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**ROLE OF EDUCATION AND TRAINING IN AGRICULTURAL
METEOROLOGY TO REDUCE VULNERABILITY TO CLIMATE
VARIABILITY**

S. WALKER

*Department of Soil, Crop and Climate Sciences,
University of the Free State,
PO Box339,
Bloemfontein, 9300
South Africa*

Tel: 27-51-401-2222

Fax: 27-51-448-0692

Email: walkers@sci.uovs.ac.za

ROLE OF EDUCATION AND TRAINING IN AGRICULTURAL METEOROLOGY TO REDUCE VULNERABILITY TO CLIMATE VARIABILITY

S. WALKER

*Department of Soil, Crop and Climate Sciences, University of the Free State, PO Box339, Bloemfontein,
9300 South Africa*

Abstract

Agricultural meteorologists are concerned with many operational aspects of the effects of climate on livestock and crop production. For them to continue to make a contribution to the economy of a country they must continually sharpen their skills and remain updated on the latest information available. Training should include a variety of skills including transferable skills (e.g. communication, numeracy), professional skills (including cognitive skills) and information technology skills. Problem-based learning can be used to promote critical thinking, decision making and analytical skills. More use should be made of Computer Aided Learning for agricultural meteorologists' in-service training. In particular the Internet or CDs could be used to disseminate specific recently developed techniques and applications to improve the understanding of the variability in the climate and its effect on agricultural production. Examples that can address the vulnerability of farmers include crop-climate matching, the use of indices, crop modelling and risk assessment together with seasonal outlooks. A strategy needs to be formulated to address these needs and implement changes in the education and training of agricultural meteorologists.

1. Introduction

Agricultural meteorology as an applied science is an important field of study that brings together the effects of the climate and weather on agricultural production of both crops and livestock. Most of the population is affected by the variability in the climate both on a daily and annual basis. This does not exclude the agricultural community – both livestock and crop production farmers are affected by the extremes in climate and the variability about the mean often causes crop losses. In many areas of the world the variability about the mean is large, presenting additional problem for the farm managers to overcome. If the agricultural meteorologists are to help these farmers then they need to remain up-to-date on all the current issues around climate change and technology advances. But more importantly they need to work at applying the predicted changes in a practical manner to the local farming systems. For this to be realised the agricultural meteorologists must receive in-service training and be able to attend short courses to sharpen their skill and learn new ones.

Some of the needs can be addressed in a generic way, as they are life skills that are applied in agricultural meteorology and are transferable skills. These include numeracy, communication and general computer skills. However, there are many specific scientific skills that are highly specialised in the areas of meteorology, climate analysis, and agricultural sciences that need to be addresses specifically for the agricultural meteorologists.

Due to the fact that there are so many advances in the field of climate change, prediction and analysis it becomes necessary that the agricultural meteorologists must also receive scientific input on these new aspects to be able to maintain an effective service to the community. This means that they need to attend frequent update sessions where they are continually challenged to refresh their knowledge base by one or other means.

As long as the agricultural meteorologist has a good firm science background then many maybe able to maintain contact with the current developments in climate science and be able to proceed alone, however, these people will be in the minority. They need to be able to be taught good logic procedures that would stand them in good stead for understanding future developments and remain up-to-date. So the undergraduate education needs to be of such a nature so as to ensure that they have a firm base on which to build in the future. During the undergraduate studies, the students need to prepared for the workplace as far as skills are concerned – both life skills and specific agricultural meteorology skills as well as being equipped to be able to keep abreast of the future developments in the science of agricultural meteorology in general.

The training requirements should not only focus on those who have received specific undergraduate training in agricultural meteorology but should also give attention to those who are now working in the area although trained in some related disciplines. Here the need is somewhat greater as there are many people who fall into this bracket. Some of the science specific skills may need attention, as the meteorology is based on sound physical, mathematical biological and statistical principles (Lomas, Milford & Mukhala, 2000). If this background is lacking, then it will be hard for the students to catch-up and understand the science at a more advanced level.

