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Item 3 of the provisional agenda
Nairobi work programme on impacts, vulnerability and adaptation to climate change

Synthesis report on technologies for adaptation identified in the submissions from Parties and relevant organizations

Note by the secretariat*

Summary

This report presents a synthesis of information and views submitted by Parties and relevant organizations on technologies for adaptation to climate change at the regional, national and local levels in different sectors. The report also synthesizes views on needs for, concerns with, and experiences and lessons learned from developing, deploying and transferring such technologies and identifies issues for further consideration.

* This document was submitted late due to heavy document workload during this period of time.

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I. Introduction

A. Mandate

1. The Subsidiary Body for Scientific and Technological Advice (SBSTA), at its twenty-fifth session,[1] invited Parties and relevant organizations to provide structured submissions, by 15 May 2007, on adaptation approaches, strategies, practices and technologies for adaptation at the regional, national and local levels in different sectors, as well as on experiences, needs and concerns. It requested the secretariat to develop the structure for these submissions and to disseminate it to Parties by 20 January 2007. The SBSTA further requested the secretariat to compile these submissions into a miscellaneous document to be made available to the SBSTA by its twenty-seventh session.[2]

2. At the same session, the SBSTA requested the secretariat to prepare a synthesis report, by its twenty-seventh session, on technologies for adaptation to climate change identified in the submissions from Parties and relevant organizations referred to in paragraph 1 above.[3]

B. Scope of the note

3. This report synthesises information on technologies for adaptation to climate change contained in 13 submissions received from Parties, representing the views of 31 Parties, and 10 submissions from relevant organizations – seven from United Nations organizations and intergovernmental organizations and three from accredited non-governmental organizations (see table). The report highlights technologies identified in different sectors to facilitate adaptation to the adverse effects of climate change by enhancing resilience at the regional, national and local levels. It also identifies common needs for these technologies, concerns and barriers related to their dissemination and transfer, and experiences and lessons learned, including measures to address these barriers, for different sectors from regional, national and local perspectives.

4. The synthesis will serve as an input to the Nairobi work programme on impacts, vulnerability and adaptation to climate change and to the work of the Expert Group on Technology Transfer (EGTT) on analysing and identifying ways to facilitate and advance technology transfer activities, including those identified in the framework for meaningful and effective actions to enhance the implementation of Article 4, paragraph 5, of the Convention (technology transfer framework).

C. Background

5. The overall objective of the Nairobi work programme is to assist all Parties, in particular developing countries, including the least developed countries (LDCs) and small island developing States (SIDS), to improve their understanding and assessment of impacts, vulnerability and adaptation, and to make informed decisions on practical adaptation actions and measures to respond to climate change on a sound scientific, technical and socio-economic basis, taking into account current and future climate change and variability.[4]

6. Activities in the area of adaptation planning and practices under the Nairobi work programme are undertaken in line with the objective in the annex to decision 2/CP.11 to advance sub-themes 3 (b) (ii), "Collecting, analysing and disseminating information on past and current practical adaptation actions and

[1] FCCC/SBSTA/2006/11, paragraph 56.
[2] The submissions are compiled in documents FCCC/SBSTA/2007/MISC.10 and FCCC/SBSTA/2007/MISC.11.
[3] FCCC/SBSTA/2006/11, paragraph 65.
[4] Decision 2/CP.11, annex, paragraph 1.

measures, including adaptation projects, short- and long-term adaptation strategies, and local and indigenous knowledge" and 3 (b) (iv), "Facilitating communication and cooperation among and between Parties and relevant organizations, business, civil society and decision makers, and other stakeholders".

7. Since the adoption of the technology transfer framework by the Conference of the Parties at its seventh session,[5] the work on development and transfer of technologies under the Convention has been focused on the implementation of a set of activities identified under the key thematic areas of this framework: that is, technology needs assessments (TNAs), technology information, enabling environments, capacity-building, and mechanisms for technology transfer. Issues relating to technologies for adaptation have been addressed under each theme.

8. The SBSTA and EGTT work on technologies for adaptation to climate change aimed to improve the current knowledge and understanding of these technologies, assess their potentials and limitations, identify prioritized needs of developing countries for these technologies, improve the process of technology development and transfer as relevant to adaptation, and further elaborate its implications for climate policy. Some outcomes of this work were:

(a) A handbook entitled *Conducting technology needs assessments for climate change* prepared by the United Nations Development Programme in collaboration with Climate Technology Initiative, the EGTT and the secretariat, to help Parties conduct TNAs;

(b) A synthesis report on TNAs completed by Parties not included in the Annex I to the Convention (non-Annex I Parties) that presents information on technology needs for mitigation and adaptation to climate change contained in 23 TNAs and 25 initial national communications (FCCC/SBSTA/2006/INF.1);

(c) A technical paper on the application of environmentally sound technologies for adaptation to climate change (FCCC/TP/2006/2);

(d) A brochure that summarizes and illustrates the conclusions of the paper mentioned in paragraph 8 (c) above, and serves as a brief introduction to the principles and methods of adaptation and the practical steps that can help put them into practice.

9. The EGTT work programme for 2007,[6] endorsed by the SBSTA at its twenty-sixth session, includes, under the cross-cutting thematic area on technologies for adaptation, an activity to consider this synthesis report with a view to identifying possible activities in support of the implementation of the programme.

