

**Pathways to Sustainability:  
an overview of the STEPS Centre  
approach**



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## SUMMARY

Who benefits from genetically-modified crops? Will there be enough water for people to survive this century? What are the implications of the HIV/AIDS pandemic? These are just some of the questions that the STEPS Centre - a new global research and policy hub based at the University of Sussex in the UK - is asking. This short document provides an overview of the approach that STEPS is taking as it seeks to grapple with two of the most pressing challenges of contemporary times: linking environmental sustainability with poverty reduction and social justice, and making science and technology work for the poor. Intended for anyone wanting a quick insight into the Centre's work, it highlights key elements of the Centre's 'pathways approach', how this approach interweaves the themes of systems dynamics, governance and designs, and the practical implications for the distinctive styles of interactive, engaged research that the Centre is undertaking.

## MAKING SENSE OF A DYNAMIC WORLD

Today's world is highly complex and dynamic. Environmental conditions are changing fast, as water, land and other ecological systems interact with climate change and new patterns of disease incidence. Developments in science and technology are proceeding faster than ever, with the spread of technologies shaped by new and often highly globalised patterns of investment and information. Social systems are changing rapidly too, linked to population growth, urbanisation, and market relationships. Such dynamics are, in turn, driven by shifting patterns of mobility – of people, microbes, ideas and technologies – and globalised economic change, as some areas of the world transform, while others remain in deep poverty.

All this raises some major policy and development challenges. For instance, how are shifting human-animal interactions and food production systems altering the likelihood of new global pandemics? How can the world respond to these interactions in ways that do not constrain poor people's livelihoods and freedom? What are the challenges of sustainability in rapidly growing Asian

cities? As technology and economic growth bring wealth for some, how can the fall-out for those living on the margins - in overcrowding, pollution, ill-health and hazard - be addressed? How are farmers in dry parts of Africa coping with the challenges of climate change and disease? Can the potentials of new agricultural and health biotechnologies be harnessed to help, or will they provoke new uncertainties and missed opportunities to build on farmers' own adaptations? And how, in a world of rapidly advancing technologies and markets for drugs, seeds and water use can regulatory arrangements be developed that suit the interests of the poor? How must global models of regulation be rethought to work in dynamic social and political settings in Latin America and Asia? And how can these models respond to poorer and marginalised people's own perspectives on risk and uncertainty, grounded in their everyday lives and livelihoods?

Today, such questions are becoming ever more pressing. On the one hand, this is because they strike at the heart of relationships between ecology, technology, poverty and justice. In a world of pervasive and growing inequality, linking environmental sustainability with poverty reduction and social justice, and making science and technology work for the poor, have become central practical, political and moral challenges of our times.

On the other hand, such questions highlight the complexity of meeting these challenges in a dynamic world. Social, technological and ecological processes are not only highly dynamic in themselves, but also interact in complex, locally-varied ways. In this context, simple blueprints, technological fixes, or the transfer of technologies and regulations developed elsewhere are unlikely to work - and often create further problems

Although there are plenty of statistics to show that there are accelerated rates of change in the world today, dynamic systems are not a new phenomenon. As ecologists have long described, non-linear interactions in very simple systems can result in highly dynamic patterns over time. In recent years, research in a vast array of areas - from studies of macro-economies at one end of the scale, to molecular biology at the other - have revealed that dynamic systems – characterised by complexity, uncertainty, non-equilibrium and sometimes chaotic dynamics – are the norm, rather than the exception. Thus wherever one looks – in biological, social, economic or political systems, and particularly in their interactions - complex dynamics are important, and always have been.

Yet dynamics – both old and new – have often been ignored in conventional policy approaches for development and sustainability. Conventional approaches have often been rooted in standard equilibrium thinking underlain by deeper-rooted notions of a 'balance' in nature, centring analyses – and so recommen-

