COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

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Fifteenth Regular Session

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LESSONS LEARNED ABOUT WAYS AND MEANS TO CONSERVE AND USE GENETIC DIVERSITY TO BUILD RESILIENCE TO CLIMATE CHANGE IN FOOD AND AGRICULTURE SYSTEMS

SURVEY REPORT
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**Acronyms**

**BV-PI**  
*Bassins versants et périmètres irrigués* (Watershed-irrigated area) (Madagascar)

**CBO**  
Community Based Organization

**CCAFS**  
CGIAR Research Programme on Climate Change, Agriculture and Food Security

**CGIAR**  
Consortium of 15 International Agricultural Research Centres

**CGRFA**  
Commission on Genetic Resources for Food and Agriculture

**CO2**  
Carbon dioxide

**DART**  
Directorate Agricultural Research and Training

**DIVA**  
Data-Interpolating Variational Analysis

**EU**  
European Union

**FAO**  
United Nations Food and Agriculture Organization

**FC**  
Forestry Commission (Scotland)

**FECOFUN**  
Federation of Community Forestry Users Nepal

**GEF**  
Global Environment Facility

**GHG**  
Greenhouse Gas

**GPA**  
Global Plan of Action

**GRFA**  
Genetic Resources for Food and Agriculture

**INC**  
Initial National Communication (UNFCCC NAPA’s process)

**IPCC**  
Intergovernmental Panel on Climate Change

**ISET-N**  
Institute on Social and Economic Transition - Nepal

**ITPGRFA**  
International Treaty on Plant Genetic Resources for Food and Agriculture

**LAPA**  
Local Adaptation Plans for Action (Nepal)

**LDCs**  
Least Developed Countries

**LI-BIRD**  
Local Initiatives for Biodiversity, Research and Development

**LPDR**  
Rural Development policy brief

**MDGs**  
Millennium Development Goals

**MLS**  
Multilateral System

**MoAD**  
Ministry of Agriculture Development

**MRV**  
Measurement, reporting and verification

**NAMA**  
Nationally Appropriate Mitigation Action

**NAP**  
National Adaptation Plan

**NAPA**  
National Adaptation Programme of Action

**NAPCC**  
National Action Plan on Climate Change

**NARC**  
Nepal Agricultural Research Council

**NBS**  
National Biodiversity Strategy

**NEPAD**  
New Partnership for Africa's Development

**NEWAH**  
Nepal Water for Health

**NGO**  
Non Governmental Organization

**NICRA**  
National Initiative on Climate Resilient Agriculture (India)

**NP**  
National Plans

**NSDR**  
National Strategy for Rice Development

**NSS**  
National Seed Strategy

**OP**  
Other Programmes

**PADR**  
Action Plan for Rural Development

**PAR**  
Platform for Agrobiodiversity Research

**PGR**  
Plant Genetic Resources

**PGRFA**  
Plant Genetic Resources for Food and Agriculture

**RAN-GRK**  

**R&D**  
Research and Development

**RDNP**  
Rural Development National Programme

**REDD**  
Reducing Emissions from Deforestation and forest Degradation

**REDD+**  
REDD which goes beyond deforestation and forest degradation by including the role of conservation, sustainable management of forests and enhancement of forest carbon stocks

**SEBAC**  
Social Empowerment and Building Accessibility Centre - Nepal
<table>
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<td>SRI</td>
<td>System of Rice Intensification</td>
</tr>
<tr>
<td>TWGs</td>
<td>Thematic Working Groups</td>
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<tr>
<td>UN</td>
<td>United Nations</td>
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<tr>
<td>UNCCD</td>
<td>United Nations Convention to Combat Desertification</td>
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<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
</tr>
<tr>
<td>UNEP</td>
<td>United National Environment Programme</td>
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<tr>
<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
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<tr>
<td>VCCCAR</td>
<td>Victorian Centre for Climate Change Adaptation Research</td>
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<td>VPA</td>
<td>Voluntary Partnership Agreement (Ghana)</td>
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LESSONS LEARNED ABOUT WAYS AND MEANS TO CONSERVE AND USE GENETIC DIVERSITY TO BUILD RESILIENCE TO CLIMATE CHANGE IN FOOD AND AGRICULTURE SYSTEMS

SURVEY REPORT

SUMMARY

The FAO Commission on Genetic Resources for Food and Agriculture (the Commission), at its Fourteenth Regular Session, reaffirmed the importance of genetic resources for food and agriculture for coping with climate change and the need for raising awareness of their potential roles, as appropriate. As part of its Programme of Work on Climate Change and Genetic Resources for Food and Agriculture, the Commission proposed that a survey be undertaken on “Lessons learned about ways and means to conserve and use genetic diversity to build resilience to climate change in food and agriculture systems”1. The Secretariat of the Commission commissioned the Platform for Agrobiodiversity Research (PAR), with the support of Bioversity International, to conduct an online survey. The survey was undertaken during August and September 2013.

The results of the survey provide up to date information on ongoing work and a reality check on the challenges currently faced around the world by those seeking to conserve and use genetic diversity to build resilience to climate change in food and agriculture systems. The survey covered all genetic resources (plant, animal, forest, aquatic, invertebrates and micro-organisms) and was concerned with both technical and policy related aspects. The survey included both direct questions and opportunities to comment or share information and documents on:

- Effects of climate change on the conservation and use of genetic resources for food and agriculture;
- Technical and policy related adaptation and mitigation activities;
- The contribution of the Global Plans of Action for genetic resources;
- Research, information management public awareness and capacity building activities.

The survey was sent to sector national focal points of the Commission, a range of civil society organizations and experts on different disciplines. The survey was also available through the PAR website and promoted through a PAR newsletter and FAO social media channels to provide opportunities for wider participation. Three hundred and ninety four participants completed at least parts of the main sections of the questionnaire and 53% of these completed the whole questionnaire (208 respondents).

The main findings of the survey have been compiled below.

<table>
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<tr>
<th>Perceptions of the effect of climate change</th>
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<tr>
<td>1. The survey results suggest that there is a widespread perception that climate change is having an effect on production, on genetic resources for food and agriculture and on ecosystem services and that the implications for food and agriculture production are generally recognized by respondents. The additional information provided by respondents suggests that there is a substantial amount of information around the world that provides evidence on what are perceived to be the main effects.</td>
</tr>
<tr>
<td>2. The direct effect of climate change on production was perceived to be greater for crop and forest production than for animal and aquatic production.</td>
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<tr>
<td>3. Production problems with respect to the currently available materials are frequently observed and the need to change species, varieties or breeds was recognized.</td>
</tr>
<tr>
<td>4. Ways of coping with increased climate stresses are needed, particularly with abiotic stresses such as heat, drought and flooding. Problems associated with water availability are of major importance. The importance of developing new varieties, breeds or populations was widely noted.</td>
</tr>
<tr>
<td>5. Respondents considered that particular attention needed to be paid to the risks from climate change to useful wild species (crop wild relatives, wild foods, medicinal species etc.) on which future breeding efforts and many poor rural communities depend.</td>
</tr>
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1 CGRFA-14/13/Report Appendix D.
Loss of forage and availability of pasture were identified as problems that require adaptation responses. The wide diversity of experiences presents a challenge to the identification of the extent and significance of the different problems identified – some systematic global monitoring of genetic resources effects might help guide responses and actions. The main barrier in dealing with climate change was considered to be lack of financial resources. Lack of policies, knowledge and research, institutional capacity, appropriate technologies and recognition were also considered significant barriers.

### Technical actions that support adaptation

1. Adaptation actions undertaken almost always involved change in species, varieties, and breeds in production systems. The changes include direct selection of materials to meet changed conditions and introduction of adapted materials (species, varieties, breeds, populations) and diversification of farming systems. The importance of traditional materials (e.g. traditional varieties or breeds) was referred to by a number of respondents.

2. Diversification was one of the most common adaptation actions specifically described. Examples given included crop/animal diversification, increased diversity of crops or species, and use of trees in crop production systems.

3. Changed practices such as those associated with low input agriculture, Conservation Agriculture, improved water management and adjustments in crop and herd management were reported as adaptation actions by many respondents.

4. Access to and availability of materials that can be used in adaptation were identified as important concerns. This has both policy and technical dimensions and involves financial support and capacity development.

5. A range of technical approaches to support adaptation exist, have been widely tested, and often meet with success. The challenges that exist relate most commonly to the wide scale adoption (mainstreaming) of adaptation actions involving genetic resources for food and agriculture. These reflect lack of capacity, lack of institutional support and limited incentives or benefits for farmers to adopt alternative methods or materials. Other barriers include lack of financial resources and inappropriate policies.

6. The social and economic dimensions of adaptation were not commonly mentioned by respondents except in a few specific cases where the importance of participatory work with farmers and rural communities was noted.

7. The need for additional conservation actions was one of the most common additional adaptation actions mentioned.

8. The need for improved methods of monitoring change in ways relevant to the conservation and use of genetic resources was noted.

9. The most common barriers to the adoption of adaptation actions were those associated with problems of mainstreaming and uptake as noted in 5. above.

### Policy measures that support adaptation and Global Plans of Action for genetic resources

1. The inclusion of genetic resources for food and agriculture perspectives in national climate change adaptation planning was uneven and a number of specific actions were identified which would improve both the inclusion of these perspectives and the involvement of those with the relevant expertise.

2. The activities identified of greatest importance related to the development of adapted materials and to the need to strengthen conservation. The importance of policies that enhance availability of materials was specifically noted by a number of participants.

3. Global Plans of Action (GPAs) were considered to provide an important framework to support the use of genetic resources for food and agriculture in adaptation. A significant percentage of respondents (35%) considered that the GPAs were an adequate framework although 25% replied that they were not sufficient.

4. Ensuring that genetic diversity and genetic resources for food and agriculture are integrated into national adaptation planning will require a number of activities that are likely to include involving genetic resources stakeholders, improved linkages between sectors and groups concerned with genetic resources work, improved awareness of policy makers and government officials, regional and international collaboration, implementation of existing international agreements and capacity development.

5. Many respondents commented on barriers to inclusion of genetic resources for food and agriculture and ways of overcoming these barriers. Stakeholder involvement, improved linkages, increased awareness, strengthening availability of resources and capacity development were all identified as important to
improving inclusion of genetic resources for food and agriculture perspectives in climate change adaptation policy aspects.

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<th>Technical actions that support mitigation</th>
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<td>1. The reduced number of replies on mitigation technical actions indicates either a lower involvement of genetic resources for food and agriculture in mitigation actions or a lower awareness of such actions.</td>
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<tr>
<td>2. A wide range of genetic resources for food and agriculture relevant mitigation actions were identified. Many or some actions were noted as being undertaken with respect to animal management and crop production practices, forestry related measures, and water management practices. Fewer replies identified rehabilitation related aspects.</td>
</tr>
<tr>
<td>3. The main limitations identified were a poor understanding of benefits by farmers (or lack of direct benefits), lack of funds, inadequate collaboration and lack of appropriate policies.</td>
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<tr>
<th>Policy measures that support mitigation</th>
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<tr>
<td>1. The reduced number of replies on mitigation policy actions indicates either a lower involvement of genetic resources for food and agriculture in mitigation related policy development or a lower awareness of such actions.</td>
</tr>
<tr>
<td>2. Barriers to involvement included lack of funds, lack of technical expertise, lack of effective national communication, lack of awareness at policy maker level leading to low priority of genetic resources at national level and finally, lack of coordination between the different initiatives related to climate change, biodiversity, genetic resource and food security.</td>
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<tr>
<td>3. Important aspects of increasing genetic resources for food and agriculture perspectives in mitigation policy development include raising awareness amongst policy and decision makers, research to provide relevant scientific evidence, specific technical actions that e.g. involve use of less fuel, and appropriate policies on pesticides and chemical fertilizers.</td>
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<th>Research activities</th>
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<td>1. While the number answering questions on this topic were reduced compared with earlier sections of the survey, it is worth noting that many comments in earlier sections emphasized the importance of research.</td>
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<td>2. Since many adaptation actions are likely to be specific to the sector and country, the survey suggests that there may well be a need to encourage sectors in some countries to initiate research activities relevant to their specific realities.</td>
</tr>
<tr>
<td>3. Some general cross-cutting topics can be identified such as the genetic control of abiotic stress tolerance, role of phenotypic plasticity and understanding adaptability to variable conditions.</td>
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<tr>
<td>4. The role of diversity and diversification in reducing vulnerability and enhancing resilience has to date received less explicit attention in research but is likely to increase in importance. This perspective was noted in both the aquatic and micro-organism Background Study Papers (55 and 57) prepared for the Commission and has obvious cross-sectoral dimensions.</td>
</tr>
<tr>
<td>5. Research that supports the development of improved economic and policy environments to support adaptation was rarely mentioned in the survey or in the Background Study Papers.</td>
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<td>1. The links between climate change information management activities and genetic resources ones at country level were unclear from responses to the survey. A specific analysis may be needed to explore the ways in which information resources are developing globally and nationally.</td>
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<td>2. One gap that emerged from the survey is the absence of a way of monitoring responses to ongoing change at sector, species or variety/breed levels.</td>
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<th>Public awareness activities</th>
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<tr>
<td>1. A wide range of public awareness tools are being used by a significant proportion of those replying to this section of the survey. The tools include publications, news media, films, TV and video, radio and the internet.</td>
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<td>2. It might be helpful to compile additional information that can help to undertake public awareness activities. This could be made web accessible with examples of the kinds of products that have been successful.</td>
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<th>Capacity Building</th>
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<td>1. There is a general perceived need for training activities that focus on conservation and use of genetic resources in relation to climate change.</td>
</tr>
<tr>
<td>2. A wide variety of suggestions were made on the type of training needed and on the groups that should be involved. The need to improve capacity of farmers and first level advisers was specifically noted as well as the importance of targeted training on aspects of policy, economics and conservation.</td>
</tr>
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1. INTRODUCTION

1.1. The context of the report

The FAO Commission on Genetic Resources for Food and Agriculture (the Commission), at its Fourteenth Regular Session, reaffirmed the importance of genetic resources for food and agriculture for coping with climate change and the need for raising awareness of their potential roles, as appropriate. At the same Session, the Commission adopted the Programme of Work on Climate Change and Genetic Resources for Food and Agriculture (Programme of Work).

The Commission’s Programme of Work has two objectives:

A. Promote the understanding of the roles and importance of genetic resources for food and agriculture in food security and nutrition and in ecosystem function and system resilience in light of climate change.

B. Provide technical information to enable countries to understand the role of genetic resources for food and agriculture in climate change mitigation and adaptation, as appropriate.2

The Secretariat of the Commission commissioned the Platform for Agrobiodiversity Research (PAR), with the support of Bioversity International, to develop and conduct an online survey to identify “Lessons learned about ways and means to conserve and use genetic diversity to build resilience to climate change in food and agriculture systems”. The survey was undertaken during August and September 2013.

This report presents an analysis of the responses to the survey together with information from other relevant sources. It seeks to highlight knowledge and experiences of the use and conservation of genetic resources for food and agriculture in coping with climate change from all around the world, taking account of the specificities of the different sectors and the need for an integrated approach. The information provided in the report provides an entry point for the identification of successful approaches to the use of genetic resources for climate change adaptation and mitigation.

1.2. Sources of Information

1.2.1. The survey

The survey was designed to gather experiences from around the world on climate change adaptation and mitigation actions that involve the use of genetic diversity. It also aimed to obtain information on the extent to which the role of genetic resources is recognized and genetic resources are used for adaptation and mitigation. For this reason, the survey sought information about the inclusion of genetic resources dimensions in the development, for example, of National Adaptation Programmes of Action (NAPAs), National Adaptation Plans (NAPs), Nationally Appropriate Mitigation Actions (NAMAs) and other climate change planning processes.

The survey included both direct questions and opportunities to comment or share information and documents on:

- Effects of climate change on the conservation and use of genetic resources for food and agriculture;
- Technical and policy related adaptation and mitigation activities;
- The contribution of the Global Plans of Action for genetic resources;
- Research, information management public awareness and capacity building activities.

Both adaptation and mitigation require increased efforts to conserve genetic resources and to enhance their use. The survey sought to assess the extent to which actions are already being undertaken and what those actions were. It provides a status report of the actual challenges and opportunities being experienced around the world in mobilizing genetic resources to help cope with climate change. Because the actions that can support adaptation and mitigation are many and varied and include both technical and policy dimensions, which need to be supported by research, capacity building and awareness development, the survey was

comprehensive and demanding. It produced a large amount of diverse information. Many participants provided detailed additional information in the form of references to literature or to documents available through the web. Where possible, these have also been reviewed and the information provided included in the analysis.

