Overseas Development Institute

Climate Change: Implications for DFID's Agriculture Policy

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Background and Acknowledgements

Over the last few years, our understanding and certainty about how the climate is changing and the possible impacts this could have has grown hugely. In response there are increasing efforts to 'mainstream' what we know about these impacts into development policy and planning processes. Given the fundamental links between agriculture and poverty reduction and agriculture's dependence on the climate, understanding in more detail about linkages between agricultural policies and climate change is important and urgent.

This paper is one of a series of five outputs produced under a small project for the Renewable Natural Resources and Agriculture Team of the UK Department for International Development (DFID). The objective of the project was to identify the implications of climate change for key areas of DFID's Agricultural Policy and the Renewable Natural Resources and Agriculture (RNRA) Team portfolio and to produce a series of practical outputs to assist the RNRA team in programme implementation and communication.

The five papers are as follows:

1. A rough guide to climate change and agriculture
2. Climate change: Implications for DFID's Agricultural policy
3. Climate change, agricultural growth and poverty reduction
4. Climate change and agriculture: Agricultural trade, markets and investment
5. Access to assets: Implications of climate change for land and water policies and management

The papers are written by a team of researchers from ODI's Rural Policy and Governance and International Economic Development Groups. The authors are grateful to DFID for their funding of this project. The arguments presented in the papers are those of the authors and do not necessarily reflect the policy position of DFID.

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Acronyms

DFID	UK's Department for International Development
FAO	Food and Agriculture Organisation of the United Nations
MDG	Millennium Development Goals
RNRA	DFID's Renewable Natural Resources and Agriculture team

1. Summary

An analysis of a number of different climate change impact scenarios and possible effects on agriculture suggest that the principles and priorities of the UK Department for International Development (DFID) Policy Paper – *Growth and Poverty Reduction: The role of Agriculture* – appear robust in the face of climate change. Uncertainty about climate change means that agricultural strategies and programmes need to be flexible and adaptable to new circumstances. Programmes emerging from the policy largely satisfy these conditions – many are explicitly designed to tackle risk and help farmers deal with uncertainty. Achieving the implementation of the policy paper within the next 20 years – before the most severe impacts of climate change kick in – is also fundamental so that poor countries to have stronger agriculture sectors and more resilient rural households.

2. Introduction

Governments and their aid agencies have only recently begun to take climate change seriously as a policy issue, however, it is now rising rapidly up the agenda of aid agencies, including DFID.

The impacts of climate change on poverty and the achievement of the Millennium Development Goals (MDG) raises critical questions for various parts of DFID about how well 'climate-proofed' their policies and programmes are. The DFID Renewable Natural Resources and Agriculture Team (hereafter RNRA Team) located in Policy Division has recently published a policy paper articulating DFID's vision for the role of agriculture in growth and poverty reduction. The paper identifies climate change as a critical physical challenge to increasing productivity in agriculture and notes that:

> *Existing climatic variability is likely to be exacerbated by longer-term climate change. Although its impact is hard to quantify, climate change is likely to increase the unreliability of farming systems, particularly in rain-fed areas* (DFID 2005, p. 11).

Beyond this, references to climate change are relatively scarce. Policy papers cannot deal with every issue relating to agriculture in great depth and the approach of the paper has been to focus on the ways in which agriculture can contribute to growth and subsequent poverty reduction. Climate change is viewed as one of a set of challenges that increases the vulnerability context in which agricultural activity takes place. Other sources of vulnerability include limited potential for irrigation in Africa, degradation of the natural resource base, low population density and therefore small markets in Africa, poor transport infrastructure, HIV/AIDS and the changing and, arguably, more difficult market conditions in which farmers exchange produce.

