Agricultural biodiversity in climate change adaptation planning:

An analysis of the National Adaptation Programmes of Action

Working Paper No. 95

CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

Ana Bedmar Villanueva
Michael Halewood
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RESEARCH PROGRAM ON
Climate Change, Agriculture and Food Security

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Correct citation:

Bedmar VA, Halewood M, Lopez Noriega I. 2015. Agricultural biodiversity in climate change adaptation planning: an analysis of the National Adaptation Programmes of Action. CCAFS Working Paper no. 95. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. Available online at: www.ccafs.cgiar.org

Titles in this Working Paper series aim to disseminate interim climate change, agriculture and food security research and practices and stimulate feedback from the scientific community.

This document is published by the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), which is a strategic partnership of the CGIAR and the Earth System Science Partnership (ESSP). CCAFS is supported by the CGIAR Fund, the Danish International Development Agency (DANIDA), the Government of Australia (ACIAR), Irish Aid, Environment Canada, Ministry of Foreign Affairs for the Netherlands, Swiss Agency for Development and Cooperation (SDC), Instituto de Investigação Científica Tropical (IICT), UK Aid, and the European Union (EU). The Program is carried out with technical support from the International Fund for Agricultural Development (IFAD).

Contact:
CCAFS Coordinating Unit - Faculty of Science, Department of Plant and Environmental Sciences, University of Copenhagen, Rolighedsvej 21, DK-1958 Frederiksberg C, Denmark. Tel: +45 35331046; Email: ccafs@cgiar.org

Abstract

To guide climate adaptation policies and investments, the majority of least developed countries (LDCs) have developed National Adaptation Programmes of Action (NAPAs). Agricultural biodiversity is an important, but often overlooked, element in climate adaptation; new crop varieties, cropping and farming systems will be important under future climates. This paper analyzes the extent to which agricultural biological diversity is included as part of national adaptation planning in the 50 NAPAs developed by LDCs as of December 2014. The paper presents an analytical framework that was used for the analysis of the NAPAs. It identifies 48 activities included in the NAPAs that do (or at least could) increase biodiversity in agricultural production systems or in research and development chains as part of strategies to adapt to climate change. These activities are clustered, first, by sectors (crops/forages, livestock, fisheries, forestry, agroforestry and natural resources) and then by biodiversity levels (genetic/intra-species, species and ecosystems). The highest concentration of activities was found in the combined crops/forages sector and at the ecosystem level. The analysis highlights that agricultural biodiversity is not incorporated within and across the NAPAs in a comprehensive manner, demonstrating that there is not a commonly adopted approach to integrating agricultural biodiversity into strategic planning. In light of these findings, one of the paper's conclusions is that country teams developing national adaptation plans (NAPs) in the future would benefit from the guidelines for integrating genetic diversity considerations into climate change adaptation planning being considered by the Food and Agriculture Organization's Commission on Genetic Resources for Food and Agriculture during its fifteenth session in January 2015. Lessons learned from the NAPA development process are potentially valuable to countries that will be developing NAPs in the years to come.

Keywords

Climate change; adaptation; agriculture; National Adaptation Programmes of Action; priorities; biodiversity.

About the authors

Ana Bedmar Villanueva is a research fellow at Bioversity International in Rome, Italy.
Email: a.bedmar@cgiar.org

Michael Halewood is the policy theme leader of Bioversity International, Rome, Italy.
Email: m.halewood@cgiar.org

Isabel López Noriega is a policy specialist at Bioversity International, Rome, Italy.
Email: i.lopez@cgiar.org

Acknowledgements

The authors are grateful for comments provided by Alexander Meybeck, Toby Hodgkin and Jacob van Etten on earlier versions of this discussion paper.

Contents

Acronyms

COP	Conference of the Parties
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
GRFA	Genetic Resources for Food and Agriculture
HLPE	High Level Panel of Experts on Food Security and Nutrition
IPCC	Intergovernmental Panel on Climate Change
LDC	Least developed country
LDCF	Least Developed Countries Fund
LEG	Least Developed Countries Expert Group
NAP	National Adaptation Plan of Action
NAPA	National Adaptation Programme of Action
OECD	Organization for Economic Co-operation and Development
PIF	Project Identification Form
SIDS	Small Island Developing States
UNFCCC	United Nations Framework Convention on Climate Change

Introduction

This study assesses the extent to which increasing biodiversity and genetic resources for food and agriculture (GRFA) in agricultural systems is included as part of the climate change adaptation planning as set out in the 50 short-term National Adaptation Programmes of Action (NAPAs) developed by least developed countries (LDCs) as of December 2014. It is based on the assumption that biological diversity, from the genetic to the ecosystem levels, increases the capacity of agriculture to adapt to, and recover from, climatic changes. The study was undertaken on the assumption that it would yield useful insights for countries as they move forward in the process of developing their mid- to long-term national adaptation plans (NAPs). This discussion paper was developed for presentation to, and consideration by, delegates to the fifteenth session of the Commission on Genetic Resources for Food and Agriculture. It underscores the potential utility of the guidelines to integrate GRFA into NAPs that are being considered for adoption by the Commission.

Pramova et al. (2012) conducted a similarly structured analysis of the NAPAs, examining the extent to which ecosystem services had been considered in the NAPAs developed as of 2010, concluding that ecosystem services were acknowledged and promoted in more than half of the NAPAs. To our knowledge, this is the first study that addresses the integration of agricultural biodiversity in NAPAs.

The first part of the paper sets out the framework and method we used for analysing the NAPAs. The second part includes a summary of the existing literature regarding key concepts and terms used in the climate change adaptation-related literature. It also includes an overview of the rationale and process for the development of NAPAs under the United Nations Framework Convention on Climate Change (UNFCCC) and the more recently decided-upon process for developing NAPs and the guidance that is being provided for countries developing those plans. The third part of the paper sets out the main findings of our analysis.

Part 1. Framework of analysis and methodology

1.1. Analytical framework

The starting point of our analysis is that diversification of agricultural production systems—including diversification of the biota in those systems, which is the focus of this paper—can increase the resilience of those systems so that they are better able to adapt to climatic variability, thereby reducing farmers' vulnerability to climate-related risks (Jackson et al. 2010). In this context, it is not sufficient to consider the biophysical elements in agricultural systems on their own; the ability to manage increased levels of biological diversity in these systems depends upon human capacity and institutional support. Given the structure and function of various components of the agricultural sector in most countries, it is necessary to look beyond the use of diversity in agricultural production systems *per se* towards the increased use of biological diversity in agricultural research, plant breeding and complementary conservation efforts—activities that take place physically outside production areas but are nonetheless critical components of national agriculture sectors and collective national (even international) level capacities to adapt to climate change.

This framework for analysis was developed drawing on the existing literature concerning climate change and adaptive capacity, agroecosystems' vulnerability and resilience and the use of biological/genetic diversity in agricultural production, plant breeding, research and development. We present a summary of the literature concerning key terms and concepts in our framework in Part 2 below.

1.2. Methodology

Our research methods evolved as the study advanced. Initially, we scanned all of the NAPAs for key words including biological diversity, crop diversity and system diversification. Since these terms appeared rarely, we searched through the NAPAs to find all of the activities that do, or at least could, involve the introduction, use or conservation of higher levels of biological diversity in: (1) production systems; (2) agriculture research and development and (3) *ex situ*, *in situ* and *circa situ* conservation efforts. Our search covered activities included as climate adaptation options—that is, activities noted within the NAPA as having the potential to contribute to countries' adaptation to climate change—and activities included in priority project proposals—that is, the adaptation options that were eventually selected and included in the final section of the NAPAs as the most important to pursue in the country concerned.

We identified 48 activities, which from here on in, we will call 'agrobiodiversity-related activities.' We use the qualifier 'or at least could' because a number of these activities—for example, 'introducing new crops species,' 'crop rotation,' 'participatory management of aquatic ecosystem services' and 'research on local and exotic animal species resistant to climate change'—may or may not result in more biological diversity in the agricultural production systems concerned. With respect to a number of such cases, there was not enough additional information in the NAPAs to allow us to be sure that increasing biodiversity in the production systems was either the intention or a necessary result. As a result of this uncertainty, we gave each of the 48 activities a relative weighting between 1 and 3, depending on the likelihood that they would involve, or result in, increased levels of agricultural biodiversity. Activities that may lead to more diversity in upstream activities and in the production agricultural systems were scored as 1. For example, we gave 'introduction or expanded production of cash crops' a score of 1 because it could involve increased diversity in the production system if the new cash crops are grown in addition to crops that are already being grown. On the other hand, the cash crop could simply replace the pre-existing crops, without any resulting increase in crop diversity overall. A score of 2 was awarded to activities that rely on the use of agricultural biodiversity in upstream activities (for example, conservation, characterization, pre-breeding and breeding) but do not necessarily translate into more diversity in the production agricultural systems. Finally, activities that would involve the use of increased agricultural biodiversity in the production agricultural systems were given a score of 3. For example, 'develop multi-species fish systems more resistant to climate changes' and 'encourage farmers to cultivate several varieties of one crop type/association of crops' were each given a score of 3. The 48 agrobiodiversity-related activities and their related scores are set out in table 1.

Of course, depending on the context, increasing agricultural biodiversity in the production systems may not be a necessary or appropriate means to increase the system's adaptive capacity. It was beyond the scope of our paper to analyse each of the 48 agrobiodiversity-related activities within the environmental and socio-economic context in which they were proposed and to identify possible trade-offs. The main purpose of this study is to provide a general picture of the level of integration of agricultural biodiversity across the NAPAs, without assessing the appropriateness of the proposed agrobiodiversity-related activities to increase adaptive capacities in each particular context.

We then focused on the incidence of the 48 agrobiodiversity-related activities in the priority project proposals and not in the more general sections on adaptation options.[1] Each NAPA was separately scrutinized taking note of each time one of the 48 biodiversity-related activities was included (either on its own or in combination with other biodiversity-related activities) in the priority project proposals. In total, the 48 agrobiodiversity-related activities appeared 267 times across a total of 169 priority project proposals under the 50 NAPAs. These 267 priority activities were classified according to the sector where they were more relevant—crops and forages, livestock, fisheries, forestry, agroforestry and 'other natural resources' (hereinafter called 'others')—and according to the level of diversity where they put more emphasis—intraspecific level, species level or ecosystem level.[2] This allowed us to identify the sectors and the levels of diversity that concentrated more activities. One could also categorize these activities according to whether they took place on a farm, landscape or national scale. Ultimately, we did not pursue this option, but it might be interesting for future research.

