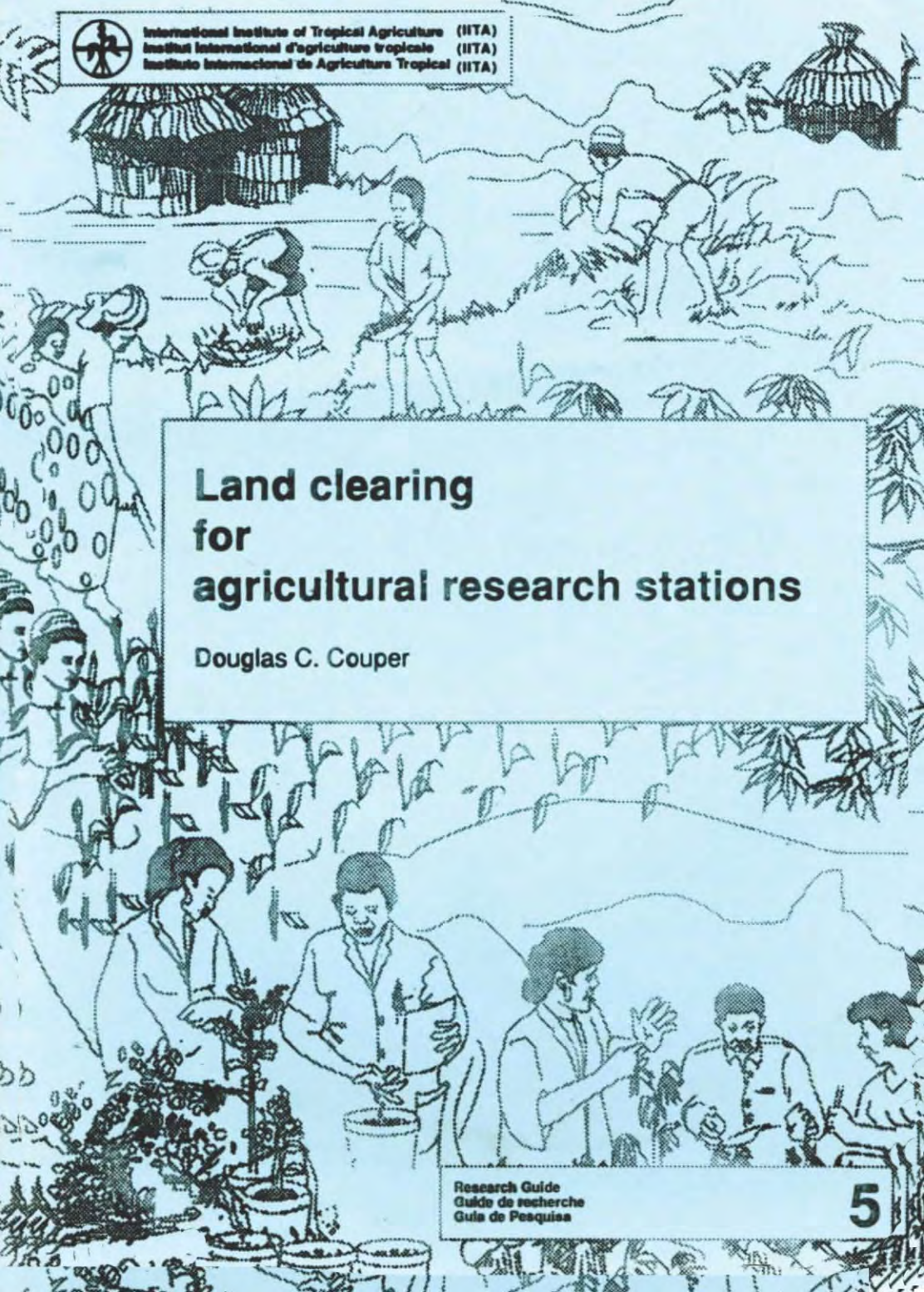




International Institute of Tropical Agriculture (IITA)  
Institut International d'Agriculture tropicale (IITA)  
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# Land clearing for agricultural research stations

Douglas C. Couper

Research Guide  
Guide de recherche  
Guía de Pesquisa

5

IITA Research Guide 5

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## **IITA Research Guides**

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## **Land clearing for agricultural research stations**

**Objectives.** This guide is intended to enable you to:

- use criteria for land clearing and when to clear land;
- apply appropriate clearing techniques;
- describe the effects of land clearing.

