

EcoRestore

A Decision Support System for the Restoration of Degraded Rangelands

Version 1.0

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Disclaimer:

The Potchefstroom University for CHE accepts no responsibility if the use and application of any procedures expressed by this system does not satisfy the needs or expectations of the user.

Contents

Introduction	1
<i>EcoRestore</i> DSS versions	4
Hardware specifications.....	4
Installation.....	5
Components of the <i>EcoRestore</i> DSS	7
Principle on which the <i>EcoRestore</i> DSS operates.....	8
Consultation of the <i>Grass Expert</i> database	11
Consultation of the <i>Bush Expert</i> database.....	14
Additional Information.....	21
Troubleshooting	22
Acknowledgements	24

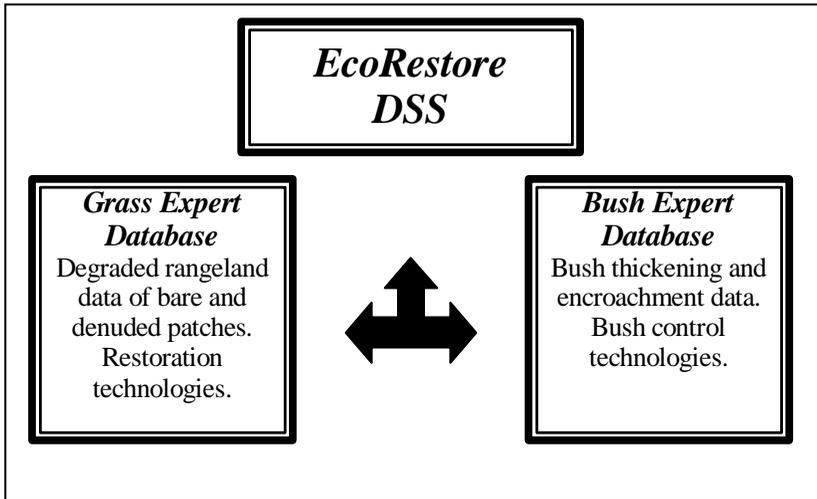
Introduction



The **EcoRestore Decision Support System** (*EcoRestore* DSS) is based on case studies of technologies and approaches that have been researched and applied by rangeland managers, scientists and farmers over the short- and long-term in order to restore degraded rangelands or combat problem woody species (bush) and alien species encroachment and thickening. The DSS consists of two databases, i.e. **Grass Expert** - which includes mechanical and/or biological technologies to restore or re-vegetate bare and denuded areas, as well as unproductive rangelands, and **Bush Expert** – which includes case studies of technologies to control or combat bush encroachment and thickening (chemical, manual, mechanical and biological).

The challenge of this DSS is to optimize the exchange of knowledge concerning these practices that have been applied previously and disseminate it to as many users as possible for future rangeland management applications.

Structure of the *EcoRestore* DSS



The restoration technologies that have been applied previously, mostly on a trial-and-error basis, over the short- and long-term in different habitats and environmental conditions are quantitatively assessed and the data is incorporated into the databases. The databases can now be consulted. By means of an expert system approach, certain results (solutions/actions) are given that can help the user to address the problem of degraded rangelands or bush encroachment. The results will indicate what the user can expect if the same technology is applied over a similar time frame and under the same environmental conditions, as indicated by the case studies in the databases.

The case studies currently incorporated into the *Grass Expert* database, includes technologies, which have mainly been assessed in South Africa. The *Bush Expert* database mainly includes technologies of case studies sampled in Namibia.

The two databases that are presently incorporated in the *EcoRestore* DSS can be used in conjunction with one another. Areas that have been cleared by means of bush control technologies are often bare and denuded. The *Grass Expert* database can then be consulted to gain knowledge on how these areas can be restored by different methods of re-vegetation or reclamation.

The *EcoRestore* DSS is, however, a dynamic system and as new data from other case studies in southern Africa or other parts of the world become available, they will be incorporated into the databases of the DSS. Please consult the developers for updated *EcoRestore* versions in future.