We then ranked each of the NAPAs according to the total number of agrobiodiversity-related activities in each and the total points assigned (1–3) to them, as discussed earlier. Based on this ranking system, the NAPAs ranged from 0 to 38 points. We also classified the NAPAs based on the evenness in the distribution of the selected priority projects across the three levels of diversity (intra-specific, specific and ecosystem). The 50 NAPAs were also grouped into five geographical regions to discern the similarities or differences between the regionally grouped NAPAs: Central and West Africa (16 countries), East Africa (8 countries), Southern Africa (6 countries), the small island developing states (SIDS) (12 countries) and Asia (8 countries).[3] We also considered the extent to which the countries followed up on their NAPA

[1] Interestingly, ten of the agrobiodiversity related activities identified as adaptation options in the NAPAs did not appear in any of the priority project proposals listed at the end of the NAPAs.

[2] These three levels of biodiversity were taken from the definition of biological diversity in Article 2 of the Convention on Biological Diversity: "'Biological diversity' means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems." Art. XX of the Convention states that "Agricultural biodiversity includes all components of biological diversity of relevance to food and agriculture, and all components of biological biodiversity that constitute agro-ecosystems: the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agricultural ecosystem, its structure and process."

[3] The reasoning behind grouping all of the Asian countries within the same region, without distinguishing sub-regions as in the other continents, was that only a few Asian countries classified as least developed countries at the time of the study and therefore had developed a NAPA.

priorities in their proposals to the Global Environment Facility (GEF) for implementation support.[4] The results of this analysis are presented in Annex 2.

Part 2: Key concepts and developments

2.1. Key concepts and terms in climate change adaptation literature concerning agriculture and biological diversity

As mentioned earlier, this section includes a summary of the existing literature concerning the key concepts and terms that we relied upon in developing our analytical framework and methodology for this study.

Resilience was defined by Holling (1973) as the "magnitude of disturbance that can be experienced before a system moves into a different state and different sets of controls". More recently, Walker et al. (2006) described it as the "capacity of a system to experience shocks while retaining essentially the same function, structure, feedbacks, and therefore identity". The resilience of a system has also been established to be related to the magnitude of shock that the system can absorb and still remain within a given state; the degree to which the system is capable of self-organization and the degree to which the system can build capacity for learning and adaptation (Folke et al. 2002). Along these lines, the concept of socio-ecological systems, understood as an intimate connection between social, economic and ecological systems (Folke et al. 2002) has been widely explored (e.g., Folke et al. 2002, Gallopín 2006, Walker et al. 2006).

Vulnerability has been defined in broad terms by Turner et al. (2003) as the capacity of a system to be wounded—that is, the degree to which a system is likely to experience harm due to exposure to a hazard. Under the climate change context, vulnerability refers to the propensity of human and ecological systems to suffer harm and their ability to respond to stresses imposed as a result of climate change effects (Brooks and Adger 2005). It has been defined as "the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with adverse impacts of climate change" (Schneider et al. 2007) and described as a function of sensitivity to climatic changes, adaptive capacity and exposure to climate hazards (Smit et al. 2000). According to the Intergovernmental Panel on

[4] Different countries had submitted different number of projects to the Global Environment Facility, and these were in different stages of development. Therefore, in order to make the analysis comparable, only those projects that were in the project identification form stage were considered.

Climate Change (IPCC) (2001) the extent to which systems are vulnerable to climate change depends on the actual exposure to climate change, their sensitivity and their adaptive capacity.

Adaptation is increasingly regarded as a key component of the response to climate change. In this paper, adaptation is considered in the context of vulnerability and adaptive capacity. Adaptation to climate change occurs through adjustments to reduce vulnerability or enhance resilience in response to observed or expected changes in climate and associated extreme weather effects (Brooks and Adger 2005). A number of definitions for climate change adaptation have been given during the last several years. Smithers and Smit (1997) defined adaptation as "changes in a system in response to some force or perturbation, in our case related to climate". Likewise, Burton et al. (1998) described it as "all those responses to climate change that may be used to reduce vulnerability" and Füssel and Klein (2005) explained it as "all changes in a system, compared to a reference case, that reduce the adverse effects of climate change". According to the IPCC (2001), "adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts". It refers to "changes in processes, practices and structures to moderate potential damages or to benefit from opportunities associated with climate change" (IPCC 2001).

Adaptive capacity has been described in some studies as a function of adaptation (e.g., Adger et al. 2004). According to the IPCC (2001), adaptation greatly depends on the adaptive capacity or adaptability of an affected system, region or community to cope with the impacts and risks of climate change. Adaptive capacity has been described as "the potential or ability of a system, region or community to adapt to the effects or impacts of climate change" (IPCC 2001). Similarly, it has been defined as "the ability of a system to adjust to climate change to moderate potential damages, to take advantage of opportunities, or to cope with the consequences" (Tompkins and Adger 2004). In the same line, Preston and Stafford-Smith (2009) have established that adaptive capacity reflects the ability of the system to manage and thereby reduce "gross" vulnerability, and Adger (2003) have defined it as "the potential or capability of a system to adjust to and therefore limit risk". Adaptive capacity has also been defined as a component of resilience, reflecting the learning aspect of system behaviour in response to a given disturbance (Walker et al. 2002). In addition, it has been established that the inclusion of adaptive capacity is a necessary condition for the design and implementation of effective climate change adaptation strategies (Brooks and Adger 2005).

Agrobiodiversity is defined by the FAO as the variety and variability of animals, plants and micro-organisms that are used directly or indirectly for food and agriculture, including crops, livestock, forestry and fisheries. It comprises the diversity of genetic resources (varieties and

breeds) and species used for food, fodder, fibre, fuel and pharmaceuticals. It also includes the diversity of non-harvested species that support production (soil micro-organisms, predators and pollinators) and those in the wider environment that support agroecosystems (agricultural, pastoral, forest and aquatic) as well as the diversity of the agroecosystems themselves (FAO 1999).

According to the literature, **diversity in genes, species and ecosystems** all contribute to climate change resilience (e.g., Altieri and Koohafkan 2008, Altieri 2009, Lin 2011, Ortiz 2011) and to the improvement of the adaptive capacity of the agricultural sector. Agricultural biodiversity constitutes an important instrument for local adaptation and the resilience of agroecosystems (AL et al., 2008). Diversification has been embraced as a key concept by the current development thinking in the agricultural context. Back in 2006, the Development Assistance Committee of the Organization for Economic Co-operation and Development (OECD) endorsed a policy statement on promoting pro-poor work where the evolving agenda for agriculture shifted from a focus on commodity production and increasing farm productivity to a focus on household productivity through diversifying production and off-farm work. This shift can also be appreciated in the development approaches of a number of UN agencies and other international development actors (OECD 2006).

Historically, a broad range of GRFA in climate change adaptation has been used. In the past, smallholder farmers have responded to environmental changes by gradually changing their agricultural practices, improving their selection of adapted cultivars and mixing crops with trees and livestock to reduce risks of crop failures by drawing from their indigenous knowledge and experience (e.g., Altieri 1999, Lasco et al. 2014, Sthapit et al. 2010, Ortiz 2011). Nowadays, adoption of agroforestry practices, crop diversification, early planting of crops, increased use of short-maturing and stress-tolerant crop varieties, wild plant gathering and mixed-cropping production systems have been found to be among some of the most common adaptation measures adopted by farmers in response to climate change (i.e., Verchot et al. 2007, Altieri and Koohafkan 2008, Altieri 2009, Mijatovic et al. 2013, Kissinger et al. 2013). Using diversity as an adaptation strategy may be a promising and viable option for farmers in LDCs as compared to producers in other countries with the capacity to adopt more resource-demanding measures. Of course, more diversity is not always appropriate or necessary. There are agricultural production systems that are already quite diverse and would not benefit from inclusion of more diversity in terms of enhanced resilience or adaptive capacity.

In addition, the diversity of traits and characteristics among existing species (both at the inter- and intra- specific levels) have the potential to contribute to climate adaptation of the

agricultural systems by providing traits for plant and animal breeders and farmers to select resilient crop varieties and animal breeds (Ortiz 2011). GRFAs constitute raw material for agricultural species improvement (Lipper and Cooper 2009). This raw material is conserved on farms, *in situ* and in gene banks (Walters et al. 2008). In the light of climate change, having available genes for the development of new and adapted varieties is extremely relevant for climate change adaptation, and, as a consequence, gene banks are acquiring an increasingly important role for the ongoing and future climate resilience and adaptation of agricultural systems (Gitz and Meybeck 2012).

Besides the conservation and use of agricultural biodiversity at different levels, other social, economic and political aspects play a key role in the adaptation and resilience of agricultural systems to climate change (e.g., Smit and Skinner 2002, Tengö and Belfrague 2004, Lane and Jarvis 2007, Vasconcelos et al. 2013). Agricultural subsidies, trade and disaster assistance might reduce the incentives for farmers to implement climate change adaptation strategies based on the diversification of their agricultural practices. Governance, public policy and institutions have been widely identified in the literature as key determinants of the efficiency of the implementation of any given adaptation strategy (e.g., Folke et al. 2002, Tompkins and Adger 2004, Walker et al. 2006, Gallopin 2006, Agrawal and Perrin 2008, Bapna et al. 2009, Berman et al. 2012). Clearly, in this context, NAPAs and NAPs are potentially extremely important policy instruments.

2.2. From NAPAs to NAPs

Implementation of adaptation strategies requires social capital and human, natural and financial resources (Brooks and Adger 2005). Therefore, countries with limited economic resources, low levels of technology, poor information, skills and infrastructure, unstable or weak institutions and inequitable empowerment and access to resources have little capacity to adapt to, and are more vulnerable to, climate change (IPCC 2001). LDCs are therefore vulnerable to the adverse effects of climate change and possess the least capacity to cope with, and adapt to, these effects. Responding to this issue, the Marrakesh Conference of the Parties (COP-7) to the UNFCCC in 2001 decided that NAPAs should be developed by LDCs to identify their most immediate needs as a step towards accessing financial support from the Least Developed Countries Fund (LDCF) (Biagini and Dobardzic 2011).

NAPAs are meant to be action oriented, country driven, flexible and based on national circumstances. To facilitate the preparation of the documents, the Least Developed Countries Expert Group (LEG) (2002) prepared the *Annotated Guideline for the Preparation of National Adaptation Programmes of Action*. Following this guideline, the NAPA preparation

is supposed to start with the establishment of a national NAPA team composed by a leading agency and comprised of representatives of stakeholders, including government agencies and civil society, which is responsible for the NAPA preparation and the coordination of its implementation. Designed by the NAPA team, a multidisciplinary team is responsible for compiling and synthesizing the available information concerning the adverse effects of, and coping strategies for, climate change as well as for conducting a participatory vulnerability assessment of the country to climate change; the identification of key potential adaptation measures and the selection of country-driven criteria for prioritizing a short list of projects and activities. Key adaptation activities are to be derived, *inter alia,* through multistakeholder consultations. A consultative process is supposed to lead thereafter to the prioritization of the potential adaptation activities. It is suggested that sectoral working group meetings are to be used for this purpose. Criteria to rank priority areas include the identification of the most urgent needs, taking into account the vulnerability of the sectors, the vulnerability of the groups, the contribution of the suggested activities to food security and to poverty reduction and economic costs (LEG 2002). According to the guideline, the preparation of the NAPA should finish with the public review of the NAPA draft and with the development of the NAPA project profiles, using focus group discussions and meetings with the working group members and other key stakeholders. As of June 2014, 50 NAPAs had been developed (see Annex 1).