The survey was structured as follows:
1. Information about respondent
2. Perceptions of the effect of climate change
3. Actions taken that support adaptation
   3.1 Technical adaptation actions undertaken
   3.2 Policy adaptation actions undertaken (including NAPAs and NAPs)
   3.3 Implementation of the Global Plans of Action for genetic resources in relation to climate change adaptation
4. Actions taken that support mitigation
   4.1 Technical mitigation actions undertaken
   4.2 Policy mitigation actions undertaken
   4.3 Implementation of the Global Plans of Action for genetic resources in relation to climate change mitigation
5. Research activities
6. Information management and public awareness activities
7. Capacity building activities

In each section of the survey a lead question sought to determine whether the respondent had been involved in the subject area addressed. Where the answer was “yes” a set of questions was then presented on the type of involvement and activities undertaken. At the end of each section the respondent was invited to provide further information in the form of references to documents or websites and to upload relevant papers or documents. Respondents could select which parts of the survey they wanted to answer and, in the report, numbers responding to the relevant part of the survey are given and percentages are calculated with reference to the numbers answering particular questions.

The survey was sent to genetic resource sector national focal points of the Commission, a wide range of civil society organizations and many genetic resources and climate change experts (over 3,500 people or organizations in total). The survey was also available through the PAR website and promoted through a PAR newsletter and FAO social media channels to provide opportunities for wider participation. Three hundred and ninety four participants completed at least parts of the main sections of the questionnaire and 53% of these completed the whole questionnaire (208 respondents).

Of the 88 participants who identified themselves as national focal-points, 61 completed the questionnaire (69%).

Of the 88 participants who identified themselves as national focal points 41, 31 and 27 were respectively from the plant, animal and forest sectors, 13 came from the aquatic sectors and others referred to themselves as cross-sectoral focal points (e.g. national focal points for the State of the World’s Biodiversity for Food and Agriculture). It should be noted that some respondents represent more than one genetic resources sectors (Figure 1.1).
Using a drop down list, 281 participants mentioned their region of origin or the region where they work (this was not specified) and these are reported in Figure 1.2.

**Figure 1.2 Respondents by Regions** (% of respondents; N= 281)

- Southwest Pacific: 2
- North America: 3
- Near and Middle East: 4
- Latin America and the Caribbean: 14
- Europe and the Caucasus: 18
- Asia: 27
- Africa: 25
- Global: 6

*Note: Global was one of the categories in the drop down list.*

Two hundred and eighty-eight participants reported on the level at which their work was implemented (Figure 1.3). The replies indicated that over three quarters of respondents were involved at national level. Of these about 26% of the respondents work at a national agency (ministry or government department, 21% at a national research centre and 21% at a university / training institution (see Figure 1.4).
A multiple choice question asked participants about their field of expertise. Two hundred and seventy-seven participants responded and the different fields of expertise with percentages of respondents are shown in Figure 1.5. Of the respondents, 40% reported having expertise in plant genetic resources, 18% in animal genetic resources, 18% in forest genetic resources, 8% in fisheries and aquatic genetic resources and 4% in invertebrate and microbial genetic resources.
1.2.2. Reports of the Commission and other literature consulted

In preparing this report, PAR reviewed a number of sources that provide information on the use of genetic resources for adaptation to climate change. These include the Background Study Papers No. 53-57, 60 (Asfaw and Lipper, 2011; Beed et al., 2011; Cock et al., 2011; Jarvis et al., 2010; Loo et al., 2011; Pilling and Hoffmann, 2011; Pullin and White, 2011; available at www.fao.org/nr/cgrfa) on climate change and micro-organism, invertebrate, animal, forest, aquatic and plant genetic resources, the synthesis paper prepared by PAR on agrobiodiversity and climate change (PAR, 2010), and a range of research papers and other documents on climate change and agriculture which contained information relevant to the maintenance and use of genetic resources.

1.3. Definitions of terms

For the purposes of this survey biodiversity for food and agriculture is defined as all the components of biological diversity that are essential for feeding human populations and improving the quality of life. It includes the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain human life as well as the key functions of ecosystems.

The United Nations Framework Convention on Climate Change (UNFCCC) describes climate change as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.
Climate change adaptation has different definitions. It has been described as “The evolutionary process whereby an organism becomes better able to live in its habitat or habitats”. The UNFCCC defines adaptation as actions taken to help communities and ecosystems cope with changing climate condition or, as stated in the UNFCCC NAP Technical Guidelines, human-driven adjustments in ecological, social or economic systems or policy processes, in response to actual or expected climate stimuli and their effects or impacts. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation. The IPCC describes adaptation as adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (VCCCAR, 2014).

Mitigation is described by the IPCC (2007) as an anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases. According to UNEP, climate change mitigation refers to efforts to reduce or prevent emission of greenhouse gases. Mitigation can mean using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behavior. It can be as complex as a plan for a new city, or as a simple as improvements to a cook stove design. Efforts underway around the world range from high-tech subway systems to bicycling paths and walkways. Protecting natural carbon sinks like forests and oceans, or creating new sinks through silviculture or green agriculture are also elements of mitigation (UNEP, 2014).

2. PERCEPTIONS OF CLIMATE CHANGE AND ITS EFFECTS

2.1. The effects of climate change

The most recent report of the IPCC states that the evidence is now clear that climate change is affecting food security for everyone, particularly for poor people (IPCC, 2014, Vermeulen et al., 2014). Although positive impacts are observed in some high latitude areas such as northeast China and the UK, globally negative impacts are more common with respect to both crop and animal production. With respect to fisheries the abundance of key species is shifting polewards, associated with rapid rises in sea temperatures in recent decades. Meanwhile subtropical species have decreased with negative implications for small-scale coastal fisheries in tropical countries, which employ the majority of people working in capture fisheries.

Several periods of rapid increases in international food prices have occurred since 2007, affecting consumers who are linked into international food markets. Price increases result from multiple factors, including competing demand among human food, animal feed and biofuels, but it is evident price spikes often follow extreme climate events, which have become more likely as a result of climate trends. Poor consumers spend a greater proportion of their incomes on food, and thus suffer the greatest negative impacts of food price rises.

A key food safety issue for plant-derived foods with climate change is mycotoxins (poisons from fungal infections, for example in stored maize). In temperate and cooler tropical regions, mycotoxins may increase with rising temperatures, but in the hotter tropics mycotoxins may be eliminated as temperature surpasses thresholds for survival of the pathogen.

The effects of climate change include rises in temperature and changes (positive and negative) in rainfall amounts, distribution and timing. Increased variability in weather patterns is also associated with climate change as well as a greater frequency of extreme events. One major feature of climate change is that the effects are often unpredictable especially at national or local scales. Another feature is that year on year changes are usually slight or even not perceptible. One year may be warmer, the next cooler making coping at farm level extremely difficult. Two concepts have thus become increasingly important – adaptability and resilience.

Table 2.1 Main effects of climate change

<table>
<thead>
<tr>
<th>Climate change effect</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂ Fertilization</td>
<td>• Increased CO₂ availability for plant growth</td>
</tr>
<tr>
<td>Increase in global mean temperatures</td>
<td>• Increase in max on hot days</td>
</tr>
<tr>
<td>0.2-0.4°C per decade</td>
<td>• Increase in min on cold days</td>
</tr>
<tr>
<td>2°C - 4°C by 2050</td>
<td>• Increase in annual occurrence of hot days</td>
</tr>
<tr>
<td></td>
<td>• Increase in intensity, duration and frequency of heat waves</td>
</tr>
<tr>
<td>Changes in precipitation</td>
<td>• Frequency, duration and intensity of dry spells and droughts</td>
</tr>
<tr>
<td></td>
<td>• Changes in timing, location and amounts of rain or snow</td>
</tr>
<tr>
<td>Increase in frequency and intensity of extreme</td>
<td>• High winds</td>
</tr>
<tr>
<td>weather events</td>
<td>• Storm surges</td>
</tr>
<tr>
<td></td>
<td>• Flash floods</td>
</tr>
<tr>
<td>Greater weather variability</td>
<td>• Instability of seasonal weather patterns</td>
</tr>
<tr>
<td></td>
<td>• Changes in start and end of growing seasons</td>
</tr>
<tr>
<td>Rising sea levels</td>
<td>• Increased salinization of available water</td>
</tr>
<tr>
<td></td>
<td>• Loss of land</td>
</tr>
</tbody>
</table>

(Source: FAO, 2008)

2.2. Perceptions of effects on conservation and use of genetic resources for food and agriculture

While it is not possible to entirely separate effects of climate change on genetic resources from effects of other drivers of change, there was a clear perception from respondents that climate change is affecting agriculture and leading to change in production practices, confirming the information from much of the scientific literature.

2.2.1. Responses from the survey

The questions in this section were answered by up to 285 participants of whom about 30% were national focal points. Up to 40% of the respondents chose to provide additional information which revealed a great diversity of experiences and perceptions.

Aspects of food production affected

The first question in this section asked participants how much had climate change affected production in their country, sector or area of expertise (major, some, little, no effect or don't know). Following that question, participants were presented a list of six aspects of production for food and agriculture and they were asked which of those aspects, in their experience, had been or are being affected by climate change and to what extent (major, some, little, no effect or don't know). They could then report on other aspects not included in the list and give more textual information about the climate change affected aspects.

Over 90% of respondents considered that climate change had at least a slight effect on all aspects of agricultural production about which they were questioned (materials used in production, production practices, input use, food availability, food price, or non-agricultural assets and income). Over 75% believed that climate change had some or a major effect on the three primary aspects of agricultural production – materials, practices and inputs. Other effects of climate change noted by respondents (in order of frequency mentioned) included: the effect on wild resources (medicinal species, crop wild relatives, wild gathered food and biodiversity in general), problems experienced by rural communities and people (labour, capacity to work in hot weather, increased human illness), challenges for the conservation of genetic resources, conflicts over resources, the reduced availability of pasture and forage and transport problems.

Production sector affected by climate change

Participants were asked which production sector (animal, aquatic, crop and forest) had been affected by climate change and to what extent (major, some, little, no effect or don't know). They could then report on other production sector(s) affected and add more detailed information.
There were differences between sectors; while 85% of respondents believed that climate change had a major (50%) or some (35%) effect on crop production; the figures for animal and aquatic production were lower (e.g. aquatic- major effect, 29%, some effect, 35%; animal- major effect, 25%, some effect, 39%). The individual comments in this section identified effects on both species and within species diversity. It was also possible to identify a number of specific sector related aspects such as changes in the availability of grazing for animals and decline in production area for forestry.

**Effect on genetic resources conservation and use**

Participants were asked which genetic resources (animal, aquatic, forest, invertebrate, microbial, plant), in their experience, had been most affected by climate change with respect to their conservation and use. They could also report on other genetic resources and add more detailed relevant information, provide references, links and upload any useful documents.

There were differences in the extent to which different sector genetic resources were considered to be affected by climate change (see Figure 2.1 below). Both microbial and invertebrate genetic resources were considered to be affected by up to 57% participants (compared with up to 86% for plants). Inter and intra-specific effects were considered more or less equally important. The responses to this question may to some extent reflect the level of knowledge about different genetic resources by people from different sectors. This would also explain the high percentage of don't know replies recorded for the invertebrates and microbial sectors (an average of 32% of “don’t know” for invertebrates and microbial sectors; compared with an average of 18% for aquatic, 9% both for animal and forest and 4% of “don’t know” for plants).

The additional information provided included many examples of effects on crop, forestry, animal and fish species. It also drew attention to the importance of wild species, particularly crop wild relatives but also alpine flora, herbal and medicinal species, aquatic biomass, amphibians, reptiles and birds.

**Figure 2.1 Percentage of respondents who considered that climate change had some or major effect on the conservation and use of genetic resources by sector**

![Figure 2.1](image)

**Effect on ecosystem services**

Participants were asked which of the ecosystem services (provisioning, supporting, regulating or cultural services), in their experience, had been affected by climate change and to what extent (major, some, little, no effect or don't know). They could also provide more detailed textual information about this subject.

Respondents considered that climate change was affecting provisioning, regulating and supporting services to a similar extent and over 72% considered there was “some” or a “major” effect on specific services. The effect noted as “some” or “major” on cultural services was lower (45% with an increased % of don't knows – 15% compared to 4 to 6 % for the other services). There were noticeably fewer respondents providing additional information for this question as compared with other questions in this section of the survey and most referred to provisioning services rather than to regulating, supporting or cultural ones. Problems such as floods or landslides were noted, as was water availability.

**Main barriers experienced in dealing with observed changes**

A list of six barriers or challenges were presented (lack of recognition of problem, lack of appropriate policies, lack of appropriate technologies, lack of capacity and institutions, lack of knowledge and research, lack of financial resources) and participants were asked what they consider as the main barriers or greatest challenges in dealing with any of the changes described in previous questions (on a scale of 0 to 5, 5 being a major barrier and 0, not a barrier). They were also invited to identify other barriers not listed.
This question was answered by up to 229 participants. The most important barriers identified were lack of financial resources and appropriate policies (identified as major barriers (score 3-5) by over 75% of respondents. In fact, differences between the rated importance of different barriers was low and even the least important barrier (lack of appropriate technologies for production) was considered to be a major barrier by 64% of respondents.

2.2.2. Other sources of information

There is an extensive literature on the expected effects of climate change on agriculture, and to a lesser extent, on aspects relevant to the conservation and use of genetic resources. Some of the major effects expected or described are listed in Table 2.2. All of the effects noted in the Table were cited by at least some respondents to the questionnaire, confirming the conclusions of earlier reports.

Table 2.2 Some expected effects of climate change on aspects of agricultural production relevant to conservation and use of genetic resources

<table>
<thead>
<tr>
<th>Effect</th>
<th>Sector most affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post harvest losses</td>
<td>animals, aquatic, plant</td>
</tr>
<tr>
<td>Heat stress</td>
<td>animals, aquatic</td>
</tr>
<tr>
<td>Drought stress</td>
<td>all</td>
</tr>
<tr>
<td>Flooding</td>
<td>all</td>
</tr>
<tr>
<td>Distribution, phenology and evolution of pests and pathogens</td>
<td>all</td>
</tr>
<tr>
<td>Emergence of new pests and pathogens</td>
<td>all</td>
</tr>
<tr>
<td>Distribution of beneficial invertebrates (e.g. pollinators)</td>
<td>plant</td>
</tr>
<tr>
<td>Fecundity and gene flow</td>
<td>forest</td>
</tr>
<tr>
<td>Population regeneration</td>
<td>forest, aquatic</td>
</tr>
<tr>
<td>Soil organism performance and function</td>
<td>Invertebrate, microbial</td>
</tr>
<tr>
<td>Frequency of fires</td>
<td>forest</td>
</tr>
<tr>
<td>Loss of crop wild relatives</td>
<td>plant</td>
</tr>
<tr>
<td>Loss of useful wild food and medicinal species</td>
<td>all</td>
</tr>
<tr>
<td>Changed phenology and synchronicity</td>
<td>all</td>
</tr>
<tr>
<td>Loss of pasture and forage</td>
<td>animal</td>
</tr>
<tr>
<td>Conflicts over diminishing resources (water, forage)</td>
<td>animal, plant</td>
</tr>
<tr>
<td>Phenology and synchronicity</td>
<td>all</td>
</tr>
<tr>
<td>Loss of adaptability of species and breeds in agriculture</td>
<td>animal, plant, aquatic, forest</td>
</tr>
</tbody>
</table>

Sources: Pilling and Hoffman, 2011; Cock et al., 2011; Pullin and White, 2011; Loo et al., 2011; Beed et al., 2011; Asfaw and Lipper, 2011; Jarvis et al., 2010; FAO, 2008; IPCC, 2007.

Complementing earlier studies, the survey provides some guidance on the relative importance of the different effects of climate change of genetic resources for food and agriculture. Thus, from the survey, abiotic stress, the loss of useful wild biodiversity such as crop wild relatives appeared as important issues identified in written comments.

2.3. Main findings

1. The survey results suggest that there is a widespread perception that climate change is having an effect on production, on genetic resources for food and agriculture and on ecosystem services and that the implications for food and agriculture production are generally recognized by respondents. The additional information provided by respondents suggests that there is a substantial amount of information around the world that provides evidence on what are perceived to be the main effects.

2. The direct effect of climate change on production was perceived to be greater for crop and forest production than for animal and aquatic production.

3. Production problems with respect to the currently available materials are frequently observed and the need to change species, varieties or breeds was recognized.
4. Ways of coping with increased climate stresses are needed, particularly with abiotic stresses such as heat, drought and flooding. Problems associated with water availability are of major importance. The importance of developing new varieties, breeds or populations was widely noted.

5. Respondents considered that particular attention needed to be paid to the risks from climate change to useful wild species (crop wild relatives, wild foods, medicinal species etc.) on which future breeding efforts and many poor rural communities depend.

