APPLICATION OF ARTIFICIAL INTELLIGENCE

IN DISEASE DIAGNOSIS OF

FISHES IN THE TROPICS AND ECONOMIC MANAGEMENT OF

FISH FARM

BY

ALADETOYINBO LAWRENCE ADEYEMI WILLIAMS

*(PGD/MCS/97/272)*

A PROJECT SUBMITTED TO

THE DEPARTMENT OF MATHS. / COMPUTER SCIENCE,

SCHOOL OF SCIENCE AND SCIENCE EDUCATION,

FEDERAL UNIVERSITY OF TECHNOLOGY,

MINNA, NIGER STATE.

IN PARTIAL FULFILMENT OF THE

REQUIREMENTS FOR THE AWARD OF

POSTGRADUATE DIPLOMA *(PGD)* IN COMPUTER SCIENCE.

SEPTEMBER, 2001.

# CHAPTER THREE

# CHAPTER FOUR

# CHAPTER FIVE

APPLICATION OF ARTIFICIAL INTELLIGENCE

IN DISEASE DIAGNOSIS OF

FISHES IN THE TROPICS AND ECONOMIC MANAGEMENT OF

FISH FARM


BY


ALADETOYINBO LAWRENCE ADEYEMI WILLIAMS

(PGD/MCS/97/272)


A PROJECT SUBMITTED TO


THE DEPARTMENT OF MATHS. / COMPUTER SCIENCE,

SCHOOL OF SCIENCE AND SCIENCE EDUCATION,

FEDERAL UNIVERSITY OF TECHNOLOGY,

MINNA, NIGER STATE.


IN PARTIAL FULFILMENT OF THE

REQUIREMENTS FOR THE AWARD OF

POSTGRADUATE DIPLOMA (*PGD*) IN COMPUTER SCIENCE.


SEPTEMBER, 2001.

# CERTIFICATION

I certify that this work was carried out by **Aladetoyinbo**
Lawrence Adeyemi Williams of the Maths. / Computer
Department, Federal University of technology, Minna.

_____        _____

**PROFESSOR K. R. ADEBOYE**        DATE

*(SUPERVISOR)*

_____        _____

**DR. S. A. REJU**        DATE

*(HEAD OF DEPARTMENT)*

_____        _____

**EXTERNAL EXAMINAR**        DATE

# DEDICATION

To all those who make living easier through computer evolution and advancement.

# ACKNOWLEDGEMENTS

I am most grateful to my supervisor, Professor K. R. Adeboye. His advice and constructive criticism in the course of producing this work helped a lot.

My thanks also go to the Head of Department Maths. / Computer Department, Dr. S. A. Reju and all other lecturers in the Department. One way or the other, they have contributed in an immeasurable way to the success of my academic sojourn in this citadel of learning, more especially towards the success of this project.

My Uncle, Hon. Justice S. E. Aladetoyinbo, friends and all others who have contributed in their own ways to the success of this project are all acknowledged.

For everything, glory is to God.

# LIST OF FIGURES AND TABLES

# ABSTRACT

Fish farming is a cardinal aspect in agricultural practices in the Tropics. Apart from being an excellent source of protein and a recreational exercise, it could as well serve as a source of income to farmers, agricultural institutes and the Government.

With the precarious nature of the business, indept knowledge is needed particularly in the area of disease management. Being a device of high versatility, computer, particularly the aspect of Artificial Intelligence (AI), can be employed for this purpose. It will offer experts' advice to successfully manage the farm - in this respect, it will help in diagnosing diseases, recommend appropriate drug and preventive measures, provide consultancy services in fish pond management and establishment.

To this end, the computer will be programmed using *dBase IV*, a powerful example of *Database Management System* (DMS), which provides a full relational database environment.

The scope of the project is restricted to only a few, but important fish diseases and problems related to fish in the tropics. This is due to the vastness and complexity of fish farm management. However, the system is designed in such a way to allow for future expansion of the scope.

# CHAPTER ONE

## 1.0   INTRODUCTION

## 1.1   A REVIEW OF FISH FARMING IN THE TROPICS

Fish farming involves capturing immature specimens and then raising them under optimal condition in which they were well fed and protected from predators and competitors to attain maturity.

In the past, fishing in the wild has been the only source of fish for man. Therefore, the use of natural free - standing ponds and lakes for keeping fish is the basis of the most ancient types of fish farming.

As the human population increased and the problem of food shortage presented itself, people had to device other means of increasing food supply.

Though very vast and expanse with multitude of fish and other aquatic species, the water ecosystem has been mismanaged and overexploited by man while some fish species and other marine stock have greatly depreciated even to the point of extinction. Cushing D. H. (1977).

In order to produce more fish for consumption, a method of rearing fish domestically was devised.

According to the encyclopedia Britanica (1982), the practice of rearing fish started long before 1400 BC as Egyptian drawings attest. Carp species in particular have been raised in ponds for several

thousand years in China and India. However, it was not until 1733 that a German farmer successfully raised fish from eggs that he had artificially obtained and fertilized. This appeared to be the beginning of scientific fish breeding and cultivation.

At that time, much attention was not given to the type of fish species being reared. Nutritional requirements of the fish, water management and diseases control were not equally given attention.

Also, there was no regulation over the pattern of breeding and growth of the species. This becomes a critical factor when a prolific breeder, such as <u>Tilapia</u>, is raised. It could lead to overpopulation and subsequently, competition for resources. As a result, the fish would not attain the growth target. Paul Bryant <u>et</u> <u>al</u> (1986).

Over the last fifty years the popularity of fish farming in the tropics has swiftly increased. Therefore most of the culture ponds in use today are to some degree artificial and the water supply not necessarily river or stream but could be spring, even borehole. This meteoric rise has been linked with advances in aquatic biology and the search for alternative food sources, together with increasing pressure from leisure pursuits. Bryant <u>et</u> <u>al</u> (1986).

Fish are produced not only for food but also for the extensive tropical and sport fish markets as well as tourism. Lowe - McConnell (1977).

By the end of the last century, fish culture contributes not less than 5 million tones of fish to the total world catch each year. This is about 6% of the annual global fish harvest. With the advent of modern farming techniques, there has been a considerable improvement in the yield from fish farm all over the tropics. Bryant et al. (1986).

Today, before a fish species is raised, it has to be rated in the background of its breeding and growth rates, hardiness, ability to breed in captivity, ability to tolerate wide range of changes in ecological parameters, food conversion co - efficient and its susceptibility to diseases and parasitic infections among other considerations.

Researches on the susceptibility of fish for farming are being carried out in Africa (in particular Cameroun) and South America. Lowe McConnell (1977).

Being a high fecundity animal, a fish can lay as much as 10 million eggs in a year. This will of course lead to overpopulation considering the degree of natural productivity of our waters in the tropics. Cushing (1977). The problem is tackled today by co - stocking predatory fishes, such as Clarias lazera Hemichromis fasciatus and Lates niloticus, in right proportions. They will eat - up the excess fries thereby suppressing the population.

Rearing Tilapia, species, a prolific breeder, a population - control technique is today adopted by feeding the fish population with

steroid supplement diet from the fry stage. In about one month, all the females become male. This will prevent the excessive production of eggs (by female). Sinha(1993).

In fish farming, crossbreeding can be easily carried out to blend desirable traits from two species thereby improving the genetic composition of the offspring and subsequently maximizing yield.

Another aspect of fish culture in tropics that has received a relatively great improvement was that of fish nutrition. Various types of supplementary feeds are in existence, which provides the required proteins, carbohydrate, fats, vitamins and minerals. Combining these proportionally has maximized yield and made the fish attain the target weight within a short time. Some of these feeds also confer on the fish the ability to withstand certain diseases and infections.

Further improvement came in the area of water management to reduce the degree of water pollution from fish wastes and other sources. This is by introducing water-recycling system. This also removes soluble wastes such as ammonia.

In area of fish diseases, a good number of drugs are available to treat the diseases and parasitic infections. Many practices abound today which farmers can adopt to avoid incidences of infection and diseases.

It should be noted however that the construction, running and output of fish ponds is up till this moment, a subject of much investigation. Bryant et al (1986).

## 1.2 AIM AND OBJECTIVE OF THE STUDY

Today there is a growing recognition of computer science as a laboratory science and its application in solving problems and efficient accomplishment of various tasks in virtually all areas of human endeavor.

Applying computer to fish farm management will go a long way in boosting fish production for human consumption, recreation and economic purposes.

Fish is known to contain, proportionally, a greater amount of edible flesh than pigs, sheep, cattle etc. And it needs to eat a smaller quantity of food to produce this flesh. Bryant et al. (1986). Since aquacultural practices produce mainly animal protein, which is the nutritional staple in shortest supply in developing countries, considerable hope needs to be given to the practice.

Fish are known to be prone to a wide range of diseases and parasitic infections and they can only tolerate relatively small changes in their physical environment. Therefore, outbreak of a disease could lead to the destruction of the entire stock! Moreover, these diseases are not easy to diagnose particularly by layman in the field.

It can therefore be concluded that the importance of fish and fish farming can not be overemphasized.

In the light of this, it will be worthwhile if a computer package is constructed to aid fish farmers in management of their farms and guide prospective farmers to undergo a successful venture in fish farming.

The project is aimed at achieving this by primarily using *EXPERT SYSTEM* to proffer solution to the problems associated with fish farm management especially as concerned disease diagnosis, vis-à-vis symptom, causative agents, prevention and cure. In addition, the program will contain a database from which farm managers can draw necessary information in other aspects of daily running of the farm.

The database will also contain a guiding instruction for prospective farmers needed in establishing a fish farm vis-à-vis which fish to farm; the nature of soil suitable for the pond; water source; ideal feed combination to maximize yield etc.

## 1.3 ARTIFICIAL INTELLIGENCE

### *1.3.1 DEFINITION*

Though many definitions and descriptions exist of artificial intelligence, the overall consensus is concerned with automating those human activities that have not been automated before.

Artificial intelligence - A.I - can therefore be defined in the way

of Tanimoto (1987), as "a field of study that encompasses computational techniques for performing tasks that apparently require intelligence when performed by human".

## 1.3.2 *HISTORY*

In early 1940s the first electronic general-purpose computer, ENIAC, was invented by Mauchly and his associates. Up till that time computer was regarded for its speed at processing, vast memory capacity, accuracy and compactness.

In the mid-1940s, H. H. Goldstine et al conceived the idea of a computer that will operate on binary system with stored instructions internally in the machine EDSAC was then constructed, precisely in 1949. It was operating without any cognitive ability.

In 1950, the domain of study in computer science was broadened to include the possibility of transferring human "intelligence" onto a machine. This led to the birth of Artificial intelligent. Doukidis G. I. et al (1988).

In 1959, the first industrial robot was introduced by animation. It followed a sequence of motion steps determined by instructions (Program) to automatically carry out a variety of tasks at a relatively low cost.

However there are records of devices made by man, which

behaved "intelligently" as far back as fourth century. A golden Buddhist was said to sit on a carriage and tended by animated models of Taoist bowing and saluting and throwing incense into censer.

In 790AD, a wooden otter was devised in China, which was said to catch fish.

In 1879 Villiers de l'Isle Adam depicted a remarkable woman animated by electricity.

In the moment Artificial intelligence is applicable in several areas of human endeavour as industrial robots, legal advisor, medical experts, laboratory analyser e.t.c.

### 1.3.3 *AREA OF ARTIFICIAL INTELLIGENCE*

Doukidis et al (1988) subdivided artificial intelligence into three major areas. These are:

i.  *Language Communication*: This is concerned with computer understanding natural language and translating from one to another.

ii. *Environmental Manipulation*: It is primarily concerned with robots. Attention is focused on vision system, which involves how robots can examine objects and places thereby manipulating the environment in which they find themselves.

iii. *Knowledge Manipulation*: This is known as intelligent knowledge Base - IKB - or knowledge Base system - KBS. It is

concerned with manipulating information in a particular field, logically, thereby turning out a recommendation with remarkable proficiency. Expert system belongs to this area.

## 1:4  <u>EXPERT SYSTEM: AN ASPECT OF ARTIFICIAL INTELLIGENCE.</u>

Expert system is a new opportunity in computing and it is classified under the area of artificial intelligence called Intelligent Artifact or knowledge Base System (KBS).

It solves problem using knowledge culled from human experts and it restricts itself to a single domain of expertise. Thus it is domain specific oriented.

As defined by Sell (1985) and Jackson (1986), Expert system is a knowledge based system that emulates experts in a particular domain of expertise. The process of constructing the system has been termed "knowledge engineering".

The first expert system, *Dendral*, was built in the 1960s. In a typical expert system, there must exist a mechanism for navigating the knowledge base - the inference engine.

### *1.4.1  <u>FEATURES.</u>*

For an expert system to perform and solve a problem to a logical end, it must possess these features:

i. *Significant Performance Capabilities:* The system must perform at least, as well as the expert in the field. It should not be expected however to perform better than an expert. In a case it does, this is regarded as a plus to its capability.

ii. *Maintainability:* Human expertise is changing all the time as new facts, techniques and findings emerge. As such, an expert system must provide the user with a similar level of flexibility as humans in modifying its knowledge base.

iii. *Simplicity:* The system must converse with user in a manner simple enough to have a meaningful interaction and with the least difficulty in extracting solution to a problem. It must, in other word, be user - friendly.

iv. *Reasonable response time:* The program should not take an unreasonably long time between questions or producing answers to the questions. Otherwise, the old system would be preferred.

## *1.4.2    MODEL*

A typical expert system comprises a number of modules of program, which work interactively to solve problem at a particular time. Basically the expert system model consists of four parts as described by Doukidis et al (1988). These are:

i. the knowledge base

ii. the inference engine

iii. the user interface

iv. the working memory.

These days an expert system can be complex in its composition to contain some more advanced features.

A diagrammatic way of representing the relationship between the different parts is shown below.

