ANNEX 1. DESCRIPTIVE FORMS

Serial no.	Program	Mentioned in:	
1.	BASCAD	Ch. 6	Field irrigation
2.	BASIN	Ch. 6	Field irrigation
3.	BCWEIR	Ch. 9	Structures
4.	BCW/RBC	Ch. 9	Structures
5.	BICAD	Ch. 6	Field irrigation
6.	BRDRFLW	Ch. 6	Field irrigation
7.	CANAL	Ch. 7	Canals
8.	CATCH3D	Ch. 6	Field irrigation
9.	CID	Ch. 7	Canals
10.	CRIWAR	Ch. 5	Scheduling
11.	CROPWAT	Ch. 5	Scheduling
12.	CWRTABLE	Ch. 5	Scheduling
13.	DORC	Ch. 7	Canals
14.	DRAINCAN	Ch. 11	Drainage
15.	DRAINMOD	Ch. 11	Drainage
16.	DUFLOW	Ch. 7	Canals
17.	ETREF	Ch. 5	Scheduling
18.	FISDEV	Ch. 6	Field irrigation
19.	FLUME	Ch. 9	Structures
20.	INCAdemo	Ch. 10	Management
21.	IRRIGAME	Ch. 4	Games
22.	IRSIS	Ch. 5	Scheduling
23.	MAINSYST	Ch. 10	Management
24.	NESTOR	Ch. 7	Canals
25.	OMISdemo	Ch. 10	Management
26.	OPTIPIPE	Ch. 8	Pipes
27.	PROFILE	Ch. 7	Canals
28.	RAINBOW	Ch. 12	Other
29.	REHAB	Ch. 4	Games
30.	REUSE	Ch. 11	Drainage

Serial no.	Program	Mentioned in:	
31.	RICEYLD	Ch. 12	Other
32.	SALTMOD	Ch. 11	Drainage
33.	SATEM	Ch. 11	Drainage
34.	SGMP	Ch. 11	Drainage
35.	SIMYIELD	Ch. 12	Other
36.	SRFR	Ch. 6	Field irrigation
37.	SUBDRAIN	Ch. 11	Drainage
38.	SUKdemo	Ch. 4	Games
39.	SUKKUR	Ch. 4	Games
40.	SURFACE	Ch. 6	Field irrigation
41.	SWACROP	Ch. 11	Drainage
42.	SWATRER	Ch. 11	Drainage
43.	UNDP	Ch. 8	Pipes
44.	WASAM	Ch. 10	Management
45.	WYEGAME	Ch. 4	Games

Program 1: BASCAD

▸ *what it does:*
BASCAD simulates advance and infiltration in a level basin with water reaching the end of the basin. It is based on the zero-inertia approach to solving the Saint Venant equations and applies Newton Raphson iteration for solving resultant non-linear equations. This happens in a 'black box'. One can input certain data and view the resulting design parameters. The program can be run in four modes, with an increasing number of input variables. It produces acceptable design values in modes 1 and 2 and indicates consequences of any changes in modes 3 and 4. The latest version (2.0) introduces pull-down menu's, on screen help, interactive data input and improved file handling.

▸ *made where:*
International Institute for Land Reclamation and Improvement (ILRI), P.O. Box 45, 6700 AA Wageningen, The Netherlands. Price NLG 28.00 (Publ. 43 + disk).

▸ *what available:*
- A 3.5" disk with an *.EXE file, which cannot be changed (May 1992);
- The manual: Boonstra, J. & R. Jurriëns, 1988. BASCAD, a mathematical model for level basin irrigation. Publ. 43, ILRI, Wageningen;
- Jurriëns, M. & J. Boonstra, 1991. Level basin irrigation: some examples of design and operation. In: Annual report 1991, ILRI, Wageningen: 8-20.

▸ *what required:*
IBM PC/XT/AT with MS-DOS operating system.

▸ *written in:*
Basic; Fortran. Shell for version 2.0 in Pascal.

▸ *remarks:*
- Version 2.0 has an installation routine;
- The floppy is protected and can only be copied three times;
- The name ....CAD is misleading, as it suggests design drawings like AutoCAD (compare DRAINCAD, which has such graphics);
- The mathematics of the model are not explained in manual; adding such a brief section would be useful for many training institutions and would instill more trust than the mentioned black-box operation;
- Previous versions had some additional drawbacks, but are no longer sold;
- Pull-down menu's, graphics of advance time and infiltrated depth, and the storage possibilities for the output (e.g. as a track record) are present in the 1992 update (version 2.0).

Program 2: BASIN

▸ *what it does:*
Determines design variables in level basin irrigation, using one design screen, showing the variables involved and the unknown calculated. Infiltration, roughness and the design question have to be specified before the program is run. Then the units are specified and an output is chosen.

▸ *made where:*
USDA-ARS US Water Conservation Laboratory, 4331 East Broadway, Phoenix, Arizona 85040, USA

▸ *what available:*
A copy of the program on a 3.5" diskette, containing 14 files, the most recent one of September 1990, but the program has not been formally released. A user's manual is apparently in preparation.

▸ *what required:* not stated.

▸ *written in:*
Turbo Pascal, although a *.BAS file indicating Basic and a *.FOR file indicating Fortran are present on our diskette.

▸ *remarks:*
- No information is provided on the screen on program structure and program logic or on operating sequence;
- Apparently, pull-down menu's are to be followed from left to right; changed values entered are not seen until calculations are made;
- The system may stall completely (re-start) if an out-of-range value is entered; the user must therefore be sure to enter acceptable values;
- By selecting Execution/Calculation a view of an output file may be obtained, although this may not be immediately clear;
- Program seems to be made to do the same as BASCAD, except by using pull-down menu's; the pull-down efforts need to be improved considerably (ought to be fool-proof);
- Program seems to focus on finding maximum length of run;
- Program needs thorough polishing to alleviate the above problems.

Program 3: BCWEIR

▸ *what it does:*
This program assists the designer in the design of broad-crested weir (BCWEIR) flumes and produces rating curves for given channel dimensions. It uses theory developed by Repogle and others, and has four main features: (i) initial data leading to an initial sill height, (ii) a re-run with new sill height and length, (iii) running the rating table from design values or known dimensions, and (iv) printing summary design and rating tables. The latest version adds more profile shapes and some computer graphics.

▸ *made where:*
Water & Power Consultancy Services (India) Ltd. and Louis Berger International, Inc., 213 Ansal Chambers-II, 6 Bhikaji Cama Place, R.K. Puram, New Delhi 110066, India

▸ *what available:*
- A 3.5" disk with a version dated 1 September 1992;
- The manual: Parrida, B.P. & W.C. Bell, 1991. Manual on computer-aided design of broad-crested weir flume. Techn. Rep. 52, Water Res. Man. & Training Project, LBII/WAPCOS, New Delhi;
- Wiser, E.H. & A.B. Pattanaik, 1992. Supplement to Technical Report no. 52. Water Res. Man. & Training Project, LBII/WAPCOS, New Delhi.

▸ *what required:*
An IBM PC XT computer with >= 640 kB RAM, running under MS-DOS 3.x. Monochrome or colour monitor. One serial and one parallel port.

▸ *written in:* Basic.

▸ *remarks:*
- Typing bcw starts the program and shows a logo screen;
- The program is menu-driven and mnemonics can be used;
- A new weir can be designed or a rating curve made for an existing weir;
- Simple graphics and lettering are used, but work alright;
- Program choices and structure look logical;
- Manning formula solutions are also available in the package, mainly intended for testing the tailwater depth;
- The worked example in the Supplement to the manual is useful;
- The latest version is only available as compiled file; there is a source code listing of the former version in Technical Report no. 52;
- Program seems to work properly and may be useful, without being sophisticated.

Program 4: BCW/RBC

▸ *what it does:*
The program produces stage-discharge ratings for broad-crested weirs and is used for design and calibration of broad-crested weirs for open-channel discharge measurement. The program is interactive with a built-in data editor. Results can be sent to a disk file or directly to a printer. The English language version is called BCW (there is also a Spanish version called RBC).

▸ *made where:*
Software Engineering Division, Biological and Irrigation Engineering, Utah State University, Logan, Utah 84322-4105, USA. Available from USU at USD 20.00 plus shipping and handling.

▸ *what available:*
- A 3.5" disk with a version 2.2 dated May 1991 (file BCW.EXE);
- There is no manual. For literature see: Bos, M.G., J.A. Repogle & J.A. Clemmens, 1984. Flow measuring flumes for open channel systems. Wiley, New York.

▸ *what required:*
An IBM PC or PS/2 compatible computer with > = 256 kB RAM, running under MS-DOS 3.30 or higher. No special graphics or colour card required. A printer is required for hardcopy output.

▸ *written in:* Not stated.

▸ *remarks:*
- The program starts by typing bcw;
- There is a short Help available on screen for each of the 8 menu options;
- Only trapezoidal cross-sections can be handled (with rectangular and triangular shapes as special cases thereof);
- The program is fully text-based; there are no graphics;
- Data entry is easy and computations are quick;
- It looks as if BCWEIR can do more; moreover, FLUME seems to make this simple BCW program rather obsolete.

Program 5: BICAD

▸ *what it does:*
This program for Border-Irrigated Computer-Aided Design calculates the design variables in border irrigation systems, i.e. mainly border length and width, slope, flow rate and application time. Inputs are infiltration constants, surface roughness and depth to be applied. The program can be run in a simple, approximate and quick regression mode or in an accurate process mode. Results can be plotted.

▸ *made where:*
University of Melbourne, Dept. of Civil and Agricultural Engineering, Parkville, Vic. 3052, Australia, by Dr. B.L. Maheshwari (for The Rural Water Commission of Victoria).

▸ *what available:*
A 3.5" disk with version 1.0, dated 10.04.1990, containing the *.EXE file B1.EXE and two more files. Clemmens (pers. comm.) mentions that the program is now called BICADAM and that there is a manual. We did not have that available while testing.

▸ *what required:* not stated.

▸ *written in:* not stated.

▸ *remarks:*
- Program starts by typing b1, after logging to a:;
- Intro screen does not show on Compaq;
- Using a fictitious data set of reasonable values, running in the regression mode produces a run-time error M6201 - MATH and a - **: DOMAIN error. Program stops;
- Action required: obtain and test most recent version for proper evaluation.

Program 6: BRDRFLW

▸ *what it does:*
The program predicts the behaviour of the surface stream flowing down an irrigation border, with a known infiltration curve. Other inputs are; border length, slope, roughness and downstream boundary condition (blocked or draining). Management parameters like required application depth, inflow rate and cutoff time are also needed. Resulting parameters are advance, recession, and runoff as functions of time, plus the ultimate distribution of water. The model runs under the zero-inertia formulation, or the kinematic-wave model, or a hybrid of the two.

▸ *made where:*
Theodor Strelkoff for: US Water Conservation Laboratory, 4331 East Broadway, Phoenix, Ariz. 85040, USA

▸ *what available:*
- A 3.5" disk with an executable file B07M.EXE, a data file and a README file; version 7.2 of March 1987;
- The source codes in Fortran of the seven constituting files, dated March 1987 (version 7.2);
- The manual: Strelkoff, T., 1985. BRDRFLW: a mathematical model of border irrigation. USDA, ARS-29, Phoenix, 104 pp.

▸ *what required:*
- IBM PC AT or 386 or compatible (there is a version for machines with a math co-processor: then the executive file is B07M7.EXE, which we do not have);
- A (wide carriage) printer had to be attached to the PC, otherwise the program did not run (even if README.NOW was followed).

▸ *written in:* Fortran 77

▸ *remarks:*
- Start program by typing B07M after logging to a:
- Example of handbook is printed till ZERO INERTIA ....; on the Compaq Deskpro 386N it takes about 17 minutes before the rest of the output is produced;
- Program is not user-friendly: you need to read most of the manual to know what to do to run the program; the input/output arrangement is typically Fortran and hence inflexible;
- Manual is quite elaborate on theoretical background of the zero-inertia and kinematic-wave approaches;
- Long processing time is a drawback, although a math co-processor would help (then B07M7.EXE required, which we do not have);
- Program is now virtually obsolete, since its successor SRFR has taken over (1991), which can do more than only borders (also basins, furrows) for more conditions.

