



# Climate change: enhancing adaptive capacity

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Climate change threatens the already fragile livelihoods of many poor people. Helping poor people to strengthen their livelihoods, through research on strategies, institutions and technologies, improves their capacity to adapt.

## Key messages

- Helping poor people to strengthen their livelihoods improves their capacity to adapt to variability (the most urgent symptom of climate change). Climate change adaptation should be a specific area within development policy, with its own criterion – adaptive capacity – to measure success among vulnerable groups.
- The capabilities of poor people, rather than their vulnerability *per se*, provide a starting point for demand-led research for development that can moderate the negative effects of climate change, and empower them to take hold of opportunities. A new research strategy is needed to provide focused scientific and external support. This strategy should evolve beyond ‘more of the same’ to respond flexibly to new challenges.
- Five themes provide foundations for a new strategy for climate change adaptation research: further development of technologies for natural resource use under variable rainfall; strategies and decision-support tools for managing small-scale assets, including livestock; building local institutions and demand-led rural service provision; involving poor people in natural resource governance, planning and policy; and building social resilience through livelihood diversification.
- Significant knowledge gaps should be addressed, in: measuring the uptake of innovations more effectively; understanding the political–economic context of development in specific times and places; understanding how poor people can optimise new knowledge in a context of competing demands; incorporating economic drivers in models and in advice; taking forward the growing understanding of institutional issues; linking livelihood diversification strategies with natural resource management; and fulfilling the need for a strategy addressing longer term ecosystem change.
- A systems approach to climate change adaptation research is advocated for: combining action with research; building partnerships between research, development and policy; linking democratic accountability, governance, planning and natural resource management; identifying creative entry points in multi-sectoral livelihood systems; and combining risk reduction with productivity objectives.
- It is important to optimise the management of a diminishing natural resources sector. Robust, diversified livelihoods have good adaptive capacity (there are trade-offs with risky specialisation). Success in building livelihoods often correlates with access to non-farm options, and income may be transferred between the two sectors. Poor people therefore need to increase the income share derived off-farm and research should reflect a multi-sectoral standpoint.
- Links with regional partners (to ensure effective uptake) need to be defined and formed between climate change adaptation research and related activities, and between scales ranging from the local (where much of the research has been conducted) to the global (where policy debates are active and instruments such as conventions are formed).

## Summary

Climate change threatens to damage the ecosystems on which poor people depend, thereby impeding their livelihood strategies. Poor people’s adaptation to climate change is a major research theme for the UK’s Department for International Development (DFID). This Brief, based on a synthesis study of 105 projects completed under

the Renewable Natural Resources Research Strategy (RNRRS), proposes a new strategy for research on such adaptation that will both add value to the earlier research and evolve to address knowledge gaps and key questions. The strategy is based on five research themes. The first four focus on providing opportuni-

ties for poor people to strengthen their livelihoods through technologies, strategies and institutions in the natural resources sector, thereby improving their capacity to adapt to climate change. The fifth theme recognises the importance of non-farm options in diverse and resilient livelihoods. It is important to link climate change adaptation research with other activities within DFID, develop regional partnerships, and engage policy processes at all scales from local to global. A systems approach is advocated. Demand-led research that builds on peoples' capabilities rather than further analysing their vulnerability should be at the centre of a new framework for studying and supporting the adaptation process.

## Background

Climate change adds a new challenge to development efforts – that of enhancing the adaptive capacities of poor people. In many countries, increased short-term variability (in rainfall, for example) and/or long-term trends (such as rising sea levels) are damaging the ecosystems on which poor people depend, threatening their livelihoods.

Adaptation to climate change is a major theme in the newly configured research funding framework of the Central Research Department of DFID. This Brief is based on a synthesis study of 105 projects completed under the RNRRS, which ran from 1995 to 2006. The purpose of the RNRRS is to generate benefits for poor people by the application of new knowledge to natural resources systems. The present study aimed to extract new knowledge on poor peoples' capacities to adapt to climate change and variability in order to formulate research questions and guide policy priorities within or outside DFID.

Little of the RNRRS work explicitly addressed climate change because the RNRRS was set up before the emergence of climate change adaptation as a policy priority. Nonetheless, since such adaptation depends to a great extent on how successfully environmental variability can be managed, RNRRS work has added to scientific understanding of some key parameters, and has developed a range of technologies, models, decision support tools and management options that can be applied to future research on adaptation to climate change.

