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(ASIA)

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IMPLEMENTATION OF THE WWW IN REGION II
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IMPLEMENTATION OF THE REGIONAL STRATEGIC PLAN FOR THE ENHANCEMENT OF THE NATIONAL METEOROLOGICAL SERVICES (NMSs) IN RA II

(Submitted by the Secretariat)

Summary and purpose of document

This document provides information on the implementation of the strategic plan for the enhancement of NMSs in RA II.

ACTION PROPOSED

The Working Group is invited to note the information given in this document and to provide guidance on the implementation of the Regional Strategic Plan related to the WWW

- References:**
1. Abridged Final Report with Resolutions of the Thirteenth Session of RA II (WMO-No. 981)
 2. Final Reports of sessions of the RA II Advisory Working Group
- Appendices:**
- A. Progress Report on the Implementation of the Strategic Plan for the Enhancement of National Meteorological Services (NMSs) in Regional Association II (Asia)
 - B. Extract of the text related to WWW from the Strategic Plan for the Enhancement of National Meteorological Services (NMSs) in Regional Association II (Asia) (2005-2008)

IMPLEMENTATION OF THE STRATEGIC PLAN FOR THE ENHANCEMENT OF NMSs IN RA II (ASIA) (2005-2008)

Background

1. The twelfth session of Regional Association II (Seoul, Republic of Korea, 19 to 27 September 2000) approved the Strategic Plan for the Enhancement of National Meteorological Services (NMSs) in Regional Association II (Asia).
2. XII-RA II endorsed the steps of the implementation of the Strategic Plan and agreed that needs analysis for the development of NMSs in Asia be carried out to identify the requirement of NMSs at national, subregional and regional levels for the enhancement of their Services. It encouraged the chairpersons of its subsidiary bodies and rapporteurs to provide reports on the status of the NMSs in their fields or specialties.
3. XII-RA II encouraged the Members to make available some of their experts to carry out visits and needs analysis on a voluntary basis and/or a cost sharing basis taking into consideration the availability of limited funds.
4. The thirteenth session of RA II (XIII-RA II: Hong Kong, China, 7-15 December 2004) had adopted the updated Strategic Plan for the Enhancement of National Meteorological Services in RA II (Asia) (2005-2008) and endorsed the steps for the implementation of the Strategic Plan as mentioned in the Plan. The updated Strategic Plan was developed taking into account the previous Plan for 2001-2004, the Sixth WMO Long-term Plan (6LTP) and suggestions from Members of the Region in response to a request from the Secretary-General of WMO made in May 2004. Hong Kong, China provided an expert to assist in the work of updating the Strategic Plan.
5. The RA II priorities; challenges and opportunities in respect of observation systems, telecommunication, data-processing and forecasting systems, public weather services, and management, capacity building and transfer of technology, extracted from the Strategic Plan (2004-2008) are presented in Appendix B.

Progress in the implementation

6. The RA II Advisory Working Group (AWG) at its sixth session (Geneva, 21 June 2005) was informed of the financial status of the Trust Fund established for the development and the implementation of the Strategic Plan. In view of the fact that there are not sufficient funds available, the Group encouraged Members to contribute to the Trust Fund.
7. The Group was presented with a preliminary summary of responses by Members to the Survey on the Basic Capability of National Meteorological Services in RA II and encouraged Members to submit the response to the Survey on an annual basis to monitor the implementation of the Strategic Plan.
8. The Group welcomed and supported the development of the two pilot projects to assist developing countries in relation to the Strategic Plan and noted that the implementation of the projects would lead to the enhancement of the capacities of those countries, in particular the Least Developed Countries (LDCs).
9. The RA II Advisory Working Group (AWG) at its seventh session (Geneva, 22 June 2006) welcomed the progress of the two pilot projects as shown below:

Pilot project on the provision of city-specific numerical weather prediction products to developing countries via the Internet

In summer of 2005, a survey was conducted to gather requirements and views from the relevant members of the Coordination Group of the project. In 2006, the first batch of city-specific forecast time series products, provided by Hong Kong, China; Japan; and Republic of Korea was launched. Forecast time series for a total of 50 cities were provided to nine Members. A VCP training course was planned in Hong Kong, China in late 2006.