II. Summary of the submissions

A. National circumstances and approach to this synthesis report

10. The table summarizes information submitted by the Parties and organizations on technologies for adaptation to climate change, the geographical scope of these technologies and the sectors in which they are used. The regional distribution of the submissions is as follows: Africa, one; Asia and the Pacific, five; Europe, 11; Latin America and the Caribbean, four; and North America, three. In terms of political groupings, the synthesis report covers 13 Parties included in Annex I to the Convention (Annex I Parties) and nine non-Annex I Parties (two LDCs; one SIDS).

[5] Decision 4/CP.7.
[6] FCCC/SBSTA/2007/4, annex II.

Table. Summary of information provided on technologies for adaptation

Country or organization[a]	Group	Region	Geographical scope			Sectors							
			Regional	National	Local	Agriculture and fisheries	Water resources	Coastal zones	Health	Biodiversity	Infrastructure	Cross-cutting	Others
Argentina	NAI	Latin America and the Caribbean				●							
Australia	AI	Asia and the Pacific					●			□			
Austria	AI	Europe				●							
Bangladesh	NAI, LDC	Asia and the Pacific				□							
Canada	AI	North America		●	●	●		□				□	
Cuba	NAI, LDC, SIDS	Latin America and the Caribbean						●					
Cyprus	AI	Europe		●		□	□						
El Salvador	NAI	Latin America and the Caribbean			□		□						
France	AI	Europe							●				
Germany	AI	Europe										●	
Japan	AI	Asia and the Pacific		●		●	●	●			●		
Latvia	NAI	Europe	●	●	●	●	●	●		●		●	
Malta	NAI	Europe					●			●			
Mexico	NAI	North America					●						
Netherlands	AI	Europe		●			●	●					
New Zealand	AI	Asia and the Pacific			●	●							
Portugal	AI	Europe				●	●						
Romania	AI	Europe	●	●	●	●	●			●		●	□
South Africa	NAI	Africa				●	●			●			
Sweden	AI	Europe										●	
Tajikistan	NAI	Asia and the Pacific		●		●	●		●			●	
United Kingdom	AI	Europe		●	●	●		●		●	●		
United States	AI	North America	●	●		●					●	●	
		Subtotal	3	9	6	14	12	6	2	6	3	7	1
		Per cent	13	39	26	61	52	26	9	26	13	30	4
CBD	IGO		●										
FAO	IGO		●	●	●	●	●		●			□	
WFP	IGO					□							
WMO	IGO		●	●	●	●	●	●			●	●	●
IRI	NGO		●		●					□			
Practical Action	NGO				●	●	●	●					
Tyndall	NGO						●						
		Total	7	11	10	17	16	8	2	7	4	8	2
		Per cent	23	37	33	57	53	27	7	23	13	27	7

Abbreviations: AI = Parties included in the Annex I to the Convention, CBD = Convention on Biological Diversity, FAO = Food and Agriculture Organization, IGO = intergovernmental organization, IRI = International Research Institute for Climate and Society, LDC = least developed country, NAI = Parties not included in the Annex I to the Convention, NGO = non-governmental organization, SIDS = small island developing State, Tyndall = Tyndall Centre for Climate Change Research (United Kingdom Met Office), WFP = World Food Programme, WMO = World Meteorological Organization.
Note: Information: ● submitted under the heading technology; □ estimated based on the submissions.
[a] The information submitted by seven Parties and three IGOs did not cover technologies for adaptation and was not considered.

11. The Parties considered in the preparation of this synthesis report have different levels of vulnerability to the effects of climate change. Some of these Parties are more reliant on agriculture and the natural resource base than others, leading to associated socio-economic issues such as poverty and unequal development. For dry and semi-dry countries there is a possibility of altered precipitation patterns, intensified desertification and lack of water and food. Sea level rise poses a major threat to SIDS and Parties with large coastal regions (e.g. Argentina, Bangladesh, Cuba, Cyprus, Mexico and South Africa). These countries are faced with problems such as flooding and the associated negative impacts on water resources, coastal infrastructure and livelihoods, and even loss of life.

12. Most Parties and organizations submitted information on technologies for adaptation in accordance with the following structure provided by the secretariat:

(a) **Category (type) of adaptation actions**: approaches and strategies, practices or technologies.[7] This synthesis focuses only on the information on technologies for adaptation; a synthesis of the other categories is contained in document FCCC/SBSTA/2007/9;

(b) **Title of the adaptation action**, including projects and a short description;

(c) **Scope of the technology for adaptation**: geographical scope (regional,[8] national or local) and sector (e.g. agriculture and fisheries, water resources, coastal zones, health and infrastructure);

(d) **Status of the technology activity**: ongoing, under implementation, under development, under consideration, etc;

(e) Specific **needs** for successful implementation and **concerns and barriers** as well as **experiences and lessons learned** that were deemed important to be shared and/or could be considered under the Nairobi work programme;

(f) **References** where more information can be found.

13. Some Annex I Parties reported bilateral technology cooperation activities. For example, Japan reported activities taking place in Burkina Faso, Cambodia, Maldives, Mexico, Philippines and Uganda. Germany reported one activity in Tajikistan. In this report, these technologies are considered under the country that reported them. The information submitted by organizations could also refer to technologies already reported in the submissions from a Party (e.g. Practical Action reported technologies used in Kenya, Nepal, Sri Lanka and Zimbabwe). Therefore, subtotals of technologies reported by Parties only are provided in table to avoid double counting. It should be noted that these limitations do not influence the results of the analysis aggregated at the sectoral or the regional, national or local level. In several cases, the submissions provided information only on the geographical scope of the technology for adaptation, although the sector could be easily identified. In these cases the corresponding sector was marked with the symbol □ in the table.

