

WORLD METEOROLOGICAL ORGANIZATION

**COMMISSION FOR AGRICULTURAL
METEOROLOGY**

THIRTEENTH SESSION

LJUBLJANA, 10–18 OCTOBER 2002

ABRIDGED FINAL REPORT WITH RESOLUTIONS AND RECOMMENDATIONS

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883 — **Executive Council**. Fiftieth session, Geneva, 16–26 June 1998.
902 — **Thirteenth World Meteorological Congress**. Geneva, 4–26 May 1999.
903 — **Executive Council**. Fifty-first session, Geneva, 27–29 May 1999.
915 — **Executive Council**. Fifty-second session, Geneva, 16–26 May 2000.
929 — **Executive Council**. Fifty-third session, Geneva, 5–15 June 2001.
932 — **Thirteenth World Meteorological Congress**. Proceedings, Geneva, 4–26 May 1999.
945 — **Executive Council**. Fifty-fourth session, Geneva, 11–21 June 2002.

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- 891 — **Regional Association I** (Africa). Twelfth session, Arusha, 14–23 October 1998.
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GENERAL SUMMARY OF THE WORK OF THE SESSION

1. OPENING OF THE SESSION (agenda item 1)

1.1 The thirteenth session of CAgM was held in Ljubljana, Slovenia, from 10 to 18 October 2002. It was opened at 9.30 a.m. on 10 October 2002 by Mr R.P. Motha (United States), president of the Commission.

1.2 Mr Motha extended a hearty welcome to all the participants. He welcomed His Excellency Mr J. Kopač, Minister of the Environment, Planning and Energy, Republic of Slovenia, and Professor G.O.P. Obasi, WMO Secretary-General. Mr Motha expressed his appreciation to the local organizers for making all the participants feel very welcome and comfortable in Slovenia. He thanked the many officials in Slovenia and the WMO Secretariat for their hard work and dedicated planning, and expressed the hope that it would be a productive and successful meeting.

1.3 Mr J. Roškar, Head of Slovenia's Meteorological Office and PR of Slovenia with WMO, welcomed everyone to the opening ceremony. He noted that more than ever, knowledge of the interaction between the biosphere and weather was needed in order to mitigate the impacts of severe weather and the adverse effects of climate change. He said that people felt helpless in hearing almost every day about natural disasters caused by severe weather events around the world, leading to loss of lives and property. He referred to the efforts of WMO and the world meteorological community, including NMHSs, universities, research institutes and other institutions, to alleviate the negative impacts weather sometimes has on society, and find new ways and practices to optimize the benefits of certain weather and climate conditions for human activity. In this regard, he said that the NMHSs, under WMO's umbrella, operated extensive observational surface and space networks, along with sophisticated atmospheric models, which together enabled monitoring of the weather and the production of information, forecasts and warnings. Faced with the growing world population, he noted that WMO shared these efforts with many other organizations and agencies around the world in ensuring that the land could produce food for all people. Therefore, he said, the Slovenian Government had decided to host this session, thereby making its small contribution to the resolution of common problems.

1.4 Mr Roškar referred to the International Workshop on Reducing Vulnerability of Agriculture and Forestry to Climate Variability and Climate Change, which had been held over the previous three days at the same venue. A number of very important issues were discussed during the Workshop. He said that there was clear evidence of global warming and significant modification of the rainfall regime in many areas around the globe. He said that variations that had occurred in the last decade of the 20th century alone were on a scale of

change that previously took place over centuries. He said that climate change had without any doubt a significant impact on agriculture. Participants at the Workshop learned about various scenarios, how to mitigate their negative impacts and how to benefit from positive impacts. He referred to the Workshop declaration, which he said could serve as a guide to a large number of countries in reducing the vulnerability of agriculture and forestry to climate variability and climate change. Mr Roškar invited everyone in attendance to take the opportunity to enjoy Ljubljana and Slovenia, and wished everyone a successful and productive session and a pleasant stay in Ljubljana.

1.5 Professor G.O.P. Obasi, Secretary-General of WMO, expressed his personal appreciation, and that of WMO, to the Government of Slovenia for the kind invitation to host the present session of the Commission in Ljubljana, along with the International Workshop on Reducing Vulnerability of Agriculture and Forestry to Climate Variability and Climate Change. He thanked Ms A. Čerček Hočevar, Director, Environmental Agency of the Republic of Slovenia, and Mr J. Roškar, Head of the Meteorological Office and PR of Slovenia with WMO, as well as their staffs and other collaborators, for making all the necessary arrangements that would help ensure the success of the session of the Commission. He said that the hosting of the session, as well as the many other meetings of interest to WMO, clearly demonstrated Slovenia's continuing support for the programmes and activities of the Organization.

1.6 The Secretary-General thanked the president of the Commission and the vice-president, Mr L.E. Akeh, for their able leadership in guiding the Commission over the previous four years. He also extended his sincere thanks to the chairpersons and members of various working groups, and the rapporteurs and their coordinators, for their contributions during the intersessional period.

1.7 Professor Obasi stated that the thirteenth session of the Commission was taking place just over a month after the WSSD, held in Johannesburg, South Africa in September 2002, where the issues relating to climate, water, food security, hunger and poverty eradication were among those at the top of the agenda. Those were issues that posed many of the economic, social and environmental challenges facing the world, and which had implications for the Commission. Indeed, several global fora, such as the United Nations Millennium Summit held in New York, and the 'World Food Summit: Five Years Later' held in Rome in June 2002, which fed into the Johannesburg Summit, all stressed the need for governments to strengthen efforts towards the attainment of food security and the eradication of hunger and poverty. Those summits gave prominence to climate,

water and food security issues, and took into account the importance of addressing food security within the wider context of poverty eradication, economic development and environmental sustainability, as well as improved and wider availability of agricultural technology.

1.8 Professor Obasi mentioned that agriculture was the sector most sensitive to weather and climate variability. He said that extreme weather events occurred in many parts of the world, with a negative impact on agricultural production and society. For this reason, he said that people throughout the world had become increasingly alarmed by severe weather and climate events, which were expected to become more frequent and more destructive. In recent months, major storm events and floods in many countries across Europe, including Germany, the Czech Republic and Austria, and in countries in Asia such as Nepal, Bangladesh, India and China, had caused mass migration of people and livestock, and widespread destruction of crops. The direct and indirect economic costs of the floods in Mozambique, caused by tropical storms *Elyne* and *Gloria* in February and March 2000, were estimated at US\$ 1 billion, compared with the country's export earnings of only US\$ 300 million in 1999.

1.9 The Secretary-General stated that WMO would continue to address the issues of drought and desertification through its AgMP, HWRP and other scientific and technical programmes by:

- (a) Advocating for enhanced observing systems at the national, regional and international levels;
- (b) Promoting the mitigation of the effects of drought and desertification through effective early warning systems;
- (c) Contributing actively to the implementation of the United Nations System's ISDR; and
- (d) Supporting the strengthening of the capabilities of the Parties to the UNCCD and regional institutions with drought-related programmes.

He said that WMO would also continue to support the strengthening of mechanisms for cooperation between the UNCCD, UNFCCC and CBD, as well as with the IPCC.

1.10 The Secretary-General noted that the recently concluded International Workshop referred to in paragraph 1.4, one of the many international efforts spearheaded by WMO to enhance agricultural production and food security, had given special attention to the latest assessments of the science and likely impacts of climate variability and climate change on agriculture and forestry in different agroecological regions. Among other things, the Workshop presented a range of adaptation options for agriculture and forestry, including the use of technological advances for reducing the vulnerability of different ecosystems to climate variability and climate change, particularly for developing countries with limited access to these technologies and to appropriate information.

1.11 The Secretary-General stressed the importance that WMO attached to enhancing its cooperation in agrometeorology with various international and regional

organizations in the promotion of increased agricultural production, food security and poverty eradication. He mentioned in particular the fruitful cooperation that existed between WMO and some national institutions such as the USDA and the Institute of Agrometeorology and Environmental Analysis for Agriculture, as well as the collaboration with FAO, UNESCO, UNEP, IARCs under CGIAR, START, ACMAD, AGRHYMET and the DMCs in Nairobi and Harare.

1.12 The Secretary-General urged the Commission to keep in view WMO's Vision, which was to be proposed for adoption at Fourteenth Congress in 2003. This Vision, together with a set of desired outcomes and a set of strategies and associated goals, would provide the framework for the formulation of the full draft of the 6LTP. As the Programme and Budget document for the Fourteenth Financial Period (2004–2007) would be prepared consistent with the first four years of the LTP, the Secretary-General felt that the Commission should ensure that it contributed substantially to the draft 6LTP. He was pleased to note that the Commission was proposing the establishment of three OPAGs: Agrometeorological Services, Support Systems for these Services, and Climate Change/Variability and Natural Disasters in Agriculture. At the regional level, he said that the Commission should arrange for effective interaction with WMO regional associations in support of regional initiatives, and encourage the participation in its work of representatives of developing countries and countries with economies in transition.

1.13 Professor Obasi mentioned that this would be the last session of the Commission that he was attending as Secretary-General. He thanked those in attendance and, through them, their Governments for the support given to him as Secretary-General of an Organization all cherished and which he had the privilege of serving for a number of years. He assured everyone of his continued commitment to the promotion of agricultural meteorology and to ensuring that WMO continued to assume a leadership role as a prestigious, respected and exemplary Organization in all global initiatives and activities aimed at addressing the concerns of humanity.

1.14 Mr Kopač welcomed everyone on behalf of the Slovenian Government and offered his personal greetings. He referred to the growing population pressures in the world and the need for research and technological advances in order to enable increased food production without further deterioration of the environment.

1.15 Mr Kopač mentioned that the Slovenian Government was prepared to make its own relatively humble contribution to solving the world food problem, which included the organization of the current session and the International Workshop that took place the preceding three days.

1.16 Mr Kopač mentioned that many of the economic, social and environmental problems were being addressed by the Commission. Just as the weather did not recognize international boundaries – and almost every country of the world, regardless of its political make-up or level of development, was gathered under

the auspices of WMO in a unified system for weather observation and analysis – it was important to recognize that the sustainable development of the entire planet could only be ensured through the joint efforts of every country in the world. There could be no exception for any country, large or small.

1.17 Mr Kopač stated that in Slovenia they had kept in mind the fact that weather and climate were decisive factors in planning agricultural production, and that without relevant data it would not be possible to carry out the analysis and research related to the interaction between weather and agriculture. He said that this had led Slovenia to become actively involved in the world meteorological observing system. The information obtained from the measurements was most valuable because Slovenia had very diverse climates: the continental climate in the north-east, alpine in the north-west, and Mediterranean in the coastal region. Mr Kopač summarized the activities of Slovenia's Environmental Agency in operational meteorology and hydrology.

1.18 Mr Kopač mentioned that the Slovenian Government had recently adopted the first national report to the Conference of Parties to the UNFCCC, and a sound policy for reducing demands on the environment in all sectors of human activity, including the economy. It was of vital importance that spatial planning took climate change into account, he said. Construction should be avoided in areas threatened by floods, and these areas could be used as natural barriers to flood waters or as reservoirs for irrigating farms.

1.19 In his statement at the opening session, Mr Motha pointed out that CAgM was charged with keeping abreast of, and promoting the development in, both scientific and practical applications of meteorology as they related to agriculture. He said that CAgM played a very important role in helping WMO Member countries promote applications of meteorology in agriculture for sustainable development. The interest of the Members was evident by the presence of a large number of participants from a number of countries.

1.20 Mr Motha emphasized that the Commission did not have an easy task. First, agriculture and food security were fundamental issues for each and every nation. Second, drought, floods and other extreme meteorological events were major contributors to annual yield fluctuations in all crop areas. Finally, local and regional diversity in agricultural land management, coupled with distinct meteorological features at the regional level, complicated the interactions between the biological systems and the physical environment.

1.21 Mr Motha pointed out that as it moved into the 21st century, the Commission, strengthened by the vision document 'CAgM - Towards 2000 and Beyond', had positioned itself to tackle three primary areas of responsibility. These focal areas included: agrometeorological services for agricultural production, support systems for agrometeorological services, and impacts of climate variability and natural disasters on agriculture. The key to success was to bring science and technological developments to the appropriate level of application.

1.22 Mr Motha emphasized that research and development transcended all focal areas, and that capacity building must be an essential component. In the area of services, weather and climate information needed by farmers at the right time and in the right format was of utmost importance. Strengthening information and dissemination networks, including monitoring and early warning systems, was essential. He said that natural resources, including land, water and air, must be properly managed. In support of these services, innovative techniques for sustainable land use management and new technological advances in GIS and remote sensing were potentially available. Computer technology, integrated information management systems and automated weather station methodologies were all becoming more reliable, user-friendly, and applicable at the eco-regional level. The results of the International Workshop had revealed that much information was available regarding the impact of climate variability on regional agriculture. A major effort was needed in natural disaster reduction and mitigation of extreme events in agriculture, forestry and fisheries. CAgM was exploring ways to work jointly with other commissions, most notably JCOMM, on a pilot study in this area.

1.23 Mr Motha mentioned that, during the session, the Commission would review some notable accomplishments arising from a number of workshops and expert group meetings, as well as from the working groups and joint rapporteurs. The session would also have the opportunity to deliberate on relevant issues of the day and to set some new priorities for the future. He sought the active participation and guidance of the participants during the in-depth discussions on many of these issues.

1.24 Mr Motha pointed out that there were very important issues ahead in a rapidly changing world with rapidly changing requirements. In order to meet these requirements, a flexible, responsive and accountable structure must be able to cope with these changes. Given the many desirable features of the existing structure, he said that the Commission strove to build upon these features to enhance its effectiveness, creativity and innovation.

1.25 Mr Motha thanked all the speakers who took time from their busy schedules to be present at the opening session. He expressed his sincere appreciation to the Government of Slovenia for hosting the thirteenth session of CAgM.

1.26 There were 104 participants at the session, including representatives from 66 countries and four international organizations. A complete list of participants is given in [Appendix A](#) to this report.

2. ORGANIZATION OF THE SESSION (agenda item 2)

2.1 CONSIDERATION OF THE REPORT ON CREDENTIALS (agenda item 2.1)

In accordance with WMO General Regulation 22, a list of participants and the capacities in which they were attending the session was prepared on the basis of

an examination of the credentials. The list, prepared by the representative of the Secretary-General, was accepted unanimously as the report on credentials. Consequently it was decided not to establish a Credentials Committee.

2.2 ADOPTION OF THE AGENDA (agenda item 2.2)

The Commission adopted the provisional agenda. The agenda of the session, as approved by the Commission, is reproduced in [Appendix B](#) to this report.

2.3 ESTABLISHMENT OF COMMITTEES (agenda item 2.3)

2.3.1 In accordance with WMO General Regulation 24, the Commission established the following committees for the duration of the session:

WORKING COMMITTEES

2.3.2 Two working committees were established to examine in detail the various agenda items:

- (a) Committee A to examine items 4 to 8 and 13 to 14. Mr H. A. Abdalla (Sudan) and Ms L. Kajfež-Bogataj (Slovenia) were elected co-chairpersons of the Committee;
- (b) Committee B to examine items 9 to 12. Mr J. Salinger (New Zealand) and Mr B.-L. Lee (Republic of Korea) were elected co-chairpersons of the Committee.

NOMINATION COMMITTEE

2.3.3 A Nomination Committee was established consisting of the following delegates:

- RA I Mr Y. Gandega (Mauritania);
- RA II Ms K. Noohi (Islamic Republic of Iran);
- RA III Mr G. Garcia (Ecuador);
- RA IV Mr A. Harou (Canada);
- RA V Ms L.V. Tibig (Philippines);
- RA VI Ms M.R.P. Guerreiro (Portugal).

Mr Harou was elected chairperson of the Nomination Committee.

COORDINATION COMMITTEE

2.3.4 In accordance with WMO General Regulation 28, a Coordination Committee was set up consisting of the president and vice-president of the Commission, the co-chairpersons of the working committees and the representative of the Secretary-General.

SPECIAL COMMITTEE FOR THE NOMINATION OF MEMBERS OF WORKING GROUPS AND RAPORTEURS

2.3.5 A special committee, consisting of:

- The president;
- The vice-president;
- Mr H. Baccour (Tunisia);
- Mr H. Das (India);
- Mr P. Doraiswamy (United States);
- Mr R. Stringer (Australia); and
- Mr H. Dommermüth (Germany);

was established to formulate proposals for the nomination of members of working groups and rapporteurs. Mr Stringer was elected chairperson of this Committee.

2.4 OTHER ORGANIZATIONAL MATTERS (agenda item 2.4)

2.4.1 The working hours adopted were from 9.30 a.m. to 12.30 p.m. and from 2.30 p.m. to 5.30 p.m.

2.4.2 The Commission decided that, in accordance with WMO General Regulation 111 and in view of the technical and specific nature of its discussions, it was not necessary to prepare minutes of the plenary meetings of the current session. A full list of documents presented at the session is given in [Appendix C](#) to this report.

3. REPORT OF THE PRESIDENT OF THE COMMISSION (agenda item 3)

3.1 The Commission noted with appreciation the report of the president, which contained a review of the activities of the Commission and its various bodies and rapporteurs since its twelfth session. The Commission further noted that the in-depth report of the activities had been submitted by the president to the fifty-fourth session of the Executive Council (June 2002).

3.2 The Commission expressed its appreciation for the comprehensive and useful periodic reports issued as circular letters by the president and posted on WMO's CAgM Web site (www.wmo.ch), which had provided detailed information on the Commission's activities. Those reports also served as background information during the current session.

POLICY ISSUES RELEVANT TO THE COMMISSION

3.3 The Commission thanked the president for the information provided on policy issues relevant to the Commission. The Commission expressed its concern with the dwindling resources being provided for its activities due mainly to the zero nominal growth approach for the Programme and Budget proposals of WMO. Given the importance of the activities of the Commission for ensuring sustainable agricultural development, especially in the developing countries, the Commission requested the Secretary-General to take into account the priorities of the Commission in programme and/or resource allocation adjustments related to the AgMP.

AGRICULTURAL METEOROLOGY PROGRAMME (AGMP)

3.4 The Commission noted with appreciation the progress made in its activities, especially the organization of a number of international workshops and training events and the publication of a large number of reports. The Commission complimented the Secretariat for the excellent support it provided to the Commission in carrying out its activities.

REPRESENTATION AT EXECUTIVE COUNCIL AND MEETINGS OF PRESIDENTS OF TECHNICAL COMMISSIONS

3.5 The Commission noted with satisfaction the Executive Council's acknowledgement of the achievements of CAgM during the intersessional period, in particular the release of electronic publications. The Commission expressed its appreciation for the prompt posting of reports on its activities on the CAgM Web site, noting that this process had made it easy for all those

interested to obtain information on the activities of the Commission. The release on CD-ROM of WMO's publications in Agricultural Meteorology (1954 to 1999) represented an outstanding achievement employing new automated technology. The CAgM Proceedings on Software for Agroclimatic Data Management, and its companion CD-ROM of accompanying public domain software packages, represented another example of state-of-the-art publishing to distribute the latest proceedings to the global user community. The Commission also noted with appreciation that the CD-ROM containing all the papers presented at the International Workshop organized in conjunction with the session had proven very useful to the delegates, and urged that this practice be continued in the future.

WORKING GROUPS ON AGRICULTURAL METEOROLOGY OF THE REGIONAL ASSOCIATIONS

3.6 The Commission expressed its concern that the Working Groups on Agricultural Meteorology of RA I, RA III and RA VI had been replaced by joint rapporteurs. Given the significant effect of weather and climate on the productivity and sustainability of farming systems, especially in Regions I and III, and noting that working groups had been functional in these regions for several of the past intersessional periods, the Commission recommended that Working Groups on Agricultural Meteorology be reappointed. Recognizing the emphasis placed by the Commission on strengthening agrometeorological activities at the regional level, especially in the developing countries, the Council urged the Secretary-General to ensure that regional AGM Working Groups be maintained. In this connection, the Commission also endorsed the recommendations of the AWG regarding the need to revitalize the Working Groups on Agricultural Meteorology of regional associations.

STATUS OF REPORT PREPARATION BY CAGM-XII WORKING GROUPS AND JOINT RAPPORTEURS

3.7 The Commission noted that some joint rapporteurs and members of the working groups had encountered serious problems in the preparation of their reports, caused by lack of necessary support, including financial provisions. The Commission agreed on the need to select good scientists who would be able to devote time within their schedules for the Commission. The Commission agreed that the proposed Commission restructuring to OPAGs would allow a more flexible and responsive mechanism to make necessary adjustments in such circumstances.

3.8 The Commission approved 'To promote operational applications of agrometeorology using innovative technologies for services to agriculture, silviculture and aquaculture' as the theme upon which to focus its activities during the following intersessional period.

NEW PROGRAMME STRUCTURE FOR CAGM

3.9 The Commission considered that it was important to agree on a programme structure that would

enable it to meet the needs of the Members in a most effective and efficient manner during the next intersessional period. The Commission commended the president and the AWG for proposing a more flexible, responsive and accountable structure of OPAGs for the Commission to meet the rapidly evolving and rapidly changing demands. Discussions and decisions of the Commission on the new programme structure for CAgM are given under agenda item 16.

NORBERT GERBIER-MUMM INTERNATIONAL AWARD

3.10 The Commission noted that since the eleventh session of the Commission, submissions for the Norbert Gerbier-Mumm International Award had improved. It requested the Members to continue to give wider coverage to the announcement regarding the submissions for the award to ensure good quality as well as an adequate number of submissions.

GUIDE TO AGRICULTURAL METEOROLOGY PRACTICES (WMO-No. 134)

3.11 The Commission endorsed the idea of a complete revision of the *Guide to Agricultural Meteorological Practices* (WMO-No. 134) as proposed by Mr C.J. Stigter (Netherlands), the coordinator of experts to assist the president in revising the *Guide*. The Commission commended the efforts of Mr Stigter and his group for their valuable suggestions in this regard. The discussion and decision of the Commission are recorded under agenda item 8.2.

CASE STUDIES OF ECONOMICALLY BENEFICIAL AGROMETEOROLOGICAL APPLICATIONS AND SERVICES

3.12 The Commission expressed the belief that agrometeorological applications at the field level could be greatly facilitated if the value and benefits of such applications were clearly demonstrated to the user community. In this connection, the Commission agreed that case studies of economically beneficial agrometeorological applications and services would serve a very useful purpose, and commended the efforts of Mr W. Baier (Canada), the coordinator for the collection of such studies, and his group for their efforts. The decision of the Commission on this subject is recorded under agenda item 11.6.

INTER-PROGRAMME AND INTER-COMMISSION ACTIVITIES

3.13 The Commission emphasized the need for continuing strong collaboration with related WMO Programmes and other WMO commissions in the implementation of the AgMP, and noted with appreciation the participation of CAgM representatives in inter-Programme and inter-commission activities. It encouraged the Members to participate in such activities.

3.14 The Commission congratulated the AWG and the WMO Secretariat for their excellent efforts in organizing the International Workshop on Reducing the Vulnerability of Agriculture and Forestry to Climate Variability and Climate Change in Ljubljana, Slovenia from 7 to 9 October 2002, which permitted increased

participation of Members from developing countries in the session. The Commission emphasized the need to carefully consider the conclusions and recommendations from the Workshop in developing future activities for the Commission.

3.15 The various other suggestions made in respect to the report of the president were considered further under the relevant agenda items.

4. NATIONAL PROGRESS REPORTS ON AGRICULTURAL METEOROLOGY (agenda item 4)

4.1 The Commission noted with appreciation the actions taken by the WMO Secretariat in preparing and circulating a detailed questionnaire using the standard layout for the preparation of National Reports on Progress Made in Agricultural Meteorology by Members during 1999-2001 as per Recommendation 1 (CAGM-XII). It expressed its satisfaction that 89 Members had provided such reports. This represented an increase of 65 per cent over the number of responses provided for the preceding intersessional period.

4.2 The Commission noted with interest that the WMO Secretariat had entered Parts 1 to 4 of the responses received from the 89 Members into a comprehensive database on the status of agrometeorological activities in Member countries. This database could be accessed through the WMO home page (www.wmo.ch).

4.3 The Commission expressed its concern regarding the low level of trained staff in agricultural meteorology, particularly in developing countries. It recognized the need for more efforts to be made to ensure the availability of adequate agrometeorologists, senior-level technicians and staff with doctoral degrees. It therefore urged Members to promote long- and short-term training activities, seminars and workshops, with a view to developing the required human resources.

4.4 The Commission noted that the number of stations in the network of agrometeorological observations had not improved over the previous four years. It was felt that increased efforts were needed to replace old instruments with new ones, and to develop new types and methods of agrometeorological observations. The Commission, however, noted with appreciation the increasing trend in the use of GIS and remote sensing facilities, as well as the continued growing trend towards the installation of AWs. The Commission encouraged donor countries to continue to assist the developing countries in improving their network of agrometeorological stations so as to enable them to provide timely and efficient agrometeorological services.

