


➔  **Better Farming Series 06 - The Soil: How to Improve the Soil (FAO - INADES, 1976, 29 p.)**

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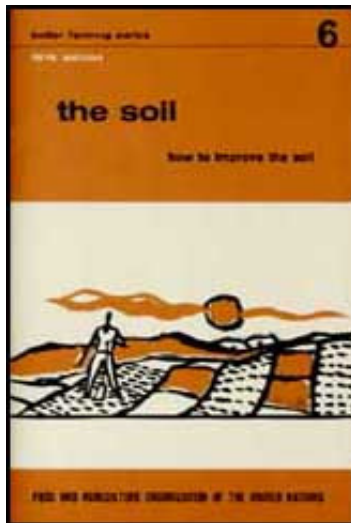
 **Irrigation**







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-  **How to keep water for irrigation**
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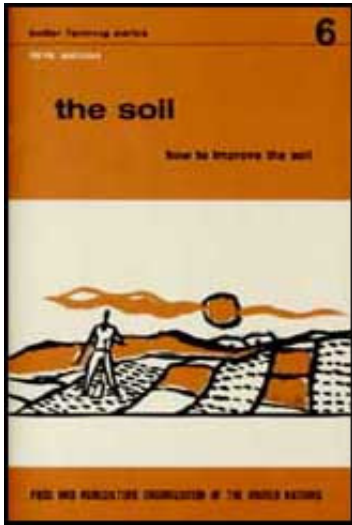


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- ☐ **Plan of work**
- ☐ **How to improve the soil for many years**
- 📄 **Farming with animal power**
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Preface

This manual is a translation and adaptation of "Le sol - comment améliorer le sol?", published by the Agri- Service Afrique of the Institut africain pour le développement économique et social (INADES), and forms part of a series. Grateful acknowledgement is made to the publishers for making available this text, which it is hoped will find widespread use at the intermediate level of agricultural education and training in English- speaking countries.

The original texts were prepared for an African environment and this is naturally reflected in the English version. However, It is expected that many of the manuals of the series - a list of which will be found on the inside front cover - will also be of value for training In many other parts of the world. Adaptations can be made to the text where necessary owing to different climatic and ecological conditions.

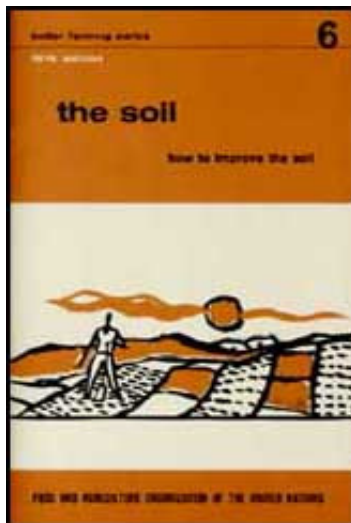
Applications for permission to issue this manual In other languages are welcomed.

Such applications should be addressed to: Director, Publications Division, Food and Agriculture Organization of the United Nations, Via delle Terme di Caracalla, 00100 Rome, Italy.










The author of this English version is Mr. A.J. Henderson, former Chief of the FAO Editorial Branch.



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Better Farming Series 06 - The Soil: How to Improve the Soil (FAO - INADES, 1976, 29 p.)

- ➔ **Plan of work**
 -  **(introduction...)**
 -  **Manure (dung)**
 -  **Compost**
 -  **Green manure**
 - Fertilizers**
 -  **(introduction...)**
 - The chief fertilizers**
 -  **Nitrogen fertilizers**
 -  **Phosphorus fertilizers**
 -  **Potassium fertilizers**
 -  **How to read a label**



Applying fertilizers

Better Farming Series 06 - The Soil: How to Improve the Soil (FAO - INADES, 1976, 29 p.)

Plan of work

FIRST WEEK

Manure, compost, green manure.

- **Read pages 4 to 8.**
- **Do they make manure and compost where you live?**
- **To understand what manure does look at Booklet No. 4, page 22.**
- **Do you know why you should both grow crops and raise animals?**

SECOND WEEK

Fertilizers.

- **Read pages 4 to 14.**
- **Study pages 4 to 8 about manure, compost and green manure once again.**
- **It is very important to understand clearly what fertilizers do, and to know how to read the label on a sack of fertilizer.**
- **How do they use fertilizers where you live?**

THIRD WEEK

- **Irrigation, drainage.**
- **Read pages 15 to 20.**

- **Do they use irrigation where you live?**
- **Can they use irrigation?**
- **What is a less tiring way of lifting water?**
- **Can they make dams where you live?**
- **Do you fully understand what water does in the soil? Look at Booklet No. 4, page 29.**

FOURTH WEEK

Grubbing trees.

- **Read pages 21 to 28.**
- **Does grubbing trees make the harvests better?**
- **How do they clear the land where you live?**
- **Look again at Booklet No, 5, page 20 where it deals with brush fires.**

You must understand that brush fires are bad.

- **Reread the whole course.**
- **Answer the question paper.**

HOW TO IMPROVE THE SOIL .

Many soils are poor and do not yield a good harvest.

A modern farmer improves his soil.

- **He gives it mineral salts (see Booklet No. 1, page 19);**
- **He improves its structure (see Booklet No. 4, page 24) by giving it humus.**

Many soils are difficult to work.

- **The soil is too dry or too wet.**

The farmer improves the soil by irrigation and drainage.

- **The land is full of trees.**

The farmer grubs the trees.

HOW TO IMPROVE SOIL FERTILITY

Plants grow by taking mineral salts from the soil.

A plant that finds plenty of mineral salts in the soil grows quickly.

You must give the soil mineral salts. Manure, compost, fertilizers all add mineral salts to the soil.

Manure (dung)

You can get manure (dung) when you keep animals, such as cows, oxen, sheep, goats, donkeys, pigs.