However, as climate change moves up the policy agenda, there is a need now to consider how climate change will affect agricultural production and growth, and what, therefore, the implications for the DFID RNRA Team policies and programmes are. In order to support the RNRA Team in its assessment of how well the logic and arguments of the policy paper hold up – given the likely future impacts of climate change on agriculture – ODI has been contracted to produce a set of five outputs. The first of these outputs is a rough guide to the impacts of climate change on agriculture which considers different scenarios for climate change and shows what the effects will be on yields, production systems and trade at various timescales. This paper is the second of these outputs and aims to directly assess how well 'climate-proofed' the RNRA Team Policy Paper is. The final three outputs focus in more depth on the implications of climate change for: i) **agricultural growth and poverty reduction**; ii) **agricultural markets, trade and investment**; and iii) **access to agricultural assets**.

The companion paper to this output[1] presents in greater detail what the impacts of climate change are likely to be on agriculture. Four particular issues are most important and will be used to structure our approach to this output:

a) The only thing that is certain about the impact of climate change on agriculture is increased uncertainty / variability;

b) There are opportunities for some countries to increases their production, but mainly for those in temperate zones;

c) All scenarios show declining yields in Africa but the level and rate of decline is different for each scenario; and

d) The scenarios show relatively similar impacts on agriculture in the next 1-2 decades.

In this paper, these four issues will be used (in a slightly different order) to structure our analysis of the RNRA Team Policy Paper. We will analyse:

i) how the ***challenges*** to increasing productivity identified in the policy paper will be affected by climate change;

ii) whether the ***principles*** still hold up when the physical challenges to increasing productivity become significant greater; and

iii) how far the **priorities** identified in the paper respond to the uncertainty around climate change i.e. how flexible and adaptable are the priority activities and programmes;

iv) what **opportunities** exist for some countries/regions that will enable agriculture to grow, and how far can this growth contribute to poverty reduction – are there potential 'winners' from climate change that donors can back?, and;

v) how far do the **timeframes** for the implementation/delivery of the actions identified in the policy paper correspond with the likely timescales over which the different impacts of climate change will be felt i.e. can the policy paper enable farmers and the agricultural sector to be better prepared for and more resilient to climate change?

[1] *Output 1: Rough Guide to Climate Change and Agriculture* paper submitted to DFID RNRA Team 23/03/07.

3. Challenges to increasing agricultural productivity

The main storyline of the policy paper is that increasing productivity is a critical step in achieving economic growth and poverty reduction. A number of challenges – some old and some new/emerging – need to be overcome in order to enable farmers to make productivity gains. Box 3.1 shows the main challenges to increasing agricultural productivity and suggests what the impact of climate change is likely to be on these challenges.

Box 3.1: Impact of climate change on challenges to increasing productivity in agriculture

Challenge	Impact of Climate Change
Natural resources: • In semi-arid and arid developing world, precipitation highly variable • Irrigation: Water critical to increasing productivity in Asia but opportunities are far more limited in Africa, where agriculture will rely heavily on rain-fed systems in the future. • Degradation of the natural resource base	• Under every climate change scenario, variability of precipitation will increase • Competition for water will increase further, particularly between productive agriculture utilisation and domestic/non-agricultural use. Agriculture will have to use less water and/or irrigate far more efficiently. • Degradation will increase especially in Africa
Population: • Agricultural development is limited where have low population densities and small markets • HIV/AIDS reducing agricultural productivity in agriculture (Slater and Wiggins, 2005)	• Increased migration and changing population densities in different parts of the world – changing markets • Adaptation hindered as coping/adaptive strategies and local knowledge not passed between generations
Transportation / infrastructure: • Poor transport infrastructure limits market access for many farmers (Dorward and Kydd, 2003) • Transport costs account for high proportion of export costs in many African countries (von Braun *et al* 2002)	• Infrastructure threatened by disasters e.g. floods. • Transport costs likely to rise as a result of (shipping and airfreight) mitigation measures – implications for global and local competitiveness
Commodity prices: • Commodity prices have fallen steady since the 1960s (UNCTAD 2003) • Volatility of input and output prices discourages investment in increasing productivity (World Bank 2006)	• Global prices for commodities may increase but there will be significant inter-regional differences • Volatility of prices will increase under climate change scenarios
Access to markets: • Product standards imposed by supermarkets are a barrier to market entry by small producers (Page and Slater 2003) • High value cash crops (e.g. horticulture and floriculture) provide opportunities for growth though small farmers receive small share of market value	• Phytosanitary standards may increase due to concerns about new disease corridors resulting from climate change • Changing consumption patterns and increased transport costs reduce access to supermarkets in developed countries
Agriculture growth linkages:	

