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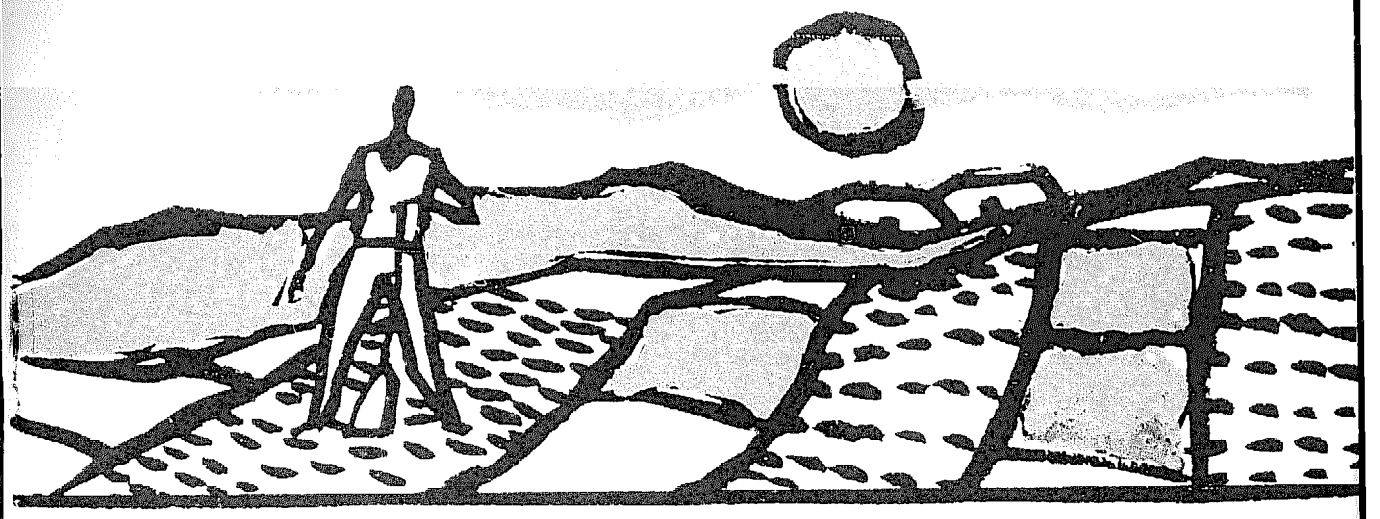
better farming series 6

the soil

how to improve the soil



FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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Twenty-six titles have been published in this series, designed as handbooks for a two-year intermediate level agricultural education and training course. They may be purchased as a set or as individual documents.

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1. The plant: the living plant; the root
2. The plant: the stem; the buds; the leaves
3. The plant: the flower
4. The soil: how the soil is made up
5. The soil: how to conserve the soil
6. The soil: how to improve the soil
7. Crop farming
8. Animal husbandry: feeding and care of animals
9. Animal husbandry: animal diseases; how animals reproduce

SECOND YEAR

10. The farm business survey
11. Cattle breeding
12. Sheep and goat breeding
13. Keeping chickens
14. Farming with animal power
15. Cereals
16. Roots and tubers
17. Groundnuts
18. Bananas
19. Market gardening
20. Upland rice
21. Wet paddy or swamp rice
22. Cocoa
23. Coffee
24. The oil palm
25. The rubber tree
26. The modern farm business