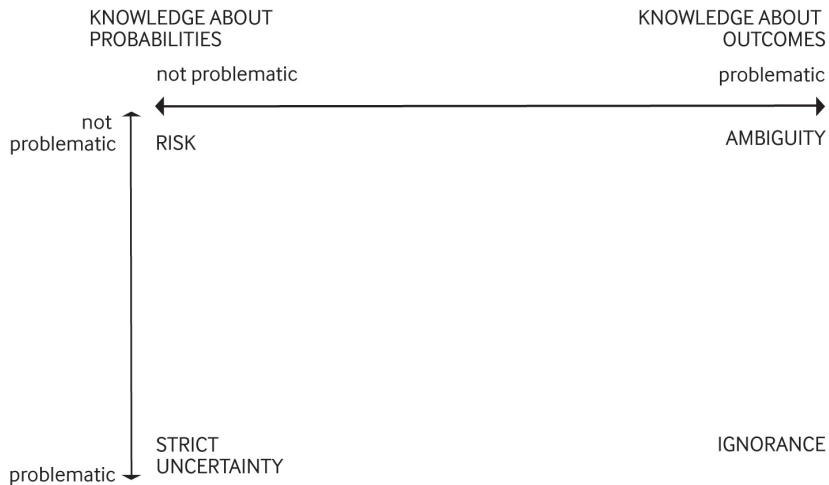
dations – on what are assumed to be aggregative, equilibrium patterns, and on attempts to control variability, rather than adapt and respond to it. Equally, they have often assumed that models developed for one setting – usually a more controlled, managed setting – will work in others: whether exported from the developed to the developing world, or from the laboratory or research station to the field. Underlying such approaches are often wider assumptions about what constitutes the goals of ‘development’ or ‘sustainability’, often assuming a singular path to ‘progress’.

Yet the failures of such approaches to intervention and policy are everywhere to see. The new dynamic contexts presented by a globalised, inter-connected world make these all the more evident. Standard approaches all too often prove to fail their intended beneficiaries. Dynamic contexts often undermine the neat assumptions of imported models. Emerging backlashes – from nature, from social movements, from politics – reveal this widening gap between standard policy approaches and dynamic systems.

## **RISK AND UNCERTAINTY**

At the same time, these dynamic systems and contexts involve various forms of incomplete knowledge, or incertitude. Some involve risk, where the range of possible outcomes and probabilities amongst them are known. Others involve uncertainty, where the possible outcomes are known but there is no basis for assigning probabilities, and judgement must prevail. Others still involve ambiguity, where there is disagreement over the nature of the outcomes, or different groups prioritise concerns that are incommensurable. Finally, some social, technological and ecological dynamics involve ignorance, where we don’t know what we don’t know, and the possibility of surprise is ever-present. These four types of incertitude are illustrated in figure 1. Whereas conventional, expert-led approaches to analysis and policy are well-attuned to handling risk, they become highly inadequate in the increasingly common situations in which these other kinds of incertitude prevail.

Figure 1: Forms of incertitude



Furthermore, different people and groups often understand systems dynamics, and value particular goals and outcomes, in very different ways. Rather than singular notions of 'progress' in relation to environment, technology or development, then, we increasingly face situations in which there is a multiplicity of possible goals, and multiple pathways to reach them. These are often contested. Put another way, systems, and their goals and properties, are open to multiple framings, where framing refers to the particular contextual assumptions, methods, forms of interpretation and values that different groups might bring to a problem, shaping how it is bounded and understood.

