

research, the role of human agency, and the need to approach the universal through the particular.

Biocultural Diversity and Indigenous Ways of Knowing should prove valuable to scholars seeking a theoretical context for research on subsistence in the North. I would recommend it to graduate students for this reason. Its strengths are the review and insights regarding human-ecology concepts, and application of these concepts to case studies—from participatory research design to the presentation of findings. While the case-study chapters discuss local knowledge and subsistence, however, most other social and economic aspects of contemporary Arctic communities remain unexamined. Biological and physical-science perspectives likewise receive little attention. For a broader interdisciplinary view of current research on human-environment interactions in the Arctic, the diverse social and natural-science articles in journals such as *Arctic* provide essential further reading.

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Taming the Anarchy: Groundwater Governance in South Asia

Tushaar Shah

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About 40% of the world's food production comes from irrigated lands. In Asia this percentage is about 60%. And this percentage is expected to increase even with an increasing population. However, there are serious challenges with the governance of irrigation systems. Typically scholars focus on surface flow irrigation. Whether they are evolved over a long period, or are created by top-down investments by regional or national governments, the challenge is to distribute water between head and tail-enders. Dr. Shah focuses on a different topic, which is growing rapidly to be a major problem, the widely used practice of using pumps to extract groundwater.

Shah provides a history of irrigation in India, Pakistan, and Bangladesh. Before colonial times the use of irrigation was at a modest level, but during colonial times a rapid construction of canals was established to make productive use of the land and the rivers. After independence the state controlled canal irrigation projects had difficulty to continue. The increasing population pressure, the small plots of land, and the inability of tail-enders to have predictable water supply, and the cheap (subsidized) availability of energy led to an increasing use of pumps.

Who are the farmers that start using groundwater? They are the small farmers in areas with high population density. They have direct benefits of using groundwater by having a reliable supply of water. This enables them to produce a variety of products, including more lucrative crops. Shah discusses the political economy related to the introduction of the use of pumps. Energy consumption is the key cost component. Initially people who

checked on meters for energy use were used to determine energy prices. However, this led to corruption and a significant part of the energy costs were spent on measuring its use. This led to different policies such as a flat tariff dependent on the capacity of the pump. But flat prices led to an overuse of pumps, and energy tariffs become an item during elections. As a consequence of the political role of energy prices, a few billion dollars a year of the energy costs is subsidized by low energy prices.

The use of groundwater has direct benefits for small farmers. They are not dependent on the upstream farmers, water provision is reliable and more diverse spectrum of crops can be planted. But its independence also led to anarchy. The uncontrolled use of groundwater starts to have impacts on the level of groundwater, and on the availability of surface water. As energy prices increased in recent years, and more energy was needed to pump from deeper grounds, farmers gave up farming, changed their crops, or switched to surface water irrigation again.

The decline of groundwater levels indicates that a swift change in governance is needed to avoid a dramatic collapse of irrigation in South Asia. Shah suggests a number of options. First at the state level, policy-makers need to shift their attention from canal construction to a more efficient use of water by groundwater irrigation. More attention needs to be given to the capture of rainwater to replenish the groundwater reservoirs. Furthermore, one needs to build irrigation systems by using pipes instead of canals for a more efficient use of water.

Shah ends with the observation that the biggest barrier to effective groundwater governance in South Asia is the institutional lock-in. Planners are used to command and control or large civil engineering projects, while smallholders have adapted to the situation in an anarchy of groundwater irrigation. Still, new canal irrigation projects are planned in India and Pakistan.

Shah delivered a remarkable book. It provides a well-researched history and political analysis of the groundwater governance problem. This development of groundwater use is not restricted to South Asia, and I recommend scholars in irrigation and natural resource management in general to read this important book.

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