

# Climate Change and Agriculture in LDCs

Timm Tennigkeit, Andreas Wilkes, Charlie Parker and Fred Kossam

## KEY POINTS

- **Climate change is likely to exacerbate the challenge of increasing food production in LDCs**, and increase their dependence on food imports.
- An **explicit treatment of agriculture in the post -2020 climate agreement** will put agriculture at the centre of global policy discussions, and address the objective of protecting food production enshrined in Article 2 of the UN Framework Convention on Climate Change (UNFCCC).
- **Adaptation is a more important priority among LDCs than mitigation** in the agricultural sector. However, **positive synergies** exist between agricultural mitigation and the core needs of LDCs, including food security, adaptation and development.
- LDCs will need support to **assess climate change impacts, identify response mechanisms, integrate the mechanisms into agricultural development plans, and implement the plans.**
- A **work programme on agriculture** under the Subsidiary Body for Scientific and Technological Advice should explicitly aim to **increase knowledge** of climate risks and adaptation options in agriculture, enhance the **development, diffusion and transfer of relevant technologies**, and support **negotiation and cooperation on agriculture** in other forums within the UNFCCC.
- **Concerted effort is needed to mobilise climate finance in the agriculture sector**, including through raising awareness of investment opportunities and providing proof of concept through early action investments.

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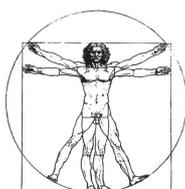
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Timm Tennigkeit and Andreas Wilkes work with UNIQUE forestry and land use. Charlie Parker is with Climate Focus.

Fred Kossam is Head of Climate Change and Research Services at the Ministry of Environment and Climate Change Management, Malawi

Series Editor: Anju Sharma  
Anju.Sharma@iied.org

**NOVEMBER 2013**



**ecbi**

The LDC Paper Series has been produced by the ecbi Publications and Policy Analysis Unit for the LDC Group. The views expressed in the papers in this Series are those of the authors and do not necessarily represent the views of the LDC Group or members of ecbi.

## Importance of agriculture for LDCs

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Agriculture contributes about 28 per cent of Gross Domestic Product (GDP) in Least Developed Countries (LDCs) on average, compared to around 10 per cent in middle-income countries. In some LDCs, agriculture contributes as much as 57 per cent of GDP and provides employment for a larger proportion of the workforce than in more developed countries. In general, the contribution of agriculture to GDP and employment in national economies declines as countries develop.

### **Agriculture is a critical basis for sustainable development in LDCs, contributing to employment and poverty alleviation.**

Agricultural growth is critical for overall economic growth and poverty reduction in LDCs. More than 80 per cent of the reduction in poverty worldwide has been due to development in rural areas, rather than migration to cities.<sup>1</sup> Studies suggest that for every 10 per cent increase in farm yields, there has been a 7 per cent reduction in poverty,<sup>2</sup> and agricultural growth is at least twice as effective in reducing poverty as economic growth originating outside the agricultural sector.<sup>3</sup> In many LDCs, foreign exchange is in short supply, the main staples consumed are not generally traded internationally, and poor rural infrastructure inhibits flow of goods. Increasing domestic staple food production is therefore critical to ensuring food availability. In other countries, agricultural exports have contributed significantly to rural income growth and food security.<sup>4</sup>

### **Recent and projected trends in food security in LDCs**

Despite above average growth in total food production in LDCs, per capita food production growth has only averaged 1.3 per cent per year, with negative growth in around one third of LDCs – mostly in low-income countries and low-income food deficit countries. Projections for the coming decade suggest that output will grow at slower rates than in the past decade, mainly because of rising costs and growing resource constraints.<sup>5</sup> Agricultural output in LDCs is expected to continue to grow faster than in other economic regions, but in per capita terms growth is expected to be minimal.

### **Trade in food products is already, and will increasingly be, important to food security in developing countries.**

LDCs are expected to become increasingly reliant on food imports due to climate change. Many LDCs are projected to increase their reliance on international markets, which will increase their exposure to commodity price shifts.<sup>6</sup> Looking further ahead to 2050, population growth is projected to be a key constraint on per capita food availability for a number of LDCs, with high population growth rates projected for several sub-Saharan

African countries that have historically had high levels of food insecurity.<sup>7</sup>

A number of rules on trade policies affecting food security in LDCs are being addressed in protracted negotiations in the World Trade Organization (WTO).<sup>8</sup> Progress in the WTO negotiations is essential to increase LDCs' abilities to meet food security needs. The UNFCCC focuses on "food production", and explicitly notes that climate change mitigation measures should not restrict trade. Although the UNFCCC is not the appropriate forum to discuss trade issues, the importance of trade to food security for LDCs should not be ignored. Thus, even without further climate change impacts, unless agricultural productivity can increase significantly, rural poverty and undernourishment are likely to continue to be common in LDCs.