better farming series 6

The soil

How to improve the soil

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Institut africain pour le développement économique et social
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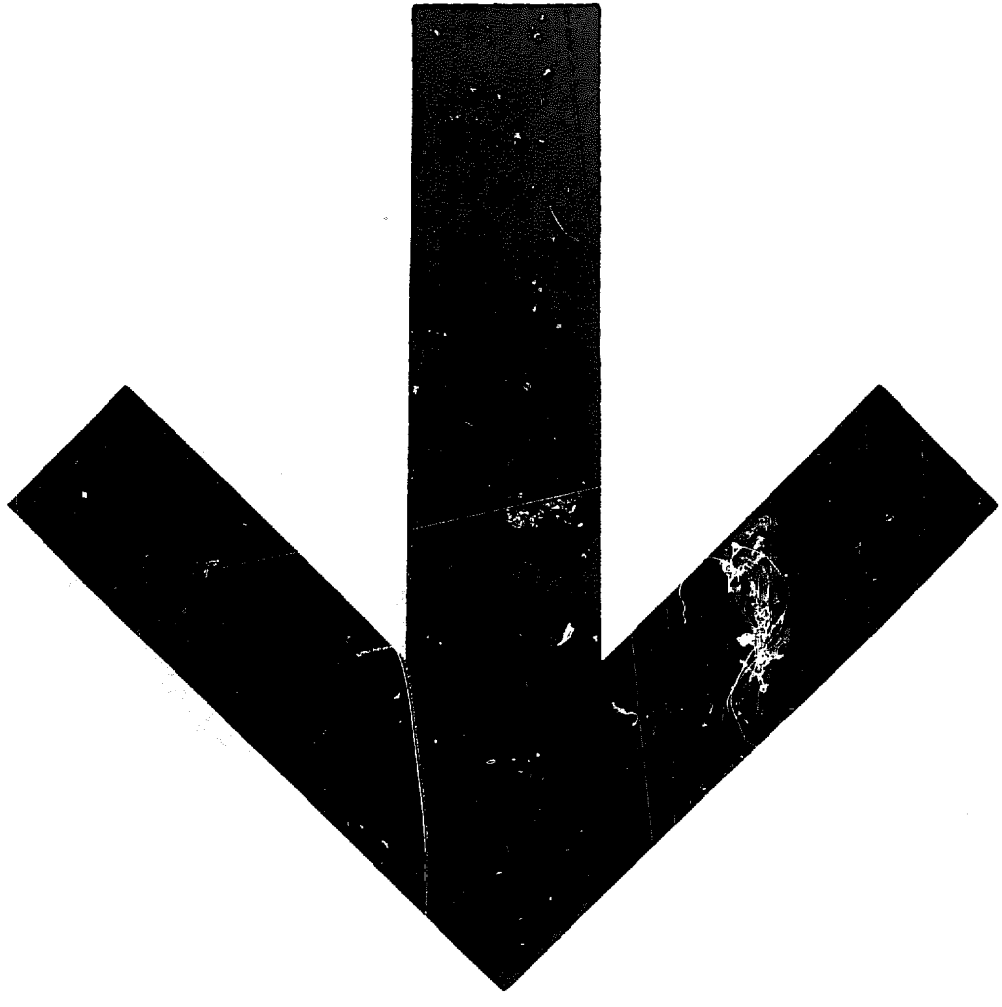
PREFACE

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 of 26 booklets. 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.

e original texts were prepared for an African environment
his is naturally reflected in the English version.
r, it is expected that many of the manuals of the
a list of which will be found on the inside front
will also be of value for training in many other parts
world. Adaptations can be made to the text where
ary owing to different climatic and ecological
tions.

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.



OUTLINE OF COURSE

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.

OW 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

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.