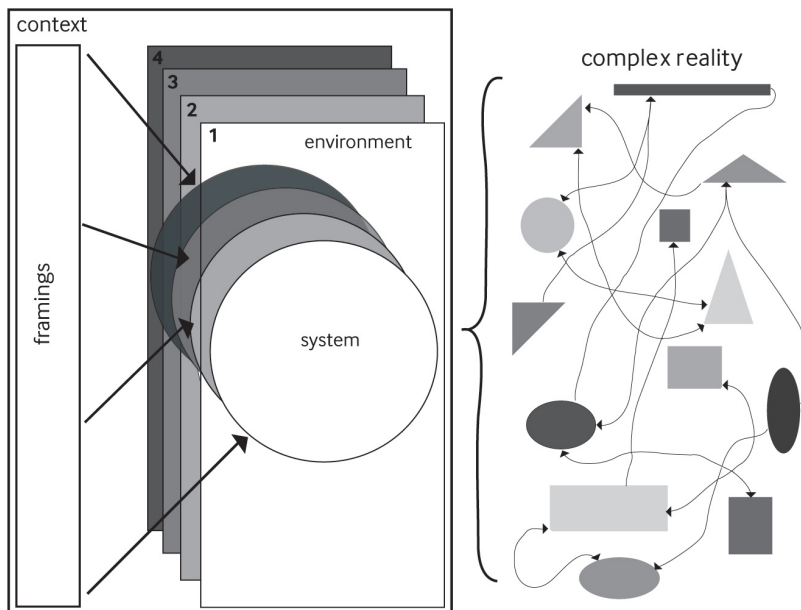
## A SYSTEMS PERSPECTIVE

This implies that systems must be seen as simultaneously objective (involving structures, functions and their interactions, existing in a context) and subjective (reflecting different framings of the system, its functions and outcomes and its contexts). Figure 2 illustrates these concepts in a simple diagram of a system in its environment - taken to include its social setting. Incertitude is part of the dynamics of both the system and the wider environment and context.

Conceived in this way, positivist and constructivist perspectives can be integrated into a single picture. In other words, we must understand the world both

through the lenses of different 'framings' (a constructivist perspective) and as objective realities (a positivist perspective). It is, we argue, the critical reflection on the interactions between such perspectives that is especially revealing. Thus each representation of the system is constituted by its context, with this context comprehended in two possible ways. First, it might be seen in terms of objective understandings of the environment in which the system is set. Second, the context might be seen in terms of more explicitly subjective framings of the system. Here, the framings might emerge from a variety of stakeholders (e.g. research and development organisations, regulators or campaign NGOs) or disciplinary perspectives (e.g. social, physical or life sciences). Under each viewpoint, the structure, substance and bounding of the system in question will of course differ, making debate and discussion across perspectives critical.

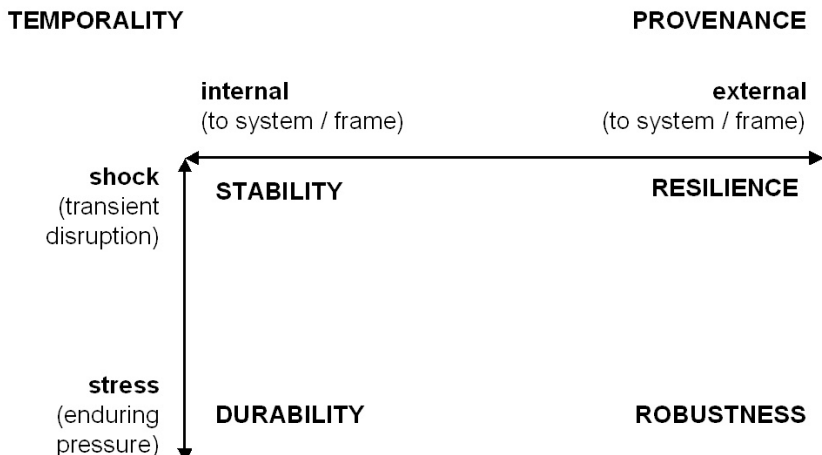
Figure 2: Understanding a complex system



## RESPONDING TO STRESSES AND SHOCKS

A crucial part of understanding systems dynamics, especially in the context of debates about sustainability, is to see how their properties respond to both transient shocks and more enduring stresses. Crucially, such shocks or stresses may be viewed equally as arising from shifting framings of actors' understandings of the system and its environment, or from shifting conditions in the systems and environments themselves. In any system we may also distinguish vulnerabilities that arise under transient disruptions (shocks) from vulnerabilities associated with enduring pressures (stresses). In terms of their origin, we may also distinguish vulnerabilities that arise from processes internal to the system and its given framing or from external processes. As figure 3 illustrates, this leads to the identification and definition of four important dynamic system properties - stability, durability, resilience and robustness.

Figure 3: Dynamic system properties – across time (temporality) and origin (provenance)



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## SUSTAINABILITY TRADE-OFFS

These system properties may be recognised as individually necessary and collectively sufficient for the overarching quality of sustainability. However, the key question arises - sustainability of what system structures and functions, according to whose framings? In a general, colloquial sense, sustainability refers to a quality of being “capable of being maintained at a certain rate or level”. This may be used in general terms to refer to any kind of structure or function, with no necessary normative connotations.

However, such a usage is insufficient if, as we suggest, contested framings of systems dynamics and goals are to be addressed. For this, we need to distinguish the general, colloquial connotations of ‘sustainability’ (with a lower case ‘s’), implying the maintenance of system properties in a general sense, from the specific normative, implications of ‘Sustainability’ (with an upper case ‘S’), referring to those properties valued by particular social groups or in the pursuit of particular goals.

