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Adapting agriculture with traditional knowledge

Over the coming decades, climate change is likely to pose a major challenge to agriculture; temperatures are rising, rainfall is becoming more variable and extreme weather is becoming a more common event. Researchers and policymakers agree that adapting agriculture to these impacts is a priority for ensuring future food security. Strategies to achieve that in practice tend to focus on modern science. But evidence, both old and new, suggests that the traditional knowledge and crop varieties of indigenous peoples and local communities could prove even more important in adapting agriculture to climate change.

Policy pointers

- **Compared with modern** hybrids, traditional crop varieties are cheaper, easier to access, more diverse and more resilient to climate pressures.
- **Agricultural policies,** subsidies, research/ extension and intellectual property rights promote a few modern varieties, often at the expense of traditional ones.
- **Traditional knowledge is an** essential element of local adaptive capacity that can be enhanced through local seed systems, farmers' rights to traditional crops and market access for local varieties.
- **Climate negotiators must** give stronger support to traditional knowledge and crops and address the threats posed by commercial agriculture and intellectual property rights.

An undervalued resource

The traditional knowledge of indigenous peoples and local communities for ecosystem management and sustainable use of natural resources is gaining credence as a key weapon in the fight against climate change. The Intergovernmental Panel on Climate Change has highlighted the role of indigenous knowledge and crop varieties in adaptation,[1] and the Institute of Advanced Studies at the UN University recently identified more than 400 examples of indigenous peoples' roles in climate change monitoring, adaptation and mitigation.[2] And in 2010, parties to the UN Framework Convention on Climate Change adopted a decision on 'enhanced action on adaptation' that identified the need to draw on traditional and indigenous knowledge as well as the best available science.

Despite this growing recognition, the role of traditional knowledge in adapting agriculture to climate change remains largely undervalued by decision makers. In international climate talks, negotiating parties — which represent countries rather than communities — tend to focus on intensifying production through modern agriculture as the key to adaptation and food security.

And yet for many indigenous peoples and local communities it is not modern agriculture but traditional knowledge that has enabled them to cope with extreme weather and environmental change over centuries. In fact, modern agriculture, like hybrid seeds, has made them more vulnerable by increasing reliance on external resources.

There are at least five types of traditional knowledge useful for adaptation in agriculture[3] (see Table, overleaf). This knowledge has also given rise to thousands of traditional crop species and varieties that local farmers have domesticated, improved and conserved over generations. The communities of the Potato Park in Cusco, Peru, for example, hold more than a quarter of the 4,000 or so potato varieties found in the country.[4]

Traditional knowledge and crop varieties are not only linked; each depends on the other. For example, maintaining and transmitting traditional knowledge relies on the use of diverse biological resources, both wild and domesticated; while the reintroduction of traditional crop varieties has revived related traditional knowledge and practices.[6]

But both also exist within a wider biocultural system where they are sustained and influenced by many other factors, including traditional landscapes, cultural and spiritual values and customary laws.[6,7]

Field evidence

Recent research with indigenous communities highlights the role of biocultural systems in adapting to climate change. In all three cases — the Karst mountains of southwest China, the Bolivian Andes and coastal Kenya

Traditional knowledge is an essential element of local adaptive capacity

— farmers are severely impacted by changes in climate, with serious consequences for crop production and food security.[8] Traditional knowledge and crops have proved vital in adapting to the changes (see Figure).

While specific uses of traditional knowledge and crops differ across the sites, there are some common approaches to resilience.

For example, farmers in all study sites choose traditional crop varieties over modern ones because they are better adapted to local conditions and more likely to survive environmental stress and climatic variability.

More than half of households surveyed in the China study still use local landraces of maize and rice because they taste good, are better adapted to mountainous and barren land, and have drought and dislodging resistance (to protect from wind force). Evidence from Guangxi province shows that most farmer-improved landraces survived the big spring drought in 2010, while most of the modern hybrids were lost.[3] Villages that had grown only hybrids lost all their production owing to a shortage of hybrid seed in the market for replacement after the drought.