The LDCF was established with the GEF as the operating entity to support LDCs during the preparation and implementation of the NAPAs (Biagini and Dobardzic 2011).[5] Following the preparation of the NAPA, in order to access this specific funding, LDCs are requested to develop and submit to the LDCF a project proposal based on one or more of the activities prioritized during the NAPA preparation process. LDCs are first asked to identify and get in contact with the most appropriate agency or agencies among the 10 GEF agencies responsible for addressing these specific issues. The role of the chosen agency is to assist the country to develop, together with the national UNFCCC focal point, a project identification form (PIF) following the LDCF templates. PIFs are submitted to, revised and cleared by the GEF Secretariat and later posted on the GEF webpage. Thereafter, a fully developed project proposal specifying further details about the budget, project activities and implementation, monitoring and evaluation arrangements is supposed to be submitted in the form of a chief executive officer endorsement document to be reviewed and approved by the GEF Secretariat and LDCF/Special Climate Change Fund Council (Biagini and Dobardzic 2011).

[5] Least Developed Countries Fund, http://www.thegef.org/gef/LDCF (last accessed November 18, 2014).

The Cancun Adaptation Framework, which was adopted at the sixteenth Conference of the Parties (COP-16) in 2010 included the development of NAPs as an instrument to plan and implement medium- and long-term adaptation planning. One year later, during COP-17, the objectives and characteristics of the NAP process were further discussed. NAPs are intended to "reduce vulnerability to the impacts of climate change, by building adaptive capacity and resilience" and to "facilitate the integration of climate change adaptation, in a coherent manner, into relevant new and existing policies, programmes and activities, in particular development planning processes and strategies, within all relevant sectors and at different levels, as appropriate" (LEG 2012). All developing country parties are invited to develop a NAP, not only LDCs as was the case for the NAPAs. However, as decided at COP-18 in Doha, LDCs are again entitled to receive financial resources from the GEF to start the NAP process. As for the NAPA process, technical guidelines for the NAP process were developed by the LEG (LEG 2012), establishing that the adaptation planning under the NAP process is to be "continuous, progressive and interactive".

The Committee on World Food Security (CFS) discussed climate change and food security at its thirty-ninth session in 2012, grounded on a report by the High Level Panel of Experts on Food Security and Nutrition (HLPE). The HLPE emphasized the importance of genetic resources and biodiversity (HLPE 2012). The committee invited the FAO Commission on Genetic Resources for Food and Agriculture (CGRFA) to continue to strengthen its work on climate change and genetic resources, particularly in the conservation and use of genetic resources for adaptation to climate change (FAO, 2012).

The FAO's CGRFA, concerned by the fact that the conservation and use of GRFA could be better integrated in national adaptation planning, adopted its Programme of Work on Climate Change and Genetic Resources for Food and Agriculture in April 2013 and agreed on developing guidelines for the integration of genetic diversity considerations into climate change adaptation planning, including NAPs (FAO, 2014). The guideline aims "to ensure the relevance of GRFA to the overall national adaptation planning process, to identify clear goals for conservation and use of GRFA as part of national adaptation to climate change, and to ensure the fullest involvement of all stakeholders", intending "to support the identification of priority areas for future investments in conservation and use of GRFA" (FAO, 2014). In addition, this guideline was designed following the approach and structure of the technical guidelines developed by the LEG for the development of NAPs, therefore allowing its use as a complementing document during the NAP process, addressing in particular the GRFA dimension in adaptation planning.

Part 3. Results

In the vulnerability analysis included in the introductory section of the 50 NAPAs, 16 (32%) of the countries made explicit references to the risks to, or value of, agricultural biodiversity in the face of climate change.[6] There are a total of 544 proposed priority projects across the 50 NAPAs. Out of all of these project proposals, 169 (31%) included one or some combination of the 48 agrobiodiverisity-related activities.[7]

Explicit mention of 'diversification of animal genetic resources' was mentioned in 2 NAPAs and 'diversification of fish genetic resources' in 1 NAPA. 'Crop diversification' was explicitly mentioned as a priority activity in 2 NAPAs and included as a sub-activity in 17 NAPAs. However, 3 of these NAPAs did not include sufficient details to ascertain the intended scale of diversification, which could range from the introduction of 1 or a few new monocropping systems for export markets to a wide range of varieties or species that increase system resilience in light of potentially dramatic climate shifts. A corollary situation was also found to exist: 5 NAPAs made no mention of 'crop diversification' per se but included a fair number of activities (at least 4) classified in the 2 groups specified above that would clearly lead to that result.

Table 1 shows the 48 agrobiodiversity-related activities included in the NAPAs that do (or at least could) increase biodiversity in agricultural production systems or in research and development chains as well as the number of times that each of them was included within the priority project proposals in the 50 NAPAs. The table presents these 48 agrobiodiversity-related activities classified according to the sectors in which they are most relevant. As shown in this table, 8 agrobiodiversity-related activities were repeatedly mentioned in the NAPAs,[8] to the extent that they accounted for 56% of all of the relevant activities mentioned.

[6] Out of these 16 NAPAs, 7 included 5 or more of the priority activities identified here as activities relying on the use of agricultural biodiversity but that do not necessarily translate into more diversity in agriculture and as activities that rely on the use of agricultural biodiversity and that lead to more diversity in agriculture and therefore potentially contribute to biodiversity-enriching measures.

[7] The details provided about the proposed priority projects varied from NAPA to NAPA and sometimes even within the same NAPA document.

[8] These eight activities were: (1) promotion of agroforestry systems/species; (2) development/dissemination of stress-tolerant varieties; (3) introduction of early-maturing/short-cycle varieties or crops and species more resistant to climate conditions such as cassava, sorghum, millet and sweet potatoes; (4) promotion of vegetable/horticulture systems; (5) establishment of new or upgraded community forest nurseries; (6) mangrove conservation and restoration practices; (7) introduction of other crops and

Table 1. Agrobiodiversity-related activities mentioned in the NAPAs as adaptation options, priority activities or both, which do (or at least could) involve the introduction or use of higher levels of biological diversity in production systems or in agriculture research and development, by sector

Prioritized adaptation activities identified in the NAPAs	**Total number of times of appearance of each prioritized activity across the 50 NAPAs**	**Degree of involvement of agricultural biodiversity in the activity: (1) the activity may lead to more diversity in upstream activities and in agricultural production systems); (2) the activity relies on the use of agricultural biodiversity in upstream activities but does not necessarily translate into more diversity in agricultural production systems and (3) the activity relies on the use of agricultural biodiversity in agricultural production systems)**
CROPS/FORAGES		
Promotion/improvement of local, indigenous or traditional crop varieties	3	3
Encouragment of farmers to cultivate several varieties of 1 crop type/association of crops	1	3
Promotion of vegetable/horticulture systems	20	3
Reseeding rangelands with suitable/resistant varieties	3	3
Promotion of soil conservation practices	9	3
Zero and minimum tillage systems	2	3
In-situ conservation practices of plant genetic resources	1	3
Ex-situ conservation practices of plant genetic resources	1	2
Establishment/maintenance of community seed banks	4	2
Development/dissemination of stress-tolerant varieties	24	2
Establishment of nurseries of vegetables and fruit trees	9	2
Introduction of early maturing/short cycle crops/varieties and species more resistant to climate conditions such as cassava, sorghum, millet and sweet potatoes	23	2
Introduction/expanded production of cash crops	12	1
Crop rotation	3	1
Terracing	4	1
LIVESTOCK		
Domestication of small animals (rabbits and small ruminants)	2	3
Genetic improvement of animal breeds	2	2
Promotion of livestock species resistant to drought and flood conditions	6	2
Support for the production of short-cycle animals	2	2
Selection and breeding of suitable varieties of indigenous goat and sheep breed types	1	2
Research on local and exotic animal species resistant to climate change*	0	2
Domestic farming of fast-breeding wild animals*	0	2
Promotion and development of domestic		

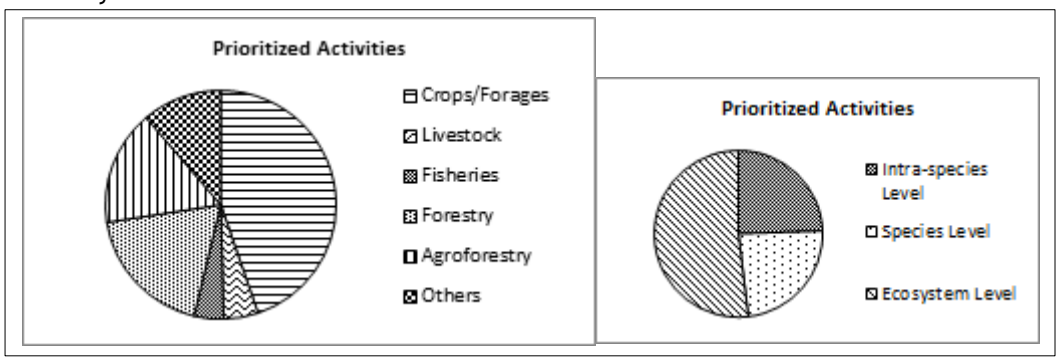
the expansion of production; (8) improvement of agro-silvo-pastoral production and the promotion and integration between agriculture, livestock and forestry.

poultry farming*	0	1
FISHERIES		
Development of multi-species fish systems that are more resistant to climate change	4	3
Protection of the diversity of the fish population and prevention of over-fishing	4	3
Establishment of fish gene banks to maintain genetic diversity of freshwater fish resources	2	2
Establishment of fish breeding and fish farming sites for restocking	2	2
Promotion of stress-tolerant fish species	1	2
Experimentation with new and alternative fish species*	0	2
Development of sustainable climate-resilient aquaculture technologies including locally adapted fish species*	0	2
Promotion of aquaculture*	0	1
Participatory management of aquatic ecosystem resources*	0	1
Introduction of traditional fishing knowledge and techniques at the community, provincial and national levels*	0	1
FORESTRY		
Enhancement of the biodiversity conservation and management of forests	8	3
Regeneration of degraded areas with local/native tree species	5	3
Promotion of the regeneration of indigenous forests	1	3
Regeneration of degraded areas with different tree species*	0	3
Conservation of forest plant genetic resources*	0	2
Establishment of new or upgraded existing community forest nurseries	18	2
Plantation of stress-tolerant, multi-use and fast-growing tree species	9	2
Promotion of community-based forest management	9	1
AGROFORESTRY		
Promotion of agroforestry systems/species	26	3
Introduction of herbaceous (graminaceous) shrubs in hedges	5	3
Improvement of agro-silvo-pastoral production/promotion of the integration between agriculture, livestock and forestry	12	3
OTHER NATURAL RESOURCES		
Mangrove conservation and restoration practices	14	3
Sustainable utilization and management, conservation or rehabilitation of degraded wetlands	7	3
Reconstitution of highly degraded areas with adapted species	4	1
Introduction of anti-erosion (soils) and dunes fixation	5	1

*Activities that appeared among the adaptation options identified at the beginning of the NAPA process but that did not appear longer among the priority activities.

