

RESULTS OF THE SURVEY ON  
IMPACTS OF ACHIEVED RESULTS ON MEMBERS  
CONDUCTED IN JULY-NOVEMBER 2013

FULL REPORT



December 2013

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## Introduction

A survey on the “Impacts of Achieved Results on Members” was undertaken in July-November 2013. The 191 Members of the World Meteorological Organization (WMO) were requested to respond to a questionnaire comprised of 74 questions. To ensure comparability to the baseline data collected in 2012, the majority of the survey questions were not changed. However, some questions were modified to align them with the revised Key Performance Indicators and some new questions were included.

As of November 2013, a total of 97 Members (51%) had responded to the survey. Of these, five submitted incomplete responses. The following is the level of response for each Regional Association (RA):

RA I (Africa): 42%;  
RA II (Asia): 44%;  
RA III (South America): 50%;  
RA IV (North America, Central America and the Caribbean): 77%;  
RA V (South-West Pacific): 33%; and  
RA VI (Europe): 61%.

The National Meteorological and Hydrological Services (NMHSs) that submitted responses are Antigua and Barbuda; Australia; Azerbaijan; Bahamas; Bahrain; Barbados; Belgium; Belize; Bhutan; Bosnia and Herzegovina (incomplete); Botswana; British Caribbean Territories; Canada; Chile; China; Colombia; Congo; Costa Rica; Croatia; Curaçao and Sint Maarten; Cyprus; Denmark (incomplete); Dominica; Dominican Republic; El Salvador; Eritrea; Estonia; Finland; Germany; Greece; Guatemala; Guinea; Guinea-Bissau (incomplete); Guyana; Hong Kong, China; Hungary; Iceland; India; Indonesia; the Islamic Republic of Iran; Ireland; Israel; Japan; Jordan; Kazakhstan; Kenya; Kuwait; Kyrgyzstan; Latvia; Libya; Lithuania; Macao, China; Malawi; Malaysia; Mauritius; Mexico; Mozambique; Namibia; Nepal; New Zealand; Nigeria; Niue; Norway; Panama; Paraguay; Peru; Poland; Qatar; Republic of Moldova; Republic of Uzbekistan; Romania; Russian Federation; Rwanda; Saint Lucia; Sao Tome and Principe; Serbia; Seychelles; Singapore; Slovakia; Solomon Islands; South Africa; South Sudan; Sudan; Sweden; Switzerland; Thailand; The former Yugoslav Republic of Macedonia; Trinidad and Tobago; Turkey; Uganda; Ukraine; United Kingdom of Great Britain and Northern Ireland; United Republic of Tanzania; United States of America; Uruguay; Zambia; and Zimbabwe.

The results, which are presented in the order of questions in the questionnaire, reflect the views of the Members that responded. They will be used to measure performance against the established baselines and targets set in the WMO Monitoring and Evaluation System.

# Results of the Survey

## Expected Result 1:

Enhanced capabilities of Members to deliver and improve access to high quality weather, climate, water and related environmental predictions, information, warnings, and services in response to users' needs, and to enable their use in decision-making by relevant societal actors

**Key Outcome 1.1:** Improved access to seamless weather, climate, water, and related-environmental products and services

KPI 1.1.1: Number of Members demonstrating quantitative measurements of the socio-economic benefits of their products and services

Eighty-two percent of 92 respondents indicated that the products and services that their NMHSs provide were used in the sectors presented in Figure 1. The sectors where the NMHS products and services were mostly used include the general public (77%), emergency management (73%), the aviation industry (63%), agriculture (62%) and the marine industry (51%). Forty-one percent indicated that their services were used in other sectors, such as energy, water, health, transportation, tourism, urban planning, housing, and industry, especially the construction industry. The environment, defence, insurance, mining, the judiciary, academia, and the media were also mentioned. The question was not applicable to 19% of respondents.

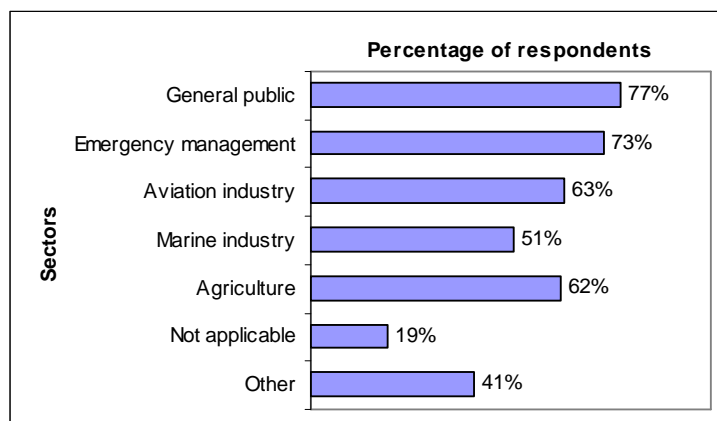


Figure 1: Sectors in which NMHS products and services are used

KPI 1.1.2: Percentage of NMHSs with regular access to products provided by global and regional centres

46% of 96 respondents indicated that they have highly reliable access to products delivered by WMO Global and Regional Centres (Figure 2). An almost similar proportion of respondents (49%) rated their access as 'mostly reliable'. Only 5% regarded their access to products as intermittent. No respondents indicated no access at all.

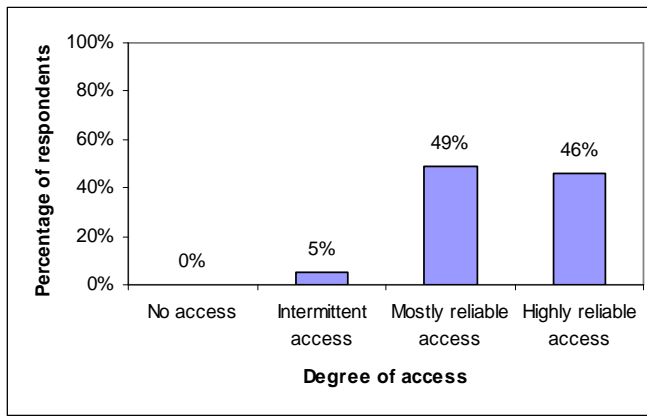


Figure 2: Access to products delivered by WMO Global and Regional Centres shown as number of NMHSs

According to 81% of 95 respondents, the level of access to products provided by global and regional centres improved in the past two years, as presented in Figure 3.

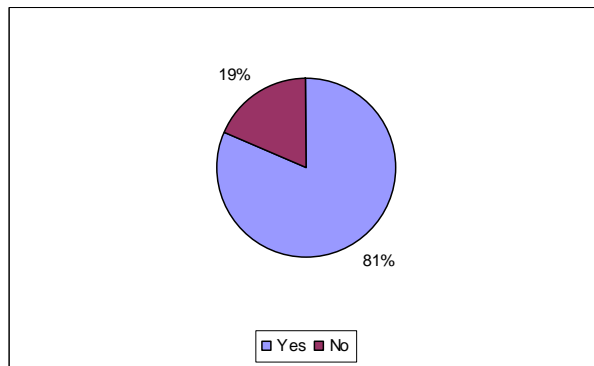


Figure 3: Improvement in level of access to products provided by global and regional centres

The majority of respondents mostly use the internet (90%) and the WMO World Weather Watch Global Telecommunication System (77%) to access data and products, as evident from Figure 4. Some NMHSs utilize private or dedicated lines to centres. Satellite and aeronautical systems represent the other communication systems utilized. Among others, these include Eumetcast (PUMA station), SADIS, Aeronautical Message Handling System (AMHS), Aeronautical Fixed Telecommunications Network (AFTN), and Aeronautical Information Service Recovery (AISR). Other means of communication utilized include fax, AMESD and METLAB 2.

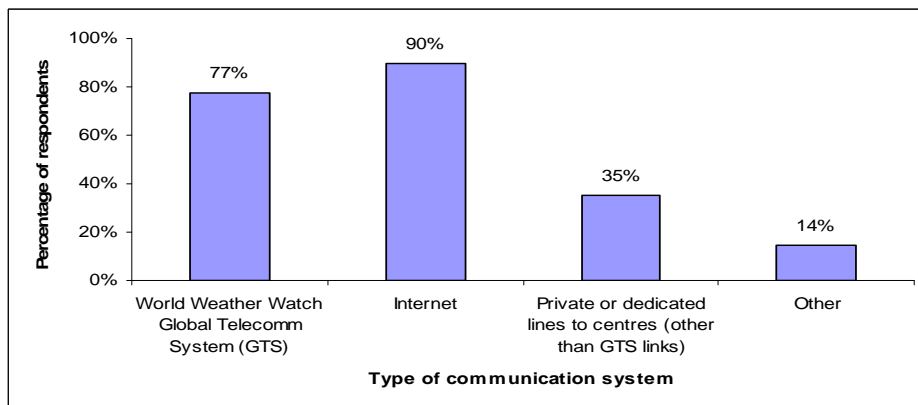


Figure 4: Communication systems used to access data and products

**Key Outcome 1.2: Delivery of weather, climate, water and related environmental products and services to users' communities is improved**

**KPI 1.2.1: Number of NMHSs expressing user satisfaction with the (a) availability, (b) reliability and (c) range of products that are (d) received in time and (e) are an essential contribution to decision making**

As exhibited in Figure 5, the majority of the 95 respondents to this question indicated high user satisfaction with their products and services, based on surveys conveyed and other information at their disposal. Over 70% rated the availability, reliability, timeliness and contribution to decision-making of NMHS products as 4 (satisfactory) or 5 (very satisfactory). The level of satisfaction with the range of products was lower (52%) in category 4 and 5. Forty-three percent gave a rating of 3 (average), and 4% a rating of 2 (dissatisfied).

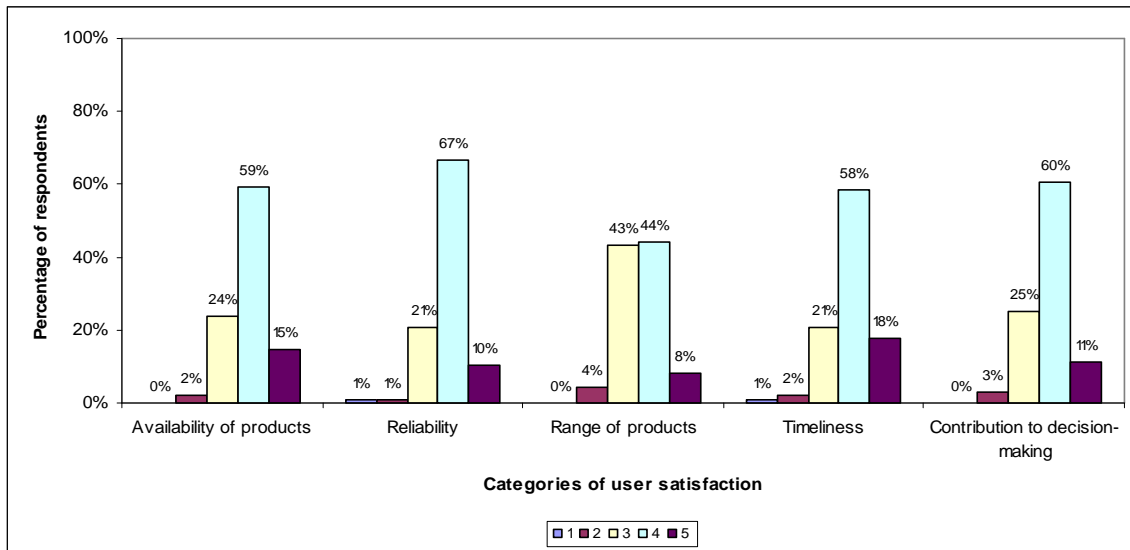


Figure 5: User satisfaction with NMHS products in terms of availability, reliability, range, timeliness and contribution to decision making (1=very dissatisfied; 5=very satisfied)

**Expected Result 2:**

Enhanced capabilities of Members to reduce risks and potential impacts of hazards caused by weather, climate, water and related environmental elements

**Key Outcome 2.1: Multi-hazard early warning systems are implemented**

**KPI 2.1.1: Number of NMHSs contributing to implementation of multi-hazard early warning systems**

95% of 96 respondents are contributing to the implementation of a multi-hazard early warning system in their respective countries.

87% of 91 respondents indicated that their contribution is recognized under a formal agreement, Memorandum of Understanding or other government mandates.

93% of the 96 respondents participate in a disaster risk reduction platform.