Pilot project to develop support for developing countries in Aeronautical Meteorology Programme

A test version of the website for the pilot project was launched for the provision of the guidance products for RA II Members. Observers from ICAO and two World Area Forecast Centres (WAFCs) were invited to the Coordination Group of the project. A VCP training course was planned in Beijing, China in late 2006.

10. Fifteenth Congress (Geneva, May 2007) noted with satisfaction the successful implementation of the RA II pilot projects on “Provision of City-Specific Numerical Weather Prediction Products to Developing Countries via the Internet” and “Support for the Developing Countries in the Aeronautical Meteorology Programme”. It recognized that these projects would raise the profile of NMHSs of developing countries, especially LDCs with their own governments, which in turn would encourage those governments to maintain or increase the support to these Services. Therefore, Congress requested the Secretary-General to continue to support the implementation of these projects and to explore the possibility of launching similar projects in other Regions.

11. At the kind invitation of the Government of Pakistan, the Fourth Technical Conference on Management of Meteorological and Hydrological Services in Regional Association II (Asia) was held in Islamabad, Pakistan, from 5 to 9 February 2007, with the theme of “Weather, Climate and Water Services for Secure and Sustainable Living”. The Conference was attended by 37 Directors or senior officials of National Meteorological and Hydrological Services (NMHSs) of 17 Members in Region II, one representative from a regional organization, and two invited lecturers.

12. The lectures and case studies were presented by Directors or senior officials of NMHSs, representatives of international/regional organizations, invited lecturers, and staff of the WMO Secretariat. The presentations covered the following topics of the Conference:

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| Topic I: | Social and economic benefits of weather, climate and water services; |
| Topic II: | New initiatives for observations: WMO Integrated Observing System (IOS) and the Global Earth Observing System of Systems (GEOSS); |
| Topic III: | WMO Information System (WIS) and use of information and communication technology; |
| Topic IV: | Strengthening of NMHSs to provide accurate and timely information to end-users; |
| Topic V: | Role of NMHSs in disaster risk reduction; |
| Topic VI: | Strategy for sustainable development of NMHSs. |

13. Under Topic II - New initiatives for observations, the Conference recommended the following:

- (i) All Members in RA II are urged to participate in GEOSS and NMHSs become fully involved in its implementation process;
- (ii) NMHSs should strengthen their observing networks;

- (iii) WMO should address the need for capacity building for LDCs and small NMHSs in satellite-based technology;
- (iv) WMO Members should have full access to all data generated by GEOSS.

14. With regard to Topic III - WMO Information System (WIS) and use of information and communication technology, the Conference recommended the following:

- (i) The Permanent Representatives should pay more attention to this key project of WMO, and promote WIS at high-level meetings such as the upcoming WMO Congress;
- (ii) For the purpose of responding to requests of users, NMHSs in RA II have to further advance the domestic meteorological services in close cooperation with each other;
- (iii) NMHSs in RA II should participate in the VPN pilot project for RAs II and V and WMO should provide assistance for their participation.

15. Under Topic IV, the Conference recommended that NMHSs should:

- (i) take into account relevance, accuracy and usefulness when preparing and issuing hydrometeorological products and warnings;
- (ii) enhance their system of dissemination of information;
- (iii) build close coordination with disaster management authorities in their respective countries;
- (iv) make use of available facilities in the area of training, NWP, etc., such as those in JMA and KMA;
- (v) In order for NMHSs to further utilize new and existing resources/services (on the Internet) such as NWP output for weekly/seasonal/typhoon forecasts for public weather services or disaster prevention and mitigation, it is worth making an environment which will enable NMHSs to share up-to-date information on available resources/services.