4.5 The Commission noted with interest the research activities being undertaken by Members, particularly in areas such as the influence of meteorological factors on the growth, development, yield and quality of crops. It also noted the extensive range of publications developed by the 89 Members during the 1999-2001 period, and encouraged Members to continue placing emphasis on regularly publishing research papers and information generated by the agrometeorological services.

4.6 The Commission took note of the various means that were being used by Members to provide agrometeorological services. These included brochures, workshops, seminars, press releases, radio, television and the Internet. It noted with appreciation that several Members issued decadal bulletins and/or weekly and monthly reviews. It encouraged all Members to continue to exploit modern communication means such as radio, television and the Internet for the delivery of forecasts and other services.

4.7 The Commission emphasized the importance of having appropriate agrometeorological institutional arrangements at the national level as well as the maintenance of close collaboration with other relevant institutions. It urged Members to foster multidisciplinary approaches to addressing agrometeorological issues and to promote more interactions with the media and users.

4.8 The Commission noted that some Members encountered difficulties in completing the National Progress Report part of the questionnaire. In some countries the responsibility for agriculture was distributed amongst different government departments and agencies. Research activities were undertaken by governments, academics and the private sector. In such cases, the data reported in the questionnaire would not be accurate or comprehensive unless information was received from all concerned departments and agencies.

4.9 The Commission recommended that the substance of the National Progress Report and the questionnaire be reviewed by:

- (a) Clearly defining the purpose and utility of the information;
- (b) Ensuring that terminology/questions were consistent and clear;
- (c) Deriving relevant statistics required for decision-making; and
- (d) Using electronic means wherever possible.

4.10 The Commission agreed that the analysis provided in the document was very useful and recommended that future analysis could provide information by region as well.

4.11 The Commission requested the WMO Secretariat to continue to compile the information provided in the reports in a comprehensive database. Noting the importance of such a database covering as many Members as possible, the Commission adopted [Recommendation 1 \(CAGM-XIII\)](#).

5. REGIONAL ACTIVITIES IN AGROMETEOROLOGY (agenda item 5)

5.1 The Commission noted the various tasks assigned to rapporteurs and members of working groups of regional associations and expressed its satisfaction with the inclusion of studies recommended by CAGM-XII in their terms of reference. The Commission reiterated the importance of Regional Working Groups on Agrometeorology and encouraged the regional associations to continue establishing and maintaining them so as to study problems of specific interest to the Region.

5.2 The Commission was informed of WMO's activities in the regions and its participation at meetings of other organizations in different regions, to promote the importance and value of applying meteorological knowledge and information to increase agricultural production and contribute to the preservation of the environment and sustainable development of nations. The Commission expressed its appreciation to the Secretary-General for his continuing efforts to sponsor and/or seek co-sponsorship for these valuable regional activities.

5.3 The Commission noted that, for the first time, an Inter-Regional Workshop had been organized that brought together representatives from several regions to discuss the effectiveness and distribution of agricultural meteorological bulletins issued by the NMHSs. It noted that this format of bringing together agrometeorologists from all the regions of WMO was found to be beneficial as it provided an opportunity to share experiences from different regions and learn from each other. The Commission encouraged the Secretary-General to continue his efforts in organizing such workshops.

REGIONAL ASSOCIATION I (AFRICA)

5.4 The Commission noted with satisfaction that the report of the RA I Working Group on Agricultural Meteorology was published in the CAgM Report series after it had been submitted to the twelfth session of RA I, held in Arusha, United Republic of Tanzania from 14 to 23 October 1998.

5.5 The Commission noted that the three rapporteurs appointed by RA I at its twelfth session to address the agrometeorological issues of priority to the Region had begun their activities.

5.6 The Commission was pleased to note that the International Workshop on Coping with Drought in Sub-Saharan Africa: Best Use of Climate Information had been held in Kadoma, Zimbabwe from 4 to 6 October 1999. Participants at the workshop included Zimbabwean farmers; representatives from African meteorological, agricultural and hydrological services, including extension officials; and representatives from NGOs, SADC, AGRHYMET, the DMCs in Nairobi and Harare, and ACMAD.

REGIONAL ASSOCIATION II (ASIA)

5.7 The Commission noted that a meeting of the Working Group on Agricultural Meteorology, established by the eleventh session of the Association, had been held at the headquarters of the Islamic Republic of Iran Meteorological Organization, Tehran, from 4 to 6 September 1999. The Commission expressed its satisfaction that the technical report of the RA II Working Group on Agricultural Meteorology had been published and distributed as part of the CAgM Report series.

5.8 The Commission noted that at the twelfth session of RA II held in Seoul, Republic of Korea (19 to 27 September 2000), the Association had adopted Resolution 12 (XII-RA II) re-establishing the Working Group on Agricultural Meteorology. Mr G.A. Kamali (Islamic Republic of Iran) was once again invited to serve

as chairperson of the working group. A number of recommendations had been made by the previous working group, including improved adaptation strategies to climate variability and change, methods to cope with extreme meteorological events such as droughts and floods, and the development of improved agrometeorological applications using tools such as GIS.

5.9 The Commission noted with appreciation the initiative taken by WMO to co-sponsor the training workshop 'Agrometeorology in Promotion of Agricultural Sustainable Development and Food Security for the 21st Century', held in Hanoi, Viet Nam from 9 to 18 July 2001. The Commission requested the Secretary-General to continue to seek co-sponsorship for the organization of such events.

5.10 The Commission noted with appreciation the collaboration between WMO, the United Kingdom Met Office, ACMAD and NOAA in co-sponsoring the Seminars on RANET for Diffusion of Agrometeorological Information and Monsoon Research in India, which were organized by the India Meteorological Department in Pune on 30 and 31 July 2001. The seminar on RANET covered several issues, including diffusion of agrometeorological information, developments in the weather information and education page and the climate information pages of RANET2000, and communication technologies. A special feature of the seminar was an interactive session with several farmers. The Commission noted the emphasis placed by the seminar on better understanding user needs, and the active involvement of users in the design and specification of seasonal weather forecasts, agrometeorological and other products and dissemination methods, including the time and spatial scales of the information, and the use of probability forecasts.

REGIONAL ASSOCIATION III (SOUTH AMERICA)

5.11 The Commission noted with regret that the activities of the RA III Rapporteur on Agricultural Meteorology established by the Association at its twelfth session could not proceed as planned because of the difficulties faced by the rapporteur in preparing and finalizing his report.

5.12 The Commission agreed that the application of meteorology to agriculture continued to be of high importance to the Region. It also noted the recommendation of RA III to strengthen regional activities in agricultural meteorology, and agreed that such activities should be continued, taking into account the developments in the Region. Among others, these activities should include evaluation of the impact of ENSO on agriculture and forestry; the potential benefit of using seasonal to inter-annual climate forecasts; improved adaptation strategies to climate variability and climate change; methods to cope with extreme meteorological events, e.g. droughts and floods; and the potential for developing improved agrometeorological applications using tools such as the GIS. The Association therefore established a Working Group on Agricultural Meteorology and adopted Resolution 9 (XIII-RA III).

5.13 The Commission was pleased to note that an RA III/RA IV Expert Group Meeting on Extreme Events had been organized in Caracas, Venezuela, from 12 to 14 July 1999, and that the meeting had resulted in a very fruitful exchange of information, ideas and scientific support to formulate suggestions to cope more efficiently with extreme events. The Commission complimented the Secretariat for the timely publication of the proceedings of this meeting, and urged the Members to use the information provided in the proceedings in their strategies to cope with extreme events in the Region.

5.14 The Commission expressed its gratitude to the Secretary-General for his continued financial assistance to the Regional Bibliographic Centre for Agrometeorology in Lima, Peru. The Centre had been assigned the responsibility for the publication and distribution of annotated bibliographies in meteorology, including agrometeorology, for use by Members of RA III and RA IV. The Commission requested the Secretary-General to seek the authorization of Congress to continue to provide support to the Centre during the following financial period.

REGIONAL ASSOCIATION IV (NORTH AND CENTRAL AMERICA)

5.15 The Commission noted with appreciation the activities of the RA IV Working Group on Agricultural Meteorology established by the Association at its twelfth session. The Commission expressed its satisfaction that the technical report of the RA IV Working Group on Agricultural Meteorology had been published in the CAgM Report series.

5.16 The Commission noted that the application of meteorology to agriculture continued to be of high importance to the Region. Hence, it was pleased to note that the Working Group on Agricultural Meteorology had been re-established, taking into account the developments in the Region. These developments included the need for evaluation of the impact of ENSO on agriculture and forestry; the potential benefit of using seasonal to inter-annual climate forecasts; improved adaptation strategies to climate variability and climate change; methods to cope with extreme meteorological events, e.g. droughts and floods; and the potential for developing improved agrometeorological applications using tools such as the GIS.

5.17 The Commission was pleased to note that a workshop had been held in Barbados on improving the effectiveness and distribution of agricultural meteorological bulletins issued by NMHSs. The Association noted in particular the needs of small farmers, who typically did not have direct access to advanced electronic methods for obtaining information. Improving the availability of information to small farmers could often be assisted through collaborative efforts with local and regional agricultural extension services. The Commission expressed its appreciation to the Secretary-General for the finalization and wide distribution of the report of the workshop.

5.18 The Commission complimented Cuba's Institute of Meteorology for its in organizing a short

refresher course on Operational Techniques of Agrometeorological Information for Sustainable Agriculture in 2001.

5.19 The Commission noted with appreciation that WMO, in cooperation with the USDA, had organized an Expert Group Meeting on Software for Agroclimatic Data Management from 16 to 20 October 2000 in Washington D.C., United States. Twenty experts from around the world participated in the meeting. The proceedings were published and distributed. CD-ROMs with software for agroclimatic data management were also distributed free of charge to all interested parties.

5.20 The Commission recorded its appreciation for the organization of an Expert Group Meeting on Internet Applications for Agrometeorological Products by WMO, NOAA and USDA from 6 to 9 May 2002 in Washington. The Commission complimented WMO for the initiative taken to establish a dedicated Web Server for Agrometeorological Products (WESAP). Noting that WESAP also provided several training modules of specific interest to agrometeorological services around the world, such as using the GIS, drought information, water resources management, crop phenology, and early warnings of extreme events, the Commission encouraged the Members to take advantage of these tools in the preparation of their agrometeorological products. The Commission expressed its opinion that WESAP would serve as a major source of information on agrometeorological products, and encouraged all Members to post their products on WESAP.

REGIONAL ASSOCIATION V (SOUTH-WEST PACIFIC)

5.21 The Commission noted that the activities of the RA V Rapporteur on Agricultural Meteorology established by the Association at its twelfth session could not proceed as planned. It agreed with the view of the Association expressed at its thirteenth session that the application of meteorology to agriculture, including animal husbandry, continued to be of high importance to the Region.

5.22 The Commission was therefore pleased to note that at the thirteenth session of RA V, the Working Group on Agricultural Meteorology had been re-established and that a chairperson and seven experts from the Region were to address a number of agrometeorological issues of interest to the Region. An RA V task team was established to review the implementation of RCCs.

REGIONAL ASSOCIATION VI (EUROPE)

5.23 The Commission noted with satisfaction the activities carried out by the Working Group on Agricultural Meteorology established by the twelfth session of RA VI. The Commission expressed its satisfaction that the technical report of the RA VI Working Group on Agricultural Meteorology would be published in the CAgM Report series.

5.24 The Commission recorded its appreciation to the Institute of Agrometeorology and Environmental Analysis for Agriculture (Florence, Italy) for serving as a specialized centre for training in remote-sensing

applications to agriculture. The Commission noted with satisfaction the training courses organized by the Institute in cooperation with WMO.

6. EVALUATION OF THE 5LTP AND THE AGMP (agenda item 6)

6.1 The Commission noted with satisfaction the progress made in the implementation of the AgMP during the intersessional period.

6.2 The Commission noted in particular the large number of activities that had been organized during the intersessional period, including four International Workshops, three expert group meetings, two training workshops and nine roving seminars (for discussion of the training activities see paragraph 13.3).

6.3 The Commission noted the specific outputs of the AgMP in the six projects undertaken by the Programme in the 5LTP. Overall, Members' capabilities to provide relevant meteorological services to agricultural and related sectors were strengthened through the provision of guidance material, training in different regions and through short-term expert missions.

6.4 In the project on promotion of agrometeorological applications, training activities were undertaken on the application of GIS and guidance material was provided. In the project on agrometeorological data management, guidance material on the use of improved software for agrometeorological data management was prepared and distributed along with free software on CD-ROMs for use by Members. In the project on the use of climate forecasts in operational agriculture, an International Workshop on Climate Prediction and Agriculture was organized, the proceedings were published and distributed, and guidance was provided for demonstration projects in South Asia and West Africa. In the project on the communication of agrometeorological information, guidance material was developed for use by Members, and seminars were organized on the effective dissemination of information. In the project on agrometeorology for extreme events, guidance material was provided to Members on drought preparedness and drought management, and training activities were organized in different regions. The Programme participated actively in the implementation activities related to the UNCCD. Through the project on agrometeorological adaptation strategies to climate variability and climate change, guidance material on the impacts of climate variability and climate change was provided to Members. In addition, preparatory work was undertaken for the organization of the International Workshop on Reducing the Vulnerability of Agriculture and Forestry to Climate Variability and Climate Change in conjunction with CAgM-XIII.

6.5 The Commission was pleased with the large number of publications issued during the intersessional period, including seven Proceedings, two Technical Notes, two brochures, 12 CAgM Reports, one inter-agency report and four technical manuals. The Commission congratulated the Secretary-General on this achievement and recommended that the

publications be distributed to all Members and, to the extent possible, the user community, in particular farmers.

7. PREPARATION OF THE 6LTP AND THE AGMP (agenda item 7)

7.1 The Commission recalled the decision of Thirteenth Congress to prepare the 6LTP. In this decision, Congress requested the technical commissions to lead the formulation of all scientific and technical aspects of WMO Programmes and activities falling within their respective responsibilities.

7.2 The Commission also recalled that the Executive Council had established its WGLTP to assist it in connection with long-term planning, and the Task Team on WMO Structure. Both groups had held a second session conjointly from 12 to 16 March 2001. The fifty-third session of the Executive Council (June 2001) had considered the report of the joint session.

7.3 The Commission noted that the president of CAgM had attended meetings held in conjunction with the Meetings of the Presidents of Technical Commissions in October 2000 and October 2001, which had reviewed draft proposals by the Executive Council's WGLTP relating to the draft 6LTP and provided further input.

7.4 The Commission noted that the Council had agreed on a set of six desired outcomes:

- (a) Improved protection of life and property;
- (b) Increased safety on land, at sea and in the air;
- (c) Enhanced quality of life;
- (d) Sustainable economic growth;
- (e) Protection of the environment; and
- (f) Enhanced WMO effectiveness.

The Commission noted the objective of identifying the desired outcomes so that the 6LTP would be more strategic and outward-looking. It recalled the nine strategies with the associated strategic goals, as adopted by the Executive Council, to meet the evolving global needs for expert advice and services pertinent to weather, water, climate and the natural environment.

7.5 The Commission noted the agreement of the Executive Council that the current programme structure be used as a basis for further developing the 6LTP and the Programme and Budget for the fourteenth financial period. The Council had recognized the importance of identifying lead responsibility for ensuring the carrying out and/or coordination of each of the Programmes, as well as the strategies and associated strategic goals. The Council had also agreed that the major Programmes and component programmes thereof should be presented in the 6LTP, using a programme layout which included the purposes of the Programme and how they would support the 6LTP strategies and associated goals.

7.6 The Commission agreed with the Executive Council that the vision, desired outcomes, strategies and associated goals, as well as the programme structure of the 6LTP, would serve as a clear basis for the Programme and Budget. The achievement of expected results defined in the Programme and Budget would contribute to the realization of 6LTP strategies and associated goals. Those

would establish the meaningful link between the 6LTP and the Programme and Budget.

7.7 The Commission adopted a new structure based on the OPAG concept to allow for both flexibility and rigour in the delivery of its programmes. The Commission was to focus its activities in three key areas:

- (a) Agrometeorological services for agricultural production;
- (b) Support systems for agrometeorological services; and
- (c) Climate change/variability and natural disasters in agriculture.

7.8 The Commission considered the draft of the 6LTP and, in light of the newly adopted OPAG structure and of the recommendations of the International Workshop on Reducing Vulnerability of Agriculture and Forestry to Climate Variability and Climate Change, proposed the text in [Annex I](#) for inclusion in the next draft of the 6LTP.

7.9 In accordance with the objective of WMO's Quality Management System, the Commission also made suggestions on key results expected from its activities in key focus areas identified above (see paragraph 7.7). These key results are included in [Annex I](#).

8. REVIEW OF *TECHNICAL REGULATIONS (WMO-NO. 49)* AND OF THE *GUIDE TO AGRICULTURAL METEOROLOGICAL PRACTICES (WMO-NO. 134)* (agenda item 8)

8.1 REPORT OF THE ADVISORY WORKING GROUP (agenda item 8.1)

8.1.1 The Commission noted with appreciation the work accomplished by the AWG during the intersessional period. It noted that the Group had proposed a well-balanced agenda for CAgM-XIII, and should be complimented for recognizing key issues that needed to be studied during the intersessional period. The tasks of the Commission were wide-ranging, diverse and extensive. The contributions from the group of experts on the AWG and the assistance provided to the president and to the Commission to achieve these tasks were indispensable.

8.1.2 The Commission endorsed the AWG's proposal to restructure CAgM into OPAGs, in order to accomplish a more streamlined functional and flexible structure that could more efficiently utilize expertise and resources. The Commission agreed that the structure of OPAGs and the Commission's Management Group allowed a more proactive and flexible mechanism of responding to rapidly changing scientific and regional issues.

8.1.3 Acknowledging that climate variability and climate change issues would be among the top priorities in the future, the Commission congratulated the AWG and the Secretariat for their initiative in organizing the International Workshop on Reducing Vulnerability of Agriculture and Forestry to Climate Variability and Climate Change, held in conjunction with CAgM-XIII. The proceedings were to be published in the Climate Change Journal.

8.2 *GUIDE TO AGRICULTURAL METEOROLOGICAL PRACTICES (WMO-NO. 134)* (agenda item 8.2)

8.2.1 The Commission expressed its gratitude to Mr C.J. Stigter (Netherlands) for the enormous amount of work carried out in putting together the proposal for the revision of the *Guide to Agricultural Meteorological Practices (WMO-NO. 134)*. It also expressed its appreciation to members of the Steering Committee for their contribution to the proposal. The Commission agreed with the additions and amendments proposed by the members of the AWG during their meeting in April 2001, after having examined the discussion paper on a homogeneous outline for the contents of the third edition of the *Guide*.

8.2.2 The Commission agreed with the views expressed by the AWG that the process of preparation of the chapters by authors, their review and the finalization of the *Guide* could be similar to the IPCC process. Following the review process and compilation of all the chapters by the Secretariat, a workshop on the subject could be organized with the participation of contributing authors during the financial period starting in 2004. It was felt that the duration of the workshop should be one week, as there were 18 chapters to be discussed.

8.2.3 The Commission reiterated the importance of the third edition of the *Guide*, which would reflect and capture new concepts and new operational applications that had evolved, rapid advances in technology and new developments in agrometeorology. The Commission also requested the president to continue his efforts in concert with the Expert Team on the Guide to Meteorological Practices and the Secretariat so as to successfully complete the preparation of the first draft of the *Guide* by 2007. Chapters of the *Guide*, as they became available, would be posted on the WMO Web page for consultation by Members.

8.3 *TECHNICAL REGULATIONS (WMO-NO. 49)* (agenda item 8.3)

The Commission noted that the AWG had made no proposals for any specific amendments to the Technical Regulations. Hence the Commission decided that there was no need to make amendments to the Technical Regulations at that time.

9. WEATHER AND CLIMATE RELATED TO AGRICULTURAL PRODUCTION (agenda item 9)

9.1 ADAPTATION STRATEGIES REQUIRED FOR REDUCING VULNERABILITY OF AGRICULTURE AND FORESTRY TO CLIMATE VARIABILITY AND CLIMATE CHANGE (agenda item 9.1)

9.1.1 The Commission noted with appreciation that an International Workshop on Reducing Vulnerability of Agriculture and Forestry to Climate Variability and Climate Change had been organized from 7 to 9 October 2002, just before the Commission's session, at the Cankarjev Dom in Ljubljana. The workshop had been organized by WMO and Slovenia's Environmental Agency, and was co-sponsored by a number of national, regional and international organizations. It was attended

by 118 participants from 76 countries and two regional and international organizations.

9.1.2 The Workshop addressed a range of important issues relating to increasing climate variability, climate change, agriculture and forestry, including:

- (a) The state of the climate and its future in different parts of the world;
- (b) The state of agriculture and forestry and their future related to the current climate variability, climate change and future scenarios;
- (c) The state of (agro)climatological and (agro)meteorological information, including seasonal to inter-annual climate forecasts;
- (d) The state of adaptation of agriculture and forestry to changing climate conditions and other pressures, using such information where possible; and
- (e) The state of agrometeorological services to such adaptations using available traditional and scientific knowledge, and defining new information needs and other appropriate policy conditions.

9.1.3 The workshop concluded that current climate variability and likely unprecedented global warming expected during the 21st century, compared with the last 10 000 years, would provide significant challenges to agriculture and forestry, making adaptation necessary everywhere. It felt that increasing preparedness would involve the use of seasonal to inter-annual climate forecasts, traditional knowledge and indigenous technologies, as well as contemporary science and technology for adaptation. At the same time, food and fibre production would be required to introduce measures to mitigate greenhouse gas emissions. Education, training and research would be vital, and integrated strategies would be required.

9.1.4 The Workshop recommended a number of adaptation strategies for reducing vulnerability of agriculture and forestry to climate variability and climate change. These included the following:

- (a) Improving monitoring of climate and crops;
- (b) Changing land allocation for stabilization of production and conservation of soil moisture;
- (c) Earlier planting and sowing of crops, including both long-season (with adequate soil moisture and low risk of heat stress) and short-season cultivars (for avoiding heat and water stress);
- (d) Efficient conservation of water;
- (e) Adoption of shorter rotations and thinning to increase spacing in areas to reduce drought stress;
- (f) Implementing sustainable agricultural practices;
- (g) Planting shelterbelts to reduce erosion;
- (h) Application of integrated pest management strategies;
- (i) Developing innovative technologies;
- (j) Prevention of grassland overgrazing leading to small to moderate improvement in soil carbon levels;
- (k) Allowing summer fallow of land in temperate regions to reduce nitrous oxide emissions;
- (l) Reducing tillage intensity and summer fallow area with improved manure management and other strategies to reduce greenhouse gas emissions;

- (m) Implementing sustainable short rotation forestry for the production of renewable biomass energy;
- (n) Arresting deforestation and improving degraded lands through agroforestry;
- (o) Seeking active participation of local communities; and
- (p) Enforcing effective intervention policies.

9.1.5 In this regard, the Commission suggested that the OPAG 3 on Climate Change/Variability and Natural Disasters in Agriculture in the proposed new structure for CAgM should consider the recommendations of the workshop in its programme planning for the following intersessional period.

9.2 IMPACT OF MANAGEMENT STRATEGIES TO MITIGATE GREENHOUSE GAS EMISSIONS FROM AGROECOSYSTEMS (agenda item 9.2)

9.2.1 The Commission noted with appreciation the work accomplished by the Working Group on the Impact of Management Strategies in Agriculture and Forestry to Mitigate Greenhouse Gas Emissions and to Adapt to Climate Variability and Climate Change. The Commission complimented the chairperson, Mr H.P. Das (India) and the other members of the group for their contributions to the various chapters of the final report. The Commission recommended that the report be suitably edited and published as a WMO Technical Note.

9.2.2 The Commission agreed that climate change had the potential to significantly change agricultural productivity at most locations. It expressed the view that vulnerability of populations in terms of hunger and malnutrition should be the primary concern, but that regional economic development, land degradation and increased environmental stress resulting from agricultural production under a changed climate were important concerns as well.

9.2.3 In this connection, the Commission expressed its concern with the possible impacts of climate variability and climate change in the developing countries, most of which were already under significant pressure to feed their growing populations. In these countries it was felt that the need for increased productivity had to be balanced with a concern for the conservation of natural resources related to sustained productivity.

9.2.4 The Commission stressed that there was considerable potential for agricultural systems to adapt to climate change. It was noted that adaptation options had the twin purposes of reducing the damage from climate change and increasing the resilience of societies and ecosystems to the aspects of climate change that could not be avoided.

9.2.5 Considering the vulnerability of agricultural production to the occurrence of climate extremes, the Commission suggested that efforts be made to determine the heat-tolerance limits of currently grown crops and of possible alternative crops and varieties, and to find suitable agronomic methods of moderating the thermal regime affecting crop growth.