EcoRestore DSS versions

Two versions of the *EcoRestore* DSS are available.

1. The on-line, web-version. This version can be extracted and consulted via the following internet address: www.puk.ac.za/EcoRestore.
2. The CD-ROM version. This version needs to be updated regularly, either by means of an updated CD of the *EcoRestore* DSS, or from the on-line web-version. Please contact the developers of the *EcoRestore* DSS as indicated in this manual for further information.

This user's manual concentrates on the use and operation of the *EcoRestore* DSS CD-ROM version.

Hardware specifications

- Internet Explorer 5 (or better) **(NB!)**
- Windows 98 (or better)
- Office 2000 (or better)
- 68 MB RAM
- Pentium I
- 10 MB Hard-drive Space

Installation

Follow these procedures for installation:

1. Go to “**Windows Explorer**” of your computer and make sure that you are in the C: drive.
2. Insert the *EcoRestore* CD-ROM in the **CD-drive** of your computer.
3. The *EcoRestore* CD will install **automatically**. A small black screen will appear. **Wait!** Please do not close the application. It will take 3-5 minutes to install, depending on the speed of your computer.
4. Depending on the settings of your computer, one of the following may happen:
 - The black screen will disappear automatically.
 - In the title bar of the black box a command will appear that installation is “finished”. Close the box by clicking on the “☒” in the right hand corner.
 - If nothing happened after 5 minutes check in Windows Explorer if *EcoRestore* has installed.
5. Go to “**View**” on your Windows Explorer toolbar. Click on “**Refresh**”.
6. An “**EcoRestore**” folder has now been created in the C: drive of your computer.
7. You can now **remove** the CD-ROM and store it in a safe place.

8. Double-click on the “**EcoRestore**” folder.
9. Search for the “**setup.exe**” application by scrolling down.
10. Double-click on “**setup.exe**”.
11. Choose “**OK**” on the next screen.
12. Click on the “**computer button**”-icon.
13. The name “**EcoRestore**” should appear in the “**Program Group**” box.
14. The name “**EcoRestore**” should be highlighted in the “**Existing group**” box.
15. Click on “**Continue**”.
16. Wait until the *EcoRestore* setup is completed successfully (a window will now appear).
17. Click on “**OK**”. The files in the *EcoRestore* folder will appear again. **NB:** The system is now installed successfully on your computer.

To activate the *EcoRestore* DSS, follow this procedure:

- Click on “**Start**” on your Windows tool bar in the bottom left hand corner.
- Go to “**Programs**”.
- Go to “**EcoRestore**”.
- Go to “**EcoRestore Index**”.
- The *EcoRestore* homepage will appear and the DSS can now be consulted.

Components of the *EcoRestore* DSS

The *EcoRestore* DSS consists of the following components:

1. **Main Page** with links to the funding agencies and important role players.
2. **Introduction** with a brief explanation of the structure of the DSS.
3. **Information** which includes the aims of the DSS.
4. **Grass Expert** introduction, questionnaire and the procedure for the consultation of the database.
5. **Bush Expert** introduction, questionnaire and the procedure for the consultation of the database.
6. **Profiles** of the developers of the *EcoRestore* DSS.
7. **Web Links** to web pages of other important institutions and interrelated service providers.

* The information contained in all of the components of the *EcoRestore* DSS can be printed by clicking on “**File**” in the toolbar at the top of the screen and choosing the “**Print**” option in the drop list.

Principle on which the *EcoRestore* DSS operates

The *EcoRestore* DSS operates on the principle of questions and answers (Figure 1). Depending on the problem the user experiences (bare/denuded areas and unproductive rangeland, or bush encroachment and thickening), either the *Grass Expert* or *Bush Expert* database can be consulted.