16. Fifteenth Congress (Geneva, May 2007) approved the WMO Strategic Plan for 2008-2011 and beyond, including three Top-level Objectives, five Strategic Thrusts and 11 Expected Results, for the fifteenth Financial Period, as given below:

WMO Strategic Plan for 2008-2011 and Beyond

11 ERs 211 Deliverables

3 Top-level Objectives

To produce more accurate, timely and reliable forecasts and warnings of weather, climate, water, and related environmental elements
To improve the delivery of weather, climate, water, and related environmental information and services to the public, governments and other users
To provide scientific and technical expertise and advice in support of policy and decision-making and implementation of the agreed international development goals and multilateral agreements

5 Strategic Thrusts

Science and Technology Development and Implementation
Service Delivery
Partnership
Capacity-building
Efficient Management and Good Governance

1. Enhanced capabilities of Members to produce better weather forecasts and warnings	12
2. Enhanced capabilities of Members to provide better climate predictions and assessments	14
3. Enhanced capabilities of Members to provide better hydrological forecasts and assessments	8
4. Integration of WMO observing systems	13
5. Development and implementation of the new WMO Information System	7
6. Enhanced capabilities of Members in multi-hazard early warning and disaster prevention and preparedness	24
7. Enhanced capabilities of Members to provide and use weather, climate, water and environmental applications and services	30
8. Broader use of weather, climate and water outputs for decision-making and implementation by Members and partner organizations	36
9. Enhanced capabilities of Members in developing countries, particularly least developed countries, to fulfil their mandates	21
10. Effective and efficient functioning of constituent bodies	16
11. Effective and efficient management performance and oversight of the Organization	32

EXTRACT FROM THE STRATEGIC PLAN FOR THE ENHANCEMENT OF NATIONAL METEOROLOGICAL SERVICES (NMSs) IN RA II (ASIA)

BACKGROUND

This Strategic Plan for the Enhancement of National Meteorological Services (NMSs) in Regional Association (RA) II (Asia) (2005-2008) has been developed taking into account the previous Plan for 2001-2004, the Sixth WMO Long-term Plan (6LTP) and suggestions from Members of the Region in response to a request of the Secretary-General of WMO made in May 2004.

RA II PRIORITIES

The Regional Association attaches the highest priority to the following issues:

- (a) Maintenance and further development of existing observing and telecommunications systems and data processing facilities;
- (b) Natural disaster reduction, mitigation and prevention through the implementation of improved detection, prediction and warning systems of tropical cyclones, monsoon depression and other extreme weather events, including associated storm surges, flash floods and droughts;
- (c) Enhancement of climate observation and monitoring as regional component of GCOS, research and application, including regional climate prediction;
- (d) Enhancement of environment monitoring, including air and water quality, forest fires, ozone, and improvement of prediction of sand/dust storms;
- (e) Implementation of the Strategic Plan for the Enhancement of the NMSs to provide better services, to the public, governments and users, through improved infrastructure and by modern technology;
- (f) Development of effective public weather services to ensure better understanding and appreciation of the value of, and increased benefit from, weather and climate and related environmental information;
- (g) Promoting and strengthening the principle of free and unrestricted international exchange of data and products among National Meteorological, Hydrological and related Services;
- (h) Enhancement of capacity building, including human resources development, to bridge the gap between NMHSs of developing and developed countries and facilitating associated technical transfer through bilateral and multilateral arrangements;
- (i) Enhancement of the collaboration and cooperation among all NMHSs in the Region and between regional centres, in particular, RSMCs, RMTCs, RICs and climate centers, drought monitoring centres, by exchange of information and knowledge and research studies on meteorology, hydrology, climate change and related environmental sciences, including numerical modelling, in order to improve the understanding and the predictions;

- (j) Strengthening meteorological applications and services for aviation and maritime transportation and agriculture;
- (k) Formulation of the Strategic Plan for the enhancement of National Hydrological Services in RA II, Enhancement of the planning and management of water resources, including assessment of surface and ground water resources, through:
 - (i) Improvement of the operational linkages between hydrological and meteorological services with the aim to improve hydrological forecasting and to minimize impacts of natural disasters;
 - (ii) Strengthening of the hydrological components of the Tropical Cyclone Development Plans in the Region;
 - (iii) Development of plans for the establishment of HYCOS – projects in the Region; and
- (l) Strengthening of collaboration with relevant regional bodies, especially ECSAP, ESCWA, ASEAN, and others.

