Human resources development at NMHSs—progress, challenges and opportunities

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Introduction

Capacity-building for National Meteorological and Hydrological Services (NMHSs) is a priority for many developing and Least Developed Countries. It is necessary to ensure that they have the appropriate infrastructure and expertise to provide adequate meteorological and hydrological services to their governments and society. To accomplish this, the further development of basic scientific knowledge and technical skills, along with enhancing management and leadership qualities, are essential for the NMHSs of those countries. The goal is to increase the ability of NMHSs to respond to user requirements with specifically targeted products and effective services, aligned with national development priorities and community information requirements.

Given the economic pressures which are forcing many governments to reduce public expenditure, WMO and NMHSs must find innovative ways to build capacity and capabilities, particularly in developing and Least Developed Countries. Full benefits from services provided by NMHSs will be achieved only through continued capacity-building of all users and providers within those countries. For NMHSs to prosper, they must both recognize the challenges and take advantage of the associated opportunities.

This article provides a preliminary “desktop” review of education and training challenges within WMO and NMHSs. It recommends actions to improve the human resources development of NMHSs through local initiatives and increased international cooperation.

The context

There are many pressures on NMHSs which often come from a combination of keeping pace with developments in science and technology, increasing expectations about the quality and usefulness of services that can be provided and responding to reductions in government financing. In general, there is a desire for “more for less”. The NMHSs need to respond to these pressures, not only by being able to adapt to the changing circumstances, but also by being active in changing perceptions of the contribution their Services make to the well-being of the community. All these changes have a marked impact on the development of human resources within the NMHSs.

The WMO Strategic Plan includes the following top level objectives:

- Delivering more accurate and reliable warnings, providing increasingly beneficial services;
- Informing societies on the state of the atmosphere and its interaction with the rest of the Earth system.

The achievement of these objectives requires a concerted effort to build capacity and enhance the service-delivery capabilities of NMHSs. In addition it is recognized that there is a growing demand for new types of products and services, as well as the need to transform scientific information and knowledge into useful and practical messages at the local level.

Education and training are critical to transferring knowledge acquired within developed NMHSs and advanced training and research institutions to less advanced NMHSs and other meteorological and hydrological communities. WMO recognizes that education and training is one of its fundamental cross-cutting activities: it has the potential to have a large positive impact on improving know-how and services in least developed and developing countries.

Within WMO it is the Education and Training Programme (ETRP) that is

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the primary vehicle for coordinating and stimulating activities to support human resource development (see box below). The Regional Training Centres (RTCs) play a key role in the implementation of this programme. To help them enhance their effectiveness and assist in the spread of good practice, a scheme for the external review of the RTCs was established under the auspices of the WMO Executive Council Panel of Experts on Education and Training. These reviews have revealed that, in general, the RTCs are effective and fulfil a regional need, though many of them have the potential to make an even greater contribution to the development of staff of NMHSs.

Enhancing the ability of the public and decision-makers to apply effectively the information received from NMHSs is a priority for most countries, both developing and developed. It requires improving the communication capacity of NMHSs to deliver weather, climate, water and related environmental information to society. At the same time, it is necessary to improve the understanding and response capacity of governments, users and the general public. WMO has prepared a “Strategy for developing public education and outreach” to help NMHSs establish programmes to address these issues.

WMO survey of Members’ training requirements

It is essential that WMO understands the education and training requirements of its Members, which will vary greatly from Region to Region. Accordingly, in 2006, the WMO Education and Training Department undertook a survey on “Members’ training requirements, opportunities and capabilities”. The aim was to assess the current status of human resources development of NMHSs and to facilitate a better identification and prioritization of the education and training needs in meteorology and hydrology during the period 2008–2011.

The survey provided some interesting information about the variation in the staffing of NMHSs:

- The number of Meteorological Technicians is much higher than that of Meteorologists with the smallest ratio of Meteorological Technicians to Meteorologists being in Region VI (Europe);
- Generally, there is a decrease in NMHS staffing from 2003 to 2006, particularly for Meteorological Technicians;
- The average number of meteorological staff per million correlates well with the national income, except for countries of the Organisation for Economic Cooperation and Development (OECD). Staffing in OECD countries is lower than in the case of upper-middle and especially high-income, non-OECD countries.

It is likely that these developments are due to a combination of increasing automation of the observing network and the need for NMHSs to become more efficient. These trends are likely to continue, so the planning for human-resource development needs to take account of the likely changes in staffing patterns.

As well as providing an overview of the staffing of the NMHSs the survey also provides useful information about the requirements for education and training. The following are some of the priority areas.