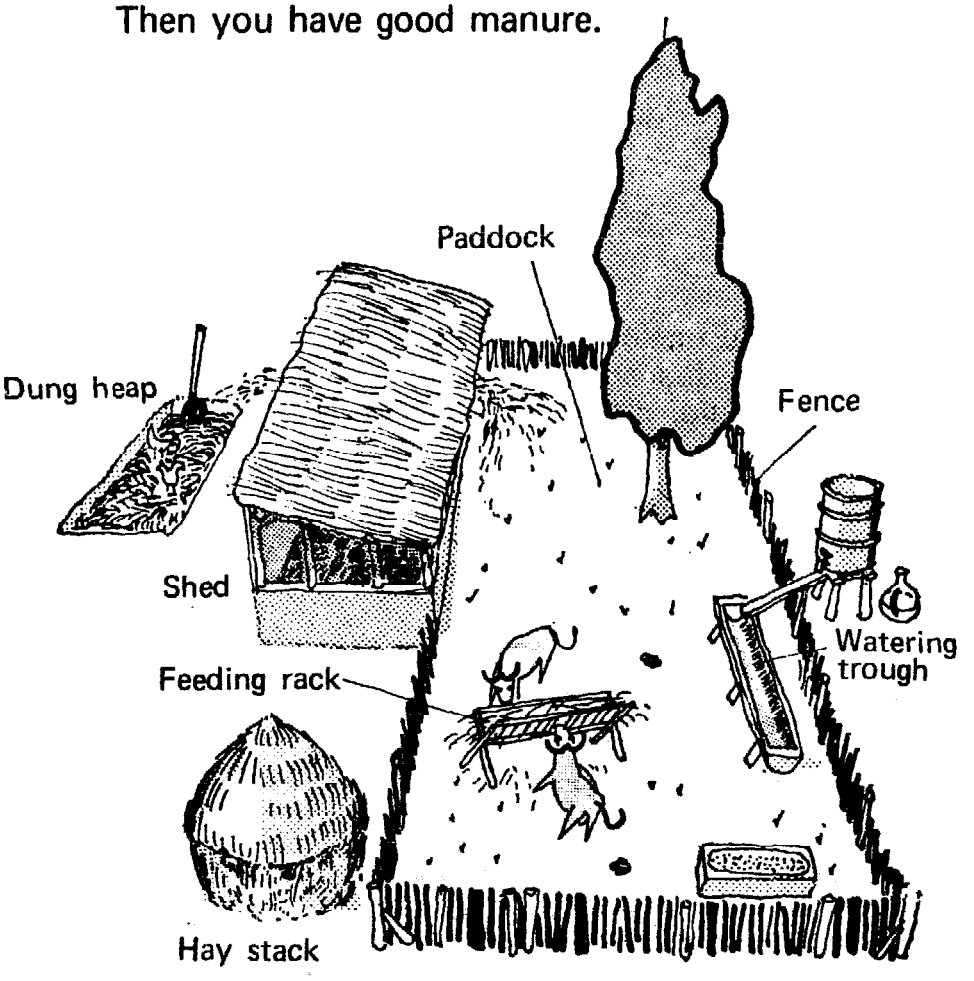
This makes manure.

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 Thiès (Senegal)
  and at Kpemé (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 24), 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.

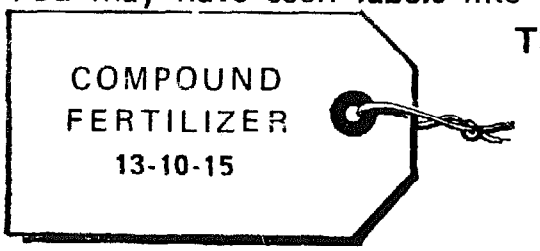
Those which contain
only nitrogen or potassium or phosphorus
are called **straight fertilizers.**

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
the quantity of **nitrogen** (N)
in 100 kilogrammes
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:

$$\frac{\text{content X weight of sack}}{100}$$

In a 50 kg sack of 13-10-15 fertilizer there is:

nitrogen ..... $\frac{13 \times 50}{100} = 6.5$ kg

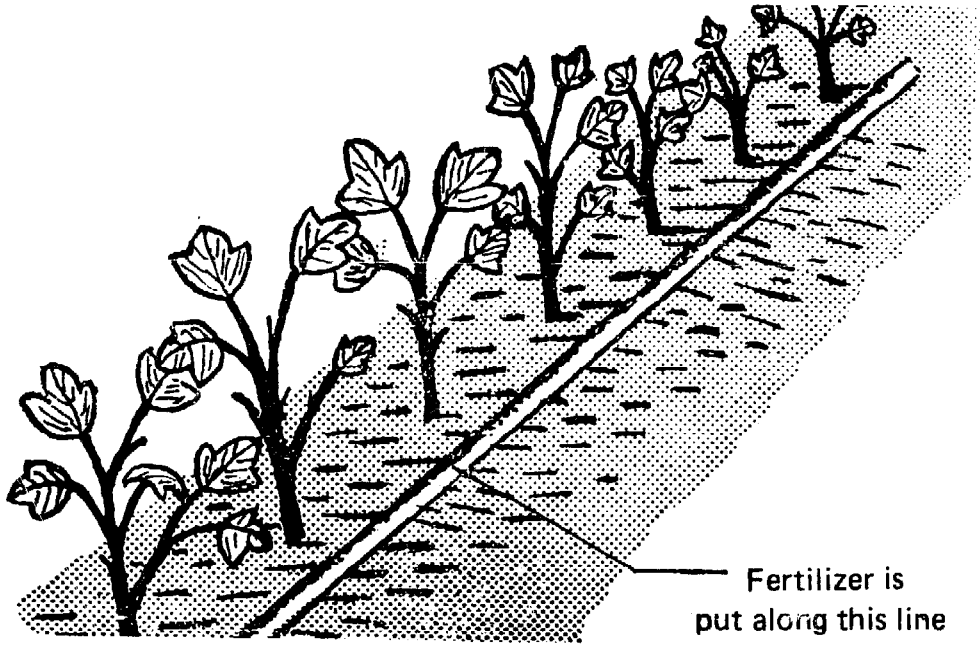
phosphorus ..... $\frac{10 \times 50}{100} = 5.0$ kg