Program 7: CANAL

▸ *what it does:*
This hydraulic model simulates unsteady flow conditions in canal systems that branch out like a tree, with the canals having a trapezoidal cross-section. In the test version there is a maximum of four branches at nine reaches each. Reaches are separated by control structures and each reach can have up to nine turnouts. There are three operation modes, i.e. (i) interactive user-specified control structure operation, (ii) pre-set control structures and (iii) operational supply setting through automatic gate scheduling. There are extensive graphical screen displays of flow profiles and other situations, while tabular numerical information is also available.

▸ *made where:*
By F.N. Gichuki (the Fortran version) and G.P. Merkley (the Pascal version), Dept. of Agric. & Irrigation Engineering, Utah State University, Logan, UT 84322-4105, USA. Available from G.P. Merkley via USU at USD 50.00 + 15.00 postage.

▸ *what available:*
- A 1991 version of the CANAL program on a 3.5" HD disk (Pascal version);
- F.N. Gichuki, 1988. (1) Development of a branching canal network hydraulic model. WMS II report 72; (2) User's manual for the Fortran version of USU main system hydraulic model. WMS II report 73. Logan, Utah;
- G.P. Merkley, 1987. Users manual for the Pascal version of the USU main system hydraulic model. WMS II report 75. Logan, Utah;
- G.P. Merkley & D.C. Rogers, 1991. Description and evaluation of program CANAL. In: Ritter, W.F., Irrigation and Drainage, ASCE, Hawaii: 390-396

▸ *what required:*
IBM AT machine or compatible, EGA card, high resolution colour monitor, 80287 co-processor, minimum 640 KB RAM and a hard disk. DOS version 3.1 or higher.

▸ *written in:* MS Pascal 3.31 with assembly language routines for screen display.

▸ *remarks:*
- The DOS path name has to be adjusted in the CDAT program first;
- In the CDAT program (a separate .EXE file) input files are created, and edited; there is a sample case (file LNOR);
- After leaving CDAT, typing CANAL (a separate .EXE file) starts the simulation;
- There is a clear manual (WMS 75), with background and operating instructions;
- There is an attractive choice between graphics and tabular data for a wide range of variables; a simulation can be interrupted for interactive changes;
- The Pascal version is now supported by USU; a new version with variable computation time steps (now: 5 min.) would be available at the end of 1992;
- A math co-processor is needed to produce reasonable run times.

Program 8: CATCH3D

▸ *what it does:*
This is a sprinkler overlap program, which simulates the water application uniformities of rectangular sprinkler patterns by overlapping catch can measurements from a single sprinkler test of from a lateral line test. The catch can grid must be square and only patterns that are multiples of the catch can grid can be evaluated. Resulting calculated values include uniformity coefficient, distribution uniformity, application efficiencies of the low half and the low quarter and catch can efficiencies. Overlapping patterns can be shown and plotted graphically.

▸ *made where:*
Dr. R.G. Allen, Dept. of Agricultural and Irrigation Engineering, Utah State University, Logan, UT 84322-4105 (copyrighted). Available at USD 39.00 + 15.00.

▸ *what available:*
- A 3.5" disk with *.DOC, *.BAS, and *.EXE files for CATCH3D and for the derived 3-dimensional plotting program 3D (by the same author); a number of data files (*.DAT) are present for demonstration; we have version 3.3 of 1988;
- No manual is present but the documentation in the *.DOC files should suffice.

▸ *what required:*
IBM-PC XT or AT under MS-DOS with CGA or EGA screen.

▸ *written in:* Basic

▸ *remarks:*
- Program works OK with test data CATCH3D.DAT;
- Although a program like SURFER may yield similar graphics, it is nice that all kinds of uniformity parameters are calculated;
- A simple and useful program e.g. for educational purposes;
- Especially the 3D plotting facility is a nice feature for research reports, etc.
- We did not look at other data files like DONUT, SIDEROL, etc.

Program 9: CID

▸ *what it does:*
Calculates irrigation and drainage canals for uniform stationary flow using Manning's formula. Canals may be trapezoidal or rectangular and lined or unlined. Calculations are made per canal section, i.e. per stretch with constant canal dimension variables. Four calculation options are present, i.e. for normal situations, for minimum slope, for minimum earth work volume and minimum earth work cost. Both numerical and graphical results are produced and can be sent to a printer or a file for future use.

▸ *made where:*
COMPAS, a combined initiative of International Agricultural College Larenstein, Laarweg 6, 6882 AA Velp and The Department of Land & Water Use of the Agric. University, Nieuwlanden 11, 6709 PA Wageningen, both in The Netherlands. Author is Ir. J.B.M. Swennenhuis. Restricted availability.

▸ *what available:*
- One copied 3.5" disk with version 1.0 (for 4 graphics cards);
- The manual: Swennenhuis, J., 1987. CID - a program for the Calculation of Irrigation and Drainage canals. IAHL/Velp, Agric. Univ./Wageningen

▸ *what required:*
- IBM PC/XT/AT with a minimum of 512 kB RAM;
- Floppy disk drive 5.25" (for original disk);
- Either HGC, CGA, EGA, AT&T graphics card;
- Epson MX, RX, FX compatible printer.

▸ *written in:* Not stated.

▸ *remarks:*
- Type EGACID to start after logging to a:
- Help facility is reasonably extensive; nicely under F1;
- Graphics are a nice feature, but X-section not very informative and top of embankment not shown on longitudinal section;
- Program logic and chosen keys for action are quite OK;
- Program easy to use, even without complete manual;
- Made for college level students, with simple graphics and no interactions;
- Language of manual (and occasionally on screen) needs some editing;
- Print out of graphs is not impressive;
- General impression is: nicely made small program; user-friendly and easy to grasp.

Program 10: CRIWAR

▸ *what it does:*
The program calculates CRop Irrigation WAter Requirements of a cropping pattern of up to 40 crops in an irrigation command area using the modified Penman method, as described by Doorenbos & Pruitt (1977). It corrects the crop water requirements in a simple way for the effective precipitation. Input data can be stored in a file and output is automatically tabulated in an output file. The user is prompted to answer simple questions appearing on-screen. Weekly or monthly data are calculated.

▸ *made where:*
International Institute for Land Reclamation and Improvement, P.O. Box 45, in co-operation with Institute for Land and Water Management Research, P.O. Box 35, 6700 AA Wageningen, The Netherlands

▸ *what available:*
A 3.5" disk with 3 *.EXE files and a TXT directory containing 103 text files with screen messages, dating from 1988. Total size = 345 kB;

▸ *what required:* IBM PC XT will do; second drive if size 5.25" XT (for output).

▸ *written in:* Fortran

▸ *remarks:*
- Was supposed to be ILRI publication 46, but was never published;
- Based on Doorenbos & Pruitt (1977) modified Penman equation;
- Loading the program after the initial 3 screens takes long (without a message);
- Meteorological data input is in fixed units (temperature in degrees C, rain in mm, wind in m/s, etc.); not flexible (like e.g. L&W:PENMAN);
- Prompting for the date (!), and for input data, choices, etc. now appears outdated (program originally dates from 1986);
- Most incorrect entries indeed produce a warning;
- There is no manual, but it is not needed to run the program;
- Usefulness now expired, with more versatile programs like CROPWAT, IRSIS and similar programs on the market;
- A few minor improvements have been made in a 1991 version, but these do not change the remarks made above.

Program 11: CROPWAT

▸ *what it does:*
The program calculates crop water requirements from climatic data using the Penman-Monteith approach, and subsequent irrigation requirements, using crop data. It also allows the development of irrigation schedules for different management conditions and produces scheme water supply data for varying cropping patterns.

▸ *made where:*
Land and Water Development Division, Food and Agriculture Organization, Via Terme di Caracalla, 00100 Rome, Italy (M. Smith).

▸ *what available:*
- Version 5.3 from Oct. 1988.; the 5 *.BAS files were hidden on the 5.25 disk; in total 64 files;
- FAO, 1988. Manual for CROPWAT (version 5.2) May 1988. FAO, Rome. 45 pp.
- FAO, 1988. Guidelines for using CROPWAT. India: National Water Management Project, Workshop Walamtari, 9-13 May 1988. 55 pp.
- Smith, M., 1992. CROPWAT - A computer program for irrigation planning and management (+ disk with v. 5.7). Irr. & Drain. Paper 46, FAO, Rome, Italy

▸ *what required:*
IBM PC XT or AT or compatible, with a minimum of 360 kB RAM. The used version 5.7 has a size of about 703 kB in 238 user files. For direct start-up from the HD 5.25" disk in I&D Paper 46, MS-DOS 3.2 or higher is needed.

▸ *written in:* Basic

▸ *remarks:*
- Start from disk, type CROPWAT or install on hard disk first using INSTALLH;
- There are 3 data directories: CLIMATE, with *.PEN and *.CLI files, CROPS (with *.CRO files), and FIELDS (with *.SOL and *.FLD files); check printer setting and proper paths first;
- Manual is sometimes needed to explain screen choices;
- Accuracy of ET calculations difficult to evaluate; no data compared with other similar programs as yet;
- Practical applicability of irrigation scheduling and scheme water supply sections difficult to evaluate; certainly useful for training;
- Program runs correctly and menu switching is alright;
- Addition of graphics would enhance scheduling section;
- CLIMWAT meteorological data set not tested (not yet received from FAO).

Program 12: CWRTABLE

▸ *what it does:*
This spreadsheet allows up to five different cropping patterns to be specified for a total of 52 periods (e.g. weeks, to make one year). Water requirements are then calculated from input data such as reference evapotranspiration and crop factors, which are thus not calculated by the spreadsheet.

▸ *made where:*
M. A. Burton at the Institute of Irrigation Studies, The University, Southampton SO9 5NH, UK. Limited availability.

▸ *what available:*
- A 3.5" disk with three IIS spreadsheet programs, among which: CWRTABLE version 1.0;
- A 15-page manual: Spreadsheet program nr. 1 - Cropping pattern crop water requirements; IIS, Southampton, Nov. 1987.

▸ *what required:*
IBM PC with 384 kB memory with colour or Mono screen. MS-DOS 2.1 or higher; Lotus 1-2-3 package.

▸ *written in:* Lotus 1-2-3.

▸ *remarks:*
- After calling Lotus 1-2-3, type /FR and at the prompt type A:\CRWTABLE\ to obtain either the empty spreadsheet (CWRTAB0) or the filled in example (CWRTAB1);
- The main input (ETo) has to come from somewhere else;
- It does simple additions, showing the effect of different planting dates on irrigation water requirements;
- It is a simple spreadsheet, suitable for introducing students to the usefulness of spreadsheets for irrigation calculations, rather than for general issue or use in irrigation project design;
- Manual has a few small errors (e.g. page 10);
- The spreadsheet can be printed in three sections;
- Plots of crop water requirements versus time can be printed with Lotus' PrintGraph menu.

Program 13: DORC

▸ *what it does:*
The software package contains a number of routines which help in the Design Of Regime Canals, i.e. canals with a stable profile as far as sedimentation and scour is concerned. Apart from a range of design methods for alluvial, unlined canals, procedures for predicting alluvial friction and sediment transport are provided. Methods for predicting the transporting capacity of sediments in the cohesive size range are also included. The package includes regime methods, tractive force, rational methods, Manning, alluvial friction predictors, and sediment transport for sand and silt.

▸ *made where:*
Overseas Development Unit, HR Wallingford, Wallingford, OX10 8BA, England.

▸ *what available:*
- A 3.5" disk with version 1.1, dated 1992 as an .EXE file, complete with installation files and a startup routine (DORC.BAT);
- A (draft) User manual (March 1992), 55 pp.

▸ *what required:*
An IBM-compatible microcomputer with > = 640 kB RAM, running under MS-DOS 3.0 or higher. A hard disk is preferred. A line printer, if printed results are required.