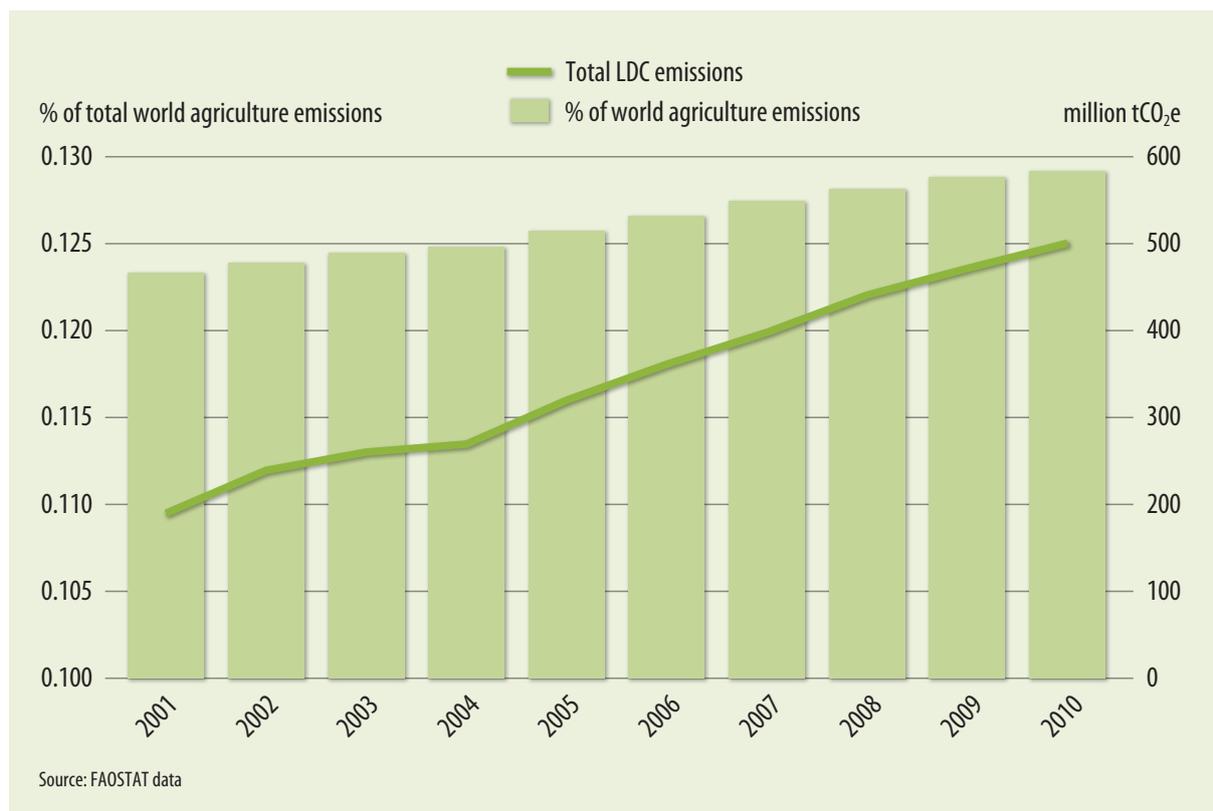
### **Agriculture and mitigation in LDCs**

Globally, agriculture contributes around 10-12 per cent of anthropogenic greenhouse gas (GHG) emissions,<sup>9</sup> a figure that has been growing at around one per cent per year over the last 10 years.<sup>10</sup> Agriculture is also a driver of deforestation and other land use changes that contribute an estimated 17 per cent of total global emissions. Considering only methane and nitrous oxide emissions from agricultural production activities, GHG emissions in LDCs account for around 12.5 per cent of global agricultural emissions, and have risen at an annual average rate of 2.3 per cent per year in the last decade (*see Figure 1 on the next page*). With growth of production in developing countries projected to be faster than the global average in the coming decades, GHG emissions will continue to increase.

**GHG mitigation in agriculture has synergies with meeting food security needs, adaptation and other agriculture sector objectives, and should be promoted in accordance with national circumstances.**

Practices that reduce GHG emissions and sequester carbon can have significant benefits for increasing yields and reducing yield variability, and for reducing production costs or increasing the efficiency of resource use. A review of more than 160 studies on sustainable land management practices finds that practices such as introducing cover crops, organic fertiliser, mulching and water harvesting consistently deliver positive yield responses, and sustainable land management generally increases soil carbon sequestration.<sup>11</sup> Where climate change constrains the availability of productive resources (such as land and water), agricultural practices that increase the efficiency of resource use are likely to promote both mitigation and adaptation to climate change, while also supporting food security. So while absolute levels of agricultural GHG emissions may continue to increase in LDCs, strategies that reduce the GHG intensity of agricultural output (GHG emissions per kg crop or livestock product) can contribute to GHG mitigation, allow increased food production and make more efficient use of increasingly limited natural resources.<sup>12</sup>

**Figure 1: Trend in LDC agriculture sector emissions of methane and nitrous oxide (million tonnes carbon dioxide equivalent, tCO<sub>2</sub>e), 2001–2010**



### Potential impacts of climate change on agriculture in LDCs

Projections of future climate change impacts on agriculture vary. The forthcoming Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) – which will include a dedicated chapter on food security and food production – will summarise state of the art knowledge on the impacts of climate change, and is expected to emphasise even more strongly than before the effects of climate change on farmers’ livelihoods and food security. Despite the existing uncertainties, most global level studies show relatively consistent results.<sup>13</sup>

**The largest declines in crop yields are expected in tropical areas, and rates of yield decline are likely to be higher as the rate of climate change increases.**

A review of multiple studies that assessed impacts on different crops suggests that in Africa and South Asia crop yields may decline by 8 per cent by the 2050s.<sup>14</sup> In LDCs, cassava, maize and rice account for about 60 per cent of food production.<sup>15</sup> In Africa, climate change is expected to decrease maize yields by 5 per cent, but no mean change was identified for rice, while results for cassava are inconclusive. Yields of other major crops (such as sorghum and millet) are expected to decline significantly.<sup>16</sup> Extreme climate events, such as droughts, extreme heat and floods also have severe impacts on agriculture. Of 24 countries

identified as highly exposed to these climate hazards and also having high numbers or proportions of poor people, 17 are LDCs.<sup>17</sup>

**Climate change is likely to exacerbate the challenge of increasing food production and eradicating poverty in LDCs and increase LDCs' dependence on food imports.**

One likely effect of climate change impacts on agriculture will be to increase LDCs' dependence on net cereal imports.<sup>18</sup> This may increase commodity prices,<sup>19</sup> further increasing the burden on foreign exchange reserves of food-importing LDCs. In addition to crop production, many LDCs are also relatively dependent on fisheries, a sector that is also potentially vulnerable to climate change,<sup>20</sup> but there is greater uncertainty with regard to the specific impacts of climate change on that sector.<sup>21</sup>