potassium ..... $\frac{15 \times 50}{100} = 7.5$ 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.

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.

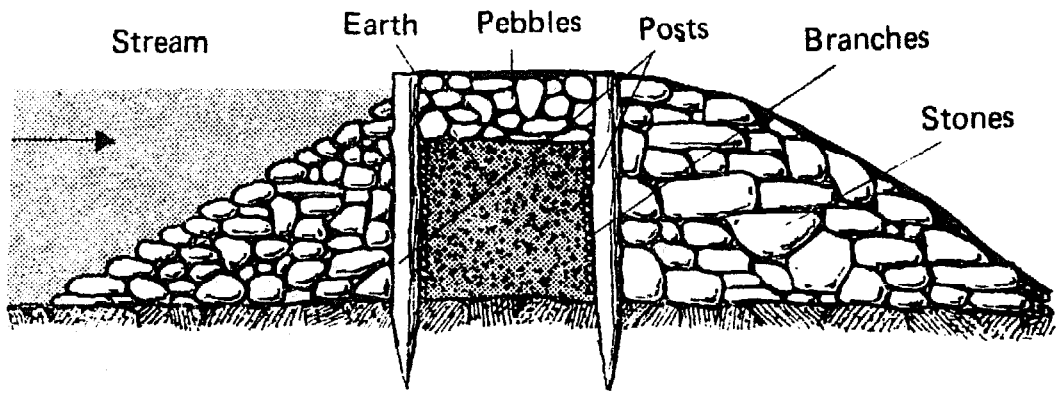
HOW TO KEEP WATER FOR IRRIGATION

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

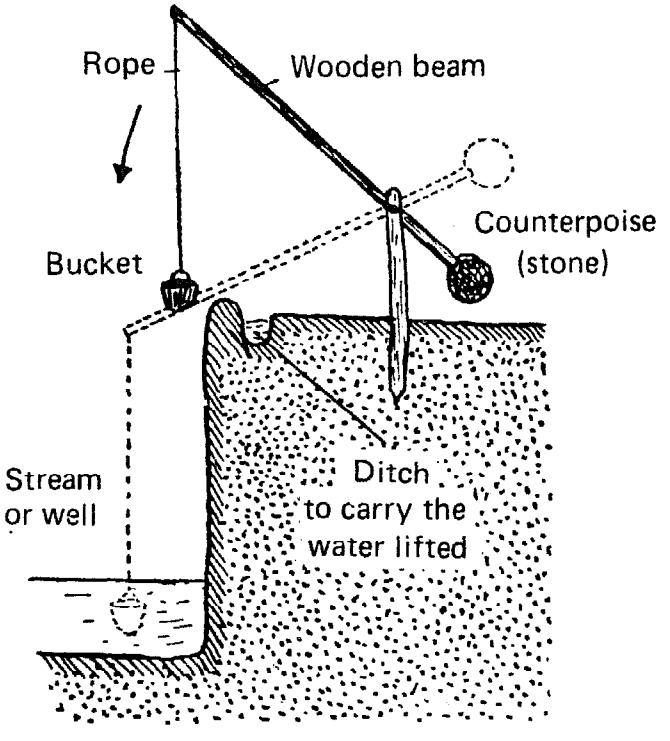
- give the animals water to drink,
- water the crops,
- even raise fish.