▸ *written in:* MS Fortran 5.0

▸ *remarks:*
- The installation procedures are simple and work correctly;
- There is a clear main menu, leading to one or two levels of sub-menu's, after which input data are requested on the top half of the screen and results are shown on the lower half of the screen;
- File handling, data entry and moving around the program are clear and straightforward;
- The manual is clear on program organization, and gives some guidance as to which method to use, but scientific background, formulae used, and coefficients selected are not mentioned (but references are given);
- Experience and judgement of the design engineer is required to select input values and to interpret the calculated output values;
- Screen display is simple and contains numerical information, once the method is selected; available Help refers mainly to units and numerical limits;
- An easy-to-use tool for designing alluvial channels appropriate to transported sediment load.

Program 14: DRAINCAN

▸ *what it does:*
This spreadsheet is to be used in Lotus 1-2-3 and will calculate the water depth of a trapezoidal secondary drainage canal (in cut, with b = 3*d, side slope 1:1.5 and n=0.025) and bed levels using Manning's formula and compute the earthwork quantities using the average end area method, for a maximum of 20 sections. The main aim, however, is educational: to show spreadsheet programmers how to set up, structure and document a spreadsheet program for a familiar irrigation/drainage problem.

▸ *made where:*
Robert Truncie (an M.Sc. student in Irrigation Engineering) at the Institute of Irrigation Studies, The University, Southampton SO9 5NH, UK.

▸ *what available:*
- A 3.5" disk with two more IIS spreadsheet programs and DRAINCAN version 1.0 of 1987;
- A 41-page "Manual", extracted from the M.Sc. thesis of R. Truncie (i.e. Appendix C and Chapter 7).

▸ *what required:*
IBM PC XT or AT. Epson FX 1000 printer using 14" paper. Lotus 1-2-3 release 2 or higher.

▸ *written in:* Lotus 1-2-3.

▸ *remarks:*
- After invoking Lotus 1-2-3, type /FR and a:\draincan\ to have a choice of an empty spreadsheet (DRAIN.WK1) or a filled-in one (SAMPLE.WK1);
- After the logo, and two documentation screens, a separate menu was created (Table View Save Access Quit) above the spreadsheet, for Creating or Updating the Table; for Viewing the longitudinal section of the drainage canal; for Saving/printing the table or graph; for Accessing the spreadsheet construction; and for Quitting Lotus;
- This program and the manual indeed show more about spreadsheet construction in Lotus 1-2-3 than about calculating canal dimensions and earthwork volumes;
- The graphics of Lotus 1-2-3 release 2 are indeed rather rudimentary (View option); there are nicer programs available which do the same (e.g. CID).

Program 15: DRAINMOD

▸ *what it does:*
Based on the water balance in a soil profile, DRAINMOD uses climatological records to simulate the performance of drainage and water table control systems for shallow water table soils. Approximate methods are used to quantify hydrologic components like subsurface drainage, subirrigation, infiltration, evapotranspiration and surface run-off. The model assumes an equilibrium soil water distribution above the water table. Hourly precipitation and daily temperatures are input and daily, monthly or annual summaries can be output of many drainage aspects.

▸ *made where:*
Prof. Dr. R. Wayne Skaggs, Biological and Agricultural Engineering Department, Box 7625, N.C. State University, Raleigh, NC 27695, USA.

▸ *what available:*
- PC version 4.6, dated April 1992;
- DRAINMOD User's manual, edited by: S.R. Workman, R.W. Skaggs, J.E. Parsons & J. Rice, 1990, North Carolina State University, Raleigh; 95 pp.
- R.W. Skaggs, 1980. Drainmod reference report. USDA-SCS, Fort Worth

▸ *what required:*
- A hard disk with 1 MB free space; DOS 3.0 or higher; minimum 320 kB RAM; minimum graphics 640*200 (CGA);
- A math co-processor is recommended;
- Files=20 in CONFIG.SYS; EDLIN to be in the path.

▸ *written in:*
There are Basic and Fortran versions; we have a Fortran version; the DMSHELL is in QuickBasic 4.0.

▸ *remarks:*
- Installation routine works OK (see Manual p. 3-10 and file INSTALL.INF);
- The hourly rainfall data may pose a problem in many locations: not measured;
- Program made for humid climate, steady state; irrigation option available, but does not seem very appropriate;
- Running time without co-processor for simple example (DCNVBN) is 15 minutes, which is rather long;
- The program promises graphs for hydrologic data files; no such (sample) files are present with the package, so no graphs could be checked;
- Test output file was made; can be viewed and printed OK;
- The subject matter is not simple and a careful study of the input data (9 editing screens/files) is required; the manual gives good practical advice; theory is in a reference report (Skaggs, 1980).

Program 16: DUFLOW

▸ *what it does:*
Provides a hydrodynamic user-oriented package for unsteady flow computations in networks of open water courses. It addresses e.g. propagation of tidal waves in estuaries, flood waves in rivers and operation of irrigation and drainage systems. Free flow in open channels is simulated and canal sections, and control structures like weirs, culverts, siphons and pumps can be included. A simple rainfall-runoff relation is part of the model.

▸ *made where:*
International Institute for Hydraulic and Environment Engineering, Delft; Rijkswaterstaat, Tidal Waters Division, The Hague; Delft University of Technology. Distribution: ICIM, P.O. Box 5809, 2280 HV Rijswijk, The Netherlands (formerly: Bureau SAMWAT). Price of version 2.0 is NLG 750 excl. VAT.

▸ *what available:*
- Two 3.5" DS DD diskettes, containing program version 1.1 and examples;
- Spaans, W., N. Booij, N. Praagman, R. Noorman & J. Lander, 1991. DUFLOW, a microcomputer package for the simulation of one-dimensional unsteady flow in open channel systems. IHE, DGW, TUD; Delft. 92 pp.
- Clemmens, A.J. & F.M. Holly, 1991. Description and evaluation of program DUFLOW. In: Ritter, W.F., Irrigation & Drainage, ASCE, Hawaii: 418-424

▸ *what required:*
IBM-compatible PC under MS-DOS, with 640 kB internal memory, graphics card (CGA, EGA, VGA, Olivetti, Hercules), preferably a math co-processor; two 360 kB floppy drives or equivalent; a hard disk is recommended.

▸ *written in:*
The non-interactive calculation module is in Fortran-77. The interactive input and output modules in GW-Basic.

▸ *remarks:*
- After making a directory c:\duflow\ and copying all files thereto, program starts upon typing DUFLOW; subsequently, one must check Setup and Filenames;
- Main program consists of three basic options: Input, Calculations, and Output; Input and Output are logically subdivided in Submenu's;
- Manual is useful, has background theory, program structure, and operation (with example in App. B: Getting started) nicely explained;
- Program runs through example without problems;
- An educational version (with limited possibilities) is available;
- Version 2.0 was issued late in 1992 and contains a water quality module as well; this version was not tested; we used its precursor, version 1.1.

Program 17: ETREF

▸ *what it does:*
This is a package of four computer programs based on FAO's Crop water requirements publication (I&D paper 24, 1977), containing ETREF, calculating the potential evapotranspiration of a reference crop, ETCROP, multiplying ETref with a crop coefficient, ETSPLIT, calculating the potential evaporation and transpiration separately, and DEFICIT, calculating net irrigation requirements.

▸ *made where:*
Center for Irrigation Engineering, K.U. Leuven, Kardinaal Mercierlaan 92, 3030 Leuven, Belgium. Price is USD 45.

▸ *what available:*
- Information brochure on this software package;
- A 3.5" disk with the four programs in source code, in an *.EXE version, all with an input chart *.CHA;
- A copy of the manual: Raes, D., P. van Aelst & G. Wyseure, 1986. ETREF, ETCROP, ETSPLIT and DEFICIT, a computer package for calculating crop water requirements. Lab. Soil & Water Eng., Leuven, 104 pp.

▸ *what required:* IBM PC/XT/AT or fully compatible.

▸ *written in:* Fortran 77

▸ *remarks:*
- The ETREF, ETCROP and DEFICIT programs are a logical sequence to arrive at irrigation project requirements; ETREF and ETSPLIT are useful for a soil-water balance model (e.g. SWATRER);
- Adjustment factor c for ETREF is discussed in Jensen, Burman & Allen (1991); more useful info given there;
- Programs have the typical Fortran input chart, which was OK in 1986, but which looks rather dated now;
- Manual appears is quite elaborate, repeating tables from I&D 24, and adding others;
- Climatological data input sometimes flexible (humidity: 4 possible units), sometimes not (wind speed: m/s only);
- No (sample) climatological data file provided on disk, only one month for Jaca (Spain) in manual: file FT04001 is not provided;
- Same goes for other examples in manual: only blank files are provided; for a sample run they must be filled first;
- Suggestion that daily ETREF values are useful is implied, which is highly questionable.

Program 18: FISDEV

▸ *what it does:*
The program is a tool for the design and evaluation of furrow irrigation systems, based on current surface irrigation theory. It distinguishes three types of systems, i.e. with fixed inflow, with cut-back, and with tailwater re-use, which can be treated separately or in comparisons. Four calculation modes allow to solve for inflow rate, furrow length, application time and minimum infiltrated depth.

▸ *made where:*
Center for Irrigation Engineering, Vital Decosterstraat 102, 3000 Leuven, Belgium

▸ *what available:*
- A copy of the program (45 files) on a 3.5" disk; it is a preliminary version of April 1992 (to become version 1.0);
- A copy of the draft Manual: Zerihun, D. & J. Feyen, 1992. FISDEV, a software package for design and evaluation of furrow irrigation systems. Center for Irrigation Engineering, Leuven, Belgium, 52 pp.;
- Zerihun, D. & J. Feyen, 1992. FISDEV - a software package for design and evaluation of furrow irrigation systems. Proc. 16th Europ. Conf. ICID, Budapest, vol. III: 189-195

▸ *what required:*
IBM XT/AT or compatible with a minimum of 360 kB RAM. Math co-processor and VGA recommended.

▸ *written in:* Turbo Pascal.

▸ *remarks:*
- As this is only a preliminary version, these remarks may not hold for the final product;
- Creating a DB directory tree takes a long time; an installation procedure may be indicated;
- Help screens require editing and are not always clear;
- The file handling facilities easily lead to confusion;
- There is no consistency in the use of Modules and Modes;
- The final version of the manual would benefit from another introduction;
- Chapters 1-4 of the draft manual could be replaced by an improved section on furrow irrigation design and evaluation;
- The manual still lacks a chapter on surface irrigation theory.

Program 19: FLUME

▸ *what it does:*
The model computes stage-discharge relations and energy losses for long-throated flumes and broad-crested weirs. It can accommodate a wide variety of flume and channel shapes and many different input and output units. Input data can entered from the keyboard or be read from a file and, similarly, output can be to the screen or to output files (in tabulated form).

▸ *made where:*
USDA Agricultural Research Service, US Water Conservation Laboratory, 4331 East Broadway, Phoenix, Ariz. 85040, USA (Contact A.J. Clemmens).

▸ *what available:*
- 3.5" disk with FLM24.EXE file (90 kB), source code in Fortran, a README and some data files;
- Manual: Clemmens, A.J., J.A. Repogle & M.G. Bos, 1987. FLUME: a computer model for estimating flow through long-throated measuring flumes. US Dep. of Agriculture, Agricultural Research Service, ARS-57, 68 p.
- Literature (e.g.): Bos, M.G., J.A. Repogle & A.J. Clemmens, 1984. Flow measuring flumes for open channel systems. Wiley, New York.

▸ *what required:*
Not stated (IBM PC XT or AT or 386, with or without a math co-processor).

▸ *written in:* Fortran IV.