This distinction is central to the STEPS approach to understanding and designing pathways to sustainability. We argue that Sustainability must be defined in normative terms that link it both to overarching goals of poverty reduction and social justice, and to the specific ways that different groups define and refine these goals in particular settings. As such, Sustainability firmly enters the realm of the political. Equally, there may be multiple, diverse views of what systems dynamics are in play, which matter and why. There may be important disputes about the origins, impacts and consequences of short term shocks and long term stresses, and of the trade-offs between system properties. For example, different groups of people may argue between wanting a robust/resilient system and stable/durable one. Pathways to Sustainability are thus constructed through decisions which must explicitly acknowledge diverse Sustainability goals, and tackle the associated trade-offs. Critically, this requires recognising that any assessment is necessarily positioned and partial, shaped by the social-economic-political positions of those involved - whether analysts, policy-makers or poorer people themselves

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## RETHINKING APPRAISAL, PLANNING AND POLICY

However, many current policy and management approaches are not responsive to such notions of systems dynamics, multiple perspectives and contested Sustainability goals. Take the case of approaches to water management through the building of large dams. Problems of water scarcity, under-development and poverty are typically framed in highly specific ways, such as to reduce ambiguity and privilege the benefits of large dams. Decision-making is typically reduced to a simple balance between the rights of the majority (or nation as a whole) pitted against the rights of a small minority (those displaced by the dam), who are asked to sacrifice their interests in the face of this greater good. Applications of appraisal techniques, such as cost-benefit analysis, tend to focus narrowly on the large dam project as if this was the single route to progress, to the exclusion of alternatives associated with other technological or policy pathways. The risk-based characterisations used in such appraisal approaches generally fail to account either for uncertain dynamics (e.g. changes in river flow) or for ambiguities, as planners and local residents, for instance, frame dynamics and their possible outcomes in very different ways. Thus planners' conceptions of water scarcity may conflict with dryland farmers' and pastoralists' understandings of ongoing water fluctuation, and the strategies they have developed for living with it

## PUTTING INSTITUTIONS AND POLITICS CENTRE-STAGE

In this example, as in many others, the dominance of particular views of systems and their goals to the exclusion of others is not mere chance; it also reflects politics and power. Thus seeing a socio-ecological system in terms of linear, aggregate notions of water scarcity serves to uphold the institutional interests of large dam planners and industrialists, while suppressing the alternative perspectives and priorities of those living downstream. Thus narratives of scarcity can be seen as part of both a powerful political economy and of political processes that constrain more marginalised water users.

Indeed, at the heart of the STEPS approach is recognition of this centrality of governance to pathways to Sustainability. In other words, political and institutional relationships, including those of power/knowledge, must be put



centre-stage. For it is political and institutional processes that shape how particular framings of system dynamics and goals come to dominate. They are also part of the context in which system dynamics unfold; they may contribute particular institutional or political disturbances to a system and, perhaps most centrally, governance processes intervene in systems dynamics themselves, affecting the pathways that unfold.

## WHAT THE STEPS CENTRE DOES AND HOW WE WORK

The work of the STEPS Centre thus:

- reveals the diverse understandings of systems goals, properties and dynamics held by different institutions and groups;
- analyses how particular perspectives come to dominate, and how they play out in politics, policy and management;
- exposes the effects and implications - for linked social-technological-ecological processes, and for the livelihoods and well-being of particular groups of poorer, marginalised people;
- challenges institutional and political relationships and forms of power/knowledge that contribute to unsustainability and social injustice and
- suggests alternative approaches that facilitate the negotiation of pathways to Sustainability.

In this respect, the STEPS Centre's approach is both analytical - focused on understanding how things are - and normative - concerned with promoting new forms of understanding, action, tools and procedures that support particular poverty reduction, social justice and sustainability goals.