14. The information on technologies provided in the submissions was coded according to the nature of the technology (i.e. hard or soft technologies, and technologies for implementation or for assisting implementation of adaptation actions) and according to the technology subgroup. Codes were also assigned to the needs and concerns related to the implementation of these technologies. A frequency analysis was then conducted and the results were summarized graphically. The experiences and lessons learned with technologies for adaptation reported by Parties and organizations were grouped and consolidated in different categories to avoid duplication.

B. Technologies for adaptation by sector

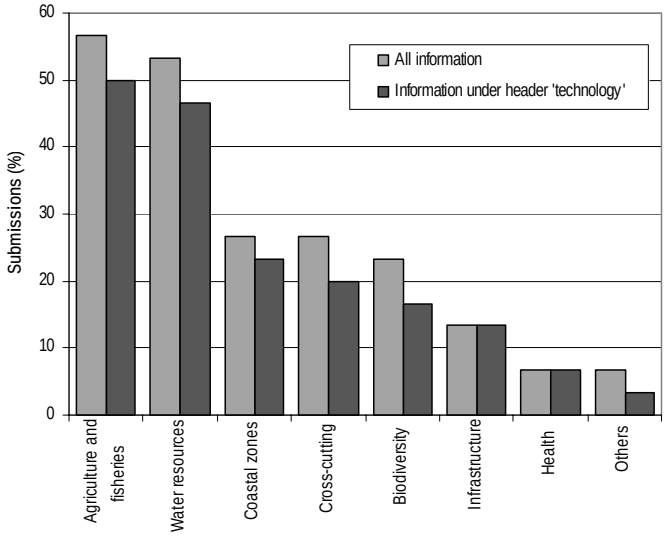
15. Figure 1 shows that the majority of technologies were reported in the agriculture sector, followed closely by those in the water resources sector. Some Parties identified technologies that cut across over several sectors or provided information for two other sectors – energy and tourism. The figure shows the results grouped under two categories: information provided under the header ‘technology’; and all the

[7] Because of the cross-cutting nature of many technologies for adaptation, some Parties and organizations chose the category that best reflects the characteristics of the action, but also mentioned other possible categories.

[8] Regional activities refers to activities undertaken among countries; activities undertaken at a sub-national level are considered local activities.

information submitted, including in the textual part of the submissions. The two sets of values are not significantly different, and the analysis below is based on the latter.

Figure 1. Commonly reported sectors for technologies for adaptation



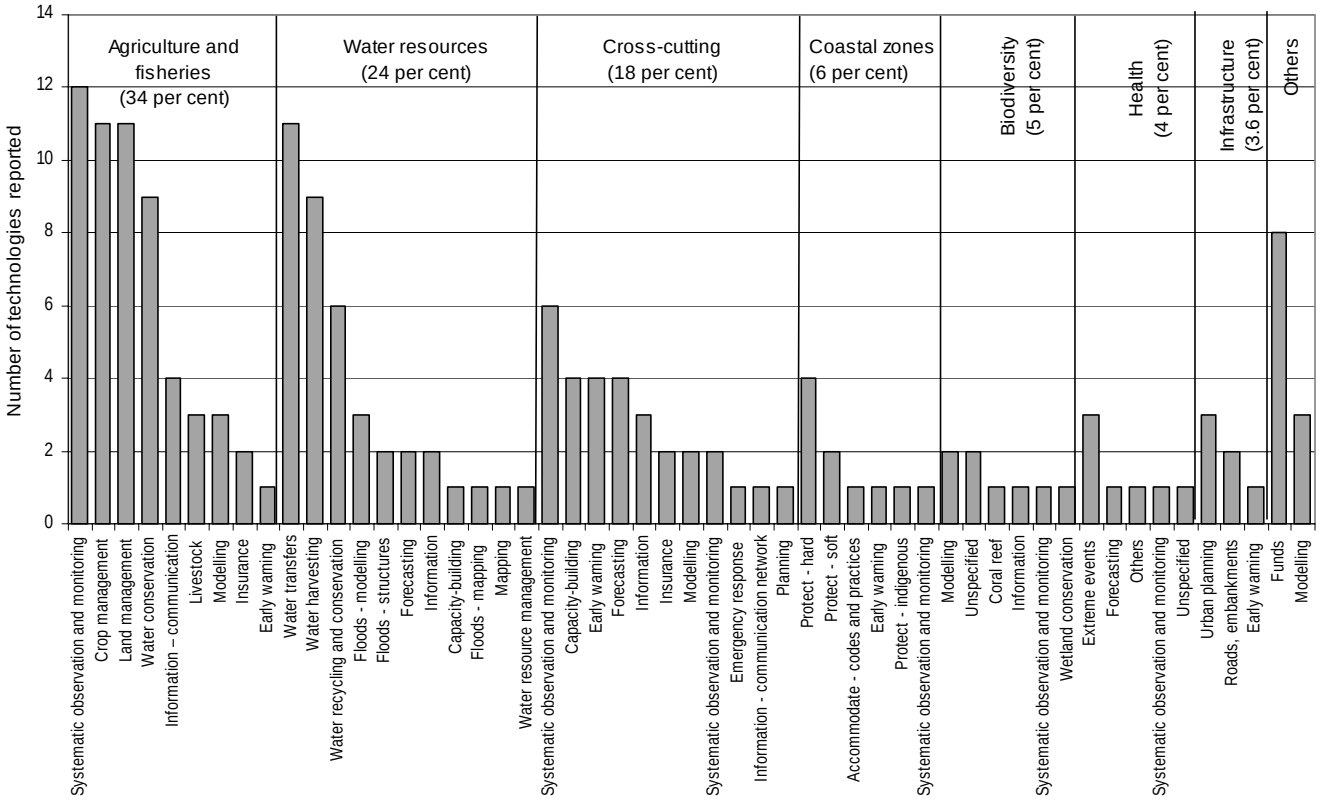
16. Over 170 technologies were cited by Parties and organizations in their submissions. Figure 2 illustrates that the technologies most commonly reported were in the agriculture and fisheries sector (34 per cent), followed by the water resources (24 per cent) and cross-cutting technologies (18 per cent) sectors. A relatively low number of technologies were identified in the coastal zones (6 per cent), biodiversity (5 per cent), health (4 per cent) and infrastructure (3.6 per cent) sectors.