▸ *remarks:*
- Program starts by logging to a: and typing FLM24;
- Input data e.g. of example (flume 7) can be either read from data file or typed in from keyboard;
- If typed in from keyboard data appear almost immediately on screen (and, if chosen, in output files);
- No plotting or graphics facilities provided: other plotting programs may import data from output files;
- Program does calibration and analysis, NOT design;
- Manual is quite useful for help in choosing inputs (pages 8-13); extensive examples are given; theory provided (pages 34-57);
- Program shows older Fortran problems with inflexible input/output arrangements; the comparison of runs must still be done by looking at long tabulated data (or by using other graphics packages);
- Hydraulic basis should be OK;
- The program does not stand alone: you need the manual;
- A new version 3.0 has been made and is to be published in 1993.

Program 20: INCAdemo

▸ *what it does:*
The demonstration disk shows in a number of subsequent screens that the Irrigation Network Control & Analysis package is based on a generalized database (in the demo for Kraseio Scheme in Thailand). The database contains, a.o. canal network data, historic rainfall data, info on soils, cropping patterns, canal water levels, etc. The program facilitates data management & processing, irrigation water management, and performance monitoring. Extensive use of graphics, including map zooming, visualizes information quickly and attractively.

▸ *made where:*
HR Wallingford Ltd., Wallingford, Oxfordshire OX10 8BA, UK. Contact: John Skutsch. Available at around GBP 3000.

▸ *what available:*
A 3.5" demonstration disk, which is 770 kB in size including zipped INCA files (unzipped size 220 kB). There is a batch file for installation on c:\incdem.

▸ *what required:*
For the demo 2.5 MB should be available on the hard disk, and a VGA colour screen is required (VGA mono will do). For the real program WINDOWS v. 3.1 is required and an SQL routine licence (GBP 150). An IBM 80386 machine is required, with 4 Mb RAM and a 60 MB hard disk, with a VGA colour screen.

▸ *written in:* not stated

▸ *remarks:*
- After installation to c:\incdem and logging there, typing ST INCA will start the demonstration (see instruction sheet);
- Program seems indeed to be an integrated package, including separate functions like calculating water requirements, preparing cropping patterns, making irrigation schedules, allocating canal target flows, etc.;
- Graphics are indeed nice, somewhat comparable to the Mott MacDonald standard (NILE, etc.), and functional; it is the first package that runs under WINDOWS (hence the 80386 and 4 MB RAM requirement); top of the market; too high and too expensive for our normal target group;
- A wide range of options (pull-down menus) are easily accessible; they seem logically structured;
- Difficult to judge how site-specific the program is; apparently it is (besides Thailand) also introduced in Sri Lanka and Bangladesh.

Program 21: IRRIGAME

▸ *what it does:*
The program asks the user to choose between various input options, such as: advisory services, growing season rainfall, reservoir water availability, type of irrigation system, crop type, crop/soil options, and two agronomic options. It then proceeds to provide weekly climatic data and graphical rooting depth and soil depletion, requesting you to say, week by week, whether or not to irrigate and how much to apply. You can operate at various speed levels. In the end a summary and plotting possibilities are provided. The 'scoring' is not completely clear.

▸ *made where:*
Brian J. Boman, Utah State University and University of Florida, USA, based on earlier irrigation games by J. Parrish & L. M. Mulkay. Available from Software Engineering Div., Biol. & Irrig. Eng. Dept., USU (April 1992) at USD 35.00 + shipping & handling (USD 8.00 in USA, USD 15.00 abroad).

▸ *what available:*
A 3.5" disk with 11 files in 182 kB, including BASICA.COM and GWBASIC.EXE. The IR.BAT does not work on the Compaq. There are 4 other *.DAT files, two (older) Fortran files (.FOR) and two Basic files (.BAS), which seem to be the current ones. References were seen to J. Parrish (1982 and undated), about an On-farm management simulation game and about Irrigation simulation game development, both from USU, Logan.

▸ *what required:*
Not specified; Hercules 720*348 or IBM 640*200 (CGA) to be selected, when prompted. Apparently, any IBM PC XT will be adequate.

▸ *written in:* Basic (new programs), Fortran (the older ones).

▸ *remarks:*
- Type IR after logging to the a: drive, containing the floppy;
- There are apparently climatic data available; it is not clear where they are, for which station, and if they can be changed;
- The provided information before being asked whether to irrigate or not is confusing; the Depletion graph may not have been understood correctly;
- The 13 plotting menu choices at the end are potentially nice, but there is no "score", or "What did I do right or wrong ?";
- It is not immediately clear what the other files (except GWBASIC.EXE and IR1.BAS, which produce IRRIGAME) are meant for;
- The purpose of the game is not clear; there is no manual or any other documentation to assist;
- We may not have tested the most recent version.

Program 22: IRSIS

▸ *what it does:*
The IRrigation Scheduling Information System package addresses irrigation scheduling at field level. For a given climate, crop and soil it offers possibilities to calculate net irrigation requirements or optimum water distribution under limited water supply, to plan irrigation schedules, to evaluate past irrigation schedules, and to plan irrigation actions. Consequences of irrigation schedules are shown in terms of water use efficiency and crop yield depressions. It employs interactive data processing and calculations, using hierarchically structured displays or screens.

▸ *made where:*
Center for Irrigation Engineering, Laboratory of Land Management, Faculty of Agricultural Sciences, Kardinaal Mercierlaan 92, b-3030 Leuven, Belgium. Available at USD 75.00.

▸ *what available:*
- A 3.5" disk with IRSIS version 4.01 in *.EXE form, with drivers, displays and a database;
- Raes, D., H. Lemmens, P. van Aelst, M. vanden Bulcke & M. Smith, 1988. IRSIS - irrigation scheduling information system, vol. 1: Manual (199 pp.) and vol. 2: Displays (71 pp.). Lab. of Land Management, Leuven;

▸ *what required:*
IBM PC/XT/AT or compatible, 640 kB RAM, PC-DOS/MS-DOS 2.xx or higher; minimum 1 FDD, CGA and a monochrome monitor.

▸ *written in:* Turbo-Pascal; interactions with SUSI (Lemmens 1988)

▸ *remarks:*
- The package in fact replaces and extends ETREF, ETCROP, ETSPLIT and DEFICIT, made in Leuven earlier (1986);
- The interaction with displays using Structured User System Interface (a developed by-product of IRSIS) is a nice improvement (for 1988, anyhow, when pull-down menus were not common);
- Works only for uniform soils and dry-foot crops (no rice); capillary rise is not included, nor are leaching, distribution losses or delivery systems;
- Hierarchical structure of displays easy to grasp; Main > Libraries > Members > Inquire/Update > ID/Data/Report > Details (e.g. text, tables, graphs);
- Working through the case study (chapter 4 of the manual) takes a few hours, leaving out smaller details;
- The total package is a handsome scheduling program, but at least a few days are required to become familiar with the terminology, the program logic and the keyboard actions. Comparable with FAO's CROPWAT (Smith, 1992).

Program 23: MAINSYST

▸ *what it does:*
This spreadsheet either works with a given reference crop relative factor (l/s/ha) and calculates the discharge at each tertiary unit and works back up the system to find the total requirement at the source, or starts from a fixed water supply at the source and then distributes this over the respective tertiary unit areas. It uses relative areas for various crops/crop stages, instead of a varying unit discharge (l/s/ha). It is thus basically an allocation program.

▸ *made where:*
M.A. Burton, Institute of Irrigation Studies, The University, Southampton SO9 5NH, UK. Restricted availability.

▸ *what available:*
- A 3.5" disk with PENEWON.WK* worksheets (one empty);
- A manual: Computer programs for management of irrigation systems - Spreadsheets and the relative area method, IIS, Southampton; 24 pp.
- Bullock & Burton, 1988. Spreadsheets for water management - a case study from the Brantas Delta, East Java. Irr. & Dr. Syst. 2: 259-278.
- Goldsmith, Bird & Howarth, 1988. Computerised irrigation scheduling using spreadsheet models. Irr. & Dr. Syst. 2: 211-227.

▸ *what required:*
IBM PC computer with 384 kB memory and Lotus 1-2-3 or QuattroPro software.

▸ *written in:* Lotus 1-2-3.

▸ *remarks:*
- Summary (Manual p. 10) is in columns A-H, rest is to the right; no worksheet PENEWONA.WKT (p. 12) copied, which gives Worksheet file revision out of date error (TWIN = simple and free spreadsheet, like Lotus 1-2-3);
- No Kapongan scheme files present (Manual p.4; Ch. 5);
- Spreadsheet is configured for particular scheme, but idea can be borrowed for other schemes;
- It calculates allocations with either the water supply at the source fixed or with the standard water use fixed (say, 0.4 l/s/ha);
- There are 4 graphs under Names which can be viewed;
- The idea is not revolutionary, but it can form a useful demonstration exercise for the use of spreadsheets for small irrigation problems;
- The sequence of the spreadsheets in terms of level of difficulty/training is: CWRTABLE - MAINSYST - DRAINCAN.

Program 24: NESTOR

▸ *what it does:*
This set of programs calculates steady non-uniform flow in channel sections of various shapes. For a maximum of 30 reaches, water profiles are calculated, i.e. the eight relevant variables are connected. Output is tabulated in a data sheet, but graphical output is also possible. A maximum of 11 different cross-section per canal reach and five structures per section can be included.

▸ *made where:*
G.J. Hunink, Int. Agric. College Larenstein, Laarweg 6, 6882 AA ,Velp, The Netherlands. Restricted availability.

▸ *what available:*
NESTIN, NESTOL and NESTUD executive files for input, as the major program and for (student) demonstration, respectively. Version number is 1.0, dated 1991.

▸ *what required:*
A math co-processor is required; other requirements not specified. The total package fits on a HD floppy only (AT machines or higher).

▸ *written in:* not stated.

▸ *remarks:*
- The programs are apparently mainly intended for demonstration and use by College students and not specifically made for further distribution;
- Input not difficult; calculations seem to work OK;
- The graphics are generally reasonable, but sometimes poor (e.g. printed length profile from NESTUD);
- A major drawback for wider use at present is that everything is written in Dutch.

Program 25: OMISdemo

▸ *what it does:*
The demonstration disk mentions that OMIS (Operation and Management of Irrigation Systems) allows the user to plan a cropping pattern, process monitoring data, prepare half-monthly operation schedules and simulate alternative operations. The demo stresses the integrated structure of the program, its fast data processing, its flexibility and its user-friendliness (menu-driven, graphic displays).

▸ *made where:*
Delft Hydraulics, Division Water Resources and Environment, P.O. Box 177, 2600 MH Delft, The Netherlands, for DHV Consultants, Amersfoort. OMIS itself costs over NLG 10,000.

▸ *what available:*
- Demo disk with 44 files (approx. 716 kB);
- Relevant publication: Verhaeghe, R.J. & W.N.M. van der Krogt, 1990. Modelling of irrigation water management. Delft Hydraulics publication no. 447, Dec. 1990.

▸ *what required:*
For the demo, an IBM AT is required with an EGA card and colour screen; Monochrome screen gives good idea, but maps are not 100%. It says that the OMIS program itself needs an IBM AT with a math co-processor, an EGA card, a colour screen, a hard disk with >= 10 MB storage, and an Epson compatible printer.

▸ *written in:* not mentioned.

▸ *remarks:*
- Demo starts with typing DEMO;
- The general text, and slides of the four main functions, give a good impression of the program's possibilities;
- Graphics shown are indeed of good quality;
- Application and data shown are for the 12000 ha Cidurian Irrigation Scheme (Indonesia), mainly for the overall network, which includes river diversion and a hydropower dam. The smallest irrigation unit is a tertiary unit;
- The operation part includes the organizational setup, (pengamats, mantris and gatekeepers) and deals with monitoring information and new gate settings on a half-monthly basis;
- It is difficult to judge from the demo how site-specific the program is. It would be useful to establish how the actual OMIS would perform under other conditions, in other places. The set-up looks promising;
- The OMIS program is basically an allocation program, taking account of crop data, climatic data, and soil data in various portions of a scheme on a half-monthly basis. It can also handle current information for monitoring.

Program 26: OPTIPIPE

▸ *what it does:*
The program calculates the most cost-effective pressurized irrigation water distribution system, considering pipe diameters only. It is meant as a practical tools for irrigation engineers to assist them in designing a branching pipe network.