CHALLENGES AND OPPORTUNITIES

NMSs are to take advantage of the challenges and opportunities facing them such as rapid changes in technology, globalization, commercialization and emerging scientific research results. At the same time, it is necessary for them to work together to develop a strategic regional approach to bridging the gap between NMSs of developing and developed countries, particularly in connection with the establishment, operation, maintenance, and enhancement of observation, telecommunication and data-processing systems. A collective approach to some of the challenges faced by individual NMSs has practical and economic benefits.

1. Observation systems

Observation systems are fundamental to the operations of NMSs. Standardization of observation ensures that data collected by each country are compatible with other countries. This includes accuracy, instrument response times and other characteristics of instruments, frequency of observations, exposure, network densities and other related matters.

The number of regional basic synoptic network (RBSN) surface stations has increased from 1195 to 1234 in the period 1999-2003. According to the results of the annual global monitoring of the operation of the WWW, the percentage of SYNOP reports actually received at MTN centres showed a positive trend starting from 82% in 1999 and amounting to 86% in 2003. The number of upper-air stations included in RBSN decreased from 334 (1999) to 327 in 2002. The percentage of TEMP reports received during this period in comparison with expected reports from RBSN stations varied between 52% in 1999 and 59% in 2003. The main reason for the improved availability of observational data was prompt coordinated action taken by the Members concerned, the Secretariat and donor countries. However, the existing gaps in the observational data coverage continues to be due to the deficiencies in the operations of both observing and telecommunication networks, high cost and therefore the lack of consumables and spare parts especially in developing countries and in countries with economies in transition.

With the closure of the Omega radio navigation system, many countries have not been able to switch over to GPS sondes due to its high cost. There is a need to consider an

alternate observing system which does not require expensive consumables, i.e. sondes, yet is capable of yielding data of required accuracy.

WWW monitoring results based on the approved lists of Regional Basic Climatological Network (RBCN) stations (593 CLIMAT and 194 CLIMAT TEMP) as of 2003, showed that the availability of CLIMAT and CLIMAT TEMP reports in the Region was not satisfactory, at about 63% and 64% respectively. The problem in the Region was mainly due to RBCN stations not compiling and transmitting reports according to existing regulations.

There are some specialized systems such as those monitoring climate variability, solar and terrestrial radiation and atmospheric constituents (e.g. ozone, greenhouse gases, air pollutants). Such systems are the Global Climate Observing System (GCOS), the Global Atmosphere Watch (GAW), the World Hydrological Cycle Observing System (WHYCOS), and the Global Ocean Observing System (GOOS).

New types of earth observing satellites including meteorological satellites which are useful to weather monitoring, forecasting, and research have been launched from time to time. However, no single receiving system is capable of receiving and processing the data from all these satellites. This poses difficulty to NMHSs in the least developed countries that may not afford to have more than one satellite receiver. It would be useful if imageries and data from different satellites can be put under and distributed through one or two low cost distribution channels.

There is a need for a survey of the current situation of stations, regionally, to determine the specific needs of each country to meet its obligations.

There is a need to enhance the roles of regional centres such as Quality Assurance/Science Activity Centres (QA/SACs) to assure the quality of GAW data, and to secure regular reports from GAW stations.

Possible solutions to observation systems issues

- (a) For maintaining the integrity of the RBSN, it would be necessary to keep under review RBSN stations of the Region and identify defaulting stations on the basis of quality monitoring reports. It would also be necessary to pursue continuous feedback on the status of RBSN stations, with National Focal Points on matters related to RBSN recently appointed by Members;
- (b) For maintaining the integrity of the RBCN, it would be necessary to keep under continuous review the availability of CLIMAT/CLIMAT TEMP reports from RBCN stations in the Region. Efforts should be made by NMSs to ensure that their operational observing stations compile and transmit the CLIMAT/CLIMAT TEMP messages according to existing regulations;
- (c) As a motivating force in the maintenance of essential observation systems, regular feedbacks and encouragement from global and regional NWP centres (e.g. ECMWF and JMA) to NMSs on data availability and quality may be considered;
- (d) To help NMSs to reduce costs of upper-air observations, the possibility of bulk procurement of GPS sondes through a Central Nodal Agency should be explored;
- (e) The combined use of a wind profiling radar and a radio acoustic sounding system for upper air measurement has been demonstrated to be viable and cost-effective, providing data with a very high temporal resolution which could be very useful to Global Data Processing System centres. Therefore, due consideration should be given to using wind profiling radars with radio acoustic sounding systems at upper air sites where observations have discontinued due to non-availability of Omega Navigation System.