• Links between agriculture and wider growth may not be as strong today as during the Green Revolution (Ellis *et al* 2000)	• Increased costs of global shipping and changing consumer demands regarding food miles may stimulate local diversification and linkages
Role of the state: • In many developing countries, fiscal unsustainability has forced states to reduce/withdraw support to agriculture and the private sector has only rarely been successful in its place. • Public expenditure on agriculture has fallen over the last 3-4 decades, especially in research (e.g. Fan *et al* 2004)	• Climate change suggests an increased role for the state to ensure successful adaptation and mitigation but whether this will result in a rejuvenation of Ministries of Agriculture or the same kinds of programme is not clear • Different and increased public expenditure in agriculture is required under climate change scenarios

In most cases, the effect of climate change is to further reinforce the challenge to increasing productivity. Thus, climatic variation, natural resource degradation, water shortages, commodity price volatility and transport costs will all increase under the climate change scenarios. In a smaller number of cases, the impact of climate change may be to reverse current trends. For example, given falls in yields, global commodity prices may increase. Prices in Africa are also set to rise. Similarly, public expenditures for agriculture may also increase as governments attempt to enable farming households to adapt.[2]

There remain many unknowns regarding the impact of climate change, particularly at country level. In the next section, we turn to the broader principles outlined in the policy paper and consider how whether these remain appropriate given what we do know about climate change. Where possible we draw on examples of RNRA Team programmes or focus countries to illustrate the policy implications in more detail.

[2] The implications of climate change on public expenditure by governments and donors, including the options for funding these expenditures through mitigation funds, are considered in output 3.ii.

4. Principles for Agricultural Development Strategies in the context of Climate Change

Box 4.1 shows the main arguments set out by DFID in the policy paper.

4.1. Match the prevailing stage of development and the nature of poverty

The policy paper argues that for the poorest countries in the earliest stages of development, efforts to increase agricultural productivity are critical and should focus on accelerating growth in labour-intensive agriculture and overcoming market failures. It also argues for a significant state role for the state and public investments that prioritise agriculture, particularly small farms.

Climate change raises two challenges for the arguments in the policy paper, with subsequent implications for DFID policy and programming.

Challenge 1: We do not yet know whether a focus on labour-intensive agriculture on small farms will be the best route for poverty reduction under a different climate scenario. There are good reasons to suggest that small farmers, on account of their lower capital requirements, small size and access to a flexible (family) labour force will be better at adaptation than larger capital-intensive farms. However, if adaptation requires significant capital, unless this is provided by the state, larger farms are likely to be more able to adapt.

Challenge 2: By extension, climate change is likely to result in an important role for state support to agriculture. However, with ministries of agriculture in many developing countries remaining under-funded and/or spending is focused on programmes that do not reach poor people (for example the Fertiliser Support Programme in Zambia costs about 80% of the Ministry of Agriculture budget but reaches a very small proportion of poor farmers (Goverah *et al* 2007)), it is not clear how ministries of agriculture will deliver support to agriculture that protects farmers from the negative impacts of climate change and takes advantage of new opportunities to enable growth. A commitment to increased spending and technical assistance by donors to help the response to climate change could potentially revitalise ministries of agriculture. Conversely, it could lead to similar fiscally unsustainable, inefficient parastatals and protectionist policies that were seen in the 1960s and 1970s.

These challenges have implications for the focus of DFIDs work:

Implication 1: As the main current challenge to small farmers in low-income countries stems from the risks associated with uncertain outputs, volatile output prices and a lack of inputs and finance, the focus of DFID on making markets work better to eradicate these market-based risks is critical. Efforts to overcome market failures and making markets work better for small farm producers should be a priority.