▸ *made where:*
FAO, AGLW Service, Land and Water Development Division, Via Terme di Caracalla, 00100 Rome, Italy

▸ *what available:*
- A version of the OPTIMIZING PIPES DIAMETER program, renamed OPTIPIPE by us, dated August 1988 (most recent file) on a 3.5" disk;
- Manual for OPTIMIZING PIPES DIAMETER (FAO and PIT's). Land & Water Dev. Div., FAO, Rome. No year. 68 pp.
- Annex: Use of the programme. pages 233-244 of FAO Irrigation & Drainage Paper 44 (from Labye et al., 1988).
- Literature: Y. Labye et al., 1988. Design and optimization of irrigation distribution networks. Irrigation & Drainage Paper 44, FAO, Rome. Chapter 4: Design and optimization techniques of pressure distribution networks. pp. 89-146.

▸ *what required:*
IBM PC XT or AT or compatible, with minimum 260 kB RAM, and a printer.

▸ *written in:*
Basic, in 11 program modules and many data files for the example. Size is: about 222 kB.

▸ *remarks:*
- Start by typing OPTIPIPE after logging to relevant drive;
- The options appearing at the start are not clear: e.g. do they take you through the example or are you starting a new network ?;
- There are sequential errors in the manual;
- Upon entering the data of Fig. 37 (F1) and Fig. 39 (F2), as mentioned in part II of the Manual, two errors appeared, i.e.:
- On ascending the network (F3) the program aborts (subscript out of range);
- On descending the network (F4) program aborts (input past end);
- Program as we have it does not work properly.

Program 27: PROFILE

▸ *what it does:*
Calculates user-defined unknowns in the Manning/Strickler formula for trapezoidal channels, using a tabulated calculation sheet, which can be written to a file for future reference. The Newton-Raphson iteration is used for unknown water depth, bed width or side slope.

▸ *made where:*
Delft University of Technology, Faculty of Civil Engineering, Sanitary Engineering & Water management, Section Irrigation, P.O. Box 5048, 2600 GA Delft, The Netherlands

▸ *what available:*
- A 3.5" disk with PROFILE.EXE and a KSVALUES.TXT file (together some 112 kB); version = 1.0, dated July 1990;
- User's Manual Profile, written by H. Hebermann & W. Schuurmans, dated February 1991, 13 pages.

▸ *what required:*
No data on requirements are given. Program will presumably run on IBM PC XT, AT, 386 or compatibles with a minimum of 256 kB memory.

▸ *written in:* not stated.

▸ *remarks:*
- Program starts after typing PROFILE;
- The KSVALUES.TXT file is too short and not geared towards earthen channels in field irrigation (Ks values are high). It can easily be replaced, but better guidance is expected from a program like this;
- User manual is very explicit, which is generally good;
- The English in the manual and in the Help could be improved;
- Future versions could include suggestions for b/h choices to be made, tabulated permissible flow velocities for various soil materials, and other channel shapes.
- The program makes files on the diskette for future reference, if a SAVE instruction is given; there needs to be space for this on the disk;
- A simple, small program suitable for a simple, small task.

Program 28: RAINBOW

▸ *what it does:*
Frequency analysis and probability plotting of hydrologic data, test of homogeneity of hydrologic records; uses Gumbel and (transformed) normal distributions only.

▸ *made where:*
Center for Irrigation Engineering, Catholic University, Vital Decosterstraat 102, 3000 Leuven, Belgium.

▸ *what available:*
- A 3.5" disk with version 1.6, March 1990;
- The manual, treating version 1.5 (October 1989); 43 pp.

▸ *what required:*
- IBM PC/XT/AT or fully compatible with 640 kB RAM;
- PC/MS-DOS 2.xx or higher;
- Monochrome or colour screen;
- Size approx. 160 kB (excl. data & output files).

▸ *written in:*
Borland's Turbo Pascal 4.0 with SUSI keyboard screen interactions.

▸ *remarks:*
- Start from disk, type RAINBOW;
- Disk works without problems and according to manual;
- LOGO does not come; first screen confusing, initially;
- Action bar at the bottom of the screen might be useful;
- The English in the manual should be edited;
- Can be quickly learnt in e.g. a few hours;
- A nice tool for a relatively simple job.

Program 29: REHAB

▸ *what it does:*
The program can be used by an individual or by one or more teams, who formulate a plan to rehabilitate a secondary canal command area within given budget and time constraints. Requirements of the plan are specified in socio-technical terms of e.g. improved water distribution and better farmer participation. Important stages are System introduction, Information Acquisition, Preliminary design, Final design, and Evaluation. The wider purpose is to create an interdisciplinary, problem-oriented learning experience for participants. An Asian and an African version are available.

▸ *made where:*
T.S. Steenhuis, Dept. of Agricultural & Biological Engineering, Cornell University, Riley-Robb Hall, Ithaca NY 14853-5701, USA

▸ *what available:*
- A 3.5" disk with the 1986 versions and the slide sets;
- Oaks, R.L., E.J. vander Velde & T.S. Steenhuis, 1986. Irrigation REHAB, User's manual. WMS Rep. 46, Ithaca
- Sikkens, R., R. Johnson, R.L. Oaks & T.S. Steenhuis, 1987. Irrigation REHAB - Africa version - User's manual. WMS Rep. 64, Ithaca

▸ *what required:*
- An IBM-compatible microcomputer with 256 kB RAM, running under MS-DOS 2.0 to 3.1, with or without a math co-processor;
- CGA or EGA or equivalent with colour monitor;
- Relay Adapter Card for automatic access to slides.

▸ *written in:* Not stated.

▸ *remarks:*
- The installation procedures are simple and work correctly;
- There is a clear root menu, leading to three sub-menu's (Environment, Information, Farmer), with several options; the Information Module is the most elaborate one;
- We had start-up difficulties on the Compaq, probably due to the monochrome VGA screen; there were no problems on the Portadesk;
- The manuals are clear on starting and running procedures, and give sufficient guidance for trying out individually;
- The graphics for the maps have a somewhat rudimentary appearance nowadays;
- The quality of many slides is not consistent with the rest of the game;
- As with most irrigation games, the group experience seems to be more important than any factual instruction.

Program 30: REUSE

▸ *what it does:*
The model simulates water and salt balances in a series of consecutive schemes in a river basin under different climatic (precipitation and evapotranspiration) and water management conditions. The latter can vary with respect to irrigation efficiencies, reuse of drainage water, quantity and salinity of water supply to the basin, etc. It is a simple mass balance, parametric model. Three types of variables need to be specified: general, river and scheme variables. Output is per sub-period or per period and relates to scheme or basin.

▸ *made where:*
Euroconsult, P.O. Box 441, 6800 AK Arnhem; Delft University of Technology, P.O. Box 5048, 2600 GA Delft; ILRI, P.O. Box 45, 6700 AA Wageningen. Limited availability.

▸ *what available:*
- A 3.5" diskette with REUSE.EXE, INPUT.DAT and OUTPUT.LIS;
- Hoogenboom, P.J., L.K. Smedema & W. Wolters, s.a. Manual of 'REUSE', Arnhem/ Delft/ Wageningen;
- Smedema, L.K., W. Wolters & P.J. Hoogenboom, 1992. Reuse simulation in irrigated river basin. J. Irr. Dr. Eng. 118(6): 841-851

▸ *what required:* not stated

▸ *written in:* Turbo-Pascal 4.0

▸ *remarks:*
- Input file lay-out needs to be exactly followed; no interactive data input; batch processing;
- Sample run with INPUT.DAT works OK and takes approximately 3 minutes on our test machine;
- Printing the output file would be best on a wide-carriage printer;
- An extra .TMP file, made during execution, is to be deleted manually afterwards;
- There is a counter during simulation (useful for the insecure or impatient user);
- Abbreviations used in the output file are in the manual;
- No iterations performed; possibly in a future version;
- Model is relatively simple, with a number of simplifying assumptions and with some slightly dated relationships;
- Testing is said to have been done in arid (Egypt: Fayoum) and semi-arid (Pakistan) conditions with satisfactory results;
- The model is clearly structured and the manual is concise and clear; it could be a useful educational program and a general planning tool, if tested and refined further;
- For wider application, the user-friendliness could be improved.

Program 31: RICEYLD

▸ *what it does:*
The program simulates yield performance of a number of plots under various irrigation schedules and policy alternatives. Its core is a simple water balance for a rice field, for which the various terms are estimated (evapotranspiration, seepage, irrigation, rainfall, drainage, etc.). A yield ratio for drought conditions actual/potential is calculated following a Wickham model as the main performance indicator. The program is a variant of SIMYIELD. It uses daily evapotranspiration and rainfall records so as to avoid effective rainfall estimates. Minimum and maximum water levels are specified.

▸ *made where:* The World Bank, New Delhi, India

▸ *what available:*
- A 3.5" disk with the SIMYIELD and RICEYLD source codes and .EXE files, plus additional files;
- Narayanamurthy, S.G., 1987. SIMULNDO software package for simulating crop performance under irrigation - user's manual (apparently pre-cursor to SIMYIELD and RICEYLD);
- Narayanamurthy, S.G., 1988. RICEYLD program for simulating performance of rice crop under irrigation - user's manual. World Bank, New Delhi.

▸ *what required:*
IBM PC with MS-DOS and an Epson FX or LX printer.

▸ *written in:* Basic

▸ *remarks:*
- The program will runs faster in the .EXE version;
- A test run for one year with existing data files took about five minutes to complete, with half a page abbreviated printed results;
- The program relies heavily on a Wickham yield relation for dry and wet season yields, and on I&D Paper 24 (Crop water requirements);
- The special flooded rice situation makes the program simpler than SIMYIELD (no unsaturated zone);
- No yield reductions due to high water levels (submergence) are calculated due to lack of existing relationships;
- There is no staggered sowing, only slightly staggered land preparation;
- The screen messages and questions are relatively simply laid out; there are no menus and no graphics and no choices to point to, merely questions to answer with letters or figures (Y, N, 1, 2, 3, etc.);
- File handling is neatly organised with choices appearing on screen, making backups, etc.;
- Data input is old-fashioned but proceeds OK using a special module GENRFILE.

Program 32: SALTMOD

▸ *what it does:*
Predicts soil salinity and the salt contents of groundwater and drainage effluent in irrigated agricultural land, based on seasonal data. It also calculates the depth of the groundwater table and the drain discharge. Calculations are based on water balances, and the salinity of each element is considered to arrive at salt balances. Various hydrologic conditions, water management options and cropping schedules can be simulated. An input data table is converted by the program to an output data table.

▸ *made where:*
R.J. Oosterbaan, International Institute for Land Reclamation and Improvement, P.O. Box 45, 6700 AA Wageningen, The Netherlands. Limited availability.

▸ *what available:*
- A 3.5" disk with the .EXE and the .FOR program files, and additional support files; revised version Jan. 92 (updated from 1986; Oosterbaan/Pedroso de Lima);
- A draft manual SALTMOD, by R.J. Oosterbaan, ILRI, revision January 1992; incomplete; 43 pp.
- Oosterbaan, R.J. & M. Abu Senna, 1989. Using SALTMOD to predict drainage and salinity in the Nile Delta. In: ILRI Annual report 1989: 63-74
- Rao, K.V.G.K., G. Ramesh, H.S. Chauhan & R.J. Oosterbaan, 1992. Salt and water balance studies to evaluate remedial measures for waterlogged saline irrigated soils. Proc. 5th Int. Dr. Workshop, ICID-IWASRI, Lahore: 2.67-2.77

▸ *what required:* IBM-PC or compatible; MS-DOS; ≥ 360 kB RAM

▸ *written in:* Fortran 77

▸ *remarks:*
- Running the program with a sample input data file is quick and without problems;
- For testing the influence of certain variables, a number of consecutive runs can easily be made (see e.g. Oosterbaan & Abu Senna, 1989);
- A thorough study of the manual is required to understand how the program operates and what it can do for the user;
- The many 3-letter abbreviations for input, for output and for temporary variables are explained in a separate file, but do not ease a quick understanding;
- Preparation of the input data table is typical for older Fortran programs, as is the batch processing;
- Output gives seasonal values for a specified number of years in a tabulated form;
- The program is still under development; scientific finalising (promised in the manual), thorough brushing up of the user interface, and providing an adequate manual are underway;
- Combination with program SGMP into a regional salinity model is attempted.