6. Loss of forage and availability of pasture were identified as problems that require adaptation responses.

7. The wide diversity of experiences presents a challenge to the identification of the extent and significance of the different problems identified – some systematic global monitoring of genetic resources effects might help guide responses and actions.

8. The main barrier in dealing with climate change was considered to be lack of financial resources. Lack of policies, knowledge and research, institutional capacity, appropriate technologies and recognition were also considered significant barriers.

3. ACTIONS THAT SUPPORT ADAPTATION

The survey asked questions about the adaptation actions in which participants, their organization or their country had been involved. A first series of questions explored technical aspects and a second, policy aspects.

3.1. Technical actions that support adaptation

This section provides information on some of the main adaptation measures of a technical nature that have been undertaken or are planned, involving the use and conservation of genetic diversity or genetic resources for food and agriculture. The survey also provides some information on lessons learned with respect to the development, implementation and the degree to which those adaptation measures have been useful and successful.

Technical actions include changes in crop, livestock or other components of biodiversity for food and agriculture that have been necessary to adapt to climate change. They also include changes in production practices or the timing of operations.

3.1.1. Survey responses

Up to 248 participants responded to this section of the survey and 64 participants provided further information. The first question in this section asked participants if they, their organization or their country had been involved in identifying, planning or implementing technical actions in support of adaptation to climate change that involve genetic diversity or the use of genetic resources. Of the 248 respondents to this question, about two thirds (approx. 170 people) answered positively.

Nine different types of adaptation actions were then listed with the request that the respondents who answered positively to the previous question indicate the extent to which those actions had been undertaken (many, some, none or don’t know). The proposed different adaptation actions were the following:

1. Changes between crop and animal production or other major changes involving different sectors (plant, animal, forest, aquatic);
2. Changes in species, crop, variety, breed or population within sectors;
3. Integrating or extending climate friendly materials (e.g. agroforestry species, perennials) in the production system;
4. Changes in production and protection practices and timing (including pest and disease management);
5. Changes in land use and/or management;
6. Changes in water management;
7. Changes in marketing and consumption patterns;
8. Economic measures including insurance;
9. Social measures (e.g. human migration).
The most popular adaptation actions reported by respondents were those involving aspects of farming practices (numbered as 1 to 6 in the above list, see Figure 3.1): from 79% to 91% the respondents stated that they undertook some or many of each of those adaptation actions. Of these actions, changes in species, crop, variety, breed or population within sectors received the highest score (91%). In contrast only 39% and 53% of the respondents indicated that actions related to changes in marketing and consumption patterns and economic or social measures were ongoing to at least some extent. Most commonly respondents indicated that some actions were ongoing (over 60% for actions 1-5).

**Figure 3.1 Percentage of respondents indicating that some or many adaptation actions of different categories had been undertaken (% of respondents)**

- Changes in species, crop, variety, breed or population within sectors: 91%
- Changes in production and protection practices and timing (including pest and disease management): 89%
- Changes between crop and animal production or other major changes involving different sectors (plant, animal, forest, aquatic): 88%
- Integrating or extending climate friendly materials (e.g. agroforestry species, perennials) in the production system: 85%
- Changes in land use and/or management: 83%
- Changes in water management: 79%
- Changes in marketing and consumption patterns: 61%
- Social measures (e.g. human migration): 50%
- Economic measures including insurance: 47%

Respondents who answered the first question of this section positively were also asked to describe any other types of adaptation actions not included in the previous list, involving genetic diversity and genetic resources.

Forty-one participants reported on other adaptation actions. Apart from those that could clearly be classified in the categories listed in Figure 3.1, these were, in order of importance:
- Conservation actions e.g. putting more effort in *ex situ* or *in situ* conservation in rare, indigenous, adapted, plant or varieties, forest and livestock or breeds, including collection, characterization, evaluation and documentation of data;
- Research e.g. more research or funding of research focused on conservation actions or more appropriate farming practices as described in the list of adaptation actions from number 1 to 6;
- A combination of the proposed farming practices (numbered 1 to 6 in the adaptation actions list) with social measures e.g. participatory plant breeding, participatory seed and variety selection, community gene bank;
- Strengthening of capacities at institutional and at community level;
- Changes in geographical zone for livestock production (e.g. transhumance).

Participants were then asked to describe in more detail the most important adaptation actions that had made use of genetic diversity or genetic resources. For each action, they were asked to provide a brief description,
to indicate at what scale (field level, farm/community level, ecosystem/landscape level) these had been applied and whether they had affected genetic resources conservation, utilization or availability. Participants could indicate, where possible, the kind of action using the categories provided and include references or web links to relevant documents. Participants were also asked if any of the adaptation measures they had described earlier contributed to mitigation and to list the relevant actions and describe their contribution to mitigation.

Up to 63 participants provided additional information and the replies suggested that the most frequently undertaken adaptation actions involved the identification (through characterization and evaluation) of more adapted varieties and breeds and the development (through breeding) of varieties or breeds with desired adaptations. Drought, heat, cold and flood tolerance were all identified as important traits together with resistance to pests and diseases and the value of crop wild relatives was noted. The importance of traditional varieties and participatory breeding were explicitly noted by a number of respondents.

Diversification was another major adaptation approach described by respondents involving the use of additional or new species, varieties and breeds. The importance of agroforestry based diversification was noted in a number of cases and Box 1 describes two large scale activities provided by a survey respondent. Conservation actions were also identified as an important response and both ex situ and in situ approaches were referred to. The importance of maintaining access to wild edible species was also noted.

Practices identified as important to supporting the development of adapted materials included Conservation Agriculture, improved irrigation and water management, reforestation and restoration of riparian corridors, reduction in use of wood as fuel and system of rice intensification (SRI). A number of respondents also noted the importance of improved information on the adaptations that might be needed through better hazard and vulnerability mapping. In general, adaptation actions were considered to be having fair degree of success. However many respondents noted that the actions were at a small scale or that it was too early to determine the level of success.

The majority of the adaptation actions were reported as taking place at field and farm/community level, and less than a fifth of the actions were considered to be at ecosystem or landscape level. Respondents reported that about half of the adaptation actions also contributed to mitigation. Examples given included the use of climate friendly materials (most commonly afforestation and agroforestry), Conservation Agriculture and adoption of low-input agriculture.

Participants were asked to describe the level of success of the adaptation actions taken, any problems or barriers encountered, the lessons learned and recommendations for the future. Fifty-three participants

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**Box 1. Two examples of tree diversification in India provided by survey respondents**

1. Over 15,000 farm-households have already planted over 75,000 plants representing 17 different species of medicinally important tree species, most of which are on the verge of extinction.

2. Currently 100 green farming models are being promoted where the following tree species are being promoted:
   - Garcinia (*Garcinia cambogia*)
   - Nutmeg (*Myristica fragrans*)
   - Mango (*Mangifera indica*)
   - Jack (*Artocarpus heterophyllus*)
   - Tamarind (*Tamarindus indica*)
   - Sapota (*Achras zapota*)
   - Pummelo (*Citrus grandis*)
   - Cinnamon (*Cinnamomum verum*)
   - Neem (*Azadirachta indica*)
   - Koovalam/Bael (*Aegle marmelos*)
   - Drumstick (*Moringa oleifera*)
   - Ashokam (*Saraca indica*)
   - Kanikonna (*Cassia fistula*)
   - Breadfruit (*Artocarpus communis*)

In both the examples the tree species will function as effective sink for CO₂ and many air pollutants, both gases and particulates, help minimize the hazards of soil and water erosion, stimulate the underlying productive capacity of the soil resource, improve the quality of local environment and strengthen biological diversity.
provided details and the most commonly reported problems or bottlenecks were lack of capacity and institutional support, lack of dissemination of techniques, lack of uptake by farmers, and lack of upscaling. Problems associated with lack of financial resources were also reported, particularly with respect to support for *ex situ* conservation. The lack of appropriate policies and the lack of political support were also reported and limitations in exchange of genetic resources, lack of clarity with respect to access and benefit sharing procedures noted. Lack of knowledge and of appropriate technologies were the least commonly reported barriers.

### 3.1.2. Information on technical adaptation actions from other sources

An important source of information on possible adaptation actions are the Background Study Papers prepared for the Commission (see Section 1.2.2). Most of the specific adaptation actions described by respondents to the survey were proposed in these Papers although some of the more general research-oriented actions were not specifically cited in responses (but see Section 5 below). The Background Study Papers and the results of the survey both note the importance of supporting actions such as the development of information systems and of improvement programmes that enhance the diversity available to users.

In 2008/9 PAR undertook a survey of climate change adaptation practices that used agrobiodiversity. Using information from over 250 reports (PAR 2010), they concluded:

- Adapting to climate change has usually involved a range of different actions at all three levels; ecosystem or landscape, farm or agricultural system, and involving both inter- and intra-specific diversity.
- Innovation based on both traditional knowledge and new information has been important, and social (e.g. community) cultural and political dimensions have played a key role.
- Use of traditional crop and livestock species and varieties, with new materials where necessary, has been a common feature.

The results of PAR’s earlier survey are confirmed by this most recent one in respect of the types of adaptation actions being undertaken including:

- Diversification within landscape, agricultural system or farm through a range of different approaches including agroforestry, maintenance of a diversity of crop, livestock or other species and varieties, and increased use of agro-ecosystem-associated biodiversity.
- Ecosystem protection and restoration, landscape rehabilitation and reforestation to reduce the adverse effects of climate change on local food systems.
- The use of sustainable agricultural practices (e.g. low-input agriculture).
- The continuing maintenance in production systems of intra- and inter-species diversity using both traditional crop and livestock species and varieties, forest and fish populations.
- The importance of facilitating the introduction of new varieties, breeds and populations.
- The importance of involving farmers and communities in planning and implementation of adaptation actions and of recognizing and including gender perspectives.
- Building on traditional agricultural practices and land-management techniques, especially in stress-prone environments.

All these were cited by at least some respondents in the additional information provided and some (such as diversification, the introduction of new materials, the use of sustainable practices) characterized the majority of actions described.

### 3.1.3. Main findings

1. Adaptation actions undertaken almost always involved change in species, varieties, and breeds in production systems. The changes include direct selection of materials to meet changed conditions and introduction of adapted materials (species, varieties, breeds, populations) and diversification of farming systems. The importance of traditional materials (e.g. traditional varieties or breeds) was referred to by a number of respondents.

2. Diversification was one of the most common adaptation actions specifically described. Examples given included crop/animal diversification, increased diversity of crops or species, and use of trees in crop production systems.
3. Changed practices such as those associated with low input agriculture, Conservation Agriculture, improved water management and adjustments in crop and herd management were reported as adaptation actions by many respondents.

4. Access to and availability of materials that can be used in adaptation were identified as important concerns. This has both policy and technical dimensions and involves financial support and capacity development.

5. A range of technical approaches to support adaptation have been developed, have been widely tested, and often meet with success. The challenges that exist relate most commonly to the wide scale adoption (mainstreaming) of adaptation actions involving genetic resources for food and agriculture. These reflect lack of capacity, lack of institutional support and limited incentives or benefits for farmers to adopt alternative methods or materials. Other barriers include lack of financial resources and inappropriate policies.

6. The social and economic dimensions of adaptation were not commonly mentioned by respondents except in a few specific cases where the importance of participatory work with farmers and rural communities was noted.

7. The need for additional conservation actions was one of the most common additional adaptation actions mentioned.

8. The need for improved methods of monitoring change in ways relevant to the conservation and use of genetic resources was noted.

9. The most common barriers to the adoption of adaptation actions were those associated with problems of mainstreaming and uptake as noted in 5. above.

3.2. Policy measures that support adaptation

There is a common perception among those working with genetic resources that national policies on climate change adaptation take insufficient account of the importance of genetic resources. A series of questions were asked about the inclusion of genetic resources for food and agriculture perspectives in national adaptation planning. These included involvement of the participants and of genetic resources for food and agriculture in the development of National Adaptation Programmes of Action (NAPAs), National Adaptation Plans (NAPs), other strategic plans and programmes concerned with adaptation to climate change, and the contribution of GPAs. In addition to analyzing the survey results, a limited analysis of the existing NAPAs was also undertaken and this is reported in Annex 1.

3.2.1. Inclusion of genetic resources in climate change adaptation policies

3.2.1.1. National Adaptation Programmes of Action (NAPAs)

Up to 214 participants responded to the section of the survey dealing with NAPAs. The first question in this section asked participants if the country in which they work had developed a National Adaptation Programme of Action (NAPA). A total of 214 participants responded to this question and of these, 47% responded positively, 22% responded negatively and 31% did not know.

Participants who answered positively were then asked if they were aware if the programme in question included any reference to genetic diversity or conservation and use of genetic resources. Sixty percent indicated that the NAPA included some reference to genetic diversity or the conservation and use of genetic resources for food and agriculture resources while 17% reported that it did not contain any reference. These replies are to some extent a subjective perception rather than an objective measure of inclusion of genetic resources since it depends on the interpretation by the respondent of what a reference to genetic resources for food and agriculture might involve. Participants who answered positively to this question were further asked to describe briefly the nature and content of the reference, to indicate the sector – animal, aquatic, forest, invertebrate, microbial or plant genetic resources and to attach any available documents or provide references or links to relevant materials. Thirty-three respondents provided examples and, these were classified in the analysis as follows, in order of frequency:

- Utilization of genetic resources and more specifically research, development and utilization of well adapted species and breeds;
• Conservation of genetic resources, including genebanks at national level, protected areas for forest and trees, maintenance of a tree cover on-farm;
• Availability of genetic resources and more specifically related to diversity and supply of planting stock;
• References to sustainable agriculture, organic agriculture, REDD and regulating marine fisheries.

The respondents’ information referred most frequently to plant genetic resources, followed by animal and forest genetic resources. Few references were made to fisheries or aquatic genetic resources and, even fewer to invertebrate and micro-organism genetic resources.

3.2.1.2. National Adaptation Plans (NAPs)

As National Adaptation Plans (NAPs) are mostly still under development, participants were first asked if the country in which they work developed or is developing a NAP. Of 203 participants replying to this question, 42% reported that the country in which they worked was developing a NAP (20% replied no and 38% did not know). The respondents who answered positively were asked if they were aware if the plan in question included any reference to genetic diversity or conservation and use of genetic resources. Seventy-five participants responded to this question and, 55% of these reported that the NAP included some reference to genetic diversity or to genetic resources for food and agriculture while 17% stated that it did not contain any reference.

Respondents who answered positively with respect to reference in the NAP to genetic resources for food and agriculture were asked to describe the nature and content of the reference, indicate the sector – animal, aquatic, forest, invertebrate, microbial or plant genetic resources and to provide references where available.

The additional information provided by 18 respondents showed that the following types of reference were most common:
• Utilization of genetic resources, mostly related to breeding for adapted or improved varieties and breeds or research on breeding, tree planting;
• Conservation of genetic resources, including in situ and ex situ conservation and policy changes for more conservation actions;
• Availability of genetic resources;
• Other references also include organic agriculture and regulating marine fisheries.

As with the replies to questions on NAPAs, the replies made most reference to plant genetic resources, followed by animal and forest genetic resources. Very few respondents mentioned fisheries or aquatic genetic resources and still fewer invertebrates and micro-organisms.

3.2.1.3. Other strategic planning processes

Participants were asked if the country in which they work developed some other strategic plan(s) or programme(s) related to adaptation to climate change (alternatively or additional to NAPAs and NAPs). Up to 205 participants answered this section: 51% positively, 12% negatively (37% did not know).