17. The technologies reported could be **hard** technologies, such as drought-resistant crop varieties, seawalls (e.g. in Male Island in the Maldives) and irrigation technologies (e.g. new or improved irrigation systems in Portugal), or **soft** technologies, such as crop rotation patterns. Many technologies have both hard and soft characteristics, and successful adaptation action would typically combine both. Figure 3 (a) shows that hard and soft technologies were equally reported (approximately 40 per cent each), and some 20 per cent of the technologies reported have both hard and soft characteristics. This finding shows the **important role of soft technologies** in helping countries adapt to the adverse effects of climate change.

18. Within these two broad categories (hard and soft), technologies have been further classified as **traditional, modern, high technology or future technology**. Traditional (indigenous) **technologies** that have been applied to adapt to weather hazards include technologies to build floating vegetable gardens, traditional housing designs and dykes. Examples of **modern** technologies include technologies to produce new chemical products (e.g. fertilizers, pesticides and solvents), improved designs (e.g. of sanitation systems, housing and commercial buildings), technologies to produce new varieties of crop (e.g. hybrid corn) and new water use technologies (e.g. drip irrigation).

19. **High technology** includes some of the more recently developed technologies resulting from scientific advances in recent decades, including in information and communications technology, earth observation systems and geographic information systems (GIS), and genetic modification. **Future technologies** include those that have yet to be invented or developed; examples include a malaria vaccine, various forms of geo-engineering to reduce climate impacts, or crops that need little or no water.

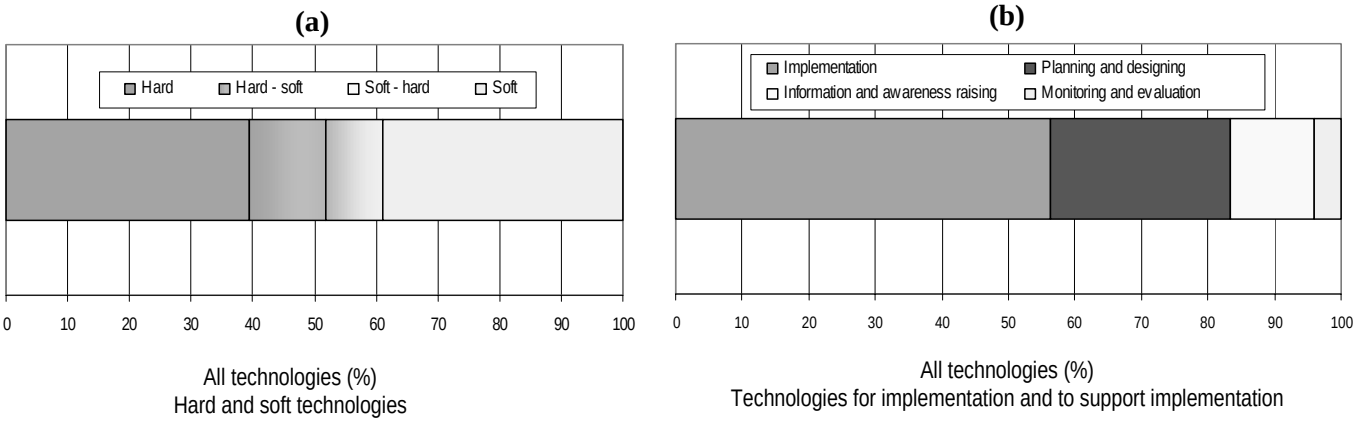
Figure 2. Technologies commonly reported by Parties and organizations



Note: Protect - hard = hard structure to protect against sea level rise (e.g. seawalls and tidal barriers); Protect - soft = soft structures to protect against sea level rise (e.g. dune restoration and beach nourishment).

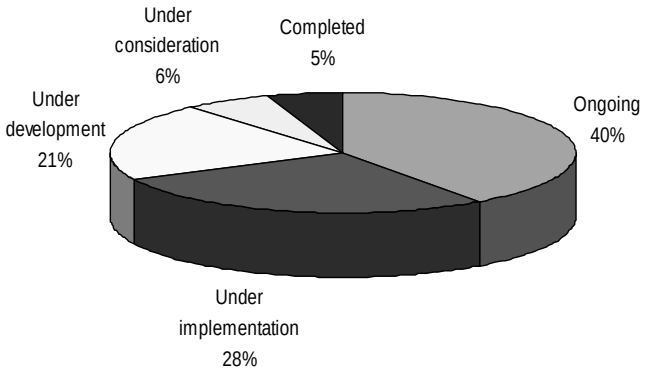
20. Figure 3 (b) also shows that over 55 per cent of the technologies were for implementation of adaptation actions. For example, in the coastal zone sector such technologies aimed to protect against sea level rise (e.g. dykes in the Netherlands and beach nourishment in Cuba); to retreat from and limit the potential effects of sea level rise (e.g. technologies to relocate threatened buildings) and to accommodate sea level rise by increasing the ability of society to cope with the effects (e.g. technologies to prepare emergency plans, and to modify land use and agricultural practices). Figure 3 (b) shows that although implementation technologies were most commonly cited in the submissions, technologies that support planning and design and those supporting information and awareness raising are also reported.