1. Choose the appropriate database on the *EcoRestore* Home Page.
2. The chosen database (*Grass Expert* or *Bush Expert*) will be activated.
3. A short introduction of the specific database will be given.
4. When consulting the chosen database, a number of questions will be asked by the *EcoRestore* expert system.
5. The type and extent of the problem is described by the land user by answering a number of questions. These questions can be answered by choosing the best possible option from the list provided by the database in the DSS. (Drop lists in *Bush Expert*).
6. Using expert system approaches, the system will now search through the database and try to match the answer given by the user to similar case studies already incorporated into the database.

7. Answer as many questions as possible. If the answer to a question is not known, choose the “other” option on the list of answers. It is not compulsory to answer all the questions.
8. Some questions and answers provide hyperlinks to additional information, e.g. maps, diagrams or images. These will assist you with the interpretation of the question and in choosing the most appropriate answer. In the *Grass Expert* database, the “Display help” function can also be consulted.
9. The best possible solution to a specific problem is obtained through the matching process as previously described.
10. The best possible solution (answer) to a specific problem is given as an “action” or “result”. The solution will depend on how close the answers given are matched to the data of previous case studies already incorporated in the specific database. The percentage match to the case studies in the database indicates the degree of the best possible solution to the user’s problem. A selection of case studies, including different technologies and results, are given. From these the user can choose the most suitable option that will address his/her specific problem.

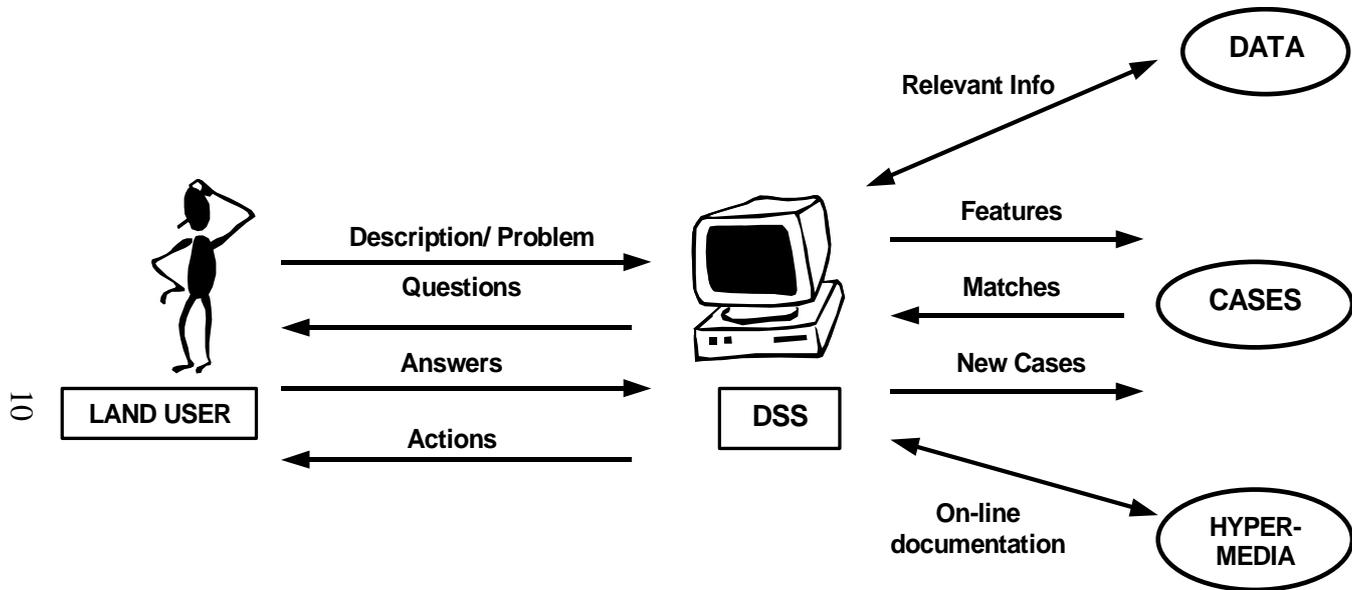


Figure 1. Principle on which the *EcoRestore* DSS operates.