As shown in figure 1, 45% of the total number of agrobiodiversity-related activities (267) mentioned across the 50 NAPAs involved crops or forages; 19% involved forestry; 16% agroforestry, 5% involved livestock and 4% involved fisheries. The remaining 11% of the activities involved other natural resources. Forty-six percent of the agrobiodiversity-related activities were at the ecosystem level; 20% were at the species level and 33% were at the intra-species level.

Figure 1. Distribution of the 267 prioritized activities across the 6 sectors and the 3 levels of diversity

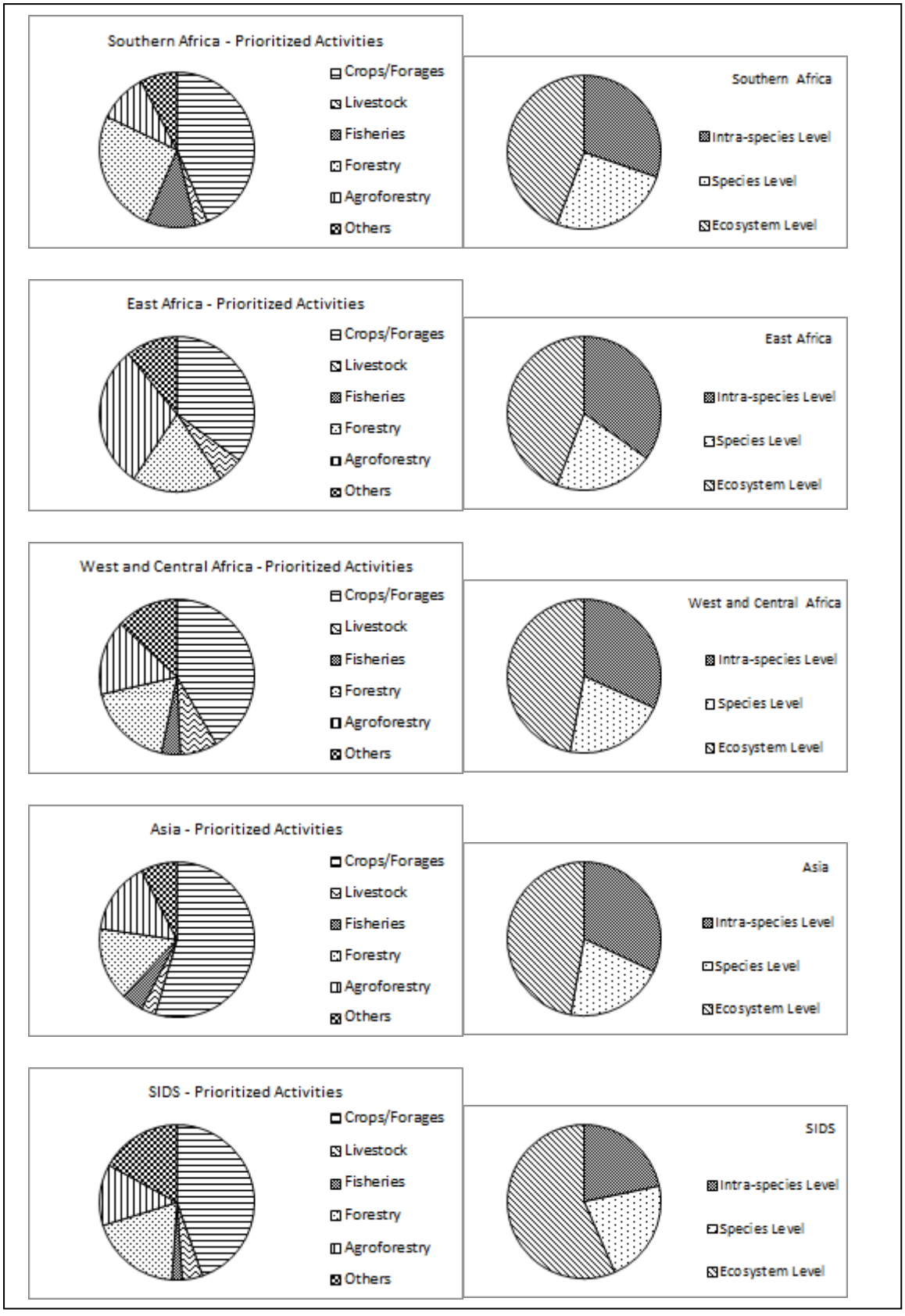


Source: Authors

For all of the four regions (East Africa, West Africa, Southern Africa, Asia and SIDS), the preponderance of biodiversity-related activities were in the crops and forages sector. This was especially true in the case of the NAPAs belonging to the Asian region, among SIDS, and in the Southern African region where 55%, 45% and 44%, respectively, of their priority activities fell under this sector. The East African countries' NAPAs included the lowest percentage (35%) in the crops/forages sector. The East African NAPAs had the highest number of agroforestry-related activities, totalling 30% of their priority activities. Southern Africa had the highest percentage of activities in the forest sector, at 26%. In the four regions, there were more activities at the ecosystem level than at the intra-species and species levels. The region with the highest percentages of ecosystem-level activities was SIDS, at 56%.

The 20 NAPAs that presented the highest degree of inclusion of agricultural biodiversity in their priority activities were those of Myanmar (38 points), Yemen (31 points), Malawi (21 points), Guinea and Mozambique (20 points), Laos PDR, Cambodia, Lesotho, Gambia and Sierra Leone (19 points), Mauritania, Nepal and Burundi (18 points), Haiti (17 points),

Figure 2. Distribution of the identified priority activities across the 6 sectors and diversity levels in each geographical region



Source: Authors

Central African Republic and Bangladesh (17 points), the former Sudan, Senegal and Solomon Islands (15 points) and Comoros (14 points). These NAPAs accounted for 165 of the 267 agrobiodiversity-related activities included in the 50 NAPAs.[9] In this subset of NAPAs, the spread of activities across the 6 sectors and the 3 levels of diversity was fairly similar to the overall spread for all of the 50 NAPAs reported above, with more activities related to the production of crops and forages and focusing on agricultural diversity at the ecosystem level. Only in a few of these NAPAs were the activities evenly distributed across the intra-species, species and ecosystem levels (Senegal, Malawi and Sudan, Myanmar and Comoros). In many of them, the majority of the activities referred to 1 or 2 of the 3 levels of diversity.

Figure 3. World map with the countries that have already developed a NAPA in light grey. Countries with NAPAS with the highest degree of integration of agricultural biodiversity in their priority activities are in black

Source: Authors

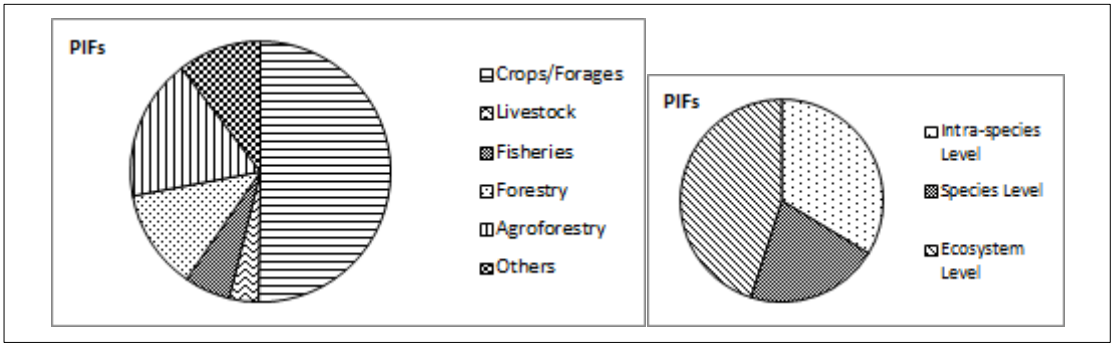
The 20 countries that incorporated agrobiodiversity most in their NAPAs are spread across the globe, with no evident positive correlation for geographic or regional location. Nor is there evidence of influence from lead national coordinating agencies or external supporting agencies. As in most countries, the lead agencies for the coordination of most of these countries were the Ministries of the Environment. As in the case of most of the other 31

[9] Including 19 priority activities that suggest the probable use of agricultural biodiversity but do not necessarily lead to more diversity in agricultural production systems (for example, 'terracing'); 78 activities that rely on the use of agricultural biodiversity but do not necessarily translate into more diversity in agricultural production systems (for example, 'development of stress-tolerant varieties') and 68 activities that rely on the use of agricultural biodiversity and that lead to more diversity in agricultural production systems (for example, 'cultivation of several varieties of one crop').

LDCs, these 20 countries received support from either the UN Development Programme or the UN Environment Programme during the NAPA preparation process.

As of June 2014, 48 of the 50 countries that developed NAPAs had submitted at least 1 PIF to the GEF requesting financial support for implementation activities. As of June 2014, a total of 137 PIFs had been developed. Unfortunately, 49 of these PIFS were not available through the GEF database (or otherwise through the GEF) and could not be included in our study. Out of the total number of PIFs submitted to the GEF for NAPA implementation, we identified 58 PIFs that included measures related to the 'master list' of 48 agrobiodiversity-related activities listed in table 1. In total, we identified the appearance of some of the activities included in the PIFs a total of 193 times. In total, the spread of those 193 activities across the 6 sectors in the PIFs was consistent with the NAPA priority activities. The same high level of corroboration was found between the overall division of activities across the 3 agrobiodiversity levels in the NAPA priority activities and the PIFs (see figure 5). The full details of the analysis of the PIFs can be found in Annexes 2 and 3.