Figure 3. Types of technologies reported by Parties and organizations



21. The majority of technology activities reported are **ongoing**, followed by those **under implementation** and **under development**. Technologies relating to activities **under consideration** and **completed** activities accounted for 6 and 5 per cent, respectively, of the total number of technology activities. Figures 3 and 4 highlight the important role of existing (i.e. traditional and modern) technologies in addressing the adaptation challenge. They also show that, although a number of activities are ongoing, there is a need for action on projects under implementation and under development.

Figure 4. Status of implementation of technology related activities reported by Parties and organizations



1. Agriculture and fisheries

22. Within the agriculture and fisheries sector, the technologies identified most often were for systematic observation and monitoring (21 per cent of technologies for this sector), followed closely by crop management (19 per cent), land management (19 per cent) and water conservation (16 per cent). Technologies cited include drought mapping and identification of drought-prone areas using coarse resolution satellite imagery (South Africa), a famine early warning network (United States of America) and the National Agro-climate Information Service (NAIS) programme in Canada (includes monitoring and reporting services, climate change decision support and provision of information for adaptation).

23. As regards **crop management** there is an emphasis on developing and using tolerant/resistant crop varieties based on drought or heat, salt, insects or pests, improved seeds (Austria, Japan, South Africa, Tajikistan and the Food and Agriculture Organization of the United Nations (FAO)). **Land management** techniques and practices were identified by Argentina, Japan, New Zealand, Romania and FAO. These included terracing and stabilization of slopes and application of contour cropping to slopes, community-based dune management, application of minimum or no tillage, measurements of soil moisture using portable dielectric probes, trash blanketing, and changing farming practices to conserve soil moisture and nutrients. Effective rangeland and livestock management was mentioned only by Portugal and FAO. These technologies include groundwater use for animal husbandry in drought conditions, heat-tolerant livestock breeds, and livestock and fodder and grazing management.

24. For **water conservation**, various technologies for efficient water utilization and improved irrigation systems were identified, for example, drip irrigation, improved networks of reservoirs, and the use of treadle pumps (Argentina, Bangladesh, Cyprus, Portugal, Romania and Tajikistan). Other technologies identified include enhanced agricultural production techniques and risk management (e.g. fodder banks and alley cropping), soil erosion control (slope stabilization and terracing), recuperation and fertility improvement of soils, and adaptation of cropping seasons and cropping structure.

25. With regard to fisheries, only one local technology was reported, by Practical Action: fish cages made locally are used to keep fish in dug ponds that fill during the monsoon, when fishing in rivers is unsafe because of heavy flows.

2. Water resources

26. Several Parties submitted information on water management technologies (water transfer, 30 per cent of total technologies for this sector; water harvesting, 25 per cent; and water recycling and conservation, 19 per cent). The most commonly cited technologies for **water transfer** are intended to upgrade water storage and discharge systems and increase surface storage capacity; reduce loss of surface run-off to the sea and reduce leakage (leakage detection); stabilize and fortify river banks; update the systems providing drinking water; treat sewage in cities; and upgrade, increase the scale and remove impediments of drainage systems (Australia, Bangladesh, Latvia, Malta, Netherlands, South Africa, United Kingdom of Great Britain and Northern Ireland, and FAO). Some soft technologies were also mentioned by the United Kingdom such as technologies to support the preparation of online, searchable flood risk maps.

27. With regard to **water harvesting**, commonly identified technologies are intended for rainwater harvesting and seawater desalination (Australia, Cyprus, Malta, Practical Action, and Tyndall Action Centre for Climate Change). Examples include building sand dams to capture water from seasonal rivers in arid and semi-arid areas, underground rainwater harvesting using a combination of contour bunds and furrows with storage tanks dug below ground level within the furrows, and homes and offices fitted with 'Freerain', an advanced rainwater harvesting system. Other technologies cited in submissions include technologies to build water catchments, manage water resources (South Africa), and to support long-term water resources prediction, GIS, and satellite remote sensing.

28. Technologies relating to **water recycling and conservation** include sewage treatment technologies (e.g. closed drainage systems with reuse of purified drainage water), drainage structures and drainage containment (e.g. a sub-surface dam for the effective use of underground water in Burkina Faso).

3. Coastal zones

29. Costal zone management and protection technologies were identified by Bangladesh, Canada, Japan, Latvia, the Netherlands, Sweden, the United Kingdom and the World Meteorological Organization (WMO). Most of these technologies aim to **protect** against sea level rise. Examples include building new coastal defence structures with an extra allowance for sea level rise and increases in wind speeds and wave heights (dykes, seawalls and replacement of revetments), coastal afforestation, beach nourishment and enforcement of beach dune belts.