## **Implementation of agricultural adaptation and mitigation in LDCs**

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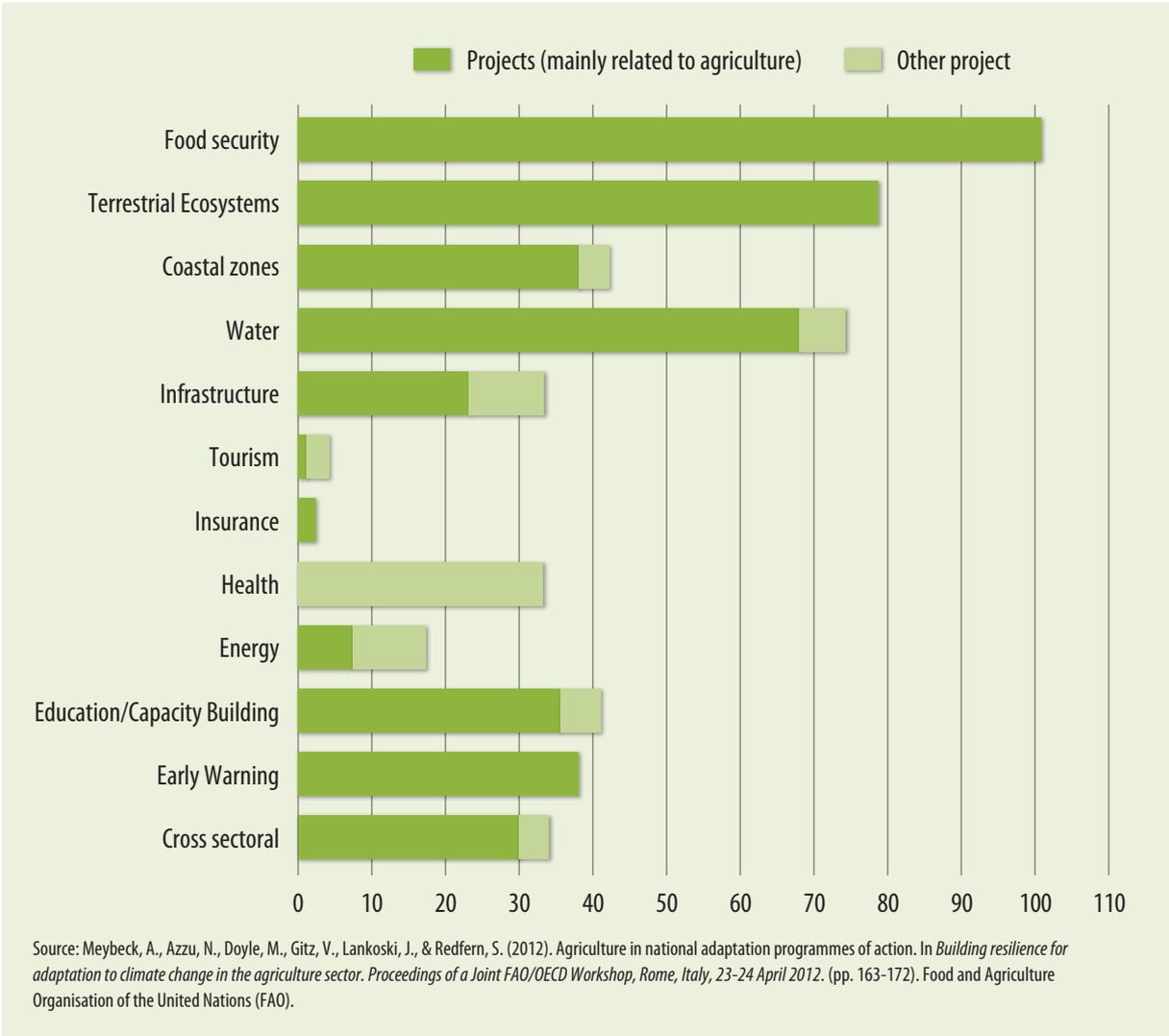
### **Agricultural adaptation in LDCs**

LDCs and other developing countries are keenly aware of the challenges that climate change poses for agricultural production. More than 90 per cent of LDCs listed agricultural needs in their Technology Needs Assessments (TNAs),<sup>22</sup> and of 490 projects listed in LDC National Adaptation Programme of Action (NAPA) documents, around 100 are mainly related to food security, while most of the remaining projects are closely related to agriculture (*see Figure 2 on the next page*).<sup>23</sup> Discussions on agricultural adaptation – including some submissions from Parties in relation to the agriculture discussions – list production technologies and techniques that have adaptation benefits, and many projects listed in NAPAs and supported by adaptation finance promote technologies that are expected to have adaptation benefits.

**Support for identifying and implementing effective adaptation policies and measures in the agriculture sector is an urgent priority for LDCs.**

Just as the shift from NAPAs to National Adaptation Plans (NAPs) offers the potential to support developing countries in developing coherent institutional, policy and regulatory frameworks for mainstreaming climate change in longer-term national planning, increasing attention needs to be paid to strengthening institutions and mainstreaming of climate change concerns in planning for agriculture and closely related sectors. These concerns are reflected in recent submissions by LDC Parties, which stress the importance of capacity building for research, policy development and implementation.

**Figure 2: NAPAs priority projects mainly related to agriculture**



**Agricultural mitigation in LDCs**

**Sustainable development benefits of adopting agricultural practices provide the primary motivation for developing countries to promote GHG mitigation in the agriculture sector.**

A relatively large number of developing countries have indicated their intention to implement agricultural mitigation activities,<sup>24</sup> and at least three LDCs have advanced mitigation practices in their national climate-resilient development strategies. With the exception of submissions by eight middle-income countries,<sup>25</sup> all of the Nationally Appropriate Mitigation Action (NAMA) submissions that mention agriculture come from African countries.