Therefore the training requirements should be developed at a range of levels including school, technical, undergraduate, and graduate levels. Another matter that should receive attention is the informal training level of the general public who have a vested interest in the interpretation of climatic analysis and the application to their specific area of expertise. In order to promote the use of climatic data in agricultural applications – the agricultural meteorologists should have a wide range of interest and influence. This would enable them to take the complicated scientific principles and interpret them for the man in the street. This would promote much goodwill in the communities and also support for the continuation of the weather services in many countries.

The aim of this paper is to address some of the options available to educators to prepare the agricultural meteorologists to address the variability of the climate and its effect on agricultural production systems.

2. Skills Training

If the agricultural meteorologists are to make an impact on the livelihood of the community despite the variability of the climate they need basic skills and professional skills to be sure to deliver the correct message. There are several different types of skills that need to be included in the further education programmes. These include the transferable skills (e.g. communication, numeracy) and professional skills (including cognitive skills) and information technology skills (e.g. retrieval of weather data sets) (Gibbs, undated). If the agricultural meteorologists are to succeed in their jobs and remain up with current developments then all these skills are necessary. Many of them probably have developed their own life skills through other situations, but sometimes they need to be made aware that those life skills are actually transferable into the present situation. For example, communication skill will have been developed during adolescence and as a young adult. These may need to be sharpened together with some professional skills to communicate technical materials with the different client groups. Slightly different skills may be used when speaking to a group of scholars compared to a group of farmers or a group of professional business people.

The training of the Agricultural Meteorologists should also address the information gathering skills, as this will enable them to retrieve the latest information from various sources and includes evaluating the sources

and interpretation of the data (Gibbs, undated). These skills should include traditional library skills as well as networking skills and the ability to use contemporary technology. This will enable them retrieve the necessary information from a local or national source or library and obtain it in a useful format. However, in this day of modern electronic technology, they should have computer skill at a level that would allow them to search the Internet and download the relevant information and data. These skills would need to include basic computer literacy, spreadsheet and word processing skills. In addition, they should also develop the necessary skills to “surf the web” and be able to discern the difference between scientifically sound or correct information and poorly grounded information. It will also be necessary for some of them to acquire skills related to Geographic Information Systems (GIS) and statistical packages and international databases.

Once the agricultural meteorologists has acquired the information or data they will need to transform it into something that is useful for the local consumer. This can require other skills such as interpretation as well as sifting the relevant data and that of which is of no consequence. These skills will be considered under professional skills, as they will most probably be related to the specific areas of expertise that the users are working in. Other transferable skills need are in basic communication – such as giving an public address, preparing a handout or listening to the audience and being able to formulate an answer to the questions. Perhaps these skills also need to be addressed to improve the transfer of information.

The type of professional skills need to assess the vulnerability of a community to the variability of the climate will be those of integration and simulation where different scenarios will be compared and contrasted in a logical manner and then explanations or causes can be found. So the students need to be exposed not only too much information –, as this alone will not ensure that they can extrapolate it to there own situation. They need to be taught to reflect and apply the theory to specific problems. So that they can take the theoretical information and argue how it is relevant to the problem faced and then by evaluation and reflection be able to deduce a logical solution or a number of options available to address the problem. One would also need to learn how to evaluate the various options and to follow through to predict the consequences of the various options. These skills are not usually acquired under the normal teaching approach which often focuses on memorisation, identification and description of the situations or conditions (Biggs, 1999). This type of surface learning need to be supplemented with deep learning that will stimulate the adoption of the required skills. One of the methods of stimulating the deep learning is the problem-based learning (Boud & Feletti, 1999). In a typical problem-based learning situation the student will be faced with a typical problem and then guided through the necessary steps to acquire the skills need to solve the problem. The students need to begin to pull together isolated knowledge, skills and experience into a holistic in-depth understanding of the conditions and situation. This will enable them to develop a strategy for a structured approach to problem solving. This problem based learning makes active use of the

students' existing knowledge (Boud & Feletti, 1999) which in turn encourages the student to gain confidence and therefore be able to succeed sooner.

So although the specific technical meteorological skills are needed, sometimes the general professional, information and transferable skills are in need of further development. If these skills can be addressed and applied to the variability of the climate in a certain area to address the specific needs and requirements of the clients – then agricultural meteorologists will be able to address the problem and provide some solutions for their clients.

