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## ABOUT THIS PROJECT

### Name

Poverty and ecology: developing a new evolutionary approach

### Principal investigator

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### Partners

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### Time frame

February 2011 to January 2013

### ESPA regions

China

### ESPA themes

Biodiversity, coasts, forests, health, political economy, water

### Objective

To provide a longer term perspective on how environmental change, ecosystem services and poverty interact over decades. This will lead to better information, including models, for policy and sustainable management strategies.

### Summary

Ecosystems under human pressure can undergo irreversible shifts, including the collapse of essential services such as water quality. Anticipating such tipping points is vital to understand links between economic and environmental change — and could avert ruin for poor communities. It relies on analysing linked trends over the long term.

This project, set in eastern China, has compiled the world's first data on ecosystem services over decades. A combined Ecosystem Services Index shows regional managers that unsustainable development has severely degraded the resource base for the farming economy. Trends for individual resources highlight urgent problems and those that have responded well to policy interventions. The work points the way for researchers and development planners worldwide to predict, and avoid, irreparable damage to regional ecosystems.

# Unearthing history, preventing disaster

Long-term regional records of ecological and economic change can inform development planning



In the fertile basin along the Yangtze river in eastern China, farmers today look out on a different landscape from previous generations. Like most of the country, this region has adopted intensive agricultural practices since the 1970s, boosting yields with fertilisers and pesticides. GDP has shot up and some people are better off than the previous generation — but rural poverty remains widespread and the gap between rich and poor continues to grow. There are signs that the new practices are badly damaging the natural systems that farmers rely on. Some local water sources are contaminated, and unstable soil has been washed away by floods. Could agricultural development be pushing these systems to the point of collapse, risking crisis for poor communities?

This ESPA-funded research offers crucial data to answer the question of how 'ecosystem services' have fared in the region over the past 150 years and what can be learnt from this for low income countries in other parts of the world.

### Uncovering the trends

Across the world, long-term records of ecosystem services — water quality, soil

stability and other benefits of a healthy environment — are seldom available. Direct monitoring of natural resources is patchy and rarely extends back even a few decades. When particular ecosystems have been slowly pushed to their limits, the decline has often gone unnoticed.

But the changes have left tracks — chemical and biological traces deposited in layers of lake sediment, for example. This ESPA project, a partnership between British and Chinese scientists, used these clues to reconstruct the history of six systems that regulate environmental health in the lower Yangtze basin: air and water quality, sediment quality and regulation, soil stability and biodiversity.

Lining these up with social and economic records clarifies the links between development and environmental change.

The results offer important guidance for resource managers in China and around the world, revealing successful strategies and top-priority problems. For example, they show that biodiversity recovered and stabilised during China's reforestation policies in the 1980s

and 1990s, though it rapidly dropped again after 2005. In contrast, drastic falls in both air and water quality since the mid-20th century demand urgent attention. The relative decline in water quality is so steep — dropping about two-thirds in 40 years — it suggests that the lakes studied may be crossing a threshold beyond which damage is irreversible.

## Warning signals

A clearer view of such tipping points is a key aim of this research. In China and worldwide, planners often assume that human pressures will cause smooth, linear changes in nature — but in reality, gradual change in a complex system often leads to abrupt, devastating shifts. The only way to see this coming is by analysing long-term trends.

With further work, the research team will be able to inform policymakers when certain ecosystem services need to be pulled back from the brink of meltdown — potentially averting disaster for the region's rural poor. Their methods could be used for similar assessments around the world. The team is building models that will let developing-world analysts enter in their own local long-term data. They note that creating an international archive for ecological trend data would greatly speed up the process.

To complement these detailed warnings, the project has created an at-a-glance indicator of environmental health, akin to the financial world's Dow Jones Index. The Ecosystem Services Index combines trends of the six ecological 'stocks'. During the past 40 years of population growth, intensifying agriculture and industrialisation, this regional index has halved.

It's a clear signal to the government, NGOs and media that efforts to create more wealth in this region have imperilled the resource base sustaining local livelihoods. To make these

results still more accessible to policymakers and local leaders, the project is developing a Google Earth application and animated graphs visualising the changes.

For other developing countries seeking ways to lift people out of poverty, the study does not offer easy answers. To combat severe water degradation, for example, Chinese managers might need to limit fertiliser use or even relocate farmers — a blow to both rural communities and food production in the short term.

But in the long term, inaction could mean ruining water sources, which would make commercial farming unviable and drag down rural incomes dramatically. Long-term policies will have to find a compromise that preserves water quality while supporting farming, for instance by switching crops, altering techniques or investing in water treatment.

## Next steps

With more data from the region, the researchers will begin to model the links between poverty, development and ecosystem services. Field visits and interviews will help clarify the political and economical factors involved and the various actions that drive environmental change. After working with communities to compare the academic analysis with local perceptions, the project will give policymakers and communities concrete scenarios that describe different options for addressing economic and ecosystem needs.

The ESPA Directorate is working with this project to ensure that lessons learnt in China are used to benefit poor people in other ESPA regions, including Africa and South Asia. In particular, the Directorate is helping by linking to other ESPA projects in Bangladesh and by collaborating with the International Ecosystem Management Programme to transfer knowledge and expertise from China to Africa.

## NEW KNOWLEDGE

- This ESPA project, set in eastern China, provides the world's first long-term data showing how regional social and economic changes have affected air and water quality, biodiversity, and other key ecosystem services.
- An Ecosystem Services Index, combining six ecological trends, shows at a glance that during the last 40 years of intensifying agriculture in this region, the natural systems that sustain farming livelihoods have degraded by 50 per cent.
- East China's history of rapid change, and existing relationships with researchers there, made it a good site to develop new methods and models — which can be reused around the world to understand development and ecological trends in depth. Creating an international archive for long-term eco-data would ease the process considerably.



## CREATING IMPACT

- Long-term measurements are essential for scientists to anticipate when human pressures are pushing ecosystems towards irreversible collapse. Replicating this project's approach could ultimately help policymakers and communities across the developing world evaluate options for alleviating poverty while protecting their natural resource base.
- The project's results differentiate ominous trends requiring urgent action from trends that have stabilised under recent environmental policies. This feedback can immediately inform resource management in the region.
- The data highlights the hard choices about poverty and ecology that unsustainable development brings. For instance, interventions to rescue regional water sources may harm poor farmers in the short term, but continued degradation could devastate farmers' incomes in the long term.

The Ecosystem Services for Poverty Alleviation (ESPA) research programme funds high-quality, cutting-edge research to improve our understanding of the way ecosystems function, the services they provide and how they can contribute to poverty alleviation and enhanced wellbeing. This provides the evidence and tools to enable decision makers to manage ecosystems sustainably and in a way that helps improve the lives of the world's poorest people.

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