## Key Outcome 2.2: National integrated flood management plans are developed

### KPI 2.2.1: Number of Members establishing flood management plans

84% of 96 respondents have a flood management plan established or under development.

### KPI 2.2.2: Number of NMHSs participating in regional hydrological forecasting systems for transboundary river basins

As illustrated in Figure 6, 41% of 93 respondents (or 39 NMHSs) participate in a regional hydrological forecasting system for a transboundary river basin. The question was not applicable to 19% of respondents.

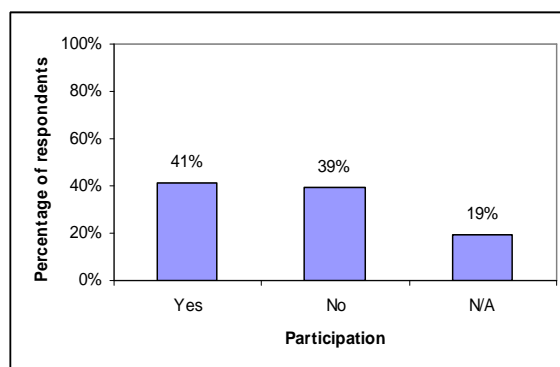


Figure 6: NMHS participation in regional hydrological forecasting systems for transboundary river basins

River basins and the respective year of establishment of the regional hydrological forecasting systems include the following:

<ul style="list-style-type: none"> <li>- Amazon (1978);</li> <li>- Anseba (after 1991);</li> <li>- Barka (after 1991);</li> <li>- Barta (2005);</li> <li>- Benue (2007);</li> <li>- Bug (2013);</li> <li>- Chuya (1997)</li> <li>- Congo basin (2002; 2010);</li> <li>- Cuvelai (unknown);</li> <li>- Danube (various years indicated ranging from 1992 to 2007);</li> <li>- Daugava (unknown);</li> <li>- Drava</li> <li>- Elbe (not known);</li> <li>- Gash (after 1991);</li> <li>- Goacoràn (since 2002);</li> <li>- Great Lakes (1909);</li> <li>- Incomati (after 2000);</li> <li>- Kura River (2010);</li> <li>- Lake of the Woods (1921);</li> <li>- Latoritsa (2001);</li> <li>- Latiroca (1993);</li> <li>- Lempa (since 2002);</li> <li>- Lielupe (unknown);</li> <li>- Limpopo (after 2000);</li> <li>- Mae Kong Basin (for a long time),</li> <li>- Mackenzie River (1997);</li> <li>- Mira river basin (2011);</li> <li>- Moravia (1985)</li> </ul>	<ul style="list-style-type: none"> <li>- MVG (1980);</li> <li>- Narva (2012);</li> <li>- Naryn (1997) Niger (1996, 2007);</li> <li>- Nile (after 1991);</li> <li>- Odra (various years indicated, incl. 2010);</li> <li>- Ottawa River (1983); Save (after 2000),</li> <li>- Pasvik (1985);</li> <li>- Paz (since 2002); Plate (late 80s);</li> <li>- Poprad (1993),</li> <li>- Punge (after 2000); Rhine (not known);</li> <li>- Rio Bravo (1944);</li> <li>- Rio Hondo (2009);</li> <li>- River basins of Russian Federation (in the 1930s);</li> <li>- Sihl (unknown);</li> <li>- Sava;</li> <li>- Senegal (2008);</li> <li>- Talas (1997);</li> <li>- Tana (2000);</li> <li>- Tessin (unknown);</li> <li>- Tisa (2001);</li> <li>- Torne (various years indicated, incl. 1980 and 1999);</li> <li>- Uh (1993);</li> <li>- Upper Vah (1993);</li> <li>- Uzh (2001);</li> <li>- Venta (2005);</li> <li>- Vuoksa (1990);</li> <li>- Zambezi (after 2000).</li> </ul>
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### Expected Result 3:

Enhanced capabilities of Members to produce better weather, climate, water and related environmental information, predictions and warnings to support in particular disaster risk reduction and climate impact and adaptation strategies

#### Key Outcome 3.1: Improved climate monitoring, long range forecasts and long-term projections

KPI 3.1.1: Number of Members issuing (a) monthly predictions, (b) seasonal predictions, (c) climate watch bulletins and (d) long-term projections

In terms of products issued, 81% of 91 respondents issue seasonal predictions, 69% monthly predictions, and 64% climate watch bulletins, as presented in Figure 7. Long-term predictions are issued by less than half of respondents (47%).

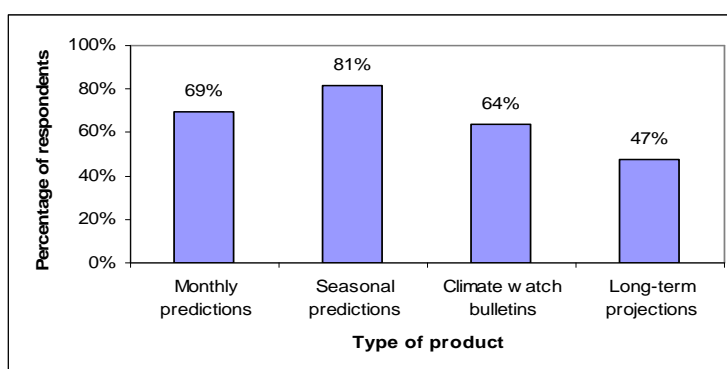


Figure 7: Regional and national-scale products issued in Member states

KPI 3.1.2: Perceived quality of the issued (a) monthly predictions, (b) seasonal predictions, (c) climate watch bulletins and (d) long-term projections

Two new dimensions (quality and timeliness of the issued products) were added to the analysis of impacts of achieved results on Members in 2013. Regarding quality, over 50% of respondents rated their products to be of high to very high quality (i.e. rating category of 4-5), while 32-44% rated the quality of their products as average (category 3) (see Figure 8). Fourteen percent and ten percent of respondents gave a low rating to the quality of seasonal predictions and long-term projections, respectively. Only 6-7% rated the quality of monthly predictions and climate watch bulletins issued in their country as low to very low.

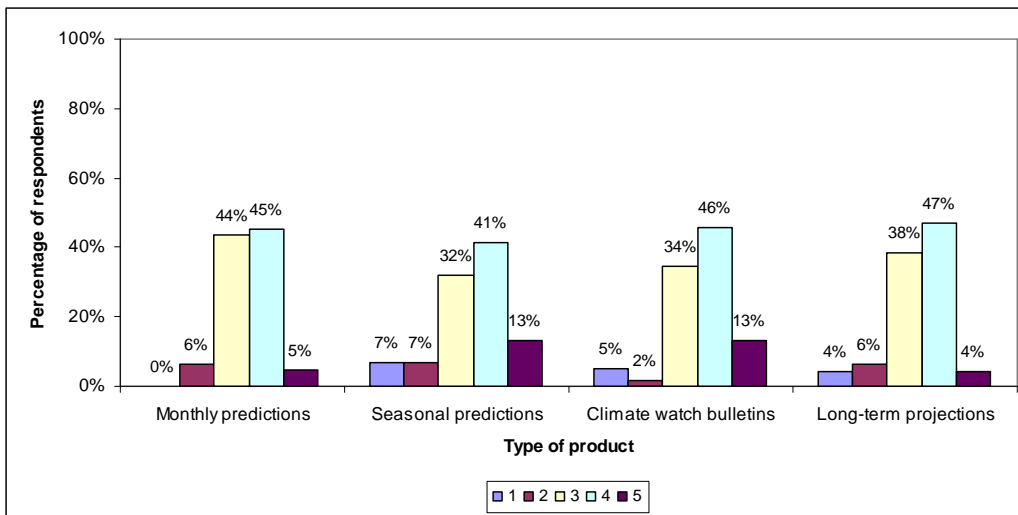


Figure 8: Quality of the regional and national-scale products issued (1=very low; 5=very high)

**KPI 3.1.3: Perceived timeliness of the issued (a) monthly predictions, (b) seasonal predictions, (c) climate watch bulletins and (d) long-term projections**

80% of respondents rated the timeliness of monthly and seasonal predictions as 'timely' or 'very timely' (see 4-5 rating categories in Figure 9). Fifteen to seventeen percent of respondents rated the timeliness of these products as average. Only 3-4% gave the lowest rating (categories 1 and 2) to the timeliness of the products.

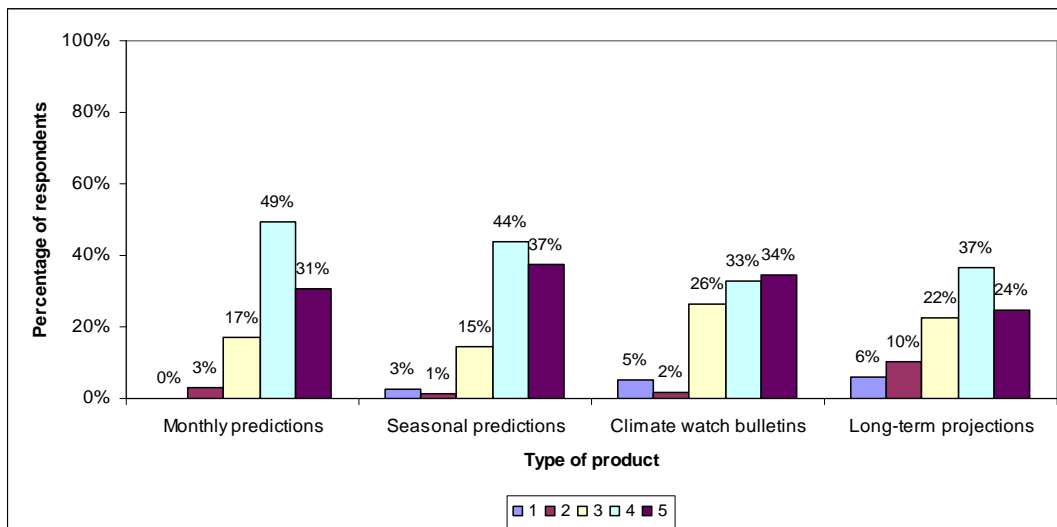


Figure 9: Timeliness of the regional and national-scale products issued (1=very untimely; 5=very timely)

67% rated the issuance of climate watch bulletins as 'timely' or 'very timely,' as presented in Figure 9, and 26% provided an average rating. Only 7% of respondents gave the lowest rating (categories 1 and 2) to the timeliness of climate watch bulletins.

Long-term projections had the lowest rating in terms of timeliness in categories 4 and 5 (61%) and 16% of respondents rated them as 'very untimely' or 'untimely'.

**Key Outcome 3.2: Climate information and prediction products for climate adaptation and risk management are improved**

**KPI 3.2.1: Perceived quality of the products of WMO Regional Climate Centres used at the national level**

For the purposes of this survey, the definition of WMO RCC included not only the operational Regional Climate Centres formally designated by WMO through Technical Regulations, but also candidate RCCs in demonstration phase.

45-60% of the 86 respondents rated the quality of products provided by WMO Regional Climate Centres (RCCs) as ‘high’ to ‘very high,’ as illustrated in Figure 10. These include long-range forecasts (50%), regional climate monitoring products (60%), regional data (50%), and guidance material on regional products (45%). 19% of respondents rated the quality of long-range forecasts and regional climate monitoring products as average. 24% and 27% of respondents rated the quality of regional data and guidance material on regional products as average, respectively.

Dissatisfaction was slightly higher with the quality of long range forecasts and guidance material on regional products, which had ratings of 10% and 8% in the lowest categories, respectively. Only 5% provided a low rating to the quality of regional climate monitoring products, and 6% to that of regional data. The question was not applicable to 16-20% of respondents, as indicated in Figure 10.