Program 33: SATEM

▸ *what it does:*
This package contains Selected Aquifer Test Evaluation Methods, which help in determining the hydraulic characteristics of water-bearing layers from pumping tests, a common phenomenon in studies of regional groundwater resources. There are four sub-programs, i.e. JACOB, HANTUSH, PARTIAL and RESIDUAL, corresponding with fully or partially penetrating wells, and confined, leaky or unconfined aquifers, and whether or not residual drawdown data are to be analyzed. Diagnostic plots are shown on screen and the user can select a satisfactory match between data and theoretical model.

▸ *made where:*
Dr. J. Boonstra, ILRI, P.O. Box 45, 6700 AA Wageningen, The Netherlands (Price NLG 34.00 for publ. 48 + floppy)

▸ *what available:*
- A 3.5" floppy with SATEM version 1.3 (Aug. 1991);
- Boonstra, J., 1989. SATEM: Selected Aquifer Test Evaluation Methods - a microcomputer program. Publ. 48, ILRI, Wageningen, The Netherlands
- Boonstra, J., 1992. Aquifer tests with partially penetrating wells: theory and practice. J. Hydrol. 137: 165-179

▸ *what required:*
IBM compatible microcomputer with Hercules card, CGA or higher and a corresponding monitor. A math co-processor would speed up the calculations.

▸ *written in:* QuickBasic

▸ *remarks:*
- The screens work OK in all four sub-programs and the test data lead to fast results, even without a co-processor;
- There are two additional small programs for assistance: INPUT helps to make input files, and with SCAL theoretical single-well and aquifer test data can be made;
- Manual is suitable mix of theoretical background and program user notes; limitations are clearly stated;
- The program is a nice, relatively small tool for a clearly defined job, and leaves sufficient room for personal interpretation and judgement;
- Program should be judged in combination with Kruseman & De Ridder's Analysis and Evaluation of Pumping Test Data (ILRI publ. 47);
- Relevance for irrigation or drainage limited to research for tubewells or boreholes (groundwater pumping or vertical drainage);
- A useful and modern enough tool.

Program 34: SGMP

▸ *what it does:*
The model can be used to predict the effect of new irrigation schemes, new patterns and rates of groundwater abstraction, and artificial recharge of the groundwater basin, for any desired length of time. It can be applied to a confined, semi-confined and an unconfined aquifer, but not to multi-aquifer systems. The model is devised for saturated laminar flow. It applies mainly the Gauss-Seidel iterative method to solve the finite difference equations, but the Gauss-Jordan elimination method can also be chosen. Plots of water table elevations can be made on screen. SGMP1 applies to single aquifers, SGMP2 to two-layered systems.

▸ *made where:*
J. Boonstra & N.A. de Ridder, ILRI, Wageningen (price for each of the programs on disk NLG 20.00; publ. 29 = NLG 40.00)

▸ *what available:*
- A 3.5" floppy disk with SGMP1 and SGMP2 programs, source codes, and sample input data files;
- Boonstra, J. & N.A. de Ridder, 1990. Numerical modelling of groundwater basins. ILRI publ. 29 (2nd ed.), Wageningen
- A short SGMP2 manual, stipulating the differences with Publ. 29 ("Description of the two-layered model").

▸ *what required:* IBM compatible microcomputer under MS-DOS

▸ *written in:* Fortran IV (SGMP1) and Fortran 77 (SGMP2)

▸ *remarks:*
- In SGMP1 there are four parts (-1, -2, -3a, -3b), to be run consecutively; results come fast in four corresponding .OUT files and two .TRF files;
- The structure of the SGMP2 package is the same, with four parts (-21, -22, -23, and -24), and there is a .DOC file, which is the text of the short SGMP2 manual, mentioned above; test input results come fast;
- Printed and graphical results must be printed on a wide carriage printer (130 char.);
- The input and output is standard older (inflexible) Fortran, dating from the punched card time (as is Publ. 29); no menu's, no interaction, no graphics (except a plotted results file for a wide printer); the program appearance looks outdated in 1992;
- The program requires a thorough understanding of the subject and the validity of the input data via Publ. 29 before the input routines can be used and before results can be interpreted;
- Attempts are made to integrate this model with SALTMOD into a regional salinity model (RSM), at the same time updating the user interface.

Program 35: SIMYIELD

▸ *what it does:*
The program simulates yield performance of a number of plots under various irrigation schedules and policy alternatives. Its core is a simple water balance for a layered top soil, for which the various terms are estimated (infiltration, runoff, evapotranspiration, seepage, rooting depth, soil moisture flow, etc.). A yield ratio actual/potential is calculated as the main performance indicator. The program draws heavily on FAO I&D papers 24 and 33. Daily data are calculated using historical rainfall records so as to avoid effective rainfall estimates.

▸ *made where:*
The World Bank, New Delhi, India

▸ *what available:*
- A 3.5" disk with the SIMYIELD and RICEYLD source codes and .EXE files, plus additional files;
- Narayanamurthy, S.G., 1987. SIMULNDO software package for simulating crop performance under irrigation - user's manual (apparently pre-cursor to SIMYIELD and RICEYLD);
- (do), 1988. SIMYIELD software package for simulating crop performance under irrigation - user's manual. World Bank, New Delhi.

▸ *what required:*
IBM PC with MS-DOS and an Epson FX or LX printer.

▸ *written in:* Basic

▸ *remarks:*
- The program will run faster in the .EXE version;
- A test run with existing *01 files took about ten minutes to complete, with 2 pages abbreviated printed results;
- The program relies heavily on I&D papers 24 and 33;
- The use of the Curve Number method for infiltration & runoff determination seems rather crude;
- Using a linear unsaturated conductivity function (K-theta) is also a gross simplification;
- There is some doubt about the multiplication of reduced yield ratios for different crop stages;
- The screen messages and questions are relatively simply laid out; there are no menus and no graphics and no choices to point to, merely questions to answer with letters or figures (Y, N, 1, 2, 3, etc.);
- File handling is rather neat and data input is old-fashioned but proceeds in a guided way in special organised modules (GENFARMF, GENRFILE and CRPSOLDT).

Program 36: SRFR

▸ *what it does:*
The program is meant to analyze a particular surface irrigation event by calculating the longitudinal distribution of infiltrated depth and the volume of runoff. The irrigation event is characterized by entering values for the relevant input parameters, which can vary widely: infiltration, bottom slope and roughness may be varied over the field length, inflow can be constant, as surges, or as a hydrograph, etc. For small-medium sloped the zero-inertia approach is used; for higher slopes the kinematic-wave approach is the default.

▸ *made where:*
Theodor Strelkoff, USDA-ARS US Water Conservation Laboratory, 4331 East Broadway, Phoenix, Arizona 85040, USA

▸ *what available:*
- A 3.5" diskette containing 16 files (651 kB), which is version 20 of January 1991; source code not available;
- The manual, called: SRFR - a computer program for simulating flow in surface irrigation -furrows-basins-borders; WCL report # 17, US Water Cons. Lab., Phoenix, by Theodor Strelkoff (69 pp.)

▸ *what required:*
IBM AT or 386 with a minimum of 540 kB free memory, CGA monochrome or EGA colour screen; a math co-processor is strongly recommended as it cuts calculation times to about 1/10th. Disk space is required for the files the program makes during execution.

▸ *written in:* Fortran 77

▸ *remarks:*
- Several settings are required before a run can start; this is mainly achieved by going through a SRFRPREP program, the entries from which are explained in quite some detail in the manual;
- The sample input (in SRFR.DAT) takes about 18 minutes on the Compaq 386N (without co-processor) to complete; 14 extra files are made, some empty;
- The SRFRPLOT aborts because QPHERC encounters an illegal function call in line 541 (in the CGA version); CGA or EGA have to be copied by the user into WS2.INI and LABELW.TEM; a new version is said to avoid this problem;
- No runs with own data (e.g. comparison with BASCAD) made;
- The program shows the pre-occupation of the researcher with the physical and mathematical theory, and the typical lack of user-friendliness nowadays standard in computer packages. The use of Fortran, the cumbersome input, and the long list of output figures are indicators. Work on a comfortable interface is in progress.

Program 37: SUBDRAIN

▸ *what it does:*
The program uses colour graphics to assist the user in designing and evaluating a simple subsurface drainage system, consisting of one collector and evenly spaced lateral pipe drains on one or on two sides, at any angle. The program is especially meant for teaching and demonstrations. Based on topographic features of an area it calculates the mainline configuration, the spacing, the depth and the diameters of the drains, as well as water table heights and the total cost of the system.

▸ *made where:*
Department of Agricultural Engineering, Riley Robb Hall, Cornell University, Ithaca, NY 14853, USA. Available via the Northeast Regional Agricultural Engineering Service at USD 30.00.

▸ *what available:*
- A 3.5" disk with the program version 2.5, copied from the original 5.25" disk;
- The manual: Bottcher, R.S., T.S. Steenhuis & M.F. Walter, 1984. SUBDRAIN - User's manual. NRAES, Ithaca, NY, USA

▸ *what required:*
IBM XT with 64 kB RAM, a colour monitor and board, PC-DOS 1.1 or 2.0

▸ *written in:* Basic

▸ *remarks:*
- The program was written (in 1984) to run with basica, but will also operate under gwbasic (but changes in the batch files are then required; the qbasic coming with MS-DOS 5.0 does not accept most basic programs as they are; conversions via gwbasic are then required;
- Program runs properly after starting gwbasic and loading and running SUBDRAIN.BAS;
- The program clearly dates from the early days of the microcomputer (see also hardware and software requirements), judging by the graphics;
- The water table depth calculations take considerable time, depending on the accuracy required (12-90 minutes);
- A relatively simple and rather dated program, which may have some application in elementary training or demonstration.

Program 38: SUKdemo

▸ *what it does:*
Demonstrates three small computer programs, i.e. Indus Allocations Program (IAP), Sukkur Barrage Game (SBG), and Pump Test Program (PTP). IAP is an interactive training model, which allocates river flows to the 14 canals fed at the 3 barrages on the Lower Indus, Pakistan. SBG simulates the operation of the largest Barrage, Sukkur Barrage, of the same river, using barrage gate openings and canal headwork settings. PTP should plot groundwater drawdowns, but the demo program on our disk aborts prematurely.

▸ *made where:*
Sir M. MacDonald & Partners, Demeter House, Cambridge, UK. IAP and SBG were made for the Government of Sind Province, Karachi (for Overseas Development Administration) and PTP by Groundwater Development Consultants, Cambridge, UK. Year of manufacture 1986.

▸ *what available:*
- A 3.5" disk with the demonstration programs for EGA and for HERCULES card (copied from two original 5.25" disks);
- 4 pages text/screens on Lower Indus Allocations (from P.D.S. Gunn in 1986);
- Ede, P.F. and P.D.S. Gunn, 1987. Computer aided management of Sukkur Barrage, Pakistan. Proceedings BHS, National symposium, Hull Univ., 33.1-33.5;
- Dempster, J.I.M., S.L. Marsden & I.K. Smout, 1989. Computer simulations in games for training irrigation management. Irr. & Drainage Systems 3: 265-280;
- Stoner, R.F., J.I.M. Dempster & S.L. Marsden, 1989. The use of simulation models in the management of irrigation systems.In: Rydzewski & Ward: Irrigation theory and practice. Pentech Press, London, UK: 901-910.

▸ *what required:*
PC/XT/AT with Hercules or EGA card; demo size 316 kB for each resolution.

▸ *written in:*
Prospero Fortran-77; graphics by Cambridge Graphics Ltd.