## Knowledge gaps

Some generic knowledge gaps emerged from the review. These provide pointers for a new research strategy for enhancing adaptive capacity.

- Uptake of new technologies tends to be measured by over-simplified indicators. Data collected before and after the promotion of a new technology, for example, does not necessarily measure impact on livelihood systems or adaptive capacity to climate change. Also, there has been no mechanism for monitoring the continuing use of technologies beyond the lifetime of a project.
- The local political economies that form the context in which new technologies are developed or introduced have not received enough attention, perhaps because most research groups were primarily interested in the biophysical aspects of natural resource management.
- Few projects have addressed the challenge of how to optimise the use of new knowledge within complex livelihood systems that are beset with competing demands on scarce resources; for example, modelling approaches tend to leave out social variables in order to simplify operation.
- Economic drivers of change have been underused in models and decision advice.
- Complex institutional issues, such as resource tenure, are too easily over-simplified in research and policy debates. The facilitation of institutional development, governance and management has only recently become a priority in natural resources research, and much work remains to be done in this area.
- In building robust livelihoods capable of withstanding climate change, the trade-off between diversification and risky specialisation needs more attention. So too do the best ways of managing a diminishing or degrading natural resources sector. Both these needs call for a broader systems framework than has been applied in most natural resources research. Territoriality (the exploitation of assets in different places) and mobility (between such places) are necessary elements in such a framework.
- A longer timeframe is needed to respond appropriately to cumulative ecosystem change than to manage variability in the weather, which resource users already do, even if sub-optimally. Building awareness of longer term risks associated with cumulative ecosystem change is difficult, partly because of scientific uncertainty. It is not clear whether the same adaptive capacity required for managing increased variability also offers the best hope of preparing for ecosystem change, or whether a different strategy is required.

## Foundations for a new research strategy

Adaptation to climate change should be a specific area of focus within development policy, with a criterion – adaptive capacity – for measuring success among vulnerable groups. There is scope for innovative theory and practice. What matters is the response of the system rather than of one or two of its components. The new strategy should embed DFID's concern for the poor within the UK's policy on climate change.

As a starting point, five thematic areas have been identified from the review of completed research. Each consists of a number of research lines, identified from related projects across the RNRRS programmes. Illustrative research lines are briefly summarised in Boxes 1–7.

### Technologies for supporting enhanced natural resource management under variable rainfall

These are: the development and promotion of better adapted crop varieties resistant to drought and to pests and diseases (Box 1); the improvement of crop–water use efficiency by means of seed priming; and community-based control of migrant pests (Box 2).

Besides offering better food security and/or enhanced incomes, such technologies can stabilise yields, reducing the costs of environmental variability. Farmer participation in plant breeding and selection

#### Box 1. Better adapted crop varieties

Identifying, evaluating and promoting pest- or disease-resistant crop varieties reduces risk, provided resource-poor farmers have reliable access to high-quality seed at low cost. In sub-Saharan Africa and South Asia, varieties of groundnut and pigeonpea have been released that combine disease and pest resistance with reduced risk from terminal drought (through short to medium maturation).

New methods of engaging farmers in participatory varietal selection and client-oriented breeding ensure local ownership and 'buy-in' of improved varieties. Examples are rice and mosaic-resistant cassava in Ghana, and millet, chickpea, maize and sorghum in India. The development of improved pearl millet varieties grown in Africa and India has been accelerated (in comparison with conventional breeding) by the use of molecular markers or molecular assisted selection in a laboratory.

*Based on research lines CPP-2, PSP-2, PSP-3*

#### Box 2. Community-based control of migrant pests

Weather-related migrant pest outbreaks may be affected by climate change either positively or negatively. Migrant pests (such as locusts) are capable of wiping out whole crops in a region, and poorer farmers are the most vulnerable to such losses. The forecasting and control of outbreaks can be strengthened by community participation, which enhances local capacity to respond to environmental variability and change. Providing better forecasts, building the capacity to react to them at the community level, and developing appropriate control technologies are the aims of work that is being carried out in southern Africa.

*Based on research line CPP-1*

for changing agro-ecological environments, fast and flexible breeding strategies, and effective promotion through appropriate institutions will be priorities.