The respondents who answered positively were asked to list the plans or programmes known to them that included any reference to genetic diversity or conservation and use of genetic resources. They could then also attach any relevant documentation. About half the respondents answering the first question positively gave details of specific plans or programmes which were extensive and varied. Many had no specific focus on genetic resources for food and agriculture but dealt more generally with adaptation in the context of land use, agriculture, biodiversity conservation etc. These proved difficult to classify and some examples of the kinds of programmes reported are given in the Table 3.1 for information.
Table 3.1 Examples of adaptation plans or programmes including references to genetic diversity or conservation and use of genetic resources by country

<table>
<thead>
<tr>
<th>Country</th>
<th>National plans (NP) and other programmes (OP)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Africa</strong></td>
<td></td>
</tr>
<tr>
<td>Cameroon</td>
<td>NP: The agriculture sector strategy is in the process of being &quot;climate proofed&quot;.</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>NP: The Ethiopian Green Economy Strategy</td>
</tr>
<tr>
<td>Ghana</td>
<td>OP: Some national schemes integrate REDD++ and VPA for meeting NEPAD and MDG's</td>
</tr>
<tr>
<td>Kenya</td>
<td>OP: Breeding of resilient crops and livestock.</td>
</tr>
<tr>
<td>Madagascar</td>
<td>NP: Action Plan for Rural Development (PADR), Rural Development Policy Brief (LPDR) and Rural Development National Programme (RDNP) (an update of the PADR process); the policy letter on BV-PI (Watershed-Irrigated area); the National Seed Strategy (NSS); the Agricultural Sector Policy whose operationalization is the Agricultural Sector Program including agriculture, livestock and fisheries, and the National Strategy for Rice Development (NSRD). In addition, a national strategy on climate change for the agriculture (including agriculture, livestock and fisheries) sector is in development.</td>
</tr>
<tr>
<td>Namibia</td>
<td>NP: Livestock Conservation Program (included in the annual plan of the Directorate Agricultural Research and Training (DART); National Climate Change Strategy and Action Plan.</td>
</tr>
<tr>
<td>Nigeria</td>
<td>OP: Research programmes; breeding programmes; development of action plan for biodiversity conservation; development of policy guidelines on access and benefit sharing; awareness creation on genetic diversity.</td>
</tr>
<tr>
<td>South Africa</td>
<td>NP: The “Climate Change Sector Plan for Agriculture, Forestry and Fisheries” is under development by the Department of Agriculture.</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>NP: National Climate Change Strategic Action Plan; National Climate Change Adaptation Plan.</td>
</tr>
<tr>
<td><strong>Asia</strong></td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>NP: Developing a national action plan for forest genetic resources.</td>
</tr>
<tr>
<td>India</td>
<td>OP: Local level plan: steps to strengthen community conservation; preparing for sea level rise; Consortium for Agrobiodiversity conservation and enhancement; identification of climate risk managers; identification of climate resilient crops; NICRA Project; Water conservation measures.</td>
</tr>
<tr>
<td><strong>Europe and the Caucasus</strong></td>
<td></td>
</tr>
<tr>
<td>Cyprus</td>
<td>NP: Short-term Action Plan for facing the effects of drought in the forests of Cyprus (Period: 2009 - 2010).</td>
</tr>
<tr>
<td>Estonia</td>
<td>NP: The action plan of Climate change adaption and mitigation on Agriculture 2012-2020.</td>
</tr>
<tr>
<td>Finland</td>
<td>NP: <em>Ex situ</em> conservation programme; Biodiversity Strategy (Ministry of the Environment).</td>
</tr>
<tr>
<td>Germany</td>
<td>NP: National Strategy for Agrobiodiversity; National Programme for the Conservation and Sustainable Use of Plant Genetic Resources of Agricultural and Horticultural Crops; Animal Genetic Resources in Germany: National Programme for Conservation and Sustainable Use; Concept for the Conservation and Sustainable Utilization of Forest Genetic Resources in the Federal Republic of Germany; German National Technical Programme on the Conservation and Sustainable Use of Aquatic Genetic Resources.</td>
</tr>
<tr>
<td>Switzerland</td>
<td>OP: Cataloguing and conservation of traditional seeds and breeds, mainly vegetables, fruits, cereals, animals.</td>
</tr>
<tr>
<td>UK</td>
<td>NP: England Biodiversity Strategy; Scotland Biodiversity Strategy.</td>
</tr>
<tr>
<td><strong>Latin America and the Caribbean</strong></td>
<td></td>
</tr>
<tr>
<td>Costa Rica</td>
<td>OP: REDD+ initiative</td>
</tr>
<tr>
<td>Cuba</td>
<td>OP: Programmes are included in projects on biological diversity, forestry plans and projects at national level.</td>
</tr>
<tr>
<td>Mexico</td>
<td>NP: National System on Plant Genetic Resources for Food and Agriculture</td>
</tr>
<tr>
<td>Panama</td>
<td>OP: Project to support the Panama action plan on climate change.</td>
</tr>
<tr>
<td>Trinidad and Tobago</td>
<td>OP: PGR conservation programme; PGR utilization through planting material multiplication and distribution; Establishment of some genebanks.</td>
</tr>
<tr>
<td><strong>Near and Middle East</strong></td>
<td></td>
</tr>
<tr>
<td>Oman</td>
<td>NP: National strategy of biodiversity and plan of action.</td>
</tr>
<tr>
<td>Sudan</td>
<td>NP: Action plan of biodiversity 2014-2020 and action plan on climate change are being updated.</td>
</tr>
</tbody>
</table>
3.2.2. Involvement of respondents in the development of the NAPAs, NAPs or other relevant plans or programmes

Participants were asked if they, their organization, their sector or others working on the conservation and use of genetic diversity and genetic resources for food and agriculture had been involved in the development of National Adaptation Programmes of Action (NAPAs), National Adaptation Plans (NAPs), or other relevant strategies and plans in their country. Up to 204 participants replied to this section of the survey. Almost 40% replied that there had been some involvement while 37% reported that there had not been any involvement.

Participants who answered positively were asked to describe the involvement and comment on its success from the perspective of recognition of the importance of conservation and use of genetic diversity and genetic resources for food and agriculture in adaptation to climate change and 56% of those replying positively to this question provided further information (45 respondents). The analysis of their replies indicated that involvement took the following form (in order of frequency mentioned):

- Implementation of genetic resources conservation and use related activities or projects (conservation, utilization or climate change related projects);
- Participation in the development of NAPAs, NAPs or other strategic plans or programmes;
- Participation into stakeholders’ consultation workshops;
- Collaborative activities at the genebank level;
- Collaborative research activities;
- Development of policy and law related with genetic resources conservation and sustainable utilization;
- Participation in an advisory committee for a specific plan;
- Development of strategies for the conservation, utilization and availability of genetic resources.

No information was provided on the success of any involvement.

Participants who answered negatively were asked if they had attempted to be involved in such planning processes. Those who answered that they had attempted to be involved were asked to describe the actions taken, the lessons learned and any main barriers to involvement.

About one quarter (26%) of those who had first replied that they were not involved had attempted to become involved in climate change adaptation planning processes through the preparation of documents, holding stakeholder meetings, collaborating with other sectors or other actions. The most common reason for failure of involvement was the difficulty of linking to policy makers. Other barriers to involvement that were noted were:

- The complexity of the process and time involved. Involving many stakeholders, requesting government officials and approvals, lobbying and obtaining political good will make the process long and tedious;
- Lack of funds to undertake necessary baseline studies on available genetic resources. This makes it impossible to make a plan of actions and decide what needs to be done in relation to genetic resource;
- The relevant processes are government driven and leave little space for other stakeholders;
- Involvement of stakeholders is not uniform;
- Lack of awareness at government level of the importance and impacts of climate change.

3.2.3. Formal provisions and financial arrangements

Participants were asked if any provisions relevant to the use and conservation of genetic diversity and genetic resources for food and agriculture for adaptation to climate change had been taken up in policy decisions, rules or regulations in their country or in the country where they work. Up to 203 participants answered questions in this section, of which 35% replied positively while 28% said that their country did not do so and 37% did not know. Participants who answered positively were asked to describe the provisions taken and provide references or links to any relevant materials and some examples are presented in Table 3.2.
Participants were further asked if they were aware of or if they had access to any financial provisions to support the conservation and use of genetic resources for food and agriculture as part of adaptation to climate change. Of the 203 replies some 25% indicated that they were aware of or had access to such resources. Participants who answered positively were asked to list the source of funds (local, national government, private, international organization, etc.) and whether they, their country or organization had accessed them. They were also asked to provide any information on the use of these funds. Most of the funding sources mentioned were recognized international donors which included the benefit sharing fund of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and the Global Environment Facility (GEF) although national funding sources were also referred to. Developed countries referred largely to national government resources.

### Table 3.2 Examples of provisions relevant to the use and conservation of genetic diversity and genetic resources for food and agriculture for adaptation to climate change

<table>
<thead>
<tr>
<th>Country</th>
<th>Provisions relevant to the use and conservation of genetic diversity and genetic resources for food and agriculture for adaptation to climate change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Africa</strong></td>
<td></td>
</tr>
<tr>
<td>Kenya</td>
<td>10% tree cover; VISION 2030, Underutilized Crops Policy of Kenya, Nutrition Policy of Kenya</td>
</tr>
<tr>
<td>Niger</td>
<td>Revision of the National Strategy and Action Plan on Biological Diversity (SNPA/DB)</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>The Environmental Management Act and the Access and Benefit Sharing Regulation of 2009.</td>
</tr>
<tr>
<td><strong>Asia</strong></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>Documentation of genetic resources; National Biodiversity Act 2002 and National Biodiversity Rules 2004; The Ministry of Environment and Forest, and the Ministry of Agriculture, Government of India have national level programmes.</td>
</tr>
<tr>
<td>Nepal</td>
<td>Agrobiodiversity policy formulated by Genebank and Nepal Agricultural Research Council (NARC) under Ministry of Agriculture Development (MoAD); development of national legislation to implement ITPGRFA/MLS as a contracting party of ITPGRFA.</td>
</tr>
<tr>
<td><strong>Europe and the Caucasus</strong></td>
<td></td>
</tr>
<tr>
<td>Cyprus</td>
<td>&quot;A Statement of Forest Policy&quot;</td>
</tr>
<tr>
<td>EU</td>
<td>In its budget for 2013, the European Parliament tabled the Preparatory action “EU plant and animal genetic resources in agriculture”. The aim of this preparatory action is to prepare the ground for enhancing the conservation and sustainable use of agricultural genetic resources in the EU. The preparatory action shall explore best ways for improving the sharing of knowledge and networking among relevant stakeholders in view of using the potential of genetic resources in the value chain, including specific quality products and short food chains.</td>
</tr>
<tr>
<td>Finland</td>
<td>Policies related to agriculture and forestry.</td>
</tr>
<tr>
<td>Germany</td>
<td>In the light of climate change, genetic monitoring obtained significance as an early warning system for changes within the forest ecosystems. With regard to climate change the Federal Government/Länder Working Group “Conservation of Forest Genetic Resources and Legislation on Forest Reproductive Material” is evaluating possibilities to strengthen the activities of forest tree breeding and genetic monitoring in the future.</td>
</tr>
<tr>
<td>Italy</td>
<td>Regional legislation with appropriate implementation.</td>
</tr>
<tr>
<td>UK</td>
<td>The climate change action plan recommends a broader use of genetic material both at species and provenance level within England. In contrast the advice within Scotland is more conservative and is reflected in the way the grant structure was set up. See &quot;Seed sources for planting native trees and shrubs in Scotland&quot; (FC 2006).</td>
</tr>
<tr>
<td><strong>Latin America and the Caribbean</strong></td>
<td></td>
</tr>
<tr>
<td>Costa Rica</td>
<td>There is a national agricultural policy that considers climate change and agro-environmental management as one of its pillars, and agro-biodiversity is one of the issues considered.</td>
</tr>
<tr>
<td>Panama</td>
<td>Conservation of wetlands RAMSAR site; Creation of marine and coastal protected areas and zones</td>
</tr>
<tr>
<td><strong>Southwest Pacific</strong></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>No export of a range of animal and plant species.</td>
</tr>
<tr>
<td>Cook Island</td>
<td>Provisions in local government laws that upheld the conservation, and safeguard the use of local genetic resources.</td>
</tr>
</tbody>
</table>
3.3. Implementation of Global Plans of Action

The Commission on Genetic Resources for Food and Agriculture negotiates Global Plans of Action (GPAs) that seek to create an efficient system for the conservation and sustainable use of genetic resources for food and agriculture. GPAs are intended as comprehensive frameworks to guide and catalyse action at community, national, regional and international levels through better cooperation, coordination and planning and by strengthening capacities. They contain sets of recommendations and priority activities that respond to the needs and priorities identified in global assessments: the reports on the state of the world’s genetic resources for food and agriculture.

GPAs have been developed for plant, animal and forest genetic resources sectors but not for aquatic, invertebrate and microbial genetic resources. The section on implementation of the GPAs was answered by up to 203 participants.

The first questions of this section asked participants if they were aware of the GPAs and if, as part of implementing the GPAs, their country or sector had developed programmes of work or initiated actions that specifically responded to climate change adaptation. Seventy percent of respondents indicated that they were aware of GPAs and 28% stated that the country or sector had developed programmes of work or initiated actions that specifically responded to climate change.

Participants who answered positively were asked to describe briefly the programmes of work or actions and to indicate how they were integrated into NAPAs and NAPs. Information was provided by 31 respondents. The activities described (in order of importance) were:

- Activities related to the conservation of genetic resources such as the establishment of genebanks for *ex situ* conservation of plants and animals;
- Activities related to the utilization of genetic resources such as breeding activities for better adapted varieties or breeds;
- Activities implemented at regional level, followed by national level or through a national strategy or international projects and funded from international or UN sources;
- Research on conservation methods, forest genetic resources.

Participants were asked if they thought that the adaptation measures based on the sustainable use and conservation of genetic resources proposed in the GPAs are sufficient to adequately address climate change in their country. Of the 182 respondents who replied to this question, 35% respond yes, 25% no, and 40% did not know. Participants who answered negatively were asked what additional actions they would recommend (30 replies). The replies most frequently mentioned the importance of research and of involving local people.

Participants were asked to describe any major actions taken in support of the implementation of the Global Plans of Actions on Genetic resources for Food and Agriculture that specifically address adaptation to climate change (referring back to answers given in the previous sections where appropriate). For each action, participants were asked to provide any available information on the scale of application, level of success, lessons learned and include references to any available additional information. There were 45 individual replies to this question. The importance of inventory and of conservation (most commonly *ex situ* conservation) was most commonly mentioned. The value of regional collaboration was also noted and the Strategic Plan for Meso-American PGR specifically mentioned.

3.3.1. Recommendations for the inclusion of genetic resources for food and agriculture in national adaptation planning

Participants were asked what, in their opinion, needed to be done to ensure that genetic diversity and genetic resources for food and agriculture will be integrated into NAPAs and NAPs, and what recommendations they would give to climate change planning authorities.

Over 90 respondents (slightly less than 50% of those answering this section of the survey) provided comments in answer to the question about what should be done to ensure that genetic diversity and genetic resources would be integrated into NAPs and NAPAs.
The recommendations made by respondents in order of frequency included:

- Ensuring participation of all relevant stakeholders, including rural communities and the genetic resources community;
- Strengthening linkages between interested groups and organizations; developing mechanisms, committees or other ways of strengthening collaboration;
- Preparing materials and undertaking actions that would improve awareness of policy makers, government agencies and officials; greater public awareness;
- Implementation of ITPGRFA;
- Ensuring resources were available to strengthen relevant components of existing conservation and use systems for genetic resources; undertaking specific actions such as baseline descriptions of the state of diversity;
- Linking with other countries to develop effective regional and international plans;
- Notifying government officials of research gaps in genetic resources fields;
- Better integration of climate change plans, strategies or activities with biodiversity plans, strategies or activities, better institutional integration of those topics in general;
- Capacity development in relevant areas.

### 3.4. Main findings

1. The inclusion of genetic resources for food and agriculture perspectives in national climate change adaptation planning was uneven and a number of specific actions were identified which would improve both the inclusion of these perspectives and the involvement of those with the relevant expertise.

2. The activities identified of greatest importance related to the development of adapted materials and to the need to strengthen conservation. The importance of policies that enhance availability of materials was specifically noted by a number of participants.

3. GPAs were considered to provide an important framework to support the use of genetic resources for food and agriculture in adaptation. A significant percentage of respondents (35%) considered that the GPAs were an adequate framework although 25% replied that they were not sufficient.

4. Ensuring that genetic diversity and genetic resources for food and agriculture are integrated into national adaptation planning will require a number of activities that are likely to include involving genetic resources stakeholders, improved linkages between sectors and groups concerned with genetic resources work, improved awareness of policy makers and government officials, regional and international collaboration, implementation of existing international agreements and capacity development.

5. Many respondents commented on barriers to inclusion of genetic resources for food and agriculture and ways of overcoming these barriers. Stakeholder involvement, improved linkages, increased awareness, strengthening availability of resources and capacity development were all identified as important to improving inclusion of genetic resources for food and agriculture perspectives in climate change adaptation policy aspects.
4. ACTIONS THAT SUPPORT MITIGATION

As section 3 on adaptation actions, this section is divided into two parts reflecting the two sets of questions asked in the survey. The first part covers technical mitigation actions and the second covers policy aspects.

4.1. Technical actions that support mitigation

Climate change mitigation generally involves reductions in human (anthropogenic) emissions of greenhouse gases (GHGs). Mitigation may also be achieved by increasing the capacity of carbon sinks, e.g. through reforestation to remove carbon dioxide from the atmosphere.

4.1.1. Survey responses

Fewer participants (181) chose to answer questions about mitigation than about adaptation. The first question of this section asked participants if they, their organization or their country had been involved in implementing technical actions in support of mitigation of climate change that involve the use of genetic diversity or genetic resources for food and agriculture. Of those who answered, 92 (51%) responded positively.

Ten kinds of mitigation actions were presented in the survey and respondents who answered the previous question positively were asked which of those mitigation actions had been undertaken and to what extent (many, some or none). The total number responding with information on the extent to which mitigation actions had been undertaken was 86.