30. Examples of technologies to **accommodate** sea level rise by increasing the ability of society to cope with its effects include upgrading dimensions for drainage and sewage systems; strengthening roads and railroad embankments and burying electric cables; upgrading river flood defences to take into account increases in peak flows; installing additional pumping capacity; increasing the discharge capacity of the sluices; sea water desalination plants; and raising the lowest level for buildings. Only one technology to **retreat** from sea level rise to limit its potential effects was mentioned: a technology to relocate threatened buildings into a set-back zones established taking into account a sea level rise of 85 cm and a time horizon of 200 years (Netherlands).

31. In the category of technologies to facilitate the implementation of adaptation actions, Canada highlighted a coastal system description technology called Light Detection and Ranging technology (LiDAR), which provides accurate digital elevation models of coastal zones. Another Party highlighted a

rural communication network that is used to communicate information about weather, markets and disasters to remote areas.

4. Biodiversity

32. Only a few submissions provided information on technologies used to protect biodiversity, and most were technologies for supporting implementation of adaptation actions. Examples include a project to strengthen the International Coral Reef Center in Palau (funded by Japan), the Global Taxonomy Initiative (Convention on Biological Diversity (CBD)) and technologies supporting modelling of movements of species in Europe due to climate change and of the vulnerability of habitat to sea level rise.

5. Infrastructure

33. Human settlements are dependant on many types of infrastructure, from power and water supply to transportation and systems for waste disposal. Climate change is likely to exacerbate the strain on this infrastructure caused by population growth, rural–urban migration, high levels of poverty and the demand for more roads and vehicles. Technologies for adaptation to such strains were reported by Argentina, Bangladesh, Japan, Malta and the United Kingdom, and include technologies for rehabilitation of structures such as roads and embankments, for development of sustainable urban drainage systems, and for construction of appropriate urban infrastructure (e.g. canals and bridges) and technologies to support road route assessments.

6. Health

34. Bangladesh, France, Japan, Tajikistan, International Research Institute for Climate and Society (IRI), Practical Action and WMO reported technologies for adaptation relating to the health sector, such as technologies used to cope with weather extremes and to protect against natural disasters, for disease monitoring and prevention/treatment, to access health services and health alert information systems. For extreme events, these technologies include technologies for the construction of multipurpose cyclone and flood shelters, flood-proof houses[9] and weather prediction systems for heat waves. Other technologies reported relate to control of vector-borne diseases, such as improvement of collection and drain arrays and prophylactics for preventing epidemics (e.g. the West Africa Climate and Health technology programme of IRI); collection and provision of climate and health surveillance data, and support to decision-making.

7. Cross-cutting

35. Approximately 18 per cent of the technologies for adaptation reported were seen to cut across several sectors. These technologies were in areas of systematic observation and monitoring, early warning systems, information and communication, modelling and forecasting, emergency response, and planning and designing. Examples are:

(a) Further development of **systematic observation and monitoring systems** such as the Global Sea Level Observing System (GLOSS). Technologies are needed, for example, to update and integrate complementary geodetic capabilities into a global geodetic ground and space network and to install global positioning systems at all appropriate GLOSS tide gauge stations to determine changes in global and regional sea level;

[9] Houses raised on a cement or earth plinth and built of woven demountable walls attached to concrete posts. These houses are raised above normal flood levels and when a river threatens to erode the whole house, the woven walls can be removed to a new site.

(b) Development and/or improvement of **multi-hazard early warning systems** (climate and market related), linked with other national and global systems (e.g. the World Weather Watch, the Global Terrestrial Observing System, and AGROMET);

(c) **Information and communication**: various databases and one-stop web-based systems which draw together guidance and tools to aid both mitigation and adaptation work, provision of climate data and the use of new climate data management systems;

(d) **Forecasting and modelling** tools such as global data processing and forecasting systems, decision-making tools integrating climate information, modelling of monsoon rainfall and ocean modelling systems;

(e) Introduction of new technologies to support **adaptation planning** and to develop risk atlases.

8. Other sectors

36. The submission from WMO mentioned several technologies to support implementation of adaptation actions in the energy sector (technologies that support seasonal prediction models and information systems on climatic elements that could affect the renewable energy industry) and in the tourism sector (early warning systems for heat waves and other extreme events that could affect the tourism industry). Other technologies include development of multi-hazard early warning systems; production of templates for climate-related outreach products to disseminate the climate information more effectively in the tourism sector.

C. Technologies for adaptation at regional, national and local levels

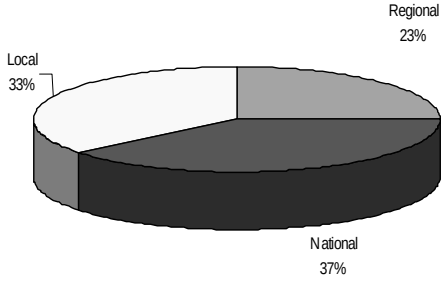
37. Figure 5 illustrates the geographical scope, when provided, of technologies for adaptation reported by Parties and organizations in their submissions, as categorized as regional, national and local. Most of these technologies are national in scope (37 per cent), followed by local technologies then regional technologies. However, it should be noted that only half of the Parties and organizations provided information on the geographical scope of technologies. This may indicate an intention to submit only illustrative examples of technologies, needs and concerns and lessons learned for each level.

1. Technologies for adaptation at the regional level

38. Regional technologies were identified in submissions by three Parties (Latvia, Romania and United States) and four organizations (CBD, FAO, IRI and WMO). Most of these were cross-cutting technologies for systematic observation and monitoring (e.g. the Global Observing System, the GeoVIS database tools of FAO for visual interpretation of remotely sensed images, networks for observing terrestrial climatic variables and remote-sensed information systems, emergency response and forecasting and irrigation). Many of these technologies have been deployed or are under implementation.

