A FOREST MANAGEMENT INFORMATION SYSTEM FOR NIGER STATE

BY

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APPROVAL SHEET

This study was carried out by Dangaladima Emmanuel Jatau (PGD/MCS/97/264) under the supervision and guidance of Mr. L. N. Ezeako as partial fulfilment of the requirement for the award of Post-Graduate Diploma (PGD) in Computer Science from the Department of Mathematics/Computer Science of the Federal University of Technology, Minna.

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DEDICATION

This project is dedicated to the lion of the tribe of Judah, the faithful witness, the prince of the Kings of the earth, the Alpha and Omega. Christ Jesus, who said " I am the way, the truth, and the life. No man comes to the Father except through me".

Of whom Apostle Paul testified " Nor is there salvation in any other, for there is no other name under heaven given among men by which we must be saved"

And to God's special gift of Esther as wife and precious children in Jemima, Bright and Murna.

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TABLE OF CONTENT

PAGE

TITLE PAGE i

APPROVAL SHEET ii

DEDICATION iii

ACKNOWLEDGEMENT iv

TABLE OF CONTENT v

ABSTRACT vii

CHAPTER ONE

1.1 INTRODUCTION 1

1.2 AIMS AND OBJECTIVES 2

1.3 SCOPE 3

1.4 RESEARCH METHODOLOGY 4

1.5 LIST OF ABBREVIATIONS 4

1.6 GLOSSARY OF TERMS 5

CHAPTER TWO

2.1 BRIEF HISTORY OF ELECTRONIC COMPUTERS 7

2.2 THE NIGERIAN FORESTRY GOALS 9

2.3 COMPUTER APPRECIATION IN FORESTRY 10

2.4 A SURVEY OF RELEVANT FORESTRY INFORMATION 13

2.5 BENEFIT OF AN INFORMATION SYSTEM 14

CHAPTER THREE

3.1 EXISTING SYSTEM REVIEW 15

3.2 SYSTEM OBJECTIVES 17

3.3 EXPLORATION OF ALTERNATIVES DESIGNS 18

3.4 THE CHOSEN DESIGN 20

3.5 PROJECT TESTING FEASIBILITY 21

CHAPTER FOUR

4.1 PROGRAM IDENTIFICATION AND DESCRIPTION 24

4.2 SYSTEM SPECIFICATION 25

4.3 PROGRAM CODING 27

4.4 PROGRAM TESTING AND MAINTENANCE 27

4.5 SECURITY IN THE NEW SYSTEM 28

CHAPTER FIVE

5.1 AUTOMATION AND JOB SECURITY IN FORESTRY 29

5.2 DISCUSSION 30

5.3 CONCLUSION AND RECOMMENDATION 31

BIBLIOGRAPHY 32

APPENDIX 1 (Form for Data Collection) 34

APPENDIX 2 (Proposed Output Format) 35

APPENDIX 3 (Screen Design and Program Output) 36

APPENDIX 4 (Source Program Listing) 50

ABSTRACT

In Niger State, a Forestry Management Information System is urgently required for present and future intensive management and planning.

After a forest inventory, data analysis to generate necessary information involves complex, careful and tedious calculations. Depending on sampling intensity, thousands of trees could be measured for Basal Area, Merchantable top heights and volumes. These information which are essential for preparation of volume and yield tables, regression equations for volume and yield forecast, can be produced by an information system.

This project highlight is the design of a dBASE program for generation of these information with less labour, better accuracy and great speed. Six of the seven top senior forestry officers were interviewed on various management information generation method.

CHAPTER ONE

1.1 INTRODUCTION

In the last couple of years, advancement in Technology has been changing the face of our profession. In the next few years, more fundamental changes will emerge. Computers are increasingly becoming indispensable and many tasks in offices that were hitherto executed manually are being automated at a very fast pace. Thus, it is becoming apparent that in whatever discipline of study or nature of employment, the computer is now an important tool for efficiency improvement and precision of job or task execution. Infact, aspects of forest and forest related data are now being revolutionized by the arrival of Computerized Forest Information System (FIS).

An information system (IS) is a collection of procedures and resources used to produce information. The ultimate of an information system is to aid managers in decision making. Decision-makers rely on adequate information for better management decisions. The heart of an information system is a Data Processing System (DPS), usually a data processing device, say a computer for example, facilitates the quality, speed and accuracy of information.

A forest information system is an aggregation of discrete and independently maintained records comprising data for which the common denomination is the forest. Thus an FIS is a computer-based system for collecting, storing, processing and presenting forest related information in the computer. The FIS can be used for forest management planning (strategic planning) and for operational planning (project management).

Quality information and efficient information management are necessities in today's world of sustainable resource management. To meet the requirement of forest management planning and forest operations, a forest information system is required to

allow input, storage, analysis of forestry related data in order to provide information that will help in decision making.

In the sixties emphasis was placed on conservation and harvesting of the Natural Forest Resources. In the seventies however, economic needs and social changes in the society necessitated a forced development of the resources, as well as increase plantation co-operation. Niger state experience much regeneration, control and exploitation and there was proper management on sustain yield basic during this period.

From the eighties to date, there has been very much exploitation, little regeneration and no control. The little that was planted far back in the eighties failed woefully and since then there has generally been no development of new plantations in the state. Furthermore, for the planting done in the seventies, except for students on research from universities, there has been no inventory by the department for management purposes but there has been constant and continuous exploitation.

1.2 AIMS AND OBJECTIVES

The computer was thought and developed to reduce complex calculations into smaller forms, help in making accurate and logical comparison between things, help in efficiently storing, filing and processing of data and information and to ease the cumbersome of inflow and outflow of data and information.

There is presently a worldwide emphasis on forest resources management and our main resources is the growing stock (trees). To this effect, a complete set of computer was issued to every State's Forestry Department by the World Bank in December, 1997 for complete forest resource inventory, and especially stock analysis. This project shall there therefore be aimed towards:-

(i) Studying in details the problem and prospects of forest management information in Niger State and offer useful suggestion for possible improvement.

(ii) Design means and strategies required to effect computerization of forest management information system.

(iii) Design software for manipulation of forest inventory in the State.

(iv) Implement the software for present and future use in the department.

1.3 SCOPE

Management stands out as the most important aspect of forestry and the scope of forest management covers yield regulation and working plans. Control of growing stock and operational efficiency are the major problems facing the forest manager. The project shall therefore be limited to finding possible solutions to the main problem facing the forest manager.

Despite problems such as finance and time constraints, adequate knowledge of the computer and its applications, the system developed would be capable of providing information such as Basal Area per plot, Basal Area of sample trees, Volume of sample trees and Volume of trees for reference purpose.

Though, Niger State is the main focus in preparation, the system is flexible in application and provision is made for programme adjustment to provide more information and can be adopted by any state forestry department of the federation. Though it is important to note that for information to be relied upon for any meaningful decision making, proper and accurate data must be obtained.

1.4 RESEARCH METHODOLOGY

No doubt there are several investigative techniques, which a researcher can employ in his attempt at getting relevant facts. A few of such method include observation, record search, special purpose records, sampling questionnaires, interviewing, etc. These are so varied that in reality the researcher is hardly restricted to a single investigative technique in his attempt.

The analysis approach to the investigation will influence the use of the various methods; it is important that the approach is appropriate to the situation under consideration. Having studied carefully the pros and cons of each technique, this project shall be undertaken via the use of observation, oral interview, textbooks, publish papers and lecture notes.

1.5 LIST OF ABBREVIATIONS

B.A	Basal Area
CRTL	Control
CV	Cylindrical Volume
Dbase	Database
D.DBH	Diameter, Diameter at Breast Height (1.3m above ground)
FF	Form Factor
FIS	Forest Information System
FMIS	Forest Management Information System
FORMAG	Forest Management
HD	High Density
MM^2M^3	Metres, Square metres, Cube metres

MCH	Merchantable Height
MS	Microsoft
MTH	Merchantable Top Height
MVOL	Merchantable Volume
PC	Personal Computer
UPS	Uninterrupted Power Supply
TV	True Volume
V8	Volume of a Plot above 8 cm.

1.6 GLOSSARY OF TERMS

ANALYSIS:-

The study of the current data processing system and the objective of a future (improved) one.

BASAL AREA:-

Cross-sectional area of a tree ex pressed in Units Square

FORM FACTOR:-

A variable obtained in a plantation by dividing the true volume of a tree by the cylindrical volume.

HARDWARE:-

The physical components of a computer system including peripheral equipment

INFORMATION:-

Data that has been processed into a form that is useful to the user.

MERCHANTABLE HEIGHT:-

The distance from the stump to the last usable position of the tree.

MERCHANTABLE TOP HEIGHT:-

The mean merchantable height of 16 largest diametre trees per 160 mm ^{2}

ROTATION:-

Years of a tree from planting to harvest

SOFTWARE:-

Computer program (instructions) that cause the hardware to work

SUSTAIN YIELD:-

A balance between exploitation and regeneration providing for continuous availability.

SYSTEM:-

A group of element (people, machines, and cells) organised for the purpose of achieving a particular goal.

CHAPTER TWO

2.1 BRIEF HISTORY OF ELECTRONIC COMPUTERS

"A computer is an electronic device which accepts and process data by following a set of instruction (program) to produce an accurate and efficient result (information). Since the ultimate aim of a computer is to produce information, the art of computing is often referred to as information processing. The value of the computer lies solely on its high speed (due to its electronic nature), ability to store large amount of data, the unfailing accuracy and precision. These account for its supremacy over manual computation" (AYO, 94).

The computer era as we know it today, began in 1939 with the so-called ABC computer. John V. Atanasoff, a mathematics professor at IOWA State College needed a calculating device to perform mathematical operations for 20 M.Sc. and Ph.D. students. None of the mechanical calculators available served his needs. With an assistant, Clifford E. Berry, they designed and name their machine the Atanasoff – Berry – Computer, or the ABC computer.

The design of the ABC computer influenced the design of the ENIAC (Electronic Numerical Integrator and Computer), as the first large-scale computer ever built. John Mauchley and J. Presper Ekert, Jnr., of the university of Pennsylvania, USA, built the ENIAC. It was designed in response to the US Army's need for a machine to compute Artillery trajectories, during the Second World War.

Also in the 1940s, another university of Pennsylvania pioneer, John Von Neumann, developed the stored program concept of reading a programme into memory for processing. This brought about today's philosophy of electronic digital computer. The

first stored program concept-based computer, the Electronic Delay Storage Automatic Computer (EDSAC) was developed by M. V. Wilkes in 1949.

The Universal Automatic Computer (UNIVAC 1) being the first computer developed to non-military work, was produced and delivered to the US Bureau of Census in 1951. The UNIVAC 1 was then used to predict the outcome of the 1952 presidential election by Colombia Broadcasting Service. With only 5% of the votes counted, it correctly predicted that Dwight Eisenhower would defeat Adlai Stevenson. This was the beginning of the wide public aware ness of computers.

By 1960, the business computers that had transistors, instead of vacuum tubes, for its controlling circuitry, were produced by the IBM and Honeywell limited , both of the USA . It marked the emergence of second generation computers that were faster, smaller, more reliable and less expensive.

By 1964, IBM announced its system 360, which is a large mainframe computer. It thereby launched the third generation of computers. It used integrated circuit technology that entails on and off circuits elements being first etched, and then burn into a silicon chip. The IBM system 360 is primarily a batch processing system. But Professor John Lemeny, did not want students to wait for batch processing delays. It motivated him and Thomas Kurt's development of time-sharing approach, which dominates today.

By 1970, IBM introduced its system 370. This mainframe computer used integrated circuit chips. The chips are called LSI (Large-Scale Integrated) chips. Some industry analysts consider this the beginning of the fourth generation of computer systems.

The Apple Personal Computer was eclipsed in the early 1980s by the IBM personal computers. Today, there are many brands of personal computers. The mid 1980s and 90 saw the microcomputer eclipse the mainframe and minicomputer in market dominance.

We are currently in the multimedia age, in which stereo, video, communications and computing are being integrated into one functional unit. The world has obviously come a very long way and the future potentials remain a matter of speculation, in view of the very rapid development in the industry (Fapohunda, 95).

