Chapter 1

INVENTORIES OF IRRIGATION SOFTWARE AND CRITERIA TO USE

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1.1   Software inventory: need and purpose

1.   Although the application of computer programs in irrigation seems to lag behind compared with many other sectors, quite a number of computer programs on various irrigation subjects have now been developed or are nearing completion. The situation has become rather confuse and few irrigation experts have a good overview of which programs are now available where, for which purposes they can be used and what their practical relevance and qualities are. This applies to public-domain software (institutes, universities) and even more to software made by commercial companies. Marketing of the software is poor, while documentation and literature are often scarce or completely absent.

It is only logical that, in such a situation, the common irrigation student, engineer, consultant or manager only sees *"a jungle of software"* (as Martin Smith of FAO named it). My experience is that many program names are not commonly known, and that their contents are even more obscure, while addresses/prices are often difficult to obtain. If one considers how much time and effort it has taken some institutions to prepare their recent overviews, one cannot expect many people to have the time and resources available to find out for themselves.

At the same time, computer applications for various practical purposes in irrigation will certainly become more important, until they become a normal professional tool, much in the same way as pocket calculators replaced the slide rule at a certain moment.

2.   A conclusion can thus be that it is needed *to establish a clear and complete inventory of irrigation software* in order to provide irrigation professionals with information on
- which programs are available where?;
- for which purposes/subjects can they be used?; and
- what are their main characteristics?.

This could be a first objective of the present workshop: seeing how best such an inventory can be made.

Such an overview, made by researchers as a service to the common user, would effectively enhance the dissemination and wider practical application of existing programs. It would also perhaps reduce the all-too-common practice of putting much effort in developing new programs for a specific purpose, where they already exist and could much more easily be modified or upgraded.

3.   For this inventory, a *classification/categorization* of subjects to be covered is needed first. This involves questions such as, e.g., how to categorize the different types of

programs dealing with canals, and: should reservoir operation or land levelling programs be included from the beginning or should we concentrate first on real direct irrigation subjects like crop water requirements, surface irrigation, canal flow simulation, etc.? A further discussion is presented in Chapters 4 and 5.

4.   Subsequently, we should agree which programs on a certain subject should be included in the inventory, which ones should not, and why. There are two possible criteria: one is *availability*. For instance, should a program costing 15 000 UK£ be considered "available" ? Or, generally, should cost criteria be used and, if so, what is the accepted limit? Should in-house programs, not available to the public, be included? A second inclusion criterion could be quality or *usability*: when does a model become a program, or: how to judge the underlying theory, how to address program verification and validation, how many bugs can be accepted, what demands can be made on user-friendliness?

5.   In the recent past various activities have taken place related to the establishment of preliminary inventories on different subjects. This work is summarized below (Sections 1.3 and 1.4). In further finalizing the inventory, experience and lessons from this work have to be used and hence co-ordination of activities is advocated.

1.2   Software criteria: need and purpose

6.   The work done so far is summarized in Section 1.3. Some lessons from these various inventories are:
-      for many programs it is not easy to get a clear picture of what they really do, certainly not quickly: purposes, possibilities and limitations, input and output are not well outlined;
-      it is no exception that different programs on a same subject give different results;
-      some programs do not really work (well). They show bugs or even give incorrect results;
-      quite some programs have been developed for research purposes, they do not have a minimal user interface, they are constantly upgraded without making it known, and have never reached the status of a real program, with which one can work for practical purposes;
-      there are many papers about models with suggestions that a program exists or can easily be made. Such programs may not exist or may not be available, however. It is therefore useful to make an explicit distinction between *models*, describing the mathematical formulation of a process, and *programs* which a common user can apply in a practical situation.

7.   Against this background, a second objective of this Workshop is *to develop criteria on how a program can be described and assessed*. This concerns its properties (what can a program do?) and qualities (how does it do that?). A proposal for a general framework is presented in Chapter 5. This framework can be detailed in future during meetings and discussions on specific subjects.

8.   Development of such criteria can serve various purposes; it can help to
-      clearly and uniformly describe main characteristics of a program in the inventory;
-      enable a user to quickly evaluate the relevance of a program for his purpose;
-      facilitate comparison of programs on a same subject;
-      give guidance for upgrading existing programs or for developing new ones.

9.   *Property criteria* should address the purpose, limitations, conceptual model used, input and output and similar aspects, which would immediately make clear what the program is about. To give one example: for surface irrigation one would like to know for which method (basins, furrows, borders, all), for which purpose (design, operation, analysis, training), which options (cut-back, re-use, etc.), which model or concept it is based on (zero inertia, volume balance, etc.), which input variables are required and which are the important performance indicators among the many output data. This list can be modified or extended as necessary. For other subjects other lists must be made.

10.   *Quality criteria* would concern two types: technical quality and user-friendliness. The technical criteria would include aspects like solution techniques, robustness, stability, accuracy, modularity, and verification, calibration and validation. The user criteria could include hardware requirements and availability and documentation, but should concentrate on simplicity of use and interface aspects. These criteria will be more generally applicable than the property criteria. Specific details are discussed in Chapter 5.