Consultation of the *Grass Expert* database

This database is consulted when bare and denuded areas, as well as unproductive rangelands, have to be restored or re-vegetated.

Follow this procedure to consult the database:

1. Double click on the “***Grass Expert***” database icon on the Home or Main page area.
2. Click on “**Click here to consult the *Grass Expert* database**”.
3. Fourteen questions will be asked, each with a list of answers to choose from.

***Grass Expert* Questionnaire**



The screenshot shows the 'Grass Expert Questions and Answers' interface. At the top, the title 'Grass Expert Questions and Answers' is displayed in red. Below the title, there is a question box labeled '(5) What is the size of the problem area?' with a text input field containing 'na' and a 'Go' button. Below the question box, there are navigation buttons: a left arrow, 'Questions 2 of 14', and a right arrow. A 'Display Results' button is located below the navigation buttons. Below the 'Display Results' button, there is an 'Answers' section with a dropdown menu set to 'Result'. The dropdown menu is expanded, showing a list of options: 'Small patches (up to 20 m in size)', 'Camp (+/- 10 ha)', 'Number of camps (10-50 ha)', 'Very large area (> 50 ha)', and 'other - if none of the above refers to your problem'. Below the dropdown menu, there is another 'Display Results' button.

4. Help to the questions can be obtained as follows:
 - (a) **Scrolling down** on the same page, e.g. average annual rainfall; terrain's topographical unit; type of mechanical implement; or
 - (b) By clicking on **“Display help for this question”**, e.g. soil type. A whole book of all the soil types with names and photos will be displayed.

5. After most or all questions have been answered, click on the **“Display results”** option. A possible solution (action) to the particular problem, as identified by the user for a specific environment, will be displayed. The solution is based on data of previous knowledge and case studies similar to the problem identified.

Grass Expert Results

The screenshot shows a web interface for 'Grass Expert Results'. At the top, there are input fields for 'Match (%)' (29.88), 'Cases (%)' (23), and a text box containing 'Till the soil with a Chisel plough and sow seed mixture.' Below this is a 'Show' button. The main content area contains the following text:

The farm Erfbackt is located in the Free State province, Balfourville district. Situated in the Grassland biome and on an A000 soil type. The average long term rainfall is 1000mm.

The following management was applied: -
 Till the soil with a Chisel plough at a depth of 300mm and sow Finger grass (*Digitaria eriantha*) and Blue buffalo (*Cenchrus ciliaris*) -
 Results of this treatment are as follows and could be expected in your application: -
 Density of the plants - 30.6 plants/m² (1994)

Plant species and their percentages:

- Aristida congesta* - 1.3%
- Digitaria eriantha* - 53.3%
- Eragrostis lemnorrhiza* - 24.5%
- Sporobolus hirsutus* - 4.3%
- Setaria sphacelata* - 3.8%
- Themeda triandra* - 2.2%
- Heteropogon contortus* - 1.5%
- Tragus berterianus* - 0.8%

At the bottom of the interface, there is a navigation bar with 'Ecorestore Results 6 of 10' and a 'Back to Questions' link. A 'Scroll down to view image' link is also present.