2.2 THE NIGERIAN FORESTRY GOALS

Forestry can be defined as the scientific management of forests for the production of goods and services. The establishment, growth and care of natural and artificial growth for the production of maximum sustain yield of forest including soil conservation. Forestry can be seen to play important role in industrialization, foreign exchange, provision of employment, forest products such as Timber and other minor products, soil conservation and protection, amenity as we have round the university and other parts of the town and weather amelioration.

Forest management is the application of business method and technical forestry principles to the operation of a forest property. Duerr 1994 said that forest management is the process of making and effectuating decisions to meet people's goals. Jerram 1945, defined forest management as denoting the application of the knowledge which has been acquired in all branches of forestry and the allied sciences to the management of forestry in the interests of man.

Forestry lands are usually managed for one or more purposes and it is usually the declared purpose that guides what should be done and gives direction and meaning to the various operations. It is very important that purpose be clearly defined in order to facilitate decision making and determination of policy in its long and short term.

The goals and objectives of an organization provide the basis for the formulation of the organization policies. Thus the broad objectives of forestry sub-sector reflect the

aspirations of the forestry services of the country which may then be articulated and harmonized into a set of goals for forestry profession in Nigeria. The major forestry goals and objectives may then be stated in outline as follows.

i Acquisition of forestry lands.

ii Consolidation, development and protection of forestry estate.

iii Environmental protection and conservation.

iv Management of the forestry resources for sustain yield.

v Improved forestry utilization and self-sufficiency in forestry produce.

vi Intensification and expansion of forestry research.

vii Maintenance of competent and effective forestry administration.

viii Improvement in Amenity or recreational forestry.

ix Strengthening forestry educational and training programmes.

x Multiple land use through Agro-forestry.

xi Conservation and improvement of water supplies.

xii Promotion of wildlife conservation and management.

xiii Increase employment opportunities for all.

xiv Interaction and cooperation with other nations on forestry matters.

2.3 COMPUTER APPRECIATION IN FORESTRY

This section of the write–up is intended to be an eye opener to the vast possibilities for the application of computers and information technology in forestry. As new uses of computers and information systems are being implemented everyday in all spheres of human life including forestry, this overview is not intended to be an exhaustive treatment of information technology possibilities. However, it seeks to acquaint readers with a few

of the ways information technology is to and, in many instances changing the face of forestry as a profession.

In far developed world, computer technology is widely applied in forestry accurate data analysis, yield forecast, resource inventory and management planning, extension services, map production and mass information storage. Forestry operations are generally dangerous. Lifting and hauling of logs (timbers) can be carried out by computerized Robots. In the USA and other nations, almost all aspects of forestry operations are fully computerized. A search through the wood technology magazine (printed monthly in USA) shows that a lot of software developed by forestry personnel are finding wider applications in various operations.

i **Veneer Drying:**

Veneer dryers such as Aki, Kiln Boss, drying master are fully computers controlled.

ii. **Wood Scanning:**

Wood scanners such as 3-D Lasar, Dynavision, Metal detectors are computer controls. Software such as Speedscan, Ripscan and Inovec are applied in wood scanning

iii. **Moisture Metres:**

Delmhorst, Wagner moisture metres are use to grade US woods due to their accuracy and consistency. The software applied is L612–stat-pak. Other software for the same purposes includes; Kiln tracking and Info-pak.

iv. **Sawblade Deviation Detectors:**

This software constantly monitors sawblade position to help assures smooth, cost effective production.

v. **Internet Connectivity:**

The same magazine is equally fully connected to Internet L:HP:II Www. Wood tec mag. Com.

In Nigeria, the application has been limited to analysis of students results and a few other computation. Presently there also exist a computer operation training centre at Ondo and other improvement such as a general information system developed by Geomatics Ltd. in conjunction with forestry extension and recreation unit (FORMECU). Other areas in which computers can be applied in Forestry includes:

i. **Word Processing:**

For extension promotional fyers, speeches for National tree planting campaigns.

ii. **Spreadsheet:**

In budgeting, estimation, costing, billing of sawmillers, presentation of Revenue realized and realizable by each zone.

iii. **Database Management:**

Records of plantations, reserves, staff, vehicles, inventories, management plans and an information system.

iv. **Graphics:**

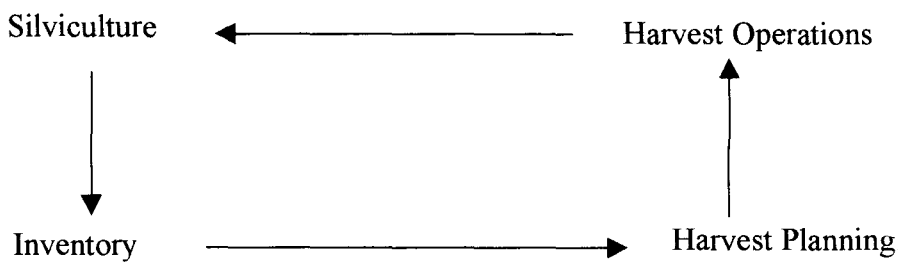
Line, Pie or Bar charts of yield, Volumes, Basal Area, can be presented for easy decision making.

v. **Programming Languages:**

Such as Basic, Fortran and Database can be use in solving various departmental problems.

2.4 A SURVEY OF RELEVANT FORESTRY INFORMATION

The organizing framework with in which forestry information is modelled is the forest life cycle. The forestry life cycle represent the cyclical stages of forest growth and the activities that occur in the forest at each stage. The main components of the life cycle are:



The cycle theoretical starting point is "bare" ground after harvest when planting and other silvicultural activities follow. At the same time growth assessments are performed to confirm the inventory. The forest is left to grow and may be periodically inventoried. When the forest reaches the end of it's planned rotation, plans are made to harvest the forest. Harvest occurs and the cycle restarts. From the above, forest information can be classified into two:

2.4.1 CLASSIFICATION OF FOREST INFORMATION

	OPERATIONAL PLANNING	MANAGEMENT PLANNING
i.	Nursery Establishment	Age
ii.	Clearing and preparation	Density
iii.	Planting	Diametre
iv.	Weeding	Basal Area
v.	Thinning and Pruning	Height
vi.	Fire tracing	Form Factor
vii.	Inventory collection	Volume
viii.	Harvesting	Total Yield

2.5 BENEFIT OF AN INFORMATION SYSTEM

As a result of the cold war between the West and the East, particularly between the USA and the former USSR both pursued gigantic space research programs aimed at military domination of the world. By 1957, the soviets launched a spacecraft called the Sputnik. The soviet success embarrassed and humiliated the USA who was supposed to be leading the world in the space program. After wards the USA reacted by devoting much time and fund to their own space research in competition with the soviets.

The US department of Defence created a body called the Advance Research Projects Agency (ARPA). The ARPA applied its funds to basic research in the application of computers to all aspects of communications development and information generation rather than the military only. This was a blessing in disguise, because it enabled a collaboration effort between Military Scientist, University Scientist and other organizations in the private sector of the US economy. The application of computer technology to communications and information transmission became a very important part of the ARPA research. Information transmission they argued, will be the major plank in conquering and domination of space. It will become very useful for business, commerce and national development as it is now. This of course developed to what today is referred to as information system with varied benefits such as:

i. Provision of an information system with degree of accuracy.

ii. Providing a better management information system

iii. Provision of a fast means of data processing and information presentation.

iv. Bringing about a more affective management system

v. Reduction in time spent in searching and storage of information.

vi. Reduction in space occupied by files, files cabinet etc.

CHAPTER THREE

3.1 EXISTING SYSTEM REVIEW

In the early days, man regarded forest as the gift of Nature to provide him with fuel wood, shelter and food. Later he took it for a facility, which he could use to his advantage. Then, he started cutting the forest to give room for accommodation, recreation etc. This destructive effect coupled with population increase caused depletion of forests, and awareness of which caused him to look at the forest as a property and to control its use.

Organized forest management through forest reservation started in the 16^{th} century, and by the next century management for specific objectives started together with organization of the forest to meet regular and adequate supply of forest products. This led to the concept of sustain yield basis management. To manage the forest on a sustain yield, three major elements are fundamental viz:

i. Exploitation

ii. Control

iii. Regeneration.

These three transcend into management of forest on a sustain yield basis and this should be the primary goal of every forest manager. The neglect of any of the elements introduces defects in management, the effect of which may not be quantified.

Presently, what obtains in Niger State forest department has been exploitation to the neglect of control and regeneration. The state is blessed with both natural and artificial forest (Plantation). It should be noted that forestry projects are capital intensive and have a long gestation period hence the need for a proper and careful management to avoid a compounded loss at the end of the rotation. There has been continuous exploitation of our natural forests resulting in desertification, depletion of Timber, Aridity and other

environmental problems. Saw millers and other illegal contractors are almost rounding up the remaining patches and forest officers seems to have completely surrendered as there is no mobility to effectively monitor and check the trend.

One may argue that for the past five years, the department has been a head of others in the ministry of Natural resources in revenue generation. It is however unfortunate to observe that for the next ten years or more, the same department will experience a serious drop in revenue realization. This is due to the fact that the harvest of the past was without a predetermine method of selection (No control). No measurement was carried out to keep the feeling at a manageable pace. Contractors were made to enter plantations themselves, make selections then come to the office and pay. This resulted in massive and random felling and in some places whole plantations were cleared. Secondly, there has never been any substantial planting since the eighties. The very few planting done is nothing to write home about as far as survival is concern. This has created a wide gap in regeneration.

Unlike the natural forest, plantations are done in Rows making assessment, inventory and management plans easier. The constitution, situation and capacity of plantations are all contained in maps. Fellings in plantations are supposed to be accomplished in an orderly Manner either fixing a minimum diameter or compartmentally so as to make provision for an out-turn every year (Sustain yield). This can only be possible if information on the diametre, volume and height of each species is available. Inventories are not carried out because a system to work on the raw data and produce the needed information is not available. The manual method is crude and gives room for a lot of mistakes. The mechanical method is equally not providing the needed solution due to the volume of trees sometimes involved. Hence most foresters have resigned to the use of what is popularly known as Occular Estimation method (eye estimation). This of course is

unscientific and cannot be used for planning. There is Mathemaphobia (fear of maths) and anything related to calculation amongst foresters.

In concluding this phase of analysis, it is truly observed through investigation that the present system has outlived its usefulness because.

i. The speed with which data are collected and processed are not fast enough to meet challenges of today.

ii. The present system gives room for many errors.

iii. The system equally gives room for collection of unscientific data due to the fact that no instruments are used in their collection. This can lead to unreliable decisions to be taken.

iv. There is no pegging of minimum felling diametre in the present system and this does not provide for control in exploitation hence no continuity as provided for in sustain yield concept.

v. It does not give room for future planning

vi. It is wasteful as felling is done disorderly.

3.2 SYSTEM OBJECTIVES

As earlier stated in the introductory chapter, there has been increased emphasis on the use of information Technology in the forestry sector for especially management and planning. This necessitated the issuance of complete set of computer system by the world Bank to each state forestry department with the aim of; saving processing time, improve output accuracy, increase range of output of information and generally create a sound foundation for management of our resources on a sustain yield basis.

Before now one would have been tempted to conclude that there was never an information system for forestry management or the one existing was neither functional nor

operational. This introduces defects and serious errors in management and there wasn't any plan for the future. For instance information is currently not available as to the number of stumps felled nor the volume removed in plantation during the stated period. If we cannot effectively monitor and manage feelings from natural forest because of distances and locations of some of these species, No excuse could be accepted for not managing, maintaining and preserving our artificial forest which are truly accessible. This system therefore shall:

i. Speed the processing of our data into needed information.

ii. Introduce accuracy which has never existed before.

iii. Encourage inventory taking and proper record keeping for our plantations.

iv. Provide scientific information for decision making and proper planning for our plantation.

v. Eliminate waste resulting from disorderly feeling

vi. Introduce control through fixing of a minimum feeling diametre.

vii. Make searching of stored information easy.

3.3 EXPLORATION OF ALTERNATIVE DESIGNS

After analysis existing system and stating objectives of a new system, it is imperative to go a head to discuss various alternative designs, their advantages and disadvantages and then making a choice of the alternative that best suit the Niger State forestry department. The common designs alternatives includes; the direct, the `parallel, the pilot and the stage changeover.