- (f) As AMDAR data have been found to have a positive impact on NWP, to pursue a substantial increase of AMDAR data over the Region;
- (g) Weather radars are very useful for monitoring weather conditions especially during the approach of cyclones/typhoons and other severe weather. The establishment of networks of radars in the Region is to be encouraged. Establishing a central expertise for several installation sites would also be a useful approach;
- (h) As an alternative to setting up meteorological satellite ground receiving stations in each NMS, the possibility of obtaining satellite data via the Internet may be employed for less developed Members. The establishment of a register of useful Websites for this purpose should be also explored;
- (i) To assist NMSs in planning reception facilities and the use of satellite data, the development of a concerted long-term strategy on satellite observation programmes within the Region, that takes account of the WMO Space Programme Long-term Strategy, should be considered; and
- (j) Collection and exchange of non-conventional meteorological data (such as precipitable water vapor retrieved from the Global Position System and observations related to the renewable energy resources) for application in weather forecasting, numerical modeling, etc., should be encouraged.
- (k) NMSs should be fully involved in the planning and implementation of the Global Earth Observing System of Systems (GEOSS).

2. Telecommunication

The collection of observational data within each country and the exchange of observational data and processed information between countries are made through the national meteorological telecommunication networks (NMTNs) and the regional meteorological telecommunication networks (RMTNs), respectively.

The NMTNs are implemented and operated by each country according to both the telecommunication services available and the financial and technical capacities of each country. There is a need to modernize and reinforce the NMTNs to ensure a cost-effective collection of observational data in the countries.

The implementation of RMTN circuits in the Region has made significant progress, in particular the implementation of the IMTN plan for MTN circuits in the Region according to CBS plans; the upgrade of a number of regional circuits to Frame Relay circuits in the southeastern part of the Region; the upgrade of a number of regional circuits to 64 kbit/s digital leased circuits, in particular in the area of responsibility of regional telecommunication hub (RTH) Jeddah; the upgrade of a number of regional circuits to V.34 (19.2-33.6 kbit/s) leased circuits in the northern part of the Region; upgrades of data-dissemination systems by the replacement of an HF radiobroadcast by a satellite-based system using DAB techniques (RTH New Delhi) and in the satellite-based TV-Info-Meteo system; and the introduction of the TCP/IP procedures.

However, there are still a number of shortcomings in the RMTN. In particular, four NMCs were only connected by GTS connections operating at low speeds (Colombo, Katmandu, Male and Yangon); five NMCs have no connection to the GTS (Baghdad, Dushanbe, Kabul, Phnom Penh and Sana'a); and a number of regional circuits were operating at low speed, with a very low cost-effectiveness.

There is a serious threat to the future of the RMTN if it fails to evolve, which could undermine the whole WWW structure and operation.

Possible solutions to telecommunication issues

These include:

- (a) It is important to implement and improve the RMTN using modern cost-effective network services such as frame relay network services and managed data-communication network services.
- (b) Each RTH should survey the technical status, capabilities and opportunities of its associated NMCs, as well as the data-communication network services that are commercially available and cost-effective in their respective zone;
- (c) RTHs should assist their associated NMCs in developing implementation plans, including target implementation dates. These plans should include the migration to TCP/IP, which is a key factor for enabling the use of cost-effective systems and communications, and the migration to Table Drive Code Forms (TDCFs);
- (d) As an initial step, current circuits should be upgraded as soon as possible using data-communication services that are the most cost-effective, such as Frame Relay services where available;
- (e) NMHSs should take the necessary measures for ensuring an adequate training of the technical staff of NMCs on the relevant information and communication technologies for the Improved RMTN;
- (f) Financial assistance is expected to be required for a number of NMCs for the implementation of the Improved RMTN, through individual VCP projects on the basis of NMC/RTH plans, or other cooperation projects;
- (g) The use of the Internet as a method of communication of all types of information to a wide audience needs to be considered and all NMSs in the Region need to enhance its use;
- (h) The Internet may be used to supplement the GTS in the exchange of meteorological data. As an example, Hong Kong, China now receives SYNOP reports (Siemreap (48966) and Phnom-Penh / Pochentong (48991)) experimentally from Cambodia via e-mail and relays the reports to RTH Bangkok via Tokyo. For Members who are still not connected to GTS, similar methods of transmission may be considered; and
- (i) Efforts to explore the use of alternate means for the exchange of meteorological information, such as the use of virtual private network over the Internet, should continue in the framework of the Future WMO Information System (FWIS).