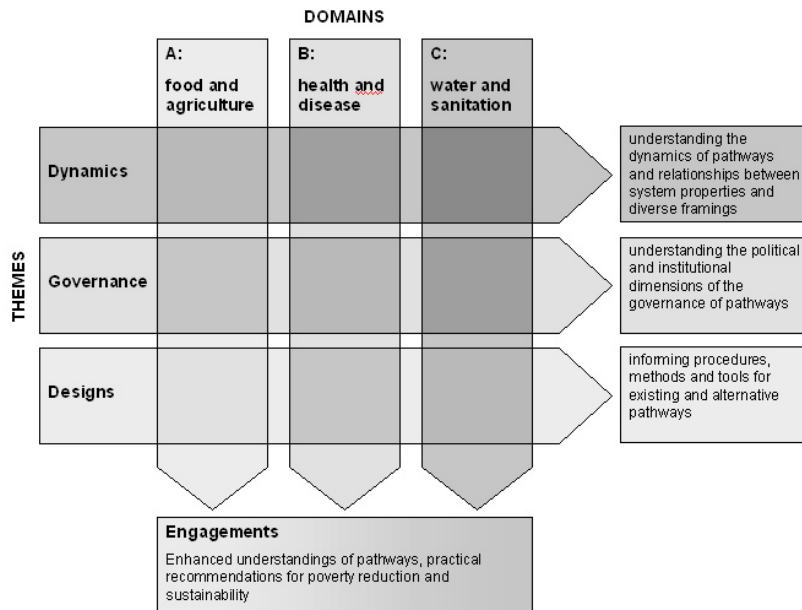
The Centre's work is organised to address challenges of sustainability that cut across three themes

- **Dynamics:** Addressing how interlinked processes of social, technological and environmental change operate in different settings, and how different groups frame these.
- **Governance:** Understanding the institutional and political processes across global and local scales that shape systems dynamics and pathways to Sustainability or otherwise.

- **Designs:** Addressing how decision-making procedures, appraisal methods and analytical tools shape the capacity for negotiating pathways to Sustainability.

The STEPS Centre addresses these themes through work that cuts across three domains - food and agriculture, health and disease and water and sanitation. In different ways, these all involve particularly strong, direct interactions between social, ecological and technological processes, and represent key areas of current international policy and technology priority in the struggle to reduce poverty in developing countries.

Figure 4: The matrix structure of the STEPS Centre's work



The STEPS Centre's aims thus require a rethinking - for both analytical and normative purposes - of politics, policy, institutions, innovation and regulation arrangements, decision-making procedures, appraisal methods and tools, moving towards ones which are:

- responsive to dynamics across multiple scales,
- inclusive of diverse framings of system properties and goals, especially those of poorer and marginalised people,

- appropriate to the social and political histories and cultures of particular places and
- positioned in relation to a normative agenda around poverty reduction and social justice.

## THE STEPS APPROACH

This rethinking will necessarily involve a plurality of approaches. For many issues, the Centre's work will link across natural and social science disciplines, while there are long traditions of social and political science and of appraisal and methodology design that STEPS will draw on and draw together. These range from approaches in political economy and political ecology, to work on social movements and citizen agency, to post-structuralist work on power and knowledge; from institutional and ecological economics, to work on the governance of socio-technical systems; and from expert-led approaches to risk analysis, to participatory and citizen-led appraisal procedures.

In particular, though, the Centre's work highlights the potential of approaches that are:

- **networked**, recognising and building on interactions and alliances between multiple actors, local and global, citizen and state, public and private, rather than focused exclusively on particular organisations or 'levels';
- **adaptive**, adjusting to dynamic systems, uncertainty and complexity, and unintended effects, rather than imposing blueprint plans;
- **deliberative**, emphasising inclusive participation, negotiation amongst multiple perspectives and social learning, rather than imposing a single viewpoint;
- **reflexive**, recognising the social and political framing of knowledge claims and management approaches with humility, rather than accepting any view unquestioningly;
- **broad**, reflecting the full character of dynamic systems and diverse knowledges of them, rather than narrow and
- **open**, conveying the plural and conditional nature of relevant knowledges into wider processes of governance, rather than closed.

## **PATHWAYS TO SUSTAINABILITY**

Different combinations of approaches, concepts and tools will be appropriate for different issues and different settings. Our analytical and programmatic task is to map out what works in different circumstances, and in relation to different systems, in order actively to promote pathways to Sustainability in different settings, north and south.