9.2.6 The Commission noted that a number of countries had listed strengthening irrigation capacity as

a possible means of adaptation to climate change, thereby increasing the need for agroclimatic information on increasing irrigation efficiency. However, it was felt that the use of irrigation as an adaptation strategy was not always appropriate because it assumed that water was available for irrigation. It was noted that analysis of climate data could provide information to improve water use efficiency. Other technological options for adaptation to climate change that the Commission noted included microclimate management and manipulation, and different forms of response farming, including changes in growing season and sowing dates, choice of different crop varieties or species, fertilizer inputs and tillage. Improved short-term climate prediction was another way to improve adaptations. For some of these options, information could be obtained using specifically adapted agroclimatic statistical analysis techniques. The INSTAT software was available free of charge, and training was available through RMTCs or NMSs.

9.2.7 The Commission agreed with the recommendation of the working group that the impact of climate change on livestock needed to be examined in detail, since livestock were important for many rural communities, depending in part or in total on animal husbandry, for milk, meat and fibre, and for energy, transport and other uses in many parts of the world, especially in arid and semi-arid areas.

9.2.8 The Commission emphasized that more precise scenarios were needed showing how climate would change at local and regional levels. Also needed was a better understanding of the social and economic factors leading farmers and others to detect and respond to the changing climate. Farmers would have difficulty responding to climate change if they could not detect what was actually happening. It was therefore felt that the aim should be to create or re-establish an agricultural production system that could adapt and respond to many changes using natural resources wisely in order to deal effectively with climate change, drawing on traditional systems that did exactly that.

9.2.9 The Commission felt that improving the reliability of carbon and nitrogen models and reducing the uncertainties in climate change scenarios were important priorities for future research, in order to quantify the potential of mitigation strategies to increase soil carbon sequestration and reduce greenhouse gas emissions.

9.2.10 The Commission noted that every step of the manufacturing process of forest products had an impact on climate change, either by reducing the capacity of forests to absorb and store carbon, or by emitting greenhouse gases through fossil fuel combustion for generating the energy required for processing. It was noted that end products also contributed to greenhouse gas emissions through their decay after disposal.

9.2.11 In this regard, the Commission noted that the managed exploitation of forests ensured that they remained productive, that early death and decay of trees were minimized, that fire hazards were reduced, and that forest yield was optimized. It was noted that all of these

factors played important roles in increasing carbon fixation and reducing release of CO₂ during decay and fires. The Commission also noted that some forest industries were taking measures to alleviate climate change impacts, through forest management and forest plantations, through measures to reduce energy consumption, and through innovative disposal techniques for end products after their useful life. However, there were still enormous problems in some countries with respect to appropriate forest management, leading to disastrous logging as well as extensive forest fires and the resulting releases of CO₂.

9.2.12 The Commission felt that there was a need for better and timelier CH₄ and N₂O emissions estimates. The lack of measurements for extended periods over large areas, the difficulty of taking the measurements, very high temporal variability and the cost of the measurements were the main reasons for the lack and uncertainty of the data.

9.2.13 The Commission noted that practices for effective management of livestock, nutrients, crops, soils and energy were relevant to greenhouse gas emission reduction and sustainable development. The Commission emphasized that no single mitigation option would provide all of the emission reductions that society required. The challenge was to ensure that information on appropriate technologies to increase carbon sequestration and reduce greenhouse gas emissions reached all sectors of agriculture and that producers were shown the best management practices. Producers also needed to be encouraged to adopt new technologies for their specific needs and conditions.

9.2.14 The Commission emphasized the role of contemporary dynamic crop production models such as DSSAT for studies in the optimization of different management practices in the adaptation strategies for mitigating the effects of climate change.

9.2.15 In this regard, the Commission suggested that the OPAG 3 on Climate Change/Variability and Natural Disasters in Agriculture in the proposed new structure for CAgM should consider the recommendations of the working group in its programme planning for the following intersessional period.

9.3 IMPACTS OF AGROMETEOROLOGICAL APPLICATIONS FOR SUSTAINABLE MANAGEMENT OF FARMING SYSTEMS, FORESTRY AND LIVESTOCK (agenda item 9.3)

9.3.1 The Commission noted with appreciation the work accomplished by the Working Group on the Impacts of Agrometeorological Applications for Sustainable Management of Farming Systems, Forestry and Livestock. The Commission complimented the chairperson, Mr A.D. Kleschenko (Russian Federation), and the other members of the group for their contributions to the various chapters of the final report. The Commission recommended that it be suitably edited and published as a CAgM Report.

9.3.2 The Commission noted that assessment of the impacts of applications for sustainable management of

farming systems, forestry and livestock was one of the most important problems facing agrometeorology in the 21st century. Despite many different agrometeorological and agroclimatological applications, there were still only a small number of examples of their impacts on decision-making for management of farming systems, forestry and livestock, taking into account ecological safety as sustainable industrial development

9.3.3 The Commission agreed that in order to promote increased operational applications of proven agrometeorological techniques and for proper evaluation of their impacts, the NMHSs should establish and further promote effective collaborative links with appropriate research and development organizations in agriculture, forestry and fishery.

9.3.4 The Commission noted that in the development of different agrometeorological applications for farming systems, forestry and livestock, it was necessary to consider not only the effects of these applications, but also their impacts on the sustainability of the applied systems. It emphasized the importance of developing mathematical models that considered the problems of sustainability and anthropogenic effects of fertilizers, pesticides and other chemicals on agricultural products.

9.3.5 The Commission was informed that in rangelands and forestry management, there were several areas in which agrometeorological characterization could be used. These included fire behaviour/danger, fire management, prescribed burning and fire effects, smoke management and air quality, and forest health and productivity.

9.3.6 The Commission agreed that a wider use of modern techniques such as GIS, remote sensing, GPS and agroecological characterization could help identify and develop efficient management strategies for improved use and conservation of natural resources.

9.3.7 Considering the importance of agrometeorological applications for sustainable management of farming systems, forestry and livestock, the Commission recommended that the matter be further investigated by OPAG 1 on Agrometeorological Services for Agricultural Production and OPAG 2 on Support Systems for Agrometeorological Services during the next intersessional period.

9.4 AGROMETEOROLOGICAL ASPECTS OF ORGANIC AGRICULTURE, URBAN AGRICULTURE, INDOOR AGRICULTURE AND PRECISION FARMING (agenda item 9.4)

9.4.1 The Commission expressed its appreciation to Mr N. Holden (Ireland) and Mr M. Carvajal Ortiz (Ecuador) for the detailed and comprehensive report. The Commission agreed the report contained useful information on agrometeorological aspects of organic agriculture, urban agriculture, indoor agriculture and precision farming, and recommended that the report be published as a CAgM Report.

9.4.2 The Commission took note of the series of definitions presented in the report to clearly reflect the meaning and understanding of organic agriculture,

urban agriculture, indoor agriculture and precision farming. The report provided useful information on the scope, history, rationale and goals, as well as geographical occurrence of these fields of agricultural production. The Commission also noted that the report addressed several issues, such as the agronomy practiced, the agroenvironmental influences on production, the relevant data and models required, and the type of interaction needed with the agricultural community in each of these fields.

9.4.3 The Commission agreed that for any region where organic production was to be developed, there should be a clear understanding of the agroclimatology, particularly the frequency of occurrence of weather conditions that typically resulted in situations requiring chemical intervention in conventional systems (e.g. the frequency with which conditions conducive to the spread of pest and diseases occurred). It therefore encouraged Members to have agroclimatologists on hand to address planning and development questions and to facilitate decision-making at both the national (macroclimatic) and regional (mesoclimatic) scales.

9.4.4 The Commission noted that the value of meteorological inputs to models was of most relevance to organic farmers when they could be used for predictive purposes. The organic farmer needed forecast information over periods ranging from a few days to a year for various activities. The Commission took note of the developments taking place in weather and climate forecasting and encouraged the NMHSs and research institutions to continue their efforts in this area. It noted that the farmer could get the most from the NMHSs if a very reliable four-day forecast could be achieved, together with a reasonable 10-day forecast, with an indication of seasonal trend by comparison with weeks and months just past with long-term climate data.

9.4.5 The Commission emphasized the importance of information dissemination in organic farming. In order for the link between organic production and agrometeorology to be developed and sustained, it would be necessary for users of agrometeorological information to demand the services that could be developed by the research community and the NMHSs. It would also be necessary for such groups to publicize the tools and services they offered. Training and support for the integration of information technology onto daily farm life would also be necessary.

9.4.6 The Commission took note of the increasing importance of urban agriculture and recognized that the combination of urban location and indoor techniques could result in crop production in areas that would not normally be suitable. In this regard, there were a number of urban specific influences that needed to be considered. These included the microclimates of cities, the urban heat island effect, wind 'tunnels' and 'hot spots', the competition for water with other domestic users, the availability of direct radiation, and high humidity and pollution levels in cities.

9.4.7 The Commission agreed that indoor agriculture could lead to better food security and could

also provide better products for domestic and international markets. It noted that the adequate use of agrometeorological data was fundamental to greenhouse gas management. The monitoring and control of temperature and humidity were among the principal factors in greenhouse gas production. The major risk for indoor agriculture was the risk of severe storm events with associated high winds, snow and hail.

9.4.8 The Commission noted that climate services for precision agriculture would need to provide more localized information so that the right management decisions could be taken. It encouraged Members to support the development of this field of agriculture by providing accurate, localized and tailored forecasts with time horizons from nowcasts, from three- and five-day forecasts to seasonal forecasts.

9.4.9 The Commission recognized the potential benefits of organic agriculture, urban agriculture, indoor agriculture and precision farming, and agreed on the need to properly determine the agrometeorological aspects in order to ensure appropriate response. The Commission therefore recommended that this issue be considered further under OPAG 1 during the next intersessional period.

9.5 CURRENT ADVANCES IN SEASONAL FORECASTS AND CLIMATE PREDICTION AND THE PRODUCTS AND SERVICES RELEVANT TO AGRICULTURE (agenda item 9.5)

9.5.1 The Commission noted with appreciation the work accomplished by the Working Group on the Use of Seasonal Forecasts and Climate Prediction in Operational Agriculture. The Commission expressed its appreciation to Mr M.J. Harrison (United Kingdom) for agreeing to act as chairperson of the group in place of Mr V. Dmitrenko (Ukraine), who could not undertake his tasks because of ill health. The Commission complimented the chairperson and the other members of the group for their contributions to the various chapters of the final report, which it recommended be suitably edited and published as a WMO Technical Note.

9.5.2 The Commission noted that significant advances in the past four to five years in seasonal climate prediction, methods of delivery of these predictions and their applications had made it possible for agrometeorological services to provide improved products and services relevant to agriculture. In particular, the Commission noted the advances made in regional climate models and limited area climate models that had made it possible to understand small, local-scale developments using large-scale information. It was felt that these developments would help enhance agricultural decision-making at the local level with respect to dates of planting, fertilizer application, irrigation scheduling, etc., if their reliability was confirmed to be sufficiently high.

9.5.3 On the question of skill level of seasonal climate predictions, the Commission noted that it was usually higher in tropical regions than at higher latitudes, and tended to be higher in the tropics at longitudes closer to the Pacific basin. In extratropical

regions, areas directly influenced by the ENSO phenomenon enjoyed more skillful forecasts than elsewhere. The Commission also noted that there were inter-annual changes in skill levels, e.g. better skills during winter and spring than in summer and autumn, and better skills in the transition from the dry to the wet season. The skill level for temperature was higher than that for rainfall.

9.5.4 The Commission took into consideration that the content of current agrometeorological forecast models was relatively simple, and agreed that more attention should be directed to the development of different models for the quality of agricultural products. The Commission felt that with the increase in the availability of climate prediction model products, the development of applications for such products in agricultural production should be encouraged.

9.5.5 The Commission noted that the organization of RCOFs over the previous few years had provided an excellent opportunity for education, multidisciplinary discussion and coordination of seasonal climate forecast applications. For example, DMCs Nairobi and Harare organized the regional seasonal outlook forums GHACOF for the Greater Horn of Africa region, and SARCOF for Southern Africa. ACMAD organized PRESAO for the West Africa region, and Algeria organized PRESANOR for the North Africa region.

9.5.6 In this regard, the Commission pointed out that it was important to clearly identify, inter alia, regional priorities with respect to prediction delivery, data set creation, research and education, in order to provide a core of expertise not available in all countries. The Commission noted with satisfaction that WMO's ICTT, on which CAgM was represented, was examining the possibility of establishing RCCs, which would be tasked with addressing such regional priorities. The Commission thanked Mr M.J. Salinger (New Zealand) for representing CAgM on the ICTT. As additional information became available, Members were to be informed of these developments.

9.5.7 The Commission noted that examining research needs, investigating downscaling methods – especially using RCMs, the development of consistent verification methods, capacity building and end-user liaison – and establishing consistent and appropriate skill levels were important for ensuring improved application of climate forecasts for agriculture. In this context, the Commission noted that these issues were being taken up by the various ETs within the new CCI OPAG structure. The Commission recommended that CAgM's proposed ET on Seasonal to Inter-annual Climate Forecasting and Impacts and Applications for Agriculture, under OPAG 3 on Climate Change/Variability and Natural Disasters in Agriculture, maintain a close linkage with CCI's ETs.

9.5.8 The Commission noted the implementation of CLIMAG projects in South Asia and West Africa. These pilot studies had shown how agricultural systems analysis and climate science and information for developing countries could be combined with direct linkages to

smallholder farmers to positively influence agricultural decisions. The Commission agreed that potentially significant enhancement in agricultural production was possible using strategies based upon climate forecast information, and that CLIMAG implementation should occur on a regional scale tailored to the specific climatological and agricultural regimes of specific areas. Noting that the partnership between WMO and START, IRI, APN, IAI and other relevant organizations was an essential ingredient underpinning the CLIMAG effort, the Commission encouraged WMO's continued participation in the activities of the CLIMAG Steering Committee.

9.5.9 The Commission also noted that there were other projects, such as the European Commission's PROMISE, that were examining the potential for seasonal prediction and the benefits that would accrue in terms of management of water resources and agriculture. Also, the Australian Bureau of Meteorology (BOM) was soon to commence a three-year project, funded by the Australian Agency for International Development (AusAID), to strengthen the capacity of Pacific Island countries in seasonal to inter-annual prediction. This complemented the seasonal climate forecasting bulletin, funded by the New Zealand Agency for International Development (NZAID) and produced by the National Institute of Water and Atmospheric Research in New Zealand. The Commission recommended that the ET on Seasonal to Inter-annual Climate Forecasting and Impacts and Applications for Agriculture maintain a liaison with such projects to ensure that implementation of potential applications followed quickly in other regions.

9.5.10 The Commission emphasized that the maximum benefit from applications of seasonal climate forecasts could be derived when there was coordinated and integrated action at all levels, i.e. the climate prediction community, agricultural research and extension personnel, policy makers and farmers. It was noted that independent, isolated decisions at any given level often missed the synergies that could be derived from well-coordinated action at all levels. In this regard, the Commission noted with interest the remarkable success achieved by the Seasonal Weather Forecasting for the Food Chain project for field vegetables, sugar beets, tomatoes and apples in the United Kingdom, where seasonal predictability was relatively limited. The Commission urged the Members to undertake similar projects on important crops in their countries.

9.5.11 The Commission noted that an effective application of a seasonal climate forecast was the use of forecast information that led to a change in a decision that generated improved outcomes. A seasonal forecast would have no value if it did not generate changed decisions. To be effective, though, the decision changes needed to produce positive changes in value by improving the relevant aspect of the targeted system performance. It was noted that in agriculture, this most often related to profitability, use and conservation. Primary producers used climate information to assist

with many decisions on seasonal to inter-annual timescales. The Commission noted that the use of software packages that combined seasonal climate forecasting information with crop simulation models enabled the extension community and farmers in some industrial countries to choose the best management options and assess the likelihood of improving the crop yields. Agricultural weather applications developed in Australia – e.g. RAINMAN, 'Whopper Cropper', Regional Commodity Forecasting System – were good examples of this approach. The Commission urged the Members to review such applications and to consider whether adaptations were possible for their countries.

9.5.12 The Commission emphasized that the full benefits of seasonal climate forecasts in developing countries could only be realized when soil and crop management at the farm level could be improved. This pointed to a great need for capacity building for the rural, small-scale farmer.

9.5.13 It was noted that the optimal use and dissemination of climate information necessarily involved a number of avenues, including fax, telephone, print publications, the Internet and the mass media. To take full advantage of these avenues, it was necessary to identify user needs and maintain an ongoing dialogue, using field days, presentations, seminars, conferences education, and assessments of forecasting and statistical skills. The Commission emphasized the importance of effective dissemination of climate forecast information to ensure prompt applications by the end-users.

9.5.14 The Commission felt that the RANET project implemented by ACMAD was an excellent example of the effective integration of the products developed by the NMHSs with multimedia formatting. This integration was achieved using digital satellite broadcasting, reception by digital radio, downloading onto a computer, adaptation of the information into local languages, rebroadcasting over local FM radio, and final reception by farmers on solar-powered or wind-up radios. The Commission encouraged Members to study such options as effective systems for delivery of information to farmers.

9.6 STATUS OF MODELLING IN AGROCLIMATOLOGY (agenda item 9.6)

The Commission noted that the joint rapporteurs were unable to undertake the tasks assigned to them by CAgM-XII. The Commission reiterated the importance of addressing the issues contained in Resolution 7 (CAgM-XII) taking into account the rapid developments in the use of computer technology and the various types of models in agrometeorology. It therefore recommended that the implementation of the resolution be undertaken by OPAG 2 during the following intersessional period.

9.7 INTERACTIONS BETWEEN CLIMATE AND BIOLOGICAL DIVERSITY (agenda item 9.7)

9.7.1 The Commission complimented Mr M.P. Bah (Gambia), coordinator of the Joint Rapporteurs on

Interaction Between Climate and Biological Diversity, for his report. It noted with appreciation the contributions made by Ms S. Korsakova (Ukraine), Ms V. Grigoryan (Armenia), Mr O. Hendrickson (Canada) and Mr W. Baier (Canada). The Commission agreed that the report contained useful information on the interaction between climate and biological diversity, and recommended that it be suitably edited and published as a CAgM Report.

9.7.2 The Commission noted that the changing patterns of climate affected the natural distribution pattern of species, and that global warming could dramatically alter a third of the world's natural habitat over the next 100 years. The predicted increase in surface temperatures, sea temperatures and sea levels, as well as land use and other anthropogenic activities such as deforestation, desertification and soil erosion, would have major impacts on the biodiversity of the sensitive ecosystem. In this regard, the Commission encouraged Members to continue their efforts in research, observation and monitoring of the environment so as to mitigate the impacts of climate change.

9.7.3 The Commission agreed that at the global level, deforestation and changes in land use made forest area cover a net source of carbon dioxide. Fortunately, appropriate measures and technologies that were currently available could significantly reduce net emissions from forests. The Commission therefore invited Members to continue to promote the establishment and development of appropriate national policies and programmes so as to encourage proper management of forest reserves and woodlands. It recognized that assessment of emissions and of climate impacts, especially on carbon sinks and sources, required a clearer definition of forest and of afforestation, reforestation and deforestation.

9.7.4 The Commission noted that global change would alter carbon inputs to soil in the form of plant litter derived from plant photosynthesis, and carbon outputs associated with decomposition of soil organic matter which arose mainly from the respiratory activity of soil decomposer organisms. It noted that the ability of agricultural and forest soils to sequester carbon depended on the balance between carbon inputs and outputs. In view of the complexity of the issue, the Commission recommended that more studies be undertaken on methods of predicting the net effects of carbon sequestration in agricultural and forest soils, particularly the measure of underground soil carbon, because of the unstable nature of carbon.

9.7.5 The Commission agreed that agricultural practices might have positive or negative effects on biodiversity, depending on the specific characteristics of the case concerned. It felt that impact assessments might be necessary to determine the likely impacts of different climate change scenarios. The Commission noted that over many years it had acquired a wealth of knowledge that could be used for contributing to sustainable agricultural practices and to the conservation of biological diversity.

10. AGROMETEOROLOGICAL DATA MANAGEMENT (agenda item 10)

10.1 USER REQUIREMENTS FOR SATELLITE AND OTHER REMOTE SENSING INFORMATION IN THE FIELD OF AGRICULTURAL METEOROLOGY (agenda item 10.1)

10.1.1 The Commission thanked Mr P. Doraiswamy (United States), Mr G.B. Diagne (Senegal), Mr M. Labo (Niger), Mr S.K. Shaha (India) and Mr O. Virchenko (Russian Federation) for their report on User Requirements for Satellite and Other Remote Sensing Information in the Field of Agricultural Meteorology. The Commission recommended that the report be published in the CAgM Report series.

10.1.2 The Commission agreed that remote sensing technology was accessible to both developed and developing countries, and that the costs for acquiring the images and data from orbiting and geostationary satellite systems had been reduced over the previous decade. However, the interpretation and timely access to remote sensing products for use in agriculture was lagging behind the development of sensors and the acquisition of data.

10.1.3 The Commission noted the examples of international projects such as the FEWS Network, GIEWS and MARS. A WMO project (Ap3A), implemented through the TCO Department, was the Early Warning Forecast for Yield Assessment for the Sahel Region. The NDVI was used by the FEWS Network to monitor vegetation conditions in the Sahel, where climate conditions were favourable for its use (i.e. no clouds). The Commission pointed out that NDVI was not as useful in East Africa, the Horn and Southern Africa, due to long periods of clouds and haze during the most critical parts of the growing season.

10.1.4 The Commission also noted examples from the USDA, China, the Russian Federation and India where specific applications of satellite imagery had provided good results. The applications included the monitoring of extreme meteorological events, such as floods, early freeze and drought. Other applications in China and India included the monitoring of sown areas and production of grain and cotton crops. Operational assessment of spring and winter wheat crop yields had been carried out in the Russian Federation since 1995, including the definition of drought.

10.1.5 Regarding the experience on the implementation, operation and dissemination of low-cost satellite receiving stations in the field of agricultural meteorology, the Commission noted that the primary source of these data available for Agrometeorology had traditionally been the polar orbiting NOAA AVHRR data. Since the launch of the Earth Observing System's Terra platform, the MODIS satellite imagery at a relatively higher resolution (250 m) was available through the NASA Data Active Archive Centers (DAAC) in the United States. These data were provided free through the Internet Web sites at the various DAACs.

10.1.6 Given the wealth of information becoming available from various remote sensing tools, the Commission considered that greater attention needed to be given to techniques for integration of information from different satellite sensors with ground-based

meteorological and agronomic data. The Commission felt that the most promising method was through the use of agrometeorological models and GIS technology.

10.1.7 Regarding the requirements for satellite and other remote sensing data and information, including AWS data for use in agriculture, the Commission pointed out that there was a need for timely access to satellite-based imagery acquired from polar orbiting and geostationary systems, and for improved access to surface climatic data. The Commission noted that there were national and regional centres (international and inter-governmental programmes) with the necessary ground stations to acquire these data, but it was unclear whether the infrastructure to disseminate the data in a regular and timely manner for operational programmes existed. In many cases, these countries needed support in developing Internet-based dissemination of local and country-level information regarding current crop and vegetation conditions. It was noted that some of the products developed from remotely-sensed data, such as crop condition and biomass, could be monitored throughout the crop season. Use of these products facilitated estimation of crop yields at the end of the season.

10.1.8 The Commission highlighted the critical need for agricultural meteorological programmes to improve and expand weather station data. The current level of data available at near-real time, or at weekly and monthly frequencies, was inadequate for the timely assessment of management decisions, especially during catastrophic events such as droughts and floods. It was noted that advances had been made in automated data acquisition systems that required little maintenance and could store data in microchips over extended periods of time.

10.1.9 Dedicated resources were required for users to access satellite data and information products. The Commission felt that training of technical personnel to acquire, process and interpret the satellite imagery was a major task that needed to be recognized by management in the agricultural ministries. It was felt that the acquisition of satellite data was usually easier than the interpretation of data for specific applications that were critical for the assessment and management of natural and agricultural resources. In this regard, the Commission pointed out that long-term planning and training of technical personnel was a key ingredient in ensuring full success in the use of current and future remote sensing technologies that could increase and sustain agricultural production, especially in developing countries.

10.1.10 In this regard, the Commission recommended that the proposed OPAG 2 on Support Systems for Agrometeorological Services convene an ET on Techniques (Including Technologies such as GIS and Remote Sensing) for Agroclimatic Characterization and Sustainable Land Management.

10.2 COMPUTER-BASED MANAGEMENT SYSTEMS, SUITABLE SOFTWARE PACKAGES AND TRAINING REQUIREMENTS (agenda item 10.2)

10.2.1 The Commission recognized the increasing importance of computer software to manage vast

quantities of data, ranging from point-source data to spatially interpolated products. It further recognized that both applications and technology had become more sophisticated, requiring timely access to a greater variety of data sources, ranging from AWS networks to remote sensing platforms to GIS products. An array of computer software packages was available to manage this system, from data collection to information delivery. The Commission acknowledged a responsibility to provide the global user community with a basic understanding of current software packages that could be utilized for agroclimatic data management. This awareness also included an assessment of shortcomings and limitations of the current software packages and the development of appropriate recommendations for future activities. Finally, it was recognized that guidelines needed to be formulated for NMHSs, including training and capacity building, especially in developing countries, for the improved management of agroclimatic databases in support of agricultural applications.