To get manure, a farmer should both grow crops and raise animals.

- **Making manure**

To make manure, put dry herbage and straw (stems of rice, maize, millet) to rot with animal droppings.

The microbes (see Booklet No. 4, pages 22 and 35) in the animal droppings decompose the leaves and straw.

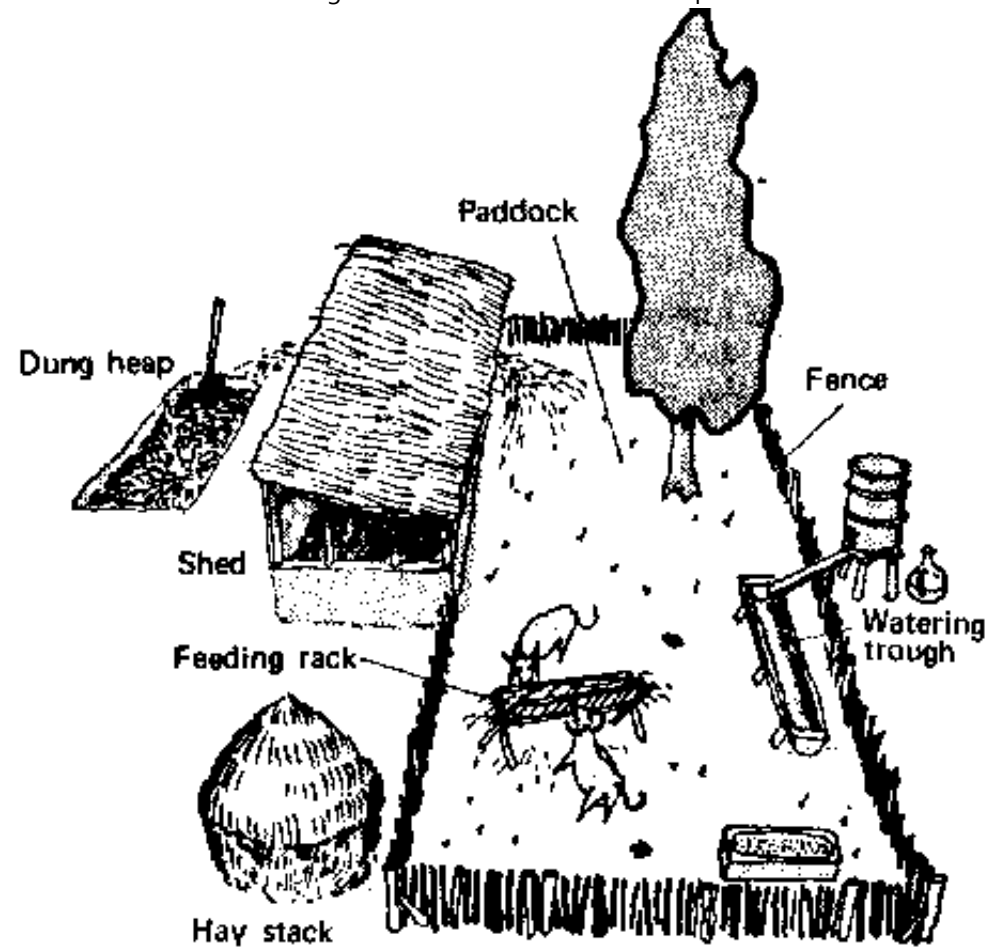
This makes manure.

Manure in the soil makes humus (see Booklet No. 4, page 22).

A good farmer does not let his animals run about the bush.

You should put them in a paddock with a shelter, a cattle shed.

In the shed put leaves and straw. The animals sleep on it, and make their droppings. With the droppings, the straw rots. You must add straw often. Then you have Good manure.



The shelter protects the animals.

It also prevents rain from making the manure too wet.

It prevents the sun from drying the manure. If it gets dry it does not rot.

Compost

When you have no animals, and no manure, you can make compost.

Compost is a mixture of plants, stems of millet and maize, etc., refuse from the house, remains of food such as vegetables and fruit, which all rot together.

- **Making compost**

Dig a hole.

At the bottom of the hole put a lot of big pebbles and stones, so that too much water will not stand in the hole.

Throw into the hole all the household refuse, weeds and plants you have cut down, and the refuse from the harvest.

Water the heap to make it rot.

Like manure, the compost must not dry out.

So make the heap in the shade to shelter it from the sun.

- **Using compost and manure**

Take it to your field.

Spread it out well.

Mix it with the soil by turning over the soil either with a hoe or a plough.

Manure and compost contain mineral salts, which enrich the soil; humus, which improves the soil structure.

Green manure

When you do not have enough manure or compost, you can enrich the soil all the same.

You do it by sowing plants.

When they have grown to a good size, cut them down, mix them with the soil by turning it over with a hoe or plough.

The plants rot and make the soil richer. These plants are called green manure.

For example, you can sow Pueraria, and plough it in when the seeds begin to form. Green manures do not yield any harvest.

They are plants which are grown and then put into the soil. They enrich the soil with humus and make possible better harvests afterwards.

Manure, compost and green manure require no money.

They require only work.

Fertilizers

- **Fertilizers give the soil mineral salts (see Booklet No. 1, page 19). With fertilizers, harvests are better.**

- **But fertilizers are costly.**

A farmer only buys fertilizers if the increase in his harvest will pay for the fertilizers.

A farmer only buys fertilizers if they will earn him money.

- **It is useless to apply fertilizers if your farming work is not well done.**
- **If you do not control erosion, the good earth with the fertilizers is carried away.**
- **If you have tilled the soil badly, plant roots grow badly.**
- **If you have sowed late, the plants will be late and will not grow enough before the dry season.**
- **If you do not get rid of the weeds, the fertilizer will chiefly benefit the weeds.**
- **If you do not control insects and diseases the harvest will be no better and the fertilizer will be wasted.**

Apply fertilizer only when all your farming jobs are well done.

