THE ROLE OF AGROMETEOROLOGICAL DATA BASES AND SOFTWARE IN AGROMETEOROLOGICAL TRAINING IN DEVELOPING COUNTRIES

by
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ABSTRACT

The paper covers a Belgian agrometeorological training course intended for francophone students from developing countries who have completed a minimum of four years training in agrometeorology. Today, many of our students are heads of agrometeorological departments and divisions. They are interested in everything that could promote agrometeorological methods to preserve food security and the natural resources of their country. During the past few years, the students have been trained in using microcomputers and solving simple agro-meteorological problems as part of the course. The results obtained so far can now be evaluated, since the microcomputer training began a few years ago; some comments on the future development of this approach are presented.

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I.THE TRAINING PROGRAM IN AGROMETEOROLOGY

All too often, the agriculture of developing countries is exposed to the vagaries of weather. Most of these countries are at the mercy of the irregular rythm of dry and wet season that characterizes tropical areas.

To help the Third-World rural populations in their agricultural activities, the governements have to establish, often with WMO or FAO assistance, well equipped operational agrometeorological centers directed and manned by skilled staff.

To help improve the efficiency of national meteorological services and to create regional "agrometeorological monitoring centres", a permanent structure of high level scientific training in agrometeorology has been created in 1979 at the Fondation Universitaire Luxembourgeoise in Arlon, Belgium.

The organization of the agrometeorology courses (Masters Degree and Certificate) results from the cooperation between WMO and AGCD/ABOS (General Administration for Cooperation and Development, the Belgian Development Aid). Lectures are given in French. An equivalent training is given for English speaking students at Reading University in the United Kingdom.

The FUL is a small Belgian university center dealing with applied scientific research and postgraduate training programs in the field of environmental sciences. It is an interuniversity body. Courses are given by lecturers coming mainly from other French speaking Belgian universities but also from the Flanders (north of Belgium) and from neighbouring countries. This allows to maintain a high quality of training which could not be achieved otherwise. Moreover, professors coming from different Schools also provide a greater variety of approaches, which is an advantage in itself.

Professors and researchers in environmental sciences are also familiar with interdisciplinarity, a concept and approach which also perfectly apply to solving agrometeorological problems as well.

This double originality, in combination with a flexible curriculum has allowed a constant development of this training program since 1979.

Agrometeorological training aims at a qualitative and quantitative understanding of the influence of the physical environment on agricultural activities at a global level. Atmospheric interactions with earth surface are studied but also the impact of climatic elements on living organisms, plants and animals.

The training program aims at providing the students with a better understanding of the quantitative and qualitative effects of natural environemental parameters, to improve decision making both upstream and downstream of agricultural production. The detail of the curriculum is given in the table below.

Table 1: Global presentation of the two agrometeorological training programmes

MASTER IN AGROMETEOROLOGY	CERTIFICATE IN AGROMETEOROLOGY
Level Required	
Bac + 4 (Bac: 4 years after secondary school)	Bac + 3
Programme Duration	
1 year: from September to September	6 month: from January to June
Programme Content	
1. general multidisciplinary lectures in environmental sciences - 130 h	1. specialized lectures in agrometeorology - 145 h
2. general lectures on the fundamentals of agrometeorology - 75 h	2. complementary lectures in agronomy for meteorologists - 90 h
3. specialized lectures in agrometeorology - 145 h	3. complementary lectures in meteorology for agronomists - 65 h
4. complementary lectures in agronomy for meteorologists - 90 h	4. training on measuring, encoding and treating agrometeorological data
5. complementary lectures in meteorology for agronomists - 65 h	5. field works, scientific trips, visits to other institutions working in the agrometeorological field
6. training on measuring, encoding and processing agrometeorological data	6. Course in general ecology
7. field work, scientific trips, visits to other institutions working in the field of agrometeorological	
8. a dissertation (written report) for the Master's students	
Lecturers	
Coordinator: Dr. Ir. V. TONNARD, **Assistant**: Dr. Ir. B. TYCHON, **Academic Responsible**: Dr. L. GOFFIN. **Professors in agrometeorology**: M. AUBINET (FSAGx), L. BOCK (FSAGx), L. DE BACKER (FUL), M. ERPICUM (ULG), R. COMPERE (FSAGx), J. FRANCOIS (FSAGx), M. FRERE (EX-FAO), B. LOUANT (UCL), H. MARAITE (UCL), R. PALM (FSAGX), E. PERSOONS (UCL), M. RADOUX (FUL), F. RONDAY (ULG), V. TONNARD (FSAGx), B. TYCHON (FUL), A. VANDERWEYEN (Service Géologique), JP. VAN YPERSELE DE STRIHOU (UCL).	
Career Prospects	
Head of agrometeorological services at regional, national or international level; expert consultants for international organisations and for private firms; Fellow-workers in developing countries; Agricultural cooperatives.	Specialists working in regional and national agrometeorological services ; Fellow-workers in developing countries; Agricultural cooperatives.

Since the training program began, students of 43 different nationalities have attended the agrometeorology courses. Most of them were nationals of countries of the Sahelian part of Africa.

Among them, many are now heads of agrometeorological services, which they often started themselves. Some of them hold very senior positions in the National Meteorological Service. The student population constitutes an ideal and high level target because many students will be incharge of solving the agrometeorological problems in their countries. To be admitted, students must have a 4-year university diploma (equivalent to class II meteorologist) for the Masters Degree, or a three-year high school diploma (equivalent to class III meteorologist) for the short training program (Certificate).

