Case 2: Diverse solutions, sustainable pathways: the case of water resources

How can we ensure high quality, reliable water sources are made available to a diverse population – for example in dryland India or Africa - over a sustained period, without depleting the resource base? A classic engineering solution is to build large dams. But are such solutions always sustainable – providing shared social, economic and environmental benefits? The evidence is variable. External stresses (long term climate change or changes in land use in watersheds) and shocks (droughts or floods) may, for example, undermine the robustness and resilience of such a solution. Small-scale water harvesting, village ponds and micro-dams may be, by contrast, more robust and resilient to external changes, how such systems respond to shocks and stresses internal to the system may pose different challenges for sustainability. This raises different issues about the durability and stability of the local organisational, management and tenure systems, for example. Pathways to sustainability often require diverse solutions, responding in different ways to the different dimensions of sustainability. No one size fits all in dynamic, complex environments.

More reading

Dynamic Systems and the Challenge of Sustainability, STEPS Working Paper 1 by Ian Scoones, Melissa Leach, Adrian Smith, Sigrid Stagl, Andy Stirling and John Thompson (2007) ISBN – 13: 978 185864 650 2

Pathways to sustainability: an overview of the STEPS Centre approach by Melissa Leach, Ian Scoones and Andy Stirling.
ISBN – 13: 978 1858646561

For other titles in this series (agriculture, water, health, dynamics, governance, designs) see: www.steps-centre.org/publications

Credits

This briefing was written by Ian Scoones and edited by Julia Day.

About the STEPS Centre

The STEPS Centre (Social, Technological and Environmental Pathways to Sustainability) is an interdisciplinary global research and policy engagement hub uniting development studies with science and technology studies. We aim to develop a new approach to understanding, action and communication on sustainability and development in an era of unprecedented dynamic change. The STEPS Centre is based at the Institute of Development Studies and SPRU Science and Technology Policy Research at the University of Sussex with a network of partners in Asia, Africa and Latin America and is funded by the Economic and Social Research Council. Find out more: www.steps-centre.org

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Dynamic systems and development challenges

From STEPS Working Paper 1: Dynamic Systems and the Challenge of Sustainability

STEPS briefing 1

Today's world is experiencing accelerated rates of change in social, technological and environmental processes, therefore taking the dynamics of systems seriously in policy and practice is essential. Dynamic systems are characterised by complexity, non-linearity and often non-equilibrium patterns, with high levels of uncertainty about likely outcomes and impacts.

You might say, well that's obvious. And in many ways it is: think about your own life and how influenced it is by uncertainties and unpredictable patterns. In some areas of science and policy, such dynamics have long been recognised. For example, ecologists often observe how complex systems result in unexpected patterns and surprises. Increasingly, these perspectives are being extended to other areas – from understanding macro-economic systems and financial flows to the molecular biology of genomes. Yet many conventional approaches to development and policy often ignore complex dynamics – and as a result often fail (see Box 1)

"Conventional approaches to development and policy often ignore complex dynamics, and as a result often fail"

Why have dynamics so often been ignored?

Much mainstream social science, policy and management thinking is traced to the 18th and 19th century traditions which saw balance, pattern and equilibrium as essential to progress. These ideas have been extended through colonialism and 'development', and institutionalised within professions and organisations across the world. They reflect a dominance of influential perspectives in, for example, economics, engineering and epidemiology. These, in turn, became interlocked with institutions, policy frameworks and professional practices – in natural resources policy, public health and economic planning– persisting, even as the science moved on.

Flood, Benin / Peeter Viisimaa / iStockphoto

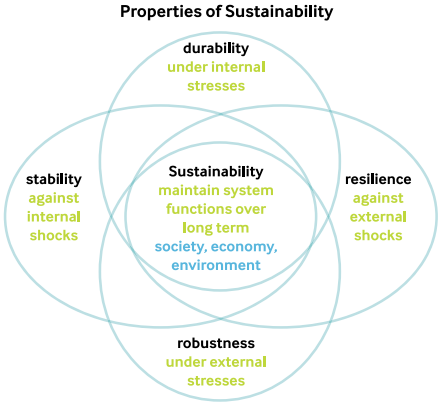
Development has long assumed models, practices and technologies can be transferred to different places without a problem. This is based on the assumption that similar, stable conditions exist across wide spatial and temporal scales, for example, Africa is similar to Europe, just underdeveloped. This tendency is combined with a political economy of equilibrium and certainty, where investments seek stability of returns and science and development seek big impacts through 'rolling out' and 'scaling up'. Diverse, dynamic contexts are too often ignored, despite long-standing evidence of the gap between idealised models and diverse, dynamic realities. These mismatches result in local resistance to development efforts or a dismissal of fundamental problems as 'implementation failures'

