Muhamad Khoiru Zaki & Keigo Noda

Using local knowledge to increase climate change resilience in Java

Hydrological events like floods and droughts are becoming more common due to climate change and communities around the world must adapt and increase their resilience to these risks. Local knowledge helps communities build resilience, but there are no studies that explicitly integrate scientific data with inherited local knowledge. Dr Muhamad Zaki and Dr Keigo Noda, of Gifu University, Japan, explored how Pranata Mangsa, *an important form of local agricultural knowledge in Java, can be used alongside scientific data to mitigate the risks associated with droughts and floods on farmland in Java.*

Environmental changes and threats are nothing new. Local communities throughout history have used shared knowledge to predict and mitigate these threats, and local knowledge is vitally important to the adaptive capacities of a community. The process isn't a static one: rather knowledge is shared from previous generations and continually updated to meet the demands of the current era. Adaptive strategies based on this knowledge might include developing early warning systems and adjusting agricultural methods, both of which increase community resilience.

ADAPTATION, RESILIENCE AND LOCAL KNOWLEDGE

There's a clear precedent for this. *Smong*, the local knowledge of communities in Aceh, Indonesia, was used to predict a devastating tsunami. The Philippine *Rapu-Rapu* has been used to forecast typhoons and in Timor Liste, *Ali lulik* and *Fatuk lulik* have prevented landslides. Even moving away from individual disasters, local knowledge in Zimbabwe is used extensively to mitigate the problems associated with climate change. Local knowledge is a complex mix of inherited practices, beliefs and methods of land management, and it is vital for maintaining community resilience in the face of a changing climate.

Despite this potential, however, no studies have been undertaken to prove exactly how local knowledge can bolster community resilience, or how it can be integrated with scientific data. Dr Muhamad Zaki and Dr Keigo Noda, of Gifu University, Japan, set out to assess whether, when integrated with scientific data, local knowledge pertaining to agriculture can enhance community resilience by mitigating the effects of drought.

The United Nations Educational, Scientific and Cultural Organization – UNESCO – advocates local and indigenous knowledge system (LINKS) as a way to mix data with local knowledge, especially in relation to disaster risk reduction (DRR) and climate change adaption (CCA).

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The growings seasons of *Pranata Mangsa*.

The system uses local cosmology to divide the year into four distinct growing seasons, each with unique characteristics.

LINKS advocates for the role of local communities in managing their environment, encourages the transfer of information between generations, and seeks to balance community with global knowledge. The LINKS toolkit allows researchers to integrate scientific data with local knowledge. In doing so, it also helps them to assess how effective local knowledge is for DRR and CCA.

PRANATA MANGSA IN JAVA

Zaki and Noda focused their research on *Pranata Mangsa* (meaning 'rule' and 'season'), a form of local agricultural knowledge used in Java. The system uses local cosmology to divide the year into four distinct growing seasons (or *Titen*), each with unique characteristics. *Titen* are further divided into individual phases, beginning with *Kasa*, which lasts for 41 days. During *Kasa*, farmers should burn rice straw and leave fallow land. *Kanem* is a high precipitation period when farmers prepare their paddy fields to be harvested, which happens during *Dhesta*.

Pranata Mangsa was introduced in 1855 and used extensively across Java but disregarded in 1960 when the government implemented policies 'consistent with the Green Revolution'. Almost overnight, these policy changes reclassified local knowledge as out of date, backwards and no longer relevant to agriculture.

The results of the Green Revolution were mixed. Initially positive, it led to rice self-sufficiency and was lauded on the international stage. Its long-term effects, however, also included unsustainable practices, land degradation and rising prices. Farmer protests were widespread, with many farmers angered by the restrictive nature of the policies and the disregard for years of local knowledge. As DRR and CCA come more sharply into focus, Zaki and Noda wanted to reassess *Pranata Mangsa* and determine whether it has a scientific basis for agricultural management.

INTEGRATING SCIENTIFIC DATA

Their first task was to translate the *Pranata Mangsa* texts, originally written in Aksara Kromo, into Bahasa Indonesian, English, and a United Nations language of international communication. Zaki and Noda then applied scientific data to Pranata Mangsa practices, to examine how effective this local knowledge is for DRR and CCA. They started by measuring precipitation according to the seasonal phases recorded in *Pranata Mangsa*, using the Standard Precipitation Index. Rainfall is, of course, crucial for predicting and mitigating droughts and floods. Strikingly, *Pranata Mangsa* was found to be more effective at predicting droughts than the Gregorian calendar, although it was less effective for floods. Nonetheless its effectiveness at helping mitigate droughts provides an important and scientifically demonstrable boost to community resilience.


Indonesian farmers protested at the Green Revolution's disregard for local knowledge.

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Diurnal rainfall matched *Pranata Mangsa* well enough to reduce crop loss and forecast droughts, though it was less effective at predicting floods.