Many of the proposed actions (such as crop residue management, restoration of degraded

cropland and grasslands, introduction of more efficient irrigation and fertilisation techniques) also figure prominently in many countries’ agricultural investment and adaptation plans. For example, Ethiopia’s ‘Climate-Resilient Green Economy Strategy’ identifies benefits of adopting a low-emission agricultural development pathway that include contributing to reductions in deforestation and soil erosion by reducing the need for agricultural expansion as the country’s growing food demand is met. Tuvalu’s ‘National Strategic Action Plan for Climate Change and Disaster Risk Management’ identifies methane recovery from pig waste as a priority to address both waste management and GHG emissions.

**Climate finance for agriculture in LDCs**

A UNFCCC assessment suggests that the additional costs of adapting to climate change in agriculture in developing countries will amount to more than US\$ 3 billion by 2030.<sup>26</sup> Most of this is due to capital investments, with smaller – but still substantial – requirements for agricultural research and extension. More recent analysis of Africa’s agriculture sector suggests that the sector’s annual investment need is around US\$ 48 billion (see Table 1 below). In addition, US\$ 3 billion is needed to avoid the effects of climate change on nutrition. Considering that sustainable agricultural land management (SALM), waste management, and agricultural intensification in areas at risk of deforestation have GHG mitigation co-benefits, the technical potential for investment in African agriculture from mitigation finance is estimated at between US\$ 10–20 billion, indicating that a substantial amount could potentially be raised from climate finance. By comparison, developed country aid to African agriculture in 2011 was US\$ 3.1 billion, representing less than 8 per cent of total aid.<sup>27</sup>

**Table 1: Agricultural financing needs in Africa<sup>28</sup>**

Financing needs	Billion US\$ per year	Remarks
Agriculture	48	Excludes climate related investments
Adaptation	3	
Mitigation (SALM and waste management)	2.6 – 5.3	Assumes abatement costs of US\$ 10-20/tCO <sub>2</sub> e
Mitigation (avoiding 75 per cent of total deforestation)	8.1 – 16.2	Assumes abatement costs of US\$ 10-20/tCO <sub>2</sub> e

**Concerted effort is needed to mobilise climate finance in the agriculture sector**

LDCs require substantial support to make the investments required to meet agricultural development needs, and climate finance is a potential source of investment to support adoption of agricultural practices with adaptation, mitigation and food security benefits. At present, however, less than one per cent of climate finance is invested in the agriculture sector.<sup>29</sup> National agriculture, food and nutrition security investment plans should be

the primary framework for channeling climate finance to support prioritised national investments in agriculture. Alignment can be enhanced if climate change adaptation and mitigation are more comprehensively considered in agriculture sector investment planning.<sup>30</sup>

## Overview of agriculture under the UNFCCC

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Agriculture under the UNFCCC has always been a high priority for LDCs. Despite the goodwill of a number of negotiation blocks, progress on agriculture in the negotiations to date, however, has been slow. But progress is now afoot. At the most recent meeting of the UNFCCC in Bonn, the Subsidiary Body for Scientific and Technological Advice (SBSTA) at its 38th session invited Parties and observer organisations to make submissions on agriculture and adaptation and further requested the UNFCCC secretariat to organise an in-session workshop on these issues at SBSTA 39, to be held in Warsaw in November 2013.<sup>31</sup> These discussions are an important milestone in the negotiations, and give critical impetus to progress on agricultural mitigation and adaptation under the UNFCCC.

### Evolution of agriculture in the climate change negotiations

At the Rio Summit in 1992, Parties highlighted that climate change should be limited to a level that does not threaten food security. This was reinforced in Article 2 of the UNFCCC:

“... stabilization of greenhouse gas concentrations in the atmosphere... should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.”

In the 2007 Bali Road Map, all Parties agreed to policy approaches and positive incentives to reduce deforestation and forest degradation, and to treat agriculture within the Ad Hoc Working Group on Long-term Cooperative Action under agenda items on cooperative sectoral approaches and sector-specific mitigation actions. As a follow-up, a technical paper on agricultural mitigation challenges and options<sup>32</sup> was presented in 2009, and a dedicated group was established to draft a text proposing a decision on agriculture.<sup>33</sup> This text was discussed in Copenhagen at the fifteenth Conference of Parties (COP 15), but never agreed amidst the general failure to reach consensus.

In 2011 at a meeting in Bangkok and later during SBSTA 34 in Bonn, a number of countries, including Canada, New Zealand and Switzerland, called for agriculture to be discussed under additional matters and not under sectoral mitigation approaches, since this would better reflect the fact that adaptation is the main objective for LDCs and other agriculture-

based economies. At COP 17 in Durban later in 2011, Parties agreed to decouple agriculture from sectoral mitigation approaches, and to exchange views on agriculture.

At SBSTA 36 in 2012 submissions were received on agriculture,<sup>34</sup> but during the negotiations there was no consensus on how to deal with mitigation and adaptation issues. The dialogue on this subject continued and Parties agreed in Bonn in June 2013 to call for submissions specifically on the state of scientific knowledge regarding adaptation in the agriculture sector in the context of sustainable development and food security.<sup>35</sup>

## Summary of submissions on agriculture

In May 2012, 23 submissions were made in response to the call,<sup>36</sup> of which seven were from LDCs (Bangladesh, Burundi, Malawi, Tanzania, The Gambia on behalf of LDCs, Uganda, and Zambia). Areas of common concern among all Parties included:

- Recognition of the **importance of agriculture for food security, employment and economic development**, especially for developing countries;
- **The need for improved knowledge** of the impacts of climate change on agriculture; and
- **The importance of promoting adaptation** measures in agriculture.