▸ *remarks:*
- To start: after choosing EGA or HERC directory on 3.5" disk, type DEMO;
- Rather simple demonstration set-up (leaving DEMO.BAT, starting 1.BAT, etc.);
- Not special demo's, but introductions copied from original programs;
- Pump Test Programs regrettably abort on defaults;
- Screens are moving rather quickly on the Compaq Deskpro 386N;
- Insufficient information as to what else the programs can be used for, except as a demo for Govt. of Sind officials.

Program 39: SUKKUR

▸ *what it does:*
Simulates incoming flows, head pond levels, canal indent levels and release volumes for the 3 left bank and 4 right bank canals, for scour/sedimentation requirements and for downstream releases at Sukkur Barrage on the Lower Indus river, Pakistan. The aim is to keep head pond levels steady at given upstream flows by setting barrage gate heights and canal headwork regulator openings. It operates for different seasons (setting irrigation requirements) and at various levels of complexity. Maximum 20 daily steps are made. It writes the performance of the player to the disk.

▸ *made where:*
Sir M. MacDonald & Partners, Demeter House, Cambridge, UK for the Government of Sind, Karachi, under assignment of the Overseas Development Administration. Year of release is 1987. Price at the end of 1987 GBP 100.

▸ *what available:*
- A 3.5" disk with the EGA version;
- A manual: MacDonald, 1987. The Sukkur barrage game. MacDonald Software, Sir M. MacDonald & Partners, Cambridge, UK. 10 pp.;
- Ede, P.F. & P.D.S. Gunn, 1987. Computer aided management of Sukkur Barrage, Pakistan. Proceedings BHS, National symposium, Hull Univ., 33.1-33.5;
- Dempster, J.I.M., S.L. Marsden & I.K. Smout, 1989. Computer simulations in games for training irrigation management. Irr. & Drain. Systems 3: 265-280;
- Stoner, R.F., J.I.M. Dempster & S.L. Marsden, 1989. The use of simulation models in the management of irrigation systems. In: Rydzewski & Ward: Irrigation theory and practice. Pentech Press, London, UK: 901-910.

▸ *what required:*
PC/AT, but will also run on XT with longer pauses; 384 kB RAM and MS-DOS 2.0 or higher; will fit on one 360 kB floppy (size is 350 kB).

▸ *written in:*
Prospero Fortran-77; Cambridge Computer Graphics Ltd.

▸ *remarks:*
- Start by typing AUTOEXEC after logging to drive;
- Objectives of the game are not immediately clear; what do I do ?;
- Graphics are nice (nicer still in colour);
- Switch between Introduction and Game is cumbersome;
- Abbreviations on the screen are not properly explained (KFE = ?);
- Question is what the game teaches you, if you do not operate Sukkur Barrage;
- The brief manual could have contained more explanations, so as to make it more widely usable.

Program 40: SURFACE

▸ *what it does:*
The program assists in the design of surface irrigation systems (borders, furrows, basins) and is based on the volume balance field design (cf. Walker & Skogerboe, 1987). Three flow regimes for furrows are possible, i.e. normal, cut-back and re-use of tailwater. Extensive input data have to be supplied, facilitated by input data screens.

▸ *made where:*
For FAO, Rome, by Prof. W.R. Walker, Dept. of Agric. & Irrig. Engineering, Utah State Univ., Logan, Utah 84322-4105, USA. Available free from FAO, from Utah State Univ. at USD 100.00 + 15.00.

▸ *what available:*
- A 3.5" disk with 10 user files in 307 kB, of which SURFACE.EXE dated 2.10.89 takes 176 kB, and Fortran source codes the remainder (received from FAO);
- W.R. Walker, 1989. Guidelines for designing and evaluating surface irrigation systems. Irrigation & Drainage Paper 45, FAO, Rome, Italy, 137 pp. (mentioning the availability of the disk in Appendix 1 on p. 137); especially chapter 5 (Surface irrigation design) seems applicable.

▸ *what required:* 256 kB RAM

▸ *written in:* Fortran 77

▸ *remarks:*
- There is no example or case study data file on the disk; the program only allows to fill an empty data input format and save it;
- A first trial run with basin data provoked an error and the program had to be aborted; upon changing the input data as best as possible according to chapter 5.6.1 of FAO#45 (file: BAS561.DAT), there was a run of output over the screen, ending in tabulated data of basin width, unit flow, advance and cutoff time and application efficiency;
- The above shows the lack of a manual (although this should not be needed): it is not clear which design parameters the program calculates, as most of them (basin width, basin length, etc. have to be entered; NB: zero slope is apparently not acceptable for basins);
- There is a reference to SURMOD (as in FISDEV) by the same author: available from USU at USD 150.00 + 15.00;
- The three flow regimes for furrows (Normal/ Cutback/ Reuse) are the same as in FISDEV;
- Sample printed output was not tested.

Program 41: SWACROP

▸ *what it does:*
The program simulates the water balance of a cropped soil under different boundary conditions, including the possibility of irrigation and drainage and the calculation of crop yield of potato (in this version of March 1989). From one general and 4 specific input data files, five output files are generated which contain tabulated figures for the water balance components and yield data. The program is based on solving the Richards equation for unsaturated soil moisture flow and additional terms (as in SWATRER) and on a crop production model (CROPR).

▸ *made where:*
J.G. Wesseling, P. Kabat, B.J. van den Broek & R.A. Feddes, The Winand Staring Centre for Integrated Land, Soil and Water Research, P.O. Box 125, 6700 AA Wageningen

▸ *what available:*
- A 3.5" disk with SWACROP.EXE and SWACROP7.EXE files (the latter for use with a co-processor) dated July 1991; one SWADAT.INP file and four .DAT files;
- P. Kabat, 1991. Agrohydrological simulation model SWACROP. Lecture notes 30th Int. Course on Land Drainage, ILRI;
- References (e.g.): Feddes, R.A., P.J. Kowalik & H. Zaradny, 1978. Simulation of field water use and crop yield. Simulation monographs, PUDOC, Wageningen; and Feddes, R.A., 1987. Simulating water management and crop production with the SWACRO model. 3rd Int. workshop on Land Drainage, Ohio State University

▸ *what required:* An IBM PC AT running under DOS. A math co-processor is recommended. Software package BALANCE would be useful.

▸ *written in:* Standard Fortran 77

▸ *remarks:*
- SWADAT.INP is the general data input file, which also allows the user to specify the names of 3 output files (e.g. OUTPUT.OUT, PROFIL.OUT and CROP.OUT); BALANCE.WB and BALANCE.SOL will be made automatically;
- Typing swacrop at the DOS prompt first results is nothing for a while, but then a time bar appears to show the simulation progress; the test run lasted about 15 minutes without a math co-processor;
- The input file is typical for the inflexible Fortran format used at the time of punched cards; there is no interactive input screen;
- The output consists of (long) lists of figures, which must be plotted, viewed and interpreted by hand or with other (graphical) packages; the BALANCE package is available for that purpose;
- Only potatoes appear as a crop in our version; this hampers the wider applicability.

Program 42: SWATRER

▸ *what it does:*
Simulates the actual water use of a field crop through calculating the various terms of the soil water balance, the main feature being the solution of the (unsaturated) soil moisture flow equation using an implicit finite difference technique with an explicit linearization. The original program SWATR (Soil Water and Actual Transpiration Rate) by Feddes et al. (1978) was extended (E) to SWATRE by Belmans et al. (1983) and in now revised (R) to SWATRER (1986). The program uses daily climatological values. An input table must be filled prior to running and tabulated output is given in four files.

▸ *made where:*
Laboratory of Soil and Water Engineering, Faculty of Agricultural Sciences, K.U. Leuven, Kardinaal Mercierlaan 92, b-3030 Leuven, Belgium. Cost USD 45.

▸ *what available:*
- Information brochure (2 pages);
- A 3.5" diskette (720 kB) with an .EXE version;
- A copy of the manual: Dierckx, J., C. Belmans & P. Pauwels, 1986. SWATRER a computer package for modelling the field water balance. Lab. of S&W Engineering, Leuven, Belgium; 114 pp. Contains program listings.

▸ *what required:* IBM PC/XT/AT or fully compatible

▸ *written in:* Fortran 77

▸ *remarks:*
- Filling in the input data is quite laborious and requires a thorough knowledge of soil, climatic, simulation and i/o parameters; program as presented appears a specific research tool;
- Having filled in the input file the program starts by typing SWATRER and then silently works on;
- Using the sample input file the program runs without any messages for almost 3 minutes on the Compaq Deskpro 386N (on HDD) and fills the four empty output files provided;
- Difficult to judge without further reading how "dated" the program is at the moment, seeing that it uses Ernst 1962 groundwater flow, a Ritchie's 1972 evaporation model, the SCS 1972 curve number method for run-off, a Hoogland 1981 root uptake model, etc.;
- It is not a program for quick learning and application, partly because the validity of the assumptions cannot be readily assessed by others than mathematical soil physicists.

Program 43: UNDP

▸ *what it does:*
This is a set of 10 small programs made for a water supply and sanitation project. The programs include BRANCH (for calculating the cheapest branched pipe network), LOOP (for calculating velocities and head losses in a looped network), SEWER (for calculating the best gravity sewer network), FLOW (for simulating flows in large looping networks), SCREEN (for financial screening of water supply projects), REGRESS (for doing multiple linear regressions), LINPROG (for carrying out linear optimizations), NELDER (for non-linear programming), HEADLOSS (for calculating head losses with the Hazen-Williams equation) and MINTREE (for finding the shortest path connecting the nodes in a primary (branched network of a looped system).

▸ *made where:*
Mostly at the Department of Environmental Sciences and Engineering, University of North Carolina, Chapel Hill, Raleigh, NC, USA

▸ *what available:*
- Three 5.25" diskettes with 8 programs (REGRESS and SEWER are missing); 8 programs in executable version have been copied onto one 3.5" disk;
- The manuals for all ten small programs, which include a listing of the source code.

▸ *what required:*
- IBM PC or compatible machines; 256 kB RAM; minimum one floppy disk drive;
- A monochrome or colour monitor and a parallel printer;
- PC-DOS 1.0 and above;
- Resident Basic (for HEADLOSS, MINTREE, LINPROG, NELDER); Fortran compiler if you want to change FLOW.

▸ *written in:* Basic (9 programs) and Fortran (only FLOW).

▸ *remarks:*
- The five most interesting for irrigation are: BRANCH, LOOP, FLOW, MINTREE and HEADLOSS;
- BRANCH and LOOP operate under the same PROGRAMS.EXE file, which should be used to start either; they run correctly;
- FLOW does seem to have problems with the input and output directories; the .EXE version cannot be changed;
- MINTREE and HEADLOSS do a very small job correctly under the Basic version of the Compaq test machine;
- BRANCH apparently does the same as OPTIPIPE, but better.

Program 44: WASAM

▸ *what it does:*
This Water Allocation, Scheduling And Monitoring program is used in the day-to-day water management of large-scale irrigation schemes. It is based on an intensive daily data collection at selected points in the system through a structured organisation for main system, laterals and canal sections and ditches. It allows comparison of canal flows and other items with expected values, so that adjustments can be made subsequently. It is thus clearly made to be an operational tool.

▸ *made where:*
ILACO/Euroconsult, P.O. Box 441, 6800 AK Arnhem, The Netherlands

▸ *what available:*
- A 3.5" diskette with 38 program files and 13 data files;
- Some information about the Kinda Irrigation Scheme in Burma, where WASAM was apparently developed/applied, but no specific info on WASAM itself;
- Van Vilsteren, A., 1987. Users oriented irrigation development in Thailand. In: Hydraulics Research, 1987: Irrigation design for management Asian regional symposium Kandy, Sri Lanka 16-18 Feb. 1987: 70-96.

▸ *what required:* not specified.

▸ *written in:* Basic.