The mitigation actions were:
- Crop residue management;
- Cropland-related mitigation practices in specific areas;
- Restoration of grasslands and degraded agricultural lands;
- Fodder crop production;
- Introduction of combined irrigation and fertilization techniques to increase efficiency;
- Methane capture for livestock;
- Improved efficiency in the production of livestock and fisheries;
- Reduced forest conversion and plantation of forests on agricultural land;
- Rehabilitation of degraded watersheds through improving and sustaining their hydrological regimes, including conservation of wetlands;
- Rehabilitation of degraded coastal zones through e.g. mangrove reforestation, conversion of abandoned or unproductive aquaculture ponds to more ecofriendly productive use and through cessation of overfishing and destructive fishing methods.

Figure 4.1 shows the extent to which respondents, their organization or their country had been involved in these different actions. All actions were identified as having been undertaken at least to some extent by over 75% respondents except for “Rehabilitation of degraded coastal zones” (70%) and “Methane capture for livestock” (48%).

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4 This list was built up from a summary of mitigation actions reported in submitted NAMAs (Wilkes, 2013; and from other sources such as Background Study Papers submitted to the CGRFA in 2011 (Pilling and Hoffman, 2011; Cock et al., 2011; Pullin and White, 2011; Loo et al., 2011; Beed et al., 2011; Asfaw and Lipper, 2011; Jarvis et al., 2010).
The respondents were then asked to describe mitigation actions that involved the use of genetic diversity or genetic resources for food and agriculture not included in the previous list. Those mentioned in replies included:

- Organic farming;
- Conservation agriculture;
- Production of bioenergy such as biogas.

Organic farming includes practices such as use of organic fertilizer, use of green manure and crop rotation to maintain soil fertility. It uses no chemical fertilizers and pesticides and reduces the use of fossil fuels and related atmospheric emissions. Organic agriculture also has a role in carbon sequestration through improved practices in cropland management and through agroforestry (Kotschi and Müller-Sämann, 2004). Conservation Agriculture contributes to mitigation though the use of no-till, soil cover and crop rotation (FAO, 2007). Both organic farming and Conservation Agriculture could have been classified under “Cropland related mitigation practices” and the fact that this was not done by some participants is noted here for completeness.

Respondents who answered the first question of this section positively were asked to describe in more detail the most important mitigation actions that had made use of genetic diversity or genetic resources, to indicate at what scale (field level, farm/community level, ecosystem/landscape level) these had been applied and whether they had affected genetic resources conservation, utilization or availability.

Twenty respondents described mitigation actions undertaken in more detail. These were most commonly related to actions that took place at farm level and to the utilization of genetic resources. However, actions that took place at landscape level and that were more related to the conservation of genetic resources were also mentioned. Mitigation actions concerned “Restoration of grasslands and degraded agricultural lands” were mentioned in 17 replies by respondents. Actions classified as "Cropland-related mitigation practices in specific areas", “Reduced forest conversion and plantation of forests on agricultural land” and “Rehabilitation of degraded watersheds through improving and sustaining their hydrological regimes, including conservation of wetlands”, which were mentioned 14 times each by respondents.
Those same respondents were then asked to describe the level of success of the actions taken, any problems or barriers encountered, the lessons learned and recommendations for the future. About a third of the actions were described by participants as having a satisfactory level of success but no specific features of successful actions were identified. The problems encountered or barriers to success identified included (in order of importance):

- Actions not identified as a priority, poor understanding of the benefits or lack of direct benefits to farmers or landowners, or the action was inappropriate for the target group;
- Lack of funds (including lack of funds to develop research);
- Lack of collaboration between research and extension entities for proper scaling up of the action(s);
- Lack of appropriate policies.

The participants were asked if any of the mitigation measures they had described above had contributed to adaptation and they were asked to list the relevant actions and describe their contribution to adaptation. Nineteen participants responded to this question and crop and breed diversification was identified most frequently as an adaptation action (as reported in the Section 3 on adaptation) closely related with mitigation. Examples given included:

- Allowing use of more efficient breeds thus lowering their consumption of costly feed (thus reducing the use of fossil fuel for the production of those animal feed);
- the use of better adapted crops, allowing for more yield, more biomass and more stable production (thus improving carbon sinks and sequestration).
- Use of higher diversity of crops and breeds that can make better use of degraded lands reducing soil erosion and fertility loss (thus lowering the use of fertilizers and reduce use of fossil fuels for their production).

4.1.2. Main findings

1. The reduced number of replies on mitigation technical actions indicates either a lower involvement of genetic resources for food and agriculture in mitigation actions or a lower awareness of such actions.

2. A wide range of genetic resources for food and agriculture relevant mitigation actions were identified. Many or some actions were noted as being undertaken with respect to animal management and crop production practices, forestry related measures, and water management practices. Fewer replies identified rehabilitation related aspects.

3. The main limitations identified were a poor understanding of benefits by farmers (or lack of direct benefits), lack of funds, inadequate collaboration and lack of appropriate policies.

4.2. Policy measures that support mitigation

Policy measures include the development of Nationally Appropriate Mitigation Actions (NAMAs), other strategic plans and programmes concerned with mitigation of climate change as well as specific programmes, legislation or regulations that address mitigation of climate change in the food and agriculture sectors. The policy dimensions of GPAs with respect to mitigation are also relevant.

4.2.1. NAMAs and other strategic plans or programmes and genetic resources conservation and use

The first question of this section asked participants if the country in which they worked had developed a NAMA. One hundred and seventy-nine participants responded of which 28% replied positively. About half of those replying positively stated that the NAMA contained reference to genetic diversity or to conservation and use of genetic resources for food and agriculture.

Respondents who answered the previous question positively were asked to describe briefly the nature and content of the reference, indicate the sector – animal, aquatic, forest, invertebrate, microbial or plant genetic resources and to attach any available documents or provide references or links to
relevant materials). Only two relevant examples were provided: the development and utilization of adapted varieties and a national animal genetic resources conservation plan.

Participants were then asked if the country in which they work developed some other strategic plan(s) or programme(s) related to mitigation of climate change. One hundred and seventy-six replies were received to this question of which 45% were positive. Respondents who answered positively were asked to list the plans or programmes known to them that included any reference to genetic diversity or conservation and use of genetic resources. Twenty nine respondents listed a series of strategies, plans or programmes which the country in which they were based had developed. Most of these overlapped with those listed under the similar questions on adaptation. Some, apparently specific to mitigation are listed in Table 4.1.

Table 4.1 Examples of mitigation plans or programmes including references to genetic diversity or conservation and use of genetic resources by country

<table>
<thead>
<tr>
<th>Country</th>
<th>National plans</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Africa</strong></td>
<td></td>
</tr>
<tr>
<td>Malawi</td>
<td>The government of Malawi has launched several projects supported by UN Agencies, like The Poverty and Environmental Initiative, and The National Program on Climate Change that provide scientific studies as basis for designing specific interventions.</td>
</tr>
<tr>
<td>Namibia</td>
<td>National Climate Change Strategy and Action Plan</td>
</tr>
<tr>
<td>South Africa</td>
<td>Climate change sector plan for agriculture, forestry and fisheries</td>
</tr>
<tr>
<td><strong>Asia</strong></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>Advisory committee on climate change, chaired by the Prime Minister; National Action Plan on Climate Change (NAPCC)</td>
</tr>
<tr>
<td>Indonesia</td>
<td>The Government of Indonesia regards the further development of the mitigation actions contained in the RAN GRK towards NAMAs as important; The establishment of a set of NAMAs will support UNFCCC compatibility and recognition of Indonesia’s mitigation framework and efforts. Indonesia’s National Mitigation Action Plan will be updated based on the latest developments.</td>
</tr>
<tr>
<td>Mongolia</td>
<td>Action Plan for Implementation of the National Program on Climate Change in Mongolia; Report on Technology Needs Assessment for Climate Change in Mongolia</td>
</tr>
<tr>
<td>Nepal</td>
<td>Local Adaptation Plans for Action (LAPA), which includes mitigation actions</td>
</tr>
<tr>
<td>Philippines</td>
<td>Plans on renewable energy</td>
</tr>
<tr>
<td><strong>Europe and the Caucasus</strong></td>
<td></td>
</tr>
<tr>
<td>Finland</td>
<td>National Strategy for Climate Change includes both adaptation and mitigation</td>
</tr>
<tr>
<td>Turkey</td>
<td>National Forestry Policy, National Biodiversity Strategy and Action Plan</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Government Carbon Plan includes a section on forestry which states a commitment to increasing forest cover and establishing the Woodland Carbon Code plus increasing the use of wood fuel.</td>
</tr>
<tr>
<td><strong>Near and middle east</strong></td>
<td></td>
</tr>
<tr>
<td>Oman</td>
<td>National strategy for biodiversity, strategy for establishing genetic resources center</td>
</tr>
<tr>
<td><strong>Southwest Pacific</strong></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>Australian government Carbon Farming Initiative, Low Carbon Economy - finance</td>
</tr>
</tbody>
</table>
4.2.2. Involvement of respondents in the development of the NAMAs or other relevant plans or programmes

Participants were asked if they, their organization, their sector or others working on the conservation and use of genetic diversity and genetic resources for food and agriculture had been involved in the development of Nationally Appropriate Mitigation Actions (NAMAs) or other relevant strategies and plans in their country. Of the 173 participants responding to this question, 22% replied that they or their organization or sector had been involved while 42% replied that there had not been any involvement.

Respondents who answered positively were asked to describe the involvement and comment on its success from the perspective of recognition of the importance of conservation and use of genetic diversity and genetic resources for food and agriculture in mitigation of climate change. The majority of respondents to this question indicated that their contribution was to provide comments, recommendations or documents such as reports related to different genetic resources sectors (crops, forestry, fisheries) and covering different subjects such as *ex situ* conservation and genebanks, community seed banks, *in situ* conservation, sustainable utilization, the role of agricultural biodiversity, research, technology needs assessment, etc. Other kinds of involvement mentioned were participation in meetings and training on the development of NAMAs.

Respondents who answered the previous question negatively were asked if they had attempted to be involved in such planning processes through preparing documents, holding stakeholder meetings, collaborating with other sectors or other actions. There were 69 respondents and 30% of those had attempted to be involved in such planning processes. The latter were asked to describe the actions taken, the lessons learned and any main barriers to involvement. Twelve respondents provided details to this questions and the different actions included, in order of importance, participation in stakeholders meetings at local or national level, involvement in national strategy development and publications related to agricultural or forest biodiversity. Some respondents commented on barriers encountered in becoming involved in the different mitigation planning processes (including NAMAs) and said that recommendations about the inclusion of agricultural biodiversity for climate change adaptation and mitigation are often disregarded by the authors of the NAMA documents. Another comment was that genetic resources level is usually raised in the adaptation strategies rather than in the mitigation strategies. The barriers identified by respondents included lack of funds, lack of technical expertise, lack of effective national communication, lack of awareness at policy maker level leading to low priority of genetic resources at national level and finally, lack of coordination between the different initiatives related to climate change, biodiversity, genetic resource and food security.

4.2.3. Formal provisions and financial arrangements

Participants were asked if any provisions relevant to the use and conservation of genetic diversity and genetic resources for food and agriculture for mitigation of climate change had been taken up in policy decisions, rules or regulations in their country or in the country where they work. One hundred and seventy participants responded to this question, 21% positively. Respondents who answered positively were asked to describe these, provide any available references or links to relevant materials and to upload any relevant documents. Eleven respondents provided detailed information and a summary table is provided below (Table 4.2). The actions listed were the same as those listed in 3.2.3 on adaptation.
Table 4.2. Examples of provisions relevant to the use and conservation of genetic diversity and genetic resources for food and agriculture for mitigation of climate change

<table>
<thead>
<tr>
<th>Country</th>
<th>Provisions relevant to the use and conservation of genetic diversity and genetic resources for food and agriculture for mitigation of climate change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Africa</strong></td>
<td></td>
</tr>
<tr>
<td>Kenya</td>
<td>“The Climate Change Authority Bill 2012” seeks to coordinate the response to climate change. It proposes the establishment of the Climate Change Authority that will be responsible for coordinating and implementing climate change response strategies.</td>
</tr>
<tr>
<td>Madagascar</td>
<td>The “Stratégie nationale face au changement climatique : secteur agriculture, élevage, pêche, 2012-2025” contains references to provisions taken in agriculture, livestock production and fisheries sectors in adapting and mitigating climate change.</td>
</tr>
<tr>
<td><strong>Asia</strong></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>Strengthening of the 5 National Bureaus on Plants, Fish, Animal, Trees and Agriculturally developed micro-organisms; the Biological Diversity Act 2002</td>
</tr>
<tr>
<td>Mongolia</td>
<td>Report on Technology Needs Assessment for Climate change in Mongolia</td>
</tr>
<tr>
<td>Nepal</td>
<td>National Biodiversity Strategy (NBS), National Agro-biodiversity Policy in place.</td>
</tr>
<tr>
<td>Philippines</td>
<td>Philippine Climate Change Commission</td>
</tr>
<tr>
<td><strong>Europe and the Caucasus</strong></td>
<td></td>
</tr>
<tr>
<td>Cyprus</td>
<td>Statement of Forest Policy</td>
</tr>
<tr>
<td>Spain</td>
<td>Special support for native breeds</td>
</tr>
</tbody>
</table>

Participants were then asked if they were aware of or if they had access to any financial provisions to support the conservation and use of genetic resources for food and agriculture as part of climate change mitigation. Replies to this question totaled 164 of which only 16% were positive. Respondents who answered positively were asked to list the source of funds (local, national government, private, international organization, etc) and whether they, their country or organization had accessed them. They were also asked to provide any information on their use. The resources listed were largely the same as those identified for the similar question in the adaptation section. More than 80% of the replies noted that they had access to governmental funds, even if in small amounts, in some cases through specific programmes by genetic resources sector (plant or animal conservation or breeding programmes for example) or through funds directed at provincial or local levels. These national funds were reported as being often combined with other sources of funds, generally from international organizations such as, in order of importance: FAO, the Global Crop Diversity Trust, GEF, UNDP, EU and others.

4.3. Implementation of Global Plans of Action

The Global Plans of Action (GPAs) for animal, plant and forest genetic resources contain references to safeguarding genetic resources and using them optimally to support mitigation of climate change. Similar to section 3.3, in this section the concern is with participants views on the implementation of these aspects of the GPAs.

Participants were asked if they were aware of the GPAs for genetic resources. One hundred and seventy-seven participants answered this question and 71% of the respondents indicated that they were aware of the GPAs. Twenty-nine percent responded that they are not aware of those plans. Participants were asked if, as part of implementing the GPAs, their country or sector had developed programmes of work or initiated actions that specifically respond to climate change mitigation. One hundred and seventy participants responded to this question and 25% responded positively (27% negatively).

Respondents who answered the previous question positively were asked how those programmes or work or actions are integrated into NAMAs. Only twelve people responded to this question and these replies indicated that actions were integrated through national climate change plans, climate change plans for specific sectors, sectors’ plan (forest, farm animal, rural development plan), through committees and projects or through specific activities related with the conservation of plant genetic resources.
4.3.1. Recommendations for the inclusion of genetic resources for food and agriculture in national mitigation planning

Participants were asked what needed to be done to ensure that genetic diversity and genetic resources for food and agriculture were integrated into NAMAs, how links could be improved so as to integrate genetic diversity and genetic resources for food and agriculture into NAMAs, and what recommendations they would give to climate change planning authorities. Forty people responded to this question giving a wide range of recommendations. Two recommendations that seem of particular importance were:

- To provide scientific evidence that genetic resources can support climate change mitigation (e.g. potential of forage crops in sequestering carbon, economic sustainability of conserving genetic resources), including research on reducing negative impacts of animal production;
- To raise awareness of the importance of genetic resources in climate change mitigation among decision and policy-makers at national level and community level; to improve dialogue between these different groups of stakeholders.

More funding was mentioned to a lesser extent. Other recommendations included: wider stakeholder consultation when developing NAMA, including involving farmers’ organizations; better coordination of efforts about climate change through bringing all climate change matters under one platform; strengthening institutions, training and capacity building for stakeholders implementing climate change mitigation actions; and providing community rights to genetic resources.

Participants were asked if they thought that mitigation measures based on the sustainable use and conservation of genetic resources proposed in the GPAs were sufficient to adequately address climate change in their country. One hundred and fifty-nine participants responded to this question and 30% responded positively (20% negatively).