Homes at garbage dump, Mexico / Milan Klusacek / iStockphoto

Challenges to equilibrium thinking

There have, however, been some important challenges to equilibrium thinking, from diverse intellectual traditions, practical experiences and policy settings, which point to new directions for both science and development. These are beginning to amount to a new science of uncertainty, complexity and dynamics – with profound consequences for development.

- Complexity science – shows the conditioning effects of system structure on emergent system properties, creating chaotic dynamics, tipping points, bifurcations and so on.
- New perspectives in ecology – highlight how shifts between multiple stable states occur, and non-equilibrium systems are dominated by external drivers and non-linear interactions.
- Understanding socio-technical transitions –emphasises inter-coupled ecological and industrial-technical systems, and how socio-technical regimes and pathways are generated, resulting in 'lock-in' and exclusion of other options.
- Policy and management sciences – show how complexity is constructed and experienced through 'soft systems' approaches; and that policies are the result of negotiated understandings among practitioners and as part of 'learning organisations'.
- Dynamic systems approaches in development –highlight the trade-offs in the properties of agro-ecosystems, and the importance of surprise and adaptive response in policy and management processes.



"A new science of uncertainty, complexity and dynamics is emerging – with profound consequences for development"

A new approach: the reflexive turn

Together these perspectives offer elements of a new approach to analysis and action that takes dynamics seriously. Two key themes are:

- Systems are diverse, complex and multi-scaled: requiring attention to the intertwining of social, technological and ecological dynamics in particular sites and settings, and across scales.
- Uncertainty is everywhere, and has different dimensions: requiring an appreciation of risk (the range of outcomes are known, and probabilities can be assigned to each), uncertainty (possible outcomes have been well characterised, but little basis exists for assigning probabilities to them), ambiguity (different views about the impacts and consequences of different outcomes), as well as ignorance (we don't know what we don't know, exposing us to the possibility of surprise) – and how these all, in different ways, affect management and policy choices.

But there is also another important dimension: the 'reflexive turn'. This has two further implications for a new approach:

- Things look different depending on who you are. There are always going to be very different interpretations and valuations of dynamics and outcomes which reflect different people's lives, perspectives, politics and priorities: 'framing' of the system is critical.
- Active awareness of how we think and act. Attention to how science, methods, management and policy approaches are co-constructed by different people with different views, and how these processes may exclude alternative visions and development pathways: 'reflexivity' is essential.

Pathways to Sustainability

Such an approach suggests a different way of thinking about the challenge of sustainability. How can we seek effective pathways to sustainable development in dynamic system contexts? This is not straightforward. First it means debating what normative and political goals are important (reducing poverty, improving social justice, conserving the environment, for example) and examining what pathways of development – of potentially many - are most likely to result in such outcomes.

A key step is assessing how sustainable different pathways are. Sustainability has many dimensions (see Figure 1), and there will always be trade-offs between stability, durability, robustness and resilience. Again, the choices will be normative and political, and so require inclusive deliberation and informed debate (see Box 2).

Case 1: Ignore dynamics at your peril: the case of rangeland management

For much of the last century, management of dry rangelands in Africa has been premised on assumptions derived from northern, temperate settings in the US. Rangeland development therefore used fixed carrying capacities, rotational grazing and fenced paddocks in settings where spatial and temporal dynamics made such solutions unworkable. By contrast, local livestock keepers had their own 'non-equilibrium' approach to management, involving flexible movement and the adaptive use of variable resources. The imposed solutions have repeatedly failed, while local versions are increasingly seen as a more effective basis for development.