### Strategies for managing livelihood assets under variable conditions, making use of formal or informal modelling

These approaches aim to support decision making at the individual or household levels. They include:

- Improved rainfall analysis and seasonal weather forecasts, enabling adjustments to be made in small-scale production systems
- Rainwater harvesting systems, applied by means of a process in which professionals interact directly with groups of farmers to optimise responses to their circumstances
- Modelling the livelihood strategies of small-scale, asset-poor livestock owners in order to support their management decisions (Box 3)
- Strategies for making the best use of grazing resources to feed mobile livestock herds in semi-arid environments
- Understanding and supporting income diversification strategies to buffer the livelihoods of fisherfolk against unpredictable movements of fish stocks (Box 4)
- Efficient use of scarce factors in agroforestry systems (especially moisture); related work offers a compendium of knowledge on tree species for planting on farms, in order to match species to particular conditions (including rainfall distribution).

### **Box 3. Asset strategies of small-scale livestock owners**

Livestock are assets that can be held in reserve against seasonal fluctuations, cash emergencies or investment requirements. The modelling of asset management decisions made by small-scale livestock keepers (feed allocation, dairying and breeding decisions) suggests that optimising these decisions improves liveweight, which may benefit reproduction. On the basis of work in Nepal, Bolivia and Mexico the model has been developed into a detailed methodology with a manual that practitioners and researchers can use in participatory work with local communities. Strengthening capacity at the household level to make wise decisions is very relevant to managing climatic variability in the longer term.

*Based on research line LPP-2a*

### **Box 4. Buffering fisherfolk against unpredictable movement of stocks**

In the course of work in Lake Malawi and off the shores of west Java, methods were developed for assessing and modelling species fluctuations, which are poorly predicted and can drastically affect livelihoods. This work has exposed the inadequacy of fishery regulations that ignore local knowledge and livelihood realities, and the inappropriateness of co-management policies that assume regular fluctuations in the fish populations. The appropriate strategy is to recognise that small-scale fisherfolk adapt flexibly and autonomously, by means of constant mobility between grounds, and by diversifying their livelihoods into non-fishing activities. Policies should not undermine these strategies. Production systems can be resilient to change, provided that flexibility is maintained. Rather than trying to enhance the productivity of one component of the system – fish stocks – a broader concept of maintaining ecosystem functions is needed, especially where climate is variable. The research aims to better inform such broad-based policies.

*Based on research line FMSP-1*

### **New approaches to local institutional development and rural service provision**

Rural institutions can easily be appropriated by the rural elites and fail to strengthen poor peoples' adaptive capacity. Three initiatives took different

routes towards empowering poor people to take more control of their circumstances and more effectively exert demand on rural service providers. These were:

1. Facilitating self-help groups through an informal and low-key methodology that has achieved rapid uptake and self-propagation (Box 5)
2. Using micro-credit provision to relax the poverty constraint that inhibits the improvement of farming systems and increased productivity
3. Providing access to information (knowledge banks) that really support poor peoples' livelihood objectives, rather than the information poor people are perceived as needing by experts.

### **Box 5. A 'dialectic approach' to rural institution building**

Advice to natural resource users in rural India has tended to be prescriptive, sectoral and supply driven. In contrast, a dialectic approach has recently been developed that uses tried and tested field methods of low key, informal entry to villages, with the aim of facilitating self-help groups (SHGs) without resorting to subsidies, project rewards or specific technological targets. The essential feature of this approach is that the locus of control is moved from external to local actors. The term refers to an interactive and iterative process that values unspectacular entry into villages, use of local volunteers, and incremental, non-deterministic facilitation, avoiding the use of distorting incentives. Participation in such a demand-led, informal process – across the range of stakeholder interests, caste or class, gender and poverty categories – strengthens and articulates the demand for service provision. Facilitation is withdrawn when the movement becomes autonomous. In the last 17 months, under a private sector programme, 1079 SHGs have formed in 320 villages in six eastern States. Mutual savings schemes and rotating loan schemes are reported to be worth £60,000 and £105,000 respectively. Marketing services have been provided, with expectations of health, education and rights services in future. The expectation is that such enhanced local capacity will benefit natural resource management and strengthen responses to environmental variability.