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)

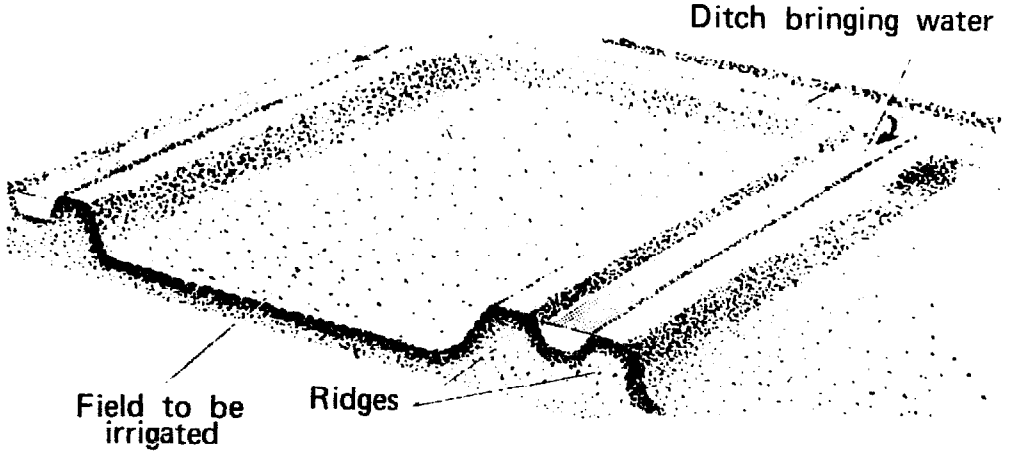
- **With a rope and bucket lift** (noria).
  This uses animal power.

- **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 o[illegible],
so that the water flows easily and is [illegible]ot wasted.



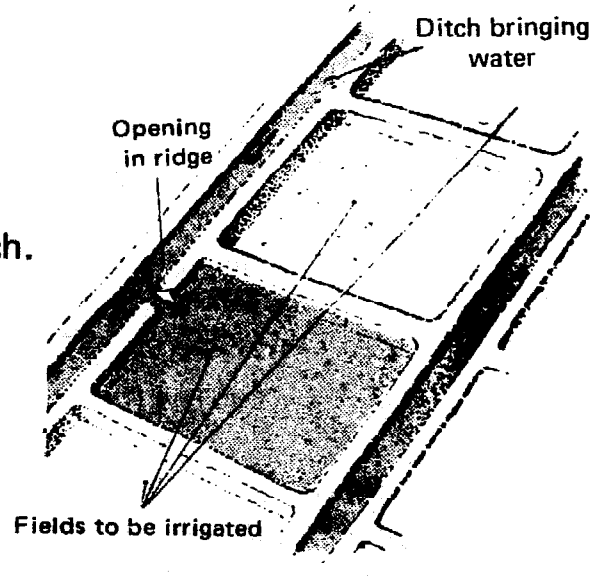
The field to be irrigated
is surrounded with a **ridge** or **bank.**

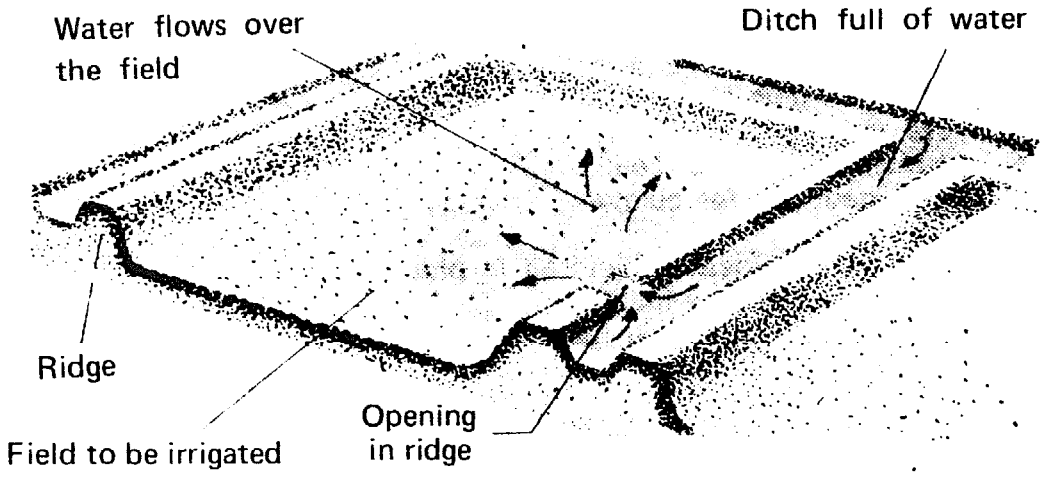
Thus the whole field
forms a basin.