The chief fertilizers

Nitrogen fertilizers

They contain nitrogen.

Nitrogen makes leaves grow and gives them a good green colour.

In the leaves raw sap is changed into elaborated sap (see Booklet No. 2, page 20).

Nitrogen helps the formation of elaborated sap.

And harvests are better.

The chief nitrogen fertilizers are:

- **sulphate of ammonia,**

- **nitrates**

If you see the letter N on the label of a sack of fertilizer, that means nitrogen.

Phosphorus fertilizers

**They contain phosphorus in the form of phosphorus pentoxide.
Phosphorus makes the plant stems strong.**

It also helps the formation of flowers and fruits.

It makes better grains and fruits.

The chief phosphorus fertilizers are:

- **natural phosphates: In Africa there are phosphate mines at Taiba and This (Senegal and at Kpem (Togo).**

- **superphosphates**

If you see the letter P on the label of a sack of fertilizer, that means phosphorus.

Potassium fertilizers

They contain potassium.

Potassium helps plants to withstand drought and diseases.

It also helps the plant to build up food reserves (see Booklet No. 1, page 241, so that the roots become fatter (cassava), and seeds are more plentiful and finer.

The chief potassium fertilizers are:

- **natural potassium: In Africa there is a big potassium mine at Holle (Congo).**
- **potassium chloride,**
- **potassium sulphate.**

If you see the letter K on the label of a sack of fertilizer, that means potassium.

- **Compound fertilizers**

The fertilizers you buy are not all the same.

Those which contain only nitrogen or potassium or phosphorus are called straight fertilizers.

Others are mixed.

They are called compound fertilizers.

Compound fertilizers contain different quantities of nitrogen, phosphorus, potassium.

How to read a label

You may have seen labels like this on sacks of fertilizer. The first Figure shows

COMPOUND the quantity of nitrogen (N)

FERTILIZER in 100 kilogrammes

13- 10- 15 of this fertilizer.

In this case 13 kg.

The second Figure shows the quantity of phosphorus (P) in 100 kilogrammes of this fertilizer. In this case 10 kg.

The third Figure shows the quantity of potassium (K) in 100 kilogrammes of this fertilizer. In this case 15 kg.

We say this fertilizer has a 13- 10- 15 content.

To find the amount of nitrogen, phosphorus and potassium contained in a sack of fertilizer, we must multiply the fertilizer content by the weight of the sack and divide the result by 100, thus: content X weight of sack 100

In a 50 kg sack of 13- 10- 15 fertilizer there is: nitrogen $3 \times 50 = 6.5$ kg

phosphorus $10 \times 50/100 = 5.0$ kg

potassium $15 \times 50/100 = 7.5$ kg

Applying fertilizers

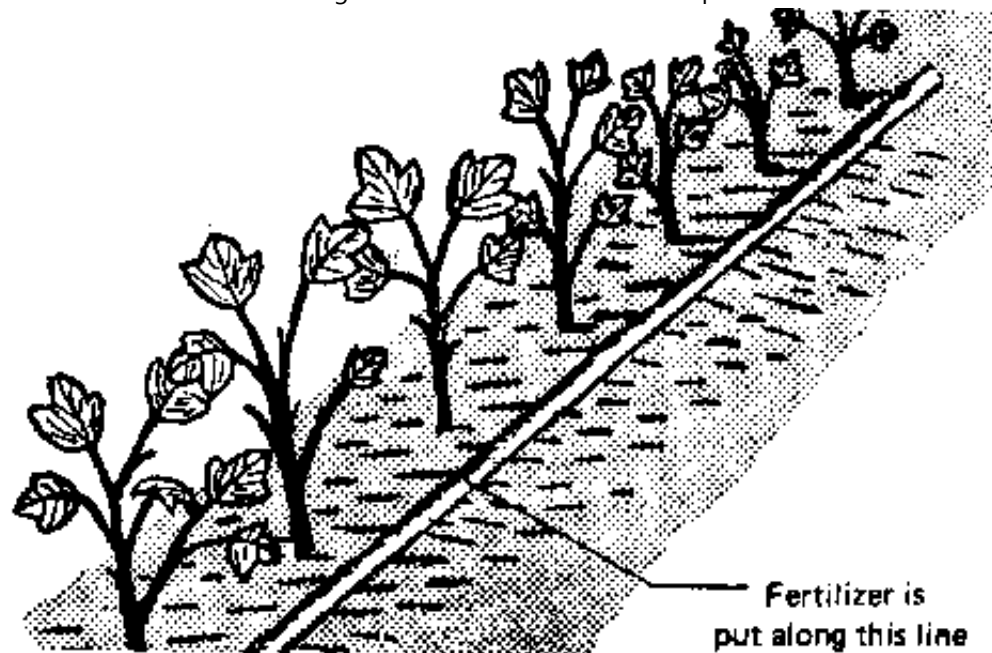
- **Apply by hand.**

You can apply the fertilizer by throwing it broadcast.

It falls all over the place.

It is better to apply fertilizer along the plant rows.

With a stick make a line in the earth a few centimetres away from the row of plants.



Put the fertilizer in this line and cover it with earth.

**Or else, put the fertilizer at the foot of the plants just before you earth them up
In tree plantations such as palms, coffee, cocoa, put the fertilizer in a circle 1 or 2 metres from the tree trunk.**



The feeding roots of the tree are at a distance of 1 or 2 metres from the trunk.

Spread fertilizer round the trunk at a distance of 1-2 m.

- **Apply with a machine.**

This machine is called a fertilizer distributor.

With some mechanical seed drills you can sow and spread fertilizer at the same time.

SOME PRACTICAL ADVICE

- **Do not put fertilizer on the stems and leaves of plants. The fertilizer may burn them.**

- **Fertilizer is costly.**

Do not put just any fertilizer on any crop. Different plants have different needs.