3. Data-processing and forecasting systems

While there had been considerable improvements in the infrastructure and models in some Global Data Processing System (GDPS) centres of the Region, there are still large deficiencies in the data processing capabilities of some Members. Some of the data processing systems of NMSs have not been automated and the Members concerned were not able to derive full benefits from the technological advances that have taken place in the recent past. Some GDPS centres in the Region still plot stations and product weather charts manually.

As regards the generation and dissemination of the GDPS products, every Regional Specialized Meteorological Centre (RSMC) in the Region produces a large number of

products on a daily basis. The availability on the Internet of high-quality products from advanced high-resolution NWP systems operated by major GDPS centres within and outside the Region has opened up new opportunities for NMSs to enhance their capability in providing weather forecast service to the users. It is however noted that the only cost-effective solution for providing access to high quality products of major GDPS centres is to establish a regional database holding high-resolution NWP products of these centres. This initiative has been included in the work-plan of the Rapporteur on Global Data Processing and Forecasting Systems.

In responding to the requirement of several Members and of the United Nations Office for the Coordination of Humanitarian Affairs (UN/OCHA) for meteorological support services for chemical incidents and other non-nuclear emergencies with transboundary pollution, it would be desirable if RSMCs in the Region would develop and implement the necessary models.

Accompanying the remarkable development of numerical modeling techniques for long-range forecasting, including the ensemble forecasting technique, the requirements of Members in the Region for using long-range forecasts produced by numerical models are increasing.

Possible solutions to data-processing and forecasting issues

These include:

- (a) Assisting NMCs which are not equipped with automated systems to acquire the minimum level of data-processing capability;
- (b) Establishing a regional database to provide access to high-resolution NWP products from major GDPS centres such as the European Centre for Medium-Range Weather Forecasts (ECMWF), World Meteorological Centres (WMCs)-Moscow, Washington and Melbourne, and RSMCs-Bracknell, Tokyo and New Delhi, through the Internet or other cost-effective telecommunication means;
- (c) Organizing regional training for the utilization of NWP products and for development of derived products from NWP model outputs, in particular a regional workshop on the use of Ensemble Prediction System (EPS) products;
- (d) GDPS centres disseminating EPS products should include instructions for the interpretation of the products, including the interpretation of probabilistic forecasts, and the associated standard verification scores;
- (e) Provision of NWP models and products by advanced GDPS centres should be in compliance with Members' requests;
- (f) Providing technical assistance to developing countries of the Region to strengthen their NWP capability;
- (g) Formulation of a regional project for NWP using PC clusters and establishment of a pilot project in Mongolia;
- (h) Exchange of software for NWP on a regular basis;
- (i) Sharing of knowledge and experience among NMSs on variation analysis which is becoming the mainstream technique for assimilating remote sensing and other asynoptic data in NWP;

- (j) Highly equipped and more capable RSMCs and NMCs providing assistance to other NMCs in the Region to improve their operational capabilities;
- (k) Exploring the development of low-cost turn-key systems to take advantage of the Internet as a cost-effective means for the exchange of meteorological data and products for the benefit of least developed Members;
- (l) The possibility of developing tailor-made products for individual Members especially the least developed countries should be explored;
- (m) Expanding the products' provision system in the Region to include long-range forecast products, taking into account the methods of provision, the use the products and the role of regional climate centres;
- (n) Expanding the emergency response functions of RSMCs in the Region with regard to chemical spills, forest fires and other accidents, and
- (o) Equipping NMSs with modern forecasting systems in order to improve services to users, including NMSs of neighbouring states, especially in regions with transboundary rivers.