*Based on research line NRSP-3a*

These approaches are targeted towards the poor and aim to transfer demand from policy makers to natural resource users. Lessons will need to be learned to support efforts to scale them up. Although their potential goes beyond climate change adaptation, demand-led service provision will facilitate locally grown responses to risk and variability.

### Supporting poor peoples' participation and interests in natural resource management, governance, and policy

The research lines under this theme include:

- Development of a participatory, evidence-based planning and policy process involving the creation of a community knowledge bank, proactive local networks, and stakeholders' entry into policy formulation and review (Ghana)
- Setting up participatory management institutions that provide equitable access and benefit sharing in island waters (Caribbean)
- Integrated catchment management, using models of land use change to identify (or question) planning options and assess incentives for resource users (Box 6)

#### Box 6. Integrated catchment management

Projects on the management of upper catchments aimed to optimise water conservation and use under a range of rainfall conditions and land uses. Instrumentation, mathematical modelling and geographic information systems were used to produce more reliable predictions of the impact of vegetation (including forests) and land use on dry-season stream flows. Projects focused on: the effects of cloud forest on dry-season flows (Costa Rica); water policy, catchment management and poverty alleviation (South Africa, Tanzania and Grenada); sustainable catchment management strategies (India); and payment for environmental services (Costa Rica). Policy and strategies for adapting to climate change may include changes in land use, such as altering cropping patterns and areas under forest and irrigation. An important finding is that afforestation programmes may have negative impacts on soil water availability. Payments for environmental services may form an essential ingredient in incentive structures, especially under conditions of environmental change.

*Based on research line FRP-3*

- Using models to understand complex fish and rice production systems on floodplains (in South Asia) as a basis for strengthening local management institutions and the representation of stakeholders' interests
- Modelling the aquaculture carrying capacity of coastal waters (in Southeast Asia), with the aim of stabilising pressure on the resource base and thereby reducing system vulnerability (Box 7).

#### Box 7. Estimating aquaculture carrying capacity

Coastal regions of South and East Asia are densely populated and urbanised, and so are affected by land scarcity, deforestation and pollution. Aquaculture is an important source of food security and livelihoods. The carrying capacity of this sector is determined by the ability of the environment to absorb wastes from aquaculture enterprises. Over-production leads to loss of water quality and yield failure. The costs of maintaining water quality on-farm, or the loss of resources (especially mangroves) for dispersing waste off-farm, may threaten economic viability.

The research aimed to develop simple models of carrying capacity, together with a set of practical guidelines, for use by farmers and policy makers as management tools. When developed and tested, the tools will make aquaculture less vulnerable to the effects of climate change.

*Based on research line AFGRP-2*

Such approaches, even when initially developed for use by planners only, can improve the quality of decision making and provide a basis for democratic participation. More work is necessary to validate them and/or to strengthen their participatory components. But there is a growing body of evidence that the judicious use of research-based methods can prevent the poor from losing out and enable them to participate in demand-led and locally appropriate responses.

#### Building resilience in poor peoples' livelihoods through diversification

Approaches noted under this theme are:

- Under semi-arid conditions, where variability is a threat to asset accumulation, flexibility both within and beyond the natural resource sector is

required and research has pointed to appropriate forms of policy support (Box 8)

- In peri-urban areas, where city spread intensifies the competition for land and other natural resources, efforts to increase access to non-farm activities have revealed adaptation pathways that may also have value under climate change
- In rural areas, technical research has shown how crop–livestock integration, on-farm tree planting and aquaculture can add value to rain-fed farming systems
- Payments for environmental services, including carbon sequestration, not only provide an incentive to mitigate climate change but also a diversification strategy that can help protect resource users exposed to it.

Diversification off-farm has been neglected in natural resources research. The emergence of risk reduction and climate change adaptation as devel-

opment priorities strengthens the case for a broader based systems approach to natural resources research that would move beyond the exploration of technical options to take into account such factors as the entry barriers, cost–benefit ratios, trade-offs and constraints affecting diversification strategies within and outside the natural resources sector. As success in building livelihoods is often associated with access to non-farm options, a case can be made for policies designed to increase the income share that poor people derive off-farm.