1.3   Recent work done

11.   Considerable work has been done on irrigation software inventories but less on criteria. This work should be known and used. In order to avoid duplication and to make some essentials known more widely, this work is listed here. A slightly more detailed review is given in Annex 3.

a.   During the 14th ICID Congress in Rio de Janeiro (1990) there was a first Workshop on Crop-Water models. Selected papers from this Workshop were published in ICID Bulletin Vol.41 No.2, 1992, giving information on about 15 models in as many articles (Pereira et al., 1992).

b.   ILRI started preparing an inventory in 1991; a first draft was distributed for comments in 1992. The final version was issued in April 1993. The publication (Lenselink and Jurriëns, 1993) contained some general chapters on computer use and criteria, and a brief overview of available programs per irrigation subject. Some 150 programs were identified of which 45 were tested. Besides the publication, the collected literature was stored in a database (using Cardbox). Programs and literature collection continues (see Chapter 4).

c.   An ICID working group started an inventory in 1990; work is still on-going. The recent version contains 146 programs on irrigation-related subjects. Core information on programs is put in a database (called LOGID) under various categories. The

diskette is distributed informally. The inventory also includes 22 programs on drainage and 10 on flood control (ICID, 1994). See also Chapter 3.

d.   A substantial part of the ASCE 1991 Hawaii conference was devoted to canal simulation programs, specially those with non-steady flow. Proceedings were issued by the ASCE (Ritter, 1991). An ASCE Task Committee presented results of an inventory/scrutiny and a discussion of model development criteria. Six selected canal-flow programs were specifically tested and reviewed.

e.   The IIMI/CEMAGREF workshop in Montpellier in 1992 also concentrated on canal modelling. Pre-workshop proceedings were distributed among participants (IIMI/CEMAGREF, 1992). Although not primarily aiming at an inventory, important conclusions were formulated on availability and quality of programs. In 26 articles about half as many programs were discussed. Unfortunately, final conclusions and recommendations were never published.

f.   During the 15th ICID Congress in The Hague, 1993, there were two Workshops dealing with computer software, one on irrigation and one on drainage. The first was the Second Workshop on Crop-Water models, where some 24 models and programs were presented in a Transactions Volume (ICID, 1993). The second was largely on subsurface drainage models, with 24 papers on almost as many programs in a Transactions Volume (edited by Lorre, 1993). Selected models appeared in a separate book (Pereira et al., 1995).

g.   In 1994, ICID organized another Working group meeting on Crop-Water models, in Varna, Bulgaria. Various programs were discussed, among which several already included in the previous workshops. No proceedings were published.

h.   In 1993, in Rome, there was a FAO-sponsored "Expert consultation on water delivery models". Proceedings were published by FAO as Water report No. 2 in October 1994 (FAO, 1994). They include some 11 programs on canal simulation, allocation and system management.

i.   Recently, i.e. by the end of 1995, Thomas Stein of the University of Kassel started an irrigation site on Internet, in which space is provided for IRRISOFT, an inventory of irrigation and hydrology programs and software-related literature (see also Chapter 2 of these proceedings).

1.4   Discussion of recent work done

12.   The picture is a bit chaotic. There are now four (attempts at) real inventories: ILRI, ICID (LOGID) and IRRISOFT for the entire irrigation field and ASCE for canal simulation models. The other meetings concerned some general aspects, or concentrated on one or two subjects only, or presented a limited number of programs. Some contain rather unusable programs, some include pure (non-program) research models, others only

include programs for practical use. Yet, all this knowledge can contribute to making a complete inventory.

13. The ILRI inventory is primarily on irrigation with a brief summary on drainage. ICID (LOGID) covers both irrigation and drainage with a start on flood control and some miscellaneous issues. They contain partly the same, partly different programs. LOGID includes many programs of which the actual availability and functioning has not been tested separately. ILRI virtually only included programs that were publicly available at an acceptable price, one third of them were tested.

ICID '93 concentrated on some crop-water models and on subsurface drainage. FAO (Rome) dealt with general software application and requirements and with some management and canal simulation programs. The latter was the explicit focus of ASCE and IIMI/CEMAGREF.

LOGID is only a database. ILRI, ASCE and FAO (Rome) also provide conclusions and recommendations (the Montpellier conclusions were not published). Complete lists of programs mentioned in the various meetings are presented in Annex 3.

IRRISOFT has just started. The "display-window" is there, but filling it with organized contents still requires a lot of work. The idea is very promising.

