companies.
- reduces the 'dead-weight' of farm power subsidies.
- generates 'green' energy and contributes to India's renewable energy targets.

This also can support gender equity. Some work that we did in Nepal showed that if we are smart and strategic about how we promote solar pumps and how they are financed, we can encourage more women to own solar pumps. Unlike electricity or diesel pumps, which were difficult for a woman to operate, solar pumps are easy for them to run.

This is a good outcome. However, I want to end on the thought, for all of us, that time and time again history shows that almost nothing is a silver bullet: almost everything comes with unintended consequences, and we should always be on the look-out for them.

References

IPCC 2018. *Special report: Global warming of 1.5°C*. https://www.ipcc.ch/sr15/

IPCC 2019. *Special report: Climate change and land*. https://www.ipcc.ch/report/srccl/

IWMI. 2017. Solar-powered irrigation: adding value through a business model approach. http://www.iwmi.cgiar.org/About_IWMI/PDF/capability-statements/r4d-capabilities-solar-powered-irrigation.pdf

Kraaijenbrink P.D.A. et al. 2017. Impact of a global temperature rise of 1.5 degrees Celsius on Asia's glaciers. *Nature* **549**: 257–260. DOI: 10.1038/nature23878 Nature

Verma S., Durga N., Shah T. 2018. Solar irrigation pumps and India's energy–irrigation nexus: rejoinder to Shasranaman et al. 2018. *Water Policy Research Highlight*. IWMI-TATA Water Policy Program. http://www.iwmi.cgiar.org/iwmi-tata/PDFs/iwmi-tata_water_policy_research_highlight-issue_02_2018.pdf

Wester P., Mishra A., Mukherji A., Shrestha A.B. 2019. *The Hindu Kush Himalaya assessment: mountains, climate change, sustainability and people*. ICIMOD HIMAP. https://link.springer.com/book/10.1007/978-3-319-92288-1

Aditi Mukherji is a Principal Researcher, and is based in the International Water Management Institute (IWMI), India office. Before this, she led the Water and Air Theme at the International Centre for Integrated Mountain Development (ICIMOD) in Nepal. She is the coordinating lead author of the water chapter of the 6th Assessment Report team of the Intergovernmental Panel on Climate Change (IPCC). She is an associate editor of the journal *Climate and Development*, and is on the Editorial Board of the journal *Water Security*. She has over 18 years of experience working on policies and institutions of water resources management with a special focus on the water–energy–food nexus. She has published over 50 peer reviewed papers. Aditi has served as a Permanent Consultative Committee member of GEF-FAO's Groundwater Governance project hosted by FAO at Rome and is a Board member of an Indian research NGO called SACiWaters. She is the first ever recipient of the Borlaug Field Award (2012), which recognises "exceptional, science-based achievement in international agriculture and food production by an individual under the age of 40 who has clearly emulated the same intellectual courage, stamina and determination in the fight to eliminate global hunger and poverty as was demonstrated by Dr Norman Borlaug as a young scientist". The award is endowed by the Rockefeller Foundation and given by the World Food Prize Foundation, USA. Aditi is a human geographer by training and has a PhD from Cambridge University, United Kingdom, where she was a Gates Cambridge Scholar.