Figure 5. Comparative importance of each of the sectors in the PIFs according to the number of priority activities included in them and according to the distribution of activities across the 3 levels of diversity



Source: Authors

Part 4. Discussion and conclusions

Thirty-one percent of all of the priority project proposals set out in the 50 NAPAs include some combination of the 48 agrobiodiversity-related activities. However, when looking at the numbers in detail, we notice that: (1) just 8 of the agrobiodiversity-related activities, which are most frequently repeated across the NAPAs, account for the majority of activities overall, demonstrating a relatively limited range of actions; (2) the presence of agrobiodiversity-related activities varies considerably across the NAPAs (20 NAPAs present the highest levels of inclusion of agricultural biodiversity; 10 NAPAs have only between zero and 2 of the

identified agrobiodiversity-related activities and approximately 39% of the 267 agrobiodiversity-related activities are concentrated in 11 NAPAs); (3) most activities focus on crops and forages (the livestock and fisheries sectors are, in contrast, comparatively under-represented but this might reflect the relatively lower importance of these two sectors in some countries) and (4) only a small number of the identified NAPAs pay a balanced attention to the three levels of diversity, which may translate into limitations in countries' adaptation strategies. In terms of location along value chains, it is noteworthy that all of the agrobiodiversity-related activities in the NAPAs related to research, development and production systems, while none of the activities was oriented towards the marketing and consumption ends of value chains. None of the identified agrobiodiversity-related activities focused on creating a demand for the products of agricultural biodiversity or promoting and regulating their commercialization in national and international markets. This concentration of activities at the initial part of the value chains could ultimately contribute to less-than-optimal outcomes. Diversification measures at the research and production stages are less likely to succeed if they are not accompanied by complementary actions taking place at later stages of the value chain (HLPE 2012).

It is widely recognized that agricultural biodiversity can play an important role in increasing agriculture's adaptive capacity and resilience to cope with climate change. However, our analysis indicates that in the majority of the NAPAs, agrobiodiversity has not been incorporated in a comprehensive or systematic manner. A number of factors in combination may have contributed to this outcome, and analysis of them is largely beyond the scope of this paper. However, we note a few issues here for possible future investigation.

The NAPAs are not meant to constitute brand new, stand-alone policy initiatives and national planning documents. Instead, they are meant to build upon, and complement, existing national economic development strategies and priorities, building in short-term adaptive capacity. The NAPA development guidelines are very clear in this regard. Very few countries have national economic development plans that promote increased use of agricultural biological diversity agricultural production systems. Indeed, the more familiar approach to national agricultural/economic development strategies is to encourage a streamlining, standardization, and biological simplification (increased use of a smaller number of genetically homogenous crops) as part of the development of commercially oriented value chains, often with aspirations for supplying international commodity markets. The pre-existence of such plans and policy directives may constrain, from the outset, NAPA developers' willingness to consider adaptation strategies involving increased biological complexity and smaller-scale, locally nuanced, decision making and planning.

Another issue concerns the fact that there are few clearly established precedents/models for scaling up of agricultural biological diversification strategies at the national level, particularly in production systems. Although the literature is rich with successful experiences in particular areas, how to translate them into short-term national adaptation strategies is not always clear. Therefore, adapting diversification practices from the literature to the different national contexts constitutes a challenge.

In light of the findings of our research, and in response to some of these contributing factors, it is clear that a more comprehensive and organized approach to including agrobiodiversity in national adaptation planning will be important for the mid- to long-term planning anticipated by the national teams developing NAPAs and NAPs. These teams require capacity strengthening and tools to help them consider options and develop practical, scalable plans. The guidelines that the CGRFA will be considering at its fifteenth session will respond to this need.

Annexes

Annex 1. List of countries that as of June 2014 had submitted a NAPA to the UNFCCC[10]

	Country	NAPA	Date of NAPA submission
1	**Afghanistan** (Af)	English	September 2009
2	**Angola** (Ag)	English	December 2011
3	**Bangladesh** (Bgh)	English	November 2005
4	**Benin** (Be)	French	January 2008
5	**Bhutan** (Bh)	English	May 2006
6	**Burkina Faso** (BF)	French	December 2007
7	**Burundi** (Bu)	French, English	February 2007
8	**Cambodia** (Cm)	English	March 2007
9	**Cape Verde (CV)**	English	December 2007
10	**Central African Republic** (CAR)	French	June 2008
11	**Chad** (Ch)	French	February 2010
12	**Comoros** (Co)	French, English	November 2006
13	**Democratic Republic of Congo** (RC)	French	September 2006
14	**Djibouti** (Dj)	French	October 2006
15	**Equatorial Guinea** (EG)	Spanish	November 2013
16	**Eritrea** (Er)	English	May 2007
17	**Ethiopia** (Et)	English	June 2008
18	**Gambia** (Gb)	English	January 2008
19	**Guinea** (Gn)	French	July 2007
20	**Guinea-Bissau** (GB)	English	February 2008
21	**Haïti** (Ha)	Français	December 2006
22	**Kiribati** (Ki)	English	January 2007
23	**Lao People's Democratic Republic** (Lao)	English	May 2009
24	**Lesotho** (Ls)	English	June 2007
25	**Liberia** (Li)	English	July 2007
26	**Madagascar** (Md)	Français	December 2006
27	**Malawi** (Mw)	English	March 2006
28	**Maldives (Mv)**	English	March 2008
29	**Mali** (Ml)	French	December 2007
30	**Mauritania** (Ma)	French, English	November 2004
31	**Mozambique** (Mz)	English	July 2008
32	**Myanmar** (My)	English	May 2013
33	**Nepal** (Np)	English	November 2010
34	**Niger** (Ng)	French, English	July 2006
35	**Rwanda** (Rw)	French, English	May 2007
36	**Samoa (Sm)**	English	December 2005
37	**Sao Tome and Principe** (ST)	English	November 2007
38	**Senegal** (Se)	French	November 2006
39	**Sierre Leone** (SL)	English	June 2008
40	**Solomon Islands** (SI)	English	December 2008
41	**Somalia** (So)	English	April 2013

[10] At the time of developing this study, Cape Verde, Maldives and Samoa no longer classified as a least developed country (LDC). South Sudan was the last country classified as a LDC in December 2012. It started the NAPA process in February 2013, and, therefore, the process was still ongoing when this study was conducted.

42	**Sudan** (Su)	English	June 2007
43	**Tanzania** (Tz)	English	September 2007
44	**Timor-Leste** (TL)	English	September 2011
45	**Togo** (Tg)	French	September 2009
46	**Tuvalu** (Tv)	English	May 2007
47	**Uganda** (Ug)	English	December 2007
48	**Vanuatu** (Vn)	English	December 2007
49	**Yemen** (Ym)	English	April 2009
50	**Zambia** (Zm)	English	October 2007

Source: UNFCCC webpage:

https://unfccc.int/adaptation/workstreams/national_adaptation_programmes_of_action/items/4585.php

ANNEX 2. Agrobiodiversity-related activities mentioned in the NAPAs as adaptation options, priority activities or in the PIFs, which do (or at least could) involve the introduction or use of higher levels of biological diversity in production systems or in agriculture research and development, by sector

East Africa

	Er	Dj	So	Et	Ug	Rw	Bu	Su
EXPLICIT AWARENESS ABOUT THE VALUE OF PGR				x	x			
CROPS/FORAGES								
Explicit mention of crop diversification			x				x	x
Promotion of soil conservation practices	x			x	x		x	
Zero and minimum tillage system								
Terracing	x				x		x	
Crop rotation	x							
Development/dissemination of stress-tolerant crops/varieties		x x	x		x x x		x x	x x x
Introduction of early maturing/short cycle crops/varieties and crops and species more resistant to climate conditions such as cassava, sorghum, millet, sweet potatoes…	x				x		x x x	x x
Encourage farmers to cultivate several varieties of one crop type/association of crops	x						x	
Promotion of vegetable gardens/horticulture systems		x x	x	x			x	
Introduction of other crops – expansion of production				x	x		x	x x
Promotion/improvement of local, indigenous, or traditional crop varieties	x			x				
Establishment/maintenance of community seed banks			x	x				
Establishment of nurseries of vegetables and fruit trees				x				
In-situ conservation practices of plant genetic resources	x							
Ex-situ conservation practices of plant genetic resources								
Reseeding rangelands with suitable/resistant varieties	x x							x
LIVESTOCK								
Explicit mention of diversification of livestock GR								
Promote livestock species resistant to drought and flood conditions	x				x		x x	
Research on local and exotic animal species resistant to climate change							x	
Genetic improvement of animal breeds				x				
Support to production of short-cycle animals								
Domestic farming of fast-breeding wild animals								
Selection and breeding of suitable varieties of indigenous goat and sheep breed types	x x							
Domestication of small animals (rabbits, small ruminants…)								
Promotion and development of domestic poultry-farming								
FISHERIES								
Explicit mention of diversification of fish GR								
Multi-species fish system more resistant to climate changes								
Promote stress-tolerant fish species								
Experiment new and alternative fish species								
Establishment of fish gene-banks to maintain genetic diversity of the freshwater fish resources								
Establishing fish breeding and fish farming sites for restocking								
Protection of the diversity of the fish population and prevention of over-fishing			x					
Promotion of aquaculture								
Sustainable climate-resilient aquaculture technologies including locally adapted fish species								

	Er	Dj	So	Et	Ug	Rw	Bu	Su
Participatory management of the aquatic ecosystems resources								
Share traditional fishing knowledge and techniques at the community, provincial and national levels								
FORESTRY								
Plantation of stress-tolerant, multi-use and fast growing tree species		x x			x		x x	x
Regeneration of degraded areas with different tree species								
Establishment of new or upgrade existing community forest nurseries	x	x		x	x		x	x
Regeneration of degraded areas with local/native tree species	x	x			x			
Promote the regeneration of indigenous forests	x							
Promotion of community based forest management				x	x			x
Enhancement of biodiversity conservation and management of forests								
Conservation of forest plant genetic resources	x							
AGROFORESTRY								
Promotion of agroforestry systems/species: multipurpose trees, fodder, legumes…	x	x x	x x	x x	x x		x	x x x
Set up herbaceous (graminaceous) shrubs in hedges	x x						x	
Improve the agro-sylvo-pastoral production/Promote integration between agriculture, livestock and forestry		x x				x	x x x	
OTHER NATURAL RESOURCES								
Sustainable utilization and management, conservation or rehabilitation of degraded wetlands				x x				
Reconstitution of highly degraded areas with adapted species					x			
Mangrove restoration practices		x x	x					
Anti-erosion (soils) and dunes fixation								x