3.3.1 DIRECT CHANGEOVER

This method is the complete replacement of the old system by the new, in one move. It is a bold move, which should be undertaker only when every one concern has confidence in the new system. When a direct changeover is planned, system tests and training should be comprehensive and the changeover itself planned in detail.

This method is potentially the least expensive but the most risky. However, for security reasons, the old system may be held in abeyance, including people and equipment. In the event of a major failure of the new system the organization would revert to the old system.

3.3.2 PARALLEL RUNNING

This means the processing of current data by both the old and the new systems to cross-check the results. Its main attraction is that the old system is kept alive and operational until the new system has been provide for at least one system cycle, using full life data in the real operational environment of place, people, equipment and fine.

It allows the result of the new system to be compared with the old system before acceptance by the user, thereby promoting user confidence.

Its main disadvantage is the extra cost, the difficulty and (sometimes) the impracticability, of user, staff having to carry out the different clerical operations for two systems (old and new) on the time available for one.

3.3.3 PILOT RUNNING:

This is similar in concept to parallel running. Data from one or more previous periods for the whole or part of the system is run on new system after results have been obtained from the old system, and the new results are compared with the old.

This method is more like an extended system test, but it may be considered a more practical form of change over for organizational reasons. It is not as disruptive as parallel operation, since timing is less critical.

3.3.4 STAGED CHANGE OVER

This involves a series of limited–size direct change over, the new system being introduced piece–by–piece. A complete part, or logical section, is committed to the new system while the remaining parts or sections are operating satisfactory is the remainder transferred.

This method reduces the risk inherent in direct change over of the whole system and enable as the change over progresses (Prince, 1998).

3.4 THE CHOSEN DESIGN

Due to problems such as ignorance on the majority of forestry officers on the relevance of computer in forestry, the long gestation period of forestry projects, facts that forestry projects are capital intensive and lack of knowledge on computer operation, enough care has been taken on the choice of a change over that would convince a majority of forestry officers through it success at the first stage. Starting from management (which is a very important but difficult aspect of forestry) would create more confidence confiding in the facts that the wonders of computers do not stop in Banks alone. More so, once data can be computed, a major part of our management problem is taken–care of giving room for better planning. The change over that would properly work for the department is:

THE STAGED CHANGE OVER

i. It enables us to learn from mistakes made as the change over progresses.

ii. There is reduction in the risk inherent in a direct change over

iii. It is not descriptive compared to parallel operation as just a part is considered at a time.

iv. The system would be inexpensive as already a free set of Hardware exists, the software is developed by a member of staff, and training of other users in the department would be inexpensive.

iv. Old data would not be relied upon as both method of collection and computations were unscientific.

3.5 TESTING PROJECT FEASIBILITY

3.5.2 OPERATIONAL FEASIBILITY

Operational feasibility conducted shows that top management accepted the idea as a policy from World Bank through the Federal Government. Though the relevant knowledge was not there changes which are best for any progressive organisation produces ecstasy and high expectation. Many staff then concluded that the innovation must be very important and relevant to forestry contrary to their earlier held belief. The mandate and impetus from above would make it work, the Staff being trained is expected to embark on aggressive extension services.

3.5.2 TECHNICAL FEASIBILITY

The equipment already available would serve the present need of the department. They include:

3.5.2.1 HARDWARE

i. Computer Server

- Pentium 300 MHz
- 64MB RAM

- 6.5GB Hard Disk
- 15" SVGA Monitor
- 2MB SVGA Card
- Windows 95 Keyboard
- Pad & Mouse Pad

ii. Standalone PC

- Pentium 166 MHz
- 16MB RAM
- 1.2GB Hard Disk
- 14" SVGA Monitor
- 1MB SVGA Card
- Windows 95 Keyboard
- Pad & Mouse Pad
- Network Card

iii. Design jet plotter

- 48MB RAM

iv. Printer Epson DFX 8000

v. UPS (APC smart) 2 pairs

vi. Data Catridges (Sonny Brand)

vii. 3.5" HD Diskettes, and External Tape Drive.

viii. Ribbons

ix. Plotting Papers

x. 2 Free Expansion Slot

xi. Plain papers.

More consumables as mentioned above would be purchased.

3.5.2.2 SOFTWARE

	SOFT WARE	VERSION	PLATFORM
i.	Arc/INFO. SDE	2.3	Workstation
ii.	ARC VIEW	3.1	PC
iii.	WINDOWS	95	PC
iv.	MS–Office	7	PC
v.	DBASE	4	PC
vi.	Oracle	7.3	Workstation.
vii	Virus Scan	7.7	Server & PC

Training on minor maintenance, installation, operations would be conducted locally.

3.5.2 ECONOMIC FEASIBILITY

Except for the Consumables such as Ribbons, diskettes, Catridges, plain papers and virus scans, all other equipment were issued free as stated earlier. The cost of maintenance, installation, office setting, security and consumable would amount to a simple Budget of Five Hundred Thousand Naira only (₦ 500,000:=).

CHAPTER FOUR

4.1. PROGRAM IDENTIFICATION AND DESCRIPTION

The program is written in dBASE IV which has two different methods of processing data stored in its database files. These are interactive processing mode and Batch processing mode. The batch processing mode is also known as the programming language mode chosen for this project due to its ability to store commands in the form of a program and is executed in a group. These commands are stored in a file known in dBASE as command file.

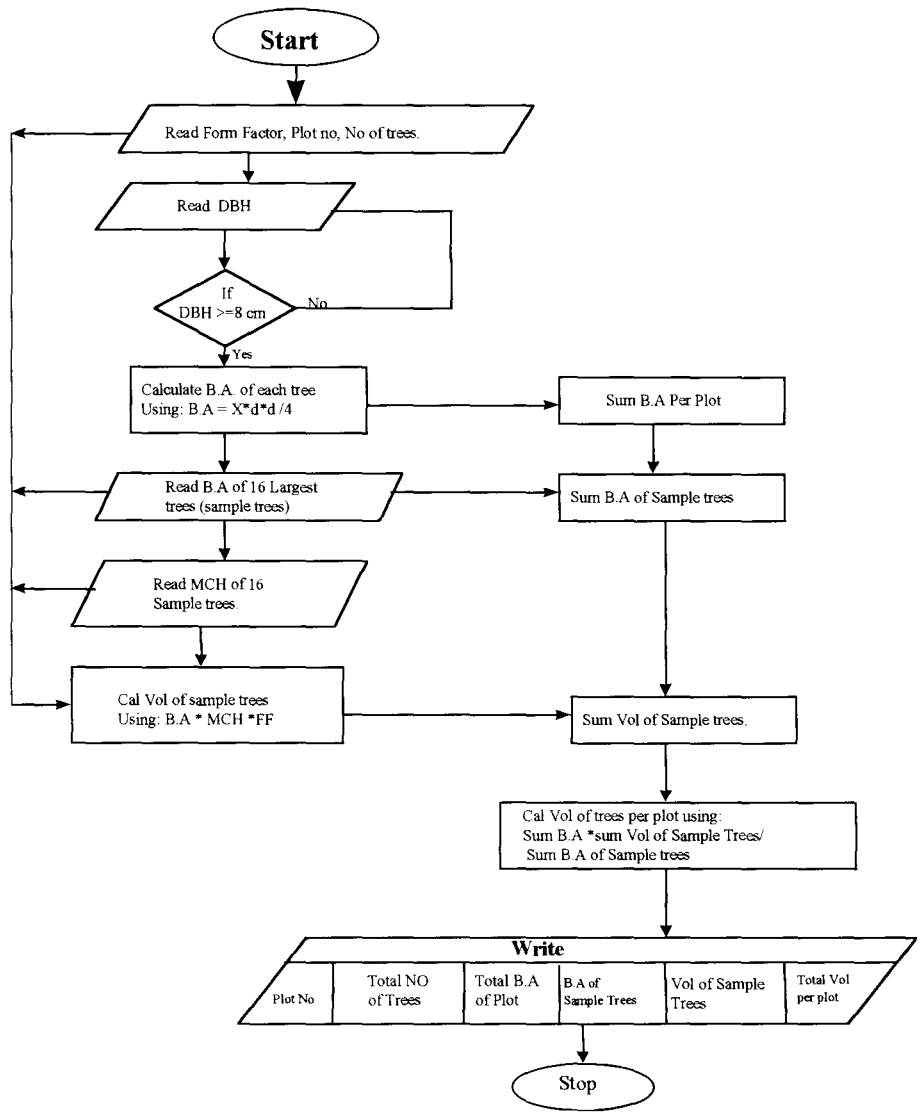
To write the program, the dBASE IV text editor was used. The text editor can be activated by typing **MODIFY COMMAND** followed by the file name. The command and the file name are entered at the DOT prompt and an environment to enter the program will be displayed on the computer screen. Once all the instruction have been entered, they are saved to disk by pressing **CTRL** and **END** keys at the same time. After the program has been saved to disk, it can be executed with the use of **DO COMMAND.** This is done by typing **DO** followed by the name of the program file also at the dot prompt dBASE IV opens the program file and read each line of the file starting at the top of the file, performing each command in sequence.

The program calculates Total Basal Area (T.B.A) for a plot, select Basal Area (B.A) of 16 samples trees whose height had been measured. Calculate the volume of the sample trees and then volume per plot, Presented in a tabular form.

Data expected include diameter of each tree in a plot, merchantable height of 16 trees and Number of trees in a plot, noting those trees whose diameter is less than 8cm are excluded.

Refer Appendix 1 & 2.

4.2 SYSTEM SPECIFICATION



4.3 DATABASE FILES

The new system is designed to use three files namely PLOT.DBF, TREE.DBF and TEMP.DBF. The structure of each of these files are described below:

PLOT. DBF

S/No	FIELD NAME	FIELD DESCRIPTION	FIELD TYPE	FIELD WIDTH
1	PLN	Plot Number	Character	7
2	NT	Number of Tree	Numeric	3
3	YP	Plalranting Year	Numeric	4
4	PS	Plot Size	Numeric	6
5	REC	Recorder	Character	25
6	DCOL	Date of Reading	Date	8
7	TBA	Total Basal Area	Numeric	10/1
8	SHA	Basal Area of sample Trees	Numeric	8/1
9	SVOL	Volume of Sample Trees	Numeric	8/1
10	PRO	Volume of Plot	Numeric	10/1

TREE.DBF

S/No	FIELD NAME	FIELD DESCRIPTION	FIELD TYPE	FIELD WIDTH
1	PLN	Plot Number	Character	7
2	TRN	Tree Number	Character	5
3	DBH	Diametre at Breast Height	Number	5/1
4	BA	Basal Area	Number	6/1
5	MCH	Merchantable Height	Number	6/1
6	VOL	Volume of Tree	Number	6/1

TEMP.DBF

S/No	FIELD NAME	FIELD DESCRIPTION	FIELD TYPE	FIELD WIDTH
1	PLN	Plot Number	Character	7
2	TRN	Tree Number	Character	5
3	DBH	Diametre at Breast Height	Number	5/1
4	BA	Basal Area	Number	6/1
5	MCH	Merchantable Height	Number	6/1
6	VOL	Volume of Tree	Number	6/1

4.4. PROGRAM CODING

This section describe the source program of the new system. The style of developing the program is modular programming where suites of program work together for the purpose of achieving a common aim. The source program of this new system is contained in Appendix 3.

4.5. PROGRAM TESTING AND MAINTENANCE

The new system was initially tested with test data obtained by the author a few years back from largest plantation in Africa (Nimbia Teak Plantation in Kaduna State.) The second stage of the system testing was done by life data collection from Mokwa Teak plantation. This provided an extra level of assurance that the system will work properly when implemented.

Such commands as **Modify, Replace, Delete** and **Pack** can be used to maintain the program. The **MODIFY** commands can be used to edit the program file. The replace command can be used to modify the contents of the specified data fields in the active data

base file. This is done by replacing the contents of a field with the new value. The format is given as:

REPLACE (field Name) with (data item)

Once data have been entered into the file, there may be need to delete any record of interest. This is done using the data deleting routine which is similar to the data editing routine because the record has to be search for before the deleting procedure can be activated. dBASE IV uses the combination of **DELETE** and **PACK** command to accomplish this task.