- Management training with emphasis on human-resources development activities; transfer of knowledge and skills associated with “change management” in NMHSs and with the needs of users in all societal sectors, including agriculture,

Cross-cutting activities within the WMO Education and Training Programme

- Providing increased assistance to least developed countries in planning and implementing human resource development activities in their NMHSs
- Promoting a greater level of international cooperation in order to exploit more efficiently the wealth of training resources available world-wide, and supporting computer-aided distance learning activities in meteorology and hydrology
- Encouraging quality education by stimulating national/international accreditation of training institutions and programmes, and professional certification of NMHS personnel
- Supporting school and popular education in meteorology and hydrology, and contributing to the increase of public awareness on disaster risk-reduction, prevention and mitigation
energy, transportation, financial services, health and public services;

- Basic education and training in meteorology and hydrology aimed to ensure a qualified workforce in NMHSs; transfer of technical knowledge related to observing, forecasting and assessment in weather, climate and water domains.

- Short-term specialized training in meteorology and hydrology with emphasis on the acquisition and transfer of knowledge associated with recent advances in the meteorological and hydrological profession and the introduction of new practices to improve working methods in NMHSs;

- Training of trainers in topics such as using information and communication technology (ICT) in training delivery, promoting and using e-learning and online sharing of training resources;

- Training of decision-makers and users on the adequate application of meteorological and hydrological products and supporting school and popular education and outreach activities to increase public awareness about climate-change adaptation and disaster-risk reduction.

The wealth of information collected by the survey also gives an assessment of the demand for fellowships. It is clear that the potential demand is huge and is far higher than funding will permit, especially with reference to long-term fellowships. It is surprising that the highest demand for fellowships is to support the training of Meteorological Technicians and that “general meteorology” is ranked third in the need for “specialized training”. In both cases, it might be expected that many Members have the capacity to address these training needs.

Responding to advances in science and technology

Perhaps the biggest changes facing NMHSs are those associated with recent advances in science and technology. Such changes undoubtedly have a big impact on the knowledge and skills required of those working within NMHSs.

Developments in science and technology have transformed the observing network so that there is now more automation. Also, these developments allow detailed and accurate forecasts to be produced which are based on output from numerical weather prediction (NWP) systems (sometimes with no human input). In both cases, the impact on the skills and expertise required of many operational staff has been immense. Indeed, where there has been no such impact, it is only a matter of time before the effects of the scientific and technological developments are felt. As a consequence, there will be an increased demand for staff to develop expertise in ICT and the interpretation of information from the observing network and NWP output.

The continued rapid improvement in NWP products suggests that the time will eventually come when forecasters can add little to improving these products. However, there will still be a role for NMHS staff to help users get full value from the services provided. After all, the users of services are not usually interested in the weather for its own sake—what they want is to make decisions based on knowledge of what the impact of the weather is likely to be. Consequently, the services provided by NMHSs will need to put more emphasis on the impact of the weather with forecasters becoming meteorological consultants who help the users of services make decisions.

All these changes brought about by rapid advances in science and technology will have a profound effect on the training of operational staff. It is likely that there will need to be:

- More emphasis on interpreting and using NWP products, identifying the impacts of weather, and understanding how services are used in the associated decision-making processes.

- Increased understanding of sensitive subjects such as climate change, water-resources management, disaster-risk reduction, air quality and public health;

- Improved processes to ensure that staff selected for forecaster training have the inter-personal skills that allow them to act as meteorological consultants;
• More comprehensive arrangements for operational staff to undergo continuing professional development to ensure their expertise is maintained.

All these developments have a cost in terms of finance and staff time, but this should be thought of as an investment in the future. Taking this approach ensures that users continue to get maximum benefit from services provided by NMHSs. At the same time, there is the additional benefit that enhancing the skills of staff and providing new career opportunities increase motivation and commitment to the Organization.

When considering how to deal with new training requirements, NMHSs need to address a fundamental problem: is it better to have a broad initial training programme which provides maximum flexibility in allocating someone to a post or a more limited training programme which prepares someone for a particular post with opportunities for additional training when another post it taken up? The answer to that depends upon local circumstances but it is something that needs to be thought about.

As well as providing significant challenges, technological and scientific advances provide an opportunity to provide better services both in terms of accuracy and usefulness. To maximize the opportunities, it will be necessary to develop services that fully meet the needs of community and national priorities. This can only be achieved by fully understanding the needs of existing and potential users of services from NMHSs. Perhaps some of the human resources released by improvements in science and technology can be used to investigate what services are really required and to develop new products. This may require the developments of new skills and changes in attitude, but it is essential that customer focus and innovative product development are embedded in the activities of NMHSs.