Southern Africa

	Tz	Mw	Mz	Zm	Md	Ls
EXPLICIT AWARENESS ABOUT THE VALUE OF PGR		x				
CROPS/FORAGES						
Explicit mention of crop diversification		x	x	x	x	
Promotion of soil conservation practices			x	x		x x x
Zero and minimum tillage system						
Terracing	x					x
Crop rotation	x					x
Development/dissemination of stress-tolerant crops/varieties	x x	x	x x x	x	x	x x x
Introduction of early maturing/short cycle crops/varieties and crops and species more resistant to climate conditions such as cassava, sorghum, millet, sweet potatoes…	x x	x	x x	x x	x	x
Encourage farmers to cultivate several varieties of one crop type/association of crops			x			
Promotion of vegetable gardens/horticulture systems		x	x		x	x x
Introduction of other crops – expansion of production			x			x x
Promotion/improvement of local, indigenous, or traditional crop varieties		x				
Establishment/maintenance of community seed banks						
Establishment of nurseries of vegetables and fruit trees						x x
In-situ conservation practices of plant genetic resources						
Ex-situ conservation practices of plant genetic resources	x					
Reseeding rangelands with suitable/resistant varieties						
LIVESTOCK						
Explicit mention of diversification of livestock GR						
Promote livestock species resistant to drought and flood conditions			x	x		x x
Research on local and exotic animal species resistant to climate change						
Genetic improvement of animal breeds						
Support to production of short-cycle animals						
Domestic farming of fast-breeding wild animals						
Selection and breeding of suitable varieties of indigenous goat and sheep breed types						
Domestication of small animals (rabbits, small ruminants…)						
Promotion and development of domestic poultry-farming						
FISHERIES						
Explicit mention of diversification of fish GR		x				
Multi-species fish system more resistant to climate changes		x		x		
Promote stress-tolerant fish species						
Experiment new and alternative fish species						
Establishment of fish gene-banks to maintain genetic diversity of the freshwater fish resources		x				
Establishing fish breeding and fish farming sites for restocking		x				
Protection of the diversity of the fish population and prevention of over-fishing	x				x	
Promotion of aquaculture		x		x		
Sustainable climate-resilient aquaculture technologies including locally adapted fish species						
Participatory management of the aquatic ecosystems resources						
Share traditional fishing knowledge and techniques at the community, provincial and national levels						
FORESTRY						
Plantation of stress-tolerant, multi-use and fast growing tree species	x	x			x	x
Regeneration of degraded areas with different tree species						x
Establishment of new or upgrade existing community forest nurseries	x	x				
Regeneration of degraded areas with local/native tree species			x	x		
Promote the regeneration of indigenous forests				x		
Promotion of community based forest management	x x		x	x	x	
Enhancement of biodiversity conservation and management of forests	x x					
Conservation of forest plant genetic resources	x					
AGROFORESTRY						
Promotion of agroforestry systems/species: multipurpose trees, fodder, legumes…	x	x	x		x	x
Set up herbaceous (graminaceous) shrubs in hedges						
Improve the agro-sylvo-pastoral production/Promote integration between agriculture, livestock and forestry			x x		x	

	Tz	Mw	Mz	Zm	Md	Ls
OTHER NATURAL RESOURCES						
Sustainable utilization and management, conservation or rehabilitation of degraded wetlands						x
Reconstitution of highly degraded areas with adapted species						
Mangrove restoration practices	x x		x		x	
Anti-erosion (soils) and dunes fixation					x	

Central and West Africa

	Ma	Se	Gb	Gn	SL	Li	To	Be	Ml	BF	Ng	Ch	CAR	RC	EG	Ag
Explicit references to the risks to, or value of, agrobiodiversity in the face of climate change						x			x x		x	x				
CROPS/FORAGES																
Explicit mention of crop diversification	x x	x x	x x			x	x			x	x x	x x				x x
Promotion of soil conservation practices	x	x			x	x		x	x	x	x	x		x	x x	x x
Zero and minimum tillage system																
Terracing																
Crop rotation			x				x	x	x							x x x
Development/dissemination of stress-tolerant crop/varieties	x x x	x x x	x	x	x x		x x		x x		x	x x x	x x	x x		x x x
Introduction of early maturing/short cycle crops/varieties and of crops and species more resistant to climate conditions such as cassava, sorghum, millet, sweet potatoes…	x	x x	x x x	x x			x x	x x	x x x	x	x x	x x	x	x		x
Encourage farmers to cultivate several varieties of one crop type/association of crops											x					
Promotion of vegetable gardens/horticulture systems		x	x x	x x			x		x	x		x x				
Introduction of other crops - expansion of production		x x		x		x										
Promotion/improvement of local, indigenous, or traditional crop varieties		x		x					x							
Establishment/maintenance of community seed banks				x	x											
Establishment nurseries vegetables and fruit trees		x							x			x				
In-situ conservation practices of plant genetic resources									x				x			
Ex-situ conservation practices of plant genetic resources																
Reseeding rangelands with suitable/resistant varieties																
LIVESTOCK																
Explicit mention of diversification of livestock GR	x										x x					
Promote livestock species resistant to drought and flood conditions								x	x		x x			x		
Research on local and exotic animal species resistant to climate change																
Genetic improvement of animal breeds	x	x	x				x			x						
Support to production of short-cycle animals							x									
Domestic farming of fast-breeding wild animals			x													
Selection and breeding of suitable varieties of indigenous goat and sheep breed types																
Domestication of small animals (rabbits, small ruminants…)				x x		x		x								
Promotion and development of domestic poultry-farming	x															

	Ma	Se	Gb	Gn	SL	Li	To	Be	Ml	BF	Ng	Ch	CAR	RC	EG	Ag
FISHERIES																
Explicit mention of diversification of fish GR	x x															
Multi-species fish system more resistant to climate changes					x											
Promote stress-tolerant fish species			x													
Experiment new and alternative fish species																
Establishment of fish gene-banks to maintain genetic diversity of the freshwater fish resources																
Establishing fish breeding and fish farming sites for restocking	x															
Protection of the diversity of the fish population and prevention of over-fishing	x x					x										
Promotion of aquaculture		x			x									x		
Sustainable climate-resilient aquaculture technologies including locally adapted fish species					x											
Participatory management of the aquatic ecosystems resources																
Share traditional fishing knowledge and techniques at the community, provincial and national levels																
FORESTRY																
Plantation of stress-tolerant, multi-use, or fast growing tree species		x x	x	x				x								x
Regeneration of degraded areas with different tree species																
Establishment of new or upgrade existing community forest nurseries	x	x x	x		x						x		x			
Regeneration of degraded areas with local/native tree species										x			x			
Promote the regeneration of indigenous forests																
Promotion of community based forest management		x	x		x	x	x					x	x		x	
Enhancement of biodiversity conservation and sustainable management of forests	x		x x		x					x			x			
Conservation of forest plant genetic resources																
AGROFORESTRY																
Promotion of agroforestry systems/species: multipurpose trees, fodder, legumes…	x x x	x x x	x x	x x	x	x x		x	x		x	x	x x			
Set up herbaceous (graminaceous) shrubs in hedges	x x			x												
Improve the agro-sylvo-pastoral production/ Promote integration between agriculture, livestock and forestry	x				x	x	x		x	x	x x		x	x		x x x
OTHER NATURAL RESOURCES																
Sustainable utilization and management, conservation or rehabilitation of degraded wetlands	x		x x	x	x x					x						
Reconstitution of highly degraded areas with adapted species																
Mangrove conservation and restoration practices		x x x	x x x	x x	x	x	x							x		
Anti-erosion (soils) and dunes fixation								x			x x					

Asia

	My	Cm	Lao	Bh	Bgh	Np	Af	Ym
Explicit references to the risks to, or value of, agrobiodiversity in the face of climate change	x		x			x	x	
CROPS/FORAGES								
Explicit mention of crop diversification	x		x		x		x x	
Promotion of soil conservation practices	x x	x x	x	x		x x		x
Zero and minimum tillage system				x	x		x x	
Terracing	x			x		x	x x x	x x x
Crop rotation			x					
Development/dissemination of stress-tolerant crops/varieties	x x	x	x x x	x	x x x	x x x	x x	x x
Introduction of early maturing/short cycle crops/varieties and of crops and species more resistant to climate conditions such as cassava, sorghum, millet, sweet potatoes…	x x	x x	x x x			x x x	x	x x
Encourage farmers to cultivate several varieties of one crop type/association of crops	x							
Promotion of vegetable gardens/horticulture systems	x x	x	x	x	x x	x x x	x x x	x
Introduction of other crops – expansion of production	x x		x x					x
Promotion/improvement of local, indigenous, or traditional varieties	x x					x		x
Establishment/maintenance of community seed banks				x		x	x	
Establishment of nurseries for vegetables and fruit trees						x	x x	x
In-situ conservation practices of plant genetic resources	x							
Ex-situ conservation practices of plant genetic resources	x							
Reseeding rangelands with suitable/resistant varieties							x	x
LIVESTOCK								
Explicit mention of diversification of livestock GR			x					
Promote livestock species resistant to drought and flood conditions	x		x x x				x	
Research on local and exotic animal species resistant to climate change								
Genetic improvement of animal breeds						x		
Support to production of short-cycle animals								
Domestic farming of fast-breeding wild animals								
Selection and breeding of suitable varieties of indigenous goat and sheep breed types								
Domestication of small animals (rabbits, small ruminants…)								
Promotion and development of domestic poultry-farming								
FISHERIES								
Explicit mention of diversification of fish GR								
Multi-species fish system more resistant to climate changes	x							x
Promote stress-tolerant fish species				x	x			
Experiment new and alternative fish species								
Establishment of fish gene-banks to maintain genetic diversity of the freshwater fish resources								
Establishing fish breeding and fish farming sites for restocking		x						
Protection of the diversity of the fish population and prevention of over-fishing	x							x
Promotion of aquaculture	x	x	x		x			
Sustainable climate-resilient aquaculture technologies including locally adapted fish species	x							
Participatory management of the aquatic ecosystems' resources								
Share traditional fishing knowledge and techniques at the community, provincial and national levels								
FORESTRY								
Plantation of stress-tolerant, multi-use, or fast growing tree species	x x		x	x	x	x	x	
Regeneration of degraded areas with different tree species								
Establishment of new or upgrade existing community forest nurseries	x		x		x x		x	x
Regeneration of degraded areas with local/native tree species	x	x	x			x	x	

	My	Cm	Lao	Bh	Bgh	Np	Af	Ym
Promote the regeneration of indigenous forests								
Promotion of community based forest management			x	x	x x		x x	
Enhancement of biodiversity conservation and management of forests							x	
Conservation of forest plant genetic resources								
AGROFORESTRY								
Promotion of agroforestry systems/species: multipurpose trees, fodder, legumes…	x x	x x	x x	x	x x x	x x x	x x	x
Set up herbaceous (graminaceous) shrubs in hedges							x	
Improve the agro-sylvo-pastoral production/Promote integration between agriculture, livestock and forestry	x x	x x		x			x x x	x
OTHER NATURAL RESOURCES								
Sustainable utilization and management, conservation or rehabilitation of degraded wetlands			x	x	x	x x	x	x x x
Reconstitution of highly degraded areas with adapted species								
Mangrove conservation and restoration practices	x x	x x			x			x x x
Anti-erosion (soils) and dunes fixation								