### **Study materials**

- slides showing positive and negative effects of land clearing;
- tools and machinery for land clearing.
- data on present deforestation, desertification, etc.

### **Practicals**

- discuss criteria of land clearing in the field;
- demonstrate tools and machinery; preferably practice actual land clearing;
- observe and discuss effects of land clearing in the field.

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## Questionnaire

- 1 What should you do with areas that are not suitable for research fields, buildings or other installations?
- 2 What is the effect of excessive land clearing?
- 3 What land should you clear only?
- 4 What is the preferable season for land clearing?
- 5 What is by far the safest method of land clearing?
- 6 What is the danger of mechanized land clearing?
- 7 Where is clearing by chaining useful?
- 8 Why is clearing by chaining not possible in dense rain forests?
- 9 What are the disadvantages of conventional mechanized clearing?
- 10 Describe shear blade clearing.
- 11 How can you stabilize soils after clearing?
- 12 What operations should the tractor operator avoid?
- 13 What safety measures should you apply?



## Land clearing for agricultural research stations

- 1 What to clear
- 2 When to clear
- 3 How to clear
- 4 Effects of land clearing
- 5 Bibliography
- 6 Suggestions for trainers

**Abstract.** Large areas of land are presently cleared of their natural cover, endangering the worldwide ecosystem. Land clearing, if necessary, should be carried out with great care after very careful consideration. Different land types require different clearing techniques. Often, soil needs to be stabilized after clearing. All clearing processes require training of persons involved.

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## 1 What to clear

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Land clearing should never be embarked upon without a great deal of thought. During the development of any new research farm, some land clearing will inevitably be required. However, land should not be cleared unless it is necessary. Areas which are not suitable for research fields, buildings or other installations should not be cleared. Such areas may have poor soils or exceptionally steep slopes. These areas are best left under their natural cover so that the soil is protected from erosion.

As larger areas of tropical land are cleared of their natural cover, a considerable number of plant and animal species are becoming extinct. It is therefore in mankind's best interest to leave intact any area of forest or bush which does not have to be cleared in order to conserve what species remain.

Only land that is required for immediate use should be cleared. So clearing of agricultural blocks on a farm should be carried out only when the land is needed.

## 2 When to clear

The seasons in tropical areas are generally divided into wet and dry periods. Land should never be cleared mechanically during the wet seasons as the damage to soil structure caused by heavy machinery is considerable. Relatively little damage occurs to the soil structure when soil is dry, therefore it is preferable to carry out all land clearing activities during the dry seasons.

During the clearing process of forest or bush, a considerable amount of biomass accumulates and the most convenient method of disposing of this biomass is by burning. This can take place effectively during the dry season only.



### 3 How to clear

Land in food producing areas of Africa may be divided into two broad types for clearing purposes:

- savannah,
- rain forest.

These two types of vegetation require different types of clearing techniques as described below.

When subsistence farmers clear forest, they do so by manual means, using axes, cutlasses and hoes. This method of clearing is by far the safest method as the soil remains relatively undisturbed. Hand clearing is however time-consuming and expensive, so it is suitable only for small farms. On intermediate or large-scale farms, manual land clearing is slow and the cost becomes prohibitive. Mechanical clearing is often required.

Mechanized land clearing requires heavy equipment, normally, track-laying tractors which have the power to push over trees and rip out roots and stumps. Generally in Africa, the only machines available for such work are available from building sites or road construction companies. The attachments for such equipment are however designed to move soil as the track-laying tractors have dozer blades mounted upon them.

When such machines are used for forest clearing, the result is normally the removal of the shallow layer of top-soil and its deposition in windrows into which the trees are pushed prior to burning. This means that on probably 90 % of the land, the shallow layer of top soil is removed and deposited on around 10 % of the land.

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When clearing is carried out in this manner, the farming project is doomed to failure before one seed is planted. It must therefore be stressed that forest clearing be carried out as an agricultural activity and not as an engineering activity.

**Clearing by chaining.** In savannah areas where the trees are relatively far apart and little if any undergrowth is present, clearing by chaining is recommended. Chaining consists of dragging a heavy (anchor) chain between two track-laying tractors. The tractors travel parallel to each other at a suitable distance apart and the chain is dragged along the ground felling the trees in its path. Often a third tractor travels behind the chain, pushing any large tree which the chain has trouble in felling.