4.6 SECURITY IN THE NEW SYSTEM

Apart from the fact that a proposal has been accepted for burglary proof, two air conditioners, a guard and a UPS. The new system has provision for back up files in the form of Son, Father, Grandfather so that in the event of destruction, there could be replacement without much problem.

"Password mechanism" is provided for so that in a network no one get access without permission. It equally has facility for logging via users ID Number. This protect data against unauthorised usage in a network.

A register is expected to be opened to show movement in and out of the computer room.

CHAPTER FIVE

5.1 AUTOMATION AND JOB SECURITY IN FORESTRY

Concern about the effects of automation began with the industrial revolution and the public is still much afraid. To many people, computers mean automation and automation means loss of jobs (Fapohunda, 1995). There is no doubt that the emergence of computer technology has resulted in the elimination of jobs involving routine, monotonous and sometimes hazardous tasks. However, the loss of these jobs has been offset by creation of more challenging ones. Many people whose jobs have been eliminated have displaced to jobs carrying greater responsibilities and offering more opportunities.

There is no denying the fact that in every sector where productivity and efficiency are a target there is the need to lay off redundant staff for more ardent and effective ones. However, happenings in some organizations of recent in which well-trained, ardent and productive staff were laid off as a result of the introduction of computer could prove disastrous and the consequences unpleasant in others. Generally, computer should complement human effort and by this prolong life. The use of robots to perform dangerous, hazardous and tedious operations is a good example. Taking the forestry sector as a case study, there are operations that cannot presently be carried out by the computer especially in Nigeria. This is apart from the well known fact that the system could crash. Lets closely view a few points for discus below:

i. Though computer can solely be relied upon for map production, data analysis and other computations such data can only be obtained from the field by forestry personnel.

ii. Extension materials which could be attractively produced by the computer would need forestry ex tension staff for display, demonstration and especially reading of speeches on planting campaign occasions.

iii. Though calculations of espacement and elimination in species trial can be effected through computer, the actual planting in the field is a task to be executed by forestry personnel.

It is clear that computer cannot and should not be a source of unemployment in forestry as feared by many, instead help in accurate data analysis thereby avoiding mistakes which could lead to mis-management, save-time in task execution, does the job quicker thereby bringing about efficiency and higher productivity.

5.2 DISCUSSION

So far the system having been tested is set for operation in the state. Being an initial work of its kind, a special record is set in preparation of system for proper management of forestry resources in Niger State and has set in motion the genesis of a continuous assessment while remaining a reference point.

The staff of the department would be given an in-house training to enable them have basic knowledge on how to operate the computer and its peripherals devices and emphasis would be given on data entry.

Once the diameter, height and form factor are obtained and, of course, other relevant information such as number of trees per plot and age of planting, the program is then applied to compute and obtain volumes in tables (volume tables) and yields can be subsequently determined (see Appendix for proposed output format).

Using graphs and other statistical methods, relationship could be established between volume and diameter, age and height, number of trees and Basal area, Basal area and age etc. Age and height could be plotted to determine site index, while number of trees over Basal area could be done to show stand density index.

5.3 CONCLUSION AND RECOMMENDATION

What has been said and done so far shows that the computer system is already married to the forestry system for onward and better management. Once volumes are computed and programmes in tables, the yield are determined and planning could be done with scientific information. The volume obtained through this system are volumes over back and of trees whose diameters are 8 cm and above. From the table a determination could be done as to when a plantation is due for harvest and for what purpose.

It is strongly recommended therefore that the system should be applied in all plantations in the state so as to prepare a solid management plan. Other states are free to apply for the system.

Though there are various methods of volume determination, the chosen method for this project is suitable and economical. From an Hectare, the height of 100 trees are measured to merchantable point and in proportion 16 trees in a plot of 160m2. Usually, calculating the volume of a tree is less affected by an error in height. The methods provide for less labour.

There is no doubt that proper implementation of the new system will enhance accuracy, speed and efficient production of information for consistent management.

From the conservative financial analysis, the benefits of installing the new system is highly encouraging.

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APPENDIX 1

FORM FOR DATA COLLECTION

Plot Number.....Number of trees.....

Year of planting.....Plot size.....

Recorder.....Date.....

TREE No	DBH	MCH	REMARK	TREE No	DBH	MCH	REMARK

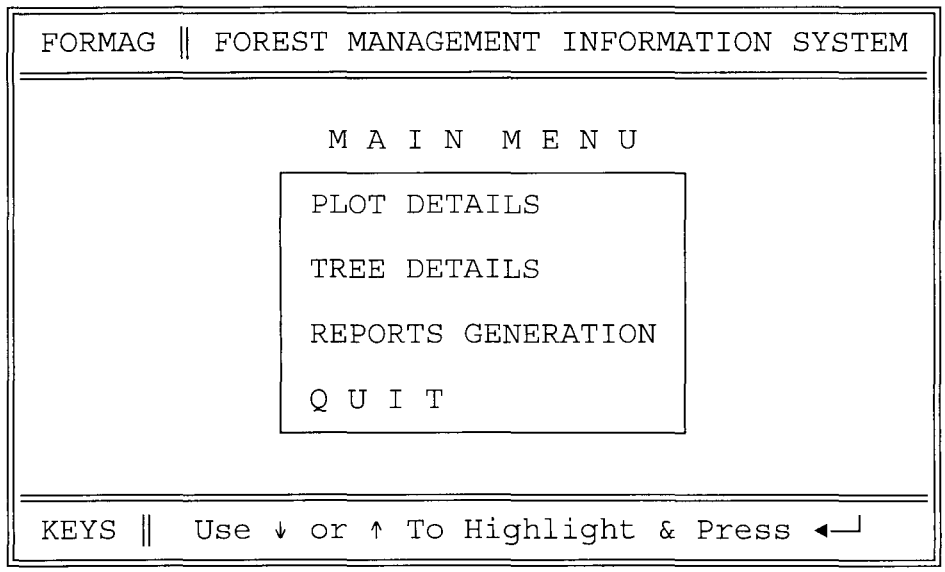
APPENDIX 2

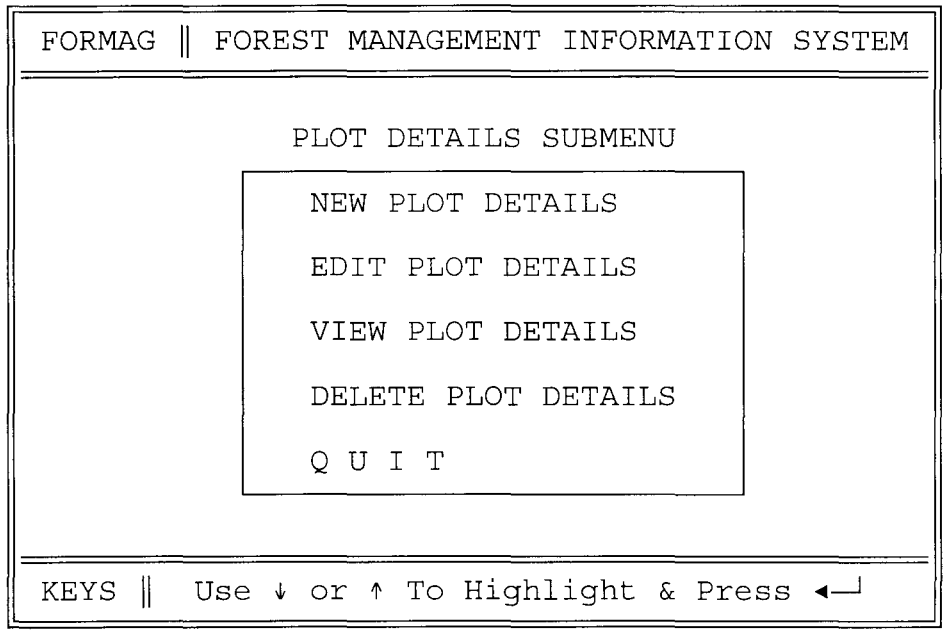
PROPOSED OUTPUT FORMAT

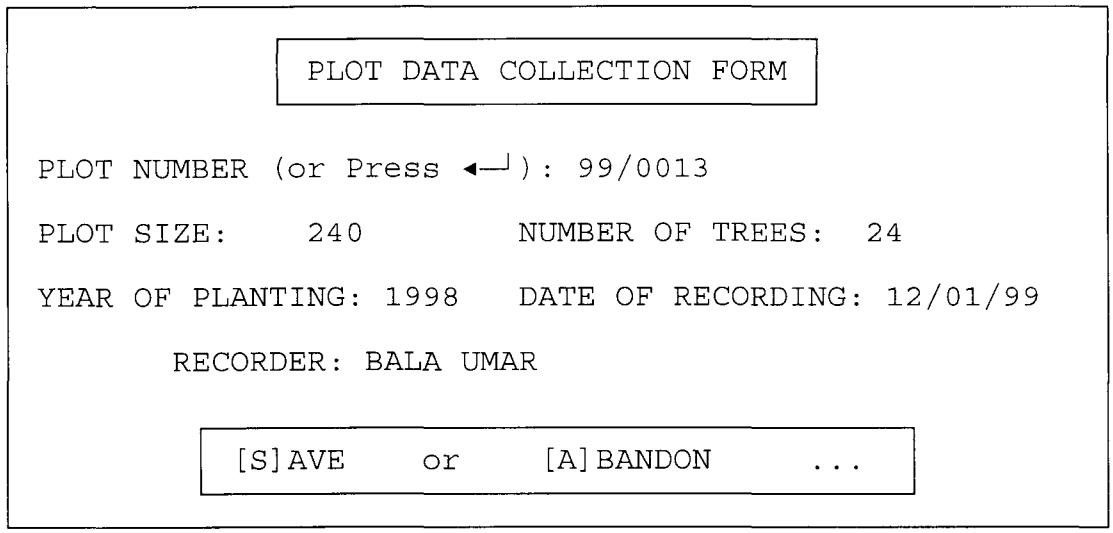
PLOT No	TOTAL No OF TREES	TOTAL B.A OF PLOT	B. A OF SAMPLE TREES	VOLUME OF SAMPLE TREES	TOTAL VOL. PER PLOT

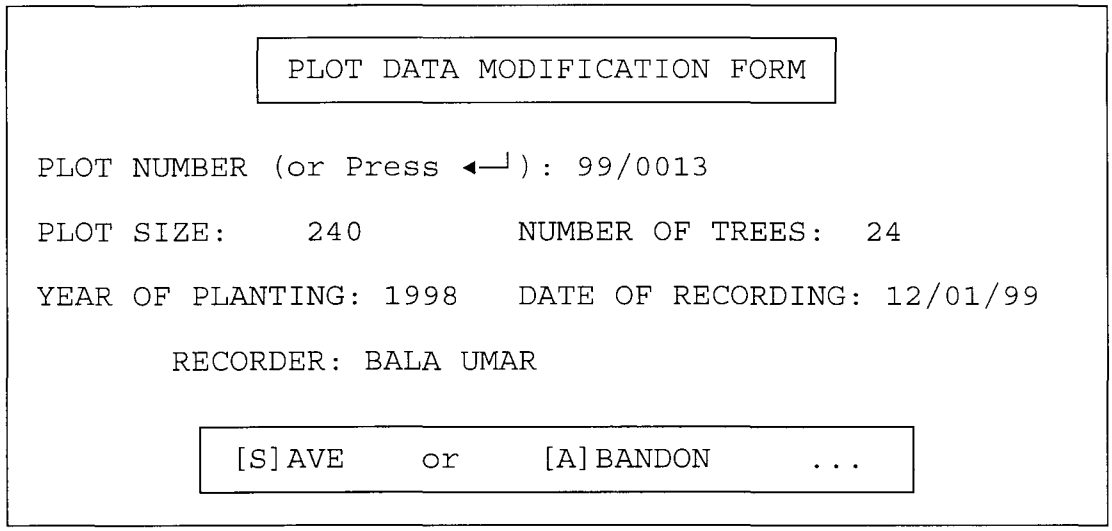
APPENDIX 3

SCREEN DESIGN AND PROGRAM OUTPUT


FORMAG || FOREST MANAGEMENT INFORMATION SYSTEM
M A I N M E N U
PLOT DETAILS
TREE DETAILS
REPORTS GENERATION
Q U I T
KEYS || Use ↓ or ↑ To Highlight & Press ◄┘