Implication 2: Climate change implies a return to a higher level of state support to agriculture but it is not clear how this will be delivered. Current work by DFID, for example public expenditure reviews, could help DFID develop models of ministry of

agriculture programming and spending that are most likely to enable agriculture to be more resilient/adaptive to the impacts of climate change.

Box 4.1: Guiding Principles for Agricultural Development Strategies

- *Reflect the stage of a country's development*. Increasing agricultural productivity is most critical in the poorest countries in the earliest stages of development. In these countries, it is justifiable for the government to give a clear priority to agriculture when investing public money and play a proactive role in stimulating and facilitating agricultural development (particularly overcoming market failure) so that they get on to the pathway to more diversified and faster economic growth;
- *Give priority to agricultural development in places where significant productivity gains are possible and the potential links to the wider economy are strongest;*
- *Give priority to strategies designed to overcome the most significant obstacles increased productivity and employment*. For many of the poorest countries this may mean focusing on small-scale, labour-intensive farming. Increasing employment opportunities for poor people will have a direct impact on poverty, but it also generates additional spending which supports growth outside agriculture;
- *Focus on demand and market opportunities*. For large parts of Africa the domestic food market is the largest and most rapidly growing source of demand for agriculture. Elsewhere, where countries or regions are self-sufficient in basic goods, the focus will need to switch to higher value agricultural crops which have greater market potential;
- *Make social protection complementary to agricultural growth*. Social protection programmes (such as cash benefits and welfare) are vital for ensuring a minimum level of well-being and social security for the chronically poor and vulnerable. Well-targeted and timed social protection programmes can support agricultural growth prospects and help people to be more comfortable with taking risks and to cope with unexpected events. New approaches to social protection, including targeted cash benefits that can assist agricultural growth by stimulating local markets; and
- *Ensure the sustainable use of the main productive resources* such as land and water and minimise any adverse impact of increasing productivity on the environment

(DFID 2005)

4.2. Focus on places where significant productivity gains are possible and the potential linkages to the wider economy are strongest

Over the next half a century or so, the places where significant productivity gains are possible and where the potential linkages to the wider economy are strongest are set to change. The policy paper suggests that greater productivity gains are more likely in Africa in comparison to India or China. However, under most scenarios, yields will fall in Africa but increase in more temperate parts of the world – including China.

This has significant implications for poverty reduction. Whilst it may mean that any progress towards the MDGs at a global level will be protected – because China accounts for the majority of people who have moved out of poverty in the last decade and economic opportunities in agriculture are likely to emerge in China as a result of climate change – the limited/stagnating progress made towards poverty reduction in Africa will be further eroded. Climate change will result in a pattern of increased global inequality (unless there are changes in immigration law that enable mass migration to areas with great productive potential).

These findings pose what is probably the most difficult question for the RNRA Team that emerges from an analysis of climate change impacts. In pursuing the principle of focusing on places where significant productivity gains are possible, the aim of the paper was to ensure that investments in agriculture are productive and contribute to growth and are not simply a way of maintaining a (poor but sometimes idealised) rural peasantry. However, climate change may force a reconsideration of this position. Under climate change scenarios, there may be very pressing reasons to use support agricultural production as a form of social security – a means of maintaining a rural population in situ, of preventing mass rural/urban or international migration – rather than using agriculture as a tool for growth and poverty reduction. Some ideas about how the RNRA Team might respond to this challenge are presented in the section on timelines and timescales.

4.3. Address the most significant constraints to increased productivity and employment

This principle focuses on the strategic advantages that small farms can have over other production systems. They are no less technically efficient than larger farms but in practice they are frequently less efficient in resource allocation because they do not have access to information that enables them to respond to market/price signals.[3] In the course of development, there is a general shift as the advantages of 'smallness' are gradually outweighed by the benefits of 'largeness'.