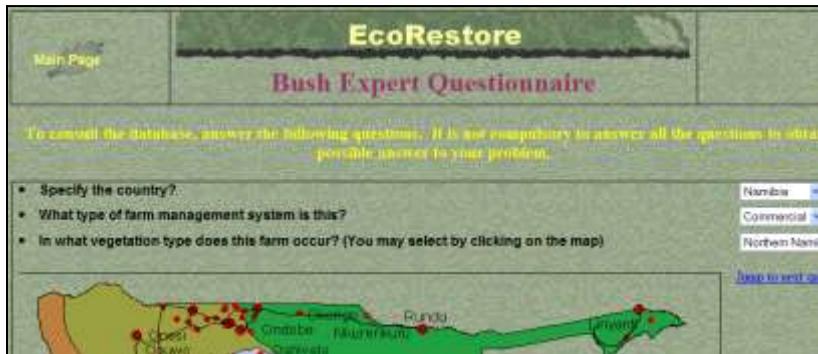
6. A number of answers (results) are given, depending on how the entered data matches the case studies already in the database. The degree to which it matches, which indicates the confidence of the possible solution, is given as a percentage (%). The case number is given, as well as the type of action that was implemented in the previous application that has led to the displayed result.
7. General information about the case study is also given. This includes the location, environmental factors, as well as a more detailed description of the action that was followed over a certain period of time, which has led to the displayed result.
8. The data of the quantitative assessment that was carried out at the study site is also provided. This includes the density of the grass species (no. of plants/m²), as well as the abundance of all the species sampled at the specific site, expressed as the percentage (%) frequency.
9. The data given for the quantitative assessment serves as an indication of the result that can be expected should a similar action be carried out by the user in the same environment and over similar time frames.
10. An image of the result is also given in some instances.
11. The user can choose from the number of results given, taking the percentage (%) match into consideration.

Consultation of the *Bush Expert* database

This database is consulted if bush encroachment and thickening needs to be controlled by means of different technologies (chemical, manual, mechanical or biological). Currently only case studies from Namibia are incorporated into the *Bush Expert* database.

Follow this procedure to consult the database:

Bush Expert Questionnaire



The screenshot shows the 'EcoRestore Bush Expert Questionnaire' web interface. At the top, it says 'EcoRestore' and 'Bush Expert Questionnaire'. Below that, a yellow box contains the text: 'To consult the database, answer the following questions. It is not compulsory to answer all the questions in order possible answers to your problem.' There are three bullet points for questions: 'Specify the country?', 'What type of farm management system is this?', and 'In what vegetation type does this farm occur? (You may select by clicking on the map)'. To the right of these questions are dropdown menus for 'Namibia', 'Commercial', and 'Northern Namib'. Below the questions is a map of Namibia with several red dots indicating farm locations. A blue link 'Click here to send on' is visible at the bottom right of the form area.

1. Double click on the “***Bush Expert***” database icon on the Home or Main page area.
2. Click on “**Click here to consult the *Bush Expert* database**”.
3. A total of 38 questions will be asked, each with a list of answers to choose from. This includes nineteen (19) general questions and 19 control technology questions. It is not compulsory to answer all the questions.

GENERAL QUESTIONS

4. The answers to the questions in this database consist of drop lists. Click on the arrow next to the answer to activate the drop list.

5. **Area, general vegetation and environment**
The first set of questions focuses on the region, farming area and general description of the vegetation and environmental factors. Please **do not** fill in the space about comments regarding the soil type, if you are not sure of your answer.

6. **Problem species**
(a) The second set of questions focuses on the type, percentage of each type, height classes and density of the problem species that need to be controlled.
(b) Also indicate the following:
 - What the problem species will be used for after bush control.
 - Is the site that needs to be controlled near an old land?
 - Is there a watering point near the site that needs to be controlled?
 - What is the aim of bush control at the site?

7. **Type and number of animals**
For this question, the type of animals (livestock and/or game), as well as the percentage of each that will utilize the rangeland needs to be indicated.

CONTROL TECHNOLOGY QUESTIONS

8. Choose the type of bush control technology that you would like to use. Only choose **one** of the following treatments i.e. **Chemical, Mechanical, Manual or Biological Control**. If you would like to investigate another technology, please run the system again.
9. Answer the questions for the specific control technologies that you would be able to apply regarding the resources (financial, manpower, etc.) available.
10. After the questions have been answered, click on

“Run Bush Expert Analysis and Show Results”

A search will now be carried out to find the best possible match between the answers given and data of the case studies already incorporated in the *Bush Expert* database.