Most submissions from both LDCs and other Parties acknowledged the relevance of GHG mitigation in agriculture, though there were differences of perspective, which included:

- **Support for mitigation as a co-benefit** of pursuing food security (for instance, through reduced emissions intensity as a result of increased productivity);
- **Targeting synergies between mitigation and adaptation and food security**, and attention to avoiding trade-offs that compromise food security; and
- A focus on adaptation to climate change only.

Some submissions from LDCs and other developing countries noted that concern with GHG emissions should not present a barrier to trade in agricultural goods nor constrain domestic agriculture and food security policies, and that discussions should not consider mitigation commitments on the part of developing countries, the latter reflecting concerns with broader discussions within the UNFCCC process.

The submissions show a common concern among Parties to improve the knowledge base on climate change impacts and adaptation and mitigation measures, capacity building and technology transfer, and a need to consider financing mechanisms. Although recognition of the need for transfer of agricultural technologies and techniques was common to submissions by many Parties, this issue is potentially complicated by the possible implications for access to

genetic resources, which is a contentious issue also discussed by the WTO.<sup>37</sup>

Submissions on agriculture in 2013<sup>38</sup> focused on the current state of scientific knowledge on how to improve resilience in agricultural systems, while taking into account the diversity of the agricultural systems.<sup>39</sup> Among the 15 submissions, five were from LDCs (Burundi, Malawi, Mali on behalf of the Like-minded Developing Countries, Nepal on behalf of the LDC group, and Zambia).

The submissions from LDCs raised the following key issues:

- **Agriculture in LDCs is particularly vulnerable to the adverse effects** of climate change, including both slow-onset climate change and extreme events;
- **Food security and adaptation to climate change are priorities** in the agriculture sector; and
- **Priority areas for support** include capacity building for impact assessment, research on adaptation and co-benefits, and integration of indigenous, traditional and science-based knowledge and practices.

Submissions by other Parties also focused on the vulnerability of the sector and the need for improved knowledge and capacities for assessment of climate change impacts and adaptation options. While only one LDC submission placed significant emphasis on mitigation in agriculture, four submissions by developed country Parties noted the importance of synergies between adaptation and mitigation, and one suggested that discussions on adaptation should be followed up with a similar process focusing on GHG emissions in the context of food security and socioeconomic development. Intellectual property rights on plant and animal genetic resources were noted in one submission as an obstacle to technology transfer to support adaptation in LDCs.

Across developed and developing countries, both sets of submissions indicate broad consensus on the following issues:

- In developing countries – and LDCs in particular – **adaptation is a more important objective than mitigation in the agriculture sector.**
- **There is a common need for improved assessment of climate change impacts** as well as capacity development to support adaptation in the agriculture sector.
- Agriculture is an important source of emissions that should be addressed in the context of **synergies between food production, adaptation and mitigation.**

It is worth noting that, although individual Parties may oppose consideration of mitigation due to concern that attention to mitigation might detract from the paramount importance

of adaptation in the agriculture sector, no Parties' submissions support prioritising mitigation without consideration of implications for food security.

## Other UNFCCC forums for discussions relating to agriculture

### Nairobi Work Programme (NWP)

Agricultural adaptation has been discussed under the NWP since it started in 2006 at COP 12 in Nairobi. A recent submission from LDCs indicates that although the five-year programme generated a lot of knowledge, this did not trickle down to the national or sub-national level to inform selection and implementation of practical, effective and high priority adaptation actions.<sup>40</sup> The submissions suggest that the NWP should be better integrated with the work of the Adaptation Committee established after COP 16 in Cancún in 2010 in order to promote coherent and tangible action.

### LDC Work Programme

The LDC Work Programme mainly deals with issues related to adaptation knowledge and capacity building, preparation of NAPAs, and implementation and monitoring. NAPAs, which will build upon the experiences in development and implementation of NAPAs, are a key instrument to address adaptation needs in LDCs. The NAPAs will provide an opportunity for LDCs to plan and implement medium and long-term adaptation actions while addressing immediate and urgent adaptation through the NAPAs. Given that most actions in NAPAs relate to agriculture, the NAP process provides a suitable framework for integrating technical support with national planning processes.

### Technology Mechanism

The Technology Mechanism of the UNFCCC is relevant to adaptation in agriculture. In the TNAs of developing countries, more than 40 per cent of the adaptation technologies and 25 per cent of mitigation technologies relate to agriculture and forestry.<sup>41</sup> Work on TNAs is now being followed up through the Technology Executive Committee (TEC) with work on Technology Road Maps (TRMs) – action plans for technology deployment, which can strengthen the implementation of NAPAs or NAMAs.<sup>42</sup> To date, most TRMs have focused on mitigation and very few on adaptation, but some experiences from LDC agriculture sectors have been shared in recent discussions. The TEC is in the process of elaborating how to strengthen its linkages with other institutional arrangements under the UNFCCC.<sup>43</sup>

### Loss and Damage Work Programme

The Work Programme on Loss and Damage is another UNFCCC agenda item of high relevance for LDCs. Loss and damage is a consequence of the lack of ambitious efforts to reduce

emissions and address adaptation needs triggering climate-related disasters, as recently described in the World Bank report, *Turn Down the Heat*.<sup>44</sup> The topic has been discussed within the UNFCCC for quite some time, but still lacks clear definition.<sup>45</sup> Depending on the preferred entry point, it focuses on insurance and risk transfer or on disaster risk reduction. Both of these topics are highly relevant to agriculture, since yield variability due to climate variability is a common characteristic of LDC agriculture, and extreme climate events such as droughts and floods are expected to increase in many parts of the world due to climate change.<sup>46</sup>

## **Key interests for LDCs in agricultural negotiations**

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LDCs have been actively involved in the discussions and negotiations on agriculture for quite some time. These discussions are directly relevant to addressing the current and future impacts of climate change on the poor in LDCs through effective adaptation and mitigation strategies. The upcoming Fifth Assessment Report of the IPCC – which will include a dedicated chapter on food security and food production – is expected to be of crucial importance for discussions of agriculture, and could be a ‘game-changer’. LDCs expect that the report will emphasise the effects of climate change on farmers, and on livelihoods and food security, even more strongly than before.

The Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP) has the mandate to discuss a legal instrument or an agreed outcome with legal force under the UNFCCC to be implemented from 2020. Developing an explicit treatment of agriculture in the future agreement will put issues related to agriculture at the centre of global policy discussions concerning the role of agriculture in food security and emissions reduction, as enshrined in Article 2 of the UNFCCC. With this in mind, the following key areas should be the focus in future discussions.

### **Developing a SBSTA work programme on agriculture**

The in-session workshop on agriculture at COP 19 in Warsaw will provide an unprecedented opportunity to build an open dialogue on SBSTA’s next steps towards achievement of the UNFCCC’s objectives in the agriculture sector. The workshop may include consideration of the possible roles of all the relevant UNFCCC and Kyoto Protocol programmes and financial mechanisms that are necessary to support equitable, food-secure, sustainable, and climate resilient agriculture. SBSTA will specifically be invited to continue its consideration of issues relating to agriculture with a view to recommending a draft decision for consideration and adoption at COP 19. This opens the possibility for COP to adopt a work programme on agriculture.

The COP 19 discussions will focus on adaptation, which is the main priority of LDCs, and also a significant concern of more developed Parties. Notwithstanding this, given the important synergies between mitigation and adaptation, the issue of agricultural mitigation should be added to the agenda of a SBSTA work programme on agriculture.

Given low levels of national capacity for scientific assessment, LDCs and other developing countries have a particular need for support with improved assessment and understanding of climate change impacts and risks and assessment of adaptation options. In many LDCs, and for LDCs as a group, systematic assessment of agricultural climate risks has not yet been conducted, and existing studies have rarely been conducted at appropriate levels of resolution to be able to inform decision-making.

There is a need for targeted assessment of the effects of key elements of the global climate system (such as El Niño and La Niña) on individual LDCs, and for capacity building in modelling and prediction. Investments in weather monitoring infrastructure and capacities for high resolution seasonal rainfall forecasting are urgently needed. In the face of gaps in scientific knowledge and significant uncertainty, support for identification of robust adaptation options, and assessment of their costs and benefits, the availability of relevant technologies or techniques and barriers to adoption can all contribute to supporting agricultural adaptation planning in LDCs.

Options should be considered in an integrated manner, including not only on-farm adaptation technologies, but also the policy, institutional and market responses (such as insurance, credit, income diversification).<sup>47</sup> There is strong interest in insurance mechanisms to offset production losses due to climate risks, and both technical support and investment are required to ensure that insurance schemes and policy support mechanisms are well designed, and that meteorology infrastructure is in place to support the development of index-based schemes.<sup>48</sup>

Considering also the relatively high dependence of many LDCs on food trade, it is also relevant to understand the projected impacts of climate change on production of the main food commodities globally, and their implications for food trade prices. SBSTA can support improved availability of scientific knowledge and assessment through assessments, production of technical papers and workshops.

### **Support for the development and elaboration of national integrated plans for climate resilient agriculture.**

Food security is already a key issue in LDCs, many of which have agriculture-based economies. Population growth, climate change and rising agricultural input and food prices are expected to increase the challenges faced. Each country will need to integrate

climate change concerns into their agricultural development plans, considering the implications for food security of future development pathways, expected climate change impacts, adaptation options and mitigation options that contribute to national food security and environmental management objectives. Options should be considered in an integrated manner, including not only on-farm adaptation practices, but also market responses (such as insurance, credit, income diversification), institutional and policy changes and finance mechanisms.<sup>49</sup>

Support will be needed by LDCs to assess climate change impacts, identify risk management and response mechanisms, to integrate these into agricultural development plans and to implement climate resilient agricultural development plans. Considering the under-investment in agricultural advisory services in past decades, international support for early action investment with in building climate resilient agriculture is of paramount importance for LDCs.

### **Support to undertake research and technology development, transfer and diffusion of practices that will enhance adaptation and mitigation in the agriculture sector.**

Agriculture in LDCs in the context of ongoing climate change faces multiple challenges of producing more food, more efficiently, under more volatile production conditions, with reductions in GHG emissions from food production and marketing.<sup>50</sup> Meeting these challenges will require research and technological development as well as enhanced systems to promote technology adoption in LDCs. In general, investments are required in public agricultural research capacities in LDCs that target improvements in agricultural productivity, resilience in the face of increasingly variable growing conditions, improvements in water use efficiency and reduced input intensity. Some key areas for innovation include: increasing yields through new breeds and crop cultivars and access to irrigation, water harvesting and water storage; reducing losses to pest and disease; improved soil nutrient management, including increased fertiliser use; increased efficiency of agricultural water use; improved agronomic and livestock management practices, including agroforestry; and access to weather forecasts and climate information.

### **Increasing attention to agriculture in other forums within the UNFCCC**

To address their adaptation needs in the agriculture sector effectively, LDCs require support with identification of vulnerabilities and adaptation options, technology transfer and finance, including addressing residual loss and damage due to continued climate change. Some work programmes, such as the Technology Mechanism, have paid insufficient attention to the topic relative to its importance to adaptation in LDCs and other developing

countries. LDCs should work with other Parties to ensure that agriculture is addressed explicitly and concretely in these work programmes, and to ensure that any SBSTA agriculture work programme can support consideration of agriculture in these forums.

The increasing participation of representatives from agriculture ministries in some Parties' negotiation teams in recent years has improved their ability to link agriculture with climate issues, though the common allocation of primary responsibility for climate issues to environment ministries still often constrains abilities to consider agriculture in a comprehensive way. Given the relative importance of agriculture to LDCs it is important that LDCs lead the way in raising awareness of agriculture in these related discussion streams within the UNFCCC.