Some new initiatives

Continually improving the quality and relevance of services provided by NMHSs will not necessarily bring about the expected benefits to users. The benefits will come only if the users of services have the expertise required to make effective decisions based on the information provided. Implementing public education and outreach programmes play a vital role in helping individuals and organizations make best use of what NMHSs provide. Also, raising awareness of decision-makers in government about the socio-economic benefits of these services is important to ensure that the contribution made by NMHSs is recognized. Of course, this is not a one-way process: as well as passing on information about services, there is the opportunity to gain feedback about the services provided or required. Staff within NMHSs need to acquire the skills to take part in these activities.

In many parts of the world, NMHSs are expected to conform to standard industrial practice in the provision of services. This is manifested by a need to demonstrate that:

• There are quality-management systems in place (e.g. satisfying the ISO 9000 standards);
• The people providing services have professional qualifications.

Establishing quality-management systems is a time-consuming process and requires the commitment of staff to make them work. Changing attitudes to what many will consider increased bureaucracy is, then, a significant problem. However, taking up the challenge is likely to bring benefits in terms of fulfilling the requirements of users, enhancing user satisfaction and achieving continual improvement in services.

Being able to demonstrate that people providing services have the required expertise is often a requirement of a quality management system. One way of doing that is to develop professional qualifications based on a set of competencies that have been agreed on by a particular sector. For example, in the United Kingdom, there are National Vocational Qualifications in Observing and Forecasting. It is interesting that these standards include mandatory requirements associated with team working, self-management and working safely, as well as a variety of technical competencies. Another example is the guidance about the training and qualifications of Aeronautical Meteorological Forecasters prepared under the auspices of WMO and the International Civil Aviation Organization (ICAO). This guidance is expressed partly in terms of the required competencies, along with the underlying knowledge and skills requirements (see box opposite).

It is likely that the demand for certification and professional qualifications will become more widespread. Such developments require a significant investment in time, but the result is more certainty that people have the expertise required to provide services. It also provides a clearer focus for training—there would be no doubt about the knowledge and skills that need to be demonstrated on completion of an initial programme of training. It is also worth noting that usually built into such qualifications is a commitment to undergo continuing professional development.

As well as staff within NMHSs requiring scientific and technical expertise, it is important that there are the management skills available that enable these organizations to adjust smoothly to changing circumstances. The key skills fall into two broad categories: change management and project management. Also there need to be senior staff within the NMHSs with leadership qualities so that
they can provide a vision, motivate, and inspire others to contribute to the success of the organization. The selection and development of managers and leaders are key tasks for any organization.

Developing expertise in a changing world

Ensuring staff acquire, maintain and develop their skills and expertise in a changing world is a challenge faced by all NMHSs. However, developments in information and communications technology have allowed a revolution in education and training. Not so long ago “chalk and talk” was just about the only technique available. Now new technology has enabled information to be manipulated and displayed in innovative ways. Even more profound has been the impact of the Web. It has opened up ways in which information can be acquired—no longer are books and the person at the front of the class the only sources of information. In addition, computer-aided learning (CAL) and the availability of training material from the Web have the potential to change fundamentally the approach to learning. It can now be made more personal in terms of both the content and when the learning is acquired. This is not to suggest that CAL will replace learning using more traditional techniques. Traditional techniques and CAL are in many ways complementary, and the “mix and match” approach allows a choice of learning techniques that are appropriate to the circumstances (also called “blended learning”).

International cooperation underpins all the activities of WMO. This outward-looking approach coupled with the widespread use of the Web is particularly beneficial in the development of human resources. There is a vast amount of education and training material available from the Web. As well as allowing more personalized learning, the availability of this material helps educators and trainers avoid always having to develop their own education and training resources. Material produced by others can be used directly or adapted for local purposes. In addition, it can inspire others to be creative in developing new materials which are then made widely available via the Web. Overall, this increases the quality and range of materials available to support learning and helps ensure the materials used are up-to-date. The result is an improvement in the learning experience for individuals and a better ability for NMHSs to have staff with the required knowledge and expertise.