FORMAG || FOREST MANAGEMENT INFORMATION SYSTEM
PLOT DETAILS SUBMENU
NEW PLOT DETAILS
EDIT PLOT DETAILS
VIEW PLOT DETAILS
DELETE PLOT DETAILS
Q U I T
KEYS || Use ↓ or ↑ To Highlight & Press ◄┘

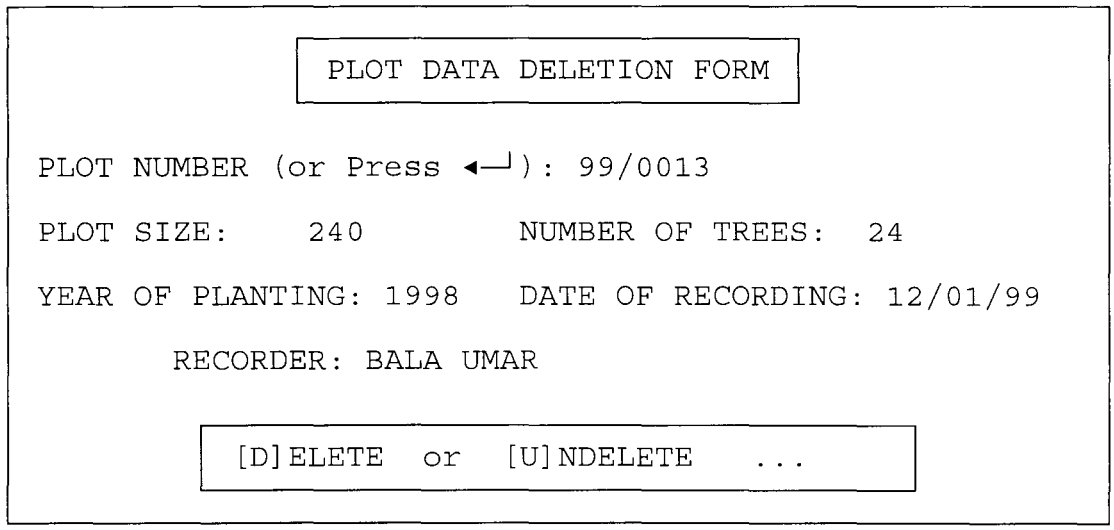

PLOT DATA COLLECTION FORM
PLOT NUMBER (or Press ◄┘): 99/0013
PLOT SIZE: 240
NUMBER OF TREES: 24
YEAR OF PLANTING: 1998
DATE OF RECORDING: 12/01/99
RECORDER: BALA UMAR
[S]AVE or [A]BANDON ...

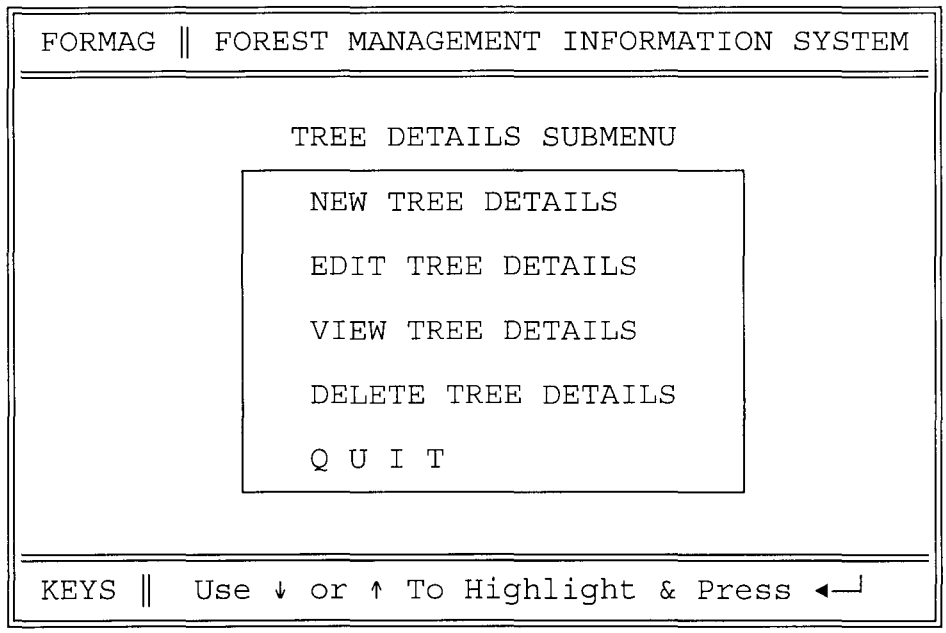

PLOT DATA MODIFICATION FORM
PLOT NUMBER (or Press ◄┘): 99/0013
PLOT SIZE: 240 NUMBER OF TREES: 24
YEAR OF PLANTING: 1998 DATE OF RECORDING: 12/01/99
RECORDER: BALA UMAR
[S]AVE or [A]BANDON ...

PLOT DATA LISTING FORM

PLOT NO	PLOT SIZE	NO OF TREES	PLANTING YEAR	RECORDING DATE
98/001	123	24	1998	12/07/98
98/003	234	25	1998	12/07/98
99/0013	240	24	1998	12/01/99

IT IS END OF FILE - Press any key


PLOT DATA DELETION FORM
PLOT NUMBER (or Press ◄┘): 99/0013
PLOT SIZE: 240
NUMBER OF TREES: 24
YEAR OF PLANTING: 1998
DATE OF RECORDING: 12/01/99
RECORDER: BALA UMAR
[D]ELETE or [U]NDELETE ...


FORMAG || FOREST MANAGEMENT INFORMATION SYSTEM
TREE DETAILS SUBMENU
NEW TREE DETAILS
EDIT TREE DETAILS
VIEW TREE DETAILS
DELETE TREE DETAILS
Q U I T
KEYS || Use ↓ or ↑ To Highlight & Press ◄—┘

TREE DATA COLLECTION FORM

PLOT NUMBER: 99/0013 NUMBER OF TREES: 24

TREE NO	DIAMETER AT BREAST HEIGHT (DBH)	BASAL AREA
TR/01	8.6	58.1
TR/02	10.2	81.7
TR/03	10.6	88.3
TR/04	13.0	132.7
TR/05	14.2	158.4
TR/06	8.8	60.8
TR/07	8.9	62.2
TR/08	14.0	154.0

PRESS ANY KEY TO PROCEED

TREE DATA COLLECTION FORM

PLOT NUMBER: 99/0013 NUMBER OF TREES: 24

TREE NO	DIAMETER AT BREAST HEIGHT (DBH)	BASAL AREA
TR/09	24.0	452.4
TR/10	24.6	475.4
TR/11	30.1	711.7
TR/12	25.6	514.8
TR/13	30.5	730.7
TR/14	8.4	55.4
TR/15	9.4	69.4
TR/16	10.2	81.7

PRESS ANY KEY TO PROCEED

TREE DATA COLLECTION FORM

PLOT NUMBER: 99/0013 NUMBER OF TREES: 24

TREE NO	DIAMETER AT BREAST HEIGHT (DBH)	BASAL AREA
TR/17	13.1	134.8
TR/18	10.2	81.7
TR/19	12.6	124.7
TR/20	10.2	81.7
TR/21	10.0	78.6
TR/22	13.0	132.7
TR/23	25.0	490.9
TR/24	24.6	475.4

DBH ENTRY COMPLETED - PRESS ANY KEY TO PROCEED

TREE DATA COLLECTION FORM

PLOT NUMBER: 99/0013 NUMBER OF TREES: 24

SAMPLE TREES = 16 TREES WITH LARGEST BASAL AREA

TO PROVIDE MERCHANTABLE HEIGHT OF THESE TREES

PRESS ANY KEY TO PROCEED !!!

TREE DATA COLLECTION FORM

PLOT NUMBER: 99/0013 NUMBER OF TREES: 24

TREE NO	BASAL AREA	MERCHANTABLE HEIGHT (MCH)	VOLUME OF TREE
TR/13	730.7	10.6	15.5
TR/11	711.7	8.6	12.2
TR/12	514.8	9.4	9.7
TR/23	490.9	12.4	12.2
TR/24	475.4	8.2	7.8
TR/10	475.4	11.6	11.0
TR/09	452.4	9.6	8.7
TR/05	158.4	10.0	3.2

PRESS ANY KEY TO PROCEED

TREE DATA COLLECTION FORM

PLOT NUMBER: 99/0013 NUMBER OF TREES: 24

TREE NO	BASAL AREA	MERCHANTABLE HEIGHT (MCH)	VOLUME OF TREE
TR/08	154.0	10.3	3.2
TR/17	134.8	13.4	3.6
TR/04	132.7	10.4	2.8
TR/22	132.7	11.6	3.1
TR/19	124.7	25.0	6.2
TR/03	88.3	27.8	4.9
TR/02	81.7	28.1	4.6
TR/16	81.7	30.0	4.9

[S]AVE or [A]BANDON ...

APPENDIX 4

SOURCE PROGRAM LISTING

FORMAG.PRG

```
SET TALK OFF
SET STAT OFF
SET SCOR OFF
SET BELL OFF
SET SAFE OFF
SET WRAP ON
SET DATE BRIT
SET COLO TO W+/B+,B+/W+,WB+
CLEA
DO WHIL .T.
 CLEA
 @ 19,15 TO 21,22 DOUB
 @ 19,15 TO 21,63 DOUB
 @ 4,15 TO 6,24 DOUB
 @ 4,15 TO 6,63 DOUB
 @ 4,15 TO 21,63 DOUB
 @ 5,17 SAY 'FORMAG'
 @ 5,26 SAY 'FOREST MANAGEMENT INFORMATION SYSTEM'
 @ 8,32 SAY 'M A I N  M E N U'
 @ 20,17 SAY 'KEYS'
 @ 20,25 SAY 'USE '+CHR(25)+' OR '+CHR(24)+' TO HIGHLIGHT & PRESS
'+CHR(17)+CHR(196)+CHR(217)
 @ 9,29 TO 17,50
 @ 10,31 PROM "PLOT DETAILS"
 @ 12,31 PROM "TREE DETAILS"
 @ 14,31 PROM "REPORTS GENERATION"
 @ 16,31 PROM "Q U I T"
 MENU TO CHOICE1
 DO CASE
  CASE CHOICE1==0
   LOOP
  CASE CHOICE1==1
```

```
    DO PLOTM
   CASE CHOICE1==2
    DO TREEM
   CASE CHOICE1==3
    DO OUTPUT
   OTHE
    EXIT
  ENDC
ENDD
CLEA
RETU
```

PLOTM.PRG

```
DO WHIL .T.
 CLEA
 @ 20,15 TO 22,22 DOUB
 @ 20,15 TO 22,63 DOUB
 @ 3,15 TO 5,24 DOUB
 @ 3,15 TO 5,63 DOUB
 @ 3,15 TO 22,63 DOUB
 @ 4,17 SAY 'FORMAG'
 @ 4,26 SAY 'FOREST MANAGEMENT INFORMATION SYSTEM'
 @ 7,30 SAY 'PLOT DETAILS SUBMENU'
 @ 21,17 SAY 'KEYS'
 @ 21,25 SAY 'USE '+CHR(25)+' OR '+CHR(24)+' TO HIGHLIGHT & PRESS
'+CHR(17)+CHR(196)+CHR(217)
 @ 8,27 TO 18,53
 @ 9,31 PROM "NEW PLOT DETAILS"
 @ 11,31 PROM "EDIT PLOT DETAILS"
 @ 13,31 PROM "VIEW PLOT DETAILS"
 @ 15,31 PROM "DELETE PLOT DETAILS"
 @ 17,31 PROM "Q U I T"
```

```
 MENU TO CHOICE2
 DO CASE
  CASE CHOICE2==0
   LOOP
  CASE CHOICE2==1
   DO PLOT1
  CASE CHOICE2==2
   DO PLOT2
  CASE CHOICE2==3
   DO PLOT3
  CASE CHOICE2==4
   DO PLOT4
  OTHE
   EXIT
 ENDC
ENDD
CLEA
RETU
```