**Fig 1. The simple expert system model (After Doukidis et al).**

```
                                          ┌─ ● Client
                                          │
                    USER ─────────────────┤  ● Expert
                       │                   │
                       │                   └─ ● Student
                       ▼
        ┌──────────────────────────────────┐
        │  ◆  Support environment          │
        │  ◆  Interface                    │
        │  ◆  File handling facility       │
        │  ◆  Explanation facility         │
        │  ◆  Knowledge base maintenance   │
        │     tool.                        │
        └──────────────────────────────────┘
                       │
                       ▼
        ┌──────────────────────────────────┐
  ◄─────┤       INFERENCE ENGINE           ├─────►
  │     └──────────────────────────────────┘     │
  │                                               │
  ▼                                               ▼
┌──────────────────┐              ┌──────────────────┐
│  KNOWLEDGE BASE  │              │  WORKING MEMORY  │
└──────────────────┘              └──────────────────┘
```
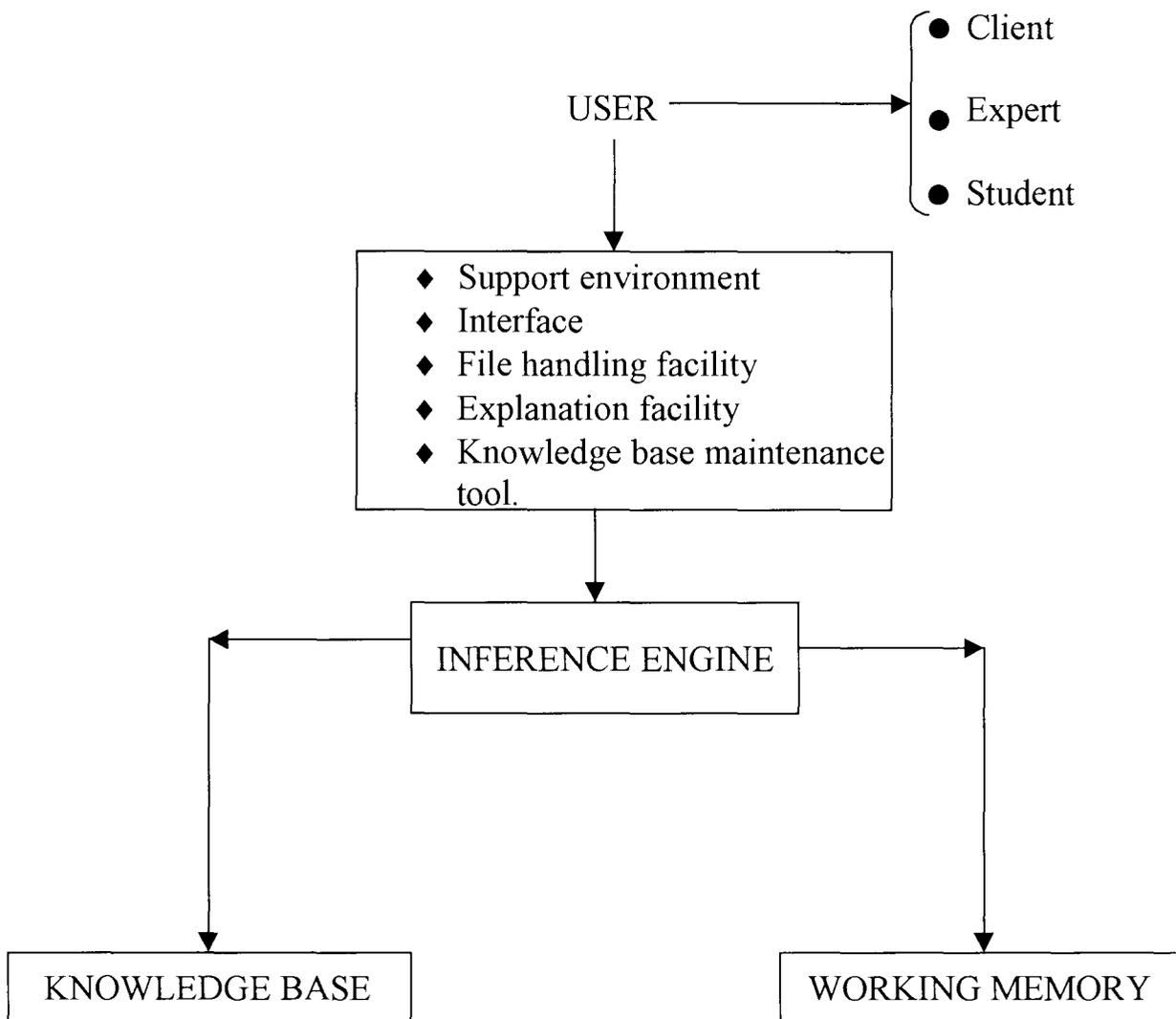
i. *The knowledge base:* This is made up of a set of files that stores the Knowledge obtained from experts - as production rules -, which the system relies on to provide the user with useful information about the domain. It is also known as **knowledge bank**.

ii. *The inference engine:* A knowledge base is of no use without an inference engine. The 'engine' manipulates the knowledge base to provide new information.

    Typically, in a production rule system, the inference engine uses some form of logical deduction to provide the answers.

iii. *The user interface:* For the expert system to be of any use, it must communicate with the user - this is done through the user interface either directly via the screen and keyboard or indirectly via external links to machines and monitoring devices e.t.c.

iv. *The working memory: This* contains details of the state of the systems knowledge at a particular time. Thus, at the start of the working, the memory is empty. As the system is used, any new fact derived by the inference engine are stored in the working memory, which increases in content during the query process.

## *1.4.3 EXAMPLE*

    The following are examples of expert system used in various domain of expertise.

**Table 1.    Example of Expert System.**

| S/NO | EXAMPLE | DOMAIN | USE |
|---|---|---|---|
| 1 | MACSYMA | Mathematics | Performs a variety of symbolic mathematical tasks. |
| 2 | MYCIN | Medicine | Prescribes treatment for infectious diseases, after gathering information about symptoms in dialog with user. |
| 3 | PROSPECTOR | Geology | Analyses geological information obtained from field observations and makes predictions about minerals that might be found at a site. |
| 4 | XCON | Computer engineering | Automatically determines optimal configurations of DEC VAX Computer system. |
| 5 | DENDRAL | Biochemistry | Identifies and enumerates all possible, but legal, Configuration of a given set of atom. It was used to identify the molecular component of the gene. |
| 6 | TAXMAN | Law | Helps the user to understand legal concepts related to taxation in a corporate environment. |
| 7 | CADUCEOUS* | Medicine | Helps physicians to diagnose diseases of the internal organs from information about a patients symptoms, medical history and laboratory tests. |

*    *The largest medical expert system developed to date.  It describes some 500 diseases.*

13

# CHAPTER TWO

## *2.0   THE PROJECT IN BROAD PERSPECTIVE*

## 2.1   <u>COST IMPLICATION OF NEW SYSTEM</u>

For the new system (computerized) to perform, it is important to acquire the list of some computer components, and their respective cost. Shown below is the list of such components.

**Table 2.      Requirement Specification of the New System**

| COMPONENT | DESCRIPTION | COST (₦) |
|---|---|---|
| Monitor | SVGA (colored) | 16, 000 |
| Keyboard | Enhanced | 1, 500 |
| Hard disk | 4.2 GB | 10, 500 |
| Printer | HP DeskJet 690C | 22, 000 |
| Uninterrupted Power Supply Unit (UPS) | 600VA Best | 19, 000 |
| Voltage Regulator | Sorex 1000 - 50 Hz 220 V Ac | 3, 500 |
| Floppy Disk Drive | 3.5 inches | 4, 500 |
| Random Access Memory (RAM) | 32 MB (SDRAM) | 2, 000 |
| VGA Card | 4 MEG PCI | 2, 000 |
| Diskette | 3.5 inches (2 packs) | 1, 000 |
| Paper | A4 size (2 Packs) | 1, 000 |
| CPU Casing | ATX Minitower | 3, 700 |
| Ink Cartridge | Colored | 2, 500 |
| Empty Motherboard | Pentium with 512K Cache memory | 8, 000 |
| Processor | Pentium II 450 MHz | 12, 500 |
| Software Development (Programming) | Using *dBase4* | 10, 000 |

## 2.2 FISH DISEASES AND MANAGEMENT

Fish, like other animals are affected by myriad of diseases, which manifest with various symptoms. The subject of fish disease is a complex one considering the diversification in type, symptom and geographical distribution.

The farmer must be familiar with the symptoms of at least a few of these diseases, for it is certain that he will encounter some of them at one time or another. Some are easily identified, others, much difficult, still more, some with virtually no symptom but only a sudden decimation of the fish population! However, diagnosis becomes easier with experience.

Basically there are four types of organism responsible for diseases in fish. These are Fungi, Bacteria, Viruses and Parasites.

Incidences of virus should be reported to the local Veterinary surgeon, as some drastic measures need to be taken to curb the spread of the disease and any possible re-occurrence. Most often the entire stock is destroyed. Cases of bacteria infection too need to be reported.

Any fish that died "naturally" should be examined immediately, both internally and externally to ascertain the cause and prevent any re-occurrence.

If the water is sourced from river or stream care should be taken to screen out any 'wild' fish which mostly accommodate a host of diseases and parasites. The water should be well treated if needs be.

It was established that a deficiency of some of the food sources, particularly Vitamins, in fish diet leads to the appearance of characteristic deficiency symptoms. Some of these symptoms are exactly like those of parasitic or disease infections. Thus, the farmer may find it difficult to contradistinguish between the symptoms from an infection and food deficiency symptoms.

To tackle such problem, the program is made to diagnose any disease after sufficiently querying the nature and nutritional content of the food fed to the affected fish. At the end, both treatment and deficient food sources are recommended.

### 2.2.1 *MAINTANING A DISEASE-FREE POND*

A good way of ensuring a disease free pond is by liming (application of lime). Lime is best applied to a pond before it is put under water for the growing season. It serves as a preliminary treatment before stocking.

Every new batch of fish brought into the farm should go through a quarantine period when they are kept separate from the other fish and observed for any possible disease before being released into the pond.

Good hygiene is also essential, for dirty equipment and habits transmit diseases to the fish. Farmers are advised to clean and disinfect the farm tools-buckets, tanks, nets, and boots, gloves e.t.c- with dilute bleach or commercial disinfectant. 10% solution of sodium hydroxide (caustic soda) is very good and recommended.

The farmed fish themselves should always be obtained from a reputable source.

Farmer should be conversant with all these information. And they should be incorporated into the database module of the program for consultation by the farmer.

## 2.3    THE EXISTING SYSTEM

A study of the existing system was carried out with visits and interview conducted with the Department of Fisheries, Ministry of Federal Capital Territory, Area 11 Abuja.

It was a fenced farm occupying a landmass of about two hectares with ten earthen ponds and a relatively large reservoir.

At the entrance of the farm is the hatchery. It is the building that normally accommodates tanks and other farm equipment. There, artificial insemination, breeding and rearing of fingerlings are carried out. Various tests and treatment of diseased fish are also conducted in the hatchery.

From the studies, it was gathered that most farmers have very limited knowledge of the diseases of fish and their management. The only methods of diagnosing fish disease which they mainly rely on, is by looking out for any wound or laceration on the fish or a dead fish in the pond.

These methods are just few and inefficient looking at the various ways of diagnosis. Besides it is very unsafe to wait till even a single fish dies to get the farmer notified of any imminent danger in the pond.

Another deficiency in the existing system is the total absence of autopsy when a fish dies. Should it be carried out, it would not be thorough, as the farmers do not have a comprehensive knowledge of what to look out for on dissection.

Of the available drugs for treating diseases and infections of fish, only a few - Malachite green, formalin and potassium permanganate- are well known to the farmers. This of course, is an indication of their level of understanding or the attention given to fish diseases as the case may be.

A typical fish farm establishment, profit oriented, sources its income from the sales of fingerlings (young fish), juveniles, brooders, ornamental fishes, aquarium design and sales as well as from consultancy services.

From the studies, it is indicated that the aspect of diagnosing and treatment of fish diseases is still very defective in fish farm management in the tropics.

A fractional part of the activities in the farm are automated. This amounts to time wastage and unproductivity.

This, among other reasons, necessitates the introduction of computer into the system.

# CHAPTER THREE

## 3.0   *SYSTEM ANALYSIS AND DESIGN*

## 3.1   <u>FEASIBILITY STUDIES</u>

A project of this nature demands much labour, time and financial requirements. A preliminary investigation of such a project, which will subject it to a test of importance, viability and practicability, is therefore necessary prior to the implementation stage. This is called feasibility study.

The study was conducted under the following sub-headings.

### I.   *UNDERSTANDING THE PROJECT*

The new system is aimed at using computer to do some of the things the farmer has been doing mechanically before. These could be summarized thus:

(a)   Providing necessary diagnostic facts on various diseases of fish more reliably and uniformly on any occasion, and recommend appropriate treatment or control.

(b)   Making available information needed by farmers and prospective farmers in daily management of fish farm.

(c)   Storing these information in an automated system more safely and in a way that will be more accessible to farmers when needed.

(d) Outputting any needed information in form of hardcopy or softcopy.

## II. *SIZE OF THE PROJECT*

The system will require one computer system - a Central Processing Unit (CPU), monitor, Printer, Keyboard with other necessary electrical accessories. The system will be suitably set up in a demarcated part of the farm hatchery.

It will be manned by two of the farm attendants who must have received adequate training in microcomputer operation and management.

## III. *TESTING PROJECT FEASIBILITY*

In system analysis and design the feasibility of a project is criticized on three backgrounds.

a. Economical feasibility

b. Technical feasibility

c. Operational feasibility

(a) ***Economical Feasibility***: - From the analysis of the cost implication of the new system as presented in chapter two, page 14, the system will cost a total sum of One hundred and nineteen thousand seven hundred Naira only (₦119, 700. 00k).

General maintenance and servicing system will take place from

time to time. Also, provision will be made for security and all other measures that will enhance smooth running of the system.

The study of the existing system indicates the various sources of income to the organisation and there is always a regular demand for the products and services. Being an economically productive venture, the farm, or any modern fish farm for that matter, will comfortably embark on such project (computerisation) without any adverse economic implication.

The system, when installed, could also be used for some other purposes in the farm such as word processing, inventory, and record keeping - on the fish stock, sales, fertilization and hatching dates. With this, the benefit of embarking on the project will certainly outweigh the cost. Therefore, it can be rightly concluded that it is economically feasible.

(b)  *Operation feasibility*: - This is concerned with the workability of the proposed project considering the ways and methods of implementation as dictated by certain factors.

The system is programmed in such a user friendly way that any computer literate person will be able to communicate meaningfully with the system.

The database is composed with virtually no technical term of aquacultural studies. This will make it usable even by new comers in

22

the field. The installation of air-conditioner as the cooling mechanism for the system will ensure an ideal environment for the system to function.

(c) *Technical feasibility*: - This tests whether the existing personnel, equipment, and the level of technological development, as the case may be, will support the proposed project.

The various hardware and software components required are listed in chapter two, page 14. They are all readily available and will allow the system to perform within the limit of modern computer technology.

In terms of speed of processing data to ensure a good response time, the recommended Pentium series will fittingly accommodate both the operating system and the written program.

Sometimes certain component parts need to be replaced. Being an International Business Machine (IBM) compatible system - locally assembled, - the system can accept spare parts from other computer company other than IBM. These parts are readily available and at a cheaper rate. On the contrary, a branded system will only accept spare component from IBM or the particular company that manufactured the system.

## 3.2 INVESTIGATION AND FACT FINDING

These are the techniques and methods of gathering information. The project adopted these three methods:

(i) **Record Searching**: - A good number of reputable texts and journals were consulted for information on pisciculture, aquaculture, computer technology as well as business management. Past works on related topic were also consulted for guides.

(ii) **Interview**: - Interview was conducted with those knowledgeable in fish farm management and project management. Hardware and software vendors were also interviewed.