14. None of the inventories is complete and some are rather inconsistent and unsystematic. There is scope for co-ordinating efforts and coming to an exchange of knowledge in the course of further inventory activities. Overseeing the work done, a number of possible conclusions are:
- a good and complete inventory is still to be made;
- only a limited number of good practical programs are (publicly) available;
- many "programs" have not developed far beyond the model and research stage and lack the necessary clarity and user-friendliness;
- there is much duplication and overlap;
- by far, most programs are on crop water requirements;
- there are very few good available canal programs; and there is hardly any publicly available canal management program;
- the real user needs must still be assessed, to make irrigation software more relevant and effective;
- case studies on practical applications are needed;
- there is a need for training of irrigation staff and professionals;
- in all respects, much more communication and co-ordination is needed between research, education and implementation institutions, as well as between software developers, so as to reduce overlap and to make software application more effective.

15. Most of these conclusions were already listed in the ILRI publication, and were supported by the ASCE, Montpellier, FAO-Rome meetings. This Workshop is an attempt to address various of these issues. At the same time it will, hopefully, be an effective contribution to more international co-ordination and collaboration.

16.   It is noted that various institutions are now working, with varying intensities, on the preparation of an inventory. This concerns ILRI, ICID and Kassel. All of them are small, with limited time, money and manpower. Judging by the way things have been going so far, it is unlikely that either of these institutions will be able to produce a consistent and complete overview in the near future. A well-organized collaboration seems to be the only logical solution to this problem.

17.   The three inventories use different media: ILRI works on a printed publication, a type of dissemination in which people are likely to remain interested. ICID concentrates on a database on diskette, while IRRISOFT is on the Internet. There seems to be no reason to prefer one medium or the other; all three have their own public and can live alongside each other happily.

18.   ILRI is also working on a database of literature on irrigation software. IRRISOFT has started this as well. LOGID does not cover this aspect. Further collaboration between ILRI and IRRISOFT seems appropriate.

1.5   Workshop approach and follow-up

19.   The workshop should specifically concentrate on practical irrigation software, and aim at co-ordinating and improving knowledge in this field. In line with the foregoing, the workshop therefore concentrated on improving the inventory and the criteria. In addition, it did:
-       scrutinize available programs on certain subjects, in order to give recommendations for use or upgrading of certain programs and for further developments;
-       draw conclusions and give recommendations on further actions in the various fields of interest.

20.   Over the past few years, insufficient progress has been made on completing a systematic inventory. The few groups working on this issue are small; altogether only a few people are really involved and they can devote only part of their time to it. The same, and probably even more so, applies to the development of software criteria. All this is not very time- and cost-effective. Therefore, it seems appropriate that these institutions co-ordinate efforts and collaborate on these issues. The workshop addressed this collaboration, tried to identify various options, weighed their pro's and con's, their organizational, logistic, and financial implications, and, in the end, arrived at conclusions and clear recommendations.

For longer-term objectives and prospective it may be useful to refer to the groundwater circles, where there is an International Groundwater Modelling Center, which started making inventories and developing criteria. It now acts as a "evaluation, testing and clearing house" for groundwater models and programs.

21.   Summarizing the above-mentioned points, in my opinion, the following subjects are to be addressed (see Annex 1 for the actual Workshop programme):

- Introduction - workshop scope and activities;
- Discussion of work done;
- Review of broad inventory; further approach:
  * categories and criteria for inclusion;
  * identify programs to include in various categories;
- Demonstration of IRRISOFT;
- Demonstration of LOGID;
- Presentation of upgraded ILRI inventory;
- Review of inventories per subject;
- Discussion on property and quality criteria:
  * general approach;
  * elaboration per subject;
- Demonstration of some programs;
  * BASDEV-FISDEV (basin-furrow irrigation);
  * FLUME (measurement structure);
  * CROPWAT-VisualBasic (old and new version);
  * SIC (old and new version);
- Discussion of possible further collaboration:
  * activities;
  * options;
  * implications;
  * recommendations;
- Summary, conclusions, recommendations, and arrangements.

1.6 Final remarks

22. We observed above that not much progress has been made in the development of irrigation software over the past years. It may be useful to discuss the reasons for this formulate recommendations to improve this situation.

23. In the discussions we should realize that the workshop participants may have different views on various subjects, as related to different interests and backgrounds. To name a few possible differences:

a. Model science or practical application? The workshop is not meant to contribute to further theoretical aspects of model development. We should not discuss theoretical model aspects. Its primary aim is the collection and dissemination of existing knowledge.

b. Who are our clients? In my view this would be the irrigation practitioners or program users: students, engineers, consultants, managers, and not the scientists or program developers.

c. Public service or commercial platform? Related to the foregoing: the inventory is meant to be a public service - making available our knowledge to a wider public - rather than a platform to promote the sale of some programs.

d. Professional objectivity or commercial subjectivity? Some texts about certain programs resemble washing-powder advertisements. Naturally we prefer the provision of objective and relevant professional information;

e. Specific interests of own institute. Of course, every institution has its own interests in contributing to the subject. This is perfectly understandable and should be taken into account, if possible without violating the previous points.

f. Irrigation experts or computer freaks? (an important source of confusion). There seems to be a tendency with some people to be more interested in aspects of advanced computer techniques rather than in practical applications to solve irrigation problems. The marriage of the two would be nice, but the irrigation expert should be the head of the family.

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