39. At the regional level, commonly identified needs for the development and deployment of these technologies include greater awareness among stakeholders of the need for common standards and compatible data sets, adoption of proposed standards, access to global climate prediction products including a funding system to allow farmers to use these systems, and infrastructure for regional climate model simulations and decision support tools. Concerns and barriers identified include lack of support for individual observation sites, lack of capacity of national staff to use data, lack of land cover, land-cover change and other environmental data needed to develop adequate policy, and limited financial resources and information.

Figure 5. Geographical scope of technologies cited in submissions by Parties and organizations



40. Experiences and lessons learned at the regional level highlight the importance of data harmonization and compatibility, access to data, and development of adequate tools and methodologies. One Party noted that it is too early to report experiences with some new technologies currently under implementation.

2. Technologies for adaptation at the national level

41. National technologies for adaptation were reported by Canada, Cyprus, IRI, Japan, Romania, Tajikistan, the United Kingdom, the United States, FAO, and the WMO in the agriculture, water resources and cross-cutting sectors. Examples include new and improved irrigation systems; soil, land and water conservation and management (e.g. slope stabilization, river bank protection, terracing and water catchments management); LiDAR; desalination plants; implementation of 'dry-farming' technologies; river dykes to reduce floods; and a national integrated drought information system (drought portal). FAO, IRI and WMO drew attention to some of their national programmes. Japan cited various initiatives as part of bilateral technology cooperation in the area of technologies for infrastructure that reduce the vulnerability of mega cities to climate change. Many of these technologies were covered in this report under their respective sectors.

42. Submissions highlight the importance of: national programmes that integrate work carried out at the local level and allocate resources to disseminate these technologies at the local level; using advanced technologies such as LiDAR in areas of sensitive coastlines; customizing information systems to the needs of users and early stage involvement of the private sector through effective national policies.

3. Technologies for adaptation at the local level

43. In their submissions, Canada, El Salvador, New Zealand, Romania, Sweden, the United Kingdom, the United States, FAO, IRI, Practical Action and WMO cited various technologies for adaptation at the local level which accounted for 33 per cent of the technologies for which geographical scope was reported. This shows that although technologies for adaptation are applied locally, they can also be used at the national and regional levels.

44. Most of these technologies have been included in ongoing projects or projects under development or implementation and many of them were traditional technologies that help vulnerable communities to cope with floods, extreme events and droughts. Examples included floating vegetable gardens, improved portable cooking stoves, flood-proof houses, sand dams for capturing water from seasonal rivers, underground rainwater harvesting, fish cage culture and dune management. Technologies aimed at enhancing access to information for these communities include rural communication networks and early warning systems, and soft technologies such as community level action, contingency planning and capacity-building.

45. Several technologies cited in submissions are deployed locally, including at the provincial, municipal and city levels. Most are soft technologies, such as systems to generate climate data for the province, publicly available via the Internet.

46. Submissions highlighted that many indigenous technologies already exist at local level, but for these technologies the needs relate mainly to deployment and dissemination, as well as to further improvement of design and quality (research and development capacity) and to increasing access to some advanced materials.

D. Identification of needs, concerns and experiences and lessons learned for successful development and deployment of technologies for adaptation

1. Needs for technology for adaptation

47. Specific needs for successful implementation of technologies for adaptation were indicated for approximately 40 per cent of the technologies reported. Building adequate human capacity (27 per cent of needs reported) and technical needs (27 per cent), including technical assistance, were the most commonly identified categories of needs, followed by information and awareness-raising (21 per cent) and financial needs (14 per cent). Community participation from the outset was an overarching need. Highlights of these needs are given below:

(a) **Building human capacity**: submissions suggested that education and training is needed for using tools and models, understanding climate information, satellite image analysis and spatial data analysis, and developing risk maps at the local and regional levels. Skilled staff are needed to design and operate water desalination plants, and for genetics research and advanced computing;

(b) **Technical assistance**: this is needed for the deployment, operation and maintenance of new technologies. Local communities need training to deploy traditional technologies such as construction of tanks for underground rainwater harvesting or on improved portable cooking stoves that can be made locally and moved during flood periods. Training could target women and most vulnerable households. Assistance is also needed to make the equipment available together with the know-how to operate and maintain it and to adapt it to local conditions. Assistance is also needed to further develop traditional technologies, sometimes with new materials;

(c) **Information and awareness-raising**: needs reported in this category include enhanced access to information on virtual reality technologies, on coastal system description technologies, on technologies for collecting local data, on innovative funding schemes that can be used by farmers to deploy technologies for adaptation, on comparative assessment of various early warning systems for heat waves and health, and on government actions and policies on technologies for adaptation and emergency response. Better information is needed for analysis of the impacts of heat waves in urban environments. On awareness-raising, examples of needs are raising awareness among the public and decision makers about various technologies, better communication between sectors and the establishment of an Internet-based drought portal;

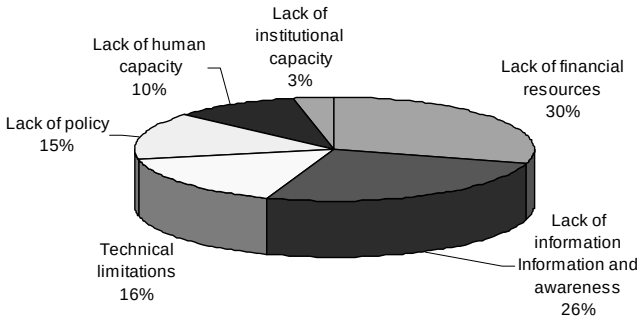
(d) **Resources**. Financial and human resources are the most cited needs in this category.