▸ *remarks:*
- The AUTOEXEC on the program disk does not work because of the Basic version (HBasic); using the "normal" Compaq Basic of the test machine is OK;
- The collection of 51 files are lacking an overall structure, like a main menu is missing;
- The Basic programs refer to data files on disk B: which is slightly problematic on a one-FDD machine;
- Even though the individual Basic programs can be listed and read, it is not easy to evaluate the whole array of files due to the missing main menu;
- Although two locations are apparently using the package (Kinda Irrigation Scheme, Burma and Mae Klong Irrigation Projects, Thailand) it is difficult to judge how flexible the program is for other projects;
- What could be inferred from the listings is that rudimentary graphics have been incorporated, and that a workable program was created in several projects at the time (1987), but that a modernization (database oriented, menu-driven, a better graphics interface) would be required before it could be issued for general use; work on this is said to be in progress at Euroconsult, Arnhem.

Program 45: WYEGAME

▸ *what it does:*
The program is a training exercise in irrigation management in the form of a role-playing game. Participants are asked to play a farmer or an irrigation manager under the supervision of a game controller. They must make decisions based on limited inputs, which are then fed to the computer, which calculates consequences. Objectives are: showing basic irrigation principles, demonstrating interactions, and promoting group discussion.

▸ *made where:*
The Department of Agricultural Economics, Wye College, Univ. of London, Wye, Ashford, Kent TN25 5AH, England. Manual from Publications Department (GBP 6.50).

▸ *what available:*
- A 3.5" disk with version 1.0, dated 25.07.88, with the Basic source code; a short startup routine (CONSOL.BAT) was added; program has its own Basic version;
- The manual: Smith, L.E.D. & Youngman, J.P., 1988. The Wye College Irrigation Game, version 1.0, 25 July 1988. ADU Occasional paper 10, Dept. Agric. Economics, Wye College. 68 pp. 11 refs;
- Smith, L.E.D., 1989. The Wye College irrigation game "Stop the breach". Irr. & Drain. Systems 3: 255-264.

▸ *what required:*
An IBM PC XT computer with >= 128 kB RAM, running under MS-DOS. A wide carriage (Epson) printer. Sufficient copies of forms and information for participants.

▸ *written in:* Basic (basic86).

▸ *remarks:*
- The PC program is a not the game itself. Participants discuss and decide; the computer processes decisions (data) and produces summaries;
- The manual suggests that the *.BAS programs may be changed to fit local conditions. This would be hard work: program structure and logic are not clear at all (no headings, no spacing, no self-explanatory variable names, etc.);
- There are three modes of play, increasingly difficult;
- It takes quite some time for a trainer to get acquainted with the particulars of the game in such a way that he can answer all sorts of questions of participants;
- As an introductory exercise (for participants to do something together and get to know each other) it may not be a bad game, but it will take at least a few weeks to get it properly shaped and tested;
- The input sequence is not very clear; the produced output was not clear/consistent in our test run. Needs thorough checking before the program can be utilized;
- No graphics are used and there is no interaction.

ANNEX 2: ADDRESSES

Addresses included in this Annex comprise:

Serial number	Organization
1.	AEI, Canterbury, New Zealand
2.	CADI, Fort Collins, USA
3.	CEMAGREF, Montpellier, France
4.	CIE, Leuven, Belgium
5.	Delft Hydraulics, Delft, The Netherlands
6.	Euroconsult, Arnhem, The Netherlands
7.	ICIM, Rijswijk, The Netherlands
8.	IAHL, Velp, The Netherlands
9.	IGWMC, Delft, The Netherlands
10.	IHE, Delft, The Netherlands
11.	IIS, Southampton, UK
12.	ILRI, Wageningen, The Netherlands
13.	Lisboa University, Portugal
14.	LBII/WAPCOS, New Delhi, India
15.	LWDD, FAO, Rome, Italy
16.	LUW/TCT, Wageningen, The Netherlands
17.	Melbourne University, Australia
18.	Mott MacDonald, Cambridge, UK
19.	NCSU, Raleigh, USA
20.	NRAES, Ithaca, NY, USA
21.	ODU, HR Wallingford, UK
22.	Silsoe College, Silsoe, UK
23.	Staring Centre, Wageningen, The Netherlands
24.	USU, Logan, Utah, USA
25.	USWCL, Phoenix, USA
26.	World Bank, Washington, USA
27.	Wye College, Ashford, UK

Note:

The program names mentioned under a certain address may include programs not mentioned in this publication; such names are printed in italics. Programs appearing in Annex 1 are in bold type.

01
Agricultural Engineering Institute,
Lincoln University,
(Dr. P. John),
P.O. Box 84, Canterbury,
New Zealand

Producers of: IRRICAD, *SPRINKPAC*, *TURFCAD*

02
Computer Assisted Development Inc.,
(Dr. T. Sheng),
1635 Blue Spruce Drive, Suite 101,
Fort Collins, Colo 80524,
USA

Producers of: MIS

03
CEMAGREF,
Groupement de Montpellier,
(Contact Mr P.O. Malaterre),
B.P. 5095,
34033 Montpellier Cedex 1,
France

Producers of: *BAHIA*, *BEL*, BILANREG, *CANAL9*, *CERES*, *DACCORD*, *DEVER*, ICARE, MECENE, PB2DIAM, RAIEOPT, SIC, *SIDRA*, *STAB*, *TALWEG-FLUVIA*, *VERITAS*, XERXES-RENFORS

04
Center for Irrigation Engineering,
(Prof. J. Feyen),
Catholic University,
Vital Decosterstraat 102,
3000 Leuven,
Belgium

Producers of: CANALCAD, **DEFICIT**, DRAINCAD, **ETREF**, **ETCROP**, **ETSPLIT**, **FISDEV**, **IRSIS**, *PISCAD*, **RAINBOW**, *SUCROS*, **SWATRER**, TOPOCAD

05
Delft Hydraulics,
Division Water Resources and Environment,
(Dr. W. Schuurmans),
P.O. Box 177,
2600 MH Delft,
The Netherlands

Producers of: **OMIS**, **PROFILE**

06
Euroconsult,
(Ir. M. Schellekens),
P.O. Box 441,
6800 AK Arnhem,
The Netherlands

Producers of: **WASAM**, and internal programs: AUGER, PENMAN, TIDE, CANALDES, HAZEN-W, LACEY, CROPF, CROPW, REHAB, IRSCHED, TKB, *SALBAL*

07
Informatica Centrum voor Infrastructuur en Milieu bv,
ICIM,
P.O. Box 5809,
2280 HV Rijswijk,
The Netherlands

Producers of: **DUFLOW**

08
International Agricultural College Larenstein,
(Ir. J. Schoenmakers),
P.O. Box 9001,
6880 GB Velp,
The Netherlands

Producers of: **CID**, and internal programs: *ERNST*, *FTW*, *GWS1D*, *GWS2DV*, *HOOGHOUD*, *NAMOD*, NESTOR, *PPG*, *RONDO*, *SEMSPARE*

09
International Ground Water Modeling Center,
TNO Institute of Applied Geoscience,
P.O. Box 6012,
2600 JA Delft,
The Netherlands

Distributors of 72 low-priced quality groundwater modeling software

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10
International Institute for Infrastructural,
Hydraulic and Environmental Engineering,
(Ir. E.R. Dahmen),
P.O. Box 3015,
2601 DA Delft,
The Netherlands

Producers of: COBRA, Benelux agent for MIKE 11, *MUST*

11
Institute of Irrigation Studies,
(Mr. M. Burton),
The University,
Southampton SO9 5NH,
United Kingdom

Producers of: CAMSIS, **CRWTABLE, DRAINCAN, MAINSYST,** *SCIGRAF*

12
International Institute for
Land Reclamation and Improvement,
(Dr. J. Boonstra),
P.O. Box 45,
6700 AA Wageningen,
The Netherlands

Producers of: **BASCAD, CRIWAR,** *DATSCR*, RSM, **SALTMOD, SATEM, SGMP**

13
Department of Agricultural Engineering,
Institute of Agriculture,
Technical University of Lisbon,
(Prof. L.S. Pereira),
Tapada da Ajuda,
1399 Lisboa, Codex,
Portugal

Producers of: ISAREG

14
Louis Berger International Inc.,
Water and Power Consultancy Services (India) Ltd.,
213, Ansal Chambers-II,
Bhikaiji Cama Place,
R.K. Puram,
New Delhi 110066,
India

Producers of: **BCWEIR** (and irrigation & drainage courses overview)

15
Water Resources, Development and Management Service,
Land and Water Development Division,
(Mr. J. Sagardoy),
Via delle Terme di Carracalla,
00100 Rome,
Italy

Producers of: CIMIS, CLIMWAT, **CROPWAT, OPTIPIPE, SURFACE**

16
Department of Irrigation and Soil Conservation,
(Ir. T. Meijer),
Agricultural University,
Nieuwe Kanaal 11,
6709 PA Wageningen,
The Netherlands

Producers of: CANAL

17
Department of Civil and Agricultural Engineering,
University of Melbourne,
(Dr. B.L. Maheshwari),
Parkville, Vic 3502,
Australia

Producers of: **BICAD**, BICADAM

18
Mott MacDonald Software,
Demeter House,
Station Road,
Cambridge CB1 2RS,
United Kingdom

Producers of: IRRIGATION MANAGEMENT GAME, MAHAKALI, NILE, SAIDIYA, **SUKKUR**

19
Department of Biological and Agricultural Engineering,
North Carolina State University,
(Prof. W.R. Skaggs),
P.O. Box 7265,
Raleigh, NC 27695,
USA

Producers of: **DRAINMOD**

20
Northeast Regional Agricultural Engineering Service,
Cornell University,
152 Riley-Robb Hall,
Cooperative Extension,
Ithaca, NY 14853,
USA

Producers of: *BURBS*, *MOUSE*, **REHAB**, *RIVER BALANCE*, *SOIL WATER BUDGETING*, **SUBDRAIN**

21
Overseas Development Unit,
Hydraulics Research Ltd.,
(Mr. J. Skutsch)
Wallingford, Oxon OX10 8BA,
United Kingdom

Producers of: *CALSITE*, DACSE, **DORC**, HADES, **INCA**, MIDAS, *SWIMM*, *PARADIGM*

22
Silsoe College,
Department of Agricultural Water Management,
(Mr. R. Carter),
Silsoe, Bedford MK45 4DT,
United Kingdom

Producers of: JUBA SUGAR ESTATE GAME

23
The Winand Staring Centre,
(Dr. P. Kabat),
P.O. Box 35,
6700 AA Wageningen,
The Netherlands

Producers of: BALANCE, *FLOWEX*, SIWARE, SWATRE, **SWACROP**

24
Software Engineering Division,
Department of Biological and Irrigation Engineering,
(Prof. W. R. Walker),
Utah State University,
Logan, Utah 84322-4105,
USA

Producers of: **BCW**/RBC, *CANDI*, **CANAL**, **CATCH3D**, CROPWAT, *CRPSM*, *GATEDPIP*, *HYSYM*, **IRRIGAME**, *ICSS*, IRRiSKED, IRRITALK, IRRITURNS, LANDLEV, LEVLGRAM, *MULTILAP*, NETDES, PCET, *REF-ET*, *SPRNKSIM*, *STEADY*, **SURFACE**, SURMOD, UCA, *UTAHET*, *WATROP*

25
US Water Conservation Laboratory,
(Dr. A. J. Clemmens),
4331 E. Broadway Rd.,
Phoenix, AZ 85040,
USA

Producers of: **BASIN**, **BRDRFLW**, **SRFR**

26
The World Bank,
Water Supply and Urban Development Department,
1818 H Street, N.W.,
Washington DC 20433,
USA

Producers of: **UNDP** programs BRANCH, FLOW, HEADLOSSLOOP, LINPROG, MINTREE, NELDER, REGRESS, SEWER, SCREEN
In New Delhi: **RICEYLD**, **SIMYIELD**, SIMULNDO

27
Wye College,
(Mr. L.E.D. Smith)
University of London,
Ashford, Kent TN25 5AH,
United Kingdom

Producers of: **WYE** COLLEGE IRRIGATION GAME

INDEX OF PROGRAM NAMES