They then turned to the question of whether science and local knowledge can be integrated, again with DRR and CCA in mind. This part of the study meant applying the UNESCO LINKS toolkit to *Pranata Mangsa*. They found that diurnal rainfall matched the seasons and transitions described in *Pranata Mangsa*, which meant crop loss could be reduced and droughts more accurately forecast. As well as reducing disaster risk, long-term implementation of the crop pattern *Bera-Palawija* was also found to improve soil quality and reduce moisture loss.

Other benefits were found, too. Farming events scheduled according to the water-management system *Macak-macak* were found to increase yields and boost the number of panicles on crops. *Macak-macak* also had positive implications for pest management and soil recovery, making the land more resilient and mitigating some of the risks of future disasters. More specifically, the process of *Berå* (leaving fields empty and burning rice husks) was found to lower the risk of drought. Berå also increased the porosity and density of soil, allowing farmers to adapt more easily to heavy rainfall.

RITUAL AND CEREMONY

Although these results demonstrate the clear potential for combining local knowledge with scientific data, there were some areas where the two proved to be incompatible. Certain elements of *Pranata Mangsa* cannot be quantified scientifically but nonetheless have a tangible effect on DRR and CCA. For example, *Istisqa* is a faith-based activity that takes place during the dry season and promotes reverence and respect for the gods. Although the practices associated with *Istisqa* can't be integrated with any scientific dataset, they nonetheless boost community resilience by encouraging respect for the natural world.

In contrast, other areas of *Pranata Mangsa* couldn't be related to DRR or CCA. Practices like *Sesajen* – the act of placing items like certain fruits and even cigarettes next to fields to repel pests – couldn't be validated in scientific terms or demonstrated to affect DRR or CCA. Whether or not such rituals and ceremonies can be explained in scientific terms, they nevertheless continue to be important community activities.

Pranata Mangsa was found to be more effective at predicting droughts than the Gregorian calendar.

BOOSTING COMMUNITY RESILIENCE

The conclusions of the study are twofold and have wide-ranging implications both for the management of farmland in Java and beyond. Using the LINKS toolkit as a form of analysis, the study proved that local knowledge can be used effectively to mitigate some of the effects of environmental change, particularly droughts. That *Pranata Mangsa* was found to be more effective than the Gregorian calendar for predicting and therefore mitigating droughts is striking. It is proof that local knowledge can be used effectively for CCA and DRR, and should be valued.

The researchers emphasise that Pranata Mangsa is not wholly effective for DRR and CCA. Its usefulness depends on factors such as the size and location of the community, and how committed the participants are to its practice, particularly younger generations.

Nevertheless, the study proved that many components of local knowledge could be verified by scientific data, making them useful for policymakers concerned with adaptation to, and mitigation of, the negative effects of extreme hydrological events, and potentially informing the way that farmers, scientists and other stakeholders manage the land in the future. A combination of scientific data and local knowledge can be used to boost community resilience in the face of a rapidly changing climate.

Behind the Research

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Research Objectives

Understanding the benefits of local knowledge for mitigating the effects of climate change.

Detail

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Bio

Dr Muhamad Khoiru Zaki has a PhD in Agricultural and Environmental Sciences from Gifu University. Trained in the field of local and scientific knowledge for extreme hydroclimate adaptation on rainfed farmland, he has published numerous peer-reviewed articles and present in the national and international conferences.

Dr Keigo Noda is an associate professor at the Department of Agricultural and Environmental Sciences, Gifu University. He has more than ten years' experience in watershed hydrology, water and material cycle and water resource management. Since 2020, he has served as a vice chair of the Working Group on Institutional and Organizational Aspects of Irrigation/ Drainage System Management in The International Commission on Irrigation and Drainage.

Funding

This research was funded by 'Advancing Co-design of Integrated Strategies with Adaptation of Climate Change in Thailand (ADAP-T)' supported by The Science and Technology Research Partnership for Sustainable Development (SATREPS), JST-JICA and by JSPS KAKENHI Grant No. JP19H03069 and No. JP20J10806.

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Personal Response

Can scientific methodologies like this one be used to preserve local knowledge and ensure that it passes from one generation to the next?

"Yes, sure. Having a system of categorising local and indigenous knowledge in this way makes it easier for everyone involved in this process to deal with knowledge that 'cannot be shared because it is too sacred, risky to disclose or weakly protected from appropriation and misuse'. Also, local knowledge can be easily integrated with scientific data, enabling optimal strategies for DRR and CCA to be adopted by scientists, farmers, and policymakers. In promoting the use of this process, it should be noted there are limitations to its utility, depending on: (1) the size and location of the community; (2) the commitment of the participants, especially from the younger generation; and (3) support from stakeholders and policymakers to follow through this system concerned with adaptation to, and mitigation of the negative effects of, climate change."