10.2.2 The Commission congratulated the WMO Secretariat and the USDA for their excellent collaboration, not only in the organization of the Expert Group Meeting on Software for Agroclimatic Data Management in Washington, D.C. in October 2000, but also for publishing the proceedings in a timely manner and distributing the report to CAgM Members. The Commission also conveyed its compliments for the publishing of a CD-ROM that contained a sample list of public domain software packages reviewed in the printed proceedings. This freely distributed set of a printed volume and CD-ROM was an exemplary illustration of resource utilization between AgMP and other national or international organizations. Several requests had already been received to send additional copies of this set of proceedings to be used for training purposes. The Commission noted with great appreciation the work accomplished by the Expert Group.

10.2.3 The Commission emphasized the importance of continuously updating the computer-based management systems software used by agrometeorological services around the world, in order to provide better services and products. In this regard, the Commission suggested that the proposed ET on Database Management, Validation and Application of Models and Research Methods at the Eco-Regional Level, under OPAG 2 on Support Systems for Agrometeorological Services in the proposed new structure for CAgM, consider this issue in its programme planning for the next intersessional period.

10.2.4 The Commission noted that the fifty-fourth session of the Executive Council had taken into account the view of the technical commissions and agreed that WMO should work towards its own quality management framework by making use of the already developed comprehensive system of documented WMO procedures and practices in the *Technical Regulations* (WMO-No. 49), Manuals, Guides, Guidelines and Technical Publications. The Council requested the Secretary-General to make information material on ISO

9000 and related quality management systems available to Members.

10.2.5 The Commission further noted that the fifty-fourth session of the Executive Council had recognized that WMO standards, elements of quality control, performance monitoring and training standards of professionals, among others, were found in a number of those publications, but that additional work needed to be done to update and/or revise those materials. In the development of the WMO quality management framework, the technical review needed to be performed for the assessment of available documentation with respect to conformity with quality management procedures. The Council requested the technical commissions, through their presidents, to develop additional documentation to describe the quality management procedures and practices to be followed and the resources required for implementation. That additional documentation was to be adopted by WMO Members through established WMO mechanisms.

10.2.6 The Commission agreed with the Council that in the preparation of the WMO quality management framework, a certification (registration) process should be developed and that the following elements need to be studied further:

- (a) Monitoring of the performance of elements of the system;
- (b) Assessment of conformity to established WMO procedures and recommended practices; and
- (c) The need for an independent 'certification' or 'registration' body or mechanism.

The Commission recognized the Council's emphasis on the importance of an independent auditing component.

10.2.7 The Commission acknowledged the request from the Executive Council to develop, through its Expert Team on the Guide to Agricultural Meteorological Practices, additional documentation that described the quality management procedures and practices to be followed, and the resources to be allocated, which would enable the overall quality, in particular of the agrometeorological outputs, to be monitored and continuously improved. That documentation, to be adopted by WMO Members, would be a part of the implementation of all activities that contributed to the delivery of agrometeorological services and products.

10.2.8 The Commission further acknowledged the view of the Executive Council that quality standards were set for the assessment as well as for the enhancement of products and services delivered. In that connection, it was important to recall that users' perspectives should be taken into account and that the assessment and/or enhancement of products and services should be considered also from the point of view of the level of usefulness of those products and services.

10.3 AGROMETEOROLOGICAL DATA MANAGEMENT (agenda item 10.3)

10.3.1 The Commission expressed its appreciation to Mr F. Huard (France) for the report on agrometeorological data management. The Commission agreed that the

report contained useful information. It noted, however, that the report did not fully address the terms of reference assigned, particularly the data derived from radars and satellites. It regretted that other joint rapporteurs had not contributed to the report.

10.3.2 The Commission noted the rapid developments in observation and computing technologies, database management, GIS, remote sensing and telecommunication techniques, and called for a reconsideration of the manner in which agrometeorological data was organized and processed. It agreed on the need to establish guidelines for future developments in standardization and data exchange, as well as in information delivery.

10.3.3 The Commission recognized the importance of standardizing and managing agrometeorological data from AWSs. It expressed its satisfaction with the resolution, ranges and reporting intervals that appeared to be appropriate for agricultural applications based on the work of the CBS OPAG Expert Team on Automatic Weather Stations. However, the Commission noted that further reporting standards from AWSs needed to be developed for the estimation of leaf wetness and volumetric soil moisture. The Commission also supported the recommendations of the ET, which included concerns expressed over inconsistencies between reference documents within WMO as they related to automatic observing systems, and the inclusion of required user parameters currently not reported through BUFR/CREX code.

10.3.4 The Commission noted that the framework existed for a comprehensive approach to data management. While a large number of software packages were available for agroclimatic data processing, analysis and dissemination, most of those packages were developed for specific needs and applications. The Commission also noted that the techniques for weather and climate data management varied widely and were dependent upon the type of data network, telecommunications, data storage capability and processing power of each system. Similarly, the current status of software for crop models and soil databases was diverse and targeted many different applications. The Commission agreed that there could be greater application of some of the current systems if selected features were integrated into a more comprehensive management systems approach.

10.3.5 The Commission recognized that CLICOM, which made small-scale data management systems possible and had been extremely successful during past years, had reached the limit of its ability to evolve further. The Commission agreed on the need to upgrade the system so as to take advantage of existing technologies. The Commission urged its Members to contribute to the current efforts of WMO in developing a replacement system for CLICOM.

10.3.6 The Commission agreed on the importance of determining future needs for more efficient management of agrometeorological data to foster improved agrometeorological applications. In that regard, the Commission recognized a greater role for its experts in continuing to identify trends in new technologies and the use of these

innovative technologies in agrometeorological data management. The Commission therefore suggested that the proposed Expert Team on Database Management, Validation and Application of Models and Research Methods at the Eco-Regional Level, under OPAG 2 on Support Systems for Agrometeorological Services, consider these issues. The Commission felt that the ET should carry out its work in close collaboration with the CCI Task Group on CDMSs.

11. APPLICATIONS OF AGROMETEOROLOGY (agenda item 11)

11.1 CURRENT METHODS AND APPROACHES BEING USED FOR THE COMMUNICATION OF AGROMETEOROLOGICAL INFORMATION (agenda item 11.1)

11.1.1 The Commission noted with appreciation the work accomplished by the Working Group on the Communication of Agrometeorological Information. The Commission complimented the chairperson, Ms V. Pérarnaud (France) and the other members of the group for their contributions to the various chapters of the final report. The Commission recommended that it be suitably edited and published as a CAgM Report.

11.1.2 The Commission recognized that more information was generally needed in all countries on the extent of user acceptance of agrometeorological products or services and the manner in which these were being communicated. It therefore encouraged Members to take appropriate action to promote continuous dialogue between the producers and users of agrometeorological information so as to identify their needs, better target the services provided in both content and means of distribution, and assess the impact of such information.

11.1.3 The Commission noted that the provision of near real-time information in a timelier fashion with minimum delay continued to pose a challenge. It noted further that this involved a series of steps, including data collection, interpretation and communication, all of which needed to take place within acceptable time frames for the information to be current. It therefore encouraged Members to promote the real-time communication of agrometeorological information with a view to improving users' decision-making, both nationally and regionally.

11.1.4 In order to efficiently develop and distribute agrometeorological information, the Commission agreed that it was important for each country to set up and maintain a good meteorological observing network, including automated stations, based on strong relationships between the NMHSs and other bodies in the field of research and the development of agronomic information.

11.1.5 The Commission urged the NMHSs of Member countries to strengthen multidisciplinary collaboration with agricultural institutions, NGOs and possibly with the private sector, with a view to systematically increase the distribution of agrometeorological information for users through balanced partnerships.

11.1.6 The Commission recognized the need for Members to be well informed of the latest communication

technologies, and agreed to help raise Members' awareness of the successful developments regarding the communication of agrometeorological information. In this regard, it took note that in Africa and Asia, the RANET programme, developed by NOAA in conjunction with ACMAD, still in its trial phase, could be a successful means of communication in these regions. The Commission noted, however, that the conventional mode of delivery of agrometeorological products continued to be used by many Members and should not be left out.

11.1.7 The Commission agreed to undertake an assessment of the training needs of the professional teams in charge of developing and distributing agrometeorological information so as to improve the response to user requirements in each regional association. It also agreed to assess the training needs of users and the most efficient way of meeting these needs. In this regard, the Commission suggested that OPAG 1 on Agrometeorological Services for Agricultural Production in the proposed new structure for CAgM should consider establishing an ET on Weather, Climate and Farmers to enhance improved communication of agrometeorological information in different regions.

11.2 IMPACT OF AGROMETEOROLOGICAL INFORMATION ON RANGELAND AND PASTURE ECOLOGY AND MANAGEMENT (agenda item 11.2)

11.2.1 The Commission noted with satisfaction the work accomplished by the Joint Rapporteurs on the Impact of Agrometeorological Information on Rangeland and Pasture Ecology and Management. It noted with appreciation the contributions to the report made by Ms L. Lebed (Kazakhstan), Coordinator of the Joint Rapporteurs; Mr D. Rijks (Netherlands); and Mr Y. Gandega (Mauritania). The Commission agreed that the report contained useful information on the impact of agrometeorological information on rangeland and pasture ecology and management, and recommended that it be suitably edited and published as a CAgM Report.

11.2.2 The Commission recognized that the condition of pastures and rangeland was deteriorating in many parts of the world. The main causes were the increasing pressure of human and animal populations in pasture areas, the influence of climate change and of the greenhouse effect on pasture ecosystems. The Commission noted that these phenomena could accelerate the process of desertification in pasture areas in arid and semi-arid zones.

11.2.3 The Commission noted that a questionnaire had been sent to Members to provide information on the theme. It expressed its appreciation for the case studies on the impact of agrometeorological information on rangeland and pasture ecology and management in different climatic regions, contributed by the Russian Federation, Canada, Mauritania, Ethiopia, Israel, Islamic Republic of Iran, Australia, Chile, Thailand, the Philippines and Kenya. The Commission also expressed its appreciation for the contribution made in the report regarding the assessment of the desertification of pastureland and meadows in Kazakhstan related to climate change, and the possibility of adaptation.

11.2.4 Research on the nature of Kazakhstan's pastureland showed that it could become more productive under gradual climate change. To ensure this, measures for pasture adaptation needed to be taken starting immediately. Of the natural conservation methods, the first action was to determine the structure and current condition of plant cover. Vegetation that was unchangeable or slightly changeable could then be recommended for pasture rotation, coupled with the reduction of pressure from cattle grazing and haymaking. Plant cover that was moderately changeable also required pasture rotation, reduced pressure from cattle grazing and haymaking, and an improvement in pasture surface. If the plant cover structure had undergone particularly serious change due to excessive human pressure and the primary plant community had been replaced by a modified form of plant community, or if the pasture had been totally stripped by cattle, then root improvement of the pasture was recommended.

11.2.5 Riverbank ecosystems in the desert zone of Kazakhstan were currently under great human pressure due to the sudden reduction in water meadow irrigation following regulation of rivers via cascading reservoirs. These ecosystems could experience continued alteration due to climate change, mainly in the further reduction of water meadows irrigation. In such cases, the optimum water meadow flooding regime needed to be developed in order to maintain the stability of riverbank ecosystems.

11.2.6 The case studies in the report highlighted the climatic elements that had an effect on rangelands and pastures. The climatic factors and their limits for effective pasture production were given separately for temperate and cold climatic regions, for arid and semi-arid climatic regions, and for tropical and sub-tropical regions. The actual values for each country were detailed in the report. The case studies indicated the agrometeorological data and information that were provided by the relevant national institutions for rangeland and pasture management, and the benefits that were derived from the agrometeorological services provided.

11.2.7 The Commission recognized the amount of work accomplished by the rapporteurs but, given the importance and scope of the theme, it agreed that continued effort should be made to fully address the terms of reference stipulated in Resolution 11 (CAGM-XII). It therefore recommended that the proposed OPAG on Agrometeorological Services for Agricultural production consider this matter.

11.3 IMPACT OF AGROMETEOROLOGICAL ADVISORIES AND INFORMATION ON OPERATIONAL ASPECTS OF FORESTRY PLANNING, WITH EMPHASIS ON WILDLAND FIRE ECOLOGY (agenda item 11.3)

11.3.1 The Commission thanked Mr A.R. Riebau (United States) and Mr D.G. Fox (United States) for their report on the impact of agrometeorological advisories and information on operational aspects of forestry planning, with emphasis on wildland fire ecology, including the use of prescribed fire and preventing and combating

wildfires in forests and rangelands. The Commission recommended that the report be published in the CAGM Report series.

11.3.2 The Commission agreed that wildfires and prescribed fires differed in many respects. Wildfires were unplanned and usually caused by lightning, human negligence or malice. In contrast, prescribed fires were managed, planned and conducted at an appropriate time, and in a safe manner, to meet specific management objectives. For example, in grasslands, prescribed fire could increase grass nutritive quality, palatability, availability and yield, reduce hazardous fuels, suppress unwanted plants, and improve wildlife habitat. On the other hand, prescribed fires posed significant risks associated with escape from containment as well as impacts of smoke emission and transport. Hence, such fires required expert planning and management.

11.3.3 The Commission expressed concern that biomass burning was becoming much more extensive and widespread than previously thought. Since biomass burning, especially of peat bogs, could be an important driver for global atmospheric and climatic change, the Commission suggested that Members take appropriate measures to carefully monitor biomass burning activities in their countries. The Commission noted that satellite imagery was an increasingly popular method of monitoring biomass burning.

11.3.4 The Commission noted that air pollution resulting from forest and agricultural fires and fires of peat bogs could be a significant danger to public health and welfare. Recent fires in South-east Asia, especially in Indonesia, highlighted the regional and international nature of these concerns.

11.3.5 The Commission emphasized the importance of observation networks in fire meteorology and agreed that meteorological data as well as satellite imagery were needed for assessing the fire danger, fire behaviour, fire weather forecasting, etc. The Commission noted that cooperation between forestry services and NMHSs was essential in such assessments.

11.3.6 The Commission noted recent United Nations reports and advisories regarding forest fires, especially the WHO health guidelines for episodic vegetation fire events. It said that ground-based air quality monitoring and remote sensing through satellite imagery were necessary to assess air pollutant concentrations of smoke caused by vegetation fires. Satellite imagery provided information on the dryness of the vegetation, location and size of major fires and smoke plumes, energy released by fires, and air pollutants in the smoke plumes. The Commission emphasized the need for regular exchange of information on forest fires between all affected countries.

11.3.7 The Commission agreed that the information needs of agricultural meteorology and fire meteorology were convergent in many respects. As forest fires were seen as contributors to global greenhouse gas emissions, agricultural burning for waste removal was also seen as a contributor. The Commission noted that with agricultural burning, especially for forage improvement in

rangelands, adjoining forests became potential starting points for forest fires. Seasonal forecasts for fire severity were thus seen as closely related to traditional agrometeorology forecasts for such issues as drought. The Commission noted with appreciation the suggestion of the joint rapporteurs that 'fire agrometeorology', which encouraged the practice of applying meteorological knowledge and information to the stewardship of fire-managed sustainable agricultural systems, was an area of activity that should be continued with new efforts. The Commission therefore proposed that, based on the work of these rapporteurs and others, along with other recent work by the Commission, the sections on 'fire agrometeorology' in the *Guide to Agricultural Meteorological Practices* (WMO-No. 134) should be updated.

11.3.8 In this regard, the Commission recommended that the OPAG 1 on Agrometeorological Services for Agricultural Production in the proposed new structure for CAgM consider including the issue of fire agrometeorology in its work plan. It was suggested that the ET to be nominated for the *Guide* involve the authors of this report in the same way that other chairpersons of working groups and rapporteurs had been asked to collaborate in writing sections of the new *Guide*.

11.4 DESIGNING PILOT SURVEYS TO ASSESS CAgM PRODUCTS AND TO EVALUATE THEIR RELEVANCE TO USER REQUIREMENTS (agenda item 11.4)

The Commission noted with disappointment that the joint rapporteurs could not undertake the tasks assigned to them by the twelfth session of CAgM. Despite reminders from the Secretariat, there was no report on the subject. The Commission reiterated the importance of addressing the issues contained in Resolution 13 (CAgM-XII) taking into account the rapid developments in the use computer technology and the various types of models in agrometeorology. It therefore recommended that the implementation of the resolution be undertaken by the appropriate OPAG during the next intersessional period.

11.5 IMPACT OF THE USE OF METEOROLOGICAL AND CLIMATOLOGICAL DATA ON FISHERIES AND AQUACULTURE (agenda item 11.5)

11.5.1 The Commission expressed its appreciation to Mr S.G. Ngo (Viet Nam), coordinator of the Joint Rapporteurs on the Impact of the Use of Meteorological and Climatological Data on Fisheries and Aquaculture, for the work accomplished by the rapporteurs. It noted that additional material was to be included in the report in due course. The Commission agreed that when finalized, the report, which already contained useful information on the subject, should be suitably edited and published as a CAgM Report.

11.5.2 Recognizing the role of meteorological, climatological and remotely sensed data for fisheries and aquaculture, the Commission expressed its particular desire that the data and information above all be used to avoid overfishing and to safeguard the diversity and critical population of fish in the future, so that the fishing

industry would remain fully sustainable. This objective extended to full consideration of such data throughout the seasonal variation in fish population, taking into account the multi-annual nature of the reproduction cycle of many species and species-associations.

11.5.3 The Commission agreed that the climatic conditions in many countries were very favourable for aquaculture. It agreed further that the distribution of aquatic resources was associated with latitude, elevation, water-area formation, flow direction in rivers, oceanic current, weather, climate and human interference. The Commission noted that aquatic creatures could adapt to cold, cold-lukewarm, lukewarm, lukewarm-warm and warm waters. It also noted that freshwater farming was the main part of aquaculture, but that in recent years, salted freshwater (1 to 24 per cent salinity) and seawater breeding had been developing rapidly. The Commission noted that the raising of sport fish for stocking streams, rivers, ponds and other water bodies was an activity of high economic value to many countries, and relied on meteorology and climatology for its success.

11.5.4 The Commission noted that the artificial breeding of fish in pools depended on the accumulated temperature of water at sexual maturation and the water temperature at ovulation. It also noted that high mortality could be caused by a deficit of sunshine and a sharp drop in temperature. The major kinds of fishes raised stopped taking feed when the temperature dropped to around 10°C in the transition from autumn to winter.

11.5.5 The Commission agreed that fish culture in inland water bodies was seriously affected in rainy seasons, especially during tropical cyclones, when water levels rose rapidly and currents ran swiftly. Fish tended to go against the current, which resulted in a colossal loss, absent precautionary measures.

11.5.6 The Commission recognized the role of water temperature, sunshine, dissolved oxygen and other meteorological conditions in the development of fish, prawns and freshwater pearls (mussel farming), as well as in the catching of fish and prawns, the transportation of live fish and the preservation and processing of aquatic products. It agreed on the need for continued studies in aquaculture so as to better understand, among other things, the ecological conditions of growth and propagation of various aquatics; the combination of weather and climatic conditions causing stress for growth and development, malformation and high mortality of aquatic fishes; and the methods for hydrometeorological and environmental forecasts for artificial fishery cultivation. The Commission also suggested that more attention be paid to the issues of climate variability and climate change and their impacts on fisheries.

11.5.7 The Commission noted that a variety of meteorological data, including data recorded from land-based and ship-board weather stations, as well as data on freshwater level/flow, were of interest to fisheries and aquaculture. Satellite remote sensing data (sea-surface temperature, sea-surface height, chlorophyll-a, sediments, etc.) could be used to derive information on thermal fronts, sea currents, position of sub-surface

features, areas of productivity, areas of particular habitat, water clarity, etc. Derived indices such as the Southern Oscillation Index (SOI), Pacific Decadal Oscillation Index (PDO) and other indices for mean sea-level pressure (MSLP) were also finding increased applications.

11.5.8 The Commission recognized that the utility of meteorological and climatological data in a fisheries/aquacultural context could be summarized according to four main levels:

- (a) Their ability to provide information on the accessibility of a fishery, both in real time as weather forecasts, and for interpreting and summarizing previous efforts in a fishery;
- (b) Their effectiveness in predicting the spatial and temporal distribution of fish, both in aiding fishermen or aquacultural collectors to locate their targets in real time and for interpreting and summarizing data and investigating trends in fisheries;
- (c) Their utility in investigating relationships between particular aspects of a fishery or fished species, such as the environmental factors influencing variations in year class strength (YCS); and
- (d) Their use in modelling the growth of fish populations in aquaculture.

11.5.9 The Commission noted that weather forecasting contrasted with the other applications summarized above because of its easy availability, and that its importance could not be stated too strongly. It had widespread application for fishermen and collectors at all levels, and its availability could be critical for the effectiveness of most fisheries and the effective management of aquacultural ventures.

11.5.10 The Commission noted that these environmental data had sometimes been used to improve fishermen's effectiveness in the fishery. It noted that such data could also be used to improve the effective management of fisheries by providing information on the factors that caused variations in surplus production. In commercial fisheries managed according to a strategy of maximum sustainable yield (MSY), knowledge of fluctuations in surplus production was fundamental to setting catch limits in the fishery. The basis of surplus production was the level of catch over some period, quantified as indices of YCS.

11.5.11 The Commission emphasized the importance of strengthening the national hydrometeorological observation and data collection networks for aquaculture, and encouraged the enhancement of capabilities in the provision of improved meteorological services for greater economic and social benefits. In this regard, the Commission recommended the organization of workshops and training courses to exchange and disseminate methodologies on observations and measurements of environmental elements in different water bodies in aquacultural regions.

11.5.12 The Commission also noted the difficulties in the collection of observations. It suggested that the proposed OPAGs on Agrometeorological Services for Agricultural Production and on Climate Change/Variability and Natural Disasters in Agriculture consider the recommendations of this report in their future work.

11.6 CASE STUDIES ON ECONOMICALLY BENEFICIAL AGROMETEOROLOGICAL APPLICATIONS AND SERVICES (agenda item 11.6)

11.6.1 The Commission expressed its appreciation to the Secretary-General for the publication and distribution of the Agricultural Meteorology Report *WMO/CAGM Related Achievements in Agricultural Meteorology* (WMO/TD-No. 1033), compiled by Mr W. Baier (Canada), in the CAgM Report series.

11.6.2 The Commission noted with appreciation the work accomplished by the experts on the collection of case studies for economically beneficial agrometeorological applications and services, and other success stories in agrometeorology for policy matters. The Commission noted that the CAgM AWG, at its meeting in Florence, Italy (April 2001), had reviewed the progress made so far with the collection of case studies, and recommended the inclusion of existing contributions, as well as additional case studies from a variety of sources in the final report. It recommended a standard format for the presentation of the final report.

11.6.3 The Commission agreed with the proposals contained in the matrix table in the report showing a balanced approach by region, and proposed CAgM OPAGs. Of the 15 proposals for case studies, six would fall under OPAG 1 and nine under OPAG 3. There were no submissions under OPAG 2, probably because it was difficult to quantify economic benefits due to network observations, data and information management, and technical support needed to support agrometeorological services.

11.6.4 The Commission underscored the importance of the report, which clearly demonstrated the socio-economic benefits of agrometeorological application in a simple and easily understandable format. It requested the Secretariat to finalize the report for publication as a CAgM Report. It also requested that a short information brochure highlighting the socio-economic benefits of the successful case studies be prepared and distributed.

12. AGROMETEOROLOGY RELATED TO EXTREME EVENTS (agenda item 12)

12.1 EXISTING KNOWLEDGE AND INFORMATION ON ASSESSING DIFFERENT ASPECTS OF DESERTIFICATION, DROUGHT AND OTHER EXTREME METEOROLOGICAL EVENTS (agenda item 12.1)

12.1.1 The Commission noted with appreciation the work accomplished by the Working Group on Impacts of Desertification, Drought and Other Extreme Meteorological Events. The Commission complimented the chairperson, Mr S.T. Gathara (Kenya) and the other members of the group for their contributions to the various chapters of the final report. The Commission recommended that the report be suitably edited and published as a CAgM Report.

12.1.2 The Commission agreed that in light of the UNCCD definition of desertification as land degradation in arid, semi-arid and sub-humid areas resulting from various factors, including climatic variations, there was a need to create a global database on the frequency,

intensity, duration and impacts of meteorological droughts, at least for the previous 50 years, as well as a global database of indices of droughts. The Commission felt that, where possible, information should also be collected on attempts to mitigate the effects of and foster adaptation to drought. Such a global database, which must be based on a widely agreed definition of meteorological drought, would provide information that would help in understanding the role of climatic factors in land degradation at the national, regional and international levels. In this connection, the Commission made reference to information on droughts available in the International Disaster Database maintained by the Office of U.S. Foreign Disaster Assistance (OFDA) and the Center for Research on the Epidemiology of Disasters (CRED) of the Université Catholique de Louvain, Belgium. The Commission recommended that a group of experts be appointed to discuss the structure of such a global database and develop and distribute appropriate software for the creation of national databases by Members' agrometeorological services, and subsequently create a global database.