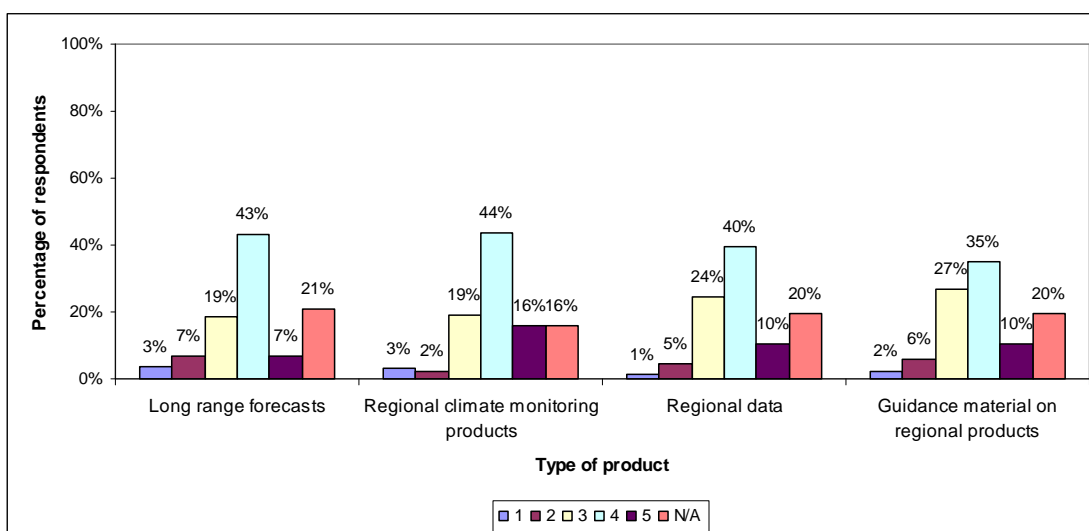


Figure 10: Quality of WMO RCC products based on use by NMHSs (1=very low; 5=very high)

**KPI 3.2.2: Number of Members operationally developing and disseminating climate products and information for national needs**

Figures 11 and 12 present the proportion of Members developing and disseminating a range of climate products and information for national needs. Between 90 and 93 responses were received to this set of questions. As evident from Figure 11, almost all Members who responded contribute to national local climate assessments (97%) and provide climate based climate products derived from national climate data (96%). A large segment of respondents also provide climate diagnostics and climate analysis (89%) as well as conduct hazards and extreme value analysis (84%). Many NMHSs further issue monthly and longer climate predictions, including seasonal climate outlooks (79%); about three-quarters provide specialized climate products, while 71% publish national climate watch advisories and bulletins.

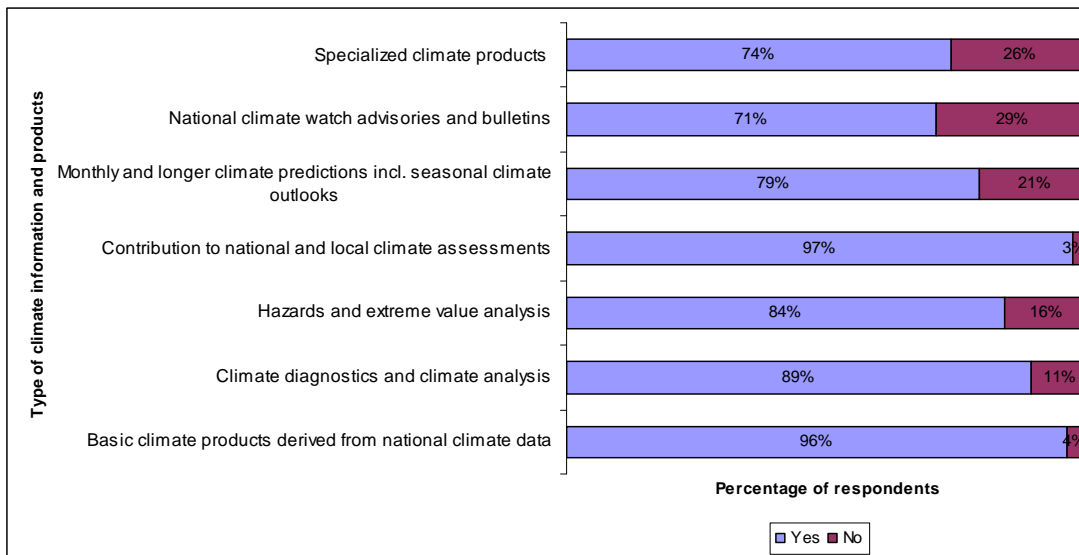


Figure 11: Climate information and products developed and disseminated for national needs

Considerably fewer NMHSs develop and disseminate the climate information and products presented in Figure 12. Sixty percent produce policy- and adaptation-oriented climate information and products, and almost a similar proportion make downscaled long-term climate projections (59%) or produce regional-scale climate model products (57%). Roughly half of respondents generate risk identification and risk assessment products (52%). New models and/or analytical tools as well as products based on interdisciplinary models are developed by 43% and 38% of respondents, respectively. Only a third of them provide global-scale climate model products.

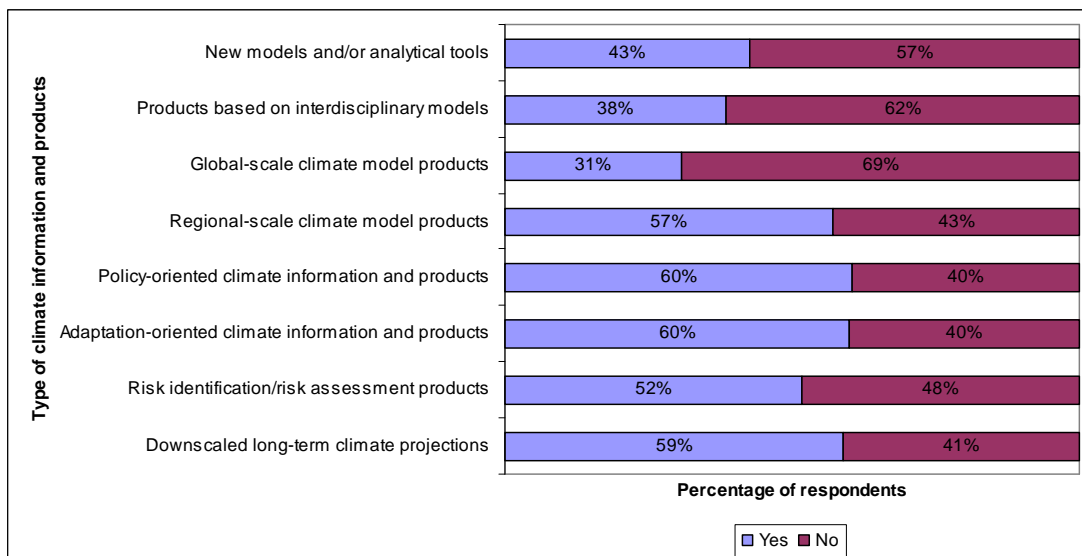


Figure 12: Climate information and products developed and disseminated for national needs (continued)

Ninety percent of 93 respondents indicated that the products and information developed and disseminated by their NMHS for national needs take into account global and regional products and their related guidance material. Eighty-three percent of the same number of respondents participate in Regional Climate Outlook Forums (RCOFs) and the development of regional climate outlook consensus statements.

Eighty-five percent of 93 respondents indicated that the providers of climate information and products in their countries have technical training in the development of climate products.

**KPI 3.2.3: Perceived quality of the national climate information and products available in Member countries**

Figures 13-15 present Members' ratings of the quality of climate information and products, based on 87-92 responses to this set of questions.

The two products/services that are considered of highest quality are (1) the basic climate products derived from national climate data, which 82% of respondents rated as above average (4-5 categories) and (2) NMHS contribution to national and local climate assessments, which 73% of respondents rated as above average (4-5 categories). These are followed by climate diagnostics/analysis and hazards/extreme value analysis, which were rated as above average by 65% and 59% of respondents, respectively. About half of respondents rated the quality of the monthly and longer climate predictions produced, including statistical and model-based seasonal climate outlooks, as above average. Only 15-24% of respondents rated the quality of the products presented in Figure 13 as average (category 3).

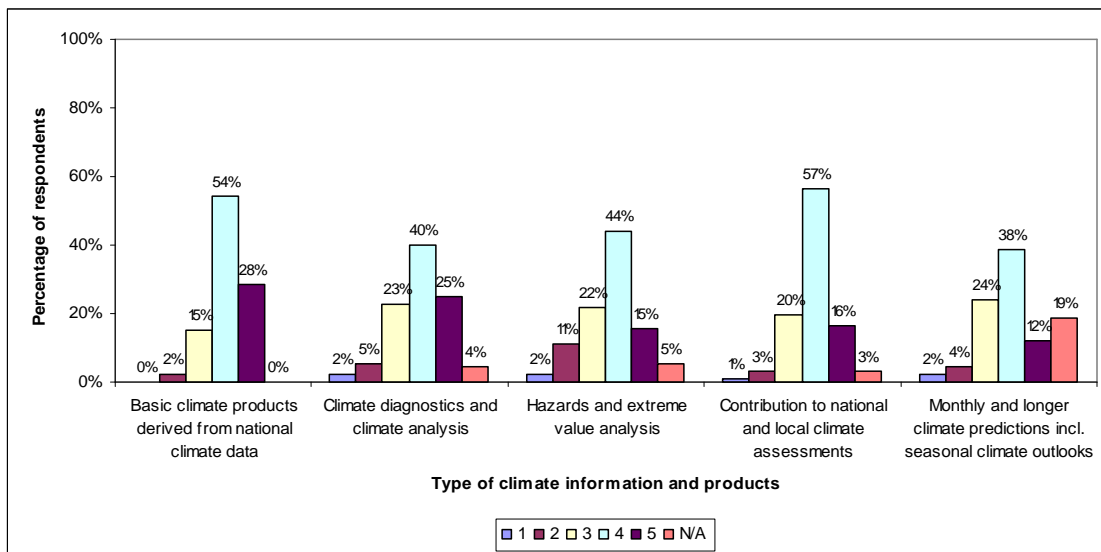


Figure 13: Quality of the climate information and products developed and disseminated for national needs (1=very low, 5=very high)

Hazards and extreme value analysis is the only type of product whose quality was rated as 'low' or 'very low' by 13% of respondents. 6-7% of respondents provided a negative rating to the quality of climate diagnostics/climate analysis and monthly and longer climate predictions. Only 4% of respondents were dissatisfied with the quality of their contribution to national and local climate assessments, and 2% with that of basic climate products.

Figure 14 shows that 57% of respondents rated the quality of specialized climate products as above average (4-5 category), while 51% that of national climate watch advisories and bulletins. The quality of specialized climate products and national climate watch advisories/bulletins received an average rating by 29% and 17% of respondents, respectively. They were negatively assessed by 8-9% of respondents. For a quarter of respondents, the climate information and products displayed in Figure 14 were not applicable. The specialized climate products were the only exception, which were not relevant to 11% of respondents only.

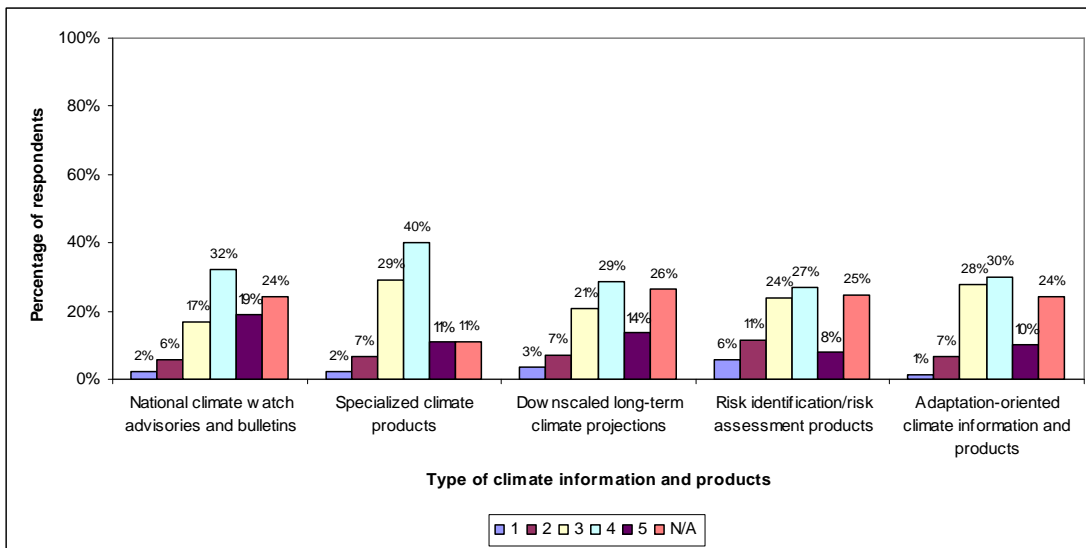


Figure 14: Quality of the climate information and products developed and disseminated for national needs (continued); 1=very low, 5=very high

The quality of the rest of the products and information presented in Figure 14 received slightly lower ratings. Forty-three percent of respondents assessed the quality of downscaled long-term climate projections as above average, 40% that of adaptation-oriented climate information and products, and 35% that of risk identification and risk assessment products. The latter were considered to be of low to very low quality by 17% of respondents. Ten percent provided a negative rating to the quality of downscaled long-term climate projections, while 8% were dissatisfied with that of adaptation-oriented climate information.