To fill the field with water,
make a hole
in the ridge of the ditch.

The water flows
into the field.

When the field is flooded,
close the ditch,
and let the water
into another field.

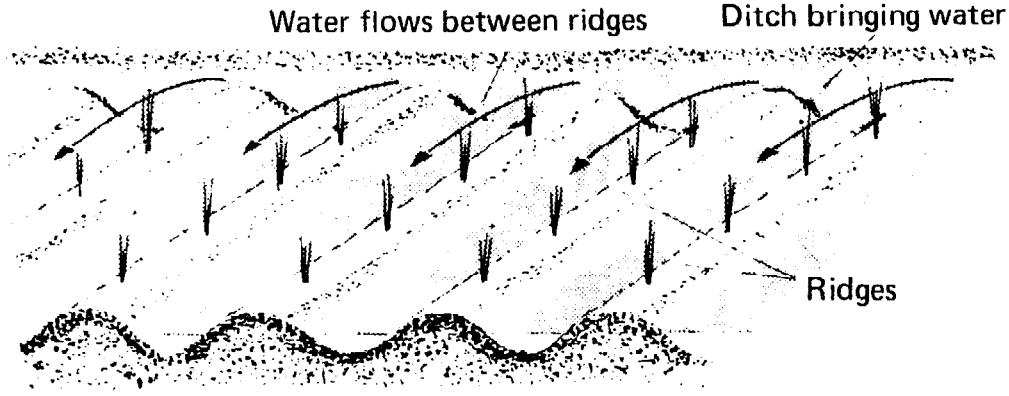




For salad plants, for tomatoes,
the whole field is not flooded.

The field is not covered with water.

The water is made to flow
between the rows of the crop,
between the crop ridges.