When all trees have been felled, the chain is removed. The tractors are then used to carefully windrow the trees with the aid of front-mounted root-rakes. During this operation, the rakes should operate just above ground level in order to cause as little soil disturbance as possible.

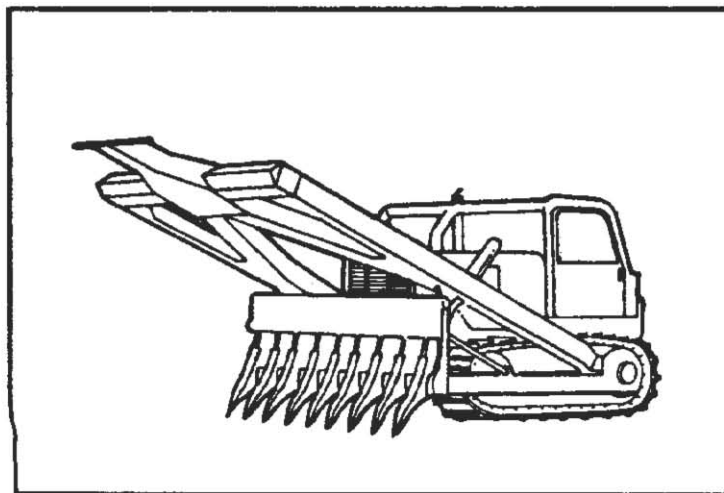
When windrowing has been completed and the trees have dried out, burning may then take place. In order to kill stumps remaining in the ground, and additionally, to ensure good water penetration in savannah areas, a root plough may be used. The root-plough fitted on the rear of a track-laying tractor runs under the ground at a depth of 50 - 80 cm, cutting off persistent shrubs below the growing point thereby killing them. Disturbance to the soil surface is minimal and the shattering effect of the root-plough can effectively alleviate compaction which has built up with the grazing of cattle over the years.

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In rain forests, due to the dense nature, chaining cannot be carried out. The dense undergrowth prevents tractor operators from seeing each other and maintaining the necessary parallel position. Also, many trees would be too large to fell by chaining.

**Conventional mechanized clearing.** Where forest is to be cleared, the tree-pusher/root-rake was considered the most suitable machine (Figure 1). The tree-pusher fells the trees and the root-rake rips out all the tree roots and stumps. This is an improvement on the bulldozer blade but it is still unsatisfactory, as in the process of stump and root removal, the soil is disturbed to a depth of at least 50 cm. After such clearing, the soil is left in a state conducive to severe soil erosion.

**Figure 1.** Tree pusher.



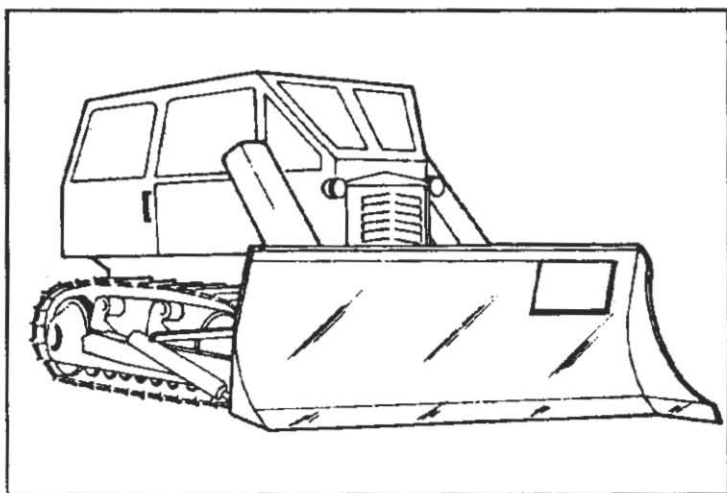
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The removal of tree roots and stumps prevents damage to cultivation equipment during subsequent cropping seasons, but if the land is not cultivated, as in the case of no-till or zero-tillage farming, stumps and roots do not need to be removed.

**Shear blade clearing.** With the development of no-till farming, the use of the shear blade should be considered for forest clearing (Figure 2). The shear blade is a flat-bottomed cutting blade which can ride over the soil surface without digging into it.