### Linking climate change adaptation with other research

In developing research on adaptation to climate change as a contribution to development policy, it is important to avoid fragmentation. The RNRRS knowledge on climate change adaptation, as summarised in the strategy outlined above, is not only relevant to DFID's Climate Change research theme but also to three programmes included in the new agriculture research strategy: Getting Agricultural Research Into Use; Sustainable Agriculture in Africa and Other Rain-Fed Regions; and possibly that proposed with the UK Science Research Councils. It may also be relevant to risk-screening in policy development work under National Adaptation Plans of Action to climate change. This will need a process of consultation, participation and oversight to ensure that adaptation receives enough emphasis within the broader development agenda.

DFID intends to devolve more research commissioning to the regions. This is appropriate for research on adaptation to climate change, since climate change will take regionally specific forms and adaptation research needs to be tailored to them. The knowledge gaps and thematic areas listed above offer a framework for deciding on regional priorities and how research should relate to national and regional institutions. Partnerships and collaboration with international research organisations as well as governments will evolve within this regional framework. The legacy of the RNRRS is a significant resource in the public domain which can help take adaptation research forward in the global context of international climate change initiatives. DFID will need scientific capacity in its regional offices if it is to realise this potential.

Much of the work of RNRRS is location- and time-specific. Effective links between scales are needed if such research is to contribute to issues that are being treated at higher levels of generality, such as

#### Box 8. Enabling of natural resource based livelihoods in semi-arid areas

Semi-arid areas of Africa are already subject to low and variable rainfall and due to climate change may experience increased risk (more droughts), overlaid on already low biological productivity and (in some areas) dense rural populations. Livelihood diversification, based on using resources in scattered locations and mobility between these, is historically deep-rooted in many areas, especially in the Sahel. Colonial occupation, urbanisation, commercialisation, human population growth and the expansion of cropping have combined with the growth in livestock numbers to create new pressures on natural resources. Research has opened up a rich variety of indigenous and local responses to these contemporary challenges, but has not settled the question of the long-term viability of livelihood systems. The most successful households are often those most deeply involved in the non-farm sector, and poorer people wish to emulate them. Investment is risky in semi-arid areas and this influences patterns of asset management in both the farm and non-farm sectors. Policy is not yet adequately informed about the dynamics of semi-arid resource management. Some research, however, has shown that enabling policy is the prime facilitator of livelihood improvement. This should focus on market access and on creating more opportunities for income diversification by removing barriers to trade.

*Based on research line NRSP-7*

global adaptation to climate change or the advocacy of agriculture as a development priority. It will also be necessary to ensure that local research findings are fed into higher level policy initiatives such as the development of poverty reduction strategy papers, and linked to the achievement of the Millennium Development Goals 1 and 9.

### **Maintaining a systems approach**

New research based on the RNRRS platform needs to find entry points that will help upgrade livelihood systems by enhancing poor people's incentives, options, access to resources, knowledge and security under uncertainty. Innovative and integrative approaches are needed with regard to:

- Combining action with research
- Building regional partnerships between research, development and policy
- Linking democratic accountability, governance, planning and natural resource management
- Identifying creative entry points in multi-sectoral livelihood systems and
- Combining risk reduction with productivity objectives ('win-win' solutions).

This will call for flexibility in institutional arrangements. Among the RNRRS programmes, the Natural Resources Systems Programme has consistently adopted systems approaches, though with variable degrees of success, and its experience in this regard should be evaluated and lessons derived for future practice. Flexible systems research may also call for a review of funding structures by donors – for example, is open competitive bidding the best option where a process of partnership-based learning is needed in response to an ever-changing environment?

### **Making best use of science**

Reliance on diagnostic approaches to natural resource management has led to overly prescriptive solutions and overestimation of the capacity of planners and policy makers to lay down pathways out of poverty that can actually be trodden by poor people. It is too easy to map, measure and analyse vulnerability in terms of constraints to which solutions are sought externally. Internal knowledge, institutions and responsiveness to incentives have often been undervalued as development tools, and poor peoples' capabilities dismissed. But a new partnership between science and the poor is now being sought in development. The direction of this change is towards demand-led rather than supply-led development, serviced by new roles for research.

This study has concluded that some research directions originating before climate change became a priority have the potential to deliver adaptive capacity. However, 'more of the same' will not be enough and natural resources research needs to evolve if it is to fully address the need exposed by climate change.