12.1.3 In order to enhance the value of the database on meteorological droughts described in paragraph 12.1.2, the Commission felt it was important that a similar database on hydrological droughts and a database on the impacts of meteorological and hydrological droughts on agriculture, livestock and forestry be developed. It was recommended that CHy examine the issue of a database on hydrological droughts and that FAO and other appropriate international organizations examine the creation of the database on the impacts of droughts on agriculture, livestock and forestry.

12.1.4 The Commission felt that NMHSs and regional centres such as ACMAD, DMCs and AGRHYMET should provide timely information on the onset, spread, intensity and expected impacts of extreme events. The Commission expressed the opinion that they should ensure that the collection, analysis and exchange of information address the needs of local communities and those of decision makers, with a view to resolving adaptation and mitigation problems. It also felt that local communities should be involved in these activities. In the provision of information on the incidence of extreme events, the Commission felt it would also be useful to provide guidance on the likely yield losses of different crops and forestry, as well as livestock.

12.1.5 In order to enhance the implementation of the UNCCD, the Commission emphasized that agrometeorological services should take an active role in strengthening drought preparedness and management strategies, including drought contingency plans, at the local, national, subregional and regional levels, which took into consideration seasonal to inter-annual climate predictions. It requested WMO to continue to promote education and training programmes and capacity building that would create public awareness about drought and desertification issues, and preparedness and response through remedial actions, in collaboration with other regional and international organizations as appropriate.

12.1.6 The Commission agreed that scientific studies should be broadened at the national and regional levels regarding the development of methods, techniques and forecasts, in particular on the medium- and long-range, related to hazardous hydrometeorological events such as drought, hot and dry winds, floods and storms, as well as desertification and degradation of biodiversity. The Commission requested WMO to continue to promote research on climate variability and on the occurrence of drought, including large-scale global atmospheric circulation, with a view to a better understanding of the climate and its variability. The Commission also requested WMO to promote research on improved preparedness for extreme events and other disasters affecting agriculture, forestry and fisheries.

12.1.7 The Commission agreed that an expert system on extreme meteorological events and meteorological information was needed to issue early warning and alleviate the effects of these events. It noted that the system should be created as soon as possible for use by NMHSs and other potential users. It recommended that during the following intersessional period appropriate measures be taken to develop and widely distribute such an expert system. One such measure would be to have the expert system covered by the appropriate ET of OPAG 3.

12.2 ASPECTS OF THE IMPLEMENTATION OF THE UNCCD (agenda item 12.2)

12.2.1 The Commission expressed its support for the continuing fruitful collaboration between WMO and the Secretariat of the UNCCD, and requested the Secretary-General to continue to support implementation activities in support of the Convention.

12.2.2 The Commission expressed its appreciation to the Secretary-General for his wide-ranging actions in support of UNCCD within the programmes and activities of WMO, such as the International Workshop on Coping with Drought in Sub-Saharan Africa: Better Use of Climate Information (Kadoma, Zimbabwe, 4 to 6 October 1999); the Expert Group Meeting on Early Warning Systems for Drought Preparedness and Drought Management (Lisbon, Portugal, 5 to 7 September 2000); and the active participation of WMO in the different sessions of the Conference of the Parties to the Convention (COP-3, COP-4 and COP-5). The Commission commended the efforts of the Secretariat in publishing and distributing a special brochure on Early Warning Systems and the proceedings of the Expert Group Meeting on Early Warning Systems for Drought Preparedness and Drought Management at COP-3 and COP-4, respectively. The Commission appreciated the initiative taken by the Secretary-General to inform the Members of the major decisions taken at COP-3, COP-4 and COP-5.

12.2.3 The Commission stressed the necessity to enhance climate monitoring networks in the fight against desertification and expressed appreciation for WMO's strong commitment to assist the UNCCD. The Commission emphasized the need to draw the attention of donors to the inadequacy of the current networks for

climate and desertification monitoring due to lack of appropriate financial support.

12.2.4 The fight against desertification and drought received a high priority in WMO's LTPs, and the Commission emphasized the need to provide strong support to the relevant activities in the AgMP, so that WMO could adequately respond to relevant articles of the UNCCD.

12.2.5 The Commission expressed its strong support for training in the fields of desertification and drought, taking advantage of the funding facilities available under the Convention. The Commission noted with appreciation the initiative taken by WMO in organizing Roving Seminars on the Application of Climatic Data for Drought Preparedness and Management for Sustainable Agriculture, in Accra, Ghana (1 to 12 November 1999) and Beijing, China (15 to 24 May 2001) in collaboration with FAO, UNEP, and the Secretariat of the UNCCD.

12.2.6 The Commission strongly urged Members to continue to strengthen and expand their activities relating to research, training and capacity building, observation data collection and exchange on matters relating to drought, early warning, preparedness and public awareness.

12.2.7 The Commission considered that studies undertaken by the Commission relating to drought and desertification, in particular on their impacts, should be continued. It felt that it should also provide advice, within its terms of reference, on matters relating to drought and to the agrometeorological aspects of the implementation of the UNCCD.

12.2.8 The Commission expressed its satisfaction with WMO's active participation in the LADA Initiative, which was held at FAO (5 to 7 December 2000). The Commission agreed that weather and climate issues should be appropriately factored into the proposed LADA project and it requested the Secretary-General to ensure WMO's continued participation.

12.3 AGROMETEOROLOGICAL ASPECTS OF DESERTIFICATION AND DROUGHT (agenda item 12.3)

12.3.1 The Commission noted that dryland ecosystems, which covered more than a third of the world's land area, were extremely vulnerable to overexploitation and inappropriate land use. It noted that more than 250 million people were directly affected by desertification, and that approximately a billion people in more than 100 countries were at risk. In this context, the fight against desertification and drought in the affected areas assumed major importance, socially as well as economically.

DESERTIFICATION

12.3.2 The Commission noted that over the past several decades, desertification had emerged as one of the major research themes in climatology. Empirical research linking precipitation levels to sea-surface conditions and associated atmospheric circulation patterns was very promising. It was felt that the continued development of global numerical climate models would also

lead to an increase in the understanding and predictability of dryland climate variations.

12.3.3 The Commission noted that rainfed arable land in the drylands was subject to a range of degradation hazards, including erosion by water and wind, sandblasting of crops, emerging seedlings on arable land and rangeland, deposition of windblown sand, plant nutrient depletion in the soils, surface sealing or crusting, depletion of aquifers and salinization in some areas. These hazards were generally thought to be more severe than in well-watered regions, for several reasons.

12.3.4 The Commission expressed its concern with the possible impacts of enhanced temperatures in dryland ecosystems due to increases in atmospheric concentrations of greenhouse gases. It was felt that projected increases in evapotranspiration rates and decreased soil moisture levels could further exacerbate the threat of desertification in the dryland areas, especially in developing countries. The Commission urged the Members to vigorously promote agrometeorological strategies to arrest land degradation.

12.3.5 The Commission noted that many irrigation projects, past and present, were severely affected by secondary salinization or sodication and waterlogging. Considering the importance of irrigation in achieving sustainable agriculture and rural development in drylands, the Commission emphasized the importance of preventing and controlling waterlogging and secondary salinization or sodication in irrigation schemes by improving irrigation and drainage systems and improving irrigated farming systems to increase productivity. For prevention and reduction of salinization in connection with irrigation, the Commission felt that water balance studies to predict drainage requirements were important, and urged Members to place emphasis on well-designed water balance studies.

DROUGHT

12.3.6 The Commission expressed its concern with the widespread occurrence of droughts in 2001 and 2002, and the impacts of these droughts on food and fodder production in the dryland regions of the world. The frequency of meteorological drought was projected to increase for some regions in the future as a result of increasing concentrations of greenhouse gases. Evidence from around the world, although sketchy, illustrated that there was an escalating trend of losses associated with drought in both developing and developed countries. Also, the complexity of impacts was increasing. The Commission stressed that investments in preparedness and mitigation would pay large dividends in reducing the impacts of drought.

12.3.7 The Commission suggested that greater attention be directed to reducing risks associated with the occurrence of droughts through the introduction of planning to improve operational capabilities (i.e. climate and water supply monitoring and building institutional capacity) and mitigation measures aimed at reducing drought impacts. In this connection, the Commission emphasized the importance of improved understanding

of drought climatology in the drought-prone regions (i.e. the probability of drought at different levels of intensity and duration) and the establishment of comprehensive and integrated early warning systems that incorporated climate, soil and water supply factors such as precipitation, temperature, soil moisture, snow pack, reservoir and lake levels, ground water levels and stream flow. The Commission also pointed to the need for an increased emphasis on drought policy and the development of regional drought preparedness networks. It noted that drought plans provided the framework for improved coordination within and between levels of government. It was felt that, through drought plans, the risks associated with drought could be better defined and addressed with proactive mitigation and response programmes. The drought planning process also provided the opportunity to involve numerous stakeholders early and often in plan development. The Commission felt that timely and reliable data and information must be the cornerstone of effective drought policies and plans. In this regard, it recommended that the proposed OPAG 1 on Agrometeorological Services for Agricultural Production convene an ET on Strengthening Information and Dissemination Networks, Including Monitoring and Early Warning Systems.

12.3.8 The Commission felt that the year-to-year variability of rainfall in drylands and of its distribution over the rainy season entailed a great risk to farmers, so that the cost of inputs applied at the start of the crop season such as fertilizer, or indeed seed or labour for land preparation, might not be recovered by the crop yield in low-rainfall years. Hence, the Commission urged Members to place emphasis on agrometeorological studies that helped assess potentials and constraints in dryland farming and identify agricultural options to safely increase cropping intensity and yields, decrease risks and offer other advantages while reducing land degradation. Agrometeorological inputs were needed in developing the following agricultural techniques, among others: improved and diversified farming systems with appropriate inclusion of livestock, multipurpose trees and shrubs; arboriculture, including adapted fruit trees; improved crop rotation; establishment of shelter belts; revegetation of watersheds; sand dune fixation; supplementary irrigation; soil and water conservation techniques; and water harvesting. In this regard, the Commission recommended that the proposed OPAG 3 on Climate Change/Variability and Natural Disasters in Agriculture convene an ET on the Reduction of the Impact of Natural Disasters and Mitigation of Extreme Events in Agriculture, Forestry and Fisheries.

13. TRAINING AND EDUCATION MATTERS (agenda item 13)

13.1 EVALUATION OF TRAINING, EDUCATION AND CAPACITY BUILDING PROJECTS/PROGRAMMES IN AGROMETEOROLOGY (agenda item 13.1)

13.1.1 The Commission noted with satisfaction the work accomplished by the Joint Rapporteurs on Evaluation of Training, Education and Capacity Building

Projects/Programmes in Agrometeorology, Including Textbooks, Information on the World Wide Web and Other Published Training Materials. Their assignment was to assess the status of training and education throughout WMO Member countries. The rapporteurs decided as a first step to conduct a preliminary pilot survey only in the SADC region of Africa. The Commission complimented the coordinator, Ms S. Walker (South Africa), and the other rapporteur, Mr E. Mukhala (Zambia) for the final report.

13.1.2 The Commission agreed that for agrometeorologists to maintain a high level of output and service to the agricultural community, it was vital that they continue to receive in-service training following their initial education. It noted that there were too few trained Class I agricultural meteorologists in each country in the SADC region to effectively serve the agricultural community in general throughout any one of those countries.

13.1.3 The Commission took note of the research and operational topics highlighted in the survey and agreed that there should be a wide variety of training for both professional and technical staff in the region. It noted that training should be well balanced with lectures and hands-on practical experiences. Attention should also be given to the use of short-term (daily, weekly, decadal) weather data for operational agrometeorology such as irrigation scheduling and disease outbreak. Research and operational topics included items such as:

- (a) Analysis of rainfall variability and its application in risk assessment;
- (b) Crop-weather modelling (including herbage production in rangelands);
- (c) Application of remotely sensed data and GIS for agrometeorology;
- (d) Operational agrometeorology including the use of currently available/used software packages;
- (e) Word processing and statistical techniques;
- (f) Agrometeorology concepts, e.g. computation of PET, soil water content, etc.;
- (g) Communication concepts, e.g. how to communicate, prepare and make a presentation;
- (h) Rainfall estimates and Water Requirement Satisfaction Index (model used in estimation of crop yield for early warning in food security);
- (i) Manipulation of images (algebra); and
- (j) World Wide Web software.

13.1.4 In light of the above, the Commission urged Members to promote the use of modern technology in the teaching methods in agrometeorology. This would mean the development of CAL modules on various agrometeorology topics. The application of CAL on CD format would mean that the training could be spread out over the entire region as many of the offices did have computers available. This was specifically applicable to agrometeorology, where there were so few personnel in each country at each level.

13.1.5 The Commission agreed that training in agrometeorology in various institutions should also

address operational issues with regard to early warning for food security and fire danger. It was deemed critical that more personnel be trained in modern methods and technology so as to be able to reach a larger proportion of the farming community. The Commission felt that agrometeorologists needed to know the models currently used for yield forecasting, and software such as ArcView, WinDisp, AgrometShell (WRSI), etc.

13.1.6 The Commission stressed that training and education in agricultural meteorology should continue to be a matter of great importance to Members, particularly in developing countries, and should therefore be given high priority. The Commission noted that the evaluation of existing training, education and capacity building programmes in agrometeorology so far undertaken was not comprehensive enough to permit the preparation of a strategic plan for further in-service training for the benefit of all Members. The Commission therefore agreed that the matter be further addressed under the appropriate OPAG arrangement, keeping in mind that the ultimate goal was to provide support to agrometeorological services.

13.2 WMO ACTIVITIES ON TRAINING IN AGRICULTURAL METEOROLOGY (agenda item 13.2)

GENERAL

13.2.1 The Commission examined the information on the activities of the ETRP of relevance to CAgM since its previous session. In noting with appreciation the progress achieved and the assistance provided to Members in developing their trained manpower resources, the Commission stressed that education and training activities were fundamental for the development of agricultural meteorological services in developing countries.

13.2.2 The Commission was pleased to note Chapter 6.6 of the Fifth WMO Long-term Plan (2000-2009) (WMO-No. 908) as adopted by Thirteenth Congress, and urged its Members to ensure that all necessary actions were taken to meet the objectives of the Plan.

EC PANEL OF EXPERTS ON EDUCATION AND TRAINING

13.2.3 The Commission was informed that the EC Panel of Experts on Education and Training considered the views and proposals from rapporteurs and working groups on education and training from several technical commissions, including CAgM, through its joint Rapporteurs on Impact of Training in Agrometeorology. The Commission, in line with the Panel's suggestions, recommended strengthening the present interactions with the Panel and the Secretariat on educational issues relevant to agrometeorology.

HUMAN RESOURCES DEVELOPMENT

13.2.4 The Commission reaffirmed the importance of the human resources development programme in assisting the Secretariat and NMHSs, particularly in developing countries, to plan and mobilize financial and other resources to meet Members' training needs. The

Commission expressed the hope that the results of the last survey on Members' training needs could help in a proper identification of the requirements of Members in the area of agrometeorology.

TRAINING ACTIVITIES

13.2.5 The Commission noted that six training events of interest to its Members had been organized by WMO since its previous session. It also noted that 16 other training events had been organized and hosted by national or international institutions, with WMO acting as co-sponsor or providing partial financial support.

13.2.6 The Commission noted with satisfaction that the quadrennial WMO Symposium on Continuing Education and Training in Meteorology and Operational Hydrology had been successfully held in Tehran, Islamic Republic of Iran in November 1999. The Commission agreed that the recommendations of the Symposium were of considerable value as a guide to Members in their efforts to strengthen their human resources by improving their staffs' skills and knowledge through continuing education and training.

13.2.7 The Commission noted with satisfaction the information on the activities of the Training Library and the use made of its services by Members. It also appreciated the continuous updating of the VTL in an effort to provide the latest and most suitable available training material through the Internet, and recommended that those actions be encouraged and continued.

REGIONAL METEOROLOGICAL TRAINING CENTRES (RMTCs)

13.2.8 The Commission expressed its gratitude to WMO's RMTCs that were offering training in agrometeorology, and expressed the hope that ways and means would continue to be found to support agrometeorological training at the RMTCs. The Commission noted with appreciation the training events on agrometeorology held at the RMTC in Florence, Italy, co-sponsored by WMO. In urging its Members to make the maximum use of the training programmes offered by the RMTCs, the Commission agreed with Thirteenth Congress about the need for more emphasis to be placed by RMTCs on training requirements for specialized courses in various subject areas. In this connection, Members were requested to assist RMTCs in organizing courses, using such ways and means as the provision of instructors for short-term assignments, the provision of relevant training materials, and other sorts of assistance under bilateral or multilateral arrangements.

NEW WMO CLASSIFICATION OF METEOROLOGICAL AND HYDROLOGICAL PERSONNEL

13.2.9 The Commission noted that Thirteenth Congress had endorsed the new WMO classification of meteorological and hydrological personnel and agreed that its implementation should be gradual, recognizing that some Members could require a longer transition period. Still, the Commission felt that this implementation should not exceed four years.

TRAINING PUBLICATIONS

13.2.10 The Commission was pleased to note the release in 2001 of the WMO training publication *Lecture Notes for Training Agricultural Meteorological Personnel* (WMO-No. 551), prepared by Mr J. Wieringa (Netherlands) with the assistance of Mr J. Lomas (Israel). The Commission also noted that the new edition of *Guidelines for the Education and Training of Personnel in Meteorology and Operational Hydrology* (WMO-No. 258), Vol. I-Meteorology, was issued in December 2001 and distributed to all WMO Members, and that Vol. II-Hydrology was under way and expected to be reviewed and prepared for distribution by the end of 2002. The Commission suggested that lecture notes in the publications should be tailored to user needs in different regions.

EDUCATION AND TRAINING FELLOWSHIPS

13.2.11 The Commission noted with appreciation that WMO continued to award fellowships in various fields, including agrometeorology, to assist Members in the strengthening and development of human resources in their NMHSs. In this connection, the Commission adopted [Recommendation 2](#).

13.2.12 The Commission noted with appreciation the cost-sharing tripartite arrangements for optimizing the use of limited VCP and regular budget fellowship resources, in which the host country would waive or meet tuition fees, the beneficiary country would meet the cost of international travel of its candidates, and WMO and VCP donors would meet the stipend or living expenses of the fellows concerned. The Commission considered these arrangements cost-effective and requested the Secretary-General to continue to promote further the implementation of these arrangements for the benefit of all concerned.

13.3 SYMPOSIA, SEMINARS AND WORKSHOPS IN AGRICULTURAL METEOROLOGY (agenda item 13.3)

13.3.1 The Commission noted, with appreciation, the large number of seminars and workshops organized by WMO, including eleven training seminars, three international workshops, one inter-regional workshop, four expert group meetings and one consultants meeting, on a wide range of topics related to agricultural meteorology. It noted in particular, the holding of:

- (a) Two Roving Seminars on Instrumentation and Operation of Automatic Weather Stations for Applications in Agrometeorology in Casablanca, Morocco, 28 June to 9 July 1999 and Tehran, Islamic Republic of Iran, 27 November to 8 December 1999;
- (b) An RA III/IV Expert Group Meeting on Extreme Events in Caracas, Venezuela, 12 to 14 July 1999;
- (c) Two Roving Seminars on Crop-Yield Weather Modelling in: Pune, India, 19-30 July 1999; and Ljubljana, Slovenia, 6-17 September 1999;
- (d) An International Workshop on Climate Prediction and Agriculture (CLIMAG) in Geneva, Switzerland, 27 to 29 September 1999;

- (e) An International Workshop on Coping with Drought in sub-Saharan Africa: Best Use of Climate Information in Kadoma, Zimbabwe, 4-6 October 1999;
- (f) A Consultants Meeting to prepare the background document for the workshop to improve agrometeorological bulletins in Geneva, Switzerland, 1-2 November 1999;
- (g) Two Roving Seminars on Data Management for Applications to Agriculture in Tashkent, Uzbekistan, 8 to 19 November 1999 and for the SADC countries in Pretoria, South Africa, 19 to 30 June 2000;
- (h) Two Roving Seminars on the Application of Climatic Data for Drought Preparedness and Management of Sustainable Agriculture in Accra, Ghana, 1 to 12 November 1999 and Beijing, China, 15 to 24 May, 2001;
- (i) A Roving Seminar on Geographical Information Systems (GIS) and Agroecological Zoning in Kuala Lumpur, Malaysia, 8 to 19 May 2000;
- (j) An International workshop on Carbon Sequestration, Sustainable Agriculture and Poverty Alleviation in Geneva, Switzerland, 30 August to 1 September 2000;
- (k) An Expert Group Meeting on Early Warning Systems for Drought Preparedness and Drought Management in Lisbon, Portugal, 5-7 September 2000;
- (l) An Expert Group Meeting on Software for Agroclimatic Data Management in Washington DC, USA, 16 to 20 October 2000;
- (m) Two Seminars on Radio and Internet (RANET) for Diffusion of Agrometeorological Information and Monsoon Research in Pune, India, 30 and 31 July 2001;
- (n) An Inter-Regional Workshop on Improving Agrometeorological Bulletins in Bridgetown, Barbados, 15 to 19 October 2001;
- (o) An Expert Group Meeting on Internet Applications for Agrometeorological Products in Washington DC, USA, 6 to 9 May 2002.

13.3.2 The Commission congratulated the Secretary-General for bringing out the proceedings of the different international workshops and expert group meetings within a short time after their organization and for ensuring the timely distribution of these proceedings to the members. These publications are of great interest to the members and they serve as a very useful source of reference in their work.

13.3.3 The Commission recorded its appreciation for the participation and collaboration of several international, regional and national organizations in WMO activities related to training in agricultural meteorology, in particular the United States Department of Agriculture (USDA), the Institute of Agrometeorology and Environmental Analysis for Agriculture (Italy), the Global Change System for Analysis, Research and Training (START), FAO, UNDP/UNSO and UNEP. The Commission requested that the Secretary-General continue to seek co-sponsorship for the organization of such events.

13.3.4 The Commission, in particular, was pleased with the initiative taken in the development of the contents for new roving seminar series in the intersessional period, the preparation of training manuals for each of them and the organization of these roving seminars in different locations in Regional Associations I, II, V and VI.

13.3.5 The Commission expressed its appreciation to WMO and the co-sponsors including: the Asia-Pacific Network for Global Change Research (APN), the Centre Technique de Coopération Agricole et Rurale – Technical Centre for Agricultural and Rural Co-operation (CTA); the Canadian International Development Agency (CIDA); the Food and Agriculture Organization of the United Nations (FAO); the Fondazione per la Meteorologia Applicata (F.M.A.) and the Laboratory for Meteorology and Environmental Monitoring (La.M.M.A.); the International START Secretariat (START); Météo-France; the Ufficio Centrale di Ecologia Agraria; the United Nations Environment Programme (UNEP) and the United States Department of Agriculture (USDA) for organizing the International Workshop on Reducing the Vulnerability of Agriculture and Forestry to Climate Variability and Climate Change in Ljubljana, Slovenia from 7 to 9 October 2002, which permitted increased participation of members from developing countries in the session. The Commission requested the Secretary-General to continue to seek co-sponsorship for the organization of such events in conjunction with future sessions of the Commission.

13.3.6 The Commission noted the symposia, seminars and workshops held during the intersessional period. The Commission requested the Secretary-General to continue to provide full support for the organization of such events. The Commission proposed the following topics of current interest for the organization of such events within the available financial resources.

Symposia/workshops:

- (a) Strengthening operational agrometeorological services at the national level (in collaboration with FAO);
- (b) Workshop on Improving Agrometeorological Bulletins (RA I);
- (c) Workshop on Improving Agrometeorological Services for Farmers (RA II);
- (d) Workshop on Applications of Climate Information for Sustainable Agriculture.

Training events

- (a) Analysis of climatic data to provide practical information to farmers and agricultural community;
- (b) Fire danger forecasting for agriculture, pastures and forests;
- (c) Remote sensing data interpretation for applications in agricultural meteorology;
- (d) Communication with media and farmers (using participatory rural appraisal);
- (e) Roving seminar on information technology related to Internet for agrometeorology;
- (f) Roving seminar on decision scenario building process for forecasting information;

- (g) Applications of crop modelling for crop yield prediction;
- (h) Roving seminar on GIS and remote sensing applications in agriculture (RA I);
- (i) Roving seminar on climatic mapping for agriculture;
- (j) Roving seminar on the strategies for practical utilization of agrometeorological information and seasonal forecasts in the daily activities and planning in agriculture.

14. COLLABORATION WITH INTERNATIONAL ORGANIZATIONS (agenda item 14)

The Commission expressed its appreciation to the Secretariat for the initiative taken in continuing and establishing collaborative activities with a number of international organizations in implementing the AgMP and to the different international organizations for their collaboration.

14.1 UNEP AND IPCC

14.1.1 The Commission noted with appreciation the collaboration between WMO and UNEP in the organization of roving seminars and on matters relating to drought and desertification. The Commission supported the continuation of the collaborative activities between the two agencies for the implementation of the United Nations Convention to Combat Desertification (UNCCD).