Respondents who answered negatively were asked what additional actions they would recommend based on the sustainable use and conservation of genetic resources proposed in the GPAs to adequately address climate change in their country. Fourteen participants chose to reply to this question and mentioned:

- Raise awareness about the importance of genetic resources and ecosystems health amongst policy and decision makers;
- More research to provide scientific evidence (more dynamic and applied research, wider involvement of researchers and involvement of local communities, bringing the research at local level, opening it up from government control) and more funds for research;
- Specific technical actions were mentioned: less use of fossil fuel, participatory plant breeding (PPB);
- Develop national policies and plans and make provisions for their implementation; more rules against genetically modified organism and hybrid seeds, against pesticides and chemical fertilizers.

Participants were asked to describe any major actions taken in support of the implementation of the GPAs that specifically address mitigation of climate change (and where appropriate to refer back to answers given earlier). For each action, they were asked to provide any available information on the scale of application, level of success, lessons learned and include references to any available additional information. They were also invited to upload any documents that provide more information on the actions described earlier.

Only twelve participants responded to this question and some replies were not relevant. Relevant technical actions mentioned included:

- Reduced use of fossil fuels through reduction in the amount of high concentrated feed in milk production using adapted breeds;
- Carbon sequestration through use of high quality fodder crop mixtures as permanent cultures;
- Research on soil management and protection;
- Variety testing;
- Crop zonification.
The policy measures suggested were concerned primarily with awareness raising about genetic resources for food and agriculture and climate change at governmental level.

Finally, participants were asked if any of the mitigation measures they had described earlier contributed to adaptation and if so, to list the relevant actions and describe their contribution to adaptation. The few replies to this question were similar to those provided in respect of the question about adaptation actions that contributed to mitigation (examples included the use of climate friendly materials - most commonly afforestation and agroforestry; conservation agriculture and adoption of low-input agriculture).

### 4.3.2. Main Findings

1. The reduced number of replies on mitigation policy actions indicates either a lower involvement of genetic resources for food and agriculture in mitigation related policy development or a lower awareness of such actions.

2. Barriers to involvement included lack of funds, lack of technical expertise, lack of effective national communication, lack of awareness at policy maker level leading to low priority of genetic resources at national level and finally, lack of coordination between the different initiatives related to climate change, biodiversity, genetic resource and food security.

3. Important aspects of increasing genetic resources for food and agriculture perspectives in mitigation policy development include raising awareness amongst policy and decision makers, research to provide relevant scientific evidence, specific technical actions that e.g. involved use of less fuel, and appropriate policies on pesticides and chemical fertilizers.

### 5. ACTIONS THAT SUPPORT ADAPTATION AND MITIGATION

Adaptation to climate change involves a number of related activities that provide the necessary knowledge, information, awareness and capacity to adopt the various approaches that have been identified as necessary or desirable. The survey asked a number of questions about these aspects and the responses are described in this section with additional relevant information from other sources.

#### 5.1. Knowledge gaps and research needs

Substantial climate change research efforts are under way around the world. Currently, even when research is not explicitly directed at specific aspects of climate change and agriculture, it is often placed in the context of climate change and the need to respond to such change. This is also true that genetic resources research is now frequently related to coping with climate change even when the relationship is not immediately obvious. Thus, any evaluation work that includes assessing abiotic stress tolerance and understanding the genetics of responses is now often described as work designed to help adapt to climate change.
5.1.1. Information from the survey

Participants were asked whether they, their organization or country were involved in research activities on climate change and the conservation and use of genetic resources. Of 185 participants replying to this question about 70% responded positively. The percentage of respondents seemed to be lower for national focal points of the Commission and might indicate that they or the organization or country they represented are less involved in research on climate change and the conservation and use of genetic resources.

Those who replied were asked about the topics of their research (Figure 5.1). The most commonly cited topics included baseline studies on the effect of climate change, participatory research and indigenous knowledge, conservation aspects, geographic distribution of genetic resources, information systems and availability of knowledge, and characterization and evaluation. Economics, participatory breeding, seed systems, agroforestry and policy focused research were less commonly cited. The numbers of respondents indicating research on plant aspects was about twice that indicating forestry or animal research with only a small number of respondents indicating work on aquatic or other genetic resources.

Additional information provided by respondents indicated that many institutes were involved in relevant research in a number of countries (e.g. Italy mentioned 12 institutes) covering a wide range of subjects in which aspects of forestry, crop wild relatives, and breed characterization were among those noted.

Figure 5.1 Respondents involvement in research relevant to climate change and genetic resources for food and agriculture (% of respondents, N= 116)

<table>
<thead>
<tr>
<th>Topic</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline data on the impacts of climate change</td>
<td>45</td>
</tr>
<tr>
<td>Participatory research and indigenous knowledge</td>
<td>41</td>
</tr>
<tr>
<td>Conservation in situ and on farm</td>
<td>40</td>
</tr>
<tr>
<td>Conservation practices and procedures</td>
<td>38</td>
</tr>
<tr>
<td>Conservation ex situ</td>
<td>37</td>
</tr>
<tr>
<td>Genetic resources geographic distribution</td>
<td>37</td>
</tr>
<tr>
<td>Information systems and availability of knowledge</td>
<td>35</td>
</tr>
<tr>
<td>Variety/breed characterization and evaluation</td>
<td>33</td>
</tr>
<tr>
<td>Ecosystem/landscape approach and management</td>
<td>32</td>
</tr>
<tr>
<td>Production systems and practices</td>
<td>31</td>
</tr>
<tr>
<td>Variety/breed improvement</td>
<td>30</td>
</tr>
<tr>
<td>Policies and rules</td>
<td>27</td>
</tr>
<tr>
<td>Agroforestry</td>
<td>24</td>
</tr>
<tr>
<td>Seed/breed exchange or seed/breed systems</td>
<td>23</td>
</tr>
<tr>
<td>Participatory breeding</td>
<td>19</td>
</tr>
<tr>
<td>Economic incentives to adaptation to climate change</td>
<td>18</td>
</tr>
</tbody>
</table>

5.1.2. Other research activities

The CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS) is a major global programme of research on agriculture and climate change. Under the auspices of the
CGIAR, CCAFS involves 15 different international research institutes and Future Earth\(^5\). At present, CCAFS work is focused on:

- Analysis of national adaptation policies and institutions and prioritizing adaptation options for various regions;
- Case studies on a selection of crops that have a large sets of data uploaded on Agtrials;
- Climatic determinants of genotypic adaptation characterized for contrasted historical normal periods (wet, dry, current) across the entire West Africa Semi-Arid Tropics; Updated agroclimatic metrics produced;
- Assessing the role that indigenous knowledge plays in enhancing the use of local agrobiodiversity for greater adaptation of local production systems to climate change;
- The collection and analysis of information on acquisition, use, distribution, uptake of germplasm useful for climate change adaptation by Centres’ partners (and other users of PGRFA beyond the CGIAR) in selected countries.

The research is focused on selected countries in West and East Africa, South and South East Asia and Latin America. The various projects include a number on the use of genetic resources, mapping of germplasm flows a systematic review of literature on the use of agricultural biodiversity for risk management and adaptation to climate change.

In addition, many countries have substantial research programmes on agriculture and climate change as noted in some of the responses to the questionnaire. In many cases the specific involvement of genetic resources in the work is difficult to assess. As noted above, in a broad sense, almost all climate change and agriculture research involves some use of genetic resources (as in identification of stress tolerance and breeding for traits associated with adaptation to climate change). However, the use of diversity as such as a means to improve ecosystem function, adaptability and resilience has been the subject of much less research.

The Background Study Papers prepared for the Commission’s 13\(^{th}\) Session identify research topics (see papers No. 53-57, 60 and Jarvis et al., 2010). Table 5.1 provides a compilation of topics from these papers that seem to be of wide general significance.

\(^5\) [http://www.futureearth.info](http://www.futureearth.info)
Table 5.1. Some major topics for research on genetic resources and climate change identified in the Background Study Papers

<table>
<thead>
<tr>
<th>Research topics by genetic resources sectors</th>
<th>Invertebrate</th>
<th>Micro-organisms</th>
<th>Forest</th>
<th>Animal</th>
<th>Aquatic</th>
<th>Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contribution of unmanaged invertebrates to sustainable agriculture</td>
<td>Quantification of responses of invertebrate species, communities and food webs to climate change</td>
<td>Rates of movement of selected key species</td>
<td>Inventory and taxonomy of micro-organisms</td>
<td>Monitoring and surveillance of distribution</td>
<td>Response and adaptation of species to climate change and to stressors</td>
<td>Understanding inheritance of physiological traits associated with tolerance of abiotic stress</td>
</tr>
<tr>
<td>Impacts of past climate change in tropical areas</td>
<td>Taxonomy and genetic characterization of invertebrates in agro-ecosystems</td>
<td>Characterization of species and community functions</td>
<td>Genetic variation in relevant traits in farmed and fished species</td>
<td>Biological control</td>
<td>Genetic variation in relevant traits in farmed and fished species</td>
<td>Understanding varietal capacity to adapt to variable conditions (especially landraces)</td>
</tr>
<tr>
<td>Rates of movement of selected key species</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Phenotypic plasticity</td>
<td>Phenotypic plasticity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Scope for improving role of aquatic ecosystems in adaptation and mitigation</td>
<td>Seed system function</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ecosystem vulnerability</td>
<td></td>
</tr>
</tbody>
</table>

Source: Asfaw and Lipper, 2011; Beed et al., 2011; Cock et al., 2011; Jarvis et al., 2010; Loo et al., 2011; Pilling and Hoffmann, 2011; Pullin and White, 2011

5.1.3. Main findings

1. While the number answering questions on this topic were reduced compared with earlier sections of the survey, it is worth noting that many comments in earlier sections emphasized the importance of research.

2. Since many adaptation actions are likely to be specific to the sector and country, the survey suggests that there may well be a need to encourage sectors in some countries to initiate research activities relevant to their specific realities.

3. Some general cross-cutting topics can be identified such as the genetic control of abiotic stress tolerance, role of phenotypic plasticity and understanding adaptability to variable conditions.

4. The role of diversity and diversification in reducing vulnerability and enhancing resilience has to date received less explicit attention in research but is likely to increase in importance. This perspective was noted in both the aquatic and micro-organism Background Study Papers (55 and 57) prepared for the Commission and has obvious cross-sectoral dimensions.
5. Research that supports the development of improved economic and policy environments to support adaptation was rarely mentioned in the survey or in the Background Study Papers.

5.2. Information management and resources

5.2.1. Information from the survey

About 52% of a total of 165 respondents stated that they, their organization or country was engaged in developing climate change related information resources. Only 50 respondents (30%) indicated that these included a link to information on genetic resources. Participants were asked to provide information on the nature of any links but the replies were of very general nature, which made interpretation difficult. Some specific information resources were listed including national genetic resources databases and information about crop wild relatives.

The combination of information on genetic resources with geographic mapping and analysis of current climates and future expectations enables the identification of possibly adapted materials and this may be a useful approach to the provision of relevant information for the use of genetic resources for adaptation and the development of climate change sensitive conservation programmes (as in the case of crop wild relatives using the DIVA software, Jarvis et al., 2010). In the survey a range of databases for aquatic resources were also cited including www.fishbase.org, www.sealifebase.org, www.seaaroundus.org, and www.aquamaps.org.

5.2.2. Main findings

1. The links between climate change information management activities and genetic resources ones at country level were unclear from responses to the survey. A specific analysis may be needed to explore the ways in which information resources are developing globally and nationally.

2. One gap that emerged from the survey is the absence of a way of monitoring responses to ongoing change at sector, species or variety/breed levels.

5.3. Public awareness

From comments made in narrative replies to the survey it would appear that there are problems in relation to awareness of the importance of genetic resources for adaptation and of the need for enhanced conservation efforts. A large amount of anecdotal evidence also supports the view that there is an inadequate appreciation of the actual or potential contribution of genetic diversity to adaptation. The specific contribution of particular resources to developing materials with desirable traits is more widely recognized (and is the basis of much breeding improvement work at present).

5.3.1. Information from the survey

About 56% of 162 respondents to this part of the survey stated that they had been involved in public awareness activities of some type and about one third of these came from the replies of national focal points. A wide range of different activities were listed including research reports, press articles, government policy briefs, brochures, videos, conferences, workshops, seminars, round tables, radio and TV interviews, and presentations or talks to a wide variety of different groups (policy makers, farmers, the general public).

No defined strategy for public awareness could be identified from the responses to the questionnaire and it may be useful to identify what approaches should be prioritized for which audiences. There is clearly a lot of experience to draw on.
5.3.2. Main findings

1. A wide range of public awareness tools are being used by a significant proportion of those replying to this section of the survey. The tools include publications, news media, films, TV and video, radio and the internet.

2. It might be helpful to compile additional information that can help to undertake public awareness activities. This could be made web accessible with examples of the kinds of products that have been successful.

5.4. Capacity building

5.4.1. Information from the survey

The survey asked whether participants, their organizations or their countries had been involved in (or introduced) climate change related training. Just over half the respondents (of 171 replies) who answered questions on this topic stated that they, their organization, country or sector had been involved. Of those who replied positively over 70% reported that the training involved strengthening capacity in conservation and use of genetic resources. Farmer and community training were most common followed by training at higher education level. Twenty one respondents also reported positively on secondary school level training. Training on technical aspects of the contribution of genetic resources to climate change adaptation was most frequently noted as the type of training. Training on policy aspects of the contribution of genetic resources to adaptation was mentioned by 32 respondents.

The comments in the survey suggested a wide range of possible training approaches particularly for farmers and communities and at higher education levels with the development of specific modules for university courses. The need for a climate change adaptation guide book was mentioned.

Training programmes are certainly ongoing although, given that over 60% of those replying to this question indicated no awareness of training on genetic resources and climate change, there is clearly considerable room for expansion of capacity development activities. A further study specifically targeted at training and capacity building would be needed to draw firm conclusions on needs and gaps.

5.4.2. Main findings

1. There is a general perceived need for training activities that focus on conservation and use of genetic resources in relation to climate change.

2. A wide variety of suggestions were made on the type of training needed and on the groups that should be involved. The need to improve capacity of farmers and first level advisers was specifically noted as well as the importance of targeted training on aspects of policy, economics and conservation.

6. CONCLUSIONS

From the main findings, provided in each section, and from an overall review of information provided in the survey, a number of overall conclusions can be drawn about the conservation and use of genetic diversity and genetic resources for food and agriculture in response to climate change.

Climate change and the importance of genetic resources for food and agriculture

Over 75% of the respondents considered that climate change was already having a moderate or major effect on production, on genetic resources for food and agriculture and on ecosystem production, regulating or supporting services. The importance of genetic resources for food and agriculture in adaptation to and mitigation of climate change was widely recognized especially with respect to the development of new varieties, breeds or populations adapted to abiotic stress.
The importance of increased conservation

Enhanced conservation efforts, particularly of useful wild species such as crop wild relatives, were identified as a major priority. In replies to questions throughout the survey the importance of increasing both in situ and ex situ conservation was noted and the value of conserving useful wild species referred to frequently.

Technical adaptation actions

A large number of technical adaptation measures are already being tested around the world by all genetic resources for food and agriculture sectors. The most substantial section of the survey concerned the identification of technical adaptation actions that were being undertaken. The emphasis to date has been primarily on adaptation to specific abiotic stresses and, to a lesser extent, on adaptation to changed patterns of pests and diseases. Actions that led to increased diversification were referred to and often described in the replies to the survey. The emphasis in responses from those involved in plant and animal genetic resources for food and agriculture was still primarily on specific adaptation while those working with forest genetic resources emphasized diversification strategies. For both crops and animals the value of traditional varieties and breeds was noted. The survey provided little explicit information about the use of invertebrate or microbial genetic resources in adaptation.

The importance of the adoption of agricultural practices that support soil and water management such as Conservation Agriculture and organic agriculture were also noted. There were very few explicit references to improving resilience in production systems.

Technical mitigation actions

Mitigation actions involving the use of genetic resources for food and agriculture are in progress and are often linked to adaptation actions. Actions described include forestation, rehabilitation and restoration of landscapes or degraded land and improving the efficiency of livestock or fishery production. The linkage to adaptation actions was noted especially with respect to organic agriculture and Conservation Agriculture.

Issues in the implementation of technical adaptation and mitigation actions

A number of general conclusions can be identified with respect to the development and adoption of adaptation and mitigation actions:

- The accessibility of new materials is of central importance in responding to climate change. The issue of availability of the genetic resources needed for both adaptation and mitigation actions was identified by a significant number of respondents to questions in these sections and other parts of the survey (e.g. in comments on the policy questions). Access involves knowledge of available materials and their properties, ensuring their availability in ways and times that are appropriate and useful to users, and appropriate policy frameworks.

- More attention needs to be given to mainstreaming and up-scaling genetic resources for food and agriculture related activities. Some of the most common comments on barriers and degree of success were concerned with problems of mainstreaming and upscaling adaptation or mitigation actions. Resource availability, capacity and farmer benefit were all cited as problems in achieving widespread adoption of actions.

