

UNDERCOVER ECONOMIST

July 13, 2012 8:32 pm

# The lessons that flow from Bali's water temples

By Tim Harford

As with Bali's ancient irrigation system, we cannot be confident that there is time to adapt in a fast-changing world



In the mid-1970s, a young anthropologist, Steve Lansing, arrived in Indonesia to study the ancient rituals of the water temples on the volcanic slopes of Bali. In a less spiritual realm, the island's agronomists were stumbling into an agricultural mess. Bali once had the highest rice yields in Indonesia, and throughout the 1970s, the Green Revolution brought new varieties of rice to the stepped paddy fields. Yet despite intensive training and expert advice, by the early 1980s the new crops were overwhelmed by pests.

The narrow technical problem was a trade-off between pest-control and irrigation. Farmers made careful use of the 170 rivers and streams flowing down the slopes of

Bali's sacred volcanoes; water conservation was most easily done with different communities – subaks – planting at different times. Pest control, in contrast, was best achieved by every farm going fallow at the same time, so that the pests were starved of food. The ideal compromise is a complicated and ever-changing schedule of regionally clustered rotation – and one which must be agreed or imposed in a system where one selfish farmer can damage many others. With the new rice crop, the government was centrally co-ordinating the rice planting, and the new system was failing.

For years, economists showed little interest in the subtleties of such resource-control problems, accepting the perspective of Garrett Hardin, an ecologist who coined the term “the tragedy of the commons”. Hardin argued that commonly owned resources, such as common grazing land or fish

in the ocean, would inevitably be overexploited as each individual gobbled up resources like two children sharing a carton of popcorn.

Hardin had a point, but he was wrong to think that common resources cannot be managed by communities. They can; that was the discovery for which Elinor Ostrom became the first woman to win the Nobel memorial prize in economics, in 2009. (Professor Ostrom died in June, and her husband and colleague, Vincent Ostrom, died shortly afterwards.)

Lin Ostrom had a curiosity for how the real world works that too few economists share, and studied examples of communal resource management from lobster fisheries in Maine to irrigation in Spain. In Nepal, she found villagers upstream helped maintain canals downstream, while villagers downstream helped maintain dams upstream. When aid donors funded modern dams that needed less maintenance, this bargain fell apart.

And so to Bali, where Lansing discovered a particularly beautiful system of communal management: highly sophisticated, more than a thousand years old, and in the process of being short-circuited by the new crops and their new planting cycles. Those water temples were no superstitious curiosity: the network of temples, their true function hidden from outsiders in plain sight, ran the irrigation system.

In a computer simulation developed with colleagues, Lansing showed that the rotation developed by the water temples was the most efficient the computer could find; the simulation also showed how the temple system could have evolved quickly through trial and error.

Although Bali's rice farmers still have their problems, the situation has greatly improved since the 1980s. This month, the entire system was recognised by Unesco's World Heritage Committee.

Lansing's ideas have reinforced my own prejudices that complex problems tend to be solved through trial and error, often on a local level. But the contrast between the water temples and our own institutions left me uneasy. Problems such as overfishing and climate change are regional or global, and moving targets. Bali's temples evolved in a stable environment. In a fast-changing world we cannot be confident that there is time for our own institutions to adapt.

*Tim Harford is the presenter of Radio 4's 'More or Less'*

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