job seekers through failed tries (*11*). These possibilities highlight fruitful research opportunities while raising the broader question of whether insights obtained by analyzing success tell the full story of the role of failure in breeding success in the labor market and beyond.

Fortunately, the situation is improving radically, thanks to newly available large-scale datasets that record ubiquitous yet often neglected failures—as well as their successful counterparts—that span social, scientific, and technical domains (*12*). New research that pays specific focus to failures has begun to uncover a range of fascinating insights that challenge the way success is thought about. For example, when people experience negative shocks in their job, they tend to tap their strong ties rather than adaptively activating weak ties to obtain new information (*13*). And, despite the widespread evidence supporting the idea that success breeds success, failure seems to have rather powerful, offsetting effects, propelling individuals to greater long-term success (*14*). Combined with mathematical tools and modeling, analyzing failures—the precursors of success—could help to identify detectable early signals embedded in failures that will lead to ultimate victory or defeat (*15*). A systematic understanding of failure may transform our thinking around not only failure, but also success.

Although science may have succeeded in understanding how networks help us succeed, it has failed to understand how networks sustain us through failures. And that highlights a profound opportunity. Indeed, many scientists study success to learn the sources of inequality. But our failure to take failure seriously may be the reason why inequality has not yet been solved. ■

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WATER MANAGEMENT

The "water machine" of Bengal

A data-driven and policy-supported strategic use of aquifers for irrigation is needed to maximize their benefits

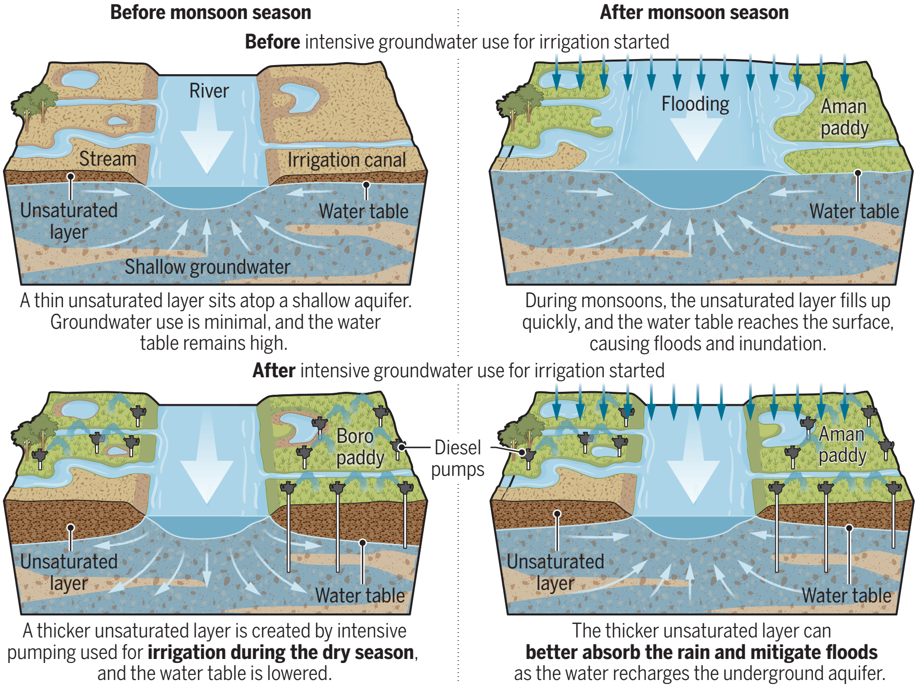
By **Aditi Mukherji**

For decades, millions of farmers in Bangladesh have been capturing more water than even the world's largest dams. They did so simply by irrigating intensively in the summer dry season using water from shallow wells. The ability to use groundwater to irrigate rice paddies during the dry seasons (January to May) helped Bangladesh become food self-sufficient by the 1990s, which was no small feat for one of the most densely populated countries in the world. Researchers proposed that lowering of the groundwater table as a result of intensive irrigation practices in the dry season created conditions for recharge from monsoon rains (June to September), which then replenishes the groundwater (*1*). On page 1315 of this issue, Shamsudduha *et al.* (*2*) present a quantitative analysis of this depletion-replenish process and show that this recharge has indeed been happening at a large scale, in a process they call the Bengal Water Machine (BWM).

The name of theBWM pays homage to the Ganges Water Machine, which was coined in the 1970s. Both "water machines" describe a process in which the underground water table is lowered during dry seasons by human activities. This creates more space in the alluvial aquifer (made of loose sediments) for taking in heavy rainfall during the monsoon season. Such replenishment has the double benefit of helping farmers to grow dry-season crops and also increasing water storage capacity in underground aquifers for flood mitigation. In Bangladesh, Shamsudduha *et al.* observed an increase in annual intake, or "recharge," after farmers started intensive irrigation from shallow wells (2011 to 2015) as compared with before (1976 to 1980). However, the authors also note that BWM is neither ubiquitous nor unlimited and can be affected by a number of factors, including local geology, land use, and year-to-year variations in rainfall.

Although Bangladesh is endowed with fertile land and a favorable climate that allows cultivation throughout the year, the country has faced food shortages throughout its history. These can be attributed to the complex colonial history of the region, but it is undeniable that Bangladesh's population density

The benefits of groundwater irrigation in the Bengal basin



A thin unsaturated layer sits atop a shallow aquifer. Groundwater use is minimal, and the water table remains high.