(iii) **Observation**: - This was made in the fish farm where some hours were spent observing / studying the activities of the farm attendants. An expert system package, though on a different topic, was studied for some more technical details in writing expert system program.

## 3.3 REQUIREMENT SPECIFICATION

This is a stage of system design and analysis that involves stating clearly what the new system requires to efficiently perform.

Normally, it is the product of studies carried out on the existing system (system analysis) during which the system is thoroughly

scrutinized pointing out the weaknesses and otherwise.

The specification will therefore state the needs required to computerize the system for better performance. Table 1 shows the details of this.

## 3.4    SYSTEM REQUIREMENT

After arriving at a required specification, a detailed documentation of what the system will look like, produced in hard copy and presented to the management for study and possible approval before the commencement of project execution, is normally made. This is termed system specification / requirement or system requirement.

In summary, it serves the following purposes:

(i)    Formal communication with the management about the proposed system.

(ii)    Provides complete record of the system, which is needed, for the purpose of evaluation, modification and training of personnel.

Below is the system specification for the project.

**PROJECT:** **APPLICATION OF ARTIFICIAL INTELLIGENCE IN DISEASE DIAGNOSIS OF FISH IN THE TROPICS AND ECONOMIC MANAGEMENT OF FISH FARM.**

## *SYSTEM SPECIFICATION*

1. *PRELIMINARY INFORMATION*: The proposed system is an automated fish disease diagnoses expert. It will offer relevant information also on other areas of fish farm management.

2. *SCOPE:* The scope of the project will be limited to the fish in the tropics. And the system will offer limited information on food preparation formular and administration to avoid inconsistencies.

   It is believed that food administration methods and formular

   vary with the prevailing climatic condition, age, state, health of the fish, natural productivity of the water e.t.c.

3. *PERSONNEL*: The services of the following will be required.

   (a) *System Analyst*: - He will study the existing system and come

   up with a design of new one. He will also be consulted for maintenance and advice after the implementation of the new system.

(b) **Programmer**:- He will, from the report of the analyst, design

appropriate program(s) to solve the problem and accomplish the

aim and objective of the organisation.

(c) **Computer Operators**:- Two of the farm attendants will be trained

in micro - computer operation and management. They will be the

only staff members operating the system.

4. <u>SECURITY</u>: The management will ensure the following:

(a) The system should generally be handled with care.

(b) The system would not be made accessible to outsiders or

non-trained staff members without permission by the

management.

(c) Back - up copies of the software would be procured and

safely kept.

(d) Anti - virus kit would be installed in the system.

5. <u>REQUIREMENT AND COST</u>: The following will be required for

effective implementation of the project:

|                                        | ₦           |
|----------------------------------------|-------------|
| IBM compatible system (hardware only)  | 109, 700. 00 |
| Staff training (two computer operators) | 15, 000. 00  |
| Software engineering                   | 10, 000. 00  |
| Installation                           | 15, 000. 00  |
| **Total**                              | **149, 700. 00** |

6.   *LOCATION*: The system would be installed within a reasonably safe distance from water tank in the hatchery. The place would be demarcated from other parts of the hatchery where the optimal temperature of the tank will not be altered by the A/C.

7.   *USING THE SYSTEM*: The following should be noted:

(a)   The operators should be familiar with the system by time - to - time consultation even if no disease is noticed.

(b)   On discovering any disease symptom or disorder, the observation should be carefully noticed and any dead fish dissected and examined before the system is consulted.

8.   *COST BENEFIT ANALYSIS*: Embarking on the project will be of

great benefit to the establishment for the following reasons:

(a)  Wrong diagnosis of disease and prescription may lead to poor yield or outright extermination of the entire stock. The system will guide against this.

(b)  The system will provide guiding information towards a successful fish rearing.

(c)  The organisation will be able to retain the information and many others mentioned earlier under economical feasibility in a reliable and permanent medium.

(d)  The exit of a farm attendant will not affect the organisation as such since the knowledge is equally stored in the system and a new user can take over the management of the farm with little or no difficulty.

## 3.5 CHANGEOVER

When the new system has been tested and it is proved satisfactory, a change or conversation from the old to the new system would take place. This is termed changeover.

Changeover may be achieved in a number of ways. Important among these are:

    i.    direct method

    ii.    parallel method / running

    iii.    staged method.

i.    *DIRECT CHANGEOVER*: This means processing data entirely with the system after replacing the old one in a single move. The method should be adopted only when everyone involved has appreciable confidence in the new system. It is a risky method in a way.

For security reasons, the old system is kept in abeyance in case any problem arises.

ii.    *PARALLEL RUNING*: This method involves processing data by both the old and new systems (methods) concurrently to compare the results and know if the new one will serve.

It is an expensive method as it involves maintaining two systems

at a time. It is equally time consuming running two systems at a time.

iii. *STAGED CHANGEOVER*: This involves a series of "limited-size"

direct changeover, the new system being introduced piece - by - piece.

Any tested and reliable section is brought in for implementation.

Considering the nature of this project (an information system),

the parallel running method is recommended. With the method

adopted, the farmer's knowledge will be complimented and up-dated

by the system as often as he uses it.

# CHAPTER FOUR

## 4.0   SOFTWARE DEVELOPMENT

## 4.1   PROGRAMMING TECHNIQUE

Software is described as a set of sequence instructions which

informs a computer of steps to take to achieve a defined task.  In other

word, software directs the affairs of a computer.

In software development, adopting a computer language is a

choice that has to be made after taking into consideration, the nature of

the problem to solve and area of human endeavour concerned.

This program is developed using *dBase IV*, a type of high level

language, which is applicable to virtually all fields of specialization.

*dBase IV* belongs to the group of programming package / language

generally termed Database Management System (DBMS).  Within the

group is a number of *dBase* versions. *dBase IV* is an advanced version

of *dBase* and it provides a full relational database environment to

users.

*dBase* provides a screen design facility for users to customise

and design the screen both for input and output.  It is said to be one of

the most popular and powerful DBMS available for personal computers.

The programming language encourages running the computer in an interactive mode. As soon as the user submits a program to the computer, it executes the program and produces the result, while meaningful dialogue continues in the course of executing the program.

*dBase IV* is a compiler i.e. a high level language that compiles (check and certify correct) all the programming statements before producing output. It supports certain features, which makes it an easy tool to manipulate complex situation with a satisfactory output. For instance, the use of blocked operations, such as DO CASE... CASE.... ENDCASE, in accessing cases. With the programming structure, a computer will efficiently access a complex case of several conditions / possible outputs and logically arrives at a conclusion - see appendix II.

*dBase IV* also supports instant syntax checking as instructions are entered and it also gives instant help on errors.

The choice of this programming language is made for the project because of its versatility in solving problems. In addition to the myriad of programming commands entrenched in *dBase*, it equally supports all

the commands in the lower versions of *dBase* and a good number from *QBASIC*, another powerful programming language.

## 4.2  PROGRAM STRUCTURE

A good program should be maintainable and understandable. In ensuring this in any program, the concept of modularity has to be employed. This involves writing the program in modules. Each module is a complete and independent program that can run on its own.

Communication between modules is made possible by using certain *dBase* commands. In this program, of forty-one (41) modules, DO / RETURN Statement is used. The commands go together as a pair. While DO statement transfers control (of execution) from the main program to the sub - program, RETURN statement directs the execution of program back to the main program at the point immediately after the DO statement.

With this method of programming, the program will appear less complex, more orderly and any section of the program can be debugged or updated without having to pass through the whole program. The chart below shows the structural arrangement of the modules as a flowchart.

## 4.3  SOFTWARE DOCUMENTATION

Documentation is the description of a program in a way to inform the user and other system programmers, about what the program does, how it works and other details that will enhance maintainability.

It aids users in understanding the program better. Documentation may be internal, as in this case, where comments are made within the program using an asterisk (*) to proceed the statement. Such statement is regarded as non-executable statement. In external documentation, comments are made in form of written description and structured diagram. This could be termed "Manual" which always accompany a package on purchase. It becomes more indispensable when a program is very complex and voluminous.

## 4.4  IMPLEMENTATION

On developing and testing a program, the next step is implementation of the program. This involves applying the program to solving the problem it is meant to solve thereby making it fully operational.

This program is tested and can be used for management in backyard fish farm, large farm for commercial purposes, agricultural

institutions, school farms and in colleges of agriculture.

For effective implementation of the program, it is designed in such a user - friendly way that it will pose little or no problem to the users.

## 4.5 **INSTALLATION**

To run the program, the computer must already have *dBase IV* compiler. The following are the steps to run the program:

(a)  If the program is already in *dBase* directory on hard disk,

    i.      boot the system

    ii.     at C:\> type cd dBase4 ⏎

    iii.    at C:\dBase4> type dBase ⏎

    iv.    at the control panel press Esc key and press Y key in response to the prompted question.

    v.     At the dot prompt, type Do mainmenu.prg ⏎

(b)  If however the program is contained in floppy disk,

    i.      boot the system

    ii.     insert the diskette into drive A:

# CHAPTER FIVE

## 5.0 *SUMMARY AND CONCLUSION*

## 5.1 <u>LIMITATION OF EXPERT SYSTEM</u>

To make good use of expert system we need to know their pitfalls and limitations. The following should be noted while using an expert system.

### 5.1.1 *Speed of inference*:

This is the most critical in a situation where optimal solutions are needed within a fixed period of time.

Medical and military decision for instance may, most of the time, be sensitive to the speed of the information processing because there may be need for the system to probe deep into the subject with an intricate network of questioning before a meaningful and precise result can be obtained.

### 5.1.2 *Extent of Knowledge*:

An expert system is limited by the extent of the knowledge built in. If the system is being applied slightly outside its area of strength, it tends to be defective in its performance or else error messages are displayed. The system at this stage is said to have a "knowledge cliff".

documentation.

The program in particular should be written in modules and with a logic flow such that an error in a module will only affect that module so that correcting the error or maintaining the module will not affect the whole program.

There should also be comments on what a program or segment of a program does to allow for easy location of error and subsequent debugging.

## 5.3 **RECOMMENDATION**

The system as a whole should be run with a maintenance culture. Since knowledge is not static, and new facts come up from researches from time to time, expert system should always be accessed regularly (system feed back) and the knowledge base upgraded if need be.

With the adoption of expert system in an organisation, it is believed that "an expert" or his knowledge has been acquired. It is however advised that the new system or a new computer technology should not be seen as a replacement for the existing personnel or human experts. Rather it should be seen as an effort to complement the old system with an improved output.

# REFERENCES

**CUSHING  D. H.** (1977):  Science and the fisheries  (studies in Biology),

Academic Press, London, No 85 pg. 1 & 17, 42 - 44.

**DIANE MEEHAN** (1990):  Computer studies series, New York: The

Macmillan Company, pg. 113 - 114.

**DONALD, H.  SANDERS** (1995):  Computer concepts and applications

McGraw-Hill International Editions,
Computer Science Series, pp. 45

**DOUKIDIS G. E. et al** (1988):  Developing Expert System,  Chartwell –

Bratt (Publishing and Training) Ltd. UK. pg. 1 - 12

**ENCYCLOPEDIA BRITANICA** (1982):  Macropedia Knowledge in

Depth. Volume 7, William Benton, Chicago, pg. 360.

**ILAN PAPERNA** (1996): Parasites, infections and diseases of fishes in

Africa  –  An  Update.  Publications  division,  FAO,
Rome, pg. 4, 14-18, 41-47, 58-63, 104-105, 122-125,
171, 176,177.

**INFOTECH** (1981):  Machine intelligence - state of the art report, series 9,

November 3; New York: The Macmillan Company,

Pg. 30.

**LOWE R. H., McCONNEL** (1977): Ecology of fisheries in Tropical

waters - studies in Biology; Longman, London, No 76,

pg. 54 - 56.

**MIKE REEVE & STEVEN ERICSSON ZENITH** (1989): Artificial

intelligence - parallel processing and art, Manchester

University Press, Manchester and New York, pg. 175.

**PAUL BRYANT & KIM ATTACK** (1980): Backyard fish farming, Prism

Press, 2 South Street, Bridport, Dorset, DT6 3NQ.

pg. 1-4, 4 -28, 36, 57 - 68, 96 - 101, 116 - 131, 141 - 156.

**PETER S. SELL** (1985): Expert system - A practical introduction, vol. vii,

Camelton Press, Pg. 1 - 3 & 14.

**SINHA V. R. P.** (1993): A compedium of aquatic Technologies for

developing countries, J. Fish. Res. Bd. Can., Pg. 59, 60.

**TANIMOTO L. STEVEN** (1987): The elements of artificial intelligence -

An introduction using LISP, Camelton Press Pg. 1 - 3, 6 -

8, 461 -477.

# APPENDIX I - Programming terminology

CLEAR                         Erase the screen

DO                               Begin execution of a program

EXIT                            End an indefinite loop e.g. DO WHILE .T. loop

GET                             Display the content of a memory variable

LOOP                          Repeat execution of a program

PICTURE or PICT         Format an input as specified

PUBLIC                     Declare a memory variable for use anywhere found

in a package/program

READ                         Permit data input into a memory variable

RETURN                  End execution of a program or transfer execution

control from sub-program back to main-program

REPLICATE             Print item in a specified number of time and at a

particular location on the screen.