With the notion of 'pathway' conveying the way in which a given system changes over time, depending on the issue in question, several different scales may be important, sometimes simultaneously and in overlapping ways. Thus attention might, for instance, be on an individual and their farming system or bodily processes; on a household, a locality, a region, a national health or innovation system, a broader social-ecological system, or a global regulatory system - as well as on the ways that pathways of change in each of these interact. Over time, understanding pathways requires a look at historical precedents, at current trajectories of change, and at future scenarios, whether over shorter or longer terms. Whatever the particular focus, central STEPS questions concern the extent to which Sustainability is being achieved; and how contestation between alternative pathways and goals is playing out, whether between women and men in a household, between wealthy and poorer groups, or between citizens, state agencies and global organisations. This might include contestation over understandings of the past, of present changes and why they matter, or between different future imaginaries of socio-technical change.

## **INVESTIGATING PROBLEMS ON THE GROUND**

Following this general set of principles, the STEPS Centre's first round of projects will include looking at:

### **CROP, DISEASE AND INNOVATION PATHWAYS IN EAST AFRICA**

Focusing on dryland Kenya and on maize, a socially and economically highly significant staple crop, this project will explore the dynamics of farming system change in areas affected by increased rainfall variability due to climate change.

It will explore the diverse ways that farmers (wealthy and poor, male and female) and national and global agricultural researchers frame and respond to emergent environmental challenges, whether through local crop, soil and water adaptations or engineering drought-resistant maize strains. It will address the interactions with human health, asking how maize-led land use changes have been shaped by and are shaping disease ecologies, whether through the emergence and spread of disease vectors or the impact of HIV/AIDS on household labour and gender relations. Asking which innovation pathways are taken up and which are left aside, as shaped by political and institutional processes, the project will aim to open up consideration of alternative pathways that meet poorer farmers' Sustainability goals amidst complex and dynamic ecologies and livelihood systems.

#### **URBANISATION AND SUSTAINABILITY IN ASIA'S GROWING CITIES**

Focusing on the expanding fringe of a major Indian city, indicative of the conditions that a growing proportion of the world's poor and marginalised citizens will inhabit in decades to come, this project explores technological, health and environmental sustainability challenges. It will ask how Sustainability should be defined and sought in systems facing multiple, interacting dynamics, including shifting disease ecologies linked to overcrowding and inadequate sanitation; changes in urban farming affected by pollution, and contestation over limited land and water. It will address the particular governance challenges of such marginal places that often do not lie clearly within urban or rural jurisdictions, exploring the potentials of innovations in both socio-technical systems and institutional arrangements to build pathways to Sustainability and social justice in peri-urban settings.

#### **RETHINKING REGULATION IN DYNAMIC CONTEXTS**

Addressing specific cases in the agricultural and health domains in specific settings in Latin America and China, this project will address the gap between current assumptions about regulation - based often on the norms of OECD countries - and the more complex realities in diverse, dynamic contexts. In a context of economic globalisation, new pharmaceutical and agricultural technologies are, today, often being supplied through trans-national as well as national research and development chains. Yet global, harmonised regulations and regimes often do not map neatly onto diverse localities in rapidly changing economies, giving rise to many unintended consequences. This project will

trace the relationships between global and local forms of governance and regulation, asking how, for specific issues and settings, global and national regulatory regimes actually work, or fail to work, in practice. The project will explore the interactions between formal and informal regulation that may emerge to fill the vacuum, whether based on citizen action and social networks, everyday means of getting-by, or semi-legal activities. Exploring who gains and who loses from these interactions, and their implications for emergent ecological dynamics - for instance as poorly-regulated drugs threaten to provoke new and devastating resistances - this project will work towards identifying alternative regulatory pathways that work for Sustainability

### **RISK, UNCERTAINTY AND TECHNOLOGY**

Focusing on issues and settings in India, this project will address how different institutions and groups frame and respond to risks and uncertainties associated with different areas of rapid scientific and technological advance - including pharmaceuticals, vaccines, crop biotechnology, and nanotechnology. These are all areas where rapid developments in science and technology are seen as key to economic growth, nationally and in the global economy. Yet, as new technologies are delivered in diverse settings, with different local needs and policy priorities, so a range of risks, uncertainties, ambiguities and indeed areas of ignorance arise. This project will explore the diverse ways that corporations, state agencies, scientific institutions, farmers and consumers understand and seek to respond to such incertitude, how their responses interact, and the implications for Sustainability. Through both focused case studies (e.g. of genetically-modified crops) and through a wider series of exchange visits and joint workshops between researchers and practitioners from India and the UK supported by a grant from the UK-India Education and Research Initiative, the project will seek to build a more deliberative and reflexive approach to considering different options for addressing uncertainties.