The cutting blade is angled to the direction of travel and therefore shears through tree trunks at ground level, leaving the stumps and roots in the soil. Disturbance to the soil is minimal, and the soil structure remains relatively unaffected. Leaf litter and earthworm casts also remain on the soil surface, giving added protection to the soil when the rains begin.

**Figure 2.** Shear blade.



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Table 1 compares the economy of different clearing methods.

**Table 1.** Economics of clearing methods.

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attachment	time (h/ha)	fuel (l/ha)
root rake/tree pusher	2.7	124
shear blade	1.9	79
manual clearing	180 man days / ha	

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## 4 Effects of land clearing

**Soil stabilization.** The use of a cover crop immediately after clearing is sometimes recommended to stabilize the soil in the following rainy season. Various creeping legumes are recommended for this purpose, including *Mucuna*, *Centrosema*, and *Peuraria*.

If these legumes are planted, they form a rapid cover, giving protection to the soil surface against rain-drop impact. They further build up a supply of organic matter which assists in retaining the store of nutrients existing in the soil, and also improves soil moisture retention.

Farmers may be unwilling to practice soil stabilization after clearing, as the first crop after clearing is normally the best due to the build up of fertility under forest.

Trials carried out at IITA yielded the data shown in (Table 2).

**Table 2.** Run-off and soil loss (IITA trials. Traditional clearing is partial clearing, leaving standing trees, as practiced by shifting cultivators.)

clearing method	cropping system	run-off (mm/yr)	soil loss (t/ha yr)
traditional	traditional	2.6	0.01
manual	no-till	15.5	0.4
shear blade	no-till	85.7	3.8
root rake/tree push	no-till	153.1	15.4



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**Operation.** In all clearing processes, it is important that operators are thoroughly trained before clearing commences. Unnecessary slewing of the tractor or too tight turning cause soil disturbance, and heaps of soil are pushed up which hinder later operations.

Manipulation of attachments is also important. For example:

- the shear blade may be operated on 'float' position of the hydraulics to prevent digging in on undulating ground;
- root ploughing must be carried out at the correct depth otherwise soil dozing with associated problems will arise;
- the shear blade must be kept sharp with an angle grinder otherwise jagged stumps will remain to damage planting machinery later on.

**Safety.** No machine should be used for land clearing without proper protection for the operator. Protection packages are available from various manufacturers, which besides protecting the operator from falling trees, also protect the engine compartment from damage while windrowing trees. A mosquito net should always be available for the operator should he fell a tree which contains bees. The sting of African bees can be lethal.

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## 6 Suggestions for trainers

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If you use this Research Guide in training:

### Generally:

- Distribute handouts (including this Research Guide) to trainees one or several days before your training activity, or distribute them at the end of your presentation.
- Do not distribute handouts at the beginning of a presentation, otherwise trainees will read instead of listen to you.
- Ask trainees not to take notes, but to pay full attention to the training activity. Assure them that your handouts (or this Research Guide) contain all relevant information.
- Keep your training activities practical. Reduce theory to the minimum that is necessary to follow the practical exercises.
- Use the questionnaire on page 4 (or a selection of questions) for examinations (quizzes, periodical tests, etc.). Allow consultation of handouts and books during examinations.
- Promote interaction of trainees. Allow questions, but do not deviate from the subject.
- Control your time.

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**Specifically:**

- Discuss with trainees experiences and effects of land clearing (10 minutes).
- Present the content of this Research Guide, using the study materials listed on page 3 (45 minutes). You may photocopy the illustrations and tables onto transparencies for projection with an overhead projector.
- Conduct the practicals indicated on page 3 (2 hours).



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*O Instituto Internacional de Agricultura Tropical (IITA) é um centro internacional de investigação agrícola pertencendo ao Grupo Consultivo para Investigação Agrícola Internacional (GCIAI), uma associação de cerca de 50 países, organizações internacionais e regionais e fundações privadas. O IITA procura aumentar duravelmente a produção agrícola para melhorar a alimentação e o bem-estar das populações da África tropical ao sul do Saara. Para alcançar esse objetivo, o IITA conduz actividades de investigação e treinamento, fornece informações, reúne e troca material genético e favorece a transferência de tecnologias em colaboração com os programas nacionais africanos de investigação e desenvolvimento.*