### **Increasing finance available for adaptation in the agriculture sector**

In many countries, agriculture has suffered from under-investment for several decades. Investment in capital goods, such as irrigation infrastructure, and agricultural research and advisory services are essential to reduce the vulnerability of agriculture in LDCs. International support for early action investment in building climate-resilient agriculture is of paramount importance for LDCs. It is therefore imperative that developed countries fulfil their pledge to mobilise US\$ 100 billion of climate finance, and that a significant proportion of this finance is available for adaptation actions through channels accessible by LDCs. Agricultural investments in LDCs are eligible for many of the sources of climate finance currently available (such as the Least Developed Countries Fund, Adaptation Fund and Pilot Programme for Climate Resilience), and may be given a prominent place within the priorities of the Green Climate Fund.<sup>51</sup> Agriculture has received very little investment from other sources of climate finance, and concerted efforts are required to raise awareness of investment opportunities in agriculture and to provide proof of concept through early action investments.

For LDCs it is also important that agricultural adaptation actions are integrated with national agricultural investment plans. This would ensure that adaptation investments are coordinated with and contribute to achieving agricultural development priorities, and that resources from multiple sources can be leveraged for these investments. The initiation of the NAP process in LDCs provides an opportunity to enhance the coordination between sectoral and adaptation-specific measures. Dedicated resources should be made available to support assessment adaptation investment needs in the agriculture sector.

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- 1 World Bank (2008). *World Development Report: Agriculture for Development*. World Bank, Washington, D.C.
  - 2 Irz, X., Lin, L., Thirtle, C. P. & Wiggins, S. (2001). Agricultural growth and poverty alleviation. *Development Policy Review*, 19(4), 449–466
  - 3 World Bank (2008). *World Development Report: Agriculture for Development*. World Bank, Washington, D.C.
  - 4 Dorward, A., Kydd, J., Morrison, J. & Urey, I. (2004). A policy agenda for pro-poor agricultural growth. *World Development*, 32(1), 73-89
  - 5 OECD and FAO (2013). *Agricultural Outlook 2013-2022*. Organisation for Economic Cooperation and Development, Paris and Food and Agriculture Organization of the UN, Rome
  - 6 OECD and FAO (2010). *Agricultural Outlook 2010-2019*. Organisation for Economic Cooperation and Development, Paris and Food and Agriculture Organization of the UN, Rome
  - 7 Alexandratos, N. & Bruinsma, J. (2012). *World Agriculture Towards 2030/2050*. Food and Agriculture Organization of the UN, Rome
  - 8 See ICTSD (2013). *G-33 proposal: early agreement on elements of the draft Doha accord to address food security*. International Center for Trade and Sustainable Development, Geneva
  - 9 2005 estimate from IPCC (2007). *Mitigation of Climate Change: Working Group III contribution to the Fourth Assessment Report of the IPCC*. Intergovernmental Panel on Climate Change, Geneva
  - 10 Data from faostat.fao.org
  - 11 Branca, G., Lipper, L., McCarthy, N. & Jolejole, M. (2013). Food security, climate change and sustainable land management: a review. *Agronomy for Sustainable Development* 33(4), 635-650
  - 12 Murray, B. & Baker, J. (2010). *An output-based intensity approach for crediting greenhouse gas mitigation in agriculture: explanation and policy implications*. Nicholas Institute for Environmental Policy Solutions, Duke University, Raleigh
  - 13 Wheeler, T. & von Braun, J. (2013). Climate change impacts on global food security. *Science*, 341, 508
  - 14 Knox, J., Hess, T., Daccache, A. & Wheeler, T. (2012). Climate change impacts on crop productivity in Africa and South Asia. *Environmental Research Letters* 7(3), 034032
  - 15 Data from faostat.fao.org
  - 16 Knox, J., Hess, T., Daccache, A. & Wheeler, T. (2012). Climate change impacts on crop productivity in Africa and South Asia. *Environmental Research Letters* 7(3), 034032
  - 17 Shepherd, A., Mitchell, T., Lewis, K., Lenhardt, A., Jones, L., Scott L. & Muir-Wood, R. (2013). *The geography of poverty, disasters and climate extremes in 2030*. Overseas Development Institute, London
  - 18 Fischer, G., Shah, M., Tubiello, F. & van Vehuizen, H. (2005). Socio-economic and climate change impacts on agriculture: an integrated assessment, 1990-2080. *Philosophical Transactions of the Royal Society*, 360(1463), 2067-2083
  - 19 Nelson, G. (2009). *Climate change: Impact on agriculture and costs of adaptation*. International Food Policy Research Institute, Washington, D.C.
  - 20 Allison, E. et al. (2009). Vulnerability of national economies to the impacts of climate change on fisheries. *Fish and Fisheries*, 10(2), 173-196
  - 21 Brander, K. (2007). Global fish production and climate change. *PNAS* 104(50), 19707-19714
  - 22 UNFCCC SBSTA (2009). Second synthesis report on technology needs identified by Parties not included in Annex I to the Convention. <http://unfccc.int/resource/docs/2009/sbsta/eng/inf01.pdf>
  - 23 Meybeck, A., Azzu, N., Doyle, M., Gitz, V., Lankoski, J. & Redfern, S. (2012). Agriculture in national adaptation programmes of action. In *Building resilience for adaptation to climate change in the agriculture sector. Proceedings of a Joint FAO/OECD Workshop, Rome, Italy, 23-24 April 2012*, 163-172. Food and Agriculture Organization of the United Nations, Rome
  - 24 A summary of agricultural NAMA submissions is provided in Wilkes, A., Tennigkeit, T. & Solymosi, K. (2013). *National integrated mitigation planning in agriculture: a review paper*. Food and Agriculture Organization of the United Nations, Rome
  - 25 Brazil, Chile, Indonesia, Jordan, the Former Yugoslav Republic of Macedonia, Mongolia, Papua New Guinea and Uruguay
  - 26 McCarl, B. (n.d.). *Adaptation options for agriculture, forestry and fisheries*. [http://unfccc.int/files/cooperation\\_and\\_](http://unfccc.int/files/cooperation_and_)