### **EPIDEMICS, LIVELIHOODS AND THE POLITICS OF POLICY**

Changing patterns of land use, interactions between humans, livestock and wildlife and new patterns of social behaviour have seen the emergence of a series of new infectious diseases that now threaten to reverse post-war progress towards improved global public health. While TB, HIV/AIDS and malaria receive the most policy attention, 'old' diseases of lower respiratory tract infection and diarrhoea remain the major killers, they are being joined by both new diseases such as SARS, avian 'flu and BSE, and modified versions of existing diseases.

Diseases emerge from changing landscape-livelihood interactions in relation to drug resistance, genetic changes in pathogens and zoonosis, as new farming practices, increased mobility and increasingly intensive food, water and social systems allow new evolutionary niches to form. Drawing on a series of cases, this project will focus on understanding these interactions and on stimulating reflection about procedures for addressing epidemics that support, rather than compromise, the livelihood needs of poorer people and wider principles of social justice. This will involve addressing the dynamics of epidemics, and how they are framed by different groups of scientists, policy-makers and the public. It will also consider institutional and governance issues, including the ways that panics and scares over epidemics are generated and dealt with, and the relationships between disease, political economy and security. The project aims to work with others to broaden and open debate about epidemics, including consideration, for instance, of the ways that citizens' own perspectives and popular epidemiology could become part of more deliberative, inclusive responses.

## **LINKING POLICY DEBATES, CUTTING ACROSS SECTORS, BUILDING PARTNERSHIPS**

Notably, each of these projects cuts across all of the STEPS Centre's themes and domains. If represented on figure 4, then, each would be a large 'splodge' across the centre of the matrix, rather than confined to any particular row, column or cell. Thus all five projects consider challenges for pathways to Sustainability that have several characteristics in common: they all cut across the conventional 'sectors' of agriculture, health and environment; they all have a local-global dimension; they all involve multiple institutions, and they all address contested policy areas in which a multiplicity of different knowledges prevails

These features underline that the STEPS Centre approach is not boxed-in by conventional boundaries between sectors, levels and disciplines. They also mean that, necessarily, the projects will be aiming to address and bring together a variety of actors and institutions, from diverse positions, backgrounds and areas of expertise. So, for example, in the crop, disease and innovation pathways in East Africa project, we will be working with the African Centre for Technology Studies in Kenya, but aiming also to engage with the African Livelihoods Unit of the international maize research organisation, CIMMYT, the United Nations Environment Programme (UNEP) Drylands Programme and medical researchers, such as those working at the Kenya Medical Research Institute (KEMRI).

## UNDERSTANDING, ENGAGING, COMMUNICATING AND INFLUENCING

Both through our projects and through wider events, publications, on-line fora and networks, the STEPS Centre will maintain a presence in each of its three domains: food and agriculture, health and disease and water and sanitation. Our work aims to engage with the existing research and policy debates in each of these sectors, helping to advance them by contributing both more dynamic perspectives, and insights from project case studies that link across domains.

In conclusion, we might ask - what is the knowledge that the STEPS Centre hopes to generate for, and who is it for? In a now much cited piece, Michael Burawoy suggests that there are four distinct types of sociology (for which one could read 'social science'), which would answer these questions in very different ways.

Figure 5: Division of social science labour (after Burawoy 2005)<sup>1</sup>

	Academic audience	Extra-academic audience
Instrumental knowledge	<b>Professional</b>	<b>Policy</b>
Reflexive knowledge	<b>Critical</b>	<b>Public</b>

One type of knowledge is for instrumental purposes, whether to solve puzzles for academic audiences (professional social science) or to solve problems for policy-makers and practitioners (policy social science). The other type of knowledge is concerned with reflexivity and dialogue about goals and values, whether focused on the foundations and directions of academic research (critical social science) or on trends in society and policy (public sociology). Most social science efforts colonise one category or another, while often erecting boundaries with the others - although at the same time Burawoy makes a plea for more mutual appreciation and more emphasis on the fourth category, of public sociology.

In contrast, the STEPS Centre consciously seeks to work in ways that occupy all four categories. We seek to do research that engages with academic audiences, both in untangling complex problems and engaging critically and reflexively with

<sup>1</sup> Burawoy, M., 2005 'Presidential address: For public sociology', *The British Journal of Sociology*, 56(2).