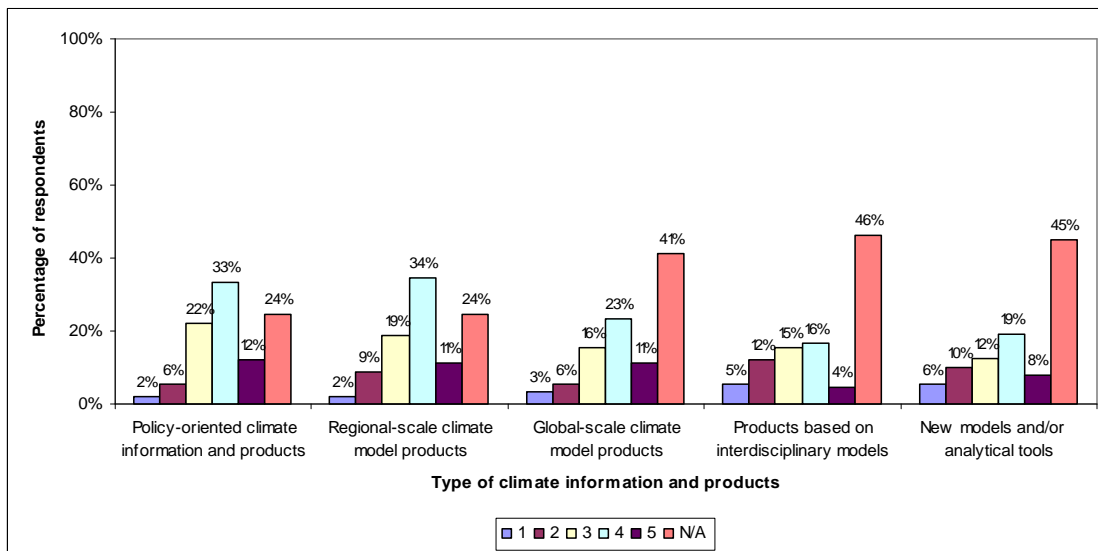


Figure 15: Quality of the climate information and products developed and disseminated for national needs (continued); 1=very low, 5=very high

Figure 15 shows that 17% of respondents rated negatively the quality of products based on interdisciplinary models, and 16% that of new models and analytical tools. Only 20-27% rated the quality of products based on interdisciplinary models and new models and analytical tools as above average. The rating was slightly higher for global-scale climate model products (34%). Products based on interdisciplinary models, new models and/or analytical tools, and global-scale climate model products were not applicable to 41-46% of respondents. They also represent the products with the poorest rating in terms of quality.

**KPI 3.2.4: Number of Members providing targeted/tailored climate information, products and services, through formal mechanisms including National Climate Outlook Forums, to support user requirements in their countries for adaptation and climate risk management in key socio-economic sectors**

As evident from Figure 16, the general public is the sector to which almost all of the 93 respondents provide targeted/tailored climate information, products and services. 80-88% provide such products and services to the agricultural and food security sector, including fisheries and livestock; water resource management; emergency management; energy; transportation (land, air, marine); and government, policy, agencies, NGOs, etc. Close to three-quarters of respondents provide services to the tourism, public health and industrial sectors. Only 65% of respondents indicated that they provided information, products and services for urban design and management.

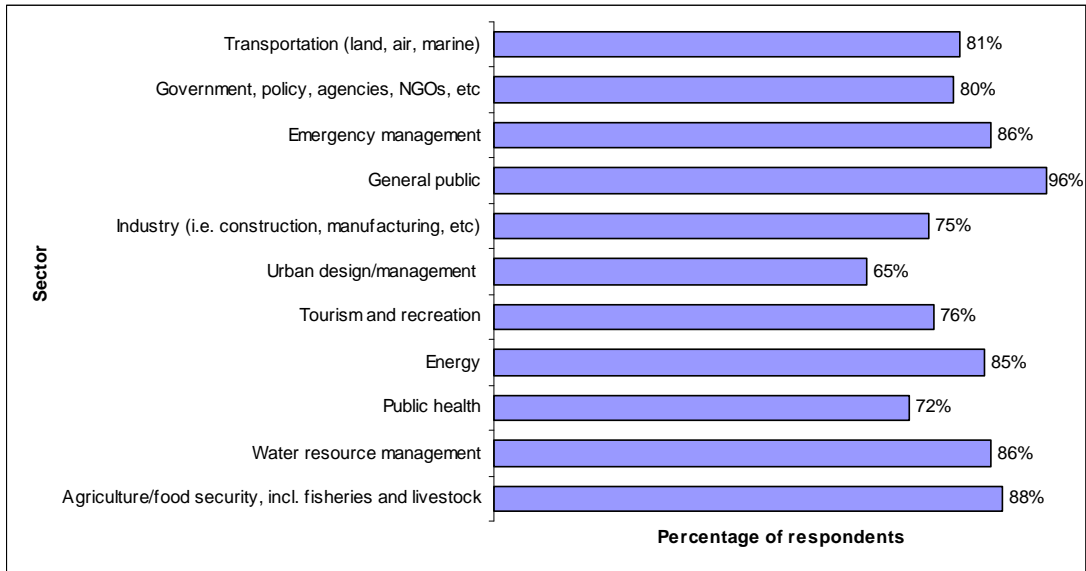


Figure 16: Sectors to which NMHSs provide targeted/tailored climate information, products and services

Figure 17 presents the extent to which liaison occurs between the climate providers and users and those involved in the dissemination of climate outlooks through the following mechanisms: Regional Climate Outlook Forums, National Climate (Outlook) Forums, user-organized forum, web-based dissemination with and without feedback from users.

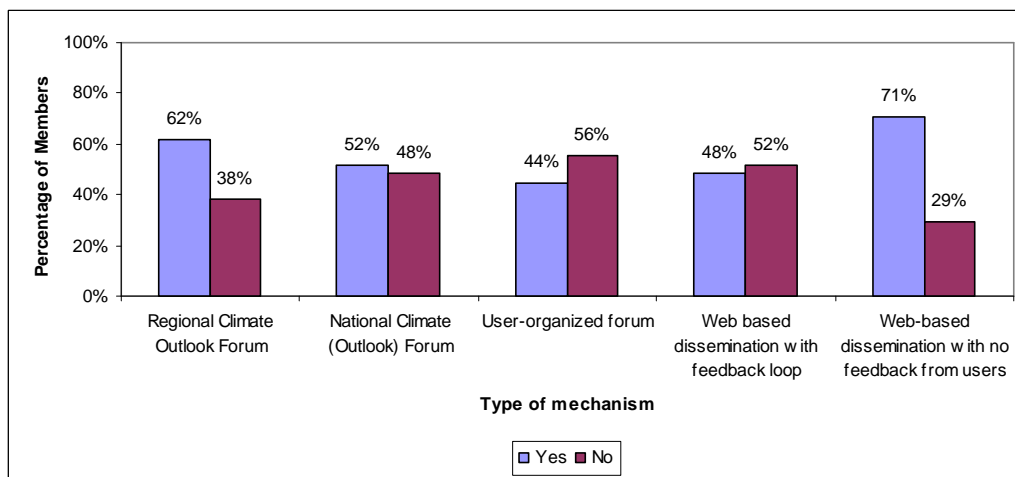


Figure 17: Extent to which liaison occurs between climate providers/users and those involved in the dissemination of climate outlooks through a variety of mechanisms



Only 49% of 90 respondents indicated that the climate providers in their respective countries measure performance statistics related to user satisfaction with national climate information, products and services (i.e. collect user feedback, respond to it, and track progress).

**Key Outcome 3.3:** Hydrological information and products, including water resources, are improved

**KPI 3.3.1:** Number of Members using a Quality Management Framework for Hydrology based on current guidance materials

A Quality Management Framework for Hydrology is in use in 31% of the 89 Members who responded to this question, which is comparable to the results of the 2012 survey when 26% of 97 respondents indicated that such a framework was in use at their NMHS.

**KPI 3.3.2:** Number of regional hydrological databases developed in transboundary river basins

Twenty-two NMHSs (or 25% of 87 respondents) reported the development of new regional hydrological data bases for transboundary river basins. These include:

- Amazon
- Barka
- Buzi
- Congo
- Danube
- Drim
- Elbe
- Gash
- Goascoràn
- Golok
- Hondo
- Incomati
- Lempa
- Limpopo
- Liucngo
- Maputo
- Niger
- Odra
- Pasvik
- Paz
- Prut
- Pungue Rhine
- River basins of the North Caucasus
- Rovuma
- Sava
- Save
- Setit
- Strumica
- Tana
- Torne
- Upper Great Lakes (study)
- Vardar
- Vuoksa
- Zambezi

## Expected Result 4:

Enhanced capabilities of Members to access, develop, implement and use integrated and interoperable Earth- and space-based observation systems for weather, climate and hydrological observations, as well as related environmental and space weather observations, based on world standards set by WMO

**Key Outcome 4.1:** WMO Integrated Global Observing System implementation phase is completed

**KPI 4.1.1:** Percentage of progress in achieving the key implementation tasks, milestones and deliverables specified by the WIGOS Implementation Plan (WIP)

Nineteen NMHSs, or only 21% of 92 respondents, initiated or implemented a WIGOS demonstration national project.

Nine out of 22 Members (or 41%) rated their progress in implementation of the key tasks, milestones and deliverables specified in the WIGOS Implementation Plan as average (Figure 18). Significant progress was achieved by six Members, or 28% of respondents (see 4-5 rating categories in Figure 18). Five Members (or a quarter of respondents) made little progress, while two (or 9% of respondents) did not make any progress.

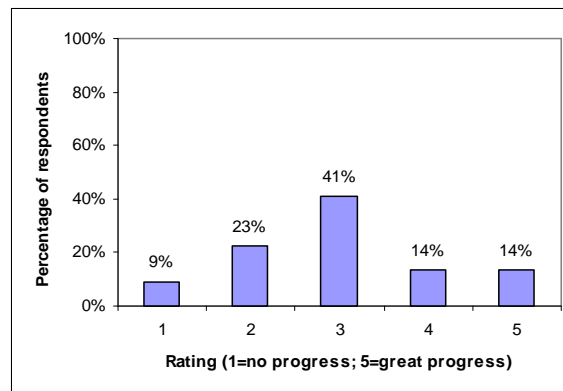


Figure 18: Progress in achieving the key implementation tasks, milestones, and deliverables specified in the WIGOS Implementation Plan

#### KPI 4.1.2: Increased availability of observations for users

77% of 92 respondents indicated an increase in the availability of observations for users/user groups. Of these, most are related to wider surface observation coverage by means of Automated Weather Stations. Many Members further increased their radar and satellite observations, while several improved real-time observations. For example, one Member introduced an online mapping tool that provides real-time observation data and indicative forecasts on a 6 x 6 km grid at any location on the country's territory. Another Member tripled the network of rainfall, meteorological, hydrological, seismic and air-quality stations in four years. Advances were generally made in the detection of lightning and thunderstorms. More synoptic observations were obtained regarding wind, precipitation, temperature, humidity and air quality. Improvements in hydrological and agrometeorological observations were also highlighted.

### Key Outcome 4.2: WMO information System is developed and implemented

KPI 4.2.1: Progress in the implementation of WIS by NMHSs as measured by (a) the percentage of registered WIS centres that have been endorsed as WIS compliant; (b) number of NMHSs with improved observational data and products as a result of implementation of WIS functions

Half of 88 respondents have implemented some functions of the WIS defined in the Manual on WMO Information System (WIS), WMO-No 1060, over the past two years. The specific functions implemented are listed below:

- Data (metadata management; data access and retrieval; publication of data statistics, maps and research; upgrading of data format to comply with TDCF format; use of WIS data for Global Spectrum Model, etc.);
- Global Information System Centres (GISCs);
- National Centres (NCs);
- Forecasting products;
- Data Collection or Production Centres (DCPCs).

Over 60% of 52 respondents improved data access by means of obtaining more observational data. Roughly the same proportion indicated improvements in receiving more products.