14.1.2 The Commission noted with appreciation the Third Assessment Report (TAR) released by the WMO/UNEP Intergovernmental Panel on Climate Change (IPCC) in 2001. The key reports of interest to CAgM are the impacts, adaptation and vulnerability report, and the synthesis report. The impacts, adaptation and vulnerability report has noted many issues of importance to agriculture and food security. In this connection, the Commission agreed that increased attention should be given to the degradation of soil and water resources, the contribution of the forestry industry to global warming and its mitigation, the impact of the projected increase in extreme events such as heat stress on crops and livestock and adaptation strategies. The Commission noted that adaptation has the potential to reduce adverse effects of climate change and can often produce immediate ancillary benefits, but will not prevent all damages. The Commission recommended that members acquaint themselves with relevant chapters of the four IPCC reports.

14.1.3 The Commission recommended that the Management Group in the new structure of CAgM should continue to have a member designated to review the activities of IPCC of interest to CAgM and to inform the members on the progress of activities of IPCC accordingly. It thanked Dr M.J. Salinger for providing the necessary link with IPCC and for submitting appropriate periodic reviews on its activities, which were included in the circular letters of the president to members of CAgM.

14.2 FAO

14.2.1 The Commission commended both WMO and FAO for the many fruitful collaborative activities

undertaken during the intersessional period, in particular, the participation at technical meetings of mutual interest, including meetings of working groups of CAgM, sessions of the Committee on World Food Security and the International Climate Agenda, training programmes and data exchange.

14.2.2 The Commission noted with appreciation the active collaboration between WMO and FAO in the organization of the Roving Seminars on the Application of Climatic Data for Drought Preparedness and Management of Sustainable Agriculture and on Crop-Yield Weather Modelling. The Commission supported the plans of the Secretariat to organize several of these seminars in different countries during the next financial period. The Commission encouraged the members to take advantage of the roving seminars to create better awareness and interest with the user services at the national level.

14.2.3 The Commission was pleased to note the initiative taken by WMO to organize, in collaboration with FAO, the International Fund for Agricultural Development (IFAD), and the United States Agency for International Development (USAID), the International Workshop on Carbon Sequestration, Sustainable Agriculture and Poverty Alleviation which was held in Geneva (30 August to 1 September 2000). Noting that carbon sequestration is an important agrometeorological mitigation strategy to reduce global warming, the Commission reiterated the necessity to perfect methods and tools that are cost effective, efficient, and relevant for reliable measurement and verification of carbon sequestration and make them more accessible and adaptable to developing countries.

14.2.4 The Commission expressed its satisfaction with WMO's active participation in the International Workshop on Dryland Land Degradation Assessment (LADA) Initiative, which was held at FAO (5 to 7 December 2000). The Commission agreed that weather and climate issues should be appropriately factored into the proposed LADA project and it requested the Secretary-General to ensure WMO's continued participation in the LADA project.

14.2.5 The Commission noted with appreciation the additional information provided by Mr R. Gomme, representative of FAO, regarding the new initiatives in FAO on addressing climate change impacts in agriculture and the activities in the area of agricultural meteorology.

14.3 UNDP/UNSO

The Commission noted with appreciation the collaboration between WMO and UNDP/UNSO to strengthen drought preparedness and mitigation efforts in Africa by conducting farmer-focused surveys in six countries, including Ethiopia, Kenya, Mali, Mozambique, Senegal and Zimbabwe, to appraise the types of climate products and services provided at the institutional level, the delivery system of that information to farmers, and its level of adoption and application in decision-making. The Commission noted the outcomes of the International Workshop on 'Coping

with Drought in Sub-Saharan Africa: Best Use of Climate Information', organized by UNDP/UNSO and WMO in Kadoma, Zimbabwe in October 1999. It fully supported the continued collaboration with UNDP/UNSO in the implementation of pilot projects in Africa to promote the best use of climate information at the farm level.

14.4 CGIAR INSTITUTES

The Commission placed on record its appreciation for the contribution to the activities of the Commission made by the IARCs under the CGIAR, in particular ICARDA, ICRISAT, IITA and ICRAF.

14.5 ACMAD

The Commission noted the collaborative activities of WMO with ACMAD, located in Niger. It expressed its appreciation to ACMAD for co-sponsoring the Roving Seminar on Instrumentation and Operation of Automatic Weather Stations for Applications in Agrometeorology, held in Casablanca, Morocco (28 June to 9 July 1999); the Roving Seminar for the SADC Countries on Data Management for Applications to Agriculture, held in Pretoria, South Africa (19 to 30 June 2000); and two Seminars on RANET for Diffusion of Agrometeorological Information and Monsoon Research, held in Pune, India (30 and 31 July 2001). Recognizing the importance of agrometeorological applications to promote sustainable agricultural production in Africa, the Commission supported the continued participation of WMO in ACMAD's SACOM.

14.6 IGBP/START

14.6.1 The Commission was pleased to note the initiative taken by WMO to collaborate closely with START of the IGBP, WCRP and the IHDP in the CLIMAG project. It congratulated the Secretariat on the successful organization of the International Workshop on CLIMAG in Geneva (September 1999), and for the timely publishing and distribution to all the Members of the Proceedings of the CLIMAG workshop. The Commission agreed that potentially significant enhancement in agricultural production was possible using strategies based upon climate forecast information, and that implementation of CLIMAG should occur on a regional scale tailored to the specific climatological and agricultural regimes of specific areas. The Commission was pleased to note that the recommendation of the CLIMAG workshop to develop CLIMAG demonstration projects from existing pilot activities in Africa, Asia-Pacific and the Americas had already been implemented in Africa and South Asia. The Commission suggested that multidisciplinary teams including experts in climate, crop and economic modelling, as well as agronomic experts at various levels including local farmers, should be involved in the regional CLIMAG demonstration projects. Noting that the partnership between START, WMO, IRI, APN, IAI and other relevant organizations was an essential ingredient underpinning the efforts of these multidisciplinary teams, the Commission encouraged WMO's continued participation in the activities of CLIMAG.

14.6.2 The Commission noted with appreciation WMO's participation in the Task Force on CLIMAG. Noting that the primary goals of START were to promote regional global climate change science and to enhance the capacity of individuals, institutions and developing regions to undertake such research, the Commission encouraged WMO's continued participation in the activities of START committees.

14.7 EUROPEAN UNION

The Commission noted with appreciation WMO's participation in the COST Action 718 on 'Meteorological Applications for Agriculture' of the Commission of the European Communities. Noting that the emphasis of the Action was to improve the meteorological applications to agriculture and environment protection, and demonstration of the practicality of such applications to management and planning of the agriculture sector at the national, regional and local levels, the Commission requested the Secretary-General to ensure WMO's continued participation in the activities of COST Action.

14.8 OTHER ORGANIZATIONS

14.8.1 The Commission noted with appreciation that many international organizations had come forward to co-sponsor the International Workshop on Reducing the Vulnerability of Agriculture and Forestry to Climate Variability and Climate Change, organized by WMO in conjunction with this session. The Commission noted that this had greatly helped Members from many developing countries participate in the workshop as well as the session.

14.8.2 The Commission recommended that collaborative activities with international organizations be actively pursued during the following financial period.

15. REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION AND OF RELEVANT EXECUTIVE COUNCIL RESOLUTIONS (agenda item 15)

The Commission examined the resolutions and recommendations adopted at its previous sessions that were still in force at the time of the thirteenth session. It also examined those Executive Council resolutions based on previous recommendations of the Commission that were still in force. The decisions of the session were incorporated in [Resolution 1 \(CAGM-XIII\)](#) and [Recommendation 3 \(CAGM-XIII\)](#).

16. STRUCTURE OF CAGM AND ESTABLISHMENT OF OPAGs (agenda item 16)

16.1 The Commission noted the discussions at Thirteenth Congress and at the fifty-second and fifty-third sessions of the Executive Council on WMO structure, including that of the technical commissions. Congress recognized that, given the rapidly changing world with rapidly changing requirements and institutions, it was essential that the overall review of the WMO structure and operating mode continue.

16.2 The Commission noted the comments of the fifty-third session of the Executive Council that the WMO structure and operating mode should be able to assure and facilitate the realization of the LTPs, together with their vision, desired outcomes, strategies and associated goals, as well as those of the related WMO Programmes. It was felt that there should be greater creativity and innovation, but that the good features of existing arrangements should be maintained.

16.3 The Commission recognized the comments of the Council that the introduction by CBS of OPAGs and small groups such as ETs and ICTs yielded positive results in achieving WWW objectives, and in improving and strengthening links with other commissions and with the regional associations. The Commission also noted the suggestion of the Council that such experience could be helpful and useful for other commissions, but that it was up to each commission to consider its appropriateness, in all or in part, to its particular requirements.

16.4 In this connection, the Commission noted with interest that CCI-XIII had adopted a new working structure and established a CCI MG and three OPAGs.

16.5 The Commission reviewed its performance over the previous intersessional period, and considered that significant progress had been achieved in several areas, assisting many Members in the process. These included the publication of important reports on Software for Agroclimatic Data Management, along with a CD-ROM containing the free software package, Drought Preparedness and Drought Management, Improving Agrometeorological Bulletins and Internet Applications for Agrometeorological Products. It noted that a common characteristic of these activities was the establishment of task-focused teams of experts to deal with particular issues or projects, with committed and active Secretariat support.

16.6 The Commission recognized the valuable work carried out by working groups and rapporteurs appointed at its previous session and through the meetings of the AWG. However, it noted that many rapporteurs had reported only at the end of the intersessional period, some had not even submitted a report, and only a few had made any recommendations for the Commission to consider. The Commission agreed that a new structure must provide for closer guidance and coordination mechanisms for all rapporteurs, and for the review of outputs, including reports submitted for publication. The Commission agreed that tasks identified for individual rapporteurs should be focused on the specific outputs required by the Commission, and that more careful consideration was needed when identifying rapporteurs, who might be considered 'one-person' ETs. The Commission further agreed that the number of individual rapporteurs and Experts must be related to its programme of work and priorities, taking close account of the roles and membership it established for other working teams. Additionally, the Commission felt that the number of appointments should be commensurate with what was manageable by the resources available within the Commission's structure. Noting that its priorities included capacity building in the NMHSs and the

Regions, the Commission considered that individual rapporteurs could play a significant role in providing reports on national and regional implementation requirements and problems.

16.7 The Commission took into account the increasing role of the regional associations in the development and implementation of the AgMP. It welcomed the activities and outputs of the Working Groups on Agricultural Meteorology established by some regional associations, and urged others to create such groups, noting that for the WWW, Planning and Implementation Groups existed for each Region. Regional coordination was considered important with regard to meeting the needs for services to support sustainable agriculture, rangelands, forestry and livestock systems, production of advisories and warnings for operational activities during the growing season, and services relating to conservation of natural resources and combating drought and desertification. The Commission concluded that in any new structure its linkages with the regional associations must be strengthened by inviting direct representation of the regions to its Management Group, and to teams concerned with the implementation of its programmes. The Commission requested its Management Group to give further early consideration to maximizing the value of linkages to the regional associations.

16.8 The Commission recognized that the challenge for CAgM was to design a working structure and to refocus the activities that would contribute effectively to the AgMP in the light of WMO's broadened responsibilities, directives from Congress and the Executive Council, and demands for improved agrometeorological services from NMHSs and WMO regional associations. The Commission agreed that proposals for any new structure should be based on the following guiding principles:

- (a) To improve efficiency and effectiveness of the work of the Commission in response to new challenges, including UNCED, and international conventions and agreements;
- (b) To cope with funding restrictions under the assumption that the resources allocated to CAgM activities would not change;
- (c) To strengthen the AWG and empower the group to guide the implementation of the work programme on a project management basis; and
- (d) To contribute effectively to the AgMP with a 21st century outlook in a cost-effective manner.

16.9 The Commission noted that the CAgM AWG, at its meeting in Florence, Italy, (2 to 5 April 2001), had paid special attention to the need for restructuring the Commission in order to respond effectively to new challenges. After careful consideration of the current CAgM structure, its vision statement ('CAgM - Towards 2000 and Beyond'), and the new CBS OPAG structure, the AWG agreed that the OPAG concept would improve the effectiveness and efficiency of CAgM in responding to challenging priority issues. The AWG proposed that the CAgM OPAG structure would have the following components: an MG, OPAGs, ETs and ICTs.

16.10 The Commission noted with appreciation that the president had presented the OPAG structure to the fifty-third session of the Executive Council during his presentation on the AgMP. The Council expressed support and full agreement for adoption of the new OPAG structure for CAgM, and strongly urged other commissions to consider the OPAG concept as well. In discussing the proposal for five OPAGs, the Council expressed concern that this could be too cumbersome, noting that CBS had only three OPAGs with a number of ETs and ICTs in each OPAG. The recommendation was to limit the CAgM OPAGs to three, since policy issues and capacity building were common to all focus areas. It was also recommended that team names be short and concise.

16.11 The Commission concluded that the most effective, flexible and responsive means of carrying out well-defined CAgM tasks would be a system of small teams and rapporteurs, complemented by suitable ways to inform and involve all CAgM Members in the process. The Commission agreed that its activities and teams should be grouped under three programme areas, as described in paragraph 16.12 of this report, and that the activities in each should be handled by OPAGs, whose members would be regularly consulted and informed by the chairperson of each group by e-mail or correspondence. This would achieve a broad ownership through the involvement of experts from among different members. The Commission noted that the success of this system would depend on the selection of an active and committed chairperson and co-chairperson for each OPAG, for whom there would be a need for committed Secretariat support. The role of the chairpersons would be to coordinate the work of the teams and rapporteurs established by the Commission to carry out specific tasks derived from the overall work programmes. ETs would be based mainly on the expertise needed from within the Commission and other bodies for developing proposed projects, solutions or outputs, and for which specific knowledge would be required. ICTs would also be required and would be based mainly on regional representation, with a focus on operational and implementation aspects.

16.12 The Commission agreed to group its activities under three main programme areas for the next intersessional period. These are outlined below and in more detail in [Annex II](#) to this report:

- (a) Agrometeorological Services for Agricultural Production, focusing on operational and research activities that promote agricultural production;
- (b) Support Systems for Agrometeorological Services, concentrating on network observations, data and information management, and technological developments needed to advance the production of services; and
- (c) Climate Change/Variability and Natural Disasters in Agriculture, dealing with priority issues affecting agriculture, such as climate change, climate variability and natural disasters.

The Commission agreed that each programme area should include both operational and research components.

16.13 The Commission agreed that coordination of two-priority cross-programme focal areas such as support systems for policy-making for agrometeorological services, as well as training, education and extension, would be assumed by the MG.

16.14 The Commission emphasized that the essential criterion for establishing ETs and defining their membership was the achievement of the identified tasks; for the ICTs it was the assessment of how programmes should be implemented worldwide. The Commission identified the main elements of the work programme and agreed on the terms of reference of teams and rapporteurs of each OPAG as listed in [Annex II](#). The Commission also requested each of the OPAG chairpersons to ensure that specific work areas described in respective parts of the final report of this session be adequately addressed. The Commission further agreed that, taking into account its priorities and available resources, not all teams and rapporteurs could or needed to be activated immediately. The Commission established membership and requested early activation of the ICTs, ETs and rapporteurs listed in [Annex III](#). With regard to the other teams, rapporteurs and work programmes, the Commission authorized the president, with assistance from the MG and the Secretariat, to complete or determine appropriate membership and initiate activities on a priority basis. The Commission also urged that special efforts be made to explore extrabudgetary resources to support the work programme.

16.15 The Commission agreed that the MG would replace the present AWG. The MG would be strengthened and empowered to assess and guide OPAG activities and coordinate the priorities of the teams. Furthermore, this proactive structure would create more functional responsibility for specific tasks. For example, linkage to the AgMP and other commissions would be coordinated by the president. Other members of the MG would be designated as coordinators for specific tasks, including links to international bodies (e.g. IPCC), to research activities, to operational activities, and to WMO regional associations. However, the Commission considered that this should be accomplished within an overall membership of 10, inclusive of the president, vice-president and chairpersons of the Commission's OPAGS. In this respect, it noted consistency with the views expressed by the fifty-second session of the Executive Council with respect to limiting the size of the AWGs, and with the endorsement of Congress concerning the need to include regional representatives in the AWGs, within available resources.

16.16 The Commission noted again that any structure, together with its schedule of activities and meetings, would have to operate within the limits of available funds. It agreed that priority areas identified for support must be consistent with the priorities identified in WMO's LTPs, and mandated the Commission's MG to ensure that this would be so. The Commission

highlighted the need to develop linkages with international and national agencies to mobilize extrabudgetary resources for the activities and meetings.

16.17 The Commission agreed and adopted the new working structure of the Commission through [Resolution 2 \(CAGM-XIII\)](#), established a CAGM MG by adopting [Resolution 3 \(CAGM-XIII\)](#), and established the OPAGs and selected their chairpersons and co-chairpersons by adopting [Resolution 4 \(CAGM-XIII\)](#).

17. OPEN FORUM (agenda item 17)

17.1 Three sessions of the open forum were held on 15, 16 and 17 October 2002, which gave an opportunity to participants to share their experiences with others. The forum also provided an opportunity to inform the Commission on problems of a specific nature in a country or in a region.

17.2 The following topics were presented at the open forum:

- (a) C. Stigter - The International Society for Agricultural Meteorology (INSAM)
- (b) B. Lee - Core Agrometeorological Stations in Asia
- (c) A. Kleschenko - Drought Center in Russia
- (d) K. Davidson - Structure and Organization of WMO
- (e) R. Motha - Structure of the CAGM
- (f) P. Doraiswamy - Remote Sensing Application in Agrometeorology
- (g) Y. Zhao - Combining Crop Growth Models and Remote Sensing Data for Crop Yield Prediction
- (h) R.P. Motha - World Agricultural Meteorological Information System (WAMIS)
- (i) R. Stringer - Obtaining Feedback from Farmers
- (j) M.J. Salinger - Regional Climate Centres

17.3 WMO agrometeorology publications were exhibited.

18. ELECTION OF OFFICERS (agenda item 18)

18.1 Mr R. Motha (United States) was declared elected by acclamation as president of CAGM.

18.2 Mr L.E. Akeh (Nigeria) was declared elected by acclamation as vice-president of CAGM.

19. DATE AND PLACE OF THE FOURTEENTH SESSION (agenda item 19)

19.1 The Commission was informed that the fourteenth session of the Commission (CAGM-XIV) was scheduled to be held in 2006. An offer was received from India to host that session.

19.2 The Commission recorded its great appreciation to India for its offer to host CAGM-XIV.

19.3 The actual date and place would be announced at a later date.

20. CLOSURE OF THE SESSION (agenda item 20)

The thirteenth session of CAGM closed at 6.05 p.m. on 17 October 2002.

RESOLUTIONS ADOPTED BY THE SESSION

RESOLUTION 1 (CAgM-XIII)

REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION FOR AGRICULTURAL METEOROLOGY

THE COMMISSION FOR AGRICULTURAL METEOROLOGY,

NOTING:

- (1) That all its previous resolutions are now obsolete,
- (2) That the substance of some of its previous recommendations have been included in recommendations of the thirteenth session,

DECIDES:

- (1) Not to keep in force any of its resolutions adopted prior to its thirteenth session;
- (2) To note with satisfaction the action taken by the competent bodies on the recommendations of its previous sessions, which are now redundant.

RESOLUTION 2 (CAgM-XIII)

WORKING STRUCTURE OF THE COMMISSION FOR AGRICULTURAL METEOROLOGY

THE COMMISSION FOR AGRICULTURAL METEOROLOGY,

NOTING:

- (1) The endorsement by Thirteenth Congress (1999) of the need to encourage and promote overall participation in, and cooperation among, the technical commissions and regional associations,
- (2) The agreement at the fifty-third session of the Executive Council (Geneva, 2001) that structural changes would better facilitate the realization of WMO's Long-term Plans, and that in the light of rapid changes would allow for more flexibility, responsiveness and delegation,
- (3) The consideration of the fifty-third session of the Executive Council that the new structure within the Commission for Basic Systems (CBS) had been successful in achieving the objectives of the World Weather Watch Programme and in improving the links with other technical commissions and the regional associations,
- (4) The adoption of a new structure by the Commission for Climatology (CCI) and the Commission for Instruments and Methods of Observation (CIMO) at their thirteenth sessions,
- (5) The request of Thirteenth Congress to the presidents of technical commissions to develop collaborative projects to improve effectiveness and efficiency,
- (6) The need for far greater resources in terms of expertise to fulfil its responsibilities,

CONSIDERING the need to:

- (1) Provide a greater opportunity for experts, including representation from other bodies dealing with

agricultural meteorology issues, to work in highly focused teams on important specific technical problems,

- (2) Enhance participation of experts from developing countries in the work of the Commission,
- (3) Build and maintain effective links to the regional associations,
- (4) Improve the flow of technical information concerning the activities of the Commission to all Members,

DECIDES to implement the new working structure as given in the Annex to this resolution with immediate effect;

AUTHORIZES the president to activate Expert Teams (ETs) in accordance with priorities agreed by the Commission and the Management Group (MG) taking into account the availability of necessary resources;

FURTHER AUTHORIZES the president, with assistance from the MG, to establish during the intersessional period Implementation/Coordination Teams (ICTs), ETs and rapporteurs, additional to those agreed by the Commission, if a demand has been established;

REQUESTS the president of the Commission, with assistance from the MG, to keep the impact and effectiveness of the new working structure under review, and to provide an interim intersessional report to Members of the Commission and a final report to the next session of the Commission;

REQUESTS further that the Secretary-General arrange within available resources a level of support for the new structure that will facilitate the participation of the members of the Open Programme Area Groups (OPAGs), the ICTs and the ETs.

ANNEX TO RESOLUTION 2 (CAGM-XIII)

WORKING STRUCTURE OF THE COMMISSION FOR AGRICULTURAL METEOROLOGY

1. The Commission agreed that the most effective, flexible and responsive means of carrying out well-defined CAgM activities is a system of small teams and rapporteurs complemented by suitable ways to involve and inform all CAgM members in the process.

2. The activities of CAgM shall be grouped under the following programmatic areas for the next intersessional period:

- (a) Agrometeorological Services for Agricultural Production;
- (b) Support Systems for Agrometeorological Services; and
- (c) Climate Change/Variability and Natural Disasters in Agriculture.

OPAGs, the members of which will be regularly consulted and informed by correspondence, shall handle the activities under each of these programme areas. Each OPAG shall be structured with one or more ICTs, ETs and rapporteurs. This achieves a broad ownership of the plans, concepts, procedures and outputs developed by CAgM through the active involvement of a large number of individual experts from among the CAgM members. The chairperson of each OPAG is also the coordinator of the work of the small teams and rapporteurs related to that specific programme area.

CAGM Management Group

3. The MG shall consist of the president and vice-president, the chairperson and co-chairperson of the OPAGs, along with the minimum additional members needed to ensure regional representation. The coordinators for support systems for policy-making for agrometeorological services and for training, education and extension would also be a part of the MG. The number of official members of the group shall not normally exceed 10, but the president may invite to its sessions experts on specific major issues, subject to available funding. The group has a strong, active and pivotal role in guiding the Commission's activities between sessions. It is responsible for ensuring the integration of the programme areas, for strategic planning issues, for the evaluation of the progress achieved in the agreed work programme, and for related necessary adjustments to the working structure in the intersessional period. The MG should meet twice in the intersessional period. The Commission, by means of a resolution, decides the terms of reference for the MG. The reports of the sessions of the MG will be distributed in a timely way to members of the Commission.

OPAGs

4. CAgM shall define by resolution the number and scope of activities of each OPAG to be established for the following intersessional period. The terms of reference, terms of office and designation of the chairpersons and co-chairpersons of the OPAGs are also decided by CAgM by means of a resolution. The terms of reference are normally of a general nature. The chairpersons will submit their reports to each session of the MG and to the next session of CAgM. Provision exists for a change of chairperson or co-chairperson in the intersessional period to be authorized by the president, with guidance from the MG, for example because of workload.

5. The OPAGs do not hold sessions and their members are consulted and informed, in particular about the activities and progress of ICTs and ETs, through correspondence. The information flows from the chairpersons to the members through suitable means of distribution such as circular letters from the CAgM president or the chairpersons, and the WMO Web site.

ICTs and ETs

6. There are two types of teams, ICTs and ETs. An ICT is mainly based on regional representation and focuses on coordinating operational and implementation aspects. An ET is mainly based on expertise for developing proposed solutions to scientific/technical problems and for studying issues for which specific expert knowledge is needed (e.g. use of crop simulation models for forecasting crop yields). It may be more effective to establish a rapporteur instead of a team for certain specific tasks. The rapporteur should be seen within this working structure as a 'one-member' team, for example either providing expert guidance or input, or enhancing the reporting of regional issues and implementation. Such individual rapporteurs shall provide specific outputs identified by the Commission, and the numbers established by the Commission will take account of the role and membership of the teams and of the resources available to provide them with proper guidance and coordination.

