

**COMPUTER AIDED PROCESSING OF DATA FOR MANAGERIAL AND OPERATIONAL ACTIVITIES
IN FORESTRY.**

by

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Purposeful research and sound planning activities in forestry should be based on adequate data recorded in the field. Normally this data is of large quantity and its manual processing was always a time consuming and tedious task. Consequently, the results obtained in this way were not of a desired standard and mostly not available on time. This was a big hinderance in the efficient execution of forestry operations. To overcome these difficulties, the Pak-German Project assisted the PFI in developing modern data-processing facilities by providing suitable computer hard-and software (computer programmes). A brief description of the available software and their application in data- processing and planning activities in forestry is given below.

COMPUTER-AIDED PLANNING IN FOREST ENGINEERING**Forest Road Planning and Design**

The available programme "FOREST" was developed by M/s. INSEER of Switzerland with the technical support of Dr. H. Duerrstein, from M/s. DENDRON, Switzerland. The programme "FOREST" offers the possibilities of transforming the field recorded data about the road planning and design, into situation plan and longitudinal profile of a forest road, designing of grade line, including rounding of vertical curves, cross-sections and calculation of earth work, with the help of a computer.

The required hardware is a personal computer-AT with mathematical co-processor, multi-colour monitor, mouse and printer.

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Planning Procedure

Field work

Planning of zero-line, design of centre line, levelling and cross-sectioning is done as for traditional methods and relevant data recorded.

Special points of consideration to record field data for computer analysis with programme "FOREST"

- Compass for taking back and fore bearings should always have graduation of 400° instead of 360°
- For planning of curves the tangent method should always be used.
- Cross-sections are to be taken at each station point.
- Direction of curves as "left or right" should be indicated.

If levelling and cross-sectioning is done with the help of a clinometer, then the surveyed data must be transformed from polar coordinates (horizontal distance and gradient between points) to cartesian coordinates (horizontal distance and altitude of points). For convenience, the basic field data should be summarized for input.

Computer Work

Data Input

The data on distance between the station points, difference between the height of points, back bearing of the first tangent, tangent angles and data of cross-sections at each station point is fed to the computer and stored under programme "FOREST".

Special points of consideration for data input to work with programme "FOREST".

- Left curves are identified by tangent angles of less than 200° and right curves by angles of more than 200° .
- Data on cross-section is identified as left and right with respect to centre-line.

Design Work

- Definition of normal profile of cross-section
- Planning of grade line on longitudinal profile
- Rounding of vertical curves on grade line
- Fitting the normal profile of cross-section to the actual terrain conditions at every cross-sectional point

Special points of consideration in designing the work

- Overlapping of vertical curves must be avoided.
- The larger adjustment of a normal profile at a cross-sectional point should also be distributed to a few cross-sections on either side.

Earth Work Calculation

- Calculation of cut and fill volume and storing of results.
- Generating of mass curve on the screen, (cumulated surplus or deficit of earth work at each station point) for evaluating the results of earth work calculation.
- Print out of earth work quantities.

General Remark on the Application of Programme "FOREST"

- Computer-aided process is supported by screen menus and can be handled with the help of a mouse. For this reason the programme can be used by beginners without detailed knowledge of electronic data processing.
- The process is very quick and needs only about 25% of the time required by the traditional manual methods of forest road planning and substitutes the tedious work of data analysis and drawing.

Costing of Forest Operations

The programme "MACO" for the cost calculation of different machine operations in forestry was developed by Professor Dr. W. Warkotsch and adopted by the authors.

This programme offers the possibilities of calculation of all types of machine costs taking into account capital costs, personnel costs and overhead costs. The programme needs the same data input as for traditional method of cost calculation.

The main advantage besides being fast is the calculations of machine costs with different annual utilization. The machine costs can be printed as a hard copy and plotted as a graph showing the optimum annual utilization.

FOREST RESOURCE INVENTORY

In order to process and compile data of forest sampling inventories, a special software package was developed by the Forest Mensuration Branch in collaboration with the Pak-German Project at PFI. The programme allows processing of data of different types of sample plots which are laid out in systematic sampling designs. It also provides a wide range of results which serve as a basis for various management planning activities.

One can use this software in personal computers (PC AT or XT) with a hard disk of 20 mega byte storage capacity and printer attached.

Data Basis

Usually quantitative and qualitative data are recorded during field work of a forest resource inventory. They are grouped into data related to the

- area: aspect, elevation, slope, ground vegetation, soil/humus conditions, regeneration, etc.
- stand: species composition, age class, degree of stocking, crown density, etc. and the
- single tree: species, diameter, height, crown length, age, tree-category, lopping intensity, stem-quality etc.

Following a specific format, all collected data of a sample plot are entered tree after tree via the monitor into the computer. For this purpose data base packages (D-Base, Lotus) or word processors (Word Perfect, Word Star) can be used.

Computer Data Processing

The software package which is written in FORTRAN consists of the following programmes:

Programme: "CHECK.FOR"

Sometimes the raw data contain errors which occur during recording in the field and/or data entering into the computer. In order to detect these errors, this programme checks each variable of a data set either by logical operations or by comparison of different qualitative characteristics. A print out shows the wrong variable along with the number of the sample plot in which the error occurred.

Programme: "INVENT.FOR"

In a first step this programme calculates various parameters of each single tree like, basal area, volume, height, increment, form factor etc. using equations which were already developed for the main species of Pakistan. Then these data are compiled for each plot by hectare basis and stored in a result file. Provisions are made to process data either from fixed area plots or from prism sampling.

Programme: "RESULT FOR"

In a final compilation, summary tables for different area categories (compartments, blocks, divisions) are prepared by this programme and can be printed if desired. These tables contain growing stock information, growth and yield parameters and various statistics for different species as well as stand and composition types.

Programme: "STAND FOR"

If desirable, also a complete stand and stock table for living and dead trees separately can be prepared for different areas by species and 10-centimeter diameter classes.

Application of the Inventory Processing Programme

- This inventory data-processing facility can be used by the forest officers for fast and accurate processing of their inventory data.
- Short-term training is required to make a user familiar with the procedure of entering the data.

- To run the programmes and to obtain all desired results needs additional supervision by the Forest Mensuration Branch. After a few days on the job training, a user can process the data independently.

Afforestation-Inventory

Standard programme-packages for all types of statistical calculations can also be used for processing of data obtained from afforestation-sampling inventories. Data of fixed area circles like, number of plants and their heights, are fed to the computer plot by plot using any kind of data base package.

The software SPSS PC+ (Statistical-Package for the Social Sciences) provides among others different procedures like Data Transformation, Frequencies, Crosstabulation, and Basic Statistics which allow a fast, accurate processing work. Any desired results are obtained by the following steps:

- Designing a short SPSS-programme, using the simple SPSS-Computer language
- Running the programme, which creates a file containing detailed results

With the help of the above described procedure, data of an afforestation inventory (25 000 hectare in N.W.F.P.) were processed. A period of only ten days was required to enter the data into the computer and to carry out the processing work.