3. Computer Aided Learning (CALMet)

There is considerable expertise available throughout the world on the variability of climates and the effect on communities, however mostly it is not communicated widely to other similar areas. As the electronic communication technology improves it is possible to share information and experiences and data with many other people around the world. Computer aided learning provides an opportunity to use CD or the Internet to develop self-paced modules on any topic of interest. The use of computer aided learning in meteorology has mainly be confined to the synoptic weather patterns and daily weather predictions (Floor, 2001). As the various systems become more widely used, modules will be developed and this method of learning will be expanded into other areas including agricultural meteorology (Spangler, & Fulker, 2001). This could become a highly efficient method of teaching the agricultural meteorologists many of the skills and techniques need to assess the variability of the climate and to address it with possible solutions

4. Examples of Professional Expertise Training

To show the application of the above logic some specific examples will be given of the types of applications that could be taught to agricultural meteorologists to empower them to make a contribution to decreasing the vulnerability of the community.

4.1 Crop-climate matching

Crop – climate matching can be used to select the most suitable crop for specific climatic conditions. All the aspects of the situation need to be considered including the socio-economic acceptability of the alternatives to the community (FAO, 1990). An approach that can be takes is to characterise the specific crop requirements from the perspective of the climate (Doorenbos & Kasaam, 1979; Doornebos & Pruit, 1992). Then the ecotope must also be described and defined in similar terms (Sys, et al, 1991) so as to determine the potential of the environment for crop production. It is important at this stage to identify the limitations of both the cropping systems and the environmental conditions and also to clarify the predicted changes. The logic is then followed whereby the most limiting fact must be satisfied first and then the others can be considered. For example, in many climates the length of the growing season is a limiting factor for crop selection due to first and last frost dates. These matters need to be considered using probabilities of extreme occurring and then a suitable crop or cultivar can be selected..

4.2 Use of indices and crop models

In operational agricultural meteorology much use has been made of climate based indices to assess and integrate the effect of the environment. Many of them have been developed from an empirical perspective and do not really represent the cause and effect relationships. Under these circumstances they will inevitably fail under some conditions so that the boundary conditions should be carefully defined (Rosenberg, Blad, & Verma, 1983). Among the most common is the use of thermal time calculations for prediction of the flowering and maturity dates of crops (McMaster & Wilhelm, 1997). Such an index can be used with the long-term climate data to make recommendations for cultivar choice and select planting dates. However it is difficult to include the climate variability into such calculations and still make it easily understood at the farmers' level. This can however be addressed by the use of deterministic crop models together with the long-term data and provide improved recommendations (Singels, & de Jager, 1991).

4.3 Risk assessment and seasonal outlooks

Risk can be defined in various ways and should be considered from the communities' perspective using the available long-term weather data. Communities face different circumstances and have different historical experience so they can be classified as risk adverse or risk susceptible (Anderson & Dillion, 1992). The climate data can be used together with modelling techniques to develop cumulative distribution curves of probabilities of obtaining a certain yield under certain conditions (Muchow, Hammer, & Carberry, 1991). These curves have been used to advise farmers on selection of cropping systems or choice of crops or tillage practices. As the seasonal outlooks improve (Mason, Joubert, Cosjin & Crimp, 1996) and become more readily available they can make a contribution to reduce the vulnerability of the communities to extreme weather events (Walker, Mukhala, van den Berg & Manley, 2001). If these probabilities can be used in conjunction with the seasonal outlook then it is possible to take into consideration some degree of the variability of the climate in a specific place and to make a recommendation to the producers in that area.

5. Conclusions

There should be no question as to the fact that education and training must be used to empower and equip the agricultural meteorologists to address the variability of the climate and its effect on many communities around the world. At the present time there is a large gap between the state of the art in the world as a whole and the information and knowledge that is available and used at an operational level. A strategy needs to be developed to begin to form a network that will rectify this serious situation. One of the most promising methods to address this would be to introduce a problem-based curriculum into the formal education system for both undergraduate and graduate studies. The use of computer-aided learning modules made available on CD or the Internet would be a good approach to distributing the information and allowing the agricultural meteorologists in the work place to access the latest technologies and information. There are various methods available that can be used to classify the variability in the climate and its effect on vulnerable communities and these need to be made available to all national meteorological

services. The agricultural meteorologists can then adapt the methods and utilise their own local data to develop recommendations for the areas that they serve.

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