TREEM.PRG

```
DO WHIL .T.
 CLEA
 @ 20,15 TO 22,22 DOUB
 @ 20,15 TO 22,63 DOUB
 @ 3,15 TO 5,24 DOUB
 @ 3,15 TO 5,63 DOUB
 @ 3,15 TO 22,63 DOUB
 @ 4,17 SAY 'FORMAG'
 @ 4,26 SAY 'FOREST MANAGEMENT INFORMATION SYSTEM'
 @ 7,30 SAY 'TREE DETAILS SUBMENU'
 @ 21,17 SAY 'KEYS'
```

```
 @ 21,25 SAY 'USE '+CHR(25)+' OR '+CHR(24)+' TO HIGHLIGHT & PRESS
'+CHR(17)+CHR(196)+CHR(217)
 @ 8,27 TO 18,53
 @ 9,31 PROM "NEW TREE DETAILS"
 @ 11,31 PROM "EDIT TREE DETAILS"
 @ 13,31 PROM "VIEW TREE DETAILS"
 @ 15,31 PROM "DELETE TREE DETAILS"
 @ 17,31 PROM "Q U I T"
 MENU TO CHOICE2
 DO CASE
  CASE CHOICE2==0
   LOOP
  CASE CHOICE2==1
   DO TREE1
  CASE CHOICE2==2
   DO TREE2
  CASE CHOICE2==3
   DO TREE3
  CASE CHOICE2==4
   DO TREE4
  OTHE
   EXIT
 ENDC
ENDD
CLEA
RETU
```

OUTPUT.PRG

```
CLEA
USE PLOT
@ 0,25 SAY 'REPORT ON TREES DETAIL ON PLOT'
@ 1,25 SAY REPL('=',30)
```

```
@ 2,0 TO 2,79
@ 3,0 SAY 'PLOT NO'
@ 3,9 SAY 'TOTAL NO'
@ 3,19 SAY 'TOTAL B.A. OF'
@ 3,34 SAY 'B.A. OF SAMPLE'
@ 3,50 SAY 'VOL. OF SAMPLE'
@ 3,66 SAY 'TOTAL VOL. PER'
@ 4,9 SAY 'OF TREES'
@ 4,19 SAY 'PLOT (M SQ.)'
@ 4,34 SAY 'TREES (M SQ.)'
@ 4,50 SAY 'TREES (M CUBE)'
@ 4,66 SAY 'PLOT (M CUBE)'
@ 5,0 TO 5,79
@ 22,0 TO 22,79
ROW=5
DO WHIL .NOT. EOF()
 ROW=ROW+1
 MPLN=PLN
 MNT=NT
 MTBA=TBA
 MSBA=SBA
 MSVOL=SVOL
 MPVOL=PVOL
 @ ROW,0 SAY MPLN
 @ ROW,11 SAY MNT PICT '999'
 @ ROW,21 SAY MTBA PICT '99999999.9'
 @ ROW,37 SAY MSBA PICT '999999.9'
 @ ROW,53 SAY MSVOL PICT '999999.9'
 @ ROW,66 SAY MPVOL PICT '99999999.9'
 SKIP
 IF EOF()
  @ 23,23 SAY 'IT IS END OF FILE - PRESS ANY KEY'
  SET CONS OFF
  WAIT
```

```
  SET CONS ON
  EXIT
 ENDI
 IF ROW=21
  @ 23,25 SAY 'PRESS ANY KEY TO CONTINUE'
  SET CONS OFF
  WAIT
  SET CONS ON
  @ 6,0 CLEA TO 21,79
  ROW=5
 ENDI
ENDD
CLOS ALL
CLEA
RETU
```

PLOT1.PRG

```
USE PLOT
INDE ON PLN TO PLOT
DO WHIL .T.
 CLEA
 @ 4,11 TO 20,68
 @ 5,25 TO 7,53
 @ 6,27 SAY 'PLOT DATA COLLECTION FORM'
 MPLN='      '
 @ 9,13 SAY 'PLOT NUMBER (OR PRESS '+CHR(17)+CHR(196)+CHR(217)+'):' GET
MPLN PICT '99/9999'
 READ
 IF MPLN='      '
  EXIT
 ENDI
 SEEK MPLN
```

```
IF FOUN()
 @ 17,21 TO 19,58
 @ 18,23 SAY 'PLOT NUMBER EXIST - PRESS ANY KEY'
 SET CONS OFF
 WAIT
 SET CONS ON
 LOOP
ENDI
MNT=0
MYP=0
MPS=0
MREC=SPAC(25)
MDCOL=CTOD('  /  /  ')
@ 11,13 SAY 'PLOT SIZE:' GET MPS PICT '999999'
@ 11,38 SAY 'NUMBER OF TREES:' GET MNT PICT '999'
@ 13,13 SAY 'YEAR OF PLANTING:' GET MYP PICT '9999'
@ 13,38 SAY 'DATE OF RECORDING:' GET MDCOL
@ 15,20 SAY 'RECORDER:' GET MREC PICT '@!'
READ
@ 17,21 TO 19,58
@ 18,23 SAY '[S]AVE   OR   [A]BANDON    ...'
CHOICE3=0
DO WHIL CHOICE3=0
 CHOICE3=INKEY()
 IF UPPE(CHR(CHOICE3))$'SA'
  EXIT
 ENDI
 CHOICE3=0
ENDD
IF UPPE(CHR(CHOICE3))='S'
 APPE BLAN
 REPL PLN WITH MPLN
 REPL NT WITH MNT
 REPL YP WITH MYP
```

```
   REPL PS WITH MPS
   REPL REC WITH MREC
   REPL DCOL WITH MDCOL
  ENDI
ENDD
CLOS ALL
CLEA
RETU
```

PLOT2.PRG

```
USE PLOT
INDE ON PLN TO PLOT
DO WHIL .T.
  CLEA
  @ 4,11 TO 20,68
  @ 5,24 TO 7,54
  @ 6,26 SAY 'PLOT DATA MODIFICATION FORM'
  MPLN='      '
  @ 9,13 SAY 'PLOT NUMBER (OR PRESS '+CHR(17)+CHR(196)+CHR(217)+'):' GET
MPLN PICT '99/9999'
  READ
  IF MPLN='      '
   EXIT
  ENDI
  SEEK MPLN
  IF .NOT. FOUN()
   @ 17,20 TO 19,59
   @ 18,22 SAY 'ILLEGAL PLOT NUMBER - PRESS ANY KEY'
   SET CONS OFF
   WAIT
   SET CONS ON
   LOOP
```

```
 ENDI
 MNT=NT
 MYP=YP
 MPS=PS
 MREC=REC
 MDCOL=DCOL
 @ 11,13 SAY 'PLOT SIZE:' GET MPS PICT '999999'
 @ 11,38 SAY 'NUMBER OF TREES:' GET MNT PICT '999'
 @ 13,13 SAY 'YEAR OF PLANTING:' GET MYP PICT '9999'
 @ 13,38 SAY 'DATE OF RECORDING:' GET MDCOL
 @ 15,20 SAY 'RECORDER:' GET MREC PICT '@!'
 READ
 @ 17,21 TO 19,58
 @ 18,23 SAY '[S]AVE   OR   [A]BANDON   ...'
 CHOICE3=0
 DO WHIL CHOICE3=0
  CHOICE3=INKEY()
  IF UPPE(CHR(CHOICE3))$'SA'
   EXIT
  ENDI
  CHOICE3=0
 ENDD
 IF UPPE(CHR(CHOICE3))='S'
  REPL NT WITH MNT
  REPL YP WITH MYP
  REPL PS WITH MPS
  REPL REC WITH MREC
  REPL DCOL WITH MDCOL
 ENDI
ENDD
CLOS ALL
CLEA
RETU
```

PLOT3.PRG

```
CLEA
USE PLOT
@ 0,5 TO 24,74
@ 1,27 TO 3,52
@ 2,29 SAY 'PLOT DATA LISTING FORM'
@ 4,6 TO 4,73
@ 5,7 SAY 'PLOT NO'
@ 5,17 SAY 'PLOT SIZE'
@ 5,29 SAY 'NO OF TREES'
@ 5,43 SAY 'PLANTING YEAR'
@ 5,59 SAY 'RECORDING DATE'
@ 6,6 TO 6,73
@ 22,6 TO 22,73
ROW=6
DO WHIL .NOT. EOF()
 ROW=ROW+1
 MPLN=PLN
 MNT=NT
 MYP=YP
 MPS=PS
 MDCOL=DCOL
 @ ROW,7 SAY MPLN
 @ ROW,18 SAY MPS PICT '999999'
 @ ROW,32 SAY MNT PICT '999'
 @ ROW,47 SAY MYP PICT '9999'
 @ ROW,62 SAY MDCOL
 SKIP
 IF EOF()
  @ 23,23 SAY 'IT IS END OF FILE - PRESS ANY KEY'
  SET CONS OFF
  WAIT
  SET CONS ON
```

```
   EXIT
  ENDI
  IF ROW=21
   @ 23,25 SAY 'PRESS ANY KEY TO CONTINUE'
   SET CONS OFF
   WAIT
   SET CONS ON
   @ 6,6 CLEA TO 21,73
   @ 23,15 CLEA TO 23,64
   ROW=6
  ENDI
ENDD
CLOS ALL
CLEA
RETU
```

PLOT4.PRG

```
USE PLOT
INDE ON PLN TO PLOT
DO WHIL .T.
  CLEA
  @ 4,11 TO 20,68
  @ 5,26 TO 7,52
  @ 6,28 SAY 'PLOT DATA DELETION FORM'
  MPLN='      '
  @ 9,13 SAY 'PLOT NUMBER (OR PRESS '+CHR(17)+CHR(196)+CHR(217)+'):' GET
MPLN PICT '99/9999'
  READ
  IF MPLN='      '
   EXIT
  ENDI
  SEEK MPLN
```

```
IF .NOT. FOUN()
 @ 17,20 TO 19,59
 @ 18,22 SAY 'ILLEGAL PLOT NUMBER - PRESS ANY KEY'
 SET CONS OFF
 WAIT
 SET CONS ON
 LOOP
ENDI
MNT=NT
MYP=YP
MPS=PS
MREC=REC
MDCOL=DCOL
@ 11,13 SAY 'PLOT SIZE:' GET MPS PICT '999999'
@ 11,38 SAY 'NUMBER OF TREES:' GET MNT PICT '999'
@ 13,13 SAY 'YEAR OF PLANTING:' GET MYP PICT '9999'
@ 13,38 SAY 'DATE OF RECORDING:' GET MDCOL
@ 15,20 SAY 'RECORDER:' GET MREC PICT '@!'
CLEA GETS
@ 17,21 TO 19,58
@ 18,23 SAY '[D]ELETE  OR  [U]NDELETE   ...'
CHOICE3=0
DO WHIL CHOICE3=0
 CHOICE3=INKEY()
 IF UPPE(CHR(CHOICE3))$'DU'
  EXIT
 ENDI
 CHOICE3=0
ENDD
@ 17,21 CLEA TO 19,58
IF UPPE(CHR(CHOICE3))='D'
 DELE
 PACK
 @ 17,21 TO 19,58
```

```
  @ 18,23 SAY 'RECORD IS DELETED - PRESS ANY KEY'
 ELSE
  @ 17,19 TO 19,60
  @ 18,21 SAY 'RECORD IS NOT DELETED - PRESS ANY KEY'
 ENDI
 SET CONS OFF
 WAIT
 SET CONS ON
ENDD
CLOS ALL
CLEA
RETU
```