The critical question is how will climate change affect these advantages? In Section 2, it was noted that we do not yet know what the advantages of 'smallness' and 'largeness' will be under different climate change scenarios. Will technical efficiency – i.e. the capacity to use existing resources and inputs to make them as productive as possible – be the most important issue in production? Or will it be more important to be more efficient with resource allocation and respond more quickly to changing conditions, especially prices? How much capital investment will be required? The implications presented in that previous sector hold true here – getting markets working is critical –

[3] For an explanation of technical and allocative efficiency see Maxwell and Slater (2004) or Ellis (1993).

and again, issues emerge relating to the timeline over which the policy paper is implemented which are discussed in the later section.

4.4. Build on market opportunities

In papers 1 and 4 of this series, the focus is on the impacts of climate change on cereals crops and markets because they are critical markets for the labour-intensive small farm producers and are the focus of many of the priorities outlined in the policy paper. But, as the policy paper suggests, other commodities and production systems can also be important. The paper shows how commodity prices, for example for tea, coffee and cocoa have been declining for decades and that new markets, for example floriculture and horticulture can quickly become saturated, and prices for these commodities will rise under the different climate change scenarios. Does this present a new opportunity for poor farmers? Any potential gains need to be considered alongside the likelihood that consumer demands for products with low food miles are likely to increase whilst demand in Europe for horticultural products from sub-Saharan Africa will probably fall. How far these ethical consumption patterns – buying local – will be offset by demand for fair-trade products from the tropics is not known.

A second challenge to building on market opportunities relates to changing production and consumption of cereals. The FAO estimates that, by 2030, agricultural trade surpluses in the developing world will become deficits (FAO 2002. Also see de Haen *et al* 2004 for further explanation). Under most climate change scenarios this trend will be exacerbated by reduced yields in the tropics. Whilst the policy paper identifies domestic and regional markets as the most important for developing countries (Diao and Hazell, 2004), the capacity of producers to meet the domestic and regional demand may be threatened by falling yields.

4.5. Ensure complementarities with social protection strategies[4]

There is significant interest in the importance of social protection given the increased vulnerability resulting from climate change. However, at present, much of this interest focuses on disaster risk reduction and responses – for example supporting households in Zambia to deal with and recover from the current flooding. But *ex ante* social protection is also critical for helping households cope with climate change. Ensuring that risk management policies, particularly new approaches for insuring against risk, are joined up with agricultural policies, are even more important in the context of climate change.

[4] This issue will be the subject of another paper for DFID so it is given less attention here than other principles

4.6. Ensure sustainability

With the focus of the policy paper on growth, issues of sustainability receive relatively little attention. There is likely to be pressure on DFID to strengthen or add to this part of the policy paper. The paper currently focuses on three challenges for sustainability – reduction in land, increasing water shortage and decreasing diversity. In many developing countries, these problems will be exacerbated by climate change.

The paper focuses on land whilst water policy receives more fleeting attention as it has been dealt with in a DFID target strategy paper which focused mainly on water for non-agriculture uses. However, we are now are likely to see a much greater focus on the use of water for agriculture. Agriculture is largest user of water in the world but is relatively inefficient. In the future, there will be increased competition with other users. Agriculture will have to use less water and/or use it more efficiently.

The sustainability principle also focuses on food security policies and food supply. It notes that, at current production levels and given projections for population growth and productivity gains, the majority view is that there will be enough food produced in the world in 2025 to feed the estimated 8 billion people. Soil and water management will be critical to achieving these outputs and even more so given the threats to yields, particularly in Africa, under various climate change scenarios. Some further thinking about how to incorporate mitigation issues into the policy paper is also important since agriculture releases such a large proportion of global emissions.[5]

[5] The relationship between increasing agricultural production, changing production systems and the mitigation of climate change will be discussed in more detail on Output 3.i *Climate Change, Agriculture Growth and Poverty Reduction*

5. Conclusion - Flexibility and timescales for responding to climate change

Two features of the findings of Output 1 in this set of papers are of critical importance for 'climate-proofing' the DFID policy paper – uncertainty and timescales of impact. Climate change has crept up on us and its impacts will be felt increasingly over time. Many scenarios show relatively small impacts of climate change for the next few decades but much more serious impacts 50 or 80 years from now. We suggest that much, if not all, of the policy paper principles and priorities (Box 4.1) will remain intact/appropriate for the next few decades but some principles and priorities will require revisions and others may become increasing irrelevant, problematic or even misguided over a longer timeframe – for example, we don't know whether small farms will still be economically efficient 50 years from now.