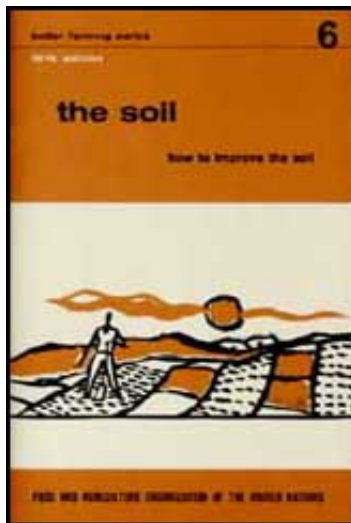
Ask the extension worker for advice. Choose the right fertilizer.

- All fertilizers are not the same.









**Fertilizers contain different amounts of the mineral salts (N, P, K).
Get to know the quality of fertilizers.**



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 - Irrigation**
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 -  **How to keep water for irrigation**
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 **How to grub trees**

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How to improve the soil for many years

In Booklet No. 4, page 29, we saw how important water is in the soil.

When land does not have enough water, you can bring water to a field. This is called irrigation.

When land has too much water, you can take water away from a field. This is called drainage.

- **Before you dig and plant a field, you must clean it.**

You have to take away the grass and plants and trees. This is clearing the land. You also have to take away the stumps of trees. This is called grubbing.

Irrigation

When you have water, in a stream, a pool, a well or a dam, use it as much as possible.

Putting water on crops is irrigation.

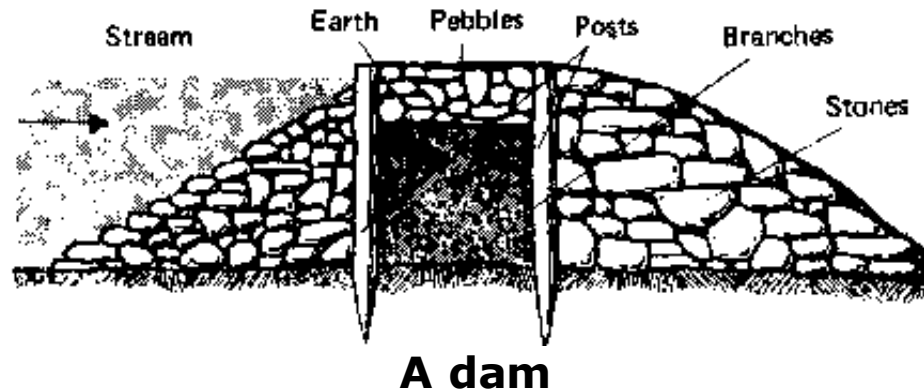
With irrigation you can get better harvests, and you can even grow crops when it does not rain.

How to keep water for irrigation

Build a little wall across a stream to hold back the water.

Look for a place where it is easy to hold back the water, where the banks of the stream are high and where the stream is not wide.

In the dry season, get stones, branches, earth and pebbles. Drive wooden posts into the bed of the stream. Build up the dam with branches, earth and pebbles. In many villages the farmers get together to build little dams.



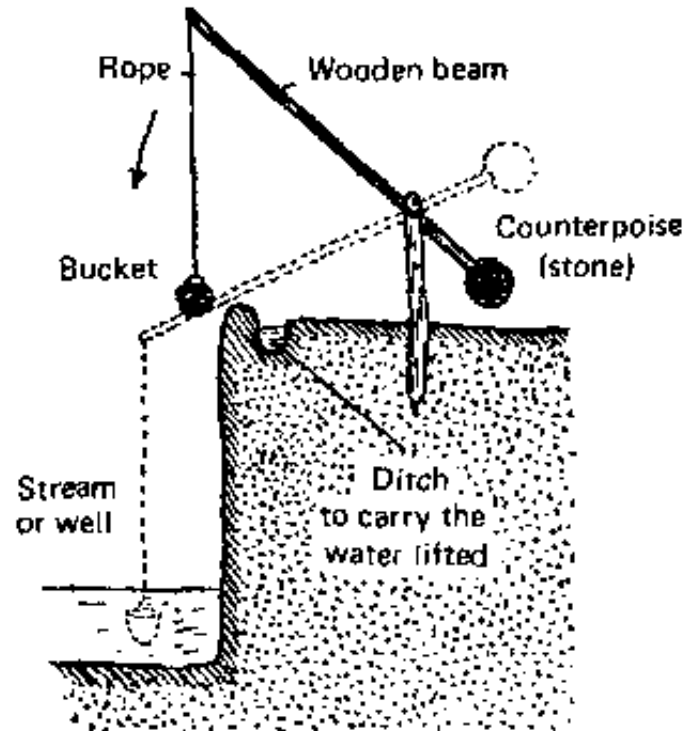
The dam stores up water. With this water you can

- **give the animals water to drink,**
- **water the crops,**
- **even raise fish.**

Before making a dam, ask for advice from the extension service.

How to fetch water

- **With a calabash or gourd. This takes a long time and is very tiring. Only small fields can be watered.**
- **With a counterpoise lift (shadoof).**

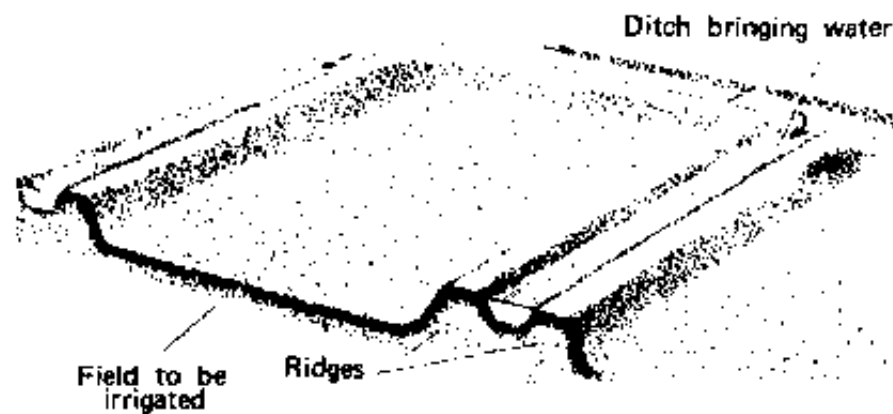


Counterpoise lift (shadoof)
Counterpoise lift (shadoof)