- Working in participatory ways with farmers, taking account of gender dimensions, and building local institutions are key elements contributing to success of adaptation and mitigation activities. A number of replies emphasized the importance of including rural communities, farmers and women in the planning, development and implementation of adaptation and mitigation actions.

- Adaptation involves both traditional and new genetic materials and involves the use of both traditional and new knowledge and experience. This needs to be achieved in ways that are relevant to rural communities and participatory approaches are of central importance.

- The social and economic dimensions of adaptation require greater consideration by those involved in conservation and use of genetic resources. Little information was provided in
responses on the social and economic dimensions of adaptation and mitigation actions and questions about social or economic aspects received generally lower numbers of positive responses than other questions. This may suggest that there is a gap in integrating the biological and production aspects of actions to the implications of these actions on the livelihoods and socio-economic situations of rural communities.

- **Improved ways for monitoring the effect of climate change on the conservation and use of genetic resources for food and agriculture and the effectiveness of adaptation or mitigation measures are needed.** The wide diversity of experiences recorded in the survey and the responses to specific questions indicate that means of monitoring the effect of climate change on the conservation and use of genetic resources would be valuable. Indeed, this was suggested in a number of comments by respondents.

**Policy aspects of genetic resources for food and agriculture in adaptation and mitigation**
Inclusion of genetic resources for food and agriculture conservation and use in national climate change strategic planning and policy development (NAPAs, NAPs, NAMAs and other strategic planning processes) is uneven. There are often significant barriers to participation in the different policy development processes. A specific concern of the survey was to try and assess the inclusion of conservation and use of genetic resources in national planning, particularly with respect to NAPAs and NAPs. The survey was only partially successful in this objective. While there was evidence that a significant proportion of NAPAs took account of genetic resources dimensions the nature of inclusion was not clear. A survey of a selected set of NAPAs (Annex 1) tended to confirm this impression. Recommendations for ensuring inclusion of genetic resources dimensions included fuller stakeholder involvement, more participatory development approaches for such policies, greater collaboration between agencies, briefing policy makers and greater public awareness. Replies also noted the importance of: (i) GPAs and their role in adaptation to climate change; (ii) international instruments such as ITPGRFA and (iii) better linkages between climate change and genetic resources actors and instruments.

**The contribution of GPAs**
GPAs have an important contribution to make in supporting use and conservation of genetic resources for food and agriculture for adaptation to and mitigation of climate change. However, links between GPAs and other national planning activities on climate change need to be strengthened. The GPAs that have been developed (plant, animal, forest) include a range of actions that can support adaptation and mitigation of climate change. The survey suggested that GPAs have not yet been fully embedded into national adaptation and mitigation planning and the importance (and difficulty) of engaging with the wider policy process involved in climate change planning was noted in a number of replies.

**Knowledge gaps and the need for research**
Knowledge gaps are limiting the capacity to respond to climate change. Research is needed in a number of key areas. Survey replies tended to focus on the need to characterize and evaluate a range of materials, the value of linking traditional knowledge and scientific knowledge and the importance of research to identify specific traits. Other material prepared for the Commission has identified the importance of developing a better understanding of adaptability and phenotypic plasticity, of strengthening evolutionary and adaptive capacity in addition to research on tolerance of specific abiotic stress. The results from the Survey on current information management systems were not clear although their importance was recognized. There may be a need for a separate investigation of the ways in which existing information systems support climate change related genetic resources for food and agriculture conservation and use issues.

**Public Awareness**
Increasing public awareness is widely recognized as an important part of work on genetic resources for food and agriculture conservation and use for climate change. A very wide range of public awareness activities were described in replies to the survey which involved different media, approaches, and audiences. It may be helpful to develop a compilation of tested approaches that have proved successful and can be widely adopted.
**Capacity Development**

Capacity development is essential to support work on conservation and use of genetic resources for food and agriculture in the context of climate change. There was a strongly stated demand throughout the survey replies for capacity development activities that focused on rural communities, other genetic resources users and those involved in conservation work. Capacity development should include efforts to increase the understanding of the importance of climate change and the kinds of genetic resources for food and agriculture related actions that can be relevant as well as enhancing the appreciation amongst the climate change community of the importance of genetic resources for food and agriculture. Other aspects noted in replies included:

- The use of participatory approaches that strengthen local involvement in developing adaptation actions.
- Ways of embedding social sciences and economic aspects and of addressing policy constraints.
References


on Genetic Resources for Food and Agriculture. Rome, Italy. 25 p.
http://www.fao.org/docrep/meeting/023/mb696e.pdf


Vermeulen S., Aggarwal P., Campbell B., Davey E., Grainger-Jones E. and Yao X. 2014. Climate change, food security and small-scale producers. Analysis of findings of the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC).

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Summary

In order to complement the information provided through the global survey on “Lessons learned about ways and means to conserve and use genetic diversity to build resilience to climate change in food and agriculture systems” a review of 13 National Adaptation Programmes of Action (NAPAs) was undertaken to assess the extent and ways in which genetic diversity of useful species and the conservation and use of genetic resources are integrated in these NAPAs. The review also sought to look at the NAPA development process in three countries.

Two approaches to inclusion of genetic diversity and genetic resources for food and agriculture (GRFA) were identified – the direct use or conservation of GRFA to provide adaptation (explicit use) and the indirect use consequent on changing management practices or other adaptation actions (implicit use). Both were identified in the NAPAs surveyed although the emphasis was on broad adaptation actions associated with overall agricultural, forestry and fisheries practices. The main conclusions were:

- Activities focusing on the conservation of habitats, ecosystems and landscapes were well represented in the NAPAs. Even though they may not explicitly address genetic diversity or the utilization, *ex situ* conservation and availability of genetic resources they reflect concern with maintenance and use of genetic diversity.
- Activities that directly include genetic resource dimensions involved changes between crop and animal production or other major changes involving different sectors (plant, animal, forest, aquatic); changes in species, crop, variety, breed or population within sectors and the development or introduction of varieties and breeds with increased tolerance of climate change related stresses.
- Adaptation actions involving changing production practices were also present in the NAPAs and included:
  - Integrating or extending climate friendly materials (e.g. agroforestry species, perennials) in the production system;
  - Changes in management;
  - Changes in production;
  - Changes in land use;
Changes in timing of agricultural practices.

- Actions to support the conservation of genetic resources were poorly represented in the NAPAs. *Ex situ* conservation is not included in high priority activities of any country.

Three NAPAs (Ethiopia, Madagascar, Nepal) were reviewed in detail to investigate how the procedures used by countries to develop the NAPAs might have influenced the inclusion or otherwise of genetic resources. The information from Nepal might suggest that a more open and inclusive process involving a wide range of civil society organizations is an important part of developing a NAPA that provides fuller recognition of GRFA dimensions.

1. **Introduction**

In order to complement the information provided through the survey on “*Lessons learned about ways and means to conserve and use genetic diversity to build resilience to climate change in food and agriculture systems*” a review was undertaken of available National Adaptation Programmes of Action (NAPAs) to assess the extent and ways in which genetic diversity of useful species and the conservation and use of genetic resources are integrated in NAPAs.

This is the first attempt to look at the inclusion of genetic resources in NAPAs. It should be noted a more extensive study is currently being undertaken by Bioversity International (M. Halewood personal communication) which will explore the inclusion of conservation and use of genetic diversity in both NAPAs and other national strategic processes as part of an analysis of how adaptation to climate change is addressed within the agricultural sector.

2. **The purpose and development of National Adaptation Programmes of Action (NAPAs)**

Designed by the United Nations Framework Convention on Climate Change (UNFCCC) to provide a systematic process for Least Developed Countries (LDCs) to address their specific climatic adaptation needs, NAPAs have been used to facilitate the development of proposals for implementation while identifying priority activities that respond to urgent and immediate needs of poorer countries to adapt to climate change. A full list of the 50 LDC NAPAs, which have been submitted to the UNFCCC Secretariat since March 2006 can be found at: http://unfccc.int/adaptation/workstreams/national_adaptation_programmes_of_action/items/4585.php

Information included in submitted NAPAs consists of: a synthesis of available information on climate change impacts; participatory assessment of vulnerability to current climate variability and extreme events and of areas where risks would increase due to climate change; identification of key adaptation measures as well as criteria for prioritizing activities; and selection of a prioritized short list of activities. These activities, which can number from about 10 to 37, are then prioritized through a selection process. Further information regarding the selection process can be found in the annotated guidelines for the preparation of NAPAs. During this process, activities are ranked by their importance. High Priority adaptation activities, which may only include about 50% of the initial proposed activities, are then included in larger project profiles.

3. **Methodology used for the review**

For this review, 13 of the 50 submitted NAPAs were selected for analysis based on geographic location, production environment and expected importance of genetic resources (see Table 1). A preliminary keyword search for relevant terms (e.g. seeds, genetic resources, gene banks, biodiversity, agrobiodiversity, agricultural biodiversity) was undertaken. This proved an

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6 The guidelines can be found at: http://unfccc.int/files/cooperation_and_support/ldc/application/pdf/annguide.pdf
unsatisfactory approach and was replaced by an in depth review of the content of the NAPAs with an evaluation of the extent to which any activity identified implied or explicitly included genetic diversity and genetic resources perspectives.

Both low priority and high priority activities, as per the specific country rating, were examined and adaptation activities with either explicit or implicit connections to genetic resources were noted in an excel table with information on the production sector concerned and on the nature and content of the references. These activities were then grouped according to the following criteria:

(i) implicit or explicit inclusion of genetic resource dimensions;
(ii) whether concerned with utilization, conservation or availability of GRFA;
(iii) the type of adaptation actions involved using the same categories as used for the global survey - change in genetic resources material used in the production system; change of species, crop, variety, breed or population within sectors; integrating or extending climate friendly materials (e.g. agroforestry species, perennials); changes in the farming practices; changes in land or water use.

Table 1: The 13 submitted NAPAs selected for further analysis

<table>
<thead>
<tr>
<th>Region</th>
<th>Sub-region</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>East Africa</td>
<td>Ethiopia</td>
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<td></td>
<td></td>
<td>Tanzania</td>
</tr>
<tr>
<td></td>
<td>North and West Africa</td>
<td>Niger</td>
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<td></td>
<td></td>
<td>Sierra-Leone</td>
</tr>
<tr>
<td></td>
<td>Southern Africa</td>
<td>Mozambique</td>
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<td></td>
<td></td>
<td>Zambia</td>
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<tr>
<td></td>
<td>Central Asia</td>
<td>Afghanistan</td>
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<tr>
<td></td>
<td>South East Asia</td>
<td>Lao People’s Democratic Republic</td>
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<td></td>
<td></td>
<td>Nepal</td>
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<tr>
<td></td>
<td></td>
<td>Bangladesh</td>
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<tr>
<td>Asia</td>
<td></td>
<td>Yemen</td>
</tr>
<tr>
<td></td>
<td>South Asia</td>
<td>Vanuatu</td>
</tr>
</tbody>
</table>

The preparation process of the NAPAs was examined for three of the 13 selected NAPAs: Nepal, Ethiopia and Mozambique. These three NAPAs were chosen on the basis of their unique characteristics. In relation to Nepal, there was interest in the influence an FAO/PAR supported project undertaken by LI-BIRD had on the representation of genetic resources throughout the stakeholder process. Ethiopia was selected as a country in which the genetic resources sector is strong and well established but genetic diversity and genetic resources are poorly reflected in the NAPA. Mozambique’s NAPA on the other hand included activities with a genetic resources component and provided an example of a country in which genetic resources inclusion appeared to have been achieved.

4. The inclusion of genetic diversity of useful species and the conservation and use of genetic resources in climate change adaptation activities in NAPAs

The proposed adaptation actions identified in the 13 reviewed NAPAs promoted genetic diversity and genetic resources by either: 1) developing and using adapted genetic resources or 2) enhancing diversity friendly farming practices. The activities included direct implementation, research, or policy relevant approaches. In some activities these are combined. Using the approach adopted for the global survey, activities were classified as being carried out at field, farm and community or ecosystem and landscape levels. The level of priority given by the countries to the activities identified was also noted.

In relation to the inclusion of genetic resources, two categories were noted: they were either formulated specifically to make direct use of genetic resources or genetic diversity (explicit use),
or they included genetic resources as part of a wider range of activities (implicit use). In the NAPA activities examined, the latter was generally more common.

**4.1 Actions that indirectly involve use and conservation of genetic resources**

A number of activities are included in all the NAPAs examined that involved ecosystem or landscape level adaptation measures and were concerned with the management of large land areas. These included reforestation of tropical hillsides, support for riparian forests and mangroves, rangeland rehabilitation and improved pasture management, and the restoration of wetlands, peatlands, watersheds, coral reef, and the vegetation of drylands. All these types of activities involve the use of genetic and species diversity and support the maintenance of genetic resources. In terms of the classification used in the global survey they involve:

1. Changes in production and protection practices;
2. Changes in land and water management/use;
3. Integrated water and land management.

**4.1.1 Changes in production and protection practices**

Activities of this nature were generally intended to minimize damage to crops and agricultural lands resulting from severe weather patterns for example floods, droughts and wind storms.

These included activities which concentrate on sustainable land-management practices such as conservation agriculture, intercropping and sustainable forestry, all of which can provide multiple benefits such as reducing erosion, building soil fertility and structure, improving water quality and buffering against drought. Other activities involved forest protection practices, especially in direct relation to the reduction of forest fires and fire prevention activities. Fire prevention was a specific focus in activities submitted by Lao People's Democratic Republic (a low priority activity) and Nepal (a high priority activity). The eradication of alien species and weeds from forests was an adaptation activity proposed in Zambia (high priority). The activity proposed the eradication of *Mimosa pigra* and *Lantana camara* to reduce the chance of the mass extinction of indigenous plants and animals in that area.

In at least four NAPAs (Sierra Leone, Cambodia, Vanuatu and Yemen) the proposed activities focus on the management, development, and protection of fisheries resources and marine, coastal and aquatic environments in such a way as to conserve and replenish them as an asset for future generations (both of low and high priority). Specific activities in Sierra Leone looked to improve the quality of fisheries related data and research whereas in Yemen, water management was the focus.

**4.1.2 Changes in land and water management/use**

Several adaptation activities were associated with changes in land and water management and use.

Five countries (Niger, Afghanistan, Nepal, Lao People’s Democratic Republic and Nepal) proposed agroforestry related activities for the improvement of soil and water quality while reducing erosion, non-point source pollution and damage due to flooding. In Afghanistan for example, an activity (ranked with high importance) was concerned with terracing and the use of agroforestry and agro-silvo pastoral systems to reduce soil erosion and run-off on steep slopes, conserve land, water resources and wood production and support soil conservation.

Activities focusing on the overall conservation of unique ecosystems and their biological diversity were included in the NAPAs of Afghanistan, Sierra Leone and Tanzania (high priority). The activities aimed to address the general protection and conservation of forests by promoting the restoration of degraded areas while making available forest products to communities living in the area.
In the Cambodian NAPA there was emphasis on activities developed specifically to increase the protection of agricultural lands from severe floods (low to high priority). The activities included: groundwater extraction for crop cultivation; construction of water gates and water culverts; development and improvement of small-scale and aquaculture ponds; vegetation planting; rehabilitation of coastal protection; and development of and rehabilitation of flood protection dykes.

4.1.3 Integrated water and land management

Activities of this type were generally proposed with the aim of protecting and restoring ecosystem functions in agriculture and are linked to development of land monitoring systems. Activities (low to high priority) were proposed by Niger, Nepal, Ethiopia, Sierra Leone and Yemen. In Yemen for example, a watershed management system was proposed to conserve hillside terraces through protection measures dedicated for projected triggered soil erosion and increased floods associated with climate change. In Ethiopia, a country partnership program for sustainable land management focussing on integrated land and water management to protect and restore ecosystem functions in agricultural landscapes was proposed together with a land monitoring system.

4.2 Actions that directly involve use and conservation of genetic resources

The inclusion of genetic resource dimensions occurred most commonly in activities that were to be implemented at the field or farm/ community level. At field level they included the use of stress-tolerant and fast-maturing crop species and varieties, and stress-tolerant species and breeds of cattle. At farm/ community level they may include measures that look at the diversification of agricultural landscapes (agroforestry), diversification of production systems (cultivation of higher diversity of crops and varieties and crop-livestock-tree integration).

Technical practices that included changes between crop and animal production or other major changes involving different sectors (plant, animal, forest, aquatic) were well represented; followed by activities focusing on the changes of species, crop, variety, breed or population within sectors and integrating or extending climate friendly materials (e.g. agroforestry species, perennials) in the production system. Other proposed activities (represented to a lower extent in the NAPAs) which included genetic resources were concerned with changes in management, changes in production practices, changes in land use and changes in timing of production.