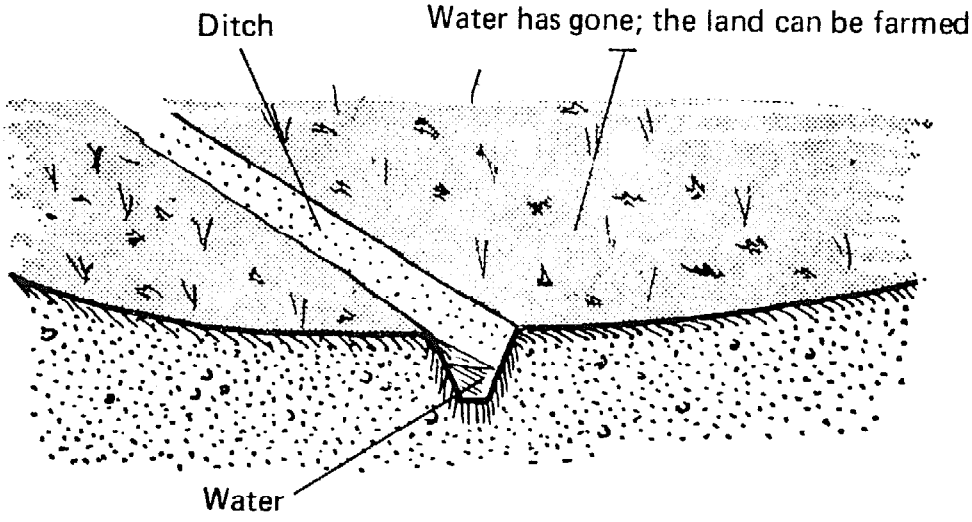


DRAINAGE

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

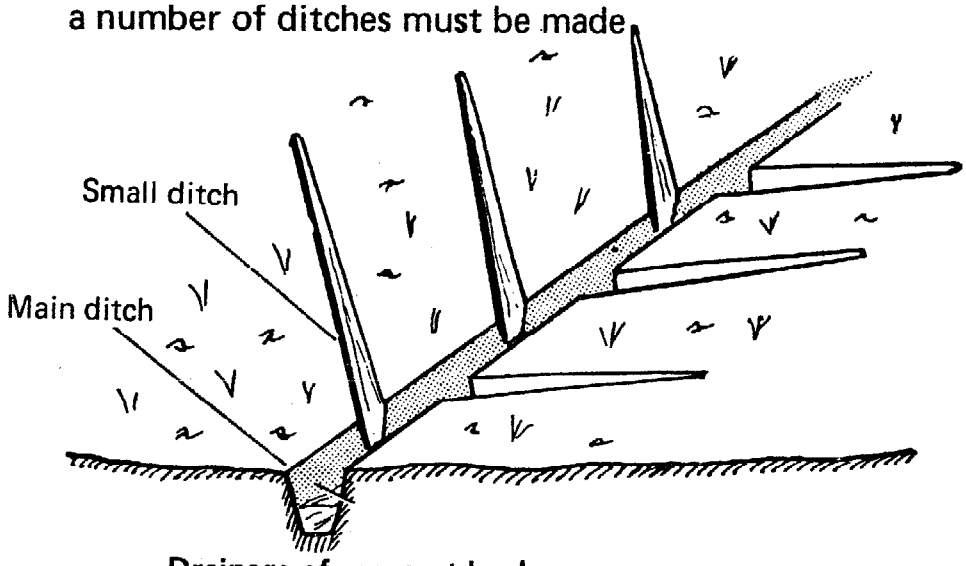
The surplus water must be made to run away,
the soil must be drained.

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.



Drainage ditch

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



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).

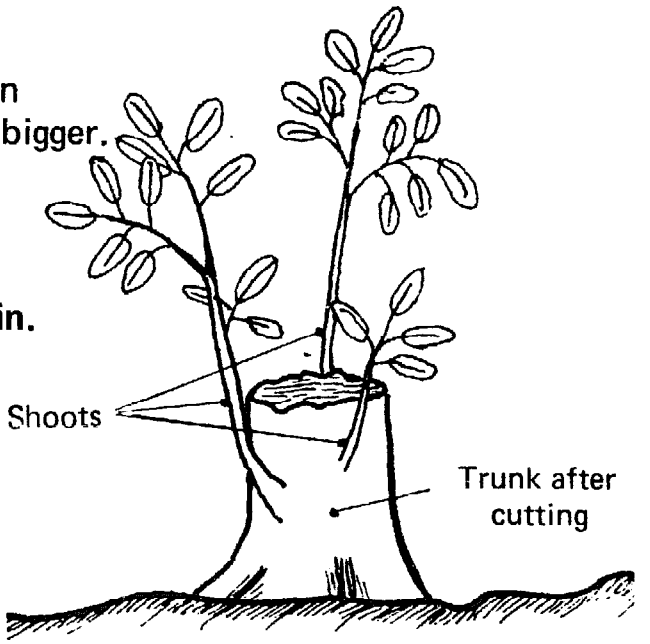
The bigger trees too must be cut.
The wood is taken to the village for fuel.

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.