4. Public weather services

Society's expectations of the meteorological community have increased over the recent decades and NMSs are expected to deliver a set of traditional and new products and services with usefulness, timeliness, accuracy and quality higher than before. NMSs are in a position to benefit from many opportunities offered to them, in particular advances in science and technology to meet such expectations. At the same time, they should be prepared to face the challenges associated with the evolving economic and political situation on the global, regional and national levels. These could range from inadequate human and financial resources, to low national status and diminished visibility, and to increasing competition from private companies and the emergence of other external forces that may redefine the role and operations of NMSs. The following strategy should be pursued by the NMSs in the Region:

- (a) To provide appropriate quality information, products and services in a language that can be understood by the community;
- (b) To make substantial effort in public education and in enhancing public awareness, through, among other things, close cooperation with the media, hazards mitigation community, government agencies and weather sensitive sectors;
- (c) To gear toward a service-oriented NMS, putting emphasis on the training of forecasters as PWS frontline personnel, the enhancement of the forecast/warning/products dissemination systems to facilitate forecasters' new role in PWS and the design of PWS products in terms of media-friendliness, convenience in retrieval, readability and user-friendly layout;
- (d) To contribute official forecasts to the WMO pilot project "World Weather Information Service" and promote its use to the public and media;
- (e) To establish Websites and produce television weather programmes to disseminate weather forecasts, warnings, data and information to the general public and other users; and

- (f) To make use of new developments in communication technology in providing “weather information any time any where” to better serve those on the “move”.

5. Management, capacity building and transfer of technology

In considering the rapid changes in technology and the social, political, economic and legal framework in which the individual NMSs are operating in addition to the global environmental challenges, NMSs need to respond to these challenges in such a way as to enable them to properly manage their services, and to have qualified and trained manpower and adequate facilities. Therefore, proper management, continuing training and development are important for the advancement of the NMSs.

The following strategy is to be pursued in respect of management:

- (a) NMSs should ensure that they have long-term development plans, and policy and legal frameworks in place when introducing new services and/or marketing their specialized services. In this regard, NMSs should exchange relevant information and experience;
- (b) NMSs should carry out regular review of and make improvement to the structure, working mechanism and skill of staff of the NMS to increase effectiveness, efficiency and flexibility to cope with changing circumstances;
- (c) NMSs should establish proper salary scales and incentive schemes to retain high calibre and trained staff and to motivate them;
- (d) NMSs should partner with relevant government agencies and institutions, and work closely with the media, private sector and the academia; and
- (e) NMSs should ensure that they have adequate building(s) with modern facilities to enable them to execute and advance their services in a suitable work environment.

The following strategy is to be pursued in respect of capacity building and transfer of technology:

- (a) NMSs should have a commitment to human resources development in all meteorological categories through the implementation of human resources development plans and the adoption of a lifelong learning culture;
- (b) NMSs should take continuing education and training as an investment to help improve the creativity and productivity of staff;
- (c) NMSs should undertake planning, implementation and evaluation of continuing education and training activities in a structured and comprehensive way. They should encourage their staff to take actions for professional certification and, in the long run, consider the adoption of auditing system for the assessment of their staff;
- (d) Regional exchange of technology and management skill among NMSs should be enhanced.

All RSMCs, Regional Instrument Centres (RICs) and Regional Meteorological Training Centres (RMTCs) in the Region should be more active in supporting the plans and requirements related to capacity building and transfer of technology in close cooperation with the Members.

Capacity building is to be underpinned by training and technology transfer in the areas of:

- (a) Observing and processing data and interpretation of outputs from regional centres;
- (b) Information and communication technology (ICT);
- (c) Equipment maintenance;
- (d) Provision of weather services for the public, including service-oriented media/communication skills;
- (e) Provision of weather services for aviation and shipping, including marketing of services and liaison with clients;
- (f) Provision of climate information services;
- (g) Application of NWP products;
- (h) Nowcasting of severe weather; and
- (i) High level and middle management skills.

Training through fellowships, seminars and workshops with assistance from outside the Region needs to be also intensified.