Regarding users, two-thirds of 35 respondents indicated that users improved data access by obtaining more observational data, whereas 57% of 30 respondents remarked that users improved data access through acquiring more products.

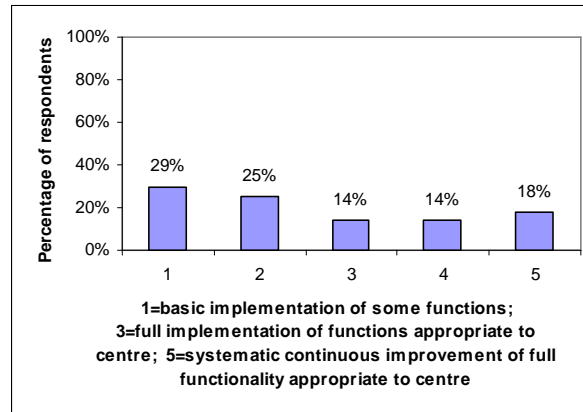


Figure 19: Maturity of WIS functions implemented at NMHSs

Figure 19 presents Members' rating of the maturity of the WIS functions implemented at their respective NMHS. Over half of 51 respondents indicated basic implementation of some functions. Fourteen percent fully implement functions appropriate to their centres, while a third of respondents approach or have reached systematic continuous improvement of full functionality (see 4-5 rating categories in Figure 19).

**KPI 4.2.2: Number of NMHSs whose data processing and management capabilities have enhanced as a result of implementation of WIS functions**

Of the 47 respondents who have implemented some WIS functions, thirty-four (or 70%) indicated improvement in data processing and management capabilities.

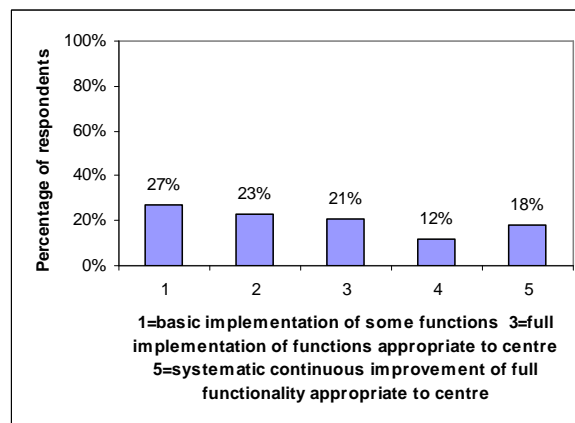


Figure 20: Level of data processing and data management capabilities

In terms of level of data processing and data management capabilities, half of 78 respondents indicate basic implementation of some WIS functions, as presented in Figure 20. About a fifth fully implement functions appropriate to centres, whereas 30% report systematic continuous improvement of full functionality appropriate to centres (see 4-5 rating categories in Figure 20).

## Key Outcome 4.3: Progress in implementing the Global Climate Observing System

### KPI 4.3.1: Percentage of progress in achieving the tasks of the GCOS implementation plan

Seventy-six percent of 92 respondents asserted that their national climate user community had access to data archives at national or global climate data centres operated by their NMHS in 2013.

As evident from Figure 21, respondents assessed highly the quality of climate observations provided by their NMHS. Seventy-two percent of 88 respondents provided an 'above average' rating. According to another 22%, the climate observations provided had been of average quality, while only 7% scored them negatively.

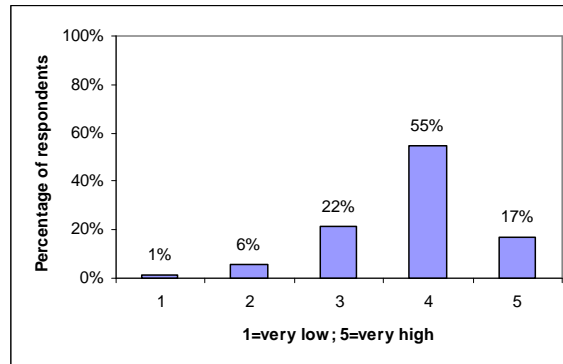


Figure 21: Quality of climate observations provided by NMHSs in meeting user needs

## Key Outcome 4.4: Data rescue and data management systems improved

### KPI 4.4.1: Number of NMHSs undertaking data rescue or being involved in regional collaborative data rescue initiatives such as MEDARE

38% of 92 respondents benefited from a WMO-coordinated data rescue project.

56% percent of the same number of respondents indicated that a data rescue project had been carried out in their country during the past two years.

88% pointed to a continued need for WMO coordinated data rescue projects in their country.

### KPI 4.4.2: Number of Members implementing modern climate data management systems and/or climate monitoring systems

Figure 22 describes the level of adequacy assigned by 93 respondents to the climate data management systems in use in their NMHSs. Almost half considered them to be adequate or very adequate; 39% assessed their adequacy as average, whereas 12% rated them as sub-standard.

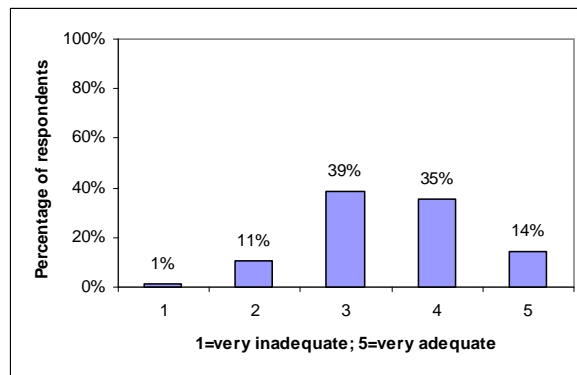


Figure 22: Level of adequacy of the Climate Data Management System in use at NMHSs

75% of 91 respondents have a climate monitoring and/or watch systems in use in their country.

## Expected Result 5:

Enhanced capabilities of Members to contribute to and draw benefits from the global research capacity for weather, climate, water and the related environmental science and technology development

**Key Outcome 5.1:** Research in climate prediction/projection to improve the skills of seasonal, decadal and longer timescales is enhanced

**KPI 5.1.1:** Number of new activities advancing climate research capacity at the global and regional level, especially for early career scientists and scientists from developing and LDC countries

No relevant questions in the survey. The data is collected by the WMO Secretariat using other sources.

**KPI 5.1.2:** Number of early career scientists and scientists from developing and least developed countries that WCRP funded to participate in activities to advance climate research

No relevant questions in the survey. The data is collected by the WMO Secretariat using other sources.

**KPI 5.1.3:** Degree of satisfaction among NMHSs with the skill of climate predictions

Ninety respondents expressed their degree of satisfaction with the skill of climate predictions, as presented in Figure 23. Of these, 39% assessed the skill of climate predictions as 'high' or 'very high,' and the same portion provided them an average rating. Twenty-two percent found the level of skill to be 'low' or 'very low'.

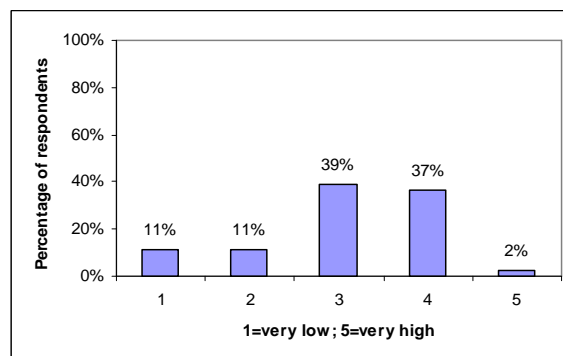


Figure 23: Level of skill of climate predictions issued by NMHSs and other mandated institutions

**Key Outcome 5.2: Research in the prediction of high-impact weather on time scales of hours to seasons is enhanced**

KPI 5.2.1: Number of total research projects (new, ongoing and completed) on operational products and services

No relevant questions in the survey. The data is collected by the WMO Secretariat using other sources.

KPI 5.2.2: Number of Members whose operational products and services have improved as a result of WMO research projects

73% of 80 respondents indicated that their operational nowcasting service had improved as a result of WMO research projects. A similar proportion (71%) saw the access and use of outputs of operational ensemble modelling systems enhanced. About half indicated advances in the design and operational use of mesoscale prediction systems as a result of WMO research projects. Other improvements named include seasonal forecasts as well as design and experimental use of the global numerical weather prediction model.

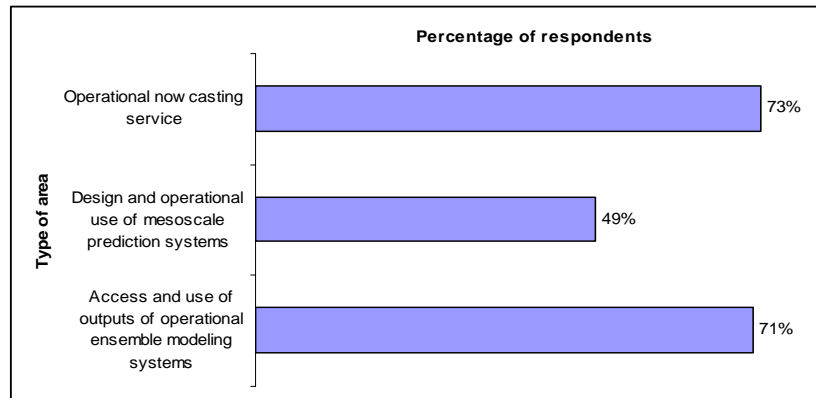


Figure 24: Areas in which operational products and services provided by NMHSs have improved as a result of WMO research projects

KPI 5.2.3: Number of NMHSs in developing and least developed countries participating in regional and international research initiatives on high impact weather or severe weather forecasting demonstration projects

Thirty-one Members, or 45% of the 69 respondents from developing and least developed countries, participated in regional or international research initiatives on high-impact weather or a severe weather forecasting demonstration projects in the past two years.

Their rating of improvements in the capabilities of their respective NMHS to forecast high-impact weather as a result of participation in these activities is presented in Figure 25. Nineteen Members, or 61% of 31 respondents, assessed highly the outcome of their participation in these research initiatives, while six Members (or 19%) gave an average rating. The same share of respondents (19%) found little or very little improvement in the capabilities of their NMHS as a result of these activities.

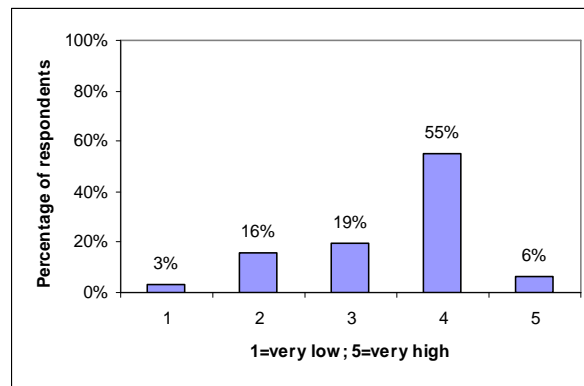


Figure 25: Improvements in capabilities in forecasting high-impact weather

**Key Outcome 5.3: Atmospheric chemistry observations and assessment meet needs of environmental conventions and policy assessments**

**KPI 5.3.1: Degree of Member satisfaction with the (a) usefulness and (b) timeliness of Global Atmospheric Chemistry Bulletins**

As exhibited in Figure 26, 42% of 76 respondents found the WMO Global Atmospheric Chemistry Bulletins to be useful or very useful, and over a quarter gave them an average rating. However, almost a third negatively assessed their usefulness, with 17% expressing doubts about their value and 13% finding them not useful.

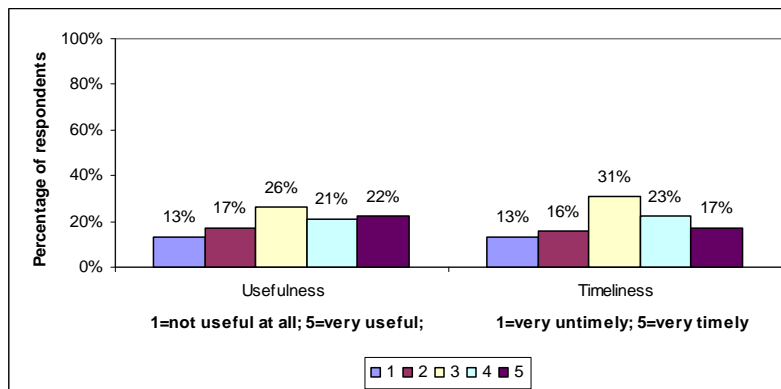


Figure 26: Rating of the usefulness and timeliness of the Global Atmospheric Chemistry Bulletins

In terms of timeliness, 40% of 75 respondents found the WMO Global Atmospheric Chemistry Bulletins to be 'timely' or 'very timely', and 30% gave them an average rating. Nevertheless, a significant share of respondents (29%) were dissatisfied with the timeliness of the bulletins, as evident from Figure 26.