In 20 years time, conditions may have changed to such an extent that DFIDs agricultural policy may need to look very different indeed. What do these features mean for DFID current policy and programming in agriculture? We have two conclusions:

Ensure that agricultural strategies and programmes are designed to deal with the uncertainty of climate change

Whilst we know some things with certainty about climate change, there are many more impacts of which we are uncertain. One of the few things we can be certain of is the increased uncertainty in agriculture, due to the impact of climate change. This suggests the need for programming priorities in agricultural strategies that are able to respond to changing circumstances as they emerge. For example, as more information about more localised impacts of climate change is analysed, there need to be opportunities to feed these impacts into existing policies. Agricultural strategies need, therefore, to be flexible.

A brief review of the existing programmes in the RNRA Team suggests that many programmatic activities are flexible and sensitive to changing physical and policy conditions under climate change – especially policies relating to adaptation but less so for mitigation. For example, programmes conducted in partnership with the World Bank on land administration move beyond static land reform programming to focus on flexible approaches to land tenure. Given changing land availability and future migration under climate change, a responsive land administration system will be critical to continue agricultural investment and growth. The programme on input and output markets in Africa focuses on reducing or mitigating the impact of uncertainty in markets and is also well placed to help identify mechanisms that can manage the increased production and price volatility likely to result from climate change.[6] Similarly, the programme on *Linking Agricultural Growth and Social Protection Policies* can also take account of the changing

[6] A question is likely to emerge in the future regarding just how much uncertainty agriculture can 'take' before it becomes economically unviable.

vulnerability context that poor households face. Public expenditure review work might be adapted to consider both current and prospective public expenditure impacts under different climate change scenarios.

However, additional programme priorities are likely to emerge. The most important of these goes a step beyond prospective public expenditure analysis and requires a revisiting of the states versus markets debates in agriculture. We need urgently to know more about options and strategies for increasing capacity and funding in ministries of agriculture (and partner ministries) so that they can respond to climate change in a timely and effective manner. For example, in the short timeframe in which this work took place we have not been able to analyse the extent to which different mechanisms for delivering new agricultural technologies to aid adaptation might require a reconfiguring of current public and private sector partnerships, standards systems and trade rules.

Achieving the implementation of the policy paper in a short time frame – within the next 20 years before the most severe impacts of climate change kick in – is fundamental *("Get agriculture working before it is too late")*.

There are three main reasons for this.

First, in places where climate change will mean new markets and productive opportunities, increasing productivity now and making small farmers more efficient and able to respond to opportunities will enable them to adapt their resources and production to take advantage of climate change.

Secondly, climate change impacts and their implications for production trade suggest that there may be a limited short-term window of opportunity for specific activities in the agricultural sector (for example making the most of regional and domestic grain trade opportunities whilst they still exist).

Finally, and most importantly, countries that have both diversified economies and strong agricultural sectors will fare better under climate change scenarios. Thus, efforts for the next few decades should be focused on investing in countries in the earliest stages of development. Getting markets working, putting complementary social protection in place; and making technology and extension work effectively will both stimulate wider economic growth so countries are not solely dependent on agriculture and will simultaneously enable the agriculture sector and agricultural livelihoods to be more resilient to the negative impacts of climate change.