SAY                           Print at a specified location on the screen

WAIT                        Temporarily stop executing a program until a key is

pressed.

```
CLEAR
SET SCOREBOARD OFF
SET STATUS OFF
* THIS PROGRAM GIVES DETAILS OF ARGULUS AND RECOMMENDED TREATMENT (ARGU).
DO BORDER
SET COLOR TO R
@4,4 SAY "...a case of Argulus."
SET COLOR TO W
@6,4 SAY "This is called"
SET COLOR TO G
@6,19 SAY "the fish louse"
SET COLOR TO W
@6,34 SAY "and it is a parasite found on the body sur-"
@7,4 SAY "face, gills and fins of fish. It is about 3-4mm long and can be seen with"
@8,4 SAY "naked eye as a small speck with two black eyespots."
SET COLOR TO G
@10,32 SAY "RECOMMENDATION"
SET COLOR TO W
@11,4 SAY "Treat with POTASSIUM PERMANGANATE and MASOTEN."
@19,29 TO 21,48 DOUBLE
SET COLOR TO G
@20,30 SAY "Fish Expert System"
SET COLOR TO W
WAIT
DO CONC
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
•   THIS PROGRAM GIVES DETAILS OF ACANTHACEPHALUS/CESTODES AND THE
•   RECOMMENDED TREATMENT (ACAN).
DO BORDER
SET COLOR TO R
@4,4 SAY "…a case of Acanthocephalus/cestodes."
SET COLOR TO W
@6,4 SAY "Acanthocephalus is a worm parasite of fish intestines with hooked probo-"
@7,4 SAY "sis. Therefore, they are called"
SET COLOR TO G
@7,36 SAY "spiny headed worms"
SET COLOR TO W
@7,54 SAY ". Once established on"
@8,4 SAY "a host, they are almost impossible to remove from the fish."
SET COLOR TO G
@10,32 SAY "RECOMMENDATION"
SET COLOR TO W
@11,4 SAY "Treat with Di-n-butyl/Tin Oxide. Always include vitamin source in the"
@12,4 SAY "diet. Examples are cereal grains."
@19,29 TO 21,48 DOUBLE
SET COLOR TO G
@20,30 SAY "Fish Expert System"
SET COLOR TO W
WAIT
DO CONC
RETURN
```

```
CLEAR
STORE SPACE (1) TO AU
SET STATUS OFF
SET SCOREBOARD OFF
*THIS PROGRAM RESPONDS TO THE SITUATION WHEREBY ALL
*THE RESPONSES TO THE EXPERT ARE (Y) - YES (ADVICE).
DO BORDER
SET COLOR TO R
@4,4 SAY "…Likely there is problem with your fish."
SET COLOR TO W
@6,4 SAY "However, you will have a good diagnosis to the problem only if you can"
@7,4 SAY "make a"
SET COLOR TO G
@7,11 SAY "carefull"
SET COLOR TO W
@7,20 SAY "examination of the fish in question, noting the symptom,"
@8,4 SAY "and be specific while providing answers to the expert."
@15,10 SAY "You may want clues on fish diseases diagnosis. Do you? (Y/N)";
GET AU PICT "!"
SET COLOR TO G
@19,29 TO 21,48 DOUBLE
@20,30 SAY "Fish Expert System"
SET COLOR TO W
READ
IF AU = 'Y'
    DO FISDIS
    RETURN
ELSE
    DO CONC
    RETURN
ENDIF
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM RESPONDS TO CASE 41 THAT IS DACTYLOGYRUS/GYRODACTYLUS "
* AND ARGULUS ARE SUSPECTED (ARDA).
DO BORDER
SET COLOR TO R
@4,4 SAY "...Dactylogyrus/Gyrodactylus and Argulus are suspected."
SET COLOR TO W
@6,4 SAY "Treat with POTASSIUM PERMANGANATE and MASOTEN, then keep observing the"
@7,4 SAY "fish for further symptom(s), after which you will re-diagnose. If, howe-"
@8,4 SAY "ver the symptom(s) persist, treat with BORAMEX."
SET COLOR TO G
@19,29 TO 21,48 DOUBLE
@20,30 SAY "Fish Expert System"
SET COLOR TO W
WAIT
DO CONC
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
LUS = SPACE (1)
* THIS PROGRAM RESPONDS WHEN ARGULUS IS SUSPECTED (ARGUSUSP).
DO BORDER
SET COLOR TO R
@4,6 SAY "...Argulus is suspected"
SET COLOR TO W
@5,4 SAY "For further details about the disease press 'U'or any other key to"
@6,4 SAY "continue." GET LUS PICT "!"
READ
IF LUS = "U"
    DO ARGU
    RETURN
ELSE
    DO CONC
    RETURN
ENDIF
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
*THIS PROGRAM DESIGNS THE PROGRAM BORDER FOR THE
*OUTPUT OF VARIOUS RESPONSES AFTER DIAGNOSING (BORDER).
SET COLOR TO W
@1,0 TO 24,79 DOUBLE
SET COLOR TO W/W
@2,1 SAY REPLICATE("*",78)
SET COLOR TO W
@3,2 TO 23,77 DOUBLE
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM RESPONDS IF ONLY CASES 14, 15 AND 25 ARE TRUE(C141525).
DO WHILE .T.
   LAB = SPACE (1)
   DO BORDER
   @4,4 SAY "If the fish has not been feeding on Vitamins, try and include it in the"
   @5,4 SAY "diet. Examples include yeast and cereal grains."
   @7,4 SAY "After this, carefully observe the fish for futher symptom(s) or improve-"
   @8,4 SAY "ment and then re-consult the expert."
   SET COLOR TO G
   @10,4 SAY "Do you want clues on how to examine fish (y/n) ?" GET LAB PICT "!"
   @19,29 TO 21,48 DOUBLE
   @20,30 SAY "Fish Expert System"
   READ
   SET COLOR TO W
   DO CASE
      CASE LAB = "Y"
         DO FISDIS
         RETURN
      CASE LAB = "N"
         DO CONC
         RETURN
   OTHERWISE
         SET COLOR TO R
         @18,15 SAY "You are expected to press 'y' or 'n' !!!"
         SET COLOR TO W
         WAIT
         CLEAR
         LOOP
   ENDCASE
ENDDO
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS IS A CONCLUDING SECTION OF THE PROGRAMM BEFORE FINAL EXIT (CONC).
DO WHILE .T.
    FISH = SPACE (1)
    SET COLOR TO W/W
    @0,0 SAY REPLICATE (" ",80)
    @1,0 SAY REPLICATE (" ",80)
    @2,0 SAY REPLICATE (" ",80)
    @3,0 SAY REPLICATE (" ",80)
    @4,0 SAY REPLICATE (" ",80)
    @5,0 SAY REPLICATE (" ",21)
    *THIS SECTION DESIGNS A FISH DIAGRAM
    SET COLOR TO N/N
    @5,22 SAY REPLICATE (" ",27)
    SET COLOR TO W/W
    @5,49 SAY REPLICATE (" ",31)
    @6,0 SAY REPLICATE (" ",20)
    SET COLOR TO N/N
    @6,19 SAY REPLICATE (" ",31)
    SET COLOR TO W/W
    @6,51 SAY REPLICATE (" ",29)
    @7,0 SAY REPLICATE (" ",17)
    SET COLOR TO N/N
    @7,17 SAY REPLICATE (" ",7)
    SET COLOR TO W/W
    @7,24 SAY REPLICATE (" ",2)
    SET COLOR TO N/N
    @7,26 SAY REPLICATE (" ",27)
    SET COLOR TO W/W
    @7,53 SAY REPLICATE (" ",13)
    SET COLOR TO N/N
    @7,66 SAY REPLICATE (" ",2)
    SET COLOR TO W/W
    @7,68 SAY REPLICATE (" ",12)
    @8,0 SAY REPLICATE (" ",15)
    SET COLOR TO N/N
    @8,15 SAY REPLICATE (" ",9)
    SET COLOR TO W/W
    @8,24 SAY REPLICATE (" ",2)
    SET COLOR TO N/N
    @8,26 SAY REPLICATE (" ",35)
    SET COLOR TO W/W
    @8,55 SAY REPLICATE (" ",8)
    SET COLOR TO N/N
    @8,63 SAY REPLICATE (" ",4)
    SET COLOR TO W/W
    @8,67 SAY REPLICATE (" ",13)
    @9,0 SAY REPLICATE (" ",14)
    SET COLOR TO N/N
    @9,14 SAY REPLICATE (" ",43)
    SET COLOR TO W/W
    @9,57 SAY REPLICATE (" ",3)
    SET COLOR TO N/N
    @9,60 SAY REPLICATE (" ",6)
    SET COLOR TO W/W
    @9,66 SAY REPLICATE (" ",14)
    @10,0 SAY REPLICATE (" ",14)
    SET COLOR TO N/N
    @10,14 SAY REPLICATE (" ",1)
    SET COLOR TO W/W
    @10,15 SAY REPLICATE (" ",2)
    SET COLOR TO N/N
    @10,17 SAY REPLICATE (" ",48)
```

```
SET COLOR TO W/W
@10,64 SAY REPLICATE (" ",16)
@11,0 SAY REPLICATE (" ",18)
SET COLO TO N/N
@11,18 SAY REPLICATE (" ",46)
SET COLOR TO W/W
@11,63 SAY REPLICATE (" ",17)
@12,0 SAY REPLICATE (" ",14)
SET COLOR TO N/N
@12,14 SAY REPLICATE (" ",1)
SET COLOR TO W/W
@12,15 SAY REPLICATE (" ",2)
SET COLOR TO N/N
@12,17 SAY REPLICATE (" ",48)
SET COLOR TO W/W
@12,64 SAY REPLICATE (" ",16)
SET COLOR TO B/B
@13,0 SAY REPLICATE (" ",14)
SET COLOR TO N/N
@13,14 SAY REPLICATE (" ",43)
SET COLOR TO B/B
@13,57 SAY REPLICATE (" ",3)
SET COLOR TO N/N
@13,60 SAY REPLICATE (" ",6)
SET COLOR TO B/B
@13,66 SAY REPLICATE (" ",14)
@14,0 SAY REPLICATE (" ",15)
SET COLOR TO N/N
@14,15 SAY REPLICATE (" ",40)
SET COLOR TO B/B
@14,54 SAY REPLICATE (" ",9)
SET COLOR TO N/N
@14,63 SAY REPLICATE (" ",4)
SET COLOR TO B/B
@14,67 SAY REPLICATE (" ",13)
@15,0 SAY REPLICATE (" ",17)
SET COLOR TO N/N
@15,17 SAY REPLICATE (" ",38)
SET COLOR TO B/B
@15,53 SAY REPLICATE (" ",13)
SET COLOR TO N/N
@15,66 SAY REPLICATE (" ",2)
SET COLOR TO B/B
@15,68 SAY REPLICATE (" ",12)
@16,0 SAY REPLICATE (" ",20)
SET COLOR TO N/N
@16,20 SAY REPLICATE (" ",31)
SET COLOR TO B/B
@16,51 SAY REPLICATE (" ",29)
@17,0 SAY REPLICATE (" ",23)
SET COLOR TO N/N
@17,23 SAY REPLICATE (" ",27)
SET COLOR TO B/B
@17,49 SAY REPLICATE (" ",31)
@18,0 SAY REPLICATE (" ",80)
@19,0 SAY REPLICATE (" ",80)
@20,0 SAY REPLICATE (" ",80)
@21,0 SAY REPLICATE (" ",80)
@22,0 SAY REPLICATE (" ",80)
SET COLOR TO W/W
@23,0 SAY REPLICATE (" ",80)
SET COLOR TO N/N
@24,0 SAY REPLICATE (" ",17)
SET COLOR TO N/W
@24,16 SAY "Do you want to consult the expert again(y/n)?"
```

```
@24,61 GET FISH PICT "!"
SET COLOR TO N/N
@24,62 SAY REPLICATE (" ",18)
READ
DO CASE
   CASE FISH ="Y"
     DO MAINMENU
     RETURN
   CASE FISH = "N"
     DO ODE
     RETURN
   OTHERWISE
     CLEAR
     DO BORDER
     SET COLOR TO R/W
   @5,17 SAY "You are requested to press 'y' or 'n' !!!"
     @17,0 SAY SPACE (1)
   WAIT
   CLEAR
   LOOP
   ENDCASE
ENDDO
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
ANS = 0
PLY = 0
* THIS PROGRAM DESIGNS THE MENU SCREEN FOR FISH FARMING CONSULTANCY
* SERVICES BASED ON THE FOUR ITEMS BELOW (CONSUL).
DO WHILE .T.
   DO BORDER
   SET COLOR TO W
   @ 1,1 TO 8,78 DOUBLE
   SET COLOR TO G
   @4,5 SAY "NOTE"
   SET COLOR TO W
   @4,9 SAY ": THIS SEGMENT OF THE PROGRAM PROVIDES YOU WITH SOME NECESSARY"
   @5,11 SAY "CLUES TO TACKLE PROBLEMS WHICH YOU COME ACROSS FROM TIME TO TIME."
   @6,11 SAY "YOU NEED TO GET FAMILIAR WITH THE INFORMATION THEREIN."
   SET COLOR TO G
   @9,34 SAY "CONSULTANCY MENU"
   SET COLOR TO W
   @10,34 TO 10,49 DOUBLE
   @11,27 SAY "1." + SPACE(5) + "ABOUT FISH DISEASES"
   @13,27 SAY "2." + SPACE(5) + "WHICH FISH TO FARM"
   @15,27 SAY "3." + SPACE(5) + "POND AND MANAGEMENT"
   SET COLOR TO G
   @20,20 SAY "Make a selection..."

   SET COLOR TO W
   @20,54 CLEAR TO 22,56
   @20,55 GET PLY PICTURE "9"
   READ
   DO CASE
      CASE PLY = 1
      CLEAR
      DO FISDIS
      RETURN
      CASE PLY = 2
      CLEAR
      DO WISH
      RETURN
      CASE PLY = 3
      CLEAR
      DO PND
        RETURN
      OTHERWISE
        ANS = SPACE(1)
        CLEAR
        DO BORDER
        SET COLOR TO R
        @5,11 SAY "Please make a correct selection. It is 1, 2, or 3"
        SET COLOR TO G
        @10,15 SAY "Press 'Y' to continue or any other key to quit"
        SET COLOR TO W
        @10,66 GET ANS PICTURE "!"
        READ
        IF ANS = "Y"
           CLEAR
           LOOP
        ELSE
           DO ODE
           RETURN
        ENDIF
      ENDCASE
ENDDO
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM GIVES DETAILS OF COSTIASIS AND THE RECOMMENDED TREATMENT(COSTI).
DO BORDER
SET COLOR TO R
@4,4 SAY "...a case of Costiasis."
SET COLOR TO W
@6,4 SAY  "This is a severe disease of young fish and fry which may ocassionally"
@7,4 SAY "affect older fish. It is caused by"
SET COLOR TO G
@7,39 SAY "Costia"
SET COLOR TO W
@7,45 SAY ", a parasite which is very"
@8,4 SAY "small and pear-shaped with two whip-like flagellae. They are observable"
@9,4 SAY "in the scraped body mucous. They can only be seen at X400 magnification"
@10,4 SAY "or more. They also cause damage to the fins."
SET COLOR TO G
@12,32 SAY "RECOMMENDATION"
SET COLOR TO W
@13,4 SAY "Several successive treatments with FORMALIN."
@19,29 TO 21,48 DOUBLE
SET COLOR TO G
@20,30 SAY "Fish Expert System"
SET COLOR TO W
WAIT
DO CONC
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM RESPONDS TO THE OPTIONS: COSTIA AND TRICHODINA/CHILODONELLA ARE
* SUSPECTED (COSTRIC).
SET COLOR TO G
DO BORDER
SET COLOR TO R
@4,4 SAY "...Costia and Trichodina/Chilodonella are suspected."
SET COLOR TO G
@6,33 SAY "RECOMMENDATION"
SET COLOR TO W
@7,4 SAY "Treat with FORMALIN and keep observing the fish for further symptom(s)"
@8,4 SAY "after which you will re-diagnose. If the same symptom(s) persist, treat"
@9,4 SAY "with MALACHITE GREEN."
SET COLOR TO G
@19,29 TO 21,48 DOUBLE
@20,30 SAY "Fish Expert System"
SET COLOR TO W
WAIT
DO CONC
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM RESPONDS TO THE CASE OF A5, A7 ANDA 14 BEING YES (COSTSUSP).
TIA = SPACE(1)
DO BORDER
SET COLOR TO R
@4,4 SAY "...Costia is suspected."
SET COLOR TO W
@6,4 SAY "For further details on the disease, press 'C', otherwise press"
@7,4 SAY "any key to continue." GET TIA PICT "!"
READ
IF TIA = "C"
    DO COSTI
    RETURN
ELSE
    DO CONC
    RETURN
ENDIF
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM GIVES DETAILS OF DACTYLOGYRUS AND GYRODACTYLUS AND