2. Concerns relating to successful development and deployment of technology for adaptation

48. Specific concerns and barriers relating to successful implementation of technologies for adaptation were indicated for approximately one third of the technologies reported. The categories of

concerns and barriers identified most frequently are lack of financial resources (30 per cent of concerns reported), followed by lack of information and awareness (26 per cent) and technical limitations (16 per cent). Lack of adequate policies and regulations and of human and institutional capacity were seen as less important barriers (see figure 6).

Figure 6. Commonly reported concerns and barriers for deployment of technologies for adaptation



49. Highlights of these concerns and barriers are as follows:

(a) **Lack of financial resources**: concerns and barriers identified were the cost of access to equipment; the cost of maintenance and water; economics of scale; lack of sufficient resources within local authorities for adaptation and for supporting research in the decision support systems; long lead times to implementation; insufficient computational resources; and poor access to the Internet. Barriers to scaling up technologies already deployed include weak cooperation between government departments and agencies and under valuing of local knowledge;

(b) **Lack of information and awareness**: in this category, the barriers identified were lack of data needed to develop and deploy adequate technologies (e.g. land cover and land-cover change data); lack of information on endogenous technologies; limited information sharing and limited availability of long time series of relevant variables; poor data collection and quality control; and systems integration. The submissions cited a lack of awareness of various stakeholders as regards the nature and format of data needed for weather forecasts, and the limited awareness and access to information by farmers;

(c) **Technical limitations**: concerns and barriers identified are that some technologies are not suitable in the dry season and thus provide a source of income for only a few months of the year; local materials are not always available due to flood water that may destroy natural vegetation or due to a long dry season; and capacity is lacking to assess vulnerability at the regional and local levels.

3. Identification of experiences and lessons learned

50. Specific experiences and lessons learned from developing, deploying and transferring technologies for adaptation to climate change were submitted for approximately 40 per cent of the technologies reported. These experiences vary from country to country and are influenced by local conditions; however some common experiences and lessons were identified that could have a global relevance. A summary of these experiences and lessons learned follows:

(a) Technologies have an important role to play in any effective adaptation action: for example, sustainable urban drainage systems in the United Kingdom improve resilience to drought and reduce flood risk; construction of cyclone shelters and protective

structures in vulnerable coastal zones has helped local communities in Bangladesh to cope with climate change; and improvement of flood control and water use management are important steps to promote collaboration on adaptation;

(b) Parties reported good experiences with some technologies for adaptation (e.g. Cuba's technology for beach restoration). On other technologies, Parties reported that it is too early to make assessments of their benefits (e.g. implementation of 'dry-farming' technologies and use of windmills for irrigation in Romania);

(c) Traditional technologies and know-how is key to technologies for adaptation and could be the starting point for future work. Specific lessons learned were:

(i) Such technologies exist already and are suitable for many developing countries. For example, floating vegetable gardens are important for large areas of central Bangladesh. They are a useful source of income for a difficult lean season and can float on public land. They are also cost effective, as most materials are low cots;

(ii) Local communities using these technologies were able to improve them (e.g. underground rainwater harvesting) and to implement them by share labour. Cultural and social norms play an important role in determining which technologies will be successful;

(iii) Technologies used in one country have been used, with local variations, in other countries and the best practices and lessons learned need to be shared;

(d) Although many technologies for adaptation are already available in developing countries, the transfer of modern technologies is needed. Examples include transfer of rice cultivation technology to Uganda and transfer of technologies for water management, desert greening and establishing an oasis network in arid land countries;

(e) Crops will face more variable weather conditions and a broad range of tolerance will be more important than optimal tolerance to one stressor. Many agricultural technology options (e.g. new crop varieties) are available and new options are under development. Farmers are well placed to select adaptation options which suit them;

(f) Building on expertise and experience in other countries is important. For example, the NAIS programme of Canada draws on the results of the climate programmes in the United States and Australia;

(g) There is still inadequate allocation of resources for implementation of technologies for adaptation. For example, although expertise is available with early warning systems and the required tools have been demonstrated in Europe, Asia and North America, more resources are needed for wide deployment of these systems;

(h) It is important to involve the private sector at an early stage of development and deployment of technologies for adaptation. The role of aid agencies should be enhanced without discouraging ownership by host countries and local communities;

(i) Technologies could help to provide scientific knowledge and tools to decision-makers, managers, researchers, and the general public by using web-based platforms that integrate satellite and other geospatial data.

III. Issues for further consideration

51. Parties may wish to consider the following questions when discussing their future work on technologies for adaptation:

(a) What would be the specific policy implications for development, deployment and diffusion of **existing technologies** (traditional and modern) for adaptation **within countries,** taking into account the important role of these technologies?

(b) What could be done to develop **high and future technologies** and make them available to countries highly vulnerable to the adverse effects of climate change?

(c) **What criteria**, if any, could be taken into account in addition to benefits, including economic/financial and costs, equity and social/legal acceptability, **in choosing the adequate technologies** for adaptation?

(d) Submissions highlighted that many activities reported relying on existing **technologies** for coping with **climate variability** which may also be important as technologies for **adaptation** to climate change. What could be done to promote the development, demonstration and deployment of such technologies for adaptation through national and international mechanisms?

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