During monsoons, the unsaturated layer fills up quickly, and the water table reaches the surface, causing floods and inundation.

A thicker unsaturated layer is created by intensive pumping used for **irrigation during the dry season**, and the water table is lowered.

The thicker unsaturated layer can **better absorb the rain and mitigate floods** as the water recharges the underground aquifer.

GRAPHIC: K. HOLOSKI/*SCIENCE*

and the region's vulnerability to cyclones and floods also played a role. After severe food shortages in the 1970s, Bangladesh embarked on a path toward agricultural intensification. Groundwater irrigation played a huge role in enabling this effort by allowing farmers to cultivate boro, a type of summer rice crop (*3*, *4*). Affordable drilling of shallow tube wells, policy support for the import of cheap water pumps, and removal of bureaucratic control over pump installation have all contributed to a consistent increase in the area and production of boro rice (*5*, *6*). In all, rice production increased from 9.9 million metric tons during the 1971–1972 season to 36.4 million metric tons during the 2018–2019 season. During the same period, the share of agricultural land use for boro cultivation also increased from 17.7 to 53.8%. However, more than 30 years after the removal of bureaucratic controls over pump installation, the government of Bangladesh reintroduced a pump permit system in 2019 to limit groundwater use (*7*). Without customizing these policies according to local aquifer and recharge conditions, the regulation may create unnecessary hurdles for farmers in search of affordable irrigation (*8*).

The findings of Shamsudduha *et al.* may help inform and develop region-specific guidelines for groundwater use. For example, their findings show that regions such as the Brahmaputra Basin, where the BWM seems to have the most potential, can be prioritized for groundwater use intensification. Conversely, restrictions for groundwater use can be tightened in the Ganges Basin and in Northwest Bangladesh, where the potential of the BWM has already reached its limit. This means that the BWM mechanism in those regions is already working at its maximum possible capability, with no room for additional recharge if the water tables are lowered further. In addition, regular upkeep of water bodies—including local streams, ponds, and canals—is needed to ensure that the BWM continues to function well. Using spatially explicit findings from Shamsudduha *et al.* to calibrate current groundwater use restrictions will ensure that the BWM continues to provide benefits.

The amount of energy needed to operate the water pumps must also be considered. Currently, roughly 1.3 million out of the 1.5 million water pumps in use are diesel operated, with the rest running on electricity generated from fossil fuels. In 2017 to 2018, the Bangladesh Petroleum Corporation sold 1.1 million metric tons of diesel to the agriculture sector, which ultimately accounted for 3.5 million metric tons of carbon dioxide (CO_2) being emitted, or 4.3% of the country's entire production-based CO_2 emissions (*9*). As a net importer of fossil fuel, it is in the interest of Bangladesh's energy security to develop a self-sufficient pathway to power the BWM. Replacing fossil fuel–reliant water pumps with solar-powered irrigation pumps is one such solution. The Bangladeshi government has started promoting solar-powered pumps, but advocates have demanded a faster pace in policy changes and public financing (*10*).

The long-term effect of climate change on the BWM is unclear. There is a lack of specificity for models of the impact of future climate change on how aquifers recharge under different conditions. There is some consensus about enhanced recharge in dry tropics because of increased precipitation (*11*, *12*). However, future projections of recharge under climate change are lacking for humid and sub-humid tropics such as Bangladesh.

Induced recharge—such as that observed in the BWM—may also work in other aquifers with similar rainfall and geological conditions. Intensive groundwater use for irrigation in the dry season has created conditions for additional water storage in underground aquifers in parts of the Bengal Basin, with the double benefits of improving food security and flood mitigation. Similar high rainfall and alluvial aquifers also exist in the Ganga basins in eastern India and Nepal, where intensive groundwater irrigation can bring livelihood improvements, with positive cobenefits of additional induced recharge. Long-term groundwater monitoring along with policy support to farmers to make intensive use of groundwater will remain essential to unleash the benefits of BWM. ■

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CANCER

Replication timing and genetic instability

Synchronized activation of DNA replication origins induces genetic instability in lymphoma

By **Marcel Méchali**

Chromosomal translocations are promoted by DNA double-strand breaks (DSBs) that are joined inappropriately. They are common in cancer cells, and some are characteristic of specific tumor types. The proto-oncogene *MYC* (on chromosome 8) often undergoes chromosomal translocation into the immunoglobulin heavy chain (*IGH*) locus on chromosome 14, which initiates B cell and plasma cell neoplasms in humans, including Burkitt lymphoma (*1*). This translocation places *MYC* under the control of the powerful *IGH* enhancer, resulting in strong MYC overexpression in lymphoid cells. It has been suggested that the spatial proximity of *MYC* and *IGH* in the nucleus, determined by chromatin folding, promotes this common translocation (*2*). On page 1277 of this issue, Peycheva *et al.* (*3*) report that replication timing mediates the *IGH-MYC* translocation. Furthermore, they infer that shared replication timing arises from the physical proximity of the two loci, resulting in a shared replication hub, where the *MYC* and *IGH* replication origins are synchronously activated.

The *IGH-MYC* translocation requires two DSBs. The first one occurs at the *IGH* locus owing to the regular action of the activation-induced cytidine deaminase (AID), which causes DNA mutations that produce antibody diversity through class-switch recombination. The other DSB, which occurs close to *MYC*, results from off-target activity of AID. Efficient class-switch recombination in the *IGH* locus depends on S phase entry and requires the helicase function of the minichromosome maintenance (MCM)

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