The contribution made by Regional Training Centres (RTCs) to capacity-building is very important. In general, the staff at RTCs are characterized by a high level of enthusiasm and expertise. In addition, there has been significant progress in improving the facilities at the RTCs and introducing new training technologies. However, many RTCs have the potential to make an even greater contribution to supporting the development of staff from NMHSs in the region. How is this to be achieved? On the one hand each RTC could put more emphasis in collaborating with NMHSs in trying to identify regional training needs and what the RTC could do to help satisfy those needs. At the same time the NMHSs in the region could take more interest in the activities of the RTCs that were originally established at their request. Increased interaction between the RTCs and the NMHSs in their region can only be of benefit to all concerned. Indeed, it would be beneficial if the RTCs worked towards being regional centres of excellence and were more fully committed to spreading good practice amongst other education and training institutions which support NMHSs.

The WMO fellowships programme has a well-deserved reputation for providing individuals with high quality education and training. However, it needs to be recognized that the demand for fellowships will always exceed the available funding. Even if there was a significant increase in funding through the Voluntary Cooperation Programme (VCP) and other sources, there would still not be

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**Minimum generic competency requirements for Aeronautical Meteorological Forecasters**

- Perform weather watch and monitoring duties, including the ability to detect and forecast hazards relevant to the aviation community, in accordance with ICAO and WMO requirements
- Derive forecast and warning products to the standards required by the user community
- Communicate effectively, using appropriate language, with aeronautical users, including oral briefings to pilots and dispatchers as necessary
- Tailor meteorological products and services to aviation operations, in accordance with local aviation procedures and regulatory requirements
What can NMHSs do?

- Review initial training programmes. Keep initial training programmes for operational staff under constant review so that they are in tune with changing circumstances. This requires a regular assessment of training needs and whether the training that has been delivered meets those needs.

- Support continuous professional development. Establish a comprehensive programme of continuous professional development based on a full understanding of current and expected advances in science and technology.

- Enhance services to the community and industry. Dedicate staff to establishing the impact of weather on the community and industry and developing innovative products and services based on impacts. Ensure that those involved have the skills required to carry out these tasks.

- Train the trainers. Provide training to trainers so that they understand how adults learn and are able to use the full range of learning techniques available.

- Establish high-speed Internet links. Ensure that establishments involved in the education and training of NMHS staff have high-speed Internet links so that full use can be made of the resources available from the Web.

- Public education and outreach programmes. Establish public education and outreach programmes aimed at users of meteorological services, including the general public and decision-makers in government. Where possible, do this in partnership with other interested parties.

- Develop partnerships. Seek to work with others in developing training resources and delivering training.

- Invest in managers and leaders. Identify members of staff that have the potential to be managers and leaders and invest in their development.

- Liaise with Regional Training Centres (RTCs). Take an interest in the activities of RTCs and ensure that they are aware of training requirements that cannot be met at national level.

- Maximize benefits from fellowships. When making an application for a fellowship, ensure that the request is based on a clear understanding of the requirements, the potential benefits to the NMHS, and the way in which the expertise acquired will be used to further strengthen capacity-building.

enough money to meet all the requests. The way forward is to do everything possible to award fellowships in such a way that they maximize benefits to the NMHSs. Indeed, if the benefits can be demonstrated in terms of capacity-building rather than just improving the career prospects of individuals, then that can be used as a powerful argument for trying to get increased funding for fellowships. Another aspect of getting value for money is to put the emphasis on supporting fellowships for specialized training events and post-graduate courses. Nowadays, most countries are able to provide graduate-level education in scientific subjects. It is also worth noting that increased use of fellowships for training at RTCs, possibly using tripartite arrangements, would be an effective use of the limited funding available. This is especially desirable if the RTCs really do become centres of excellence so that high quality training is guaranteed.

Where do we go from here?

It is clear that there are many challenges and opportunities involved in developing human resources within NMHSs. Also, it needs to be recognized that there are no panaceas or quick solutions. However, in tackling these challenges, there are some simple principles that can be applied.

- Ensure that the services provided by NMHSs meet the current and future needs of users and that the staff have the knowledge and skills to provide those services;

- Build strong partnerships between the NMHSs and other interested parties in the development of human resources;

- Recognize that rapid changes in the development of human resources are very unsettling for those involved so that these
changes need to be carefully and sympathetically managed.

WMO can make a contribution to supporting the NMHSs in developing human resources, but there is no doubt that the main burden has to fall upon NMHSs. When it comes to specific actions by NMHSs, it is important that they take full account of their own circumstances and national priorities. (See box on previous page.)

The above are some suggested actions, but there are many more that could be taken. What is important is to recognize that the development of human resources is key to the continued success of NMHSs. Developing human resources is an investment in the future.

References and further reading


WMO/TD No. 1380, 2007: WMO Survey 2006 on Members training requirements, opportunities and capabilities in meteorology and hydrology, 141 pp.