Small Island Developing States (SIDS)

	Ha	CV	GB	Co	Mv	ST	Sm	Ki	SI	TL	Tu	Vn
Explicit references to the risks to, or value of, agrobiodiversity in the face of climate change						x	x	x		x		x
CROPS/FORAGES												
Explicit mention of crop diversification	x	x	x x	x			x	x	x x		x	x x
Promotion of soil conservation practices	x x						x					
Zero and minimum tillage system												
Terracing												
Crop rotation												
Development of stress-tolerant varieties	x x	x	x			x			x x	x	x	
Introduction of early maturing/short cycle crops/varieties and crops and species more resistant to climate conditions such as cassava, sorghum, millet, sweet potatoes…	x	x	x x	x			x x		x x	x		
Encourage farmers to cultivate several varieties of one crop type/association of crops												
Promotion of vegetable gardens/horticulture systems	x	x	x				x x	x	x x			
Introduction of other crops – expansion of production	x						x	x	x			
Promotion/improvement of local, indigenous, or traditional varieties	x								x			
Establishment/maintenance of community seed banks	x			x				x				
Establishment of nurseries of vegetables and fruit trees								x			x	
In-situ conservation practices of plant genetic resources												
Ex-situ conservation practices of plant genetic resources												
Reseeding rangelands with suitable/resistant varieties												
LIVESTOCK												
Explicit mention of diversification of livestock GR												
Promote livestock species resistant to drought and flood conditions						x x						
Research on local and exotic animal species resistant to climate change												
Genetic improvement of animal breeds												
Support to production of short-cycle animals			x x									
Domestic farming of fast-breeding wild animals												
Selection and breeding of suitable varieties of indigenous goat and sheep breed types												
Domestication of small animals (rabbits, small ruminants…)			x			x						
Promotion and development of domestic poultry-farming					x							
FISHERIES												
Explicit mention of diversification of fish GR												
Multi-species fish system more resistant to climate changes	x											
Promote stress-tolerant fish species												
Experiment new and alternative fish species					x							
Establishment of fish gene-banks to maintain genetic diversity of the freshwater fish resources												
Establishing fish breeding and fish farming sites for restocking												x
Protection of the diversity of the fish population and prevention of over-fishing									x			
Promotion of aquaculture					x							x
Sustainable climate-resilient aquaculture technologies including locally adapted fish species												
Participatory management of the aquatic ecosystems' resources												
Share traditional fishing knowledge and techniques at the community, provincial and national levels									x			

	Ha	CV	GB	Co	Mv	ST	Sm	Ki	SI	TL	Tu	Vn
FORESTRY												
Plantation of stress-tolerant trees, multi-use, or fast growing tree species				x			x					
Regeneration of degraded areas with different tree species												
Establishment of new or upgrade existing community forest nurseries	x			x			x				x	
Regeneration of degraded areas with local/native tree species							x					
Promote the regeneration of indigenous forests												
Promotion of community based forest management							x x		x	x	x	
Enhancement of biodiversity conservation and sustainable management of forests	x					x						x
Conservation of forest plant genetic resources												
AGROFORESTRY												
Promotion of agroforestry systems/species: multipurpose trees, fodder, legumes…	x x x	x		x			x			x x		
Set up herbaceous (graminaceous) shrubs in hedges				x			x					
Improve the agro-sylvo-pastoral production/Promote integration between agriculture, livestock and forestry		x		x		x x						
OTHER NATURAL RESOURCES												
Sustainable utilization and management, conservation or rehabilitation of degraded wetlands												
Reconstitution of highly degraded areas with adapted species	x		x							x		
Mangrove conservation and restoration practices			x					x	x	x	x	x
Anti-erosion (soils) and dunes fixation	x											

ANNEX 3. Agrobiodiversity-related activities mentioned in the NAPAs as adaptation options, priority activities or in the PIFs, which do (or at least could) involve the introduction or use of higher levels of biological diversity in production systems or in agriculture research and development, across the three levels of diversity

East Africa

	Er	Dj	So	Et	Ug	Rw	Bu	Su
INTRA-SPECIES LEVEL								
Promotion/improvement of local, indigenous, or traditional crop varieties	x			x				
Development/dissemination of stress-tolerant crops/varieties		x x	x		x x x		x x	x x x
Establishment/maintenance of community seed banks			x	x				
Establishment of nurseries of vegetables and fruit trees				x				
In-situ conservation practices of plant genetic resources	x							
Ex-situ conservation practices of plant genetic resources								
Research on local and exotic animal species resistant to climate change							x	
Genetic improvement of animal breeds				x				
Support to production of short-cycle animals								
Selection and breeding of suitable varieties of indigenous goat and sheep breed types	x x							
Establishment of fish gene-banks to maintain genetic diversity of the freshwater fish resources								
Establishment of new or upgrade existing community forest nurseries	x	x		x	x		x	x
Conservation of forest plant genetic resources	x							
SPECIES LEVEL								
Introduction of early maturing/short cycle crops/varieties and crops and species more resistant to climate conditions such as cassava, sorghum, millet, sweet potatoes…	x				x		x x x	x x
Encourage farmers to cultivate several varieties of one crop type/association of crops	x						x	
Introduction of other crops - expansion of production				x	x		x	
Promote livestock species resistant to drought and flood conditions	x				x		x x	
Domestic farming of fast-breeding wild animals								
Domestication of small animals (rabbits, small ruminants…)								
Promotion and development of domestic poultry-farming								
Multi-species fish system more resistant to climate changes								x x
Protection of the diversity of the fish population and prevention of over-fishing			x					
Sustainable climate-resilient aquaculture technologies including locally adapted fish species								
Promote stress-tolerant fish species								
Experiment new and alternative fish species								
Plantation of stress-tolerant, multi-use or fast growing tree species		x x			x		x x	x
ECOSYSTEM LEVEL								
Promotion of soil conservation practices	x			x	x		x	
Zero and minimum tillage system								
Crop rotation	x							
Terracing	x				x		x	
Set up herbaceous (graminaceous) shrubs in hedges	x x						x x	
Promotion of vegetable gardens/horticulture systems		x x	x	x				
Promotion of agroforestry systems/species: multipurpose trees, fodder, legumes…	x	x x	x x	x x	x x		x	x x x
Improve the agro-sylvo-pastoral production/Promote integration between agriculture, livestock and forestry		x x				x	x x x	
Promotion of aquaculture								
Participatory management of the aquatic ecosystems' resources								
Share traditional fishing knowledge and techniques at the community, provincial and national levels								
Establishing fish breeding and fish farming sites for restocking								
Promotion of community based forest management				x	x			x
Enhancement of biodiversity conservation and management of forests								

	Er	Dj	So	Et	Ug	Rw	Bu	Su
Promote the regeneration of indigenous forests	x							
Reconstitution of highly degraded areas with species adapted to the terrestrial ecosystems					x			
Regeneration of degraded areas with local/native tree species	x	x			x			
Regeneration of degraded areas with different tree species								
Sustainable utilization and management, conservation or rehabilitation of degraded wetlands				x x				
Mangrove restoration practices		x x	x					
Reseeding rangelands with suitable/resistant varieties	x x							x
Anti-erosion (soils) and dunes fixation								x

Southern Africa

	Tz	Mw	Mz	Zm	Md	Ls
INTRA-SPECIES LEVEL						
Promotion/improvement of local, indigenous, or traditional crop varieties		x				
Development/dissemination of stress-tolerant crops/varieties	x x	x	x x x	x	x	x x x
Establishment/maintenance of community seed banks						
Establishment of nurseries of vegetables and fruit trees						x x
In-situ conservation practices of plant genetic resources	x					
Ex-situ conservation practices of plant genetic resources						
Research on local and exotic animal species resistant to climate change						
Genetic improvement of animal breeds						
Support to production of short-cycle animals						
Selection and breeding of suitable varieties of indigenous goat and sheep breed types						
Establishment of fish gene-banks to maintain genetic diversity of the freshwater fish resources		x				
Establishment of new or upgrade existing community forest nurseries	x	x				
Conservation of forest plant genetic resources	x					
SPECIES LEVEL						
Introduction of early maturing/short cycle crops/varieties and crops and species more resistant to climate conditions such as cassava, sorghum, millet, sweet potatoes…	x x	x	x x	x x	x	x
Encourage farmers to cultivate several varieties of one crop type/association of crops			x			
Introduction of other crops – expansion of production			x			x x
Promote livestock species resistant to drought and flood conditions		x	x	x		x x
Domestication of small animals (rabbits, small ruminants…)						
Domestic farming of fast-breeding wild animals						
Promotion and development of domestic poultry-farming						
Multi-species fish system more resistant to climate changes		x		x		
Protection of the diversity of the fish population and prevention of over-fishing	x				x	
Sustainable climate-resilient aquaculture technologies including locally adapted fish species						
Promote stress-tolerant fish species						
Experiment new and alternative fish species						
Plantation of stress-tolerant, multi-use or fast growing tree species	x	x			x	x
ECOSYSTEM LEVEL						
Promotion of soil conservation practices			x	x		x x x
Zero and minimum tillage system						
Crop rotation	x					x
Terracing	x					x
Set up herbaceous (graminaceous) shrubs in hedges						
Promotion of vegetable gardens/horticulture systems		x	x		x	x x
Promotion of agroforestry systems/species: multipurpose trees, fodder, legumes…	x	x	x		x	x
Improve the agro-sylvo-pastoral production/Promote integration between agriculture, livestock and forestry			x x		x	
Promotion of aquaculture		x		x		
Participatory management of the aquatic ecosystems' resources						
Share traditional fishing knowledge and techniques at the community, provincial and national levels						
Establishing fish breeding and fish farming sites for restocking		x				
Promotion of community based forest management	x x		x	x	x	
Enhancement of biodiversity conservation and management of forests	x x					
Promote the regeneration of indigenous forests				x		
Reconstitution of highly degraded areas with species adapted to the terrestrial ecosystems						
Regeneration of degraded areas with local/native tree species			x	x		
Regeneration of degraded areas with different tree species						x
Sustainable utilization and management, conservation or rehabilitation of degraded wetlands						x
Mangrove restoration practices	x x		x		x	
Reseeding rangelands with suitable/resistant varieties						
Anti-erosion (soils) and dunes fixation					x	