TREE1.PRG

```
USE PLOT
INDE ON PLN TO PLOT
USE
USE TEMP
IF .NOT. EOF()
 ZAP
ENDI
USE
SELE 1
 USE PLOT INDE PLOT
SELE 2
 USE TREE
SELE 3
 USE TEMP
DO WHIL .T.
 SELE 1
 CLEA
 @ 0,25 TO 2,53
```

```
 @ 0,11 TO 24,68
 @ 22,12 TO 22,67
 @ 1,27 SAY 'TREE DATA COLLECTION FORM'
 MPLN=SPAC(7)
 @ 3,13 SAY 'PLOT NUMBER (OR PRESS '+CHR(17)+CHR(196)+CHR(217)+'):' GET
MPLN PICT '99/9999'
 READ
 IF MPLN='      '
  EXIT
 ENDI
 SEEK MPLN
 IF .NOT. FOUN()
  @ 23,17 SAY 'ILLEGAL PLOT NUMBER - PRESS ANY KEY TO PROCEED'
  SET CONS OFF
  WAIT
  SET CONS ON
  LOOP
 ENDI
 MNT=NT
 MPS=PS
 MFF=0.002
 XBAR=3.142
 @ 3,24 SAY SPAC(25)
 @ 3,24 SAY ':' GET MPLN PICT '99/9999'
 CLEA GETS
 @ 3,46 SAY 'NUMBER OF TREES:' GET MNT PICT '999'
 CLEA GETS
 @ 4,12 TO 4,67
 @ 5,21 TO 21,21
 @ 5,55 TO 21,55
 @ 5,13 SAY 'TREE NO'
 @ 5,23 SAY 'DIAMETER AT BREAST HEIGHT (DBH)'
 @ 5,57 SAY 'BASAL AREA'
 @ 6,12 TO 6,20
```

```
@ 6,22 TO 6,54
@ 6,56 TO 6,67
KNT=1
ROW=5
TOTALBA=0
SELE 3
IF .NOT. EOF()
 ZAP
ENDI
DO WHIL KNT<=MNT
 ROW=ROW+2
 MDBH=0
 MTRN='TR/'
 IF KNT<10
  MTRN=MTRN+'0'
 ENDI
 MTRN=MTRN+LTRI(STR(KNT))
 @ ROW,14 SAY MTRN
 @ ROW,35 GET MDBH PICT '999.9'
 READ
 MBA=XBAR*MDBH^2/4
 @ ROW,60 SAY MBA PICT '9,999.9'
 TOTALBA=TOTALBA+MBA
 APPE BLAN
 REPL PLN WITH MPLN
 REPL TRN WITH MTRN
 REPL DBH WITH MDBH
 REPL BA WITH MBA
 KNT=KNT+1
 IF KNT>MNT
  @ 23,17 SAY 'DBH ENTRY COMPLETED - PRESS ANY KEY TO PROCEED'
  SET CONS OFF
  WAIT
  SET CONS ON
```

```
  @ 5,12 CLEA TO 21,67
  EXIT
 ENDI
 IF ROW=21
  @ 23,28 SAY 'PRESS ANY KEY TO PROCEED'
  SET CONS OFF
  WAIT
  SET CONS ON
  @ 7,12 CLEA TO 21,20
  @ 7,22 CLEA TO 21,54
  @ 7,56 CLEA TO 21,67
  @ 23,23 SAY SPAC(36)
  ROW=5
 ENDI
ENDD
CLOS ALL
@ 22,12 CLEA TO 23,67
@ 9,14 TO 18,65
@ 11,16 SAY 'SAMPLE TREES = 16 TREES WITH LARGEST BASAL AREA'
@ 13,17 SAY 'TO PROVIDE MERCHANTABLE HEIGHT OF THESE TREES'
@ 16,26 SAY 'PRESS ANY KEY TO PROCEED !!!'
SET CONS OFF
WAIT
SET CONS ON
USE TEMP
SORT ON BA/D TO TEMP2
KNT=1
USE
SELE 1
 USE PLOT INDE PLOT
SELE 2
 USE TREE
SELE 3
 USE TEMP
```

```
SELE 4
 USE TEMP2
CLEA
@ 0,25 TO 2,53
@ 0,3 TO 24,76
@ 22,4 TO 22,75
@ 1,27 SAY 'TREE DATA COLLECTION FORM'
@ 3,5 SAY 'PLOT NUMBER:' GET MPLN
@ 3,54 SAY 'NUMBER OF TREES:' GET MNT PICT '999'
CLEA GETS
@ 4,4 TO 4,75
@ 5,13 TO 21,13
@ 5,31 TO 21,31
@ 5,59 TO 21,59
@ 5,5 SAY 'TREE NO'
@ 5,15 SAY 'BASAL AREA'
@ 5,33 SAY 'MERCHANTABLE HEIGHT (MCH)'
@ 5,61 SAY 'VOLUME OF TREE'
@ 6,4 TO 6,12
@ 6,14 TO 6,30
@ 6,32 TO 6,58
@ 6,60 TO 6,75
KNT=1
ROW=5
SAMPLEVOL=0
MSBA=0
SELE 4
DO WHIL KNT<=16
 ROW=ROW+2
 MMCH=0
 MTRN=TRN
 MBA=BA
 MSBA=MSBA+MBA
 @ ROW,6 SAY MTRN
```

```
 @ ROW,16 SAY MBA PICT '9,999.9'
 @ ROW,40 GET MMCH PICT '999.9'
 READ
 MVOL=MBA*MMCH*MFF
 @ ROW,65 SAY MVOL PICT '9,999.9'
 SAMPLEVOL=SAMPLEVOL+MVOL
 REPL MCH WITH MMCH
 REPL VOL WITH MVOL
 SKIP
 KNT=KNT+1
 IF KNT>16
  @ 23,17 SAY 'MCH ENTRY COMPLETED - PRESS ANY KEY TO PROCEED'
  SET CONS OFF
  WAIT
  SET CONS ON
  @ 23,15 CLEA TO 23,64
  EXIT
 ENDI
 IF ROW=21
  @ 23,26 SAY 'PRESS ANY KEY TO PROCEED'
  SET CONS OFF
  WAIT
  SET CONS ON
  @ 7,4 CLEA TO 7,12
  @ 7,14 CLEA TO 21,30
  @ 7,32 CLEA TO 21,58
  @ 7,60 CLEA TO 21,75
  @ 23,23 SAY SPAC(40)
  ROW=5
 ENDI
ENDD
MPVOL=TOTALBA*SAMPLEVOL/MSBA
@ 23,23 SAY '[S]AVE   OR   [A]BANDON   ...'
CHOICE3=0
```

```
 DO WHIL CHOICE3=0
  CHOICE3=INKEY()
  IF UPPE(CHR(CHOICE3))$'SA'
   EXIT
  ENDI
  CHOICE3=0
 ENDD
 IF UPPE(CHR(CHOICE3))='S'
  SELE 1
  REPL TBA WITH TOTALBA
  REPL SBA WITH MSBA
  REPL SVOL WITH SAMPLEVOL
  REPL PVOL WITH MPVOL
  CLOS ALL
  USE TREE
  APPE FROM TEMP2.DBF
  USE TEMP
  ZAP
  USE TEMP2
  ZAP
  USE
 ENDI
 SELE 1
  USE PLOT INDE PLOT
 SELE 2
  USE TREE
 SELE 3
  USE TEMP
ENDD
CLOS ALL
ERAS TEMP2.DBF
CLEA
RETU
```

TREE2.PRG

```
USE PLOT
INDE ON PLN TO PLOT
USE TREE
INDE ON PLN TO TREE
USE
USE TEMP
IF .NOT. EOF()
 ZAP
ENDI
USE
SELE 1
 USE PLOT INDE PLOT
SELE 2
 USE TREE INDE TREE
SELE 3
 USE TEMP
DO WHIL .T.
 SELE 1
 CLEA
 @ 0,21 TO 2,57
 @ 0,11 TO 24,68
 @ 22,12 TO 22,67
 @ 1,23 SAY 'TREE DATA MODIFICATION FORM - DBH'
 MPLN=SPAC(7)
 @ 3,13 SAY 'PLOT NUMBER (OR PRESS '+CHR(17)+CHR(196)+CHR(217)+'):' GET
MPLN PICT '99/9999'
 READ
 IF MPLN='      '
  EXIT
 ENDI
 SEEK MPLN
```

```
IF .NOT. FOUN()
 @ 23,17 SAY 'ILLEGAL PLOT NUMBER - PRESS ANY KEY TO PROCEED'
 SET CONS OFF
 WAIT
 SET CONS ON
 LOOP
ENDI
MNT=NT
MPS=PS
MFF=0.002
XBAR=MPS/MNT
@ 3,24 SAY SPAC(25)
@ 3,24 SAY ':' GET MPLN PICT '99/9999'
CLEA GETS
@ 3,46 SAY 'NUMBER OF TREES:' GET MNT PICT '999'
CLEA GETS
@ 4,12 TO 4,67
@ 5,21 TO 21,21
@ 5,55 TO 21,55
@ 5,13 SAY 'TREE NO'
@ 5,23 SAY 'DIAMETER AT BREAST HEIGHT (DBH)'
@ 5,57 SAY 'BASAL AREA'
@ 6,12 TO 6,20
@ 6,22 TO 6,54
@ 6,56 TO 6,67
KNT=1
ROW=5
TOTALBA=0
SELE 3
IF .NOT. EOF()
 ZAP
ENDI
DO WHIL KNT<=MNT
 ROW=ROW+2
```

```
SELE 2
IF .NOT. EOF()
 MDBH=DBH
 MTRN=TRN
 MBA=BA
 SKIP
 @ ROW,60 SAY MBA PICT '9,999.9'
ELSE
 MDBH=0
 MTRN='TR/'
 IF KNT<10
  MTRN=MTRN+'0'
 ENDI
 MTRN=MTRN+LTRI(STR(KNT))
ENDI
@ ROW,14 SAY MTRN
@ ROW,35 GET MDBH PICT '999.9'
READ
MBA=XBAR*MDBH^2/4
@ ROW,60 SAY MBA PICT '9,999.9'
TOTALBA=TOTALBA+MBA
SELE 3
APPE BLAN
REPL PLN WITH MPLN
REPL TRN WITH MTRN
REPL DBH WITH MDBH
REPL BA WITH MBA
KNT=KNT+1
IF KNT>MNT
 @ 23,17 SAY 'DBH ENTRY COMPLETED - PRESS ANY KEY TO PROCEED'
 SET CONS OFF
 WAIT
 SET CONS ON
 @ 5,12 CLEA TO 21,67
```

```
  EXIT
 ENDI
 IF ROW=21
  @ 23,28 SAY 'PRESS ANY KEY TO PROCEED'
  SET CONS OFF
  WAIT
  SET CONS ON
  @ 7,12 CLEA TO 21,20
  @ 7,22 CLEA TO 21,54
  @ 7,56 CLEA TO 21,67
  @ 23,23 SAY SPAC(36)
  ROW=5
 ENDI
ENDD
CLOS ALL
@ 22,12 CLEA TO 23,67
@ 9,14 TO 18,65
@ 11,16 SAY 'SAMPLE TREES = 16 TREES WITH LARGEST BASAL AREA'
@ 13,17 SAY 'TO PROVIDE MERCHANTABLE HEIGHT OF THESE TREES'
@ 16,26 SAY 'PRESS ANY KEY TO PROCEED !!!'
SET CONS OFF
WAIT
SET CONS ON
USE TEMP
SORT ON BA/D TO TEMP2
KNT=1
USE
SELE 1
 USE PLOT INDE PLOT
SELE 2
 USE TREE
SELE 3
 USE TEMP
SELE 4
```

```
 USE TEMP2
CLEA
@ 0,21 TO 2,57
@ 0,3 TO 24,76
@ 22,4 TO 22,75
@ 1,23 SAY 'TREE DATA MODIFICATION FORM - MCH'
@ 3,5 SAY 'PLOT NUMBER:' GET MPLN
@ 3,54 SAY 'NUMBER OF TREES:' GET MNT PICT '999'
CLEA GETS
@ 4,4 TO 4,75
@ 5,13 TO 21,13
@ 5,31 TO 21,31
@ 5,59 TO 21,59
@ 5,5 SAY 'TREE NO'
@ 5,15 SAY 'BASAL AREA'
@ 5,33 SAY 'MERCHANTABLE HEIGHT (MCH)'
@ 5,61 SAY 'VOLUME OF TREE'
@ 6,4 TO 6,12
@ 6,14 TO 6,30
@ 6,32 TO 6,58
@ 6,60 TO 6,75
KNT=1
ROW=5
SAMPLEVOL=0
MSBA=0
SELE 4
DO WHIL KNT<=16
 ROW=ROW+2
 SELE 2
 IF .NOT. EOF()
  MMCH=MCH
  SKIP
  SELE 4
 ELSE
```

```
 MMCH=0
ENDI
MTRN=TRN
MBA=BA
MSBA=MSBA+MBA
@ ROW,6 SAY MTRN
@ ROW,16 SAY MBA PICT '9,999.9'
@ ROW,40 GET MMCH PICT '999.9'
READ
MVOL=MBA*MMCH*MFF
@ ROW,65 SAY MVOL PICT '9,999.9'
SAMPLEVOL=SAMPLEVOL+MVOL
REPL MCH WITH MMCH
REPL VOL WITH MVOL
SKIP
KNT=KNT+1
IF KNT>16
 @ 23,17 SAY 'MCH ENTRY COMPLETED - PRESS ANY KEY TO PROCEED'
 SET CONS OFF
 WAIT
 SET CONS ON
 @ 23,15 CLEA TO 23,64
 EXIT
ENDI
IF ROW=21
 @ 23,26 SAY 'PRESS ANY KEY TO PROCEED'
 SET CONS OFF
 WAIT
 SET CONS ON
 @ 7,4 CLEA TO 7,12
 @ 7,14 CLEA TO 21,30
 @ 7,32 CLEA TO 21,58
 @ 7,60 CLEA TO 21,75
 @ 23,23 SAY SPAC(40)
```

```
   ROW=5
  ENDI
ENDD
MPVOL=TOTALBA*SAMPLEVOL/MSBA
@ 23,23 SAY '[S]AVE   OR   [A]BANDON   ...'
CHOICE3=0
DO WHIL CHOICE3=0
  CHOICE3=INKEY()
  IF UPPE(CHR(CHOICE3))$'SA'
    EXIT
  ENDI
  CHOICE3=0
ENDD
IF UPPE(CHR(CHOICE3))='S'
  SELE 1
  REPL TBA WITH TOTALBA
  REPL SBA WITH MSBA
  REPL SVOL WITH SAMPLEVOL
  REPL PVOL WITH MPVOL
  CLOS ALL
  USE TREE
  DELE ALL FOR PLN=MPLN
  PACK
  APPE FROM TEMP2.DBF
  USE TEMP
  ZAP
  USE TEMP2
  ZAP
  USE
ENDI
SELE 1
  USE PLOT INDE PLOT
SELE 2
  USE TREE
```

```
 SELE 3
  USE TEMP
ENDD
CLOS ALL
ERAS TEMP2.DBF
CLEA
RETU
```