7. The activities of the ICTs, ETs and rapporteurs of the OPAGs are mostly established by the session of the Commission, but may be established by the president under guidance from the CAgM MG when a substantiated new need arises.

8. The leaders of the ICTs will normally be the chairperson and/or co-chairpersons of the OPAG. Otherwise,

they will be designated by a session of the CAgM or by the president. The membership of the ICTs (including the team leader) will include representatives familiar with implementation issues in each WMO Region for the specific programme areas. The presidents of regional associations will be consulted about regional representation. Up to two additional members may be invited as a source of expertise on major technical issues, designated by the team leader. The team leader, in consultation with the chairpersons of the WGs on Agricultural Meteorology of the regional associations (RAs), may designate another two members from developing countries, as a capacity building measure. For an ICT, the total number of members should be between seven and 11.

9. The leaders of the ETs are normally designated by a session of CAgM. If this is not possible, the team leaders will be designated by the president upon a recommendation from the chairperson or co-chairperson of the OPAG (COPAG) concerned. In addition, when appropriate, a co-leader of an ET may be designated by the president upon recommendation from the chairperson or co-chairperson of the OPAG concerned. Members of the ETs will be designated by their team leaders in consultation with the COPAG, or if this is not possible by an alternative mechanism agreed by the president. This will be done as far as possible at the session of the Commission. The COPAG will take full account of the need to invite suitable experts from other interested bodies to participate in CAgM teams. As an approximate guide, the total number of members of an ET should not exceed eight, and experience has frequently shown that greater progress is achieved with a smaller number.

10. ETs and ICTs are created to perform agreed tasks and provide specific outputs within a specific time period. Once established and activated, the teams will perform their tasks and provide their reports to their parent body. Correspondence or meetings, as necessary,

may achieve this. The process is entirely determined by the nature and the urgency of the task(s) entrusted to the teams and by the availability of funds. It is expected that each ICT will have at least one meeting during an intersessional period. Activation of teams established by a session of the Commission and the timing of any meetings will be decided by the MG in consultation with the Secretariat. Every team report will be accessible through the WMO Web site and distributed by regular mail, as necessary. It is the task of the Secretariat to facilitate consultation and the necessary flow of information outside CAgM sessions.

Liaison between CAgM and the regional associations, and the roles of developing countries

11. It is expected that this working structure will significantly improve and strengthen the links to the regional associations and ensure their greater involvement in the planning, implementation and coordination of the Agricultural Meteorology Programme (AgMP) at the regional level and, most importantly, through an improved mechanism for providing feedback to CAgM (see also paragraph 8 above). This will contribute to the process of consensus building, achieve full participation in the CAgM decision-making process and broaden the information flow. With further development of the agricultural working group concept at the regional level, these processes can be further improved.

12. Particular emphasis has been placed on the involvement of experts from developing countries in the activities of CAgM. Many of the proposed ETs require input from developing countries in order to achieve their aims. This involvement is seen as an important means of strengthening the knowledge and capabilities in these countries. CAgM has a strong interest to continue this practice because it improves, in the long run, the countries' ability to participate in and contribute to the AgMP.

RESOLUTION 3 (CAGM-XIII)

MANAGEMENT GROUP OF THE COMMISSION FOR AGRICULTURAL METEOROLOGY

THE COMMISSION FOR AGRICULTURAL METEOROLOGY,
(1) NOTING the *Abridged Final Report with Resolutions of the Thirteenth World Meteorological Congress* (WMO-No. 902), general summary paragraph 6.4.3,

RECOGNIZING:

(1) That the effectiveness of the Commission depends to a large extent on the effective management of its activities between sessions,

(2) That an ongoing management function is required to ensure the integration of programme areas, decide upon priorities taking account of the availability of resources, evaluate the working progress achieved, coordinate strategic planning, and decide on necessary adjustments to the working structure of the Commission during the intersessional period,

DECIDES:

- (1) To establish the Management Group of CAgM with the following terms of reference:
 - (a) Advise the president on all matters related to the work of the Commission;
 - (b) Keep under review the internal structure and working methods of the Commission and make necessary adjustments to the working structure in the intersessional period;
 - (c) Ensure the overall integration of the programme areas and coordinate strategic planning issues;
 - (d) Review and decide upon priorities and schedules for the activation of Open Programme Area Group (OPAG) teams and rapporteurs, taking into account requirements expressed at the session of the Commission, and assess and evaluate the progress achieved and provide continuing guidance on timescales for their work and outputs;
 - (e) Advise the president of the Commission on matters related to cooperation with other technical commissions and support to other WMO and related programmes;
- (f) Advise the president of the Commission on requirements arising between its sessions for new appointments of OPAG chairpersons and co-chairpersons, establishment or activation of teams and rapporteurs, and designation of team leaders;
- (2) That the composition of the Management Group (MG) (normally not to exceed 10 members in total) shall be as follows:
 - President of CAgM (chairperson)
 - Vice-president of CAgM
 - OPAG chairpersons and co-chairpersons
 The following additional members to provide advice on specific major issues:
 - (a) Mr C.J. Stigter (The Netherlands) – Coordinator for support systems for policy making;
 - (b) Mr W. Baier (Canada) – Coordinator for capacity building.
- (3) That the MG, subject to available resources, should meet at least twice during the intersessional period, and that the members of CAgM shall be informed of its decisions within eight weeks of its meetings.

RESOLUTION 4 (CAGM-XIII)

**OPEN PROGRAMME AREA GROUPS OF THE COMMISSION FOR
AGRICULTURAL METEOROLOGY**

THE COMMISSION FOR AGRICULTURAL METEOROLOGY, CONSIDERING the need for continued development and coordination of activities within WMO relating to:

- (a) Agrometeorological services for agricultural production,
- (b) Support systems for agrometeorological services, and
- (c) Climate change/variability and natural disasters in agriculture,

DECIDES:

- (1) To establish the Open Programme Area Group (OPAG) on Agrometeorological Services for Agricultural Production with the following terms of reference:
 - (a) To maintain an active and responsive overview of all activities related to provision of improved agrometeorological services to the agriculture, rangeland, forestry and fishery sectors, strengthening information and dissemination networks (including monitoring and early warning systems) and management of natural resources;
 - (b) To ensure that the subsidiary bodies of the OPAG are well informed of global and regional activities within the OPAG's areas of responsibility;
- (c) To monitor the roles, activities and priorities of the Implementation/Coordination Teams (ICTs), Expert Teams (ETs) and rapporteurs established by the Commission under the responsibility of the OPAG, to ensure coordination of work between the Teams and to advise on changes;
- (2) To establish the OPAG on Support Systems for Agrometeorological Services with the following terms of reference:
 - (a) To maintain an active and responsive overview of all activities related to the data support systems for agrometeorological services including technologies such as Geographical Information System (GIS), remote sensing for agroclimatic characterization and sustainable land management, database management, validation and application of models, and research methods at the eco-regional level;
 - (b) To ensure that the subsidiary bodies of the OPAG are well informed of global and regional activities within the OPAG's areas of responsibility;
 - (c) To monitor the roles, activities and priorities of the ICTs, ETs and rapporteurs established

- by the Commission under the responsibility of the OPAG, to ensure coordination of work between the teams and to advise on changes;
- (3) To establish the OPAG on Climate Change/Variability and Natural Disasters in Agriculture with the following terms of reference:
- (a) To maintain an active and responsive overview of all activities related to climate change/variability, medium- to long-range predictions for agriculture, reduction of the impact of natural disasters and mitigation of extreme events in agriculture, rangelands, forestry and fisheries and on the contribution of agriculture to the state of climate;
- (b) To ensure that the subsidiary bodies of the OPAG are well informed of global and regional activities within the OPAG's areas of responsibility;
- (c) To monitor the roles, activities and priorities of the ICTs, ETs and rapporteurs established by the Commission under the responsibility of the OPAG, to ensure coordination of work between the Teams and to advise on changes;
- (4) To appoint a chairperson and co-chairperson of each OPAG with the following terms of reference:
- (a) To facilitate and assist the work of the OPAG, in particular with respect to providing overall guidance to, and monitoring and coordinating of, the work of the teams and the rapporteurs, in liaison with the team leaders;
- (b) In consultation with the president and other members of the Management Group (MG), to establish priorities for the activation of Teams and rapporteurs (taking account of decisions of the previous session of the Commission), and schedules for their outputs;
- (c) To chair the ICT(s);
- (d) To act upon matters referred to the OPAG by the president of CAgM, and to advise the president on the composition of teams established between sessions of the Commission, including their leadership;
- (e) To provide advice to team leaders on the membership (designation and numbers) of their teams, including representation of other interested bodies;
- (f) To provide feedback to the members of the OPAG, including activity reports at regular intervals;
- (g) To submit reports for MG meetings and for the next session of the Commission;
- (5) To select, in accordance with General Regulation No. 32, a chairperson and co-chairperson for each OPAG as follows:
- (a) For the OPAG on Agrometeorological Services for Agricultural Production, P. Doraiswamy (United States) and H. Abdalla (Sudan);
- (b) For the OPAG on Support Systems for Agrometeorological Services, G. Maracchi (Italy) and O. Brunini (Brazil);
- (c) For the OPAG on Climate Change/Variability and Natural Disasters in Agriculture, M.J. Salinger (New Zealand) and S. Wang (China);

NOTES:

- (1) The chairperson and co-chairperson of each OPAG will be expected to divide their tasks specified above on an equitable basis.
- (2) The terms of office of the chairperson and co-chairperson of each OPAG will normally be two years, with the option of renewal for the full intersessional period.

RECOMMENDATIONS ADOPTED BY THE SESSION

RECOMMENDATION 1 (CAgM-XIII)

NATIONAL REPORTS ON PROGRESS MADE IN AGRICULTURAL METEOROLOGY

THE COMMISSION FOR AGRICULTURAL METEOROLOGY,
NOTING:

- (1) Recommendation 1 (CAgM-XII) – National Reports on Progress Made in Agricultural Meteorology,
- (2) The responses so far received from the Members to the questionnaire on the National Reports on Progress made during 1999-2001,
- (3) The creation by the WMO Secretariat of a comprehensive database of the status of agrometeorological activities in Member countries based on the information provided in the reports from the Members,

RECOMMENDS:

- (1) That Members:
 - (a) Who have not so far submitted their responses to the current questionnaire do so as soon as possible, for inclusion in the comprehensive Database on Agricultural Meteorology being compiled by the WMO Secretariat;
 - (b) Submit, six months before the next session of the Commission, their responses to the ques-

tionnaire on progress which has taken place in agrometeorology since the preparation of the previous national report;

- (2) That the Secretary-General:
 - (a) Circulate the list of Members who have sent their reports to all other Members with a note asking them to submit their reports by 31 May 2003;
 - (b) Arrange for the update of a comprehensive database on agrometeorology based on the responses provided by the Members before 31 December 2003;
 - (c) Publish brief summaries of progress in agricultural meteorology for information of Members, before the next session of the Commission;
- (3) That the WMO Secretariat:
Undertake a critical review of the questionnaire before it is sent out before CAgM-XIV to ensure the relevance and accuracy of the derived information.

RECOMMENDATION 2 (CAgM-XIII)

WMO ACTIVITIES ON TRAINING IN AGRICULTURAL METEOROLOGY

THE COMMISSION FOR AGRICULTURAL METEOROLOGY,
NOTING:

- (1) The emphasis placed by the World Summit on Sustainable Development (WSSD) in Johannesburg and the World Food Summit: Five Years Later in Rome on poverty and providing adequate food for that part of the global population now undernourished,
- (2) The contribution that agricultural meteorology can make to help reduce poverty and help produce food through a more efficient and sustainable use of natural resources,
- (3) The advances made in operational applications of agricultural meteorology and the need to train more people to help farmers to obtain access to

operational agrometeorological information for daily farming activities,

- (4) The existing infrastructure of international, regional and national meteorological training centres,
- (5) The great number of meteorological observers and technicians that can help achieve the aims of the United Nations, if given access to further training,

RECOMMENDS that the Secretary-General:

- (1) Continue to request Members to increase their contributions to the various fellowship funds or equivalent training resources;
 - (2) Consider a significant increase in the existing WMO training fund allocation for training in Agricultural Meteorology.
-

RECOMMENDATION 3 (CAGM-XIII)

**REVIEW OF RESOLUTIONS OF THE EXECUTIVE COUNCIL BASED ON PREVIOUS
RECOMMENDATIONS OF THE COMMISSION FOR AGRICULTURAL METEOROLOGY**

THE COMMISSION FOR AGRICULTURAL METEOROLOGY,
NOTING with satisfaction the action taken on its previous
recommendations by the Executive Council,

RECOMMENDS:

(1) That the following Executive Council resolutions be
maintained in force:

5 (EC-LIV); and

6 EC-LIV

(2) That Resolution 4 (EC-LIV) be replaced by a new
resolution, relating to the report of the thirteenth
session of CAgM.

ANNEXES

ANNEX I

Annex to paragraph 7.8 of the general summary

PROGRAMME 4.2 - AGRICULTURAL METEOROLOGY PROGRAMME

Introduction

Purpose and scope

6.4.9 The purpose of the Agricultural Meteorology Programme is to assist Members in the provision of meteorological and related services to the agricultural community in order to help develop sustainable and economically viable agricultural systems. The main emphasis is to improve production and quality, reduce losses and risks, decrease costs, increase efficiency in the use of water (especially on the semi-arid and drought-prone lands), labour and energy, conserve natural resources, combat drought and desertification and decrease pollution by agricultural chemicals or other agents that contribute to the degradation of the environment. The programme deals with applications to agriculture of both climate information which is used mainly for strategic planning purposes and recent weather data and weather forecasts used mostly in day-to-day agricultural operations.

6.4.10 As regards the programme's involvement in the implementation of the WMO strategies, its main contribution will be made to Strategy 2, since it will enable the provision of increasingly beneficial agricultural services, and to Strategy 7 through enhancing the NMHSs capabilities to provide forecasts and warnings relevant to agriculture.

Main long-term objectives

6.4.11 The main long-term objectives of the Agricultural Meteorology Programme are:

- (a) To promote environmentally sustainable, economically viable and high quality agricultural production by strengthening Members' capabilities to provide relevant meteorological services to agricultural and other related sectors;
- (b) To foster a better understanding, by farmers and other end-users in the agricultural, forestry and related sectors, of the value and use of meteorological information in planning and operational activities.

6.4.12 Three major key focus areas under which activities will be carried out were adopted in order to adequately fulfil the above objectives. These areas are:

- (a) Agrometeorological services for agricultural production;
- (b) Support systems for agrometeorological services and;
- (c) Climate change/variability and natural disasters in agriculture.

Implementation activities 2004-2007

6.4.13 Implementation activities will be presented in relation to key focus areas. The implementation of the programme will include:

6.4.13.1 Agrometeorological services for agricultural production:

- (a) Assistance to Members in improving their agrometeorological services for agricultural production;

Members will be provided guidance and advice, particularly through CAgM, on the improvement of early warning and monitoring systems, short- and medium-range weather forecasts for agriculture and agrometeorological aspects of land and water management in agriculture. Emphasis will be placed on promoting the more active use of seasonal to inter-annual climate forecasts in agricultural planning and operations in active collaboration with the CLIPS programme.

Expert emphasis in the guidance provided by CAgM will be placed on issues such as strengthening relevant observation and information networks and dissemination of information through advisories and warnings. Case studies for developing policy support systems will be encouraged and assisted as appropriate. Recommendations on strategies to adapt to climate variability and climate change, and to achieve improved water management and protection and use of tropical forests will also be provided. Emphasis will be placed on provision of training, education and extension support systems for the

provision of improved agrometeorological services through technology transfer, better methods, procedures and techniques for disseminating agrometeorological information and awareness and training for disaster mitigation and climate disaster prediction. One of the major activities in this project is on weather, climate and farmers where a bottom-up approach of the full involvement of farmers is envisaged to ensure that the agrometeorological methods and procedures developed and used will adequately respond to the appropriate needs of the farmers.

Key deliverables include:

- Completing final draft of the *Guide to Agricultural Meteorological Practices* (WMO-No. 134) and make it available on the Internet;
 - Conducting roving seminars with emphasis on vulnerability, mitigation and adaptation to climate change by 2007;
 - Help re-establish working groups on agricultural meteorology in Regions where none is in existence by 2005;
 - Producing a guide for forest fire management by 2007;
 - Providing guidelines and procedures for the analysis and dissemination of agroclimatic information by 2007.
- (b) Foster a better understanding of agrometeorological information by farmers and other users.

Key deliverables include:

- Developing procedures and guidance material for the proper use of agrometeorological information by farmers by 2007.

6.4.13.2 Support systems for agrometeorological services

- (a) Provision of guidance, with active participation of CAgM, on the development by Members of support systems for agrometeorological services, including the use of GIS and remote sensing for sustainable land management and agroclimatic characterization.

- (b) Expert group meetings and organization of training activities on applications of geographical information systems, agroecological characterization and crop modelling are envisaged. Guidance and advice will also be provided to Members on validation and application of crop simulation models and other research results at the national and regional level.

Key deliverables include:

- Organization of roving seminars with emphasis on GIS application by 2007;
- Providing guidelines and procedures for agrometeorological data management by 2005.

6.4.13.3 Climate change/variability and natural disasters in agriculture

Promotion of, and assistance in evaluation studies by Members of impacts of climate change/variability and natural disasters on agriculture.

Relevant guidance and recommendations will be provided, together with guidance and recommendations on measures to help reduce the contributions of agriculture to global warming and measures for the prevention and mitigation of the effects of droughts, floods and other extreme events in agriculture and forestry. Meetings of expert groups and regional workshops on agrometeorological impacts and other related topics will be organized by the Secretariat, together with roving seminars to disseminate the results of these workshops.

Key deliverables include:

- Providing guidelines for mitigation and adaptation of agriculture to climate change by 2007;
- Providing guidance material on the measures for prevention and mitigation of the effects of droughts, floods and other extreme events in agriculture and forestry.

6.4.14 Activities and key results presented above are summarized in the following table:

AGRICULTURAL METEOROLOGY PROGRAMME – KEY ACTIVITIES AND RESULTS			
Key areas	Activities	Key results	Performance measure
Agrometeorological services for agricultural production	<ul style="list-style-type: none"> Assistance to Members in improving their agrometeorological services for agricultural production 	<ul style="list-style-type: none"> Complete final draft of the Guide on Agricultural Meteorology and make it available on the Internet Conduct roving seminars with emphasis on vulnerability and adaptation to climate change by 2007 Help re-establish working groups on agricultural meteorology where none exists currently in Regions by 2005 Produce a guide for forest fire management by 2007 Provide guidelines and procedures for the analysis and dissemination of agrometeorological information by 2007 Develop procedures and guidance material for the proper use of agrometeorological information by farmers by 2007 Provide guidelines and procedures for agrometeorological data management by 2005 	<p>Draft of the Guide completed by 2007</p> <p>XX roving seminars conducted</p> <p>XX working groups were created</p> <p>Procedures and guidance material are available</p> <p>Procedures and guidance material are available</p> <p>Procedures and guidance material are available</p>
Support systems for agrometeorological services	<ul style="list-style-type: none"> Foster a better understanding of agrometeorological information by farmers and other users Provision of guidance, with active participation of CAgM, on the development by Members of support systems for agrometeorological services, the use of GIS and remote sensing for including sustainable land management and agroclimatic characterization 	<ul style="list-style-type: none"> Provide guidelines for mitigation and adaptation of agriculture to climate change by 2007 Provide guidance material on the measures for prevention and mitigation of the effects of droughts, floods, and other extreme events in agriculture and forestry 	<p>Procedures and guidance material are available</p>
Climate change/variability and natural disaster in agriculture	<ul style="list-style-type: none"> Promotion of, and assistance in evaluation studies by Members of impacts of climate change/variability and natural disasters on agriculture 		

ANNEX II

Annex to paragraph 16.12 of the general summary

OPAG TEAMS AND THEIR TERMS OF REFERENCE**1. OPAG 1 ON AGROMETEOROLOGICAL SERVICES FOR AGRICULTURAL PRODUCTION****1.1 ICT for Agrometeorological Services:**

- (a) To consider agrometeorological requirements for developing farm-level strategies and for making specific proposals for applications to agriculture, rangelands, forestry and fisheries, and sustainable rural development based on the output of the ETs;
- (b) To make recommendations on regional training needs to improve agrometeorological services to farms, forests and fisheries;
- (c) To ensure the availability of accurate, reliable and systematic procedures and agrometeorological technologies adopted for regionalized services to agriculture;
- (d) To liaise with the coordinator for support systems for policy-making for agrometeorological services and the coordinator for training, education and extension of the CAgM MG, as appropriate, in the implementation of the activities of the team.

1.2 ET on Weather, Climate and Farmers:

- (a) To review and develop recommendations for enhancing more effective and regular communication and dialogue for training and demonstration between agrometeorological services and farmers at the local level, in order to provide better services to farmers;
- (b) To review the use of weather and climate data and make recommendations for improvements in applications of agrometeorological products, advisories and forecasts for both short-term daily operational decisions and long-term strategic planning at the farm level;
- (c) To establish procedures and guidance for the proper use of agrometeorological information for crop, livestock, forestry and fisheries management;
- (d) To describe, using case studies from Member countries, successful applications of weather and climate for agriculture, and review the strengths, weaknesses and limitations for more general use;
- (e) To prepare reports for operational applications in accordance with timetables established by the OPAG and/or MG.

1.3 ET on Strengthening Information and Dissemination Networks, Including Monitoring and Early-Warning Systems:

- (a) To survey the status of information and dissemination networks in Member countries and make recommendations on enhancing and/or establishing information delivery systems to specifically address the needs of operational agriculture;
- (b) To determine the gaps in agricultural information, such as crop phenology, crop moisture status and

drought indices, to improve agrometeorological analyses for agriculture;

- (c) To establish guidelines and procedures to standardize the flow of timely and accurate information to farmers;
- (d) To review and develop recommendations for promoting better use of technological advances in communication of information, e.g. radio and Internet, for the delivery of timely information to agriculture, rangelands, forestry and fisheries;
- (e) To submit reports in accordance with timetables established by the OPAG and/or MG.

1.4 ET on Management of Natural and Environmental Resources for Sustainable Agricultural Development:

- (a) To assess and report on the appropriate agrometeorological criteria to conserve and manage natural and environmental resources for the benefit of agriculture, rangelands, forestry and fisheries, and for other relevant rural activities;
- (b) To survey the status of and summarize the information on trends in land degradation at the national and regional levels;
- (c) To document case studies of successful measures to manage land use, protect land and mitigate land degradation;
- (d) To provide liaison with JCOMM on inter-commission activities on natural disaster reduction in coastal lowland areas;
- (e) To establish practical guidelines from an agrometeorological perspective for the conservation of natural and environmental resources in harmony with agricultural production systems;
- (f) To establish operational guidelines for fire weather agrometeorology;
- (g) To prepare reports in accordance with timetables established by the OPAG and/or MG.

2. OPAG 2 ON SUPPORT SYSTEMS FOR AGROMETEOROLOGICAL SERVICES**2.1 ICT on Support Systems for Agrometeorological Services:**

- (a) To review the operational applications of current agrometeorological data, analytical tools, and information delivery systems at the national and regional levels;
- (b) To make recommendations on procedures, methodologies and resources to improve the regional-based capability for operational applications;
- (c) To prepare reports in accordance with timetables established by the OPAG and/or MG;
- (d) To liaise with the coordinator for support systems for policy-making for agrometeorological services and the coordinator for training, education and

extension of the CAgM MG, as appropriate, in the implementation of the activities of the team.

2.2 ET on Techniques (Including Technologies such as GIS and Remote Sensing) for Agroclimatic Characterization and Sustainable Land Management:

- (a) To develop a statement of requirements for defining and quantifying observational characteristics in general and for specific regions pertaining to agroclimatic features, land use management and projected future trends, emphasizing the adequacy of information needed for application of GIS technology to agriculture, rangelands, forestry and fisheries;
- (b) To review and recommend appropriate agroclimatic zoning methods and promote their use in operational applications and agrometeorological bulletins and advisories;
- (c) To promote innovative techniques for sustainable land use management, based on suitable agroclimatic characterization, as documented from surveys of successful pilot projects at the national and regional levels;
- (d) To make recommendations on the methods to cope with limitations and weaknesses in the provision and accessibility of innovative operational technologies at the national and regional levels;
- (e) To prepare reports in accordance with timetables established by the OPAG and/or MG.

2.3 ET on Database Management, Validation and Application of Models and Research Methods at the Eco-regional Level:

- (a) To make recommendations on the efficient ways and means of database management, including computer technology, standardized analytical techniques and integrated information management systems;
- (b) To investigate and document appropriate operational requirements for the validation of selected models in agriculture, rangelands, forestry and fisheries, and methodological developments to apply these models at a regional scale;
- (c) To determine and specify the needs of agriculture, rangelands, forestry and fisheries in future agrometeorological information management systems;
- (d) To assess and report on eco-regional research at the national and regional levels that may serve as models for broader application;
- (e) To submit reports in accordance with timetables established by the OPAG and/or MG.