Demand-led research needs to be extended beyond the natural resources sector to embrace diversification options, whose importance as a buffer against risk or as an opportunity for enrichment is increasing (regardless of climate change). Many such options entail mobility on the part of individuals, whose decisions reflect a constant balancing of conflicting or complementary responsibilities. Mobility will be one of the great strengths of poor people as they seek to adapt to climate change – but it may also prove disruptive, heightening competition for scarce resources and conflict.

Demand is only effective as a motor for development research when complemented by an inward flow of knowledge, extending the technical, management or institutional options available to resource users. In the past, such knowledge has come from autonomous exchange, experimentation and adaptation as well as from centralised promotion. Under climate change, whose impact is not reliably predictable, it is not clear how far local demand can go in anticipating the need for research-based services. Neither can the adaptive capacity of future production systems be predicted. Narrowing these gaps should be a priority for climate change adaptation research.

Meanwhile, it can be said that the potential of new approaches to the rational management of natural resources, based on the RNRRS platform, has run ahead of capacity to insert innovations into livelihood systems on a scale sufficient to have a major impact on climate change adaptation. The need for adaptation has exposed a gap in the area of change, risk and uncertainty management. A new framework for analysing and supporting the process of adaptation is needed. It should embrace demand-led rather than supply-led research, integrate research with action at the local level, build on peoples' current capabilities, and combine these with the forms of external support that will be needed to introduce people to new livelihood options. Local partnerships between natural resource users, researchers, extensionists and other development workers should be the driving force in implementing the new framework. The challenge facing DFID, like other development agencies, is how

to develop such partnerships and link them with global knowledge systems. The RNRRS legacy, with its rich bank of site-specific knowledge on natural resources management, provides an appropriate starting point.

### About this brief

NRSP Briefs present research carried out at the culmination of the programme to synthesise results across projects. They derive lessons and key messages that could benefit future research and policy on a range of topics that added to or crosscut the NRSP and RNRRS research agenda.

This Brief is based on **NRSP Project R8496 Synthesis of RNRRS knowledge on adaptive capacity to climate change**. Details of this project and its publications, and those of other NRSP projects, can be found in the Project Database at the NRSP website: [www.nrsp.org.uk](http://www.nrsp.org.uk).

Details of the other RNRRS programmes on which the illustrative research lines in Boxes 1–7 are based can be found at:

AFGRP – Aquaculture and Fish Genetics Research Programme  
[www.dfid.stir.ac.uk/afgrp](http://www.dfid.stir.ac.uk/afgrp)

CPP – Crop Protection Programme  
[www.cpp.uk.com](http://www.cpp.uk.com)

FMSP – Fisheries Management Science Programme  
[www.fmsp.org.uk](http://www.fmsp.org.uk)

FRP – Forestry Research Programme  
[www.frp.uk.com](http://www.frp.uk.com)

LPP – Livestock Production Programme  
[www.lpp.uk.com](http://www.lpp.uk.com)

PSP – Plant Sciences Programme  
[www.dfid-psp.org](http://www.dfid-psp.org)

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### Other NRSP Briefs

The peri-urban interface: intervening to improve livelihoods

Linking research, policy and livelihoods: challenges and contradictions

Common pool resources: management for equitable and sustainable use

Communication in research uptake promotion (*forthcoming*)

Gender sensitive research in natural resources management (*forthcoming*)



The **Natural Resources Systems Programme (NRSP)** is one of ten programmes comprising the Renewable Natural Resources Research Strategy (RNRRS) of the UK Department for International Development (DFID). The RNRRS started in 1995 and ends in 2006. NRSP's purpose is the delivery of new knowledge that can enable poor people who are largely dependent on the natural resource base to improve their livelihoods. To achieve this NRSP undertakes research on the integrated management of natural resources. This research encompasses the social, economic, institutional and biophysical factors that influence people's ability to both use and maintain the productive potential of the natural resource base over a relatively long timeframe. The intended outcome of the research is that natural resource related strategies for improving people's livelihoods, that are of proven relevance to poor people, will be delivered in forms that could be taken up by the poor themselves and/or by development practitioners operating at a range of levels, from grassroots to senior policy level.

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This document presents research funded by the UK Department for International Development (DFID) for the benefit of developing countries. The views expressed are not necessarily those of DFID.