The result of the analysis will follow.

Bush Expert Results

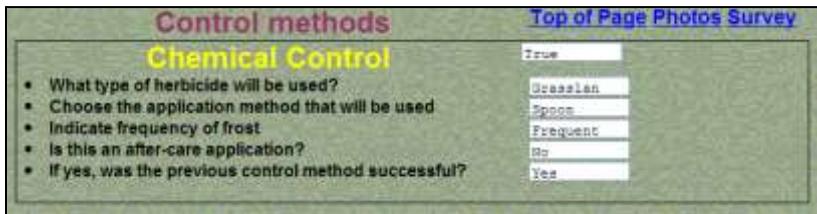
The screenshot shows the 'EcoRestore Bush Expert Results' interface. At the top, there is a navigation bar with 'Main Page' and 'Back to Bush Expert Questionnaire Controls Photo Survey' links. Below this is a search bar with '100%' and 'Match' options, and a 'Show Photos' button. The main content area displays 'Bush Expert Results 1 of 12'. A list of questions is shown on the left, and a dropdown menu with various options is on the right.

Questions	Options
Specify the country?	Malawi
What type of farm management system is this?	Commercial
In what vegetation type does this farm occur?	Thicket
Farm District	OT-020202JUP
Municipal area	OT-110202020
Agro Ecological Zone (AEZ)	Other
Fairly Homogeneous Farming Area (FHFA)	Other
Long-term average rainfall (> 30 years)	252 - 400
Short-term average rainfall (< 5 years)	252 - 400
Soil Type	Highly
Soil Clay percentage	11 - 15 %

11. The results of up to 15 case studies are shown. The results are based on previous knowledge and include possible actions and technologies that can be implemented to control bush encroachment in similar areas and environmental conditions. The value of the answer to the specific problem identified by the user will depend on the percentage (%) match as indicated.
12. Other **general information** of the technologies that were previously implemented by land users, includes:
 - The number of the case study in the database.
 - The area, location and main environmental factors.
 - The type, frequency (%), structure and density (trees/ha) of the problem species that were previously controlled.
 - The type of animals of the previous land user.

13. Details of the control technologies that were applied by the previous land user are given (“Control methods”). These include:
- The type of herbicide, implement or management system.
 - The method of application.
 - Frequency of frost
 - Whether the application was part of an after-care treatment or not.

Control methods



The image shows a screenshot of a survey form. At the top, there are two tabs: "Control methods" (highlighted in red) and "Top of Page Photos Survey" (highlighted in blue). Below the "Control methods" tab, the section is titled "Chemical Control" in yellow. There are four bullet points on the left side of the form:

- What type of herbicide will be used?
- Choose the application method that will be used
- Indicate frequency of frost
- Is this an after-care application?
- If yes, was the previous control method successful?

On the right side of the form, there are five input fields:

- A "True" checkbox.
- A dropdown menu with "Grasslan" selected.
- A dropdown menu with "Spoon" selected.
- A dropdown menu with "Frequent" selected.
- A dropdown menu with "No" selected.
- A dropdown menu with "Yes" selected.

After-care

After-care can be characterized by any maintenance strategy implemented after the first bush control treatment, or a follow-up treatment after the first application. After-care is aimed at preventing or stunting re-growth and coppicing of problem plants.

14. Images of the “before” and “after” situation in a previous application of a specific control method are supplied in some case studies. This gives a visual representation of the success of the applied technology and what can be expected should the

same technology be applied in a similar environment and over the same time frame.

15. A detailed description of all the qualitative and quantitative data that was surveyed for the case study is given as a result (“Survey Data Results”). Qualitative data includes all information given by the farmer in answering certain questions of a questionnaire. Quantitative data includes the results of the vegetation sampling that was carried out at the study site of the case study, to assess or estimate the success rate of the applied technology. This mainly includes the woody (bush) and herbaceous composition of the current sward.