* AND THE RECOMMENDED TREATMENT (DACT).
DO BORDER
SET COLOR TO R
@4,4 SAY "...a case of Dactylogyrus or Gyrodactylus."
SET COLOR TO W
@6,4 SAY "Dactylogyrus are metazoan parasites found in the gills, and are about 1mm"
@7,4 SAY "long with a vicious-looking array of suckers and hooks."
@8,4 SAY "Gyrodactylus are similar to Dactylogyrus but smaller (0.5-0.8mm), and"
@9,4 SAY "most often found on body surface instead of gills. They have no dark eye-"
@10,4 SAY "spots but much more visible hooks than Dactylogyrus."
SET COLOR TO G
@12,31 SAY "RECOMMENDATION"
SET COLOR TO W
@13,4 SAY "Treat with FORMALIN or BORAMEX."
@14,4 SAY "For Tilapia in hatchery tank use:"
@15,6 SAY "* 2ppm of 50% DDVP (Di-n-butyl tin oxide)"
@16,6 SAY "* 0.2 ppm of BORAMEX"
@17,6 SAY "* 25 ppm of FORMALIN (36% formaldehyde) can be mixed together for treat"
@18,6 SAY "  ment for 6 hours."
@19,6 SAY "Always feed the fish with vitamin source e.g cereal grains and yeast."
@20,29 TO 22,48 DOUBLE
SET COLOR TO G
@21,30 SAY "Fish Expert System"
SET COLOR TO W
WAIT
DO CONC
RETURN
WAIT
```

```
CLEAR
* THIS IS ERROR PROGRAM IN RESPONSE TO WRONG ANSWER
* FROM USERS TO THE EXPERT SYSTEM (ERR).
SET STATUS OFF
SET SCOREBOARD OFF
DO BORDER
SET COLOR TO R
@5,34 SAY "Error !!!"
@8,24 SAY "You are expected to  answer yes"
@10,24 SAY "  or no by pressing 'y' or 'n'"
@12,24 SAY "         respectively."
SET COLOR TO W
@20,0 SAY SPACE (1)
WAIT
CLEAR
RETURN
```

```
CLEAR
*THIS PROGRAM INTRODUCES THE PROGRAM (FES).
FOX = SPACE (1)
ANS = SPACE (1)
SET CONFIRM ON
SET TALK OFF
SET SCOREBOARD OFF
SET STATUS OFF
ANS = SPACE (1)
KANT = 0
DO BORDER
@4,18 SAY "APPLICATION OF ARTIFICIAL INTELLIGENCE"
@5,23 SAY "IN FISH DISEASE DIAGNOSIS OF "
@6,27 SAY "FISH IN THE TROPICS"
@7,24 SAY "AND ECONOMIC MANAGEMENT OF"
@8,32 SAY "FISH FARM"
@10,35 SAY "BY"
SET COLOR TO N/GR
@12,18 SAY "ALADETOYINBO LAWRENCE ADEYEMI WILLIAMS"
@13,29 SAY "(PGD/MSC/97/272)"
SET COLOR TO W
@15,19 SAY "DEPARTMENT OF MATHS/COMPUTER SCIENCE"
@16,17 SAY "SCHOOL OF SCIENCES AND SCIENCE EDUCATION"
@17,20 SAY "FEDERAL UNIVERSITY OF TECHNOLOGY"
@18,28 SAY "MINNA, NIGER STATE"
@19,34 SAY "NIGERIA"
@21,31 SAY "FEBRUARY 1999"
WAIT
CLEAR
DO FES2
*THIS PROGRAM SECTION DISPLAYS ON THE SCREEN "FISH EXPERT"
*SYSTEM" BOTH IN WRITTEN AND DESIGNED FORMS - AS F E S
@0,0 TO 23,78 DOUBLE
SET COLOR TO W/W
@1,1 SAY REPLICATE (" ",77)
SET COLOR TO W
@2,2 TO 22,76 DOUBLE
@3,31 SAY "FISH EXPERT SYSTEM"
SET COLOR TO B/B
@6,7 SAY REPLICATE (" ",20)
@6,30 SAY REPLICATE (" ",20)
@6,53 SAY REPLICATE (" ",20)
@7,7 SAY REPLICATE (" ",20)
@7,30 SAY REPLICATE (" ",20)
@7,53 SAY REPLICATE (" ",20)
@8,7 SAY REPLICATE (" ",20)
@8,30 SAY REPLICATE (" ",20)
@8,53 SAY REPLICATE (" ",20)
@9,7 SAY REPLICATE (" ",20)
@9,30 SAY REPLICATE (" ",20)
@9,53 SAY REPLICATE (" ",20)
@10,7 SAY REPLICATE (" ",9)
@10,30 SAY REPLICATE (" ",9)
@10,53 SAY REPLICATE (" ",9)
@11,7 SAY REPLICATE (" ",9)
@11,30 SAY REPLICATE (" ",9)
@11,53 SAY REPLICATE (" ",9)
@12,7 SAY REPLICATE (" ",20)
@12,30 SAY REPLICATE (" ",20)
@12,53 SAY REPLICATE (" ",20)
@13,7 SAY REPLICATE (" ",20)
@13,30 SAY REPLICATE (" ",20)
@13,53 SAY REPLICATE (" ",20)
@14,7 SAY REPLICATE (" ",20)
@14,30 SAY REPLICATE (" ",20)
@14,53 SAY REPLICATE (" ",20)
@14,53 SAY REPLICATE (" ",20)
@15,7 SAY REPLICATE (" ",20)
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM GIVES DETAILS ABOUT FURUNCULOSIS, THE TREATMENT AND
* RECOMMENDATION (FUR).
DO BORDER
SET COLOR TO R
@4,4 SAY "...a case of Furunculosis."
SET COLOR TO W
@6,4 SAY "This is caused by two bacteria,"
SET COLOR TO G
@6,35 SAY "Aeromonas salamonicida"
SET COLOR TO W
@6,58 SAY "and"
SET COLOR TO G
@6,62 SAY "Pseudomonas."
SET COLOR TO W
@7,4 SAY "In young fish, death can result without any further symptom other than a"
@8,4 SAY "period of feeding suppression. Older fish develops boil-like swellings"
@9,4 SAY "called"
SET COLOR TO G
@9,11 SAY "furuncules"
SET COLOR TO W
@9,21 SAY ", hence the name of the disease. Other symptoms include"
@10,4 SAY "putrid odour on dissection and heavy pigmentation."
SET COLOR TO G
@12,32 SAY "RECOMMENDATION"
SET COLOR TO W
@13,4 SAY "Treat with ANTIBIOTICS. Always feed the fish with Vitamins sources. These"
@14,4 SAY "include cereal grains and yeast. Report any bacterial infection to Local"
@15,4 SAY "Veterinary Surgeon."
SET COLOR TO G
@19,29 TO 21,48 DOUBLE
@20,30 SAY "Fish Expert System"
SET COLOR TO W
WAIT
DO CONC
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
*THIS IS THE "QUESTIONAIRE". THE PROGRAM ASKS EXPERTS' QUESTIONS (GNOSIS).
PUBLIC A1,A2,A3,A4,A5,A6,A7,A8,A9,A10,A11,A12,A13,A14,A15,A16,A17
STORE SPACE (1) TO A1
STORE SPACE (1) TO A2
STORE SPACE (1) TO A3
STORE SPACE (1) TO A4
STORE SPACE (1) TO A5
STORE SPACE (1) TO A6
STORE SPACE (1) TO A7
STORE SPACE (1) TO A8
STORE SPACE (1) TO A9
STORE SPACE (1) TO A10
STORE SPACE (1) TO A11
STORE SPACE (1) TO A12
STORE SPACE (1) TO A13
STORE SPACE (1) TO A14
STORE SPACE (1) TO A13
STORE SPACE (1) TO A14
STORE SPACE (1) TO A15
STORE SPACE (1) TO A16
STORE SPACE (1) TO A17
DO WHILE .T.
 CLEAR
 DO BORDER
 @5,5 SAY "The Fish Expert System will be asking you series of questions. You are"
 @6,5 SAY "expected to respond YES or NO by pressing"
 SET COLOR TO G
 @6,47 SAY "'Y'"
 SET COLOR TO W
 @6,51 SAY "or"
 SET COLOR TO G
 @6,54 SAY "'N'"
 SET COLOR TO W
 @6,58 SAY "respectively."
 @7,5 SAY "This is followed by enter key."
 @21,10 SAY SPACE (1)
 SET COLOR TO W
 WAIT
 CLEAR
 DO BORDER
 @3,29 SAY "DIAGNOSTIC PROCEDURE"
 SET COLOR TO G
 @4,4 SAY "1. Do you observe any dark coloration on the fish ?" GET A1 PICT "!"
 READ
 IF A1 <> "Y" .AND. A1 <> "N"
    DO ERR
    LOOP
 ENDIF
 @5,4 SAY "2. Is it an intense dark coloration ?" GET A2 PICT "!"
 READ
 IF A2 <> "Y" .AND. A2 <> "N"
    DO ERR
    LOOP
 ENDIF
 @6,4 SAY "3. Is the fish unable to feed well (feeding supression) ?" GET A3 PICT "!"
 READ
 IF A3 <> "Y" .AND. A3 <> "N"
    DO ERR
    LOOP
 ENDIF
 @7,4 SAY "4. Is the feeding supression so pronounced ?" GET A4 PICT "!"
 READ
 IF A4 <> "Y" .AND. A4 <> "N"
    DO ERR
```

```
LOOP
ENDIF
@8,4 SAY "5. Do you notice any abnormal mucous production ?" GET A5 PICT "!"
READ
IF A5 <> "Y" .AND. A5 <> "N"
    DO ERR
    LOOP
ENDIF
@9,4 SAY "6. Is the mucous production in excess ?" GET A6 PICT "!"
READ
IF A6 <> "Y" .AND. A6 <> "N"
    DO ERR
    LOOP
ENDIF
@10,4 SAY "7. Do you notice any abnormal swimming such as fish"
@11,4 SAY "   rubbing the body on the wall of pond or tank ?" GET A7 PICT "!"
READ
IF A7 <> "Y" .AND. A7 <> "N"
    DO ERR
    LOOP
ENDIF
@12,4 SAY "8. Is the abnormal swimming very often ?" GET A8 PICT "!"
READ
IF A8 <> "Y" .AND. A8 <> "N"
    DO ERR
    LOOP
ENDIF
@13,4 SAY "9. Do you notice swollen belly on the fish (ODEMA) ?" GET A9 PICT "!"
READ
IF A9 <> "Y" .AND. A9 <> "N"
    DO ERR
    LOOP
ENDIF
@14,4 SAY "10. Is the swollen belly very pronounced ?" GET A10 PICT "!"
READ
IF A10 <> "Y" .AND. A10 <> "N"
    DO ERR
    LOOP
ENDIF
@15,4 SAY "11. Do you notice period of motionless and quivery in the fish ?"
@15,69 GET A11 PICT "!"
READ
IF A11 <> "Y" .AND. A11 <> "N"
    DO ERR
    LOOP
ENDIF
@16,4 SAY "12. Do you notice any external leision on the fish body ?"
@16,62 GET A12 PICT "!"
READ
IF A12 <> "Y" .AND. A12 <> "N"
    DO ERR
    LOOP
ENDIF
@17,4 SAY "13. What about wasting of any body part ?" GET A13 PICT "!"
READ
IF A13 <> "Y" .AND. A13 <> "N"
    DO ERR
    LOOP
ENDIF
@18,4 SAY "14. Do you notice any visible organism attached to the fish body"
@19,4 SAY "   and/ or gill ?" GET A14 PICT "!"
READ
IF A14 <> "Y" .AND. A14 <> "N"
    DO ERR
    LOOP
ENDIF
@20,4 SAY "15. Is there any symptom of gill problem such as gasping for air ?"
@20,71 GET A15 PICT "!"
```

```
READ
 IF A15 <> "Y" .AND. A15 <> "N"
    DO ERR
    LOOP
 ENDIF
 @21,4 SAY "16. Do you record any mortality ?" GET A16 PICT "!"
 READ
 IF A16 <> "Y" .AND. A16 <> "N"
    DO ERR
    LOOP
 ENDIF
 @22,4 SAY "17. Is it a mass mortality ?" GET A17 PICT "!"
 READ
 IF A17<> "Y" .AND. A17 <> "N"
    DO ERR
    LOOP
 ENDIF
 *INFERENCE MECHANISM: THE PROGRAM INFERS THE FISH PROBLEM FROM THE
 *QUESTIONS ABOVE AND THE SUBSEQUENTLY MAKE RECOMMENDATION.
 DO CASE
    CASE A1 = 'Y' .AND. A2 = 'Y' .AND. A3 = 'Y' .AND. A4 = 'Y' .AND. A5 = 'Y';
         .AND. A6 = 'Y'.AND. A7 = 'Y' .AND. A8 = 'Y' .AND. A9 = 'Y' .AND.;
         A10 = 'Y'.AND. A11 = 'Y' .AND. A12 = 'Y'.AND. A13 = 'Y' .AND.;
         A14 = 'Y';
         .AND. A15 = 'Y' .AND. A16 = 'Y' .AND. A17 = 'Y'
         DO ADVICE
         RETURN
    CASE A1 = 'N' .AND. A2 = 'N' .AND. A3 = 'N' .AND. A4 = 'N' .AND. A5 = 'N';
         .AND. A6 = 'N'.AND. A7 = 'N' .AND. A8 = 'N' .AND. A9 = 'N' .AND.;
         A10 = 'N'.AND. A11 = 'N' .AND. A12 = 'N'.AND. A13 = 'N' .AND.;
         A14 = 'N'.AND. A15 = 'N' .AND. A16 = 'N' .AND. A17 = 'N'
         DO WELL
         RETURN
    CASE A5 = 'Y' .AND. A6 = 'Y' .AND. A7 = 'Y' .AND. A8 = 'Y' .AND. A15 = 'Y';
         .AND. A16 = 'Y' .AND. A17 = 'Y'
         DO ICH
         RETURN
    CASE A5 = 'Y' .AND. A6 = 'Y' .AND. A7 = 'Y' .AND. A8 = 'Y'
         DO SUSP7
         RETURN
    CASE A5 = 'Y' .AND. A6 = 'Y' .AND. A7 = 'Y' .AND. A15 = 'Y' .AND. A16 = 'Y'
         DO TRICH
         RETURN
    CASE A5 = 'Y' .AND. A6 = 'Y' .AND. A7 = 'Y' .AND. A15 = 'Y'
         DO SUSP8
         RETURN
    CASE A5 = 'Y' .AND. A7 = 'Y' .AND. A14 = 'Y' .AND. A16 = 'Y'
         DO ARGU
         RETURN
    CASE A5 = 'Y' .AND. A7 = 'Y' .AND. A15 = 'Y' .AND. A16 = 'Y'
         DO DACT
         RETURN
    CASE A5 = 'Y' .AND. A7 = 'Y' .AND. A14 = 'Y'
         DO ARGUSUSP
         RETURN
    CASE A5 = 'Y' .AND. A7 = 'Y' .AND. A15 = 'Y'
         DO ARDA
         RETURN
    CASE A9 = 'Y' .AND. A10 = 'Y' .AND. A13 = 'Y' .AND. A16 = 'Y'
         DO ACAN
         RETURN
    CASE A9 = 'Y'.AND. A10 = 'Y'
         DO SUSP4
         RETURN
    CASE A1 = 'Y' .AND. A2 = 'Y' .AND. A9 = 'Y' .AND.  A16 = 'Y' .AND.;
         A17 = 'Y'
         DO VIRAL
         RETURN
```

```
CASE A1 = 'Y' .AND. A9 = 'Y' .AND. A16 = 'Y' .AND.  A17 = 'Y'
     DO VIRAL
     RETURN
CASE A1 = 'Y' .AND. A2 = 'Y' .AND. A16 = 'Y' .AND. A17 = 'Y'
     DO SUSP11
     RETURN
CASE A1 = 'Y' .AND. A2 = 'Y' .AND. A16 = 'Y'
     DO MYXO
     RETURN
CASE A1 = 'Y' .AND. A2 = 'Y'
     DO SUSP2
     RETURN
CASE A1 = 'Y' .AND. A16 = 'Y' .AND. A17 = 'Y'
     DO SUSP11
     RETURN
CASE A1 = 'Y' .AND. A16 = 'Y'
     DO MYXO
     RETURN
CASE A2 = 'Y' .AND. A16 = 'Y'
     DO MYXO
     RETURN
CASE A2 = 'Y' .AND. A17 = 'Y'
     DO SUSP2
     RETURN
CASE A1 = 'Y'
     DO C141525
     RETURN
CASE A2 = 'Y'
     DO C141525
     RETURN
CASE A3 = 'Y'.AND. A11 = 'Y' .AND. A13 = 'Y'
     DO HEXA
     RETURN
CASE A3 = 'Y' .AND. A11 = 'Y'
     DO C141525
     RETURN
CASE A3 = 'Y' .AND. A9 = 'Y' .AND. A16 = 'Y' .AND. A17 = 'Y'
     DO FUR
     RETURN
CASE A3 = 'Y' .AND. A9 = 'Y'
     DO SUSP10
     RETURN
CASE A3 = 'Y'
     DO C141525
     RETURN
CASE A3 = 'Y' .AND. A9 = 'Y' .AND. A16 = 'Y'
     DO SUSP10
     RETURN
CASE A5 = 'Y' .AND. A6 = 'Y' .AND.  A7 = 'Y'
     DO SUSP8
     RETURN
CASE A5 = 'Y' .AND. A6 = 'Y' .AND. A16 = 'Y' .AND. A17 = 'Y'
     DO COSTI
     RETURN
CASE A5 = 'Y' .AND. A6 = 'Y' .AND. A16 = 'Y'
     DO COSTRIC
     RETURN
CASE A9 = 'Y' .AND. A13 = 'Y' .AND. A16 = 'Y'
     DO SUSP4
     RETURN
CASE A9 = 'Y'
     DO MAMO
     RETURN
CASE A7 = 'Y' .AND. A12 = 'Y' .AND. A14 = 'Y' .AND. A15 ='Y' .AND.;
     A16 = 'Y'
     DO LERN
     RETURN
CASE A7 = 'Y' .AND. A12 = 'Y'
```

```
DO SUSP6
        RETURN
    CASE A7 = 'Y' .AND. A12 = 'Y' .AND. A14 = 'Y'
        DO SUSP6
        RETURN
    CASE A7 = 'Y'
        DO C141525
        RETURN
    CASE A7 = 'Y' .AND. A12 = 'Y' .AND. A14 = 'Y' .AND. A15 = 'Y'
        DO SUSP6
        RETURN
    CASE A5 ='Y' .AND. A6 = 'Y'
        DO COSTSUSP
        RETURN
    CASE A5 = 'Y' .AND. A6 = 'Y' .AND. A7 = 'Y' .AND. A8 = 'Y' .AND. A15 = 'Y';
        .AND. A16 = 'Y'
        DO SUSP7
        RETURN
    CASE A5 = 'Y' .AND. A6 = 'Y' .AND. A7 = 'Y' .AND. A8 = 'Y' .AND. A15 = 'Y'