TREE3.PRG

```
USE PLOT
INDE ON PLN TO PLOT
USE TREE
INDE ON PLN TO TREE
USE
USE TEMP
IF .NOT. EOF()
 ZAP
ENDI
USE
SELE 1
 USE PLOT INDE PLOT
SELE 2
 USE TREE INDE TREE
SELE 3
 USE TEMP
DO WHIL .T.
 SELE 1
 CLEA
 @ 0,21 TO 2,57
 @ 0,11 TO 24,68
 @ 22,12 TO 22,67
 @ 1,23 SAY 'TREE DATA MODIFICATION FORM - DBH'
```

```
 MPLN=SPAC(7)
 @ 3,13 SAY 'PLOT NUMBER (OR PRESS '+CHR(17)+CHR(196)+CHR(217)+'):' GET
MPLN PICT '99/9999'
 READ
 IF MPLN='      '
  EXIT
 ENDI
 SEEK MPLN
 IF .NOT. FOUN()
  @ 23,17 SAY 'ILLEGAL PLOT NUMBER - PRESS ANY KEY TO PROCEED'
  SET CONS OFF
  WAIT
  SET CONS ON
  LOOP
 ENDI
 MNT=NT
 MPS=PS
 MFF=0.002
 XBAR=MPS/MNT
 @ 3,24 SAY SPAC(25)
 @ 3,24 SAY ':' GET MPLN PICT '99/9999'
 CLEA GETS
 @ 3,46 SAY 'NUMBER OF TREES:' GET MNT PICT '999'
 CLEA GETS
 @ 4,12 TO 4,67
 @ 5,21 TO 21,21
 @ 5,55 TO 21,55
 @ 5,13 SAY 'TREE NO'
 @ 5,23 SAY 'DIAMETER AT BREAST HEIGHT (DBH)'
 @ 5,57 SAY 'BASAL AREA'
 @ 6,12 TO 6,20
 @ 6,22 TO 6,54
 @ 6,56 TO 6,67
 KNT=1
```

```
ROW=5
TOTALBA=0
SELE 3
IF .NOT. EOF()
 ZAP
ENDI
DO WHIL KNT<=MNT
 ROW=ROW+2
 SELE 2
 IF .NOT. EOF()
  MDBH=DBH
  MTRN=TRN
  MBA=BA
  SKIP
  @ ROW,60 SAY MBA PICT '9,999.9'
 ELSE
  MDBH=0
  MTRN='TR/'
  IF KNT<10
   MTRN=MTRN+'0'
  ENDI
  MTRN=MTRN+LTRI(STR(KNT))
 ENDI
 @ ROW,14 SAY MTRN
 @ ROW,35 GET MDBH PICT '999.9'
 READ
 MBA=XBAR*MDBH^2/4
 @ ROW,60 SAY MBA PICT '9,999.9'
 TOTALBA=TOTALBA+MBA
 SELE 3
 APPE BLAN
 REPL PLN WITH MPLN
 REPL TRN WITH MTRN
 REPL DBH WITH MDBH
```

```
 REPL BA WITH MBA
 KNT=KNT+1
 IF KNT>MNT
  @ 23,17 SAY 'DBH ENTRY COMPLETED - PRESS ANY KEY TO PROCEED'
  SET CONS OFF
  WAIT
  SET CONS ON
  @ 5,12 CLEA TO 21,67
  EXIT
 ENDI
 IF ROW=21
  @ 23,28 SAY 'PRESS ANY KEY TO PROCEED'
  SET CONS OFF
  WAIT
  SET CONS ON
  @ 7,12 CLEA TO 21,20
  @ 7,22 CLEA TO 21,54
  @ 7,56 CLEA TO 21,67
  @ 23,23 SAY SPAC(36)
  ROW=5
 ENDI
ENDD
CLOS ALL
@ 22,12 CLEA TO 23,67
@ 9,14 TO 18,65
@ 11,16 SAY 'SAMPLE TREES = 16 TREES WITH LARGEST BASAL AREA'
@ 13,17 SAY 'TO PROVIDE MERCHANTABLE HEIGHT OF THESE TREES'
@ 16,26 SAY 'PRESS ANY KEY TO PROCEED !!!'
SET CONS OFF
WAIT
SET CONS ON
USE TEMP
SORT ON BA/D TO TEMP2
KNT=1
```

```
USE
SELE 1
 USE PLOT INDE PLOT
SELE 2
 USE TREE
SELE 3
 USE TEMP
SELE 4
 USE TEMP2
CLEA
@ 0,21 TO 2,57
@ 0,3 TO 24,76
@ 22,4 TO 22,75
@ 1,23 SAY 'TREE DATA MODIFICATION FORM - MCH'
@ 3,5 SAY 'PLOT NUMBER:' GET MPLN
@ 3,54 SAY 'NUMBER OF TREES:' GET MNT PICT '999'
CLEA GETS
@ 4,4 TO 4,75
@ 5,13 TO 21,13
@ 5,31 TO 21,31
@ 5,59 TO 21,59
@ 5,5 SAY 'TREE NO'
@ 5,15 SAY 'BASAL AREA'
@ 5,33 SAY 'MERCHANTABLE HEIGHT (MCH)'
@ 5,61 SAY 'VOLUME OF TREE'
@ 6,4 TO 6,12
@ 6,14 TO 6,30
@ 6,32 TO 6,58
@ 6,60 TO 6,75
KNT=1
ROW=5
SAMPLEVOL=0
MSBA=0
SELE 4
```

```
DO WHIL KNT<=16
 ROW=ROW+2
 SELE 2
 IF .NOT. EOF()
  MMCH=MCH
  SKIP
  SELE 4
 ELSE
  MMCH=0
 ENDI
 MTRN=TRN
 MBA=BA
 MSBA=MSBA+MBA
 @ ROW,6 SAY MTRN
 @ ROW,16 SAY MBA PICT '9,999.9'
 @ ROW,40 GET MMCH PICT '999.9'
 READ
 MVOL=MBA*MMCH*MFF
 @ ROW,65 SAY MVOL PICT '9,999.9'
 SAMPLEVOL=SAMPLEVOL+MVOL
 REPL MCH WITH MMCH
 REPL VOL WITH MVOL
 SKIP
 KNT=KNT+1
 IF KNT>16
  @ 23,17 SAY 'MCH ENTRY COMPLETED - PRESS ANY KEY TO PROCEED'
  SET CONS OFF
  WAIT
  SET CONS ON
  @ 23,15 CLEA TO 23,64
  EXIT
 ENDI
 IF ROW=21
  @ 23,26 SAY 'PRESS ANY KEY TO PROCEED'
```

```
   SET CONS OFF
   WAIT
   SET CONS ON
   @ 7,4 CLEA TO 7,12
   @ 7,14 CLEA TO 21,30
   @ 7,32 CLEA TO 21,58
   @ 7,60 CLEA TO 21,75
   @ 23,23 SAY SPAC(40)
   ROW=5
  ENDI
ENDD
MPVOL=TOTALBA*SAMPLEVOL/MSBA
@ 23,23 SAY '[S]AVE   OR   [A]BANDON   ...'
CHOICE3=0
DO WHIL CHOICE3=0
  CHOICE3=INKEY()
  IF UPPE(CHR(CHOICE3))$'SA'
   EXIT
  ENDI
  CHOICE3=0
ENDD
IF UPPE(CHR(CHOICE3))='S'
  SELE 1
  REPL TBA WITH TOTALBA
  REPL SBA WITH MSBA
  REPL SVOL WITH SAMPLEVOL
  REPL PVOL WITH MPVOL
  CLOS ALL
  USE TREE
  DELE ALL FOR PLN=MPLN
  PACK
  APPE FROM TEMP2.DBF
  USE TEMP
  ZAP
```

```
   USE TEMP2
   ZAP
   USE
  ENDI
  SELE 1
   USE PLOT INDE PLOT
  SELE 2
   USE TREE
  SELE 3
   USE TEMP
ENDD
CLOS ALL
ERAS TEMP2.DBF
CLEA
RETU
```

TREE4.PRG

```
USE PLOT
INDE ON PLN TO PLOT
USE TREE
INDE ON PLN TO TREE
USE
USE TEMP
IF .NOT. EOF()
  ZAP
ENDI
USE
SELE 1
  USE PLOT INDE PLOT
SELE 2
  USE TREE INDE TREE
DO WHIL .T.
```

```
SELE 1
CLEA
@ 0,26 TO 2,52
@ 0,11 TO 24,68
@ 22,12 TO 22,67
@ 1,28 SAY 'TREE DATA DELETION FORM'
MPLN=SPAC(7)
@ 3,13 SAY 'PLOT NUMBER (OR PRESS '+CHR(17)+CHR(196)+CHR(217)+'):' GET
MPLN PICT '99/9999'
READ
IF MPLN='      '
 EXIT
ENDI
SEEK MPLN
IF .NOT. FOUN()
 @ 23,17 SAY 'ILLEGAL PLOT NUMBER - PRESS ANY KEY TO PROCEED'
 SET CONS OFF
 WAIT
 SET CONS ON
 LOOP
ENDI
MNT=NT
MPS=PS
MFF=0.002
XBAR=MPS/MNT
@ 3,24 SAY SPAC(25)
@ 3,24 SAY ':' GET MPLN PICT '99/9999'
CLEA GETS
@ 3,46 SAY 'NUMBER OF TREES:' GET MNT PICT '999'
CLEA GETS
@ 4,12 TO 4,67
@ 5,21 TO 21,21
@ 5,55 TO 21,55
@ 5,13 SAY 'TREE NO'
```

```
    CHOICE3=INKEY()
    IF UPPE(CHR(CHOICE3))$'DU'
     EXIT
    ENDI
    CHOICE3=0
  ENDD
  IF UPPE(CHR(CHOICE3))='D'
    SELE 1
    REPL TBA WITH 0
    REPL SBA WITH 0
    REPL SVOL WITH 0
    REPL PVOL WITH 0
    SELE 2
    DELE ALL FOR PLN=MPLN
    PACK
    USE
  ENDI
ENDD
CLOS ALL
CLEA
RETU
_
```