Survey Data Results



Survey Data Results

Case number: 32
Owner: Schültenbach
Name of sampler: H. Hölling
Site ID: Camp 2/ head
Date: 21/2/2001
Farm region/ name: Christodora/ Gembokvlei
Farm number: 104+ 214
Farm size (ha): 10 317 ha
Type of enterprise: Large stock
District: Bobabis
Tel nr 1: (062) 570907
Experience in bush control (years): 15 years
Vegetation type: Camelthorn savanna
Estimated carrying capacity of treated area: 14 ha/LSU
Long-term rainfall (mm): 303 mm
Short-term rainfall (mm): 398 mm
Frequency of frosts: Frequent
Soil type: Mispoh
Clay content (%): 12%
Soil colour: Red
Soil depth: 25- 50 cm
Slope of site where control has taken place: Mid- slope
Soil condition before control: 50% bare, bare+ annuals
Vegetation composition before control (species): Annuals > 50%

16. Other information displayed in the “Survey Data Results” includes:
- The owner of the farm, including his/her contact details.
 - The name of the sampler that conducted the survey.
 - The region, location, vegetation type and some important environmental factors, especially long- and short term rainfall.
 - The experience of the farmer with regard to bush control.
 - The type, structure and density of the problem species that was controlled by the farmer.
 - The carrying capacity before and after the control technology was applied.
 - Current kg live animal biomass/ ha on the treated area and the percentage (%) increase in grazing capacity after the implementation of the control technology.
 - Details about the control technology, including the type of control, period since control, application and all the resources that were necessary for the application.
 - The composition and abundance (%) of the grass species that occurred at the study site at the time of the vegetation survey. This data indicates how the grass cover has improved after the specific control technology was applied.
 - Any negative and/or positive observations of the farmer regarding the control technology that he/she has implemented.

Additional Information

The user can consult additional information in the *Bush Expert* database. This information can be accessed by clicking on the icons given at the end of the Result window. The information includes:

1. The **cost of** certain **bush control** methods.
2. Name, address and telephone list of chemical/**herbicide** suppliers and distributors in southern Africa. A list of the most commonly used herbicides.
3. Some **statistical analyses** of the control methods that are currently included in the database.
4. **Opinions** by **experts** with regard to bush encroachment and control thereof.
5. List of **literature** on bush control, land degradation and other relevant information.

The additional information given is by no means complete and will be improved with updated versions of the *EcoRestore* DSS.

Troubleshooting

The following problems may occur while operating the *EcoRestore* Decision Support System:

1. The *EcoRestore* Decision Support System does not respond.

- Firstly, make sure that your computer meets the hardware requirements that have been set (see section on ‘Hardware specifications’). It is important that Internet Explorer 5 should be installed on your computer as well as Windows 98 (or better).
- If the problem persists, repeat the *EcoRestore* installation procedure.

2. An error is shown, indicating that *EcoRestore* cannot find the expert database or is unable to connect to the data. (“Error on page” message will occur at the bottom of the page in *Bush Expert* Questionnaire.)

The above mentioned is caused by one of the following problems:

- (a) Your computer does not meet the hardware specifications. Usually you do not have Internet Explorer 5 or better installed on your computer.

(b) A problem may have occurred while installing the *EcoRestore* DSS. In order to correct the problem, you have to re-install *EcoRestore* by completing the following procedure:

- The CD-ROM must be **out** of the CD-drive.
- Double click on “**My Computer**”.
- Double click on the **C: drive**.
- Click once on the “**Ecorestore**” folder.
- Right click on the mouse button and select “**Delete**”.
- Click on the “**Yes**” button of the box to proceed.
- Now follow the normal installation procedures (see section on ‘Installation’ in this manual).

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www.puk.ac.za



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www.agrinamibia.com.na



Desert Research Foundation of
Namibia (DRFN)
www.drfn.org



National Department of Agriculture in
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www.nda.agric.za



Namibian Ministry of Environment
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