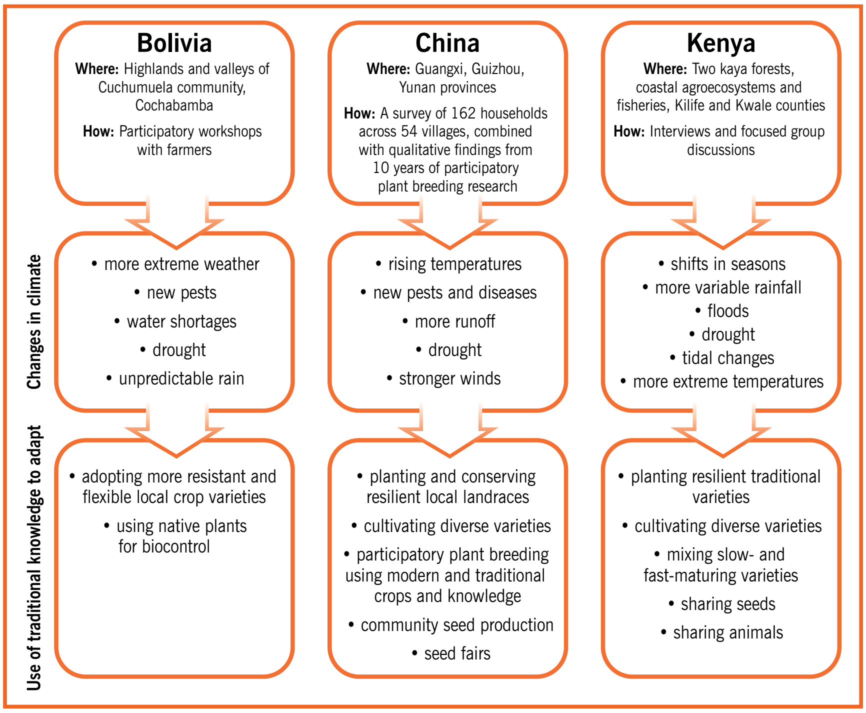
In coastal Kenya, many farmers are going back to using traditional maize varieties because they are hardy and better able to cope with unpredictable weather conditions and local pests.

And in the Bolivian Andes, farmers are using local potato varieties in response to new pests and water shortages. For example, the local variety 'Doble H', which was not previously planted in the community, has become the most widely grown because it always produces, even with little rainfall.

Table. Five types of traditional knowledge useful for adaptation in agriculture

Traditional knowledge about...	How it helps adaptation in agriculture
Resilient properties	Traditional farmers often live on marginal land where climate change impacts and selection pressures are greatest. This enables them to identify resilient crop species and varieties for adaptation.
Plant breeding	Traditional farmers — particularly women and the old — are active plant breeders, conserving local landraces and selecting seeds for preferred and adaptive characteristics over generations. Some innovative farmers cross lines for crop improvement.
Wild crop relatives	Local communities often draw on wild areas around farms for crop improvement and domestication[4] as well as to supplement their diet and provide food when crops fail[5].
Farming practices	Traditional farming practices — from water, soil or pest management to erosion control and land restoration — conserve key resources for resilience and adaptation, such as biodiversity, water, soil and nutrients.
Climate forecasting	Traditional knowledge can help forecast local weather, predict extreme events and provide accessible information to farmers at a local scale. Traditional farmers can also monitor climate change in specific locations and fill the resolution gap of scientific models.

Figure. Climatic changes felt, and responses using traditional knowledge, in three case studies.



A natural gene bank

It is because traditional varieties or landraces are more genetically diverse than modern varieties that they can better withstand environmental stress such as lack of water or nutrients.[9] In coastal Kenya, sacred forests (or 'kayas') conserve plant and animal biodiversity and provide a valuable source of germplasm for species that can tolerate extreme weather and soil conditions.

In Southwest China, laboratory analysis has shown that *in situ* varieties have much higher genetic diversity than those same lines held *ex situ* for 30 years.[10] Here, the use of resilient landraces in participatory plant breeding shows real potential for adaptation, while also enhancing incomes, biodiversity and traditional knowledge (see Participatory plant breeding in China).

In all three case studies, farmers understand and appreciate the value of diversity — not only as a natural gene bank for resilient crop varieties but also as a key farming practice to reduce risk. In both China and Kenya, farmers grow different varieties together to reduce the risk of crop loss and ensure some varieties survive even if crops fail completely in some parts of the community area.

Accessible adaptation

Another key advantage of traditional crop varieties — particularly for poor communities — is that they are cheap and easily accessible. This is because they come from farmers' own saved seeds and are commonly shared within and between villages. Research in Southwest China shows that exchanges occur over very large distances and that women play crucial roles in the local seed system.[3]

Modern varieties on the other hand usually have to be bought each season, depend on market availability and quality, and are often protected by intellectual property rights (IPRs), which can restrict their use. They also require costly inputs such as fertilisers and pesticides. Access to modern seeds and inputs is particularly challenging for farmers in remote areas not well reached by markets or agricultural extension services. For these communities, being self-reliant is vital and traditional crop varieties may be the only option.