        DO SUSP7
        RETURN
    OTHERWISE
        DO WISE
        RETURN
 ENDCASE
ENDDO
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM GIVES DETAILS OF HEXAMITIASIS AND THE RECOMMENDED TREATMENT(HEXA).
DO BORDER
SET COLOR TO R
@4,4 SAY "...a case of Hexamitiasis."
SET COLOR TO W
@6,4 SAY "This is a disease caused by"
SET COLOR TO G
@6,32 SAY "Hexamita"
SET COLOR TO W
@6,41 SAY "or"
SET COLOR TO G
@6,44 SAY "Octomitis"
SET COLOR TO W
@6,53 SAY ". Hexamita is a small"
@7,4 SAY "but active pear-shaped parasite found in the intestine and gall bladder"
@8,4 SAY "of fish. It can only be seen at X400 magnification or more. It appears"
@9,4 SAY "in smears of gut contents or faeces and usually causes inflamation of"
@10,4 SAY "organs infected. The gall bladder may also become thick-walled with"
@11,4 SAY "jelly-like contents."
SET COLOR TO G
@13,32 SAY "RECOMMENDATION"
SET COLOR TO W
@14,4 SAY "Treat with ENHEPTIN."
@15,4 SAY "If the fish is deficient in vitamin source, include it in the meal."
@16,4 SAY "Examples include cereal grains and yeast."
SET COLOR TO G
@19,29 TO 21,48 DOUBLE
@20,30 SAY "Fish Expert System"
SET COLOR TO W
WAIT
DO CONC
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM GIVES DETAILS OF ICHTHYOPTHIRIUS, ICH OR WHITE SPOT
* DISEASE AND THE RECOMMENDED TREATMENT (ICH).
DO BORDER
SET COLOR TO R
@4,4 SAY "... a case of White spot."
SET COLOR TO W
@6,4 SAY "The classical symptom of the disease is the appearance of small white"
@7,4 SAY "spots or"
SET COLOR TO G
@7,13 SAY "pustules"
SET COLOR TO W
@7,22 SAY "on the body surface, covering the eyes in severe cases."
@8,4 SAY "It is caused by round and slow-revolving parasite which can be observed"
@9,4 SAY "under a hand lense. It is about 0.5mm-1.0mm in diameter. Gill problem/"
@10,4 SAY "gasping occur only in severe cases."
SET COLOR TO G
@12,32 SAY "RECOMMENDATION"
SET COLOR TO W
@13,4 SAY "Several successive treatments with MALACHITE GREEN and FORMALIN."
@19,29 TO 21,48 DOUBLE
SET COLOR TO G
@20,30 SAY "Fish Expert System"
SET COLOR TO W
WAIT
DO CONC
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM GIVES DETAILS OF LERNEA AND THE RECOMMENDED TREATMENT (LERN).
DO BORDER
SET COLOR TO R
@4,4 SAY "...a case of lernea."
SET COLOR TO W
@6,4 SAY "Lernea is also called"
SET COLOR TO G
@6,26 SAY "Anchor worm"
SET COLOR TO W
@6,37 SAY ". It is an ectoparasite of fish. The"
@7,4 SAY "males are not parasites. They have a long worm - like body and can reach"
@8,4 SAY "a length of about 20mm, and frequently embed themselves in the fish, in"
@9,4 SAY "the region of anus. Mortality in fish population is recorded only in"
@10,4 SAY "severe cases."
SET COLOR TO G
@12,32 SAY "RECOMMENDATION"
SET COLOR TO W
@13,4 say "Treat with POTASSIUM PERMANGANATE and MASOTEN."
SET COLOR TO G
@19,29 TO 21,48 DOUBLE
@20,30 SAY "Fish Expert System"
SET COLOR TO W
WAIT
DO CONC
RETURN
```

```
CLEAR
*THIS IS THE MAIN MENU PROGRAM. IT STARTS THE RUNNING (MAINMENU).
SET CONFIRM ON
SET TALK OFF
SET STATUS OFF
SET SCOREBOARD OFF
DO FES
KANT = 0
MAIN = SPACE(1)
MAIN = 0
DO WHILE .T.
    CLEAR
    DO BORDER
    SET COLOR TO B
    @4,4 SAY REPLICATE ('MAINMENU',9)
    @5,4 SAY REPLICATE ('MAINMENU',9)
    @6,4 SAY "MAINMENU"
    SET COLOR TO W
    @7,13 TO 20,66 DOUBLE
    SET COLOR TO B
    @7,4 SAY "MAINMENU"
    SET COLOR TO W
    @6,35 SAY "MAIN MENU"
    SET COLOR TO B
    @6,68 SAY "MAINMENU"
    @7,4 SAY "MAINMENU"
    SET COLOR TO W
    @7,35 TO 7,43 DOUBLE
    SET COLOR TO B
    @7,68 SAY "MAINMENU"
    @8,4 SAY "MAINMENU"
    @8,68 SAY "MAINMENU"
    @9,4 SAY "MAINMENU"
    @9,31 TO 11,56 DOUBLE
    @9,68 SAY "MAINMENU"
    @10,4 SAY "MAINMENU"
    SET COLOR TO W
    @10,23 SAY "1." + SPACE(7) + "Disease Diagnosis"
    SET COLOR TO B
    @10,68 SAY "MAINMENU"
    @11,4 SAY "MAINMENU"
    @11,68 SAY "MAINMENU"
    @11,4 SAY "MAINMENU"
    @11,68 SAY "MAINMENU"
    @12,4 SAY "MAINMENU"
    @12,68 SAY "MAINMENU"
    SET COLOR TO B
    @12,31 TO 14,56 DOUBLE
    SET COLOR TO W
    @13,23 SAY "2." + SPACE(7) + "Consultancy services"
    SET COLOR TO B
    @15,31 TO 17,56 DOUBLE
    SET COLOR TO W
    @16,23 SAY "3." + SPACE(7) + "Quit"
    @19,23 SAY "Make a selection and press enter"
    @19,56 GET MAIN PICTURE "9"
    SET COLOR TO W
    SET COLOR TO B
    @14,4 SAY "MAINMENU"
    @14,68 SAY "MAINMENU"
    @15,4 SAY "MAINMENU"
    @15,68 SAY "MAINMENU"
    @16,4 SAY "MAINMENU"
    @16,68 SAY "MAINMENU"
    @17,4 SAY "MAINMENU"
    @17,68 SAY "MAINMENU"
    @18,4 SAY "MAINMENU"
    @18,68 SAY "MAINMENU"
```
C-30

```
@19,4 SAY "MAINMENU"
@19,68 SAY "MAINMENU"
@20,4 SAY "MAINMENU"
@20,68 SAY "MAINMENU"
@21,4 SAY REPLICATE('MAINMENU',9)
@22,4 SAY REPLICATE('MAINMENU',9)
SET COLOR TO W
READ
DO CASE
   CASE Main = 1
      CLEAR
      DO GNOSIS
      RETURN
   CASE MAIN = 2
      CLEAR
      DO CONSUL
      RETURN
   CASE MAIN = 3
      CLEAR
      DO ODE
      RETURN
   OTHERWISE
      SET COLOR TO R
      @19,20 SAY "Please make a right entry: 1, 2 or 3 !!!"
      SET COLOR TO W
      WAIT
      LOOP
  ENDCASE
ENDDO
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM RESPONDS TO CASE 21 THAT IS ACANTHOCEPHALUS AND AEROMONAS"
* ARE SUSPECTED(MAMO).
DO WHILE .T.
   MUG = SPACE (1)
   CLEAR
   SET COLOR TO R
   DO BORDER
   SET COLOR TO R
   @4,4 SAY "...Acanthocephalus and Aeromonas are suspected."
   SET COLOR TO W
   @6,4 SAY "Treat with FORMALIN and keep observing the fish for further symptom(s)"
   @7,4 SAY "and then re-diagnose."
   @9,4 SAY "If mortality is recorded, Acanthocephalus(R.) is suspected. However, if"
   @10,4 SAY "there is mass mortality, then Pseudomonas/Aeromonas(D.) are suspected."
   @13,14 SAY "For details on R., Press R"
   @14,14 SAY "For details on D., Press D"
   @15,41 GET MUG PICT "!"
   @19,29 TO 21,48 DOUBLE
   SET COLOR TO G
   @20,30 SAY "Fish Expert System"
   SET COLOR TO W
   READ
   DO CASE
      CASE MUG = "R"
         DO ACAN
         RETURN
      CASE MUG = "D"
         DO FUR
         RETURN
      OTHERWISE
         SET COLOR TO R
         @16,4 SAY "You are requested to press R or D !!!"
         SET COLOR TO W
         WAIT
         LOOP
   ENDCASE
ENDDO
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM GIVES DETAILS OF MYXOSOMATIASIS AND THE RECOMMENDED
* TREATMENT (MYXO).
DO BORDER
SET COLOR TO R
@4,4 SAY "... a case of Myxosomatiosis or whirling disease."
SET COLOR TO W
@6,4 SAY "The disease is caused by a protozoan parasite. The parasite"
@6,63 SAY ","
SET COLOR TO G
@6,64 SAY " Myxosoma"
SET COLOR TO W
@6,73 SAY ","
@7,4 SAY "normally lodges in the cartilage of young fish and spreads through the"
@8,4 SAY "skeleton causing deformation of backbone, thus a curved back. The paras-"
@9,4 SAY "ite can be seen in scrapings taken from the bone at the back of the head"
@10,4 SAY "and can be seen only at X400 magnification or more."
SET COLOR TO G
@12,32 SAY "RECOMMENDATION"
SET COLOR TO W
@13,4 SAY "The disease has no known treatment. The black color of the  fish could be"
@14,4 SAY "treated by including enough vitamin in the meal. Examples are cereal"
@15,4 SAY "grains and yeast."
@19,29 TO 21,48 DOUBLE
SET COLOR TO G
@20,30 SAY "Fish Expert System"
SET COLOR TO W
WAIT
DO CONC
RETURN
WAIT
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
*THIS PROGRAM ENDS THE RUNNING (ODE).
DO WHILE .T.
    CLEAR
    DECISION = SPACE(1)
    SET COLOR TO W
    @18,22 TO 20,58 DOUBLE
    DO BORDER
    SET COLOR TO R
    @19,23 SAY "Are you sure you want to quit(y/n)?"
    SET COLOR TO W
    @19,58 GET DECISION PICTURE "!"
    READ
    DO CASE
        CASE DECISION = "Y"
            SET TALK ON
            SET SCOREBOARD ON
            SET STATUS ON
            SET CONFIRM OFF
            RETURN
        CASE DECISION = "N"
            DO MAINMENU
            RETURN
        OTHERWISE
            CLEAR
            SET SCOREBOARD OFF
            SET STATUS OFF
            DO BORDER
            SET COLOR TO R
            @5,18 SAY "You are requested to press 'y' or 'n' !!!"
            SET COLOR TO W
            @18,20 SAY SPACE (1)
            WAIT
            LOOP
    ENDCASE
ENDDO
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM GIVES INFORMATION ABOUT FISH POND CONSTRUCTION
* AND MANAGEMENT (PND).
DO WHILE .T.
   FOX = SPACE (1)
   JAB = SPACE (1)
   CLEAR
   DO BORDER
   SET COLOR TO G
   @5,27 SAY "FISH POND AND MANAGEMENT"
   SET COLOR TO W
   @7,3 SAY "(1) Pond design should allow for easy drainage. Thus, inlet point must"
   @8,7 SAY "be located above the outlet point."
   @10,3 SAY "(2) Water depth of over 2 meters is"
   SET COLOR TO R
   @10,39 SAY "NOT"
   SET COLOR TO W
   @10,43 SAY "good as it would keep some parts"
   @11,7 SAY "of the pond in total darkness, and also reduce the amount of dissolved"
   @12,7 say "oxygen."
   @14,3 SAY "(3) Moving or drainable water is recommended to run a fish pond."
   @16,3 SAY "(4) The pond floor should be slightly slopy towards the outlet point to"
   @17,7 SAY "enhance easy drainage."
   @19,3 SAY "(5) If the water is sourced from river or stream, 'wild fish' should be"
   @20,7 SAY "screened out because fishes in the wild are known to always harbour"
   @21,7 SAY "parasites and diseases germs."
   @22,20 SAY SPACE (1)
   WAIT
   CLEAR
   DO BORDER
   @5,3 SAY "(6) Water source should be able to supply water throughout the rearing"
   @6,7 SAY "season. Therefore the best source of water is spring or borehole."
   @8,3 SAY "(7) A neutral or slightly alkaline water with Biological Oxygen Demand"
   @9,7 SAY "i.e. BOD of about 3mg/1 is ideal."
   @11,3 SAY "(8) A pond with sandy bottom will likely be poor and it is liable to"
   @12,7 SAY "excessive percolation except when underlined by impervious rock."
   @14,3 SAY "(9) Every new batch of fish brought into the farm should go through a"
   @15,7 SAY "quarantine period when they are kept from the other fish and "
   @16,7 SAY "observed for any possible disease before being released into the"
   @17,7 SAY "pond."
   @19,3 SAY "(10)Dirty equipment and habits transmit diseases to fish. Farmers"
   @20,7 SAY "are advised to clean and disinfect the farm tools - such as"
   @21,7 SAY "buckets, tanks, nets, gloves, boots, etc -with bleach or commercial"
   @22,7 SAY "disinfectant. An example is 10% solution of"
   SET COLOR TO G
   @22,51 SAY "SODIUM HYDROXIDE"
   SET COLOR TO W
   @22,68 SAY "(NaOH)."
   WAIT
   CLEAR
   DO BORDER
   @5,4 SAY "(11) Application of lime such as 10% caustic soda (NaOH) should preceed"
   @6,9 SAY "stocking long before putting the pond under water."
   @8,4 SAY "(12) Over-generous application of fertilizer should be avoided because"
   @9,9 SAY "it depletes dissolved oxygen and causes mass mortality of the fish."
   @11,4 SAY "(13) Drainage and drying of the pond for a period of time each year is"
   @12,9 SAY "recommended. These destroy harmful organisms in the pond."
   @14,4 SAY "(14) Never hurry in feeding the fish because:"
   @15,9 SAY "i. it causes wastage of food as large quantity of the food may"
   @16,12 SAY "sink uneaten."
   @17,9 SAY "ii. it will not allow close observation of feeding pattern of the"
   @18,12 SAY "fish which (feeding pattern) is an indicator of state of general"
   @19,12 SAY "well being of the fish."
   @20,20 SAY SPACE (1)
   WAIT
   CLEAR
   DO BORDER
```

```
@4,4 SAY "(15) Fencing the pond will help to keep out predators."
@6,4 SAY "(16) Always carry out autopsy of any fish that died 'naturally'."
@8,4 SAY "(17) Most chemicals used for fish treatment are toxic to fish if applied"
@9,9 SAY "out of proportion."
@11,4 SAY "(18) Always purchase toxic - free"
SET COLOR TO G
@11,38 SAY "MALACHITE GREEN."
SET COLOR TO W
@13,4 SAY "(19) Always aerate the pond while using FORMALIN because it removes"
@14,9 SAY "oxygen from water."
@16,4 SAY "(20) Bathing fish in"
SET COLOR TO G
@16,25 SAY "POTASSIUM PERMANGANATE"
SET COLOR TO W
@16,48 SAY "should be of 10 sec."