Central and West Africa

	Ma	Se	Gb	Gn	SL	Li	To	Be	Ml	BF	Ng	Ch	CAR	RC	EG	Ag
INTRA-SPECIES LEVEL																
Promotion/improvement of local, indigenous, or traditional crop varieties		x		x					x							
Development/dissemination of stress-tolerant crop/varieties	xx x	xxx	x	x	x x		x x		x x		x	xxx	x x	x x		xxx
Establishment/maintenance of community seed banks				x	x											
Establishment of nurseries vegetables and fruit trees		x							x			x				
In-situ conservation practices of plant genetic resources									x				x			
Ex-situ conservation practices of plant genetic resources																
Research on local and exotic animal species resistant to climate change																
Genetic improvement of animal breeds	x	x	x				x			x						
Support to production of short-cycle animals							x									
Selection and breeding of suitable varieties of indigenous goat and sheep breed types																
Establishment of fish gene-banks to maintain genetic diversity of the freshwater fish resources																
Establishment of new or upgrade existing community forest nurseries	x	x x	x		x						x		x			
Conservation of forest plant genetic resources																
SPECIES LEVEL																
Introduction of early maturing/short cycle crops/varieties and crops and species more resistant to climate conditions such as cassava, sorghum, millet, sweet potatoes…	x	x x	xxx	x x			x x	x x	xxx	x	x x	x x	x	x		x
Encourage farmers to cultivate several varieties of one crop type/ association of crops											x					
Introduction of other crops - expansion of production		x x		x		x										
Promote livestock species resistant to drought and flood conditions								x	x		x x			x		
Domestication of small animals (rabbits, small ruminants…)				x x		x		x								
Domestic farming of fast-breeding wild animals			x													
Promotion and development of domestic poultry-farming	x															
Multi-species fish system more resistant to climate changes					x											
Plantation of stress-tolerant, multi-use, or fast growing tree species		x x	x	x				x								x
Protection of the diversity of the fish population and	x x					x										

prevention of over-fishing																
	Ma	**Se**	**Gb**	**Gn**	**SL**	**Li**	**To**	**Be**	**Ml**	**BF**	**Ng**	**Ch**	**CAR**	**RC**	**EG**	**Ag**
Sustainable climate-resilient aquaculture technologies including locally adapted fish species					x											
Promote stress-tolerant fish species			x													
Experiment new and alternative fish species																
ECOSYSTEM LEVEL																
Promotion of soil conservation practices	x	x			x	x		x	x	x	x	x		x	x x	x x
Zero and minimum tillage system																
Crop rotation			x				x	x	x							xxx
Terracing																
Set up herbaceous (graminaceous) shrubs in hedges	x x			x												
Promotion of vegetable gardens/horticulture systems		x	x x	x x			x		x	x		x x				
Promotion of agroforestry systems/species: multipurpose trees, fodder, legumes…	xxx	xxx	x x	x x	x	x x		x	x		x x	x	x x			
Improve the agro-sylvo-pastoral production/Promote integration between agriculture, livestock and forestry	x				x	x	x		x	x	x x		x	x		xxx
Promotion of aquaculture		x			x									x		
Participatory management of the aquatic ecosystems' resources																
Share traditional fishing knowledge and techniques at the community, provincial and national levels																
Establishing fish breeding and fish farming sites for restocking	x															
Promotion of community based forest management		x	x		x	x	x					x	x		x	
Enhancement of biodiversity conservation and sustainable management of forests	x		x x		x					x			x			
Promote the regeneration of indigenous forests																
Reconstitution of highly degraded areas with species adapted to the terrestrial ecosystems																
Regeneration of degraded areas with local/native tree species										x			x			
Regeneration of degraded areas with different tree species																
Sustainable utilization and management, conservation or rehabilitation of degraded wetlands	x		x x	x	x x					x						
Mangrove conservation and restoration practices		xxx	xxx	x x	x	x	x							x		
Reseeding rangelands with suitable/resistant varieties																
Anti-erosion (soils) and dunes fixation								x			x x					

Asia

	My	Cm	Lao	Bh	Bgh	Np	Af	Ym
INTRA-SPECIES LEVEL								
Promotion/improvement of local, indigenous, or traditional varieties	x x					x		x
Development/dissemination of stress-tolerant crops/varieties	x x	x	x x x	x	x x x	x x x	x x	x x
Establishment/maintenance of community seed banks				x		x	x	
Establishment of nurseries for vegetables and fruit trees						x	x x	x
In-situ conservation practices of plant genetic resources	x							
Ex-situ conservation practices of plant genetic resources	x							
Research on local and exotic animal species resistant to climate change								
Genetic improvement of animal breeds						x		
Support to production of short-cycle animals								
Selection and breeding of suitable varieties of indigenous goat and sheep breed types								
Establishment of fish gene-banks to maintain genetic diversity of the freshwater fish resources								
Establishment of new or upgrade existing community forest nurseries	x		x		x x		x	x
Conservation of forest plant genetic resources								
SPECIES LEVEL								
Introduction of early maturing/short cycle crops/varieties and crops and species more resistant to climate conditions such as cassava, sorghum, millet, sweet potatoes…	x x	x x	x x x			x x x	x	x x
Encourage farmers to cultivate several varieties of one crop type/association of crops	x							
Introduction of other crops – expansion of production	x x		x x					x
Promote livestock species resistant to drought and flood conditions	x		x x x				x	
Domestication of small animals (rabbits, small ruminants…)								
Domestic farming of fast-breeding wild animals								
Promotion and development of domestic poultry-farming								
Multi-species fish system more resistant to climate changes	x							x
Protection of the diversity of the fish population and prevention of over-fishing	x							x
Sustainable climate-resilient aquaculture technologies including locally adapted fish species	x							
Promote stress-tolerant fish species				x	x			
Experiment new and alternative fish species								
Plantation of stress-tolerant, multi-use, or fast growing tree species	x x		x	x	x	x	x	
ECOSYSTEM LEVEL								
Promotion of soil conservation practices	x x	x x	x	x		x x		x
Zero and minimum tillage system				x	x		x x	
Crop rotation			x					
Terracing	x			x		x	x x x	x x x
Set up herbaceous (graminaceous) shrubs in hedges							x	
Promotion of vegetable gardens/horticulture systems	x x	x	x	x	x x	x x x	x x x	x
Promotion of agroforestry systems/species: multipurpose trees, fodder, legumes…	x x	x x	x x	x	x x x	x x x	x x	x
Improve the agro-sylvo-pastoral production/Promote integration between agriculture, livestock and forestry	x x	x x		x			x x x	x
Promotion of aquaculture	x	x	x		x			
Participatory management of the aquatic ecosystems' resources								
Share traditional fishing knowledge and techniques at the community, provincial and national levels								
Establishing fish breeding and fish farming sites for restocking		x						
Promotion of community based forest management			x	x	x x		x x	
Enhancement of biodiversity conservation and management of forests							x	
Promote the regeneration of indigenous forests								
Reconstitution of highly degraded areas with species adapted to the terrestrial ecosystems								
Regeneration of degraded areas with local/native tree species	x	x	x			x	x	

	My	Cm	Lao	Bh	Bgh	Np	Af	Ym
Regeneration of degraded areas with different tree species								
Sustainable utilization and management, conservation or rehabilitation of degraded wetlands			x	x	x	x x	x	x x x
Mangrove conservation and restoration practices	x x	x x			x			x x x
Reseeding rangelands with suitable/resistant varieties							x	x
Anti-erosion (soils) and dunes fixation								

Small Island Developing States (SIDS)

	Ha	CV	GB	Co	Mv	ST	Sm	Ki	SI	TL	Tu	Vn
INTRA-SPECIES LEVEL												
Promotion/improvement of local, indigenous, or traditional varieties	x								x			
Development of stress-tolerant varieties	x x	x	x			x			x x	x	x	
Establishment/maintenance of community seed banks	x			x				x				
Establishment of nurseries of vegetables and fruit trees								x			x	
In-situ conservation practices of plant genetic resources												
Ex-situ conservation practices of plant genetic resources												
Research on local and exotic animal species resistant to climate change												
Genetic improvement of animal breeds												
Support to production of short-cycle animals			x x									
Selection and breeding of suitable varieties of indigenous goat and sheep breed types												
Establishment of fish gene-banks to maintain genetic diversity of the freshwater fish resources												
Establishment of new or upgrade existing community forest nurseries	x			x			x				x	
Conservation of forest plant genetic resources												
SPECIES LEVEL												
Introduction of early maturing/short cycle crops/varieties and crops and species more resistant to climate conditions such as cassava, sorghum, millet, sweet potatoes…	x	x	x x	x			x x		x x	x		
Encourage farmers to cultivate several varieties of one crop type/association of crops												
Introduction of other crops – expansion of production	x						x	x	x			
Promote livestock species resistant to drought and flood conditions						x x						
Domestication of small animals (rabbits, small ruminants…)			x			x						
Domestic farming of fast-breeding wild animals												
Promotion and development of domestic poultry-farming					x							
Multi-species fish system more resistant to climate changes	x											
Protection of the diversity of the fish population and prevention of over-fishing									x			
Sustainable climate-resilient aquaculture technologies including locally adapted fish species												
Promote stress-tolerant fish species												
Experiment new and alternative fish species					x							
Plantation of stress-tolerant, multi-use, or fast growing tree species				x			x					
ECOSYSTEM LEVEL												
Promotion of soil conservation practices	x x						x					
Zero and minimum tillage system												
Crop rotation												
Terracing												
Set up herbaceous (graminaceous) shrubs in hedges				x			x					
Promotion of vegetable gardens/horticulture systems	x	x	x				x x	x	x x			
Promotion of agroforestry systems/species: multipurpose trees, fodder, legumes…	x x x	x		x			x			x x		
Improve the agro-sylvo-pastoral production/Promote integration between agriculture, livestock and forestry		x		x		x x						
Promotion of aquaculture					x							x
Participatory management of the aquatic ecosystems' resources												
Share traditional fishing knowledge and techniques at the community, provincial and national levels									x			

	Ha	CV	GB	Co	Mv	ST	Sm	Ki	SI	TL	Tu	Vn
Establishing fish breeding and fish farming sites for restocking												x
Promotion of community based forest management							x x		x	x	x	
Enhancement of biodiversity conservation and sustainable management of forests	x					x						x
Promote the regeneration of indigenous forests												
Reconstitution of highly degraded areas with species adapted to the terrestrial ecosystems	x		x							x		
Regeneration of degraded areas with local/native tree species							x					
Regeneration of degraded areas with different tree species												
Sustainable utilization and management, conservation or rehabilitation of degraded wetlands												
Mangrove conservation and restoration practices			x					x	x	x	x	x
Reseeding rangelands with suitable/resistant varieties												
Anti-erosion (soils) and dunes fixation	x											

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Research supported by: CGIAR Fund; European Commission; IFAD; Swiss Agency for Development and Cooperation SDC; IICT; UKaid from the British people; Australian Government Australian Centre for International Agricultural Research; Irish Aid; Ireland's commitment to a world without poverty and hunger; Ministry of Foreign Affairs of the Netherlands; Government of Canada / Gouvernement du Canada; New Zealand Ministry of Foreign Affairs & Trade / Manatū Aorere