**KPI 5.3.2: Degree of Member satisfaction with the usefulness of (a) GAW measurement guidelines and reports, (b) Sand-and-Dust storm forecasting, and (c) the chemical weather activities of GURME**

Of the 62 respondents to whom the measurement guidelines and procedures developed in the GAW Programme were relevant, 65% highly appreciated their usefulness (see 4-5 rating categories in Figure 27(a)). Sixteen percent of respondents found them moderately useful, while 20% expressed doubts about their utility.

The same situation is true with regard to the sand-and-dust storm forecasting system and information, marked as relevant by 41 respondents. Whereas half positively assessed the usefulness of these products, 30% questioned their value, as evident from the 1-2 rating categories in Figure 27(b). Twenty-two percent found them moderately useful.

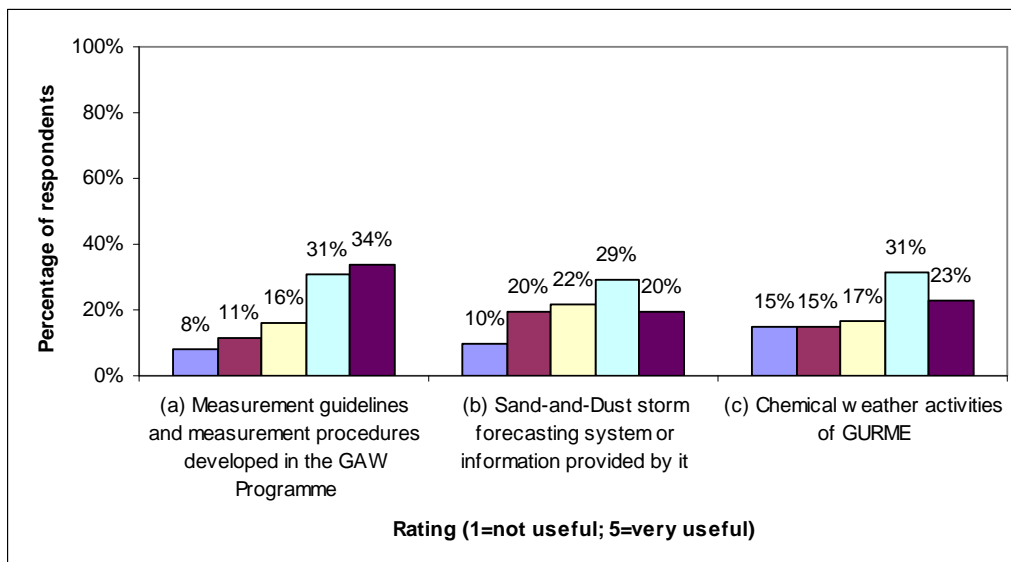


Figure 27: Rating of the usefulness of (a) measurement guidelines and measurement procedures developed in the GAW Programme; (b) Sand-and-Dust storm forecasting system or information; and (c) Chemical weather activities of GURME

The chemical weather activities of GURME were highly valued by 54% of 48 respondents, as presented in Figure 27(c). Seventeen percent rated their usefulness as average, while 30% gave them a negative rating of 1-2.

## Expected Result 6:

Enhanced capabilities of NMHSs, in particular in developing and least developed countries, to fulfil their mandates

**Key Outcome 6.1:** Visibility and relevance of NMHSs in national and regional development agendas is improved, particularly in developing and least developed countries

KPI 6.1.1: Number of NMHSs with (a) increased contribution to national policy setting; (b) improved awareness by users on type of services NMHSs can deliver; (c) improved user accessibility; (d) improved timeliness; and (e) increased accuracy of forecasts and warnings

As illustrated in Figure 28, Members observed significant improvements in their visibility and relevance in the national development agenda, especially with regard to user accessibility to forecasts and warnings (88% of 93 respondents reported moderate to significant increase in this regard). Other important factors were the timeliness and accuracy of forecasts and warnings. The former contributed to the enhanced visibility and relevance of NMHSs at the national level according to 84% of 93 respondents; the latter played a role in the opinion of 82% of 92 respondents. Eighty percent thought that users were better aware of the types of services that NMHSs can deliver. Two-thirds further reported increased contribution to national policy setting. A quarter indicated no change in this respect.



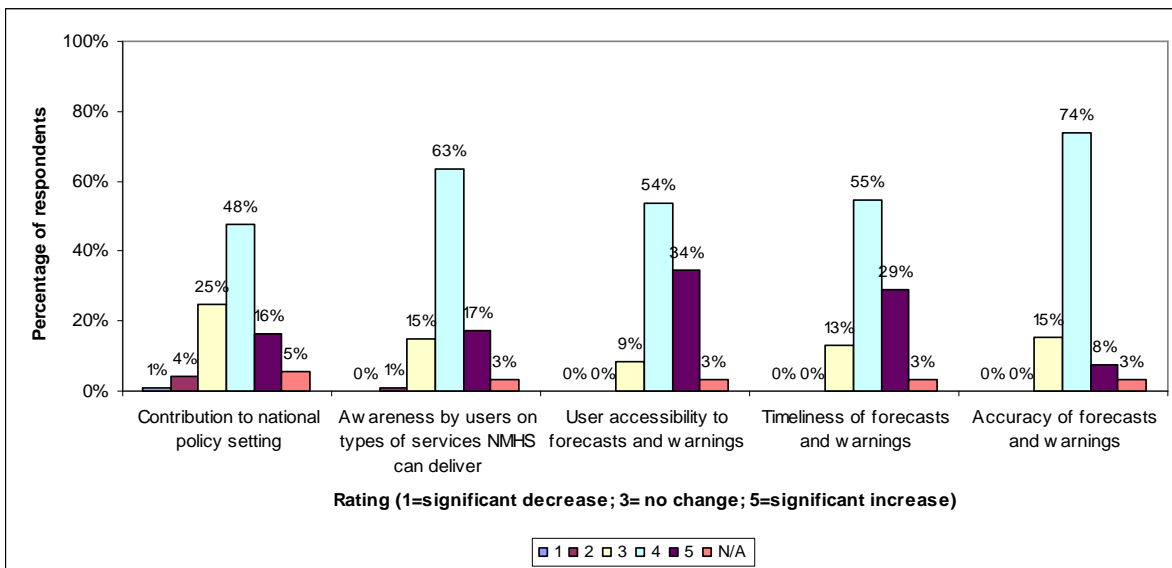


Figure 28: Change in the visibility and relevance of NMHSs in the national development agenda

As evident from Figure 29, considerably less improvement was noted in terms of the visibility and relevance of the regional services provided by NMHSs in the regional development agenda, though this question was not applicable to 20-24% of the 91 respondents. About half accounted the increased visibility and relevance of their regional services to improved user accessibility to forecasts and warnings delivered by Regional Centres as well as to their enhanced timeliness and accuracy. A quarter reported no change in this regard.

In terms of contribution to regional policy setting, 38% indicated that the visibility and relevance of their NMHS had increased over the past two years, though an equal portion indicated no change in this regard. Forty-one percent of respondents attributed this positive development to increased awareness by regional users of the types of services that can be provided by Regional Centres.

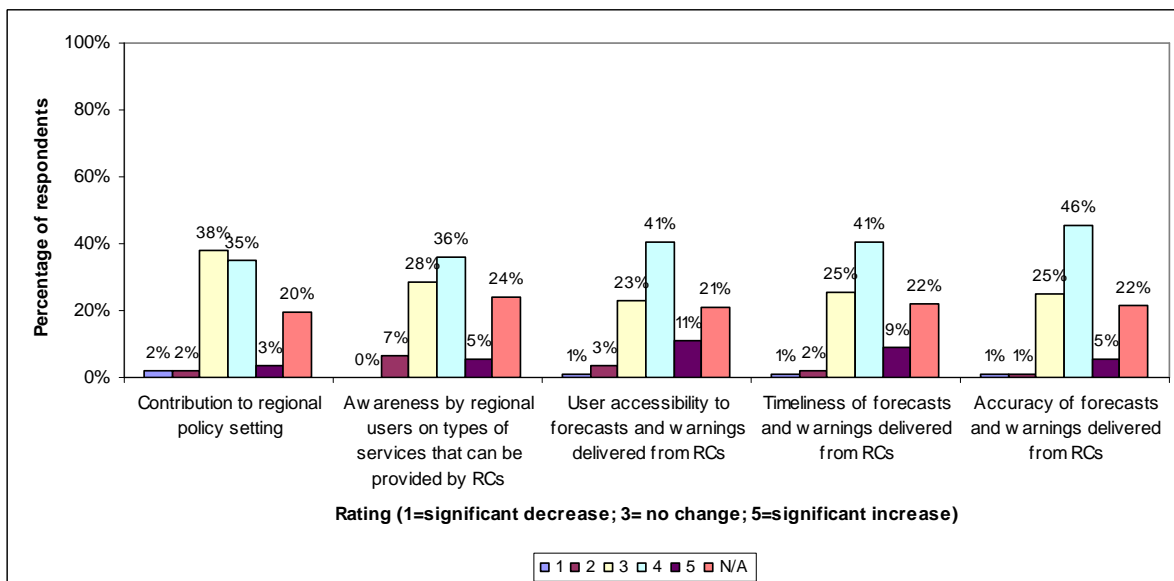


Figure 29: Change in the visibility and relevance of the regional services delivered by NMHSs in the regional development agenda

**Key Outcome 6.2:** Infrastructure and operational facilities of NMHSs and Regional Centres are improved, particularly in developing and least developed countries

**KPI 6.2.1:** Number of NMHSs with improved infrastructure and operational facilities

Improvements to the infrastructure and operational facilities of NMHSs were reported as follows by the 92 respondents to this question:

- 93% in the surface observing network;
- 43% in the upper-air observing network;
- 74% in equipment for meteorological/environmental satellite data;
- 82% in the data-processing/forecasting sector.

Other improvements mentioned include web and mobile service delivery, the use of social media, increased radar coverage as well as repairs to radar and satellite systems, upgrade to corobor systems, enhancements to server and storage virtualization technology, increased quality control and calibration, satellite data acquisition, local area numerical weather prediction, the use of biometeorological indices, and the conduct of hydrometeorological early warning and hazard risk assessments.

**Key Outcome 6.3:** Education and training development activities at national and regional levels are improved, especially in developing and least developed countries

**KPI 6.3.1:** Number of institutions providing education and training support for GFCS related activities

No relevant questions in the survey. The data is collected by the WMO Secretariat using other sources.

**KPI 6.3.2:** Degree to which Members are getting value for money from the WMO Fellowship Programme

The WMO Fellowship Programme was not applicable to 37% of the 92 respondents to this question. Of the 58 respondents to whom it was relevant, 55% obtained high to very high value from the Programme as evident from the 4-5 rating categories in Figure 30. The Fellowship Programme was moderately useful to 17% of respondents, while 28% rated its value as low to very low.

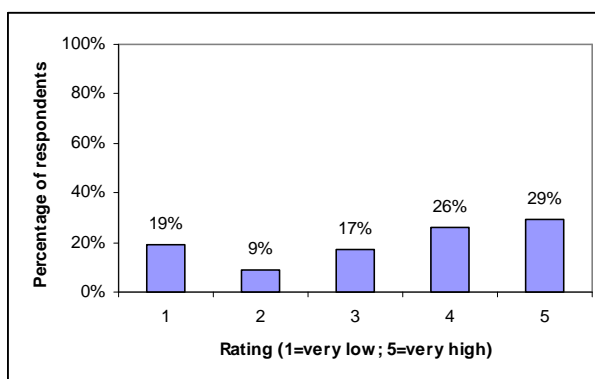


Figure 30: Value obtained from the WMO Fellowship Programme

**KPI 6.3.3: Degree of Member satisfaction with the RTCs in use**

The WMO Regional Training Centre(s) where NMHSs sent staff are as follows:

- Region I = 17 (Africa)
- Region II = 26 (Asia)
- Region III = 6 (South America)
- Region IV = 16 (North America, Central America and Caribbean)
- Region V = 7 (South-West Pacific)
- Region VI = 25 (Europe)

Their degree of satisfaction with the RTCs is presented in Figure 31, rated on a scale of 1-5, where 1=very low and 5=very high.