@17,9 SAY "duration. Fish immersed in this chemical for more than two minutes"
@18,9 SAY "will die."
@20,4 SAY "(21) Always seek the advice of Local Verterinary Surgeon on outbreak of"
@21,8 SAY " viral or bacterial infection."
@23,10 SAY "Press 'P' for previous screens or any other key to continue."
SET COLOR TO W
@23,69 GET FOX PICT "!"
READ
IF FOX = "P"
    CLEAR
    LOOP
ELSE
    DO CONC
    RETURN
ENDIF
ENDDO
RETURN
```

```
CLEAR
*THIS PROGRAM RECOMMENDS THE USE OF THIS PACKAGE (RECO).
SET TALK OFF
SET STATUS OFF
SET SCOREBOARD OFF
SET COLOR TO G
@0,0 TO 0,79 DOUBLE
R1 = 1
C1 = 0
R2 = 2
C2 = 0
DO WHILE C1 < 70
      @R1,C1 TO R2,C2 DOUBLE
      C1 = C1 + 1
      R2 = R2 + 1
      IF C1 > 7
         SET COLOR TO R
         R2 = 10
      ENDIF
      IF C1 > 26
         SET COLOR TO W
      ENDIF
      IF C1 > 52
         SET COLOR TO R
      ENDIF
      C2 = C2 + 1
ENDDO
@1,70 TO 9,70 DOUBLE
@1,71 TO 9,71 DOUBLE
@1,72 TO 9,72 DOUBLE
SET COLOR TO G
@1,73 TO 9,73 DOUBLE
@1,74 TO 8,74 DOUBLE
@1,75 TO 7,75 DOUBLE
@1,76 TO 6,76 DOUBLE
@1,77 TO 5,77 DOUBLE
@1,78 TO 4,78 DOUBLE
@1,79 TO 3,79 DOUBLE
SET COLOR TO W
@10,0 TO 16,78 DOUBLE
SET COLOR TO G
@11,1 SAY "  THIS PROGRAM IS RECOMMENDED FOR FARMERS WITH BACKYARD FISH PONDS,SCHOOLS"
@12,1 SAY "  COMMERCIAL FISH FARMS AND AQUACULTURAL, AS WELL AS AGRICULTURAL SECTORS."
@13,1 SAY "   DUE TO THE ENORMITY OF DISEASES OF FISH,THE PROGRAM LIMITS CONSULTANCY"
@14,1 SAY "  SERVICES TO ONLY THE CASES IN THE TROPICS. FOR THE SAME REASON, A FEW BUT"
@15,1 SAY "                    IMPORTANT DISEASES ARE FOCUSED."
SET COLOR TO W
R1 = 17
C1 = 8
R2 = 23
C2 = 8
DO WHILE C1 < 72
   @R1,C1 TO R2,C2 DOUBLE
   C1 = C1 + 1
   C2 = C2 + 1
   IF C1 > 26
      SET COLOR TO R
   ENDIF
   IF C1 > 51
      SET COLOR TO W
   ENDIF
ENDDO
@17,7 TO 23,7 DOUBLE
@17,72 TO 23,72 DOUBLE
SET COLOR TO G
@17,6 TO 23,6 DOUBLE
```

```
@17,73 TO 23,73 DOUBLE
@18,5 TO 23,5 DOUBLE
@18,74 TO 23,74 DOUBLE
@19,4 TO 23,4 DOUBLE
@19,75 TO 23,75 DOUBLE
@20,3 TO 23,3 DOUBLE
@20,76 TO 23,76 DOUBLE
@21,2 TO 23,2 DOUBLE
@21,77 TO 23,77 DOUBLE
@22,1 TO 23,1 DOUBLE
@22,78 TO 23,78 DOUBLE
SET COLOR TO G
@23,1 TO 23,78 DOUBLE
SET COLOR TO W
WAIT
CLEAR
RETURN
```

```
CLEAR
* THIS PROGRAM RESPONDS TO CASES 15 AND 16 THAT IS FURUNCULOSIS IS
* SUSPECTED (SUSP10).
SET STATUS OFF
SET SCOREBOARD OFF
STORE SPACE (1) TO MONAS
DO BORDER
SET COLOR TO R
@4,4 SAY "...Furunculosis is suspected."
SET COLOR TO W
@6,4 SAY "For more information about the disease prss 'F' otherwise press any"
@7,4 SAY "other key to continue." GET MONAS PICT "!"
SET COLOR TO G
@19,29 TO 21,48 DOUBLE
@20,30 SAY "Fish Expert System"
SET COLOR TO W
READ
IF MONAS = "F"
   DO FUR
   RETURN
ELSE
   DO CONC
   RETURN
ENDIF
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM RESPONDS TO CASES 3, AND 4 THAT IS VIRAL INFECTION IS"
* SUSPECTED (SUSP11).
STORE SPACE (1) TO VIR
DO BORDER
SET COLOR TO R
@4,4 SAY "...Viral infection is suspected."
SET COLOR TO W
@6,4 SAY "For more information about the disease press 'V' otherwise press any"
@7,4 SAY "other key to continue." GET VIR PICT "!"
SET COLOR TO G
@19,29 TO 21,48 DOUBLE
@20,30 SAY "Fish Expert System"
SET COLOR TO W
READ
IF VIR = "V"
    DO VIRAL
    RETURN
ELSE
    DO CONC
    RETURN
ENDIF
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
*THIS PROGRAM RESPONDS TO CASES 7 AND 10, THAT IS MYXOSOMATIOSIS IS
*SUSPECTED (SUSP2).
STORE SPACE(1) TO MYX
DO BORDER
SET COLOR TO R
@4,4 SAY "...Myxosomatiosis is suspected."
SET COLOR TO W
@6,4 SAY "If you have not been feeding the fish on vitamin diet, do include it in"
@7,4 SAY "the diet and keep observing the fish for futher symptom or improvement."
@8,4 SAY "Example of Vitamin source includes: cereal grains and yeast."
@10,4 SAY "For more information about the disease, press 'M' or any other key to"
@11,4 SAY "continue." GET MYX PICT "!"
SET COLOR TO G
@19,29 TO 21,48 DOUBLE
@20,30 SAY "Fish Expert System"
SET COLOR TO W
READ
IF MYX = "M"
    DO MYXO
    RETURN
ELSE
    DO CONC
    RETURN
ENDIF
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM RESPONDS TO CASES 19 AND 21 THAT IS ACANTHOCEPHALUS/CESTODES
* IS SUSPECTED (SUSP4).
STORE SPACE (1) TO AC
DO BORDER
SET COLOR TO R
@4,4 SAY "...Acanthocephalus/cestode is suspected."
SET COLOR TO W
@6,4 SAY "For more information about the disease press 'A' otherwise press"
@7,4 SAY "any other key to continue." GET AC PICT "!"
SET COLOR TO G
@19,29 TO 21,48 DOUBLE
@20,30 SAY "Fish Expert System"
SET COLOR TO W
READ
IF AC = "A"
    DO ACAN
    RETURN
ELSE
    DO CONC
    RETURN
ENDIF
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM RESPONDS TO CASES 22, 23 AND 25 THAT IS LERNEA IS
* SESPECTED (SUSP6).
STORE SPACE (1) TO LERN
DO BORDER
SET COLOR TO R
@4,4 SAY "...Lernea is suspected."
SET COLOR TO W
@6,4 SAY "For more information about the disease press L, otherwise press any"
@7,4 SAY "other key to continue." GET LERN PICT "!"
@19,29 TO 21,48 DOUBLE
SET COLOR TO G
@20,30 SAY "Fish Expert System"
SET COLOR TO W
READ
IF LERN = "L"
   DO LERN
   RETURN
ELSE
   DO CONC
   RETURN
ENDIF
RETURN
```

```
CLEAR
*THE PROGRAM RESPONDS TO CASES 33, 34 AND 36 THAT IS WHITE SPOT IS
*SUSPECTED (SUSP7).
SET STATUS OFF
SET SCOREBOARD OFF
STORE SPACE (1) TO WHITE
DO BORDER
SET COLOR TO R
@4,4 SAY "...White spot is suspected."
SET COLOR TO W
@6,4 SAY "For more information about the disease press 'W' otherwise press any"
@7,4 SAY "other key to continue." GET WHITE PICT "!"
SET COLOR TO G
@19,29 TO 21,48 DOUBLE
@20,30 SAY "Fish Expert System"
SET COLOR TO W
READ
IF WHITE = "W"
    DO ICH
    RETURN
ELSE
    DO CONC
    RETURN
ENDIF
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM RESPONDS CASES 30 AND 32 THAT IS TRICHODINIASIS"
*IS SUSPECTED (SUSP8).
STORE SPACE (1) TO CHIL
DO BORDER
SET COLOR TO R
@4,4 SAY "...Trichodiniasis and Chilodonelliasis are suspected."
SET COLOR TO W
@6,4 SAY "For more information about the disease press 'T', otherwise press any"
@7,4 SAY "other key to continue." GET CHIL PICT "!"
SET COLOR TO G
@19,29 TO 21,48 DOUBLE
@20,30 SAY "Fish Expert System"
SET COLOR TO W
READ
IF CHIL = "T"
   DO TRICH
   RETURN
ELSE
   DO CONC
   RETURN
ENDIF
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM GIVES DETAILS OF TRICHODINASIS/CHILODONELLASIS AND
* THE RECOMMENDED TREATMENT (TRICH).
DO BORDER
SET COLOR TO R
@4,4 SAY "...a case of Trichodinasis/Chilodonellasis."
SET COLOR TO W
@6,4 SAY "This is a disease caused by parasites, Trichodina or Chilodonella. It"
@7,4 SAY "affects the gill and skin. Trichodina is a large saucer-shaped parasite"
@8,4 SAY "that feed on its host by means of rows of rasping teeth. The parasite can"
@9,4 SAY "be seen under a hand lense or low power microscope. Chilodonella is a"
@10,4 SAY "killer of fry and fingerlings."
@12,4 SAY "It is a large slow-moving heart-shaped parasite. It is only visible in"
@13,4 SAY "mucous scrapings from freshly dead or dying fish as they leave the host"
@14,4 SAY "immediately after its death. Gill problem and mortality are recorded only"
@15,4 SAY "in severe cases."
SET COLOR TO G
@17,32 SAY "RECOMMENDATION"
SET COLOR TO W
@18,4 SAY "For Trichodinasis treat with 25 ppm of MALACHITE GREEN or FORMALIN."
@19,4 SAY "For Chilodonellasis, treat with 40-45ppm of MALACHITE GREEN or FORMALIN"
@20,29 TO 22,48 DOUBLE
SET COLOR TO G
@21,30 SAY "Fish Expert System"
SET COLOR TO W
WAIT
DO CONC
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM GIVES INFORMATION ABOUT VIRAL INFECTION AND THE PRECAUTIONS
* AS WELL AS RECOMMENDATION (VIRAL).
DO BORDER
SET COLOR TO R
@4,4 SAY "...Viral infection is suspected."
SET COLOR TO W
SET COLOR TO W
@6,4 SAY "This is a rear case in African continent. It is mainly restricted to"
@7,4 SAY "North America, Japan and Europe. Since there is no known cure for viral"
@8,4 SAY "infection, any infected fish should be destroyed and the pond disinfected"
@9,4 SAY "before use."
@11,4 SAY "All cases of viral infection should be reported immediately to Local"
@12,4 SAY "Veterinary Surgeon."
SET COLOR TO G
@19,29 TO 21,48 DOUBLE
@20,30 SAY "Fish Expert System"
SET COLOR TO W
WAIT
DO CONC
RETURN
```

```
CLEAR
* THIS PROGRAM RESPONDS TO OTHER OPTIONS MADE BESIDES THE AVAILABLE 41
* CASES (WISE).
SET SCOREBOARD OFF
SET STATUS OFF
DO WHILE .T.
  FAG = SPACE (1)
  CLEAR
  DO BORDER
  SET COLOR TO R
  @4,4 SAY "You likely did not carefully observe the fish before this consultation"
  SET COLOR TO W
  @6,4 SAY "Before you consult this expert, you have to make a"
  SET COLOR TO G
  @6,55 SAY "DETAILED"
  SET COLOR TO W
  @6,64 SAY "and"
  SET COLOR TO G
  @6,68 SAY "CAREFUL"
  SET COLOR TO W
  @7,4 SAY "observation of the fish in question, otherwise you may"
  SET COLOR TO R
  @7,59 SAY "NOT"
  SET COLOR TO W
  @7,63 SAY "make a correct"
  @8,4 SAY "diagnosis."
  SET COLOR TO G
  @18,15 SAY "Do you want more clues on fish observation(y/n) ?" GET FAG PICT "!"
  @19,29 TO 21,48 DOUBLE
  SET COLOR TO G
  @20,30 SAY "Fish Expert System"
  SET COLOR TO W
  READ
  SET COLOR TO W
  DO CASE
     CASE FAG = "Y"
        DO FISDIS
        RETURN
     CASE FAG = "N"
        DO CONC
        RETURN
     OTHERWISE
        SET COLOR TO R
        @22,22 SAY " You are expected to press 'y' or 'n' !!!"
        SET COLOR TO W
        WAIT
        CLEAR
        LOOP
  ENDCASE
ENDDO
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM RESPONDS TO ANY VITAMIN DEFICIENT CASE(REP1&2).
DO BORDER
@4,4 SAY "If the fish had not been feeding on vitamin diets, include it in the meal"
@5,4 SAY "and watch out for further symptoms/improvement, and then re-diagnose."
@21,20 SAY SPACE (1)
WAIT
DO CONC
RETURN
```

```
CLEAR
* THIS PROGRAM GIVES INFORMATION ABOUT THE TYPE OF FISH THAT IS GOOD
* FOR REARING (WISH).
SET STATUS OFF
SET SCOREBOARD OFF
DO WHILE .T.
   STORE SPACE (1) TO FOX
   DO BORDER
   SET COLOR TO G
   @4,4 SAY "Features of a rearable fish"
   SET COLOR TO W
   @5,6 SAY "Rearable fish are those that can:"
   @6,8 SAY "i.   tolerate pond or artificial conditions"
   @7,8 SAY "ii.  grow quickly on both natural and artificial feed"
   @8,8 SAY "iii. reproduce or breed in captive"
   @9,8 SAY "iv.  fairly resist diseases and parasitic infection"
   @10,8 SAY "v.   be hardy generally"
   SET COLOR TO G
   @12,4 SAY "The following are some examples of fish species that are commonly"
   @13,4 SAY "rared."
   SET COLOR TO W
   @14,6 SAY "Tilapia sp. - Oreochromis niloticus"
   @15,20 TO 15,30
   @15,32 TO 15,40
   @16,20 SAY "Oreochromis mosambicus"
   @17,20 TO 17,30
   @17,32 TO 17,41
   @18,20 SAY "Tilapia zilli"
   @19,20 TO 19,26
   @19,28 TO 19,32
   @20,20 SAY "Sarotherodon melanotheron"
   @21,20 TO 21,31
   @21,33 TO 21,44
   WAIT
   CLEAR
   DO BORDER
   @5,6 SAY "Carp sp. - Caprinus cappio"
   @6,17 TO 6,24
   @6,26 TO 6,31
   @8,17 SAY "Silver carp"
   @10,17 SAY "Bighead carp"
   @12,17 SAY "Grass carp"
  SET COLOR TO G
   @16,8 SAY "Press 'P' for previous page or any other key to continue."
   @16,66 GET FOX PICT "!"
   @18,29 TO 20,48 DOUBLE
   @19,30 SAY "Fish Expert System"
   SET COLOR TO W
   READ
   IF FOX = "P"
      CLEAR
      LOOP
   ELSE
      DO CONC
      RETURN
   ENDIF
ENDDO
RETURN
```

```
CLEAR
SET STATUS OFF
SET SCOREBOARD OFF
* THIS PROGRAM RESPONDS TO THE CASE WHEN ALL ANSWERS
* TO THE EXPERT ARE NO (WELL).
DO BORDER
STORE SPACE (1) TO AD
SET COLOR TO G
@4,4 SAY "...Your fish is likely well."
SET COLOR TO W
@6,4 SAY "However, if you are not satisfied, re-consult the expert. But make sure"
@7,4 SAY "you"
SET COLOR TO G
@7,8 SAY "carefully"
SET COLOR TO W
@7,18 SAY "examine your fish and look out for the possible symptoms"
@8,4 SAY "of fish diseases. Otherwise, you may not get satisfied with the experts'"
@9,4 SAY "advice."
SET COLOR TO G
@15,15 SAY "Do you need clues on how to examine fish?(Y/N)" GET AD PICT "!"
@19,29 TO 21,48 DOUBLE
@20,30 SAY "Fish Expert System"
SET COLOR TO W
READ
IF AD = 'Y'
    DO FISDIS
    RETURN
ELSE
    DO CONC
    RETURN
ENDIF
RETURN
```