- **With a rope and bucket lift (noria). This uses animal power.**
- **With a hand pump or motor-driven pump.**

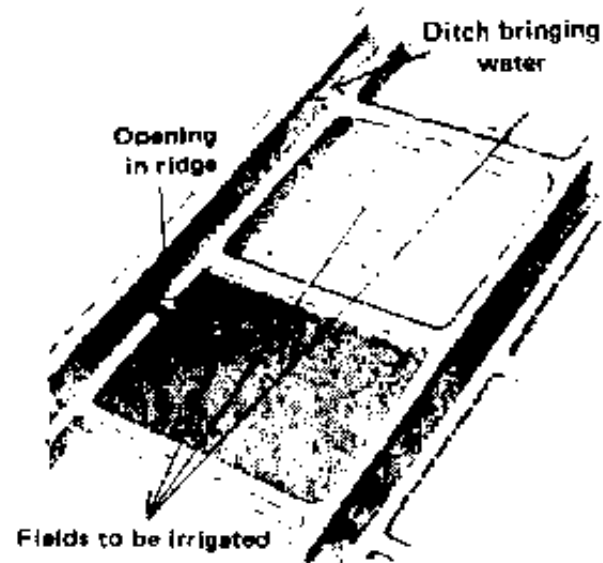
How to irrigate

**Ditches must be made so as to bring water to the edge of the field.
The ditches must be kept well cleaned out, so that the water flows easily and is not wasted.**

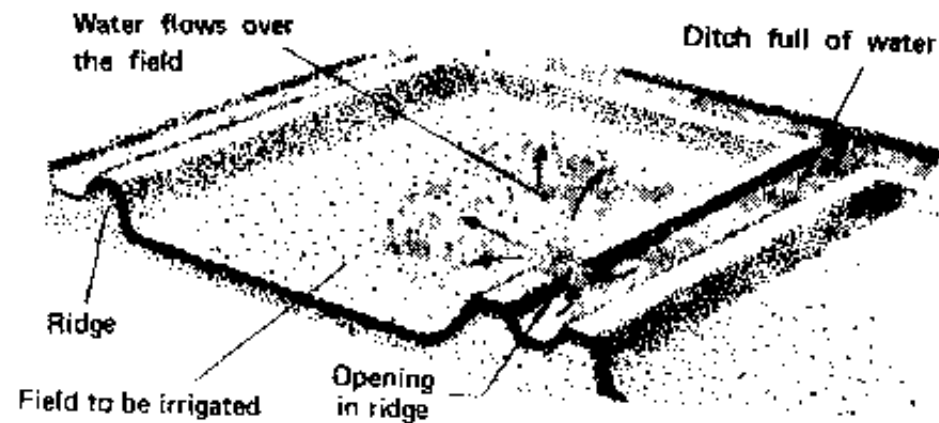


Ditch bringing water

**The field to be irrigated is surrounded with a ridge or bank.
Thus the whole field forms a basin.
To fill the field with water, make a hole in the ridge of the ditch.**

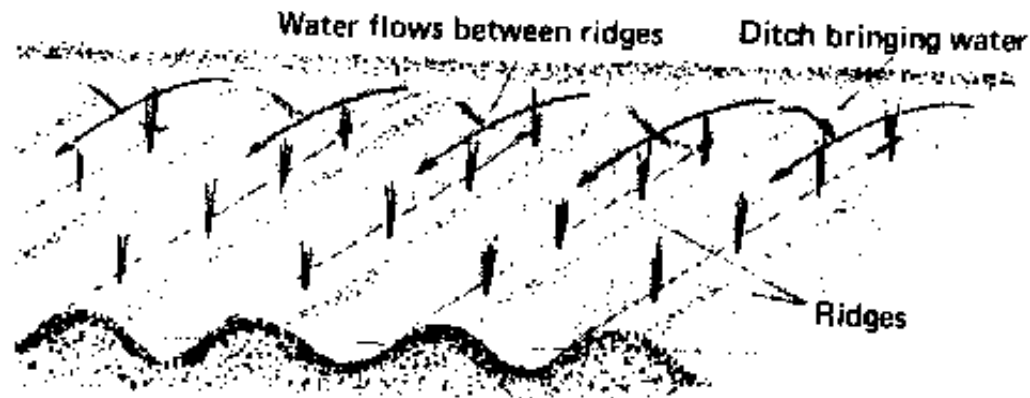


The water flows into the field.



The water flows over the field

**When the field is flooded, close the ditch, and let the water into another field.
 For salad plants, for tomatoes, the whole field is not flooded.
 The field is not covered with water.
 The water is made to flow between the rows of the crop, between the crop ridges.**