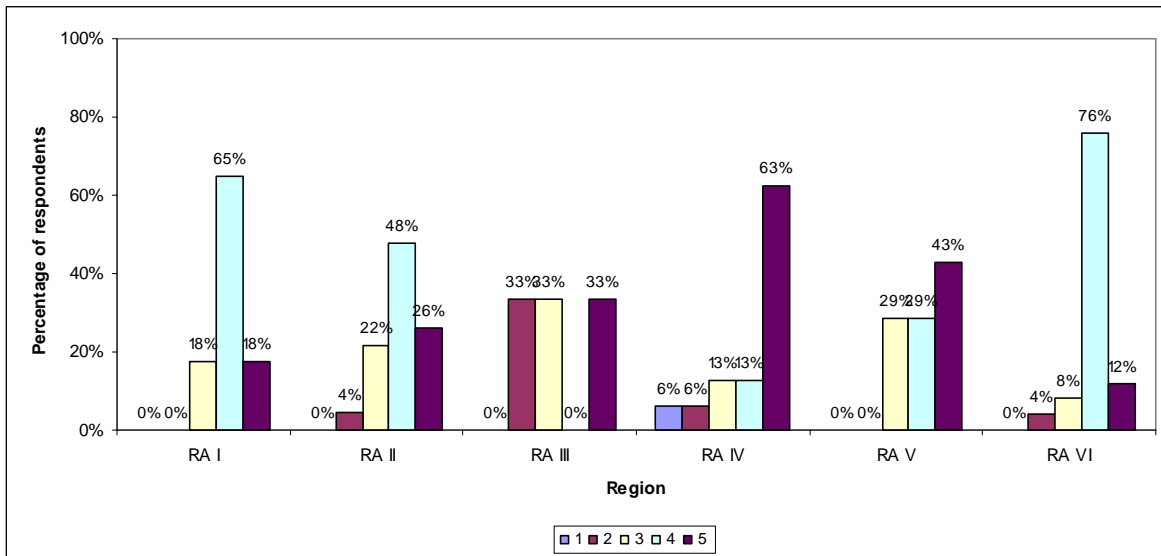


Figure 31: Rating of satisfaction with RTCs in each Region

**Key Outcome 6.4: Capacities of NMHSs are enhanced through cooperation and partnerships with other national and regional organizations**

**KPI 6.4.1: Development projects and activities funded through voluntary contributions**

Of 91 respondents, 56% received development funding or assistance from international partners to support projects and activities. Of these, 88% believed that the capacity of their NMHS had enhanced or significantly enhanced as a result of the implemented activities. Only 8% were moderately satisfied with the impact of these activities, as presented in Figure 32. Four percent saw no improvement as a result.

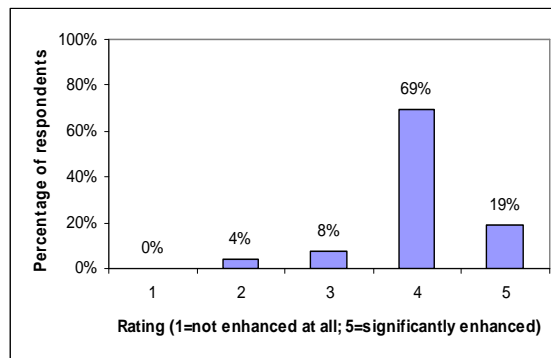


Figure 32: Rating of success in enhancing NMHS capacities as a result of projects and activities implemented with funding from international partners

## Expected Result 7:

New and strengthened partnerships and cooperation activities to improve NMHSs' performance in delivering services and to increase the value of the contributions of WMO within the UN system, relevant international conventions and national strategic issues

**Key Outcome 7.1:** WMO leadership and contribution in relevant UN system and other international partners' initiatives and programmes is improved

**KPI 7.1.1:** Number of reports of WMO and its co-sponsored programmes submitted to UN and other international conventions, particularly the UNFCCC, UNCCD and UNCBD

No relevant questions in the survey. The data is collected by the WMO Secretariat using other sources.

**KPI 7.1.2:** Number of contract/cooperation agreements within which WMO is engaged with partners

No relevant questions in the survey. The data is collected by the WMO Secretariat using other sources.

**KPI 7.1.3:** Number of NMHSs implementing projects with the UN and other international and/or regional organizations

Seventy-two percent of 92 respondents implemented projects or activities in partnership with United Nations (UN) and other international organizations over the last two years.<sup>1</sup> The vast

<sup>1</sup> The following is an exhaustive list of the partner organizations mentioned: Adam Smith International, ADB, AFDB, AEMET (the Spanish State Meteorological Agency), AECID (the Spanish Agency for International Cooperation for Development), APEC Climate Centre, APEC Research Centre for Typhoon and Society, Association of Southeast Asian Nations (ASEAN), Caribbean Catastrophe Risk Insurance Facility (CCRIF), BSC, CARE International, the Caribbean Community Climate Change Centre, CATHALAC (Water Centre for the Humid Tropics of Latin America and the Caribbean), CICOS (International Commission for the Congo-Oubangui-Sangha Basin), Coordination Group for Meteorological Satellites (CGMS), CMA, CNES (National Centre for Space Studies), Danish Government, Department for International Development (DFID), European Centre for Medium-Range Weather Forecasts (ECMWF), European Environment Agency, European Research Council, Environment Canada, EUMETNET, EUMETSAT, the European Union, Food and Agriculture Organization (FAO), FMI, Group on Earth Observations (GEO), Global Environmental Facility (GEF), GIZ (German Society for International Cooperation), International Civil Aviation Organization (ICAO), ICPE, International Council for Science (ICSU), Intergovernmental Oceanographic Commission, Indian Ocean Commission, International Atomic Energy Agency (IAEA), International Red Cross, JICA, Mekong River Commission, NASA, National Oceanic and Atmospheric Administration (NOAA), Nordic Council, Nordic Development Fund, Norwegian Government, Pacific Tsunami Warning Centre (PTWC), Oxfam, Swedish International Development

majority were realized in cooperation with multilateral partners, including UN organizations and the World Bank. A large number of activities were implemented in partnership with regional organizations, such as the European Union, the African Development Bank (AFDB), the Asian Development Bank (ADB), the Caribbean Community Climate Change Centre, the Secretariat of the Pacific Regional Environment Programme (SPREP), etc. Quite a few involved the participation of bilateral partners, such as the Finish Meteorological Institute (FMI), the Japan International Cooperation Agency (JICA), the China Meteorological Administration (CMA), the Norwegian Government, etc. Only three respondents mentioned direct collaboration with universities and research institutes.

Sixty-eight percent of the 92 NMHSs actively contributed to the work of IPCC. Of these, 58% did so by nominating and supporting authors and review editors and 88% by contributing to government/expert review of IPCC reports.

**Key Outcome 7.2: Public, decision-makers and other stakeholders are increasingly aware of key WMO and NMHSs issues, activities and priorities through enhanced communication**

**KPI 7.2.1:** Uptake of WMO public information outputs as measured by (a) number of unique visitors on the WMO website; (b) number of times WMO was mentioned in press articles; (3) number of Facebook fans; and (d) number of Twitter followers

No relevant questions in the survey. The data is collected by the WMO Secretariat using other sources.

**KPI 7.2.2: Degree to which NMHSs make use of WMO public information outputs**

As evident in Figure 33, there is a high level of utilization of WMO non-technical, public information outputs, such as website, press releases, World Met Day materials, In the Media, Facebook, Twitter, etc. Of 92 respondents, almost two-thirds indicated that they use them frequently or on a regular basis. Sixteen percent indicated that they always make use of the non-technical materials produced by WMO, while 22% only use them occasionally.

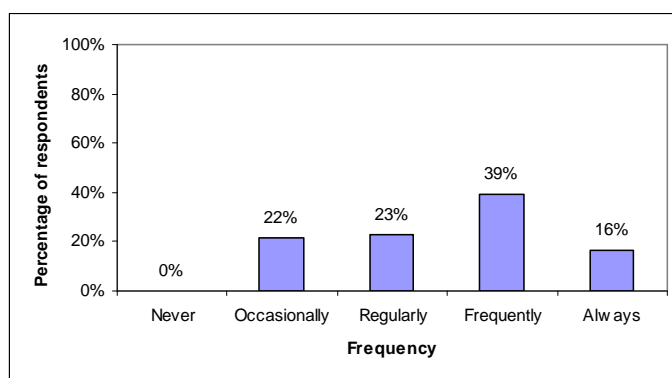


Figure 33: Frequency of use of non-technical, public information outputs

Cooperation Agency (SIDA), Secretariat of the Pacific Community (SPC), SPREP, UK Met Office, UN Water, United Nations Convention to Combat Desertification (UNCCD), United Nations Framework Convention for Climate Change (UNFCCC), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Office for Disaster Risk Reduction (UNISDR), World Health Organization (WHO), World Food Programme (WFP) and the World Bank.

**KPI 7.2.3:** Number of NMHSs that have provided training to senior managers and/or communication officers in media relations, social media or other aspects of communications

The senior managers and communication officers at 51% of 89 Members received training in media relations, social media or other aspects of communication.

## **Expected Result 8:**

### **An effective and efficient Organization**

#### **Key Outcome 8.1: Effective and efficient WMO Congress and EC**

**KPI 8.1.1:** Degree of Member satisfaction (rating of 3-5) with documentation for Cg, EC and its working groups

Seventy-three percent of respondents rated the technical content of EC-65 documentation as average to above average, while 80% provided such rating to the language quality of documents.

**KPI 8.1.2:** Degree of Member satisfaction (rating of 3-5) with supporting services for Cg and EC (interpretation, conference activities and facilities)

Sixty-seven percent provided a rating of 3-5 (average to above average) to the quality of interpretation at EC-65; 73% expressed satisfaction with the paperless sessions, while 93% were happy with the efficiency of badge delivery.

**KPI 8.1.3:** Decrease in the total cost of sessions held under similar conditions

No relevant questions in the survey. The data is collected by the WMO Secretariat using other sources.

#### **Key Outcome 8.2: An effective and efficient WMO Secretariat**

**KPI 8.2.1:** Degree of Member satisfaction (rating of 3-5) with documentation for Cg, EC and its working groups

No relevant questions in the survey. The data is collected by the WMO Secretariat using other sources.

#### **Key Outcome 8.3: Effective and efficient constituent bodies (RAs and TCs)**

**KPI 8.3.1:** Degree of Member satisfaction (rating of 3-5) with constituent body documentation

Based on responses to questionnaires regarding the CAS-16 and RA VI-16 meetings, 80% of respondents rated the technical content of constituent body documentation as average to above average. Ninety-three percent provided such rating to the language quality of documents.

**KPI 8.3.2:** Degree of Member satisfaction (rating of 3-5) with constituent body supporting services

Ninety-three percent provided a rating of 3-5 (average to above average) to the quality of interpretation at CAS-16 and RA VI-16. Ninety-one percent expressed satisfaction with the paperless sessions, while 86% were happy with the efficiency of badge delivery.

**KPI 8.3.3: Decrease in the total cost of constituent body sessions held under similar conditions**

No relevant questions in the survey. The data is collected by the WMO Secretariat using other sources.

## WMO Services and Activities

### ***Overall satisfaction with WMO services and activities***

As presented in Figure 34, 69% of 86 respondents highly value the services and activities provided by WMO. Over a fifth found them moderately useful, while only 8% questioned their utility.

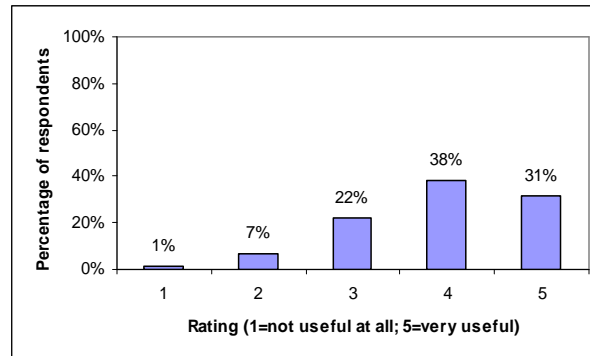


Figure 34: Usefulness of WMO services and activities

### ***Areas in which WMO activities and services have been beneficial***

The two areas of WMO services and activities that the 90 respondents value most are:

- Observing systems and data collection, exchange and rescue, with WIS and WIGOS featuring widely in Members' responses; and
- Capacity building, including trainings, workshops, fellowships, study tours, etc.