3. OPAG 3 ON CLIMATE CHANGE/VARIABILITY AND NATURAL DISASTERS IN AGRICULTURE

3.1 ICT on Climate Change/Variability and Natural Disasters in Agriculture:

- (a) To summarize the status of climate change/variability studies and potential impacts of climate

change/variability on national and regional agriculture, rangelands, forestry and fisheries;

- (b) To summarize the status of mitigation and adaptation strategies with respect to impacts of climate change/variability and natural disasters in agriculture;
- (c) To appraise and report on current capabilities in the analysis of climate change and variability and natural disasters specifically as they relate to and affect agriculture, rangelands, forestry and fisheries at the national and regional levels;
- (d) To analyze and review the results of climate change scenarios and climate variability studies at the regional level and promote appropriate agrometeorological adaptation strategies to mitigate the impacts on agriculture, rangelands, forestry and fisheries;
- (e) To identify deficiencies in the operational applications of long-range predictions for agriculture, and make recommendations for improving the technology for the benefit of agriculture at the national and regional levels;
- (f) To collaborate with CBS and CCI on matters of common interest;
- (g) To submit reports in accordance with timetables established by the OPAG and/or MG;
- (h) To liaise with the coordinator for support systems for policy-making for agrometeorological services and the coordinator for training, education and extension of the CAgM MG, as appropriate, in the implementation of the activities of the team.

3.2 ET on Climate Change/Variability on Medium- to Long-Range Predictions for Agriculture:

- (a) To appraise and report on current capabilities in the analyses of climate change/variability and long-range prediction studies, specifically as they relate to and affect agriculture, rangelands, forestry and fisheries at the national and regional levels;
- (b) To produce a review on the current status of methodologies for the presentation of seasonal to inter-annual prediction products and applications to the agricultural end-user;
- (c) To review the availability and suitability of software packages for the calculation of appropriate seasonal climate variability indices for agricultural applications;
- (d) To make recommendations on research and development activities needed to improve the technology for the benefit of agriculture, rangelands, forestry and fisheries;
- (e) To prepare reports in accordance with timetables established by the OPAG and/or MG.

3.3 ET on Reduction of the Impact of Natural Disasters and Mitigation of Extreme Events in Agriculture, Rangelands, Forestry and Fisheries:

- (a) To develop a list of requirements quantifying observational data needs, analytical tools, and information delivery mechanisms to facilitate greater early detection of extreme events to help

- mitigate their impacts on agriculture, rangelands, forestry and fisheries;
- (b) To document national, regional, and global guidelines for awareness of potential natural disasters, and to make recommendations for early alert monitoring;
 - (c) To study prototype examples at the national level on how agrometeorological information is being used operationally to reduce the impact of natural disasters and extreme events, and compile a survey to be prepared for the Member countries;
 - (d) To make recommendations on research and development activities needed to better understand the potential risks to agriculture, rangelands, forestry and fisheries from natural disasters and extreme events;
 - (e) To prepare reports in accordance with timetables established by the OPAG and/or MG.

3.4 ET on Contribution of Agriculture to the State of Climate:

- (a) To review estimates of greenhouse gas emissions from agroecosystems as well as recommend best management practices to reduce greenhouse gas emissions from agroecosystems;
- (b) To assess the feedback mechanisms from human activities in agriculture, rangelands, forests and fisheries that may influence weather and climate at the local, national, regional and global levels;
- (c) To document both positive and negative influences of agriculture on weather and climate systems;
- (d) To investigate and report on how alterations or trends in national, regional and global agriculture will contribute to variations in the state of weather and climate systems;
- (e) To develop guidelines for increasing awareness within farming communities of adaptation/mitigation strategies to address climate change issues;
- (f) To make recommendations on research and development activities needed to better understand the contribution of agriculture, rangeland, forestry and fishery activities to the state of the climate;

- (g) To submit reports in accordance with timetables established by the OPAG and/or MG.

4. ETS REPORTING DIRECTLY TO THE PRESIDENT AND/OR MG

4.1 ET on the Guide to Agricultural Meteorological Practices:

- (a) To assist the president in updating services, technologies, methodologies and operational applications of agrometeorology in the revision of the *Guide to Agricultural Meteorological Practices* (WMO-NO. 134);
- (b) To coordinate a thorough revision of each chapter in the Guide as well as to oversee the introduction of new chapters, as necessary, to update the Guide;
- (c) To establish procedures for users, presidents of regional associations and Members to collaborate on recommendations and editorial reviews for each chapter;
- (d) To make changes, as necessary, in authors and reviewers to ensure that progress remains on schedule;
- (e) To develop a strategy for draft preparations, editorial reviews and deadlines for completion of each section of the Guide;
- (f) To report on progress to the president and MG through brief written reports on an annual basis.

5. EXPERTS REPORTING TO THE APPROPRIATE COPAG

5.1 CAgM Experts Serving on Teams of Other Technical Commissions:

- (a) To actively determine the views of the Commission on issues relating to agricultural meteorology that are being addressed by working bodies of other WMO technical commissions;
- (b) To represent these views at meetings of other commissions as appropriate;
- (c) To work positively with their working bodies in developing guidance and implementation programmes that meet the overall needs of Members.

ANNEX III

Annex to paragraph 16.14 of the general summary

MEMBERSHIP OF OPAG TEAMS

The Commission noted the following details concerning the operational procedures for OPAGs. Each OPAG chairperson and co-chairperson is also the leader and co-leader for the ICT under that OPAG. In addition, regional representatives are identified for each ICT. The Commission also noted that further experts and/or representatives from developing countries may be added by the ICT leader and co-leader.

A leader was identified for each of the ETs that had been agreed on at this Commission meeting (noting that further ETs may be formed during the intersessional period). Membership of the ETs will be developed by the ET leader in consultation with the relevant OPAG chairperson and co-chairperson. The list of experts who have been nominated as candidates to contribute to the OPAGs will be made available to the leaders of the ETs

and OPAG chairperson and co-chairperson. This will be the primary resource used to identify members of ETs, but other experts may also be identified if required.

Membership of OPAG Teams

1. OPAG 1 ON AGROMETEOROLOGICAL SERVICES FOR AGRICULTURAL PRODUCTION

Chairperson: P. Doraiswamy (United States)
Co-Chairperson: H. Abdalla (Sudan)

1.1 *ICT for Agrometeorological Services*

Leader: P. Doraiswamy (United States)
Co-leader: H. Abdalla (Sudan)
RA I: S. Walker (South Africa)
RA II: N. Van Viet (Vietnam)
RA III: M. Egaña (Chile)
RA IV: J. Andresen (United States)
RA V: M. Williams (Australia)
RA VI: A. Marica (Romania)

1.2 *ET on Weather, Climate, and Farmers*

Leader: R. Stone (Australia)
Experts: (to be decided)

1.3 *ET on Strengthening Information and Dissemination Networks, Including Monitoring and Early-Warning Systems*

Leader: B. Lee (Republic of Korea)
Experts: (to be decided)

1.4 *ET on Management of Natural and Environmental Resources for Sustainable Agricultural Development*

Leader: (to be decided)
Experts: (to be decided)

2. OPAG 2 ON SUPPORT SYSTEMS FOR AGROMETEOROLOGICAL SERVICES

Chairperson: G. Maracchi (Italy)
Co-Chairperson: O. Brunini (Brazil)

2.1 *ICT on Support Systems for Agrometeorological Services*

Leader: G. Maracchi (Italy)
Co-leader: O. Brunini (Brazil)
RA I: B. Razafindrakoto (Madagascar)
RA II: A. Kleschenko (Russian Federation)
RA III: (to be decided)
RA IV: E. Kanemasu (United States)
RA V: E. Juanillo (Philippines)
RA VI: S. Korsakova (Ukraine)

2.2 *ET on Techniques (Including Technologies such as GIS and Remote Sensing) for Agroclimatic Characterization and Sustainable Land Management*

Leader: K. Monnick (South Africa)
Experts: (to be decided)

2.3 *ET on Database Management, Validation and Application of Models and Research Methods at the Eco-regional Level*

Leader: C. Barnes (Australia)
Experts: (to be decided)

3. OPAG 3 ON CLIMATE CHANGE/VARIABILITY AND NATURAL DISASTERS IN AGRICULTURE

Chairperson: M.J. Salinger (New Zealand)
Co-Chairperson: S. Wang (China)

3.1 *ICT on Climate Change/Variability and Natural Disasters in Agriculture*

Leader: M.J. Salinger (New Zealand)
Co-leader: S. Wang (China)
RA I: B. Gomez (Gambia)
RA II: H. Das (India)
RA III: (to be decided)
RA IV: F. Gavavito (Guatemala)
RA V: L. Tibig (Philippines)
RA VI: E. Cloppet (France)

3.2 *ET on the Impact of Climate Change/Variability on Medium- to Long-Range Predictions for Agriculture*

Leader: M. Kadi (Algeria)
Experts: (to be decided)

3.3 *ET on Reduction of the Impact of Natural Disasters and Mitigation of Extreme Events in Agriculture, Forestry and Fisheries*

Leader: H.P. Das (India)
Experts: (to be decided)

3.4 *ET - Contribution of Agriculture to the State of Climate*

Leader: R. Desjardins (Canada)
Experts: (to be decided)

4. ETs REPORTING DIRECTLY TO THE PRESIDENT AND/OR MG

4.1 *ET on the Guide to Agricultural Meteorological Practices*

Leader: C.J. Stigter (Netherlands)
Experts: (to be decided)

5. EXPERTS REPORTING TO THE APPROPRIATE COPAG

5.1 *CAGM Experts Serving on Teams of Other Technical Commissions:*

Experts: (to be decided)

APPENDIX A

LIST OF PERSONS ATTENDING THE SESSION

A. OFFICERS OF THE SESSION

R.P. Motha	President
L. Akeh	Vice-president

B. REPRESENTATIVES OF WMO MEMBERS

<i>Member</i>	<i>Name</i>	<i>Capacity</i>
Algeria	A. Tagnit-Hamou C. Negri	Principal delegate Delegate
Armenia	V. Grigoryan (Ms)	Principal delegate
Australia	R. K. Stringer	Principal delegate
Austria	H. Dobesch	Principal delegate
Canada	R. Desjardins A. Harou B. Angle	Principal delegate Alternate Delegate
China	S. Ruan C. Zhou D. Li (Ms) Y. Zhao (Ms)	Principal delegate Delegate Delegate Delegate
Croatia	D. Kaučić	Principal delegate
Czech Republic	J. Valter J. Rožnovský	Principal delegate Delegate
Ecuador	G. García	Principal delegate
Finland	L. Leskinen (Ms)	Principal delegate
France	V. Péronaud (Ms) B. Itier E. Cloppet	Principal delegate Delegate Delegate
Gambia	M.P. Bah	Principal delegate
Georgia	T. Tourmanidze	Principal delegate
Germany	H. Dommermüth R. Krüger	Principal delegate Delegate
Ghana	M.M. Tanu	Principal delegate
Hungary	Z. Dunkel	Principal delegate
India	H. Das	Principal delegate
Iran, Islamic Republic of	K. Noohi (Ms) H. Bari Abarghouei	Principal delegate Delegate
Israel	T. Harovitz (Ms)	Principal delegate
Italy	A. Brunetti G. Maracchi M. Bindi G. Dal Monte	Principal delegate Alternate Delegate Delegate
Jordan	A. Fayez	Principal delegate
Kenya	S.M. Gachara	Principal delegate
Libyan Arab Jamahiriya	F.A. El Mansuri S.M. Amar	Principal delegate Delegate
Madagascar	D. Randrianoro	Principal delegate
Malaysia	L.S. Tan	Principal delegate

<i>Member</i>	<i>Name</i>	<i>Capacity</i>
Mauritania	Y. Gandega	Principal delegate
Mauritius	P. Goolaup	Principal delegate
Netherlands	C. J. Stigter D. Rijks	Principal delegate Delegate
New Zealand	J. Salinger A. Porteous	Principal delegate Delegate
Nigeria	M.A. Ogunwale (Ms)	Principal delegate
Poland	J. Zielinski P. Kowalczak J. Kozyra	Principal delegate Alternate Adviser
Portugal	M.R.P. Guerreiro (Ms)	Principal delegate
Republic of Korea	B.L. Lee S.B. Lee	Principal delegate Delegate
Russian Federation	A.D. Kleschenko O.D. Sirotenko V.V. Pavlova (Ms) Y. Baklanov	Principal delegate Delegate Delegate Delegate
Slovenia	J. Čepļjak L. Kajfež-Bogataj (Ms) A. Sušnik (Ms) A. Žust B. Zupančič	Delegate Delegate Delegate Delegate Delegate
South Africa	S. Walker (Ms)	Principal delegate
Spain	A. Mestre Barceló	Principal delegate
Sudan	A. Haroun	Principal delegate
Thailand	T. Raktabutr	Principal delegate
The former Yugoslav Republic of Macedonia	I. Panov S. Stevkova (Ms) N. Aleksovska (Ms)	Principal delegate Delegate Delegate
Tunisia	H. Baccour	Principal delegate
Uganda	P. Isabirye	Principal delegate
United Arab Emirates	K.M. Hassan	Principal delegate
United Kingdom of Great Britain and Northern Ireland	I. Barrie	Principal delegate
United Republic of Tanzania	D.A.R. Kashasha	Principal delegate
United States of America	R. Motha P. C. Doraiswamy A. R. Riebau	Principal delegate Delegate Alternate
Viet Nam	V.V. Nguyen	Principal delegate
Yugoslavia	P. Spasov	Principal delegate
Zimbabwe	B. Chipindu	Principal delegate

<i>Member</i>	<i>Name</i>	<i>Capacity</i>
C. INVITED EXPERT		
Z. Gat (Ms)	Israel	
D. REPRESENTATIVES OF INTERNATIONAL ORGANIZATIONS		
<i>Organization</i>	<i>Name</i>	
Food and Agriculture Organization of the United Nations (FAO)	R. A. Gommès	
International Commission on Irrigation and Drainage (ICID)	B. Maticic	
International Society for Agricultural Meteorology (INSAM)	C.J. Stigter	
International Union of Soil Science Society	F. Lobnik	

E. Representative of Joint Commission	
J. Guddal	JCOMM
F. WMO SECRETARIAT	
G. O. P. Obasi	Secretary-General
K. Davidson	Director, World Climate Programme Department (WCP)
M.V.K. Sivakumar	Chief, Agricultural Meteorology Programme (AgMP), WCP
M. Saho	Scientific Officer, WCP
R. Stefanski	WMO Consultant, WCP
M. Peeters	Conference Officer

APPENDIX B

AGENDA

<i>Agenda item</i>	<i>Document Nos.</i>	<i>PINK Nos. and person submitting</i>	<i>Resolutions and recommendations adopted</i>
1. OPENING OF THE SESSION		1, president of CAgM	
2. ORGANIZATION OF THE SESSION		2, president of CAgM	
2.1 Consideration of the report on credentials			
2.2 Adoption of the agenda	2.2(1); 2.2(2)		
2.3 Establishment of committees			
2.4 Other organizational matters			
3. REPORT OF THE PRESIDENT OF THE COMMISSION	3; 3, ADD. 1	3, president of CAgM	
4. NATIONAL PROGRESS REPORTS ON AGRICULTURAL METEOROLOGY	4	4, co-chairperson, Committee A	Rec. 1
5. REGIONAL ACTIVITIES IN AGROMETEOROLOGY	5	5, co-chairperson, committee A	
6. EVALUATION OF THE 5LTP AND THE AGMP	6	co-chairperson Committee A	
7. PREPARATION OF THE 6LTP AND THE AGMP	7	7, co-chairperson, Committee A	
8. REVIEW OF <i>TECHNICAL REGULATIONS</i> (WMO-No. 49) AND OF THE <i>GUIDE TO AGRICULTURAL METEOROLOGICAL PRACTICES</i> (WMO-No. 134)			
8.1 Report of the Advisory Working Group	8.1	8.1, co-chairperson, Committee A	
8.2 <i>Guide to Agricultural Meteorological Practices</i> (WMO-No. 134)	8.2	8.2, co-chairperson, Committee A	
8.3 Review of <i>Technical Regulations</i> (WMO-No. 49)	8.3	8.3, co-chairperson, Committee A	
9. WEATHER AND CLIMATE RELATED TO AGRICULTURAL PRODUCTION			
9.1 Adaptation strategies required for reducing vulnerability of agriculture and forestry to climate variability and climate change		9.1, co-chairperson, Committee B	
9.2 Impact of management strategies to mitigate greenhouse gas emissions from agroecosystems	9.2	9.2, co-chairperson, Committee B	
9.3 Impacts of agrometeorological applications for sustainable management of farming systems, forestry and livestock	9.3	9.3, co-chairperson, Committee B	
9.4 Agrometeorological aspects of organic agriculture, urban agriculture, indoor agriculture and precision farming	9.4	9.4, co-chairperson, Committee B	
9.5 Current advances in seasonal forecasts and climate prediction and the products and services relevant to agriculture	9.5	9.5, co-chairperson, Committee B	

<i>Agenda item</i>	<i>Document Nos.</i>	<i>PINK No. and person submitting</i>	<i>Resolutions and recommendations adopted</i>
9.6 Status of modelling in agroclimatology	9.6	9.6, co-chairperson, Committee B	
9.7 Interactions between climate and biological diversity	9.7	9.7, co-chairperson, Committee B	
10. AGROMETEOROLOGICAL DATA MANAGEMENT			
10.1 User requirements for satellite and other remote sensing information in the field of agricultural meteorology		10.1, co-chairperson, Committee B	
10.2 Computer-based management systems, suitable software packages and training requirements	10.2	10.2, co-chairperson, Committee B	
10.3 Agrometeorological data management		10.3, co-chairperson, Committee B	
11. APPLICATIONS OF AGROMETEOROLOGY			
11.1 Current methods and approaches being used for communication of agrometeorological information	11.1(1)	11.1, co-chairperson, Committee B	
11.2 Impact of agrometeorological information on rangeland and pasture ecology and management	11.2(1)	11.2, co-chairperson, Committee B	
11.3 Impact of agrometeorological advisories and information on operational aspects of forestry planning, with emphasis on wildland fire ecology	11.3	11.3, co-chairperson, Committee B	
11.4 Designing pilot surveys to assess CAgM products and to evaluate their relevance to user requirements		11.4, co-chairperson, Committee B	
11.5 Impact of the use of meteorological and climatological data on fisheries and aquaculture		11.5, co-chairperson, Committee B	
11.6 Case studies on economically beneficial agrometeorological applications and services	11.6	11.6, co-chairperson, Committee B	
12. AGROMETEOROLOGY RELATED TO EXTREME EVENTS			
12.1 Existing knowledge and information on assessing different aspects of desertification, drought and other extreme meteorological events	12.1	12.1, co-chairperson, Committee B	
12.2 Aspects of the implementation of the UNCCD	12.2	12.2, co-chairperson, Committee B	
12.3 Agrometeorological aspects of desertification and drought		12.3, co-chairperson, Committee B	
13. TRAINING AND EDUCATION MATTERS			
13.1 Evaluation of training, education and capacity building projects/programmes in agrometeorology	13.1	13.1, co-chairperson, Committee A	
13.2 WMO activities on training in agricultural meteorology		13.2, co-chairperson, Committee A	Rec. 2
13.3 Symposia, seminars and workshops in agricultural meteorology	13.3	13.3, co-chairperson, Committee A	
14. COLLABORATION WITH INTERNATIONAL ORGANIZATIONS	14	14, co-chairperson, Committee A	

<i>Agenda item</i>	<i>Document Nos.</i>	<i>PINK No. and person submitting</i>	<i>Resolutions and recommendations adopted</i>
15. REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION AND OF RELEVANT EXECUTIVE COUNCIL RESOLUTIONS	15	15, president of CAgM	Rec. 3 Res. 1
16. STRUCTURE OF CAGM AND ESTABLISHMENT OF OPAGs	16	16, chairperson, Committee of the Whole	Res. 2; 3; 4
17. OPEN FORUM		17, president of CAgM	
18. ELECTION OF OFFICERS		18, president of CAgM	
19. DATE AND PLACE OF THE FOURTEENTH SESSION		19, president of CAgM	
20. CLOSURE OF THE SESSION		20, president of CAgM	

APPENDIX C

LIST OF ABBREVIATIONS

5LTP	Fifth WMO Long-term Plan
6LTP	Sixth WMO Long-term Plan
7LTP	Seventh WMO Long-term Plan
ACMAD	African Centre of Meteorological Applications for Development (Niamey, Niger)
AeMP	Aeronautical Meteorological Programme
AGM	Agricultural Meteorology (Division, WMO)
AGM	Annual Global Monitoring
AgMP	Agricultural Meteorology Programme
AGRHYMET	Regional Training Centre for Agrometeorology and Operational Hydrology and their Applications (Niamey, Niger)
APN	Asia-Pacific Network for Global Change ResearchARCHISS Archival Climate History Project
ASECNA	Agency for Air Navigation Safety in Africa and Madagascar (Dakar, Senegal)
AWG	Advisory Working Group
AWS	Automatic Weather Station
CAGM	Commission for Agricultural Meteorology
CAL	Computer-aided learning
CBS	Commission for Basic Systems
CBD	Convention on Biological Diversity
CCI	Commission for Climatology
CDMS	Climate Database Management System
CGIAR	Consultative Group on International Agricultural Research
CHy	Commission for Hydrology
CIMO	Commission for Instruments and Methods of Observation
CLICOM	Climate Computing
CLIMAG	Task Force on Climate Prediction and Agriculture
COPAG	Chairperson of the OPAG
COST	European Cooperation in the Field of Scientific and Technical Research
DMC	Drought Monitoring Centre
DSSAT	Decision Support System for Agrotechnology Transfer
EC	Executive Council
ENSO	El Niño/Southern Oscillation
ET	Expert Team
ETRP	Education and Training Programme
FAO	Food and Agriculture Organization of the United Nations
GHACOF	Greater Horn of Africa (GHA) Climate Outlook Forum
GIEWS	Global Information and Early Warning System on Food and Agriculture (FAO)
GIS	Geographical Information System
GPS	Global Positioning System
HWRP	Hydrology and Water Resources Programme
IAI	Inter-American Institute for Global Change Research
IARC	International Agricultural Research Centre
ICARDA	International Center for Agricultural Research in Dry Areas (Damascus)
ICRAF	International Centre for Research in Agroforestry (Nairobi, Kenya)
ICRISAT	International Crop Research Institute for the Semi-Arid Tropics (Hyderabad, India)
ICT	Implementation/Coordination Team
ICTT	Intercommission (or Inter-commission) Task Team

IFAD	International Fund for Agricultural Development
IGBP	International Geosphere-Biosphere Programme (ICSU)
IHDP	International Human Dimensions Programme on Global Environmental Change
IITA	International Institute for Tropical Agriculture (Ibadan, Nigeria)
INSTAT	Interactive Statistic
IOS	IGOSS Observing System
IPCC	Intergovernmental Panel on Climate Change
IRI	International Research Institute for Climate Prediction
ISDR	International Strategy for Disaster Reduction
ISO	International Organization for Standardization
IT	Implementation Team
IT	Information Technology
JCOMM	Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology
LADA	Land Degradation Assessment
MARS	Monitoring Agriculture by Remote Sensing
MG	Management Group
NDVI	normalized difference vegetation index
NGO	non-governmental organization
NMC	National Meteorological Centre
NMHS	National Meteorological and Hydrological Service
NMS	National Meteorological or Hydrometeorological Service
NOAA	National Oceanic and Atmospheric Administration
OPAG	Open Programme Area Group
PET	Potential Evapotranspiration
PR	Permanent Representative
PRESANOR	Seasonal Forecast for North Africa
PRESAO	Forum on Climate Prediction and its applications in the Early Warning System for Food Security in West Africa
PROMISE	PRedictability and variability Of Monsoons and the agricultural and hydrological ImpactS of climate change
RA	Regional Association
RANET	Radio and Internet
RCC	Regional Climate Centre
RCM	Regional Climate Model
RCOF	Regional Climate Outlook Forum
RMTC	Regional Meteorological Training Centre
SACOM	Scientific Advisory Committee (ACMAD)
SADC	Southern African Development Community (formerly SADCC)
SARCOF	Southern Africa Regional Climate Outlook Forum
SOI	Southern Oscillation index
START	SysTem for Analysis, Research and Training
TAR	Third Assessment Report (IPCC)
TCO	Technical Cooperation Department
TCOP	Technical Cooperation Programme
TREND	Training, the Environment and New Developments
UNCCD	United Nations Convention to Combat Desertification
UNCED	UN Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change

UNSO	United Nations Sudano-Sahelian Office
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VCP	Voluntary Cooperation Programme
VTL	Virtual Training Library
WCRP	World Climate Research Programme
WGLTP	Working Group on Long-term Planning
WHO	World Health Organization
WSSD	World Summit on Sustainable Development
WWW	World Weather Watch