Unfortunately, many of the students have only a very limited background outside their basic professional training. For example, a meteorologist will have a poor understanding of basic agronomic problems while, agronomists will know very little about meteorology and atmospheric physics. Admittedly, 6 or 12 months training is sufficient only to learn the basic elements wich they lack. It is also clear that our students come in Belgium after having left university for several (sometimes many) years. Some find it difficulkt to adapt again to intensive studies. Finally, most of them have no cumputer skills at all.

Over the last three years, a new course called "introduction to computing" has been included in the curriculum. Today, a minimum knowledge in computing seems indispensible for an agrometeorologist. He is more and more in contact with computer data and data management software. He may achieve a significant improvement in his interpretations of data if he is able to use his new tool efficiently. Moreover, the development of computers and other electronic equipment for meteorology, agronomy and other sciences of earth observation provides new tools which the students must know, and use if possible.

This computer training has already been successfully applied within several courses (statistics, physico-chemical bases of agrometeorology, synoptic interpretation, practical work in agrometeorology...).

II. THE PLACE OF AGROMETEOROLOGICAL DATA BASES AND SOFTWARE IN THE TRAINING PROGRAM

What can agrometeorological data base systems and software add to the training program? As mentioned above, new technologies (computer, remote sensing, automatic weather stations), together with new methodologies in data analysis like chronological series or other types of samples (digital image pixels), new methods of extrapolation and interpolation must absolutely be included in the curriculum in agrometeorology because they open the door to better and new agrometeorological analyses.

Agrometeorological data basesystems and software should not only allow to improve and make easier the routine tasks of agrometeorological services, but they should also reveal previously unsuspected agrometeorological characteristics.They should help create new working hypotheses essential to develop agrometeorolgical skills.

Moreover, the cost of sophisticated field observations keeps increasing and we have to use them optimally by associating them with new techniques that will reduce this type of observations to a strict minimum (for example, the interpolation of point rainfall readings using remote sensing *a posteriori* and soil water fluxes with a calibrated and validated model, etc).

It is worth reminding that every new method must be checked (calibrated and validated) before it is accepted, and this requires most of the time a number of observations when they are applied to actual and not perfectly known conditions. To train students in new techniques that are still experimental does not really make sense.

In Belgium, for example, there is an automatic weather stations network which informs about the treatment dates for potato blight (Pameseb Network). This network has significantly allowed to reduce pesticide applications. The consequences are a reduction of both the production cost and the negative impact on the environment. This project has been possible because it was assisted by an expert knowing the process of potato plants infection and the plant itself.

How do we introduce data base systems and software in the curriculum ?

We think it is important that students know the vocabulary and the basic syntax, to have a general understanding of the work with data base systems and software. This allows them to avoid gross mistakes when using these systems in their own experimentations. This should also save time when they have to manipulate new software or data base systems because they will inevitably evolve with the new means available. It is clear that a poor or partial understanding of a software can lead to lower quality results as compared with traditionnal, old methods. This shows the importance of a correct training program before the new methods can be used.

We also have to foresee that this course will evolve because of data base systems and software evolution (structure, format, accessibility...). Students must be prepared for all these changes (for example : change in magnetic hardware media for data storage, data base systems and software). Basically, this apprenticeship must be included in a fully dedicated course. It can not be restricted to a short information or a passive understanding. These software and data base systems must become work tools that students will have to handle during their training to improve their understanding and that they can take home after their one year training program.

Which software and data base systems should we choose ?

Up to now, we do not train our students in agrometeorological data base systems and software because :

- there is always a short time period between the development of a new method and the time when it is taught;

- we still have some doubt about the efficiency of some new methods in their current state of development;

- as yet, there exists no data base systems and software specialized in agrometeorology;

- there is no standardization, which makes the choice more complicated. There is no software and data base systems such as CLICOM in the meteorological world, which might already be a reference in agrometeorology. May be a software like CROPWAT could be a base for the development of a future standard software.

Ideally, agrometeorological database management systems and software should be easy to use. User-friendliness in database management and software generally helps preventing mistakes and gives confidence to unexperienced users. It must be interactive, for the same reason. It must be expandable according to a modular approach to maintain the basic structure and permit further development.

It must be adaptable. This means that it must work with input data of various types (for example: agrometeorological information obtained with dekad rainfall as well as daily rains, possibility to describe soils with textural composition as well as with their pF curves, ...). Input and output data should be in a standard format. That would make their transferability easier. Finally, this soft/database system should be free to help its spreading.

CONCLUSIONS

A good knowledge of agrometeorological database systems and software requires first a sufficient basic computing knowledge. We should make sure that this minimum level has been reached before proposing new agrometeorological tools.

The success of database systems and software depends not only on its intrinsic quality but also on the user's ability to extract the information he requires. It is essential to take this last point into account.

An agrometeorological training centres such as the Fondation Universitaire Luxembourgeoise could become a preferential training centre for these software and databases. The short training time (1 year) and the background of the students (carefully and jointly selected by national and international bodies) are two assets for this type of training centres. These centres could also serve for testing agrometeorological software and their user-friendliness. They could be the showcase for companies or organisations providing these new products.

But before agrometeorological software can be taken up into the curriculum, it should first be standardized and harmonized with other software. That is why we show a great interest in the different expert discussions on the subject. We think international organizations such as FAO and WMO can play a crucial role in the harmonization of database systems and software in agrometeorology.