- support/financial\_mechanism/application/pdf/mccarl.pdf
- 27 OECD-DAC (2013). *International Statistics Database*, <http://www.oecd.org/dac/stats/idsonline.htm>
  - 28 Branca, G., Tennigkeit, T., Mann, W. & Lipper, L. (2012). *Identifying opportunities for climate-smart agriculture investments in Africa*. Food and Agriculture Organization of the United Nations, Rome
  - 29 Hodas, R. (2012). *Bilateral Finance Institutions and Climate Change: a mapping of 2012 climate financial flows to developing countries*. UN Environment Programme, Nairobi
  - 30 Branca, G., Tennigkeit, T., Mann, W. & Lipper, L. (2012). *Identifying opportunities for climate-smart agriculture investments in Africa*. Food and Agriculture Organization of the UN, Rome
  - 31 <http://unfccc.int/resource/docs/2013/sbsta/eng/l20.pdf>
  - 32 <http://unfccc.int/resource/docs/2008/tp/08.pdf>
  - 33 <http://unfccc.int/resource/docs/2009/awglca8/eng/l07a09.pdf>
  - 34 [http://unfccc.int/meetings/bonn\\_may\\_2012/session/6643/php/view/documents.php](http://unfccc.int/meetings/bonn_may_2012/session/6643/php/view/documents.php)
  - 35 <http://unfccc.int/resource/docs/2013/sbsta/eng/l20.pdf>
  - 36 [http://unfccc.int/meetings/bonn\\_may\\_2012/session/6643/php/view/documents.php](http://unfccc.int/meetings/bonn_may_2012/session/6643/php/view/documents.php)
  - 37 See [http://www.wto.org/english/tratop\\_e/trips\\_e/art27\\_3b\\_background\\_e.htm](http://www.wto.org/english/tratop_e/trips_e/art27_3b_background_e.htm)
  - 38 <http://unfccc.int/resource/docs/2013/sbsta/eng/misc17.pdf>
  - 39 <http://unfccc.int/resource/docs/2013/sbsta/eng/l20.pdf>
  - 40 [http://unfccc.int/files/adaptation/nairobi\\_work\\_programme/application/pdf/nepal\\_ldc\\_group\\_submission\\_on\\_nwp.pdf](http://unfccc.int/files/adaptation/nairobi_work_programme/application/pdf/nepal_ldc_group_submission_on_nwp.pdf)
  - 41 Lybbert, T. & Sumner, D. (2010). *Agricultural technologies for climate change mitigation and adaptation in developing countries: Policy options for innovation and technology diffusion: ICTSD-IPC platform on climate change, agriculture and trade*. International Centre for Trade and Sustainable Development, Geneva
  - 42 [http://unfccc.int/ttclear/templates/render cms\\_page?s=TEM\\_expert\\_meeting](http://unfccc.int/ttclear/templates/render cms_page?s=TEM_expert_meeting)
  - 43 UNFCCC (2012). Report on the linkage modalities and the rolling workplan of the Technology Executive Committee for 2012-2013. <http://unfccc.int/resource/docs/2012/sb/eng/01.pdf>
  - 44 World Bank (2012). *Turn Down Heat: Why a 4°C Warmer World Must be Avoided*. [http://climatechange.worldbank.org/sites/default/files/Turn\\_Down\\_the\\_heat\\_Why\\_a\\_4\\_degree\\_centrigrade\\_warmer\\_world\\_must\\_be\\_avoided.pdf](http://climatechange.worldbank.org/sites/default/files/Turn_Down_the_heat_Why_a_4_degree_centrigrade_warmer_world_must_be_avoided.pdf)
  - 45 [http://cdkn.org/2012/04/loss-and-damage-from-climate-change-%E2%80%93building-a-critical-agenda/?loclang=en\\_gb](http://cdkn.org/2012/04/loss-and-damage-from-climate-change-%E2%80%93building-a-critical-agenda/?loclang=en_gb)
  - 46 IPCC 2012. *Intergovernmental Panel on Climate Change Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. Cambridge University Press, Cambridge
  - 47 Kurukulasuriya, P. & Rosenthal, S. (2003). *Climate change and agriculture: a review of impacts and adaptations*. Climate Change Series Paper No. 91. World Bank, Washington, D.C.
  - 48 Mahul, O. & Stutley, C. (2010). *Government support to agricultural insurance: challenges and options for developing countries*. World Bank, Washington, D.C.; Cole, S., Bastian, G., Vyas, S., Wendel, C. & Stein, D. (2012). *The effectiveness of index based micro-insurance in helping smallholders manage weather-related risks*. EPPi-Centre, Social Science Research Unit, Institute of Education, University of London, London
  - 49 Kurukulasuriya P. & Rosenthal S. (2003). *Climate change and agriculture: a review of impacts and adaptations*. Climate Change Series Paper No. 91, World Bank, Washington D.C.
  - 50 Lybbert, T. & Sumner D. (2010). *Agricultural Technologies for Climate Change Mitigation and Adaptation in developing Countries: Policy Options for Innovation and Technology Diffusion*, ICTSD-IPC Platform on Climate Change, Agriculture and Trade, Issue Brief No.6, International Centre for Trade and Sustainable Development, Geneva, Switzerland and International Food & Agricultural Trade Policy Council, Washington D.C.
  - 51 Green Climate Fund (2013). *Business Model Framework: Initial Result Areas and Performance Indicators*. GCF/B.05/02