Other WMO activities and services that are also highly appreciated by Members include:

- WMO programmes, including the Aeronautical Meteorology Programme (AMP) and related Quality Management System (QMS), the Disaster Risk Reduction (DRR) Programme, the Severe Weather Forecasting Demonstration Project (SWFDP), the Tropical Cyclone Programme (TCP), and the Marine Meteorology and Oceanography Programme (MMOP).
- Provision of climate services, with the Global Framework for Climate Services (GFCS) specifically highlighted;
- Standardization and provision of guidelines, procedures, manuals and other publications;
- The role of WMO as convener and sponsor of meetings/conferences;
- Meteorological services, and specifically the Public Weather Services (PWS) Programme and the development of medium- and long-term weather and climate diagnostics and prognosis.

The ability to participate in technical commissions, expert teams and regional activities is also considerably valued by Members, and especially the financial assistance provided by WMO to representatives from developing and least developed countries. The provision of technical support (e.g. equipment, software, tools, expertise and the Voluntary Cooperation Programme) is another area of WMO support that is seen as particularly beneficial to Members.

### **Ability to respond to users' needs and contribute to decision making**

Sixty percent of 91 respondents indicated significant improvement in their ability to respond to users' needs and contribute to decision making through participation in WMO activities, as evident from Figure 35. Close to 40% registered minor improvements, while only 2% did not assign any credit to WMO for their capacity development.

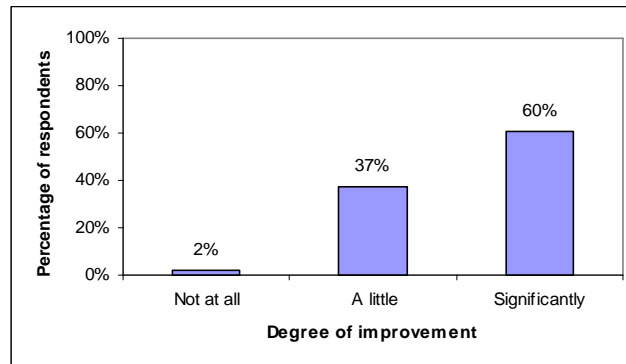


Figure 35: Improvement in the ability of NMHSs to respond to users' needs and to contribute to decision makers as a result of participation in WMO activities

### **Major successes from leveraging off WMO activity in changing influence on decision makers or users of services**

The three areas where respondents indicated highest achievements are:

- Communication to the public and decision makers, including the provision of more accurate forecasts and heightened awareness of climate change;
- Capacity building and technology transfer; and
- Climate services.

Other areas highlighted, though to a lesser extent, include:

- Early warning and disaster risk reduction;
- Institutional and policy developments (e.g. application of WMO standards in decision making, approval and publication of a national protocol for the installation and operation of hydrometeorological stations, integration of NMHS into national emergency management network, development of national policies, etc.);
- Elevated international status and improved reputation due to WMO's authority on the science of meteorology and hydrology;
- Strengthened cooperation among government institutions;
- Development of guidelines and tools.

The following are a few highlights of achievements mentioned by respondents:

**British Caribbean Territories:** *“By attending the WMO Hurricane Committee meetings we are always equipped with the latest information and techniques. Recently we brought the country's National Hurricane Plans to commendable standard which was welcomed by the Hazards Management Committee and the Government.”*



**Canada:** “GFCS has helped us focus attention on the need for robust climate services in Canada and link it to adaptation to a changing and variable climate for increased resiliency of infrastructure, the economy and society.”

**China:** “The WMO/CMA Pavilion in EXPO 2010, MeteoWorld Pavilion was a good case. The Pavilion was more than a simple exhibition pavilion, it was a complete facility providing not only demonstrations of meteorological science and technology, but also bringing a real working weather service to provide accurate, interactive and customized service to the EXPO Organizer, participants, and visitors. (...)The Pavilion helped people better understand weather service, and the leaders of the Shanghai Municipal Government, the Expo organizer as well as participants all gave high comments to weather service.”

**Costa Rica:** “A successful early warning system project in a basin in the country (River Sarapiquí), where the participation of the WMO Secretariat together with the World Bank was crucial to the successful completion of the project for a community of some 50,000 people.”

**Dominican Republic:** “We consider that the management of tropical cyclones and improved dissemination of information to the public have been very successful in recent years. Also knowledge of climate change has improved, and it has become more visible to the general public and decision-makers.”

**Indonesia:** “GAW Program for policy making in Ministry of Environmental Management Quality Management System for Aviation Services data rescue program through DARE Data History Project increased the national capacity for disaster risk reduction.”

**Kuwait:** “Two departments of the Kuwait Meteorological Administration participated in a training seminar related to aviation organized by WMO with the aim of assessing competence standards for employees in aviation meteorology. The recommendations and guidelines resulting from the seminar were used to determine the weaknesses and strengths of employees working in the aviation industry, which helped enhance their competencies and will certainly contribute to improving the quality of the services offered to all users, especially the services of the aviation industry.”

**Kyrgyzstan:** “Obtaining a satellite platform in the framework of WMO VCP.”

**Malaysia:** “Climate Outlook Forum has enhanced the understanding by user groups on application of climate products.”

**Mexico:** “Under the Premia project, with several WMO consultancies, a project was proposed to modernize Mexico's National Meteorological Service, which was planned for 2010-2019 and is being carried out thanks to a loan from the World Bank.”

**New Zealand:** “Strengthening capability of the Wellington Volcanic Ash Advisory Centre through participation in related WMO science workshops.”

**Nigeria:** “The major success is the development of a National Framework for Application for Climate Services from WMO GFCS in the country which will likely be adopted as a government policy programme.”

**Peru:** “Manage the approval and publication of a national protocol for the installation and operation of hydrometeorological stations for the country, which is a process forming part of strengthening and modernizing the observing systems and monitoring of climatic and hydrometeorological phenomena.”

**Russian Federation:** “A successful audit and recommendations for GISC Moscow.”

**Seychelles:** *“This year the guidance forecasts from Pretoria (Severe Weather Demonstration Project) has been quite accurate thus helping us to make good forecasts/warnings to our users, especially during the severe weather in January due to active clouds associated with tropical cyclone Felleng.”*

**Singapore:** *“Publication of the IPCC AR5 has renewed interest from the public and policymakers on extreme weather and resilience against climate change. This has paved the way for greater capacity building in our NMS.”*

**Trinidad and Tobago:** *“WMO Fellowship at M.Sc. level has enabled the Met Service to influence decisions at a consultant level in developing national early warning systems, in making positive interventions at international conferences, in developing user specific climate products for specific sectors.”*

**Uganda:** *“Implementing the mobile weather alert service for fishermen over Lake Victoria and farmers in Kasese District of Western Uganda have improved visibility of our NMHS to government and communities.”*

**United States of America:** *“Success in articulating WMO's value added to Member countries through Results Based Management and Budgeting tools (RBM and RBB) which lead to approval for small increase to assessed contributions for the 2012-2015 financial period.”*

### **Services and programme activities in need of improvement**

The majority of respondents indicated highest need for improvement in the following three areas:

- Observation and monitoring networks, including data management and rescue. The need to strengthen NMHS capacity for WIS and WIGOS implementation has been specifically highlighted;
- Training and capacity building;
- Climate information, products and services to meet user needs, especially further consolidation and implementation of GFCS.

Other areas for improvement identified include:

- Public weather services, including the development of useful, timely and user-friendly products; improvements to the information dissemination system; and reaching out to specific user sectors. A few respondents have emphasized the need for conducting social and economic benefits analysis and developing specific guidance.
- Infrastructure development (i.e. acquisition of tools and equipment, especially computer hardware and software; knowledge and technology transfer). Several respondents mention the Voluntary Cooperation Programme (VCP), with one emphasizing the need for a more timely and efficient delivery of large projects.
- Cooperation, especially at the regional level (e.g. implementation of regional projects, development of regional communication systems, technical transfer and exchange of experts, strengthened RAs and Regional Offices). At the national level, respondents identify the need for improved inter-agency dialogue and increased engagement of the scientific community.
- Numerical weather prediction, development of nowcasting systems, long-term forecasting (monthly and seasonal);
- Disaster risk reduction, including the WMO DRR Programme and the development of natural hazard risk assessments;

- Scientific research (especially climate and atmospheric). Several respondents stress the need to support operational research at the NMHS level as a way of better understanding the local weather and climate.
- Aeronautical and marine meteorological services, including Quality Management Systems;
- Communications, including training in communication and the use of social media; expansion of the WMO digital library to include publications older than 1988.

Several respondents highlighted the need to strengthen hydrological services (especially flood forecasting), build capacity for water resources management, and improve coordination among Members in this area. Others emphasized the need to improve the Agricultural Meteorology Programme, including food safety and drought forecasting, and the Instruments and Methods of Observation Programme. A few respondents pointed to progress needed in extreme weather event prediction (e.g. hurricanes and tropical cyclones). Sand-and-dust forecasting, space weather, dispersion modelling of nuclear incidents, volcanic ash and environmental pollution monitoring were some of the other areas featuring in Members' responses.

In terms of governance, no specific matter was stressed by respondents. The issues raised range from streamlining projects to customization of the WMO Strategic and Operating Plan at the NMHS level to improved documentation and action-oriented meetings. A couple of respondents underlined the need for increased advocacy and visibility of the services provided by NMHSs at the national level. Several emphasized increased efficiency and the need to monitor and evaluate effectively, through linking budget to outcomes. One respondent suggested that RA sessions be held every two years instead of every four.

### ***Areas in which biggest improvements have been made over the past two years***

The biggest improvements were accounted in the areas listed below (ordered from most to least frequently appearing in respondents' answers):

- Modernisation of the observation network and enhanced surface coverage (e.g. equipment and software, use of radar and satellite data, use of automated observation systems, acquisition of supercomputing systems, etc.);
- Data collection, management, rescue, processing, archiving, exchange and dissemination;
- Communications, especially information provided to the general public and the media, but also enhanced services via mobile platforms and social networks; improved services to government partners and the private sector;
- Weather prediction, especially short-term forecasting, numerical weather prediction and nowcasting;
- Aviation service delivery, QMS, improved competency assessment;
- Climate forecasting and observations as well as development of climatological databases climate modelling;
- Disaster risk reduction (better early warning for severe weather events, development of risk assessment products, safety and security management, increased participation in national emergency response);
- Personnel training;
- Partnerships and coordination among national stakeholders;
- Long-term forecasting (especially seasonal forecasts);

Some respondents also indicated improvements in the field of hydrology, severe weather forecasting, marine observations, agrometeorological services, resource mobilization and strategic

planning. A couple of respondents pointed out the increased visibility of WMO and NMHSs achieved as well as the increased role of NMHSs at the government level. Two Members highlighted the adoption of relevant legislation.

### ***Areas in which more development is needed***

The majority of respondents indicated highest need for improvement in the following five areas:

- Modernisation and expansion of the observation network (equipment and software, automation, improvement in telecommunication systems); radar use, upgrade and maintenance;
- Weather forecasting, especially short-term numerical prediction, modelling (e.g. development of mesoscale models, use of probabilistic forecast products), nowcasting and long-term forecasts (monthly and seasonal forecasts, long-term projections);
- Database management, including data collection, processing, access, rescue, archiving and sharing;
- Human capacity development;
- Climate information, products and services, including GFCS and climate modelling;

Other areas that frequently appeared in respondents' answers are:

- Communications and service delivery (i.e. web development, mobile application development, use of social media, broadcasting to the general public, development of tailored products and services for specific sectors, such as energy, health, agriculture, shipping, disaster management etc.);
- Early warning systems;
- Aviation services and QMS;
- Water services and hydrological forecasting;
- Research (few specific areas have been identified, among which climate research and research in support of multi-hazard early warning system development);
- International cooperation;

In terms of institutional development, various issues were raised ranging from engaging stakeholders and managing innovation to business development, strategic management, and development of projects for resource mobilization. One respondent suggested aligning budget to function and linking it to performance. Another comment involved the need to balance the pace of change between an orderly process vs. immediate savings.

Finally, a few respondents highlighted the need for future development in the areas of extreme weather forecasting, marine meteorology and agrometeorological services.