Box 5.1: Priority areas for efforts to accelerate agricultural growth and appropriateness under climate change scenarios

Priority areas for efforts to accelerate agricultural growth	Appropriateness of priority under climate change scenarios / flexibility of programme
• *Create policies that support agriculture*. In many developing countries agriculture has been hurt by overvalued exchange rates, high export taxes and policies that have kept prices low to benefit consumers. Many countries have changed their policies to address these issues, but elsewhere progress on reducing their effect still needs to be made;	• Under climate change scenarios, state roles may need to go beyond tight fiscal and macro-economic management but the balance between current state roles such as regulation, standards and creating the enabling environment for growth versus protecting agriculture / prices / consumers in the face of climate change is not well understood.
• *Target public spending more effectively*. Strategic public investment in agriculture – particularly in roads, irrigation and agricultural research – is highly effective in increasing agricultural productivity and reducing poverty. But in many countries, public spending in support of agriculture is inadequate and often poorly directed. Where appropriate, governments should give priority to spending that supports agriculture and direct it towards important infrastructure and services that support private investment and benefit all citizens, including the poor.	• Climate change will require increased spending to enable both adaptation and mitigation in the agricultural sector. Public expenditure reviews that include projections of the impact of climate change can help identify expenditure priorities and different modalities – state-centred / aid / public-private partnerships etc. for delivering agricultural support (infrastructure, technology, etc).
• *Tackle market failure*. Poorly functioning markets continue to hinder agricultural development in many poor countries. State intervention, particularly in Africa, has a poor track record, but when markets have been liberalised, the private sector has often failed to fill the gap left when government withdraws. Building effective markets that are accessible to poor people needs actions to reduce the transaction costs and risks that inhibit the private sector. This involves improving infrastructure and communications, and removing burdensome regulations or inconsistent policies. Where markets are very weakly developed, governments may need to play a more direct role in encouraging private sector participation by using targeted and time-bound guarantees or subsidies;	• Making markets work better for poor people will be critical in the short-term, to ensure that they can access markets and to reduce market risks that reduce risky but more productive investments. In the longer-term better functioning markets will enable more allocative and technical efficiency under new agro-ecological conditions and enable the movement of goods between differently affected areas.

• *Fill the agricultural finance gap*. Limited access to finance, particularly short-term seasonal credit, remains a major obstacle to many poor farmers investing and innovating. Financial service providers are often reluctant to meet small farmers' credit needs and new approaches are needed to meet this demand;	• Access to finance will be more costly under climate change scenarios because of increased variability and higher risks of default. Alternative / complementary rural finance options should be considered – including insurance options
• *Spread the benefits of new technology*. Agricultural research must be effectively funded and research priorities must respond to demand and reflect agriculture's role in poverty reduction. Efforts are also needed to improve the availability to poor people of knowledge and technology through both public and private sector institutions, and to improve public access to the results of privately financed agricultural research;	• The catch-22 of climate change and agriculture is that those countries who will be worst affected by climate change are those with the weakest technology innovation and access. Climate change may encourage new cooperation / collaboration between public and private sectors to deliver technologies that enable adaptation (and mitigation).
• *Improve access to land and secure property rights*. Ownership and access to land in many poor countries remain inequitable, reducing agriculture's contribution to poverty reduction. Efforts are needed to help poor people to buy land and to encourage large landowners to sell it. This may be done by simplifying legal and administrative procedures and strengthening the financial position of the poor. In addition to measures aimed at increasing poor farmers' land ownership, attention should be given to new approaches to land administration that can help provide secure access to land through, for example, leasing arrangements. Special attention should be given to improving access to land for the most marginalised people, particularly women and indigenous communities; and	• Flexible and efficient land administration that can manage increasing demands on land and high levels of migration will be increasingly important under climate change scenarios.
• *Reduce distortions in international agricultural markets*. Subsidies, tariffs and non-tariff barriers continue to distort patterns of international trade and to depress prices. Continued efforts are needed to ensure their reduction in line with World Trade Organisation commitments and to assist those countries facing short-term problems adjusting to international agricultural trade reform.	• It is not clear whether climate change might result in a 'battening down of the hatches' and increasingly protectionist policies on the part of countries. Developing countries, particularly in Africa, are likely to require increased assistance (e.g. in WTO negotiations) to protect them against subsidies and other barriers that may be used in temperate climates to protect national production levels.

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