Water flows between ridges

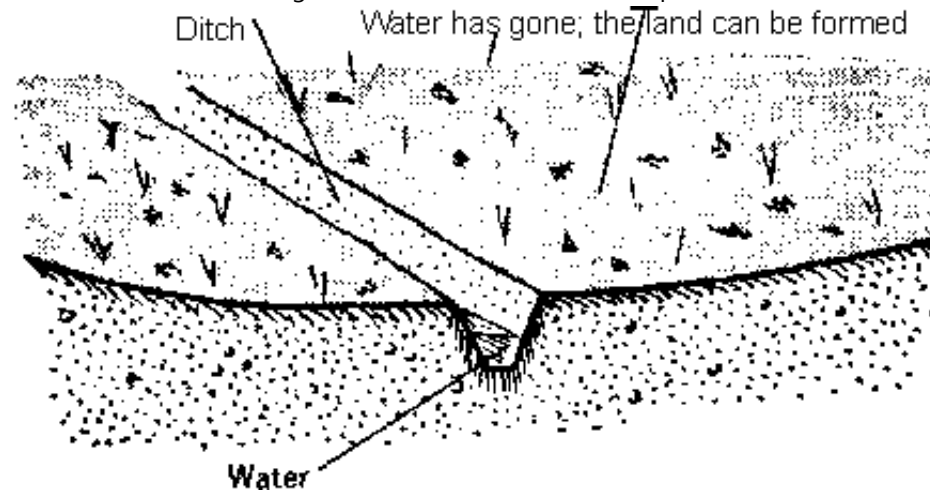
Drainage

Sometimes clay soils and the soil beside rivers and streams are covered with water. The land cannot be farmed.

The surplus water must be made to run away, the soil must be drained.

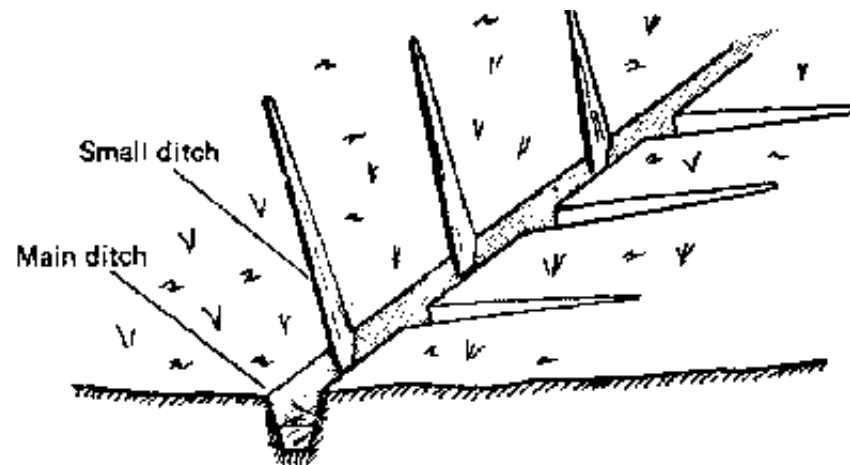
Dig a ditch at the lowest place. The water flows into this ditch. Bit by bit the land beside the ditch becomes dry and can be farmed.

Ditch Water has gone; land can be farmed



Drainage ditch

When the land is very wet, a number of ditches must be made.



Drainage of very wet land

Drainage of very wet land

Clearing the land and grubbing the trees

Clearing the land means removing weeds and grasses and cutting down small

trees.

But not all plants are removed.

Trees are left standing if they:

- **are too big.**

You cannot easily cut down and remove big trees such as the baobab, or the kapok tree.

- **are useful.**

For instance, if they provide food for people or animals, such as the oil palm.

If they protect and enrich the soil, especially in savanna country.

If they give shade: cocoa, coffee and pepper grow better if they are In shade.

- **can be sold.**

There are trees that can be sold for firewood, or for making furniture, or for export.

If the land is not well cleared, if too many trees are left, the harvests are less good, because the crop plants have to share food with the trees left in the field.

If the land is well cleared, if only a few plants are left, the harvests are better.

The crop plants can use all the food in the soil.

How to clear land

Cut the grass and weeds and the small trees.

Put them in a heap to make them rot.

This organic matter (see Booklet No. 2, page 23) will give humus to the soil.

Do not make a brush fire (see Booklet No. 5, page 21).

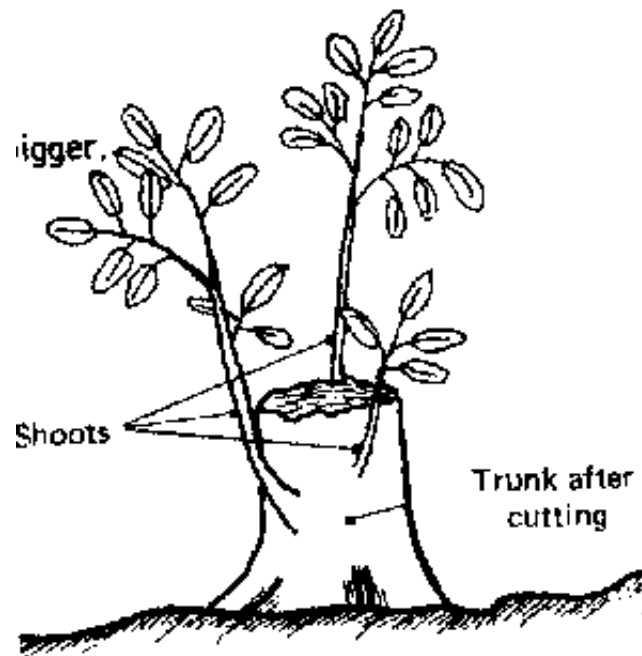
The bigger trees too must be cut. The wood is taken to the village for fuel.

Often farmers cut the trunk of a tree, and leave in the ground the base of the tree and its roots. This is the stump. New shoots may grow on the stump.

When the stump is left in the ground the tree often remains alive.

When the field is left fallow, the tree grows again and the shoots get bigger.

After the fallow, all the work has to be done again.



A stump

Stumps prevent farming with animal power.

Tools such as hoes and ploughs are often damaged and bent by big roots.

- **You cannot sow in rows, the stumps get in the way.**
- **The stumps go on taking food from the soil. Around stumps the crops are less good, the plants are not so tall, and rice, for example, turns yellow.**
- **The tree stumps must be taken out.**

The trees must be grubbed.

Grubbing takes a lot of work. Grubbing is hard. Grubbing is necessary to improve your farming and earn more.