Although the principle of sharing seeds and knowledge is found across most traditional farming communities, the mechanisms for doing so are becoming weaker. In Southwest China, annual seed fairs and local culture activities organised by farmers, mainly women, have revived seed and knowledge sharing to meet emerging economic and climatic challenges. Women's groups in some villages have also begun producing their own seeds — selecting local varieties, improving them and sharing them with other villages. Such community-based seed production can also boost incomes: one of the maize hybrids developed in Shanggula village has good market value in both its seed and fresh cob.

The idea of sharing does not only apply to seeds. During periods of drought in Kenya, livestock farmers share their animals with friends and relatives with different sources of water and pasture to minimise chances of losing all their stock.

Threats to traditional knowledge

Research by IIED and partners[6] has identified multiple drivers of loss of traditional knowledge and genetic diversity, which are often interlinked and mutually reinforcing (see What's driving the loss of traditional knowledge).

The biggest threat to traditional varieties is the extension of 'modern' varieties, mainly hybrids. In Southwest China both maize and rice have been highly commercialised and the area of land cultivated with traditional maize and rice rapidly decreased between 1998 and 2008 (by 44 per cent and 21 per cent respectively). Soybean landraces have been better conserved as a traditional intercropping crop for maize, but they have also decreased by 5 per cent in recent years.

In Kenya, following the Green Revolution and the push to use modern agriculture to improve food production and security, a high proportion of farmers similarly grow modern monoculture crop varieties.

In China, IPRs acquired by big international seed companies in joint ventures with domestic companies, are facilitating the rapid spread of hybrids. One hybrid maize, Zhenda 619, has wiped out half of the remaining maize landraces in Guangxi province since 2002. There is a lack of incentive and responsibility for enhancing germplasm among government, public research institutes and farmers.

The expansion of IPR regimes in agriculture tends to create a market for seeds that is dominated by a few large companies. IPRs also raise the price of seeds, and can limit access to seed by farmers and scientists.[13] The challenges of a changing climate may require the widest possible circulation and sharing of germplasm to enable effective and timely adaptive breeding. In addition, IPRs do not provide any incentives for *in situ* conservation by farmers since they do not reward their role in conserving and improving landraces for breeding.

In some cases, government efforts to conserve biodiversity are also undermining traditional laws and customs and so threatening genetic resources. In Kenya,

Participatory plant breeding in China[3]

In 2000, a participatory plant breeding (PPB) initiative began in Southwest China to develop varieties of maize and rice with better adapted characteristics such as drought and pest resistance.

The project brings together traditional farmers with formally trained plant breeders in active plant breeding, on-farm biodiversity management and seed marketing.[11,12] More than 200 varieties have been trialled in fields. Six varieties have been selected and released in research villages and have spread beyond these, and five landraces from the trial villages have been improved. All of these varieties meet local yield and palatability demands and are better adapted to the local environment than modern hybrids.

More importantly, the PPB initiative and related activities have had other knock-on benefits: farmer incomes have increased by about 30 per cent, women are participating more in decision making, and farmers are more confident and organised with better links to external markets.

The project has also enhanced crop and animal diversity, forest resources, herbal medicines and related traditional knowledge.

What's driving the loss of traditional knowledge?

1. Agricultural policies, subsidies and research that promote modern varieties and technologies at the expense of local knowledge and biodiversity.

2. Intellectual property rights that protect new varieties without equal protection of farmers' rights over traditional varieties, which means that farmers have no incentive to sustain traditional varieties.

3. Media promotion of modern varieties and foods, which influences consumer demand and reduces markets for traditional varieties.

4. Limited arable land and smaller landholdings, which can force communities to adopt high-yielding modern varieties.

5. Erosion of cultural values and customary rules, due to modernisation, weakening of traditional authorities, out-migration and changes in occupation.

governance structures to protect sacred kaya forests have reduced the role of traditional elders and are proving ineffective. This, combined with adverse climatic changes, has meant that some plant and animal species that local communities used to rely on for construction, medicine and food have become extinct. In this case, enabling kaya elders to control plant and animal harvesting using their traditional knowledge and customary laws is essential to conserve the sacred forest's biocultural resources that support adaptation.