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the ways those problems are framed. We also seek to engage with policy-makers and practitioners, both instrumentally in offering practical recommendations for building pathways to Sustainability and designs for new tools and procedures. We also aim to work reflexively with diverse stakeholders to consider the framings, values, implications and shortfalls, both of current policy approaches and understandings and of alternatives.

## **JOIN THE DEBATE**

Pursuing such an agenda means that tensions between these different approaches will need to be addressed centrally as part of the Centre's own debates. These tensions are very real, yet, we suggest, there is no substitute for dealing with them head-on. On the one hand, they relate to wider epistemological distinctions between positivist and constructivist ways of understanding and engaging with the world. Here, by developing the systems framework outlined in this document - that combines both 'objective' and 'constructed' notions of dynamics and pathways - we hope the STEPS Centre will handle and work with this tension in productive ways.

On the other hand, tensions arise through the requirement to engage simultaneously with very different institutions and audiences in very different ways. Here, the Centre hopes to overcome these tensions and turn them to productive ends through a distinctive approach to communication. Our approach has several particular features: It embeds communication as part of the research process from the start; it seeks to engage partners, other researchers, policy-makers and practitioners as participants, rather than audiences; and it makes use of interactive and new media, as well as face-to-face events and documents, to generate dialogue amongst those with different perspectives. The result, we hope, will be a dynamic research-communication process involving interactions between multiple actors, which will include unintended outcomes and surprises - not unlike the dynamic systems in the 'real world' that the Centre is studying.

Above all, the research that the STEPS Centre is embarking on, and the approach it is taking, depends on involvement of people from diverse backgrounds, in diverse positions. If you are interested in such global challenges as the interactions between environmental change and poverty reduction, the regulation of new technologies or the health consequences of rapid urbanisation, we invite you to engage with us in this ambitious and exciting journey to understand and support pathways to Sustainability.

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## A BRIEF GLOSSARY OF TERMS AS USED BY THE STEPS CENTRE

(Bold terms are cross-referenced to their own individual definitions)

**dynamics:** the patterns of complexity, interaction (and associated **pathways**) observed in the behaviour over time of social, technological and environmental systems.

**governance:** political and institutional relationships, including those of power and knowledge

**designs:** the deliberate configurings of social appraisal and institutions through which we come to understand interactions between society, technology and environment.

**sustainability:** (in general usage): the general capability to maintain any unspecified feature of system structure or function over indefinite periods of time.

**Sustainability:** the capability of maintaining specified values of human wellbeing, social equity and environmental quality over indefinite periods of time.

**pathways:** the particular directions in which interacting social, technological and environmental systems co-evolve over time.

**reflexivity:** recognition that **framings** of a system are partly constituted by the observer's own circumstances and so are conditioned by (as well as inform) intended action.

**social appraisal:** social processes through which knowledges are gathered and produced to inform decision making and wider institutional commitments.

**incertitude:** a general state of knowledge, which may take the form of various combinations of more specific conditions of **risk, uncertainty, ambiguity** or **ignorance**.

**risk:** when possible outcomes have been well characterised and it is also possible confidently to determine the probabilities associated with each.

**uncertainty:** when possible outcomes have been well characterised, but there is little basis for assigning probabilities

**ambiguity:** due to divergent understandings in bounding, characterising or prioritising different possible outcomes.

**ignorance:** due both to **uncertainty** about probabilities and **ambiguity** over outcomes – in other words: exposure to the possibility of surprise.

**(system) environment** – those relevant parts of the external world which interact with a system

**(system) framing** – the different ways of understanding or representing a social, technological or natural **system** and its relevant **environment**

**(system) context** – a term referring collectively to the totality of framings of a given system and its associated **environments**

**(system) property** – a feature of a system or its behaviour, for instance in the face of shocks or stresses arising in its own evolution or that of its **environment** or **context**, including:

**resilience** : the ability to sustain structure or functional value despite short term episodic shocks in the system **environment** or **context**.

**robustness** –the ability to sustain structure or functional value despite long term enduring stress from system **environment** or changes in **context**.

**durability** –the ability to sustain structure or functional value despite long term enduring change due to the evolution of the system itself.

**stability** –the ability to sustain structure or functional value despite short term episodic shocks due to the dynamics of the system itself.