If a farmer has cleared the land, if he has grubbed all the trees, he can farm with animal power, he can farm his field for a longer time.

After a fallow, the next clearing will be much easier, the trees will not have grown again. There will be no more grubbing to do.

Grubbing takes a lot of work.

How to grub trees

When you grub trees, ask the authorities for permission to farm the field for a long time.

- **First way Cut the trees with a machete or axe. Then take out the stump.**

Make a hole round the stump so that you can clearly see the roots.

Cut the roots with an axe or a special grubbing tool.

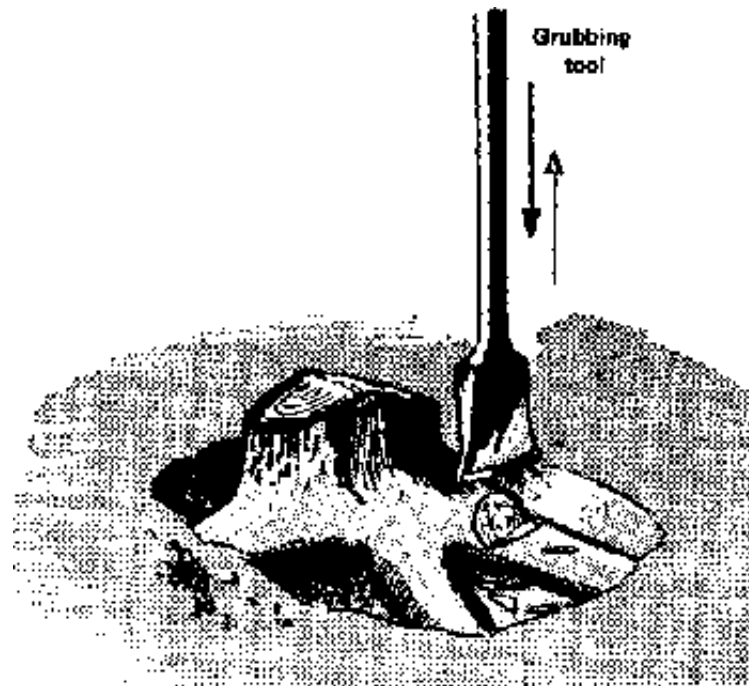
This tool can be made by the village blacksmith from a leaf of a lorry spring.

The blacksmith flattens one end in his forge and sharpens it on a stone.

He turns over the other end to make it hold in a long wooden handle. This is 1.50 metres long.

This tool is used for taking out earth from around roots, and also for cutting roots.

The tool cuts better if the handle is heavy.



Grubbing tool

Pull out the tree with its stump. Do not cut the tree trunk.

Tie a thick, very strong rope to the tree trunk, about half way up.

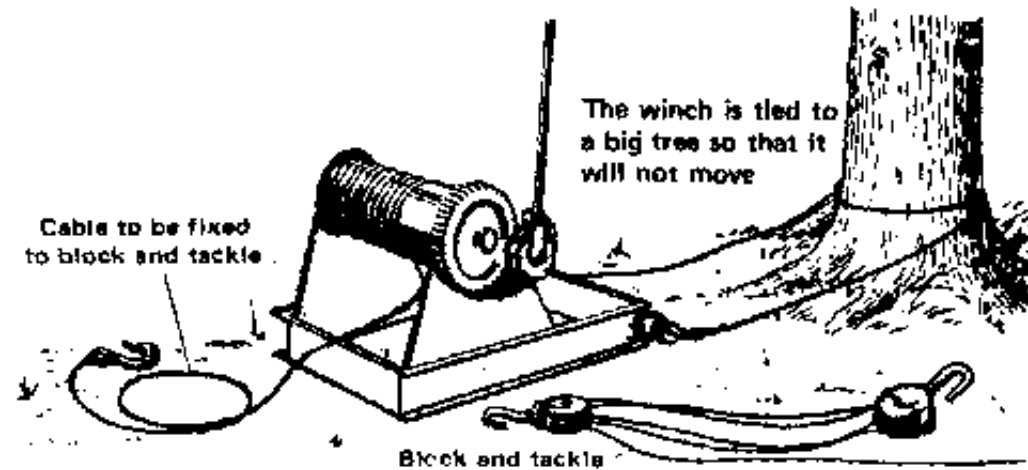
The rope should be longer than the height of the tree.

Make a hole around the tree.

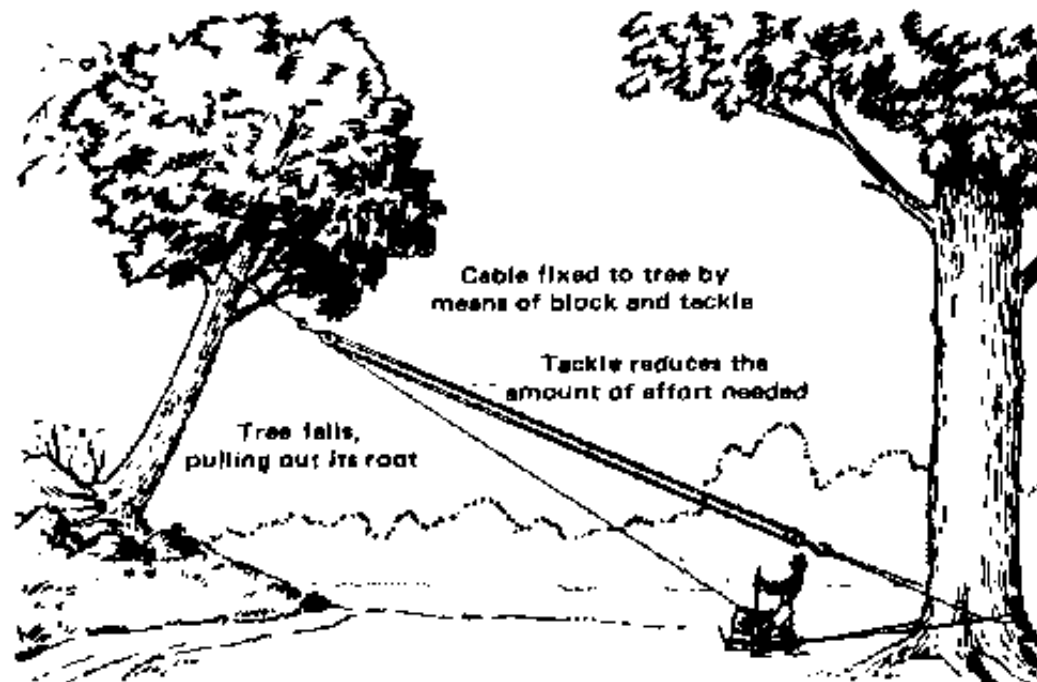
Cut the roots.