The nature and content of the genetic resources references were generally related to the following elements:

- Utilization of genetic resources and more specifically research, development and use of well adapted species and breeds;
- Conservation of genetic resources; and
- Availability of genetic resources (diversity and supply of planting materials) which was most often included as an aspect of genetic resources utilization.

The 13 examined NAPAs made most reference to plant genetic resources, followed by animal and forest genetic resources and fisheries or aquatic genetic resources. Activities that explicitly included genetic resources were included in both the low and high priority ranking by countries.

4.2.1 Utilization of genetic resources

Changes between crop and animal production or other major changes involving different sectors (plant, animal, forest, aquatic); Changes in species, crop, variety, breed or population within sectors

In all sectors, the bulk of activities with explicit genetic resources dimensions were focused on the utilization of genetic resources and, more specifically, the research, development and identification (through characterization and evaluation) of adapted varieties and breeds. The majority of these activities involved the crop production sector, and 10 of the 13 NAPAs included adaptation activities of this nature. Adaptation activities of this type were also proposed in livestock, forestry and fisheries sectors but much less frequently. Not all of these
activities were ranked with high priority. For example, in the crop production sector, just over half of the proposed activities of this kind are identified as high priority and included in final project profiles.

The desired traits for crops or new varieties reflected specific vulnerabilities of each country and included drought, heat, flood and salt intrusion. A few were concerned with tolerance to pests and disease. The mention of the use of indigenous species, even if intended, was rare.

Some examples of proposed activities of this type across the various sectors are listed in Table 2. Actions that related to the availability of genetic resources largely concerned supply of planting stock and were usually part of larger proposed activities with a focus on utilization and more specifically with changes in species, crop, variety, breed or population. Some examples of these have been included in the table above (see Niger and Mozambique examples).
Table 2. Examples of specific NAPA adaptation activities involving the use of genetic resources for food and agriculture by sector

<table>
<thead>
<tr>
<th>Plant and animal genetic resources</th>
<th>High priority activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>Promotion of research on drought, flood and saline tolerant varieties of crops to facilitate adaptation in future.</td>
</tr>
<tr>
<td>Mozambique</td>
<td>Applied research on drought and disease resistant crops, as well as the use of crops that have short growing cycles. Strengthening capacities of agricultural producers to cope with climate change: disseminating and encouraging the use of drought tolerant crops.</td>
</tr>
<tr>
<td>Nepal</td>
<td>Identification and provision of plant and animal genetic resources that have highly climate adaptive characteristics: drought tolerance, resistance to flooding, shorter growing seasons, heat tolerance (both of these activities are research based activities).</td>
</tr>
<tr>
<td>Niger</td>
<td>Popularization of animal and vegetative species that are most adapted to climatic conditions, including an accessibility aspect e.g. disseminate the advantages related to the species, making the species accessible to the population and create nurseries.</td>
</tr>
<tr>
<td>Tanzania</td>
<td>Improving food security in drought-prone areas by promoting drought-tolerant crops.</td>
</tr>
<tr>
<td>Zambia</td>
<td>Adaptation of land use practices (crops, fish, and livestock) in light of climate change. Improving awareness of the advantages related to adapted species; putting the species to be popularized at the disposal of the population; creating nurseries; popularizing animal and crop species; and monitoring and evaluation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low priority activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afghanistan</td>
</tr>
<tr>
<td>Cambodia</td>
</tr>
<tr>
<td>Lao People's Democratic:</td>
</tr>
<tr>
<td>Sierra Leone</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fish genetic resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>High priority activities</td>
</tr>
<tr>
<td>Bangladesh</td>
</tr>
<tr>
<td>Sierra Leone</td>
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<tr>
<td>Zambia</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Forest genetic resources</th>
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</thead>
<tbody>
<tr>
<td>Low priority activities</td>
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<tr>
<td>Lao People's Democratic:</td>
</tr>
</tbody>
</table>
**Changes in farming practices**
The explicit inclusion of genetic diversity of useful species and the conservation and use of genetic resources was also identified in adaptation activities concerned with the following changing farming practices:

- Integrating or extending climate friendly materials (e.g. agroforestry species, perennials) in the production system;
- Changes in management;
- Changes in production;
- Changes in land use;
- Changes in timing.

Examples of proposals that involve these changed management practices are included in Table 3. Often a number of different management practices were integrated into a particular activity. The promotion of indigenous species was mentioned in three of the 11 activities listed below.

**Table 3. Examples of NAPA adaptation actions involving use of GRFA in relation to changed management practices**

<table>
<thead>
<tr>
<th>High priority activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ethiopia</strong> Introduction of agroforestry systems in existing farming systems and conservation of agrobiodiversity resources.</td>
</tr>
<tr>
<td><strong>Nepal</strong> Forest and ecosystem management for supporting climate-led adaptation innovations. The promotion of indigenous species is emphasized in this activity.</td>
</tr>
<tr>
<td><strong>Sierra Leone</strong> Management and protection of forest reserves and catchments areas including wetlands. Stimulation of local community participation in the conservation of forests and silvicultural activities with a view to increasing their incomes. Restoring biodiversity and increasing the forest vegetation cover.</td>
</tr>
<tr>
<td><strong>Vanuatu</strong> Increased national forest resources, through improved natural forest management, joint-venture commercial forest plantations and agroforestry, despite a shrinking natural forest area. Improved knowledge of Vanuatu’s forest resources, ecosystems, biological diversity and of the silviculture of the indigenous species.</td>
</tr>
<tr>
<td><strong>Yemen</strong> Develop and implement sustainable land management strategies to combat desertification and land degradation. Objectives include: enhancing native vegetative cover and biodiversity and introducing appropriate plant species, salt tolerant and cultural practices suitable for the prevailing environment and water availability.</td>
</tr>
<tr>
<td><strong>Zambia</strong> An activity for the identification of species suitable for aquaculture is the focus of fish farming trials. This activity is part of a larger high prioritized activity focusing on the adaptation of land use practices (crops, fish, and livestock) in light of climate change.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low priority activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lao People's Democratic Republic</strong> Carry out surveys and identify and develop forest areas suitable for supporting seed production; promote and establish tree nurseries to provide saplings to areas at high risk from flooding or drought; promote soil improvement using locally available organic fertilizer and agricultural waste; develop the capacity of technical staff in organic fertilizer research.</td>
</tr>
<tr>
<td><strong>Yemen</strong> Conduct studies and research on the development of agriculture manuals for the different zones of Yemen that include sowing dates, new sowing dates, utilization of flow-water in the wadis, climate and other agriculture-related databases, introduce and expand drought tolerant, and heat- and salinity-resistant crops.</td>
</tr>
</tbody>
</table>
4.2.2 Conservation of Genetic Resources

**Ex Situ Conservation**

*Ex situ* conservation was poorly represented in the adaptation activities of the 13 reviewed NAPAs. In two countries, the establishment of community seed banks was identified as a planned activity:

- Sierra Leone: Improve food storage facilities and establish seed banks.
- Ethiopia: Development of a community seed bank and food storage facilities in Amhara, Tigray, Oromia.

A key word search using the words *ex situ*, gene bank, gene, seed bank, was also carried out to establish if the *ex situ* conservation of genetic resources is discussed in any other area of the reviewed NAPAs. The following references were found in five countries:

- Tanzania: *ex situ* conservation of important plant genetic resources is identified as a priority.
- Nepal: during the transect appraisal exercise, there has been a discussion related to adaptation options for developing guidelines and improving food security. During those discussions, the promotion of seed banks, the establishment of decentralized buffer stock and cold storage is suggested.
- Ethiopia: the establishment of community genebanks, especially for drought and disease resistant landraces, was one of the adaptation options proposed in the Initial National Communication (INC) to UNFCCC.
- Sierra Leone: when discussing past and present practices for adaptation to climate change and climate variability, it is noted that future consideration will be given to the establishment of genebanks.
- Afghanistan: with reference to their obligations under the Convention on Biological Diversity *ex situ* conservation is stated as presently not considered a priority in the country.

The selected keywords were absent from the NAPAs of the remaining eight countries (Bangladesh, Cambodia, Mozambique, Niger, Vanuatu, Yemen, Zambia and Lao People's Democratic).

**Conservation and utilization of local ecological resources**

Specific references were made in some NAPAs to the conservation and utilization of what were referred to as ecological resources. For example, in Nepal, the objectives in the high priority activity include “Conserve and utilize local ecological resources for livelihood support” and refer to the study and documentation of indigenous wetland conservation knowledge, skills and practices, biodiversity conservation and forest and habitat management plan-promoting indigenous species.

5. **Involvement of GRFA perspectives in NAPA Development**

Submitted NAPAs present a comprehensive summary of a consultative process that has involved a range of inclusive stakeholder discussions. NAPA reports from three countries were selected to see where, how and to what extent genetic resource dimensions were represented during stakeholder consultations and in the selection of priority activities. The NAPAs for Nepal, Mozambique and Ethiopia were chosen on the basis of their unique stakeholder consultation process. In the case of Nepal, we were interested to see the influence of the FAO/PAR/LI-BIRD project on the representation of genetic resource dimensions throughout the development process. In Ethiopia, a country where the importance of genetic resources is believed to be well recognized, we wished to explore why relatively little attention was given to the promotion of genetic resources in their adaptation activities. Mozambique included a number of activities with a genetic resource component in their final project profiles yet the motivation behind this inclusion is unclear.

A common thread across the three countries is that they mention the consideration of multi-lateral environmental agreements (such as the Convention on Biological Diversity and the UN Convention to Combat Desertification (UNCCD)) when developing adaptation activities. The importance of these agreements was indicated in the guidelines on developing NAPAs.
The process involved in the development of adaptation activities was different in each country. In Nepal, adaptation activities were developed directly from the findings proposed during consultation events. In Ethiopia, ongoing and planned projects together with consultation meetings and initial communication to the UNFCCC determined the identification of activities. In Mozambique, although the process of formulating adaptation activities is poorly reported on, it is clear that a few adaptation activities including activities promoting genetic resources were included in project profiles as a result of a stakeholder consultation.

**Nepal**

In Nepal, adaptation activities were developed by 60 Government and Non-governmental organizations (NGOs) Thematic Working Groups (TWGs) who participated in both macro-level impact assessments through three transect appraisal exercises and 15 consultations and awareness raising activities. These took place with a wide group of stakeholders. During the process, NGOs, Community Based Organizations (CBO) and Civil Society were well represented. The organizations involved in this process included: LIBIRD\(^7\), ISET-N\(^8\), Practical Solution, NEWAH\(^9\), FECOFUN\(^10\), Practical Action and SEBAC\(^11,12\). These, together with groups including indigenous peoples, women, and youth were present in almost half of the total number of consultations during the drafting of the NAPA. Consultations were mostly focused in the following areas: vulnerability assessment, prioritized projects, local adaptation practices, local and regional climate change issues. In addition, more than 3,300 stakeholders attended transect appraisal exercises in three regions in the country. The key outputs of these exercises were: identifying people’s perception on climate change, mass sensitization, vulnerability observation, triangulation with stocktaking, active involvement of TWGs, essential information for NAPA.

In Nepal, the inclusion of genetic resource dimensions is evident. Local and expert perceptions collected through the consultative process identified the following climate change impacts:

- Changes in crop productivity due to delays in cropping cycles; upward shift in agro-ecological zone; increase in crop diseases and pests; reduced water availability.
- Decline in livestock productivity due to incidents of disease including sterility and decrease in fodder species; loss of crop and forest diversity.
- Forests-biodiversity loss, increase in invasive species and dryness in forests, increase in forest fire incidents.

Adaptation options (with a focus in genetic resource promotion) that resulted from the transect appraisal exercise included:

- Increase use of organic fertilizers;
- Adoption of new varieties of crops adapted to higher temperatures;
- Breeding of more adaptable varieties and breeds;
- Selection of short duration crop varieties;
- Use of improved varieties and fertilizers;
- Promotion of agroforestry;
- Promotion of seed banks, establishment of decentralized buffer stock, cold storage;
- Replace present crops with hardier varieties.

Most of these adaptation activities were included in Nepal’s list of high priority activities except the one that related to the promotion of seed banks.

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\(^7\) Local Initiatives for Biodiversity, Research and Development
\(^8\) Institute on Social and Economic Transition - Nepal
\(^9\) Nepal Water for Health
\(^10\) Federation of Community Forestry Users Nepal
\(^11\) Social Empowerment and Building Accessibility Centre - Nepal
\(^12\) A deeper look into the mandates of these organizations and their involvement with genetic resources could be beneficial to understand how their input may have influenced the inclusion of genetic resources into adaptation activities.
**Ethiopia**

In Ethiopia, the preparation of the NAPA also adopted a participatory process involving stakeholders. The “participatory workshop technique” was used for consultations to elicit information from grassroots population so as to inform the process of prioritization and selection of adaptation options. In this regard, two national and eight regional workshops were conducted involving about 500 participants with various expertise. Unfortunately in the NAPA, it is not clearly indicated who the stakeholders were.

At the national and regional consultation workshops, genetic resource related potential adaptation options proposed included:

- Promoting drought/crop insurance programmes; irrigation scheme development, promotion of irrigated agriculture;
- Feed conservation, forage development, rotation grazing and changing of the traditional feeding practices;
- Crop diversification, promotion of crop types that offer comparative advantage (cash crops);
- Research on stress and drought resistant and early maturing crops;
- Improving agricultural productivity through improved inputs, adapting improved farm technologies, improving animal health service, strengthening disease and pest control mechanisms;
- Forestry, agroforestry, participatory forest management, strengthening natural resources conservation and management practices.

Ethiopia’s process was different from that of Nepal in that the list of 37 proposed adaptation activities have been developed not just through consultation workshops but also took account of on-going and planned projects throughout the country and initial communications with the UNFCCC.

Genetic resources were represented in on-going and planned projects in the following ways:

- Sustainable Development and Ecological Land Management with Farmers in Tigray. Activities of this project include: compost making, capacity building, water resources development, multipurpose tree planting, soil and water conservation, institutional strengthening of local community.
- National Livestock Development Project. Activities of this project include: improvement of animal genotype and better disease parasite control through upgrading of local breeds of cattle, through artificial and natural mating and animal health care; promotion of grazing management through forage legumes production.

In initial National Communication of Ethiopia to the UNFCCC, genetic resource dimensions are represented in the following proposed activities:

- Growing crops which require less water;
- Improving and changing management practices and techniques such as planting date, seedling rate, fertilizer application rate;
- Improving animal genotypes and developing better disease parasite control to take advantage of the improved management;
- Establishing community genebanks especially for drought and diseases resistant landraces.

These adaptation activities were then examined in relation to their synergy with multilateral environmental agreement assessment reports.

The explicit reference to genetic resources largely disappeared from the final list of priority activities although a number of the actions would involve genetic resources related actions. The final list of high priority activities in Ethiopia’s NAPA are as follows:

1. Promoting drought/crop insurance program in Ethiopia
2. Strengthening/enhancing drought and flood early warning systems in Ethiopia
3. Development of small scale irrigation and water harvesting schemes in arid, semi-arid, and dry subhumid areas of Ethiopia
4. Improving/enhancing rangeland resource management practices in the pastoral areas of Ethiopia
5. Community based sustainable utilization and management of wet lands in selected parts of Ethiopia
6. Capacity building program for climate change adaptation in Ethiopia
7. Realizing food security through multi-purpose large scale water development project in Genale–Dawa Basin
8. Community Based Carbon Sequestration Project in the Rift Valley System of Ethiopia
9. Establishment of national research and development center for climate change
10. Strengthening malaria containment program in selected areas of Ethiopia
11. Promotion of on-farm and homestead forestry and agro-forestry practices in arid, semi-arid and dry-sub humid parts of Ethiopia

Mozambique
The link to the promotion of genetic resources and the development of Mozambique’s NAPA is not easily recognizable. Unlike the NAPAs produced by Ethiopia and Nepal, there was no list of initial activities for prioritization available. What is presented in the Mozambique’s NAPA, are four large scale final proposed projects. Unlike the other two countries, Mozambique received inputs from stakeholder groups via questionnaire. Without a clear indication of represented groups, it is impossible to determine the involvement of marginal groups, NGOs, CBOs and civil society in general. As stated in the NAPA, 28% of the 621 people interviewed represent professionals from government institutions and NGOs, 29% are community leaders and the remaining 43% represent members of the community. In total, 1123 answers were obtained, however no other clarification is given.

The following (among others) were identified as activities that would help lessen the effects of climate change:

- Distribution of crops that are resistant to drought (millet, cassava, sweet potatoes);
- Distribution of seeds and agricultural utensils.

These activities were included in a final project profile on strengthening capacities of agricultural producers to cope with climate change which also included:

- Applied research on drought and disease resistant crops;
- Use of crops that have short growing cycles.