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
        APPLICATION OF ARTIFICIAL INTELLIGENCE
            IN FISH DISEASE DIAGNOSIS OF
                FISH IN THE TROPICS
            AND ECONOMIC MANAGEMENT OF
                    FISH FARM

                        BY

        ALADETOYINBO LAWRENCE ADEYEMI WILLIAMS
                (PGD/MSC/97/272)

        DEPARTMENT OF MATHS/COMPUTER SCIENCE
        SCHOOL OF SCIENCES AND SCIENCE EDUCATION
            FEDERAL UNIVERSITY OF TECHNOLOGY
                    MINNA, NIGER STATE
                        NIGERIA

                    FEBRUARY 1999
Press any key to continue...
```

```
        The program was written by YEMI ALADETOYINBO


                    submitted to


            The Department of MATHS/COMPUTER SCIENCE
        Federal University of Technology (FUT), Minna,Niger State
                In partial fulfilment of the.
                requirements for the award of
        Post-graduate Diploma(PGD) in Computer Science


                    February, 1999
Press any key to continue...
```

D-1

THIS PROGRAM IS RECOMMENDED FOR FARMERS WITH BACKYARD FISH PONDS,SCHOOLS
COMMERCIAL FISH FARMS AND AQUACULTURAL, AS WELL AS AGRICULTURAL SECTORS.
DUE TO THE ENORMITY OF DISEASES OF FISH,THE PROGRAM LIMITS CONSULTANCY
SERVICES TO ONLY THE CASES IN THE TROPICS. FOR THE SAME REASON, A FEW BUT
IMPORTANT DISEASES ARE FOCUSED.

Press any key to continue...

```
MAINMENUMAINMENUMAINMENUMAINMENUMAINMENUMAINMENUMAINMENUMAINMENUMAINMENU
MAINMENUMAINMENUMAINMENUMAINMENUMAINMENUMAINMENUMAINMENUMAINMENUMAINMENU
MAINMENU                        MAIN MENU                         MAINMENU
MAINMENU                                                          MAINMENU
MAINMENU                                                          MAINMENU
MAINMENU                                                          MAINMENU
MAINMENU      1.        Disease Diagnosis                         MAINMENU
MAINMENU                                                          MAINMENU
MAINMENU                                                          MAINMENU

MAINMENU      2.        Consultancy services
MAINMENU                                                          MAINMENU
MAINMENU                                                          MAINMENU
MAINMENU      3.        Quit                                      MAINMENU
MAINMENU                                                          MAINMENU
MAINMENU                                                          MAINMENU
MAINMENU      Make a selection and press enter 0                  MAINMENU
MAINMENU                                                          MAINMENU
MAINMENUMAINMENUMAINMENUMAINMENUMAINMENUMAINMENUMAINMENUMAINMENUMAINMENU
MAINMENUMAINMENUMAINMENUMAINMENUMAINMENUMAINMENUMAINMENUMAINMENUMAINMENU
```

```
********************************************************************************
  The Fish Expert System will be asking you series of questions. You are
  expected to respond YES or NO by pressing 'Y' or 'N' respectively.
  This is followed by enter key.
```

Press any key to continue...

```
********************************************************************************
===============================DIAGNOSTIC PROCEDURE============
  1.  Do you observe any dark coloration on the fish ? Y
  2.  Is it an intense dark coloration ? N
  3.  Is the fish unable to feed well (feeding supression) ? Y
  4.  Is the feeding supression so pronounced ? N
  5.  Do you notice any abnormal mucous production ? Y
  6.  Is the mucous production in excess ? N
  7.  Do you notice any abnormal swimming such as fish
      rubbing the body on the wall of pond or tank ? Y
  8.  Is the abnormal swimming very often ? N
  9.  Do you notice swollen belly on the fish (ODEMA) ? Y
  10.  Is the swollen belly very pronounced ? N
  11.  Do you notice period of motionless and quivery in the fish ? Y
  12.  Do you notice any external leision on the fish body ? Y
  13.  What about wasting of any body part ? Y
  14.  Do you notice any visible organism attached to the fish body
       and/ or gill ? Y
  15.  Is there any symptom of gill problem such as gasping for air ? Y
  16.  Do you record any mortality ? Y
  17.  Is it a mass mortality ? N
```

```
*************************************************************************

  ...a case of Argulus.

  This is called the fish louse and it is a parasite found on the body sur-
  face, gills and fins of fish. It is about 3-4mm long and can be seen with
  naked eye as a small speck with two black eyespots.

                              RECOMMENDATION
  Treat with POTASSIUM PERMANGANATE and MASOTEN.




                              ┌─────────────────────┐
Press any key to continue...  │ Fish Expert System  │
                              └─────────────────────┘
```

Do you want to consult the expert again (y/n)?

Are you sure you want to quit(y/n)?

```
**************************************************************************

NOTE: THIS SEGMENT OF THE PROGRAM PROVIDES YOU WITH SOME NECESSARY
      CLUES TO TACKLE PROBLEMS WHICH YOU COME ACROSS FROM TIME TO TIME.
      YOU NEED TO GET FAMILIAR WITH THE INFORMATION THEREIN.

                              CONSULTANCY MENU
                              ================

                    1.    ABOUT FISH DISEASES

                    2.    WHICH FISH TO FARM

                    3.    POND AND MANAGEMENT



             Make a selection...                    0
```

```
**************************************************************************

When observing fish...
    * both the inner and outer parts should be considered.
    * internally, the kidney, liver, gall-bladder, the intestine and swim
      bladder should be thoroughly observed for any abnormal appearance.
    * excessive collection of fluid in the belly should be looked out for.
    * always prepare a slide of scraped mucous from both the gill and skin
      for observation.

Also, look out for...
    i.    endoparasite
    ii.   haemorhage
    iii.  putrid odour on dissection
    iv.   abnormal organ appearance
    v.    excessive collection of fluid in abdomen
    vi.   bacteria in fluid sample


Press any key to continue...
```

```
*************************************************************************

    Features of a rearable fish
       Rearable fish are those that can:
          i.    tolerate pond or artificial conditions
          ii.   grow quickly on both natural and artificial feed
          iii.  reproduce or breed in captive
          iv.   fairly resist diseases and parasitic infection
          v.    be hardy generally

    The following are some examples of fish species that are commonly
    rared.
       Tilapia sp.  - Oreochromis niloticus
                      ‾‾‾‾‾‾‾‾‾‾‾ ‾‾‾‾‾‾‾‾‾

                      Oreochromis mosambicus
                      ‾‾‾‾‾‾‾‾‾‾‾ ‾‾‾‾‾‾‾‾‾

                      Tilapia zilli
                      ‾‾‾‾‾‾‾ ‾‾‾‾‾

                      Sarotherodon melanotheron
                      ‾‾‾‾‾‾‾‾‾‾‾ ‾‾‾‾‾‾‾‾‾‾‾
Press any key to continue...
```

```
*************************************************************************

                        FISH POND AND MANAGEMENT

    (1) Pond design should allow for easy drainage. Thus, inlet point must
        be located above the outlet point.

    (2) Water depth of over 2 meters is NOT good as it would keep some parts
        of the pond in total darkness, and also reduce the amount of dissolved
        oxygen.

    (3) Moving or drainable water is recommended to run a fish pond.

    (4) The pond floor should be slightly slopy towards the outlet point to
        enhance easy drainage.

    (5) If the water is sourced from river or stream, 'wild fish' should be
        screened out because fishes in the wild are known to always harbour
        parasites and diseases germs.

Press any key to continue...
```

```
************************************************************************

    Carp sp. - Caprinus cappio
               ────────  ──────

            Silver carp

            Bighead carp

            Grass carp


    Press 'P' for previous page or any other key to continue.

                    ┌─────────────────────┐
                    │ Fish Expert System  │
                    └─────────────────────┘
```

Do you want to consult the expert again (y/n)?

```
            Are you sure you want to quit(y/n)?
```