Then several men pull on the rope till the tree falls and pulls out its stump.

The work is easier if the rope is pulled by oxen, by an actor, or with a winch.



The winch is tied to a big tree so it will not move



Tackle reduces the amount of effort needed

HOW TO PULL OUT A TREE WITH A WINCH

The winch is tied to the base of a big tree.

Take the cable of the winch (a cable is an iron rope) and fix it to the middle of the tree that is to be pulled down.

With the winch handle or lever, wind the cable round the winch.

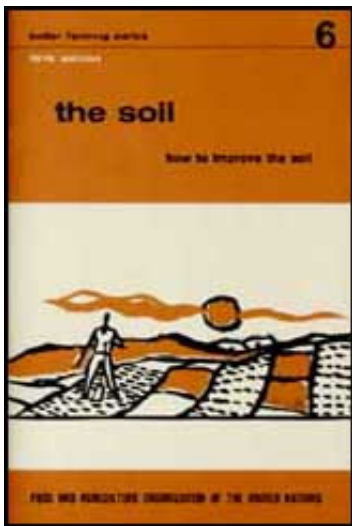
The cable pulls the tree.

The tree falls, pulling out its root.

Several farmers in a village can get together to buy or hire a winch.

Ask the extension service for advice.





Better Farming Series 06 - The Soil: How to Improve the Soil (FAO - INADES, 1976, 29 p.)

 *(introduction...)*

 Preface

 Plan of work

 How to improve the soil for many years

  Farming with animal power

 Suggested question paper

Farming with animal power

Grubbing trees makes farming with animal power possible. We shall study animal power next year. But we can say something about it now.

Farming with animal power is very interesting.

With it you can plough, weed, transport goods.

With animal power: work is done more quickly, farming is done better. You can farm bigger fields. You get a bigger harvest. You can pay for the oxen and the tools. You will earn more money than by traditional farming.

Examples:

At Agoudou- Manga (Central African Republic).

With traditional farming, a farmer earns 8 000 CFA francs a year.

With animal power, he can earn 30 000 francs.

Each year he pays part of the cost of his oxen, plough and cultivator: 12 000 francs.

So he earns $30000 - 12\ 000 = 18\ 000$ francs, that is 10 000 francs more than by traditional farming.

In Upper Volta (Mossi country).

With traditional farming, a farmer earns 17 000 CFA francs a year.

With animal/ power, he can earn 66 000 francs.

Every year he pays part of his donkey, cultivator, fertilizers, chemical pesticides: 29 000 francs.

So he earns $66\ 000 - 29\ 000 = 37\ 000$ francs, that is 19 000 francs more than by traditional farming

But, to farm with animal power, you must:


- **get permission to cultivate your fields for a long time. Preparing the ground (irrigation, contour lines, grubbing) takes a lot of work. You must benefit from this work.**

- **have regular, straight fields, rectangles big enough to work easily with animals.**
- **grub all the trees in the fields so as not to break your tools.**
- **have fields near the village, so as not to lose time getting to and from the fields.**
- **know how to feed and look after your animals. Strong, well fed animals work quickly and well.**
- **know how to take care of your tools.**

**Grubbing also makes mechanized farming possible.
Instead of working with animals, you can use a tractor.
But you need a great deal of money to pay for a tractor and its repairs.
You need very big fields.
You need a lot of crops that earn a lot of money.**



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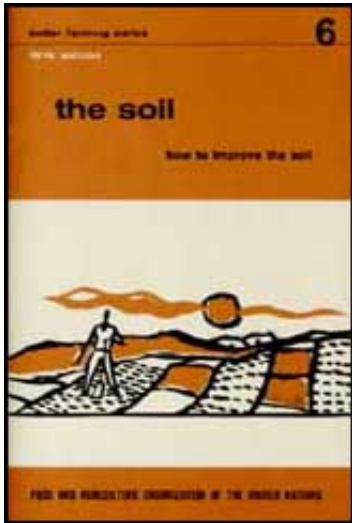
 **Better Farming Series 06 - The Soil: How to Improve the Soil
(FAO - INADES, 1976, 29 p.)**

 ***(introduction...)***

 **Preface**

 **Plan of work**

 **How to improve the soil for many years**



Farming with animal power



Suggested question paper

Suggested question paper

FILL IN THE MISSING WORDS

A modern farmer gives his field or

In this way he gives the soil

He improves theof the soil.

He can also grow plants to mix in the soil. This is

A farmer can apply fertilizers, but fertilizers are

Fertilizers are only useful when all farming are well done.

Before farming a field, a farmer mustand.....

This requires a lot of work, so he must be sure of.....the field for a long time.

To farm with animal power, you need a field that is.....and

ANSWER THE FOLLOWING QUESTIONS

What is green manure?

Why' should you both grow crops and raise animals?

Why is drainage needed?

What does nitrogen do in plant food?

What should a farmer do before applying fertilizer?

How do you make manure?

Explain to a friend what manure or compost does in the soil.

Why must trees be grubbed?