Action needed

Traditional knowledge, crops and farming practices offer huge potential for building resilience and adapting agriculture to climate change. But if we are to harness them, we must do more to support traditional knowledge and genetic resources, while also tackling the multiple drivers of their loss.

The studies from Bolivia, China and Kenya all identify the need to support local initiatives such as community-based landrace conservation and seed banks, local seed production and sharing, and participatory plant breeding.

They also highlight the need to protect biocultural systems as a whole. The capacity of the world's poorest and most affected communities to adapt to climate change ultimately depends not only on traditional knowledge or on individual ecosystems, but on both — on the interlinked biocultural systems from which new innovations can develop and spread, and on the landscapes, cultural and spiritual values and customary laws that sustain them.

At a broader level, there is an urgent need to tackle the agricultural policies, research/extension systems and IPR regimes that drive the loss of local crop varieties. Policies and regulations must create incentives and encourage responsibility for managing agricultural germplasm as a common good. This includes changing plant breeding criteria such as DUS (distinctness, uniformity and stability), which lead to an increasingly narrow genetic base. Public breeding institutes need a clearly defined public role to encourage fundamental research on issues such as meeting the diverse needs of farmers, conserving agrobiodiversity and broadening the genetic base in breeding.

Incentives are also needed for *in situ* conservation by farmers of thousands of traditional varieties that are in danger of being lost. This requires reforming IPR regimes so that farmers are rewarded for conserving traditional varieties; and improving market access for farmer varieties.

The importance of traditional knowledge in adapting to climate change means that these issues should be addressed as a priority in national adaptation actions and global climate negotiations. When country leaders and decision makers gather in Durban for the 2011 UN climate talks, they must have traditional knowledge firmly in their sights and begin discussing how to reform IPRs in agriculture as a main concern.

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Notes

■ [1] Parry, M.L. *et al.* (eds). 2007. Cross-chapter case studies. Indigenous knowledge for adaptation to climate change. In: *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge. ■ [2] Galloway McLean, K. 2010. *Advance Guard: Climate change impacts, adaptation, mitigation and indigenous peoples. A compendium of case studies.* UNU-IAS. ■ [3] Swiderska, K., Reid, H., Song, Y., Li, J., Mutta, D., Ongogu, P., Mohamed, P., Oros, R., Barriga, S. *The role of traditional knowledge and crop varieties in adaptation to climate change and food security in SW China, Bolivian Andes and coastal Kenya.* Paper prepared for UNU-IAS workshop Indigenous Peoples, Marginalised Populations and Climate Change: Vulnerability, Adaptation and Traditional Knowledge, Mexico, July 2011. ■ [4] ANDES (Peru), the Potato Park Communities, IIED. 2011. *Community Biocultural Protocols: Building mechanisms for access and benefit-sharing among the communities of the Potato Park based on customary Quechua norms.* IIED, London. ■ [5] Jarvis, A., Lane, A., Hijmans, R.J. 2008. The effect of climate change on crop wild relatives. *Agriculture, Ecosystems & Environment* 126 13–23. ■ [6] IIED, ANDES, FDY, Ecoserve, CCAP, ICIPE, KEFRI. 2009. *Protecting community rights over traditional knowledge: Implications of customary laws and practices.* IIED, London. ■ [7] See www.bioculturalheritage.org. ■ [8] These may not necessarily be human-induced changes, although a comparison of a climate model with meteorological observations in Bolivia suggest that they may well be. ■ [9] CBD Secretariat. 2010. *Linking biodiversity conservation and poverty alleviation: A state of knowledge review.* CBD Technical series 55. ■ [10] Zhang, S., Song, Y. Forthcoming. *Genetic diversity of 170 farmer maintained maize landraces from southwest China based on fluorescence-labeled SSR markers.* Center for Chinese Agricultural Policy. ■ [11] Ashby, J.A. 2009. The impact of participatory plant breeding. In: Ceccarelli, S., Guimaraes, E.P., Weltzien, E. (eds). *Plant breeding and farmer participation.* FAO, Rome. ■ [12] Song, Y., Vernooy, R. (eds) 2010. *Seeds and Synergies. Innovating rural development in China.* IDRC, Canada. ■ [13] Tansey, G., Rajotte, T. (eds) 2008. *The future control of food. A guide to international negotiations and rules on intellectual property, biodiversity and food security.* Earthscan, London.

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