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

HOW TO GRUB TREES

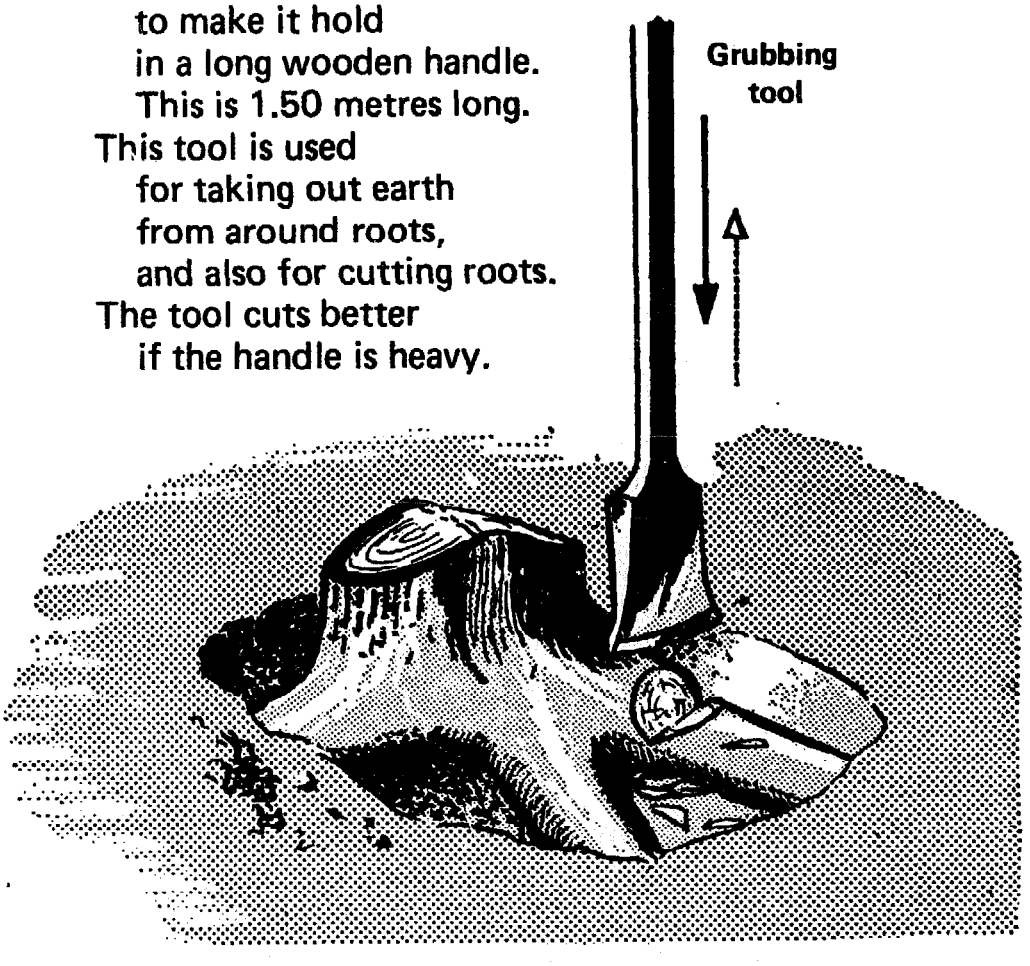
- **First way**

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.



- **Second way**

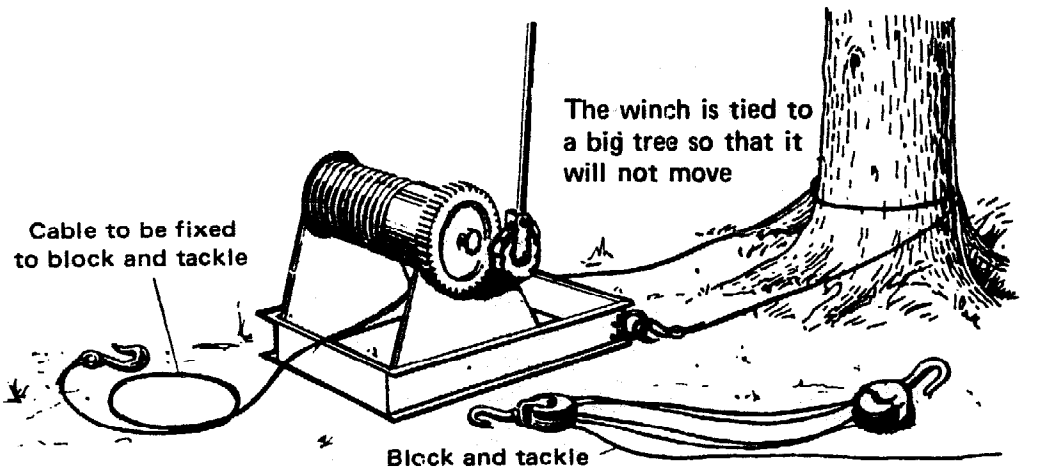
Pull out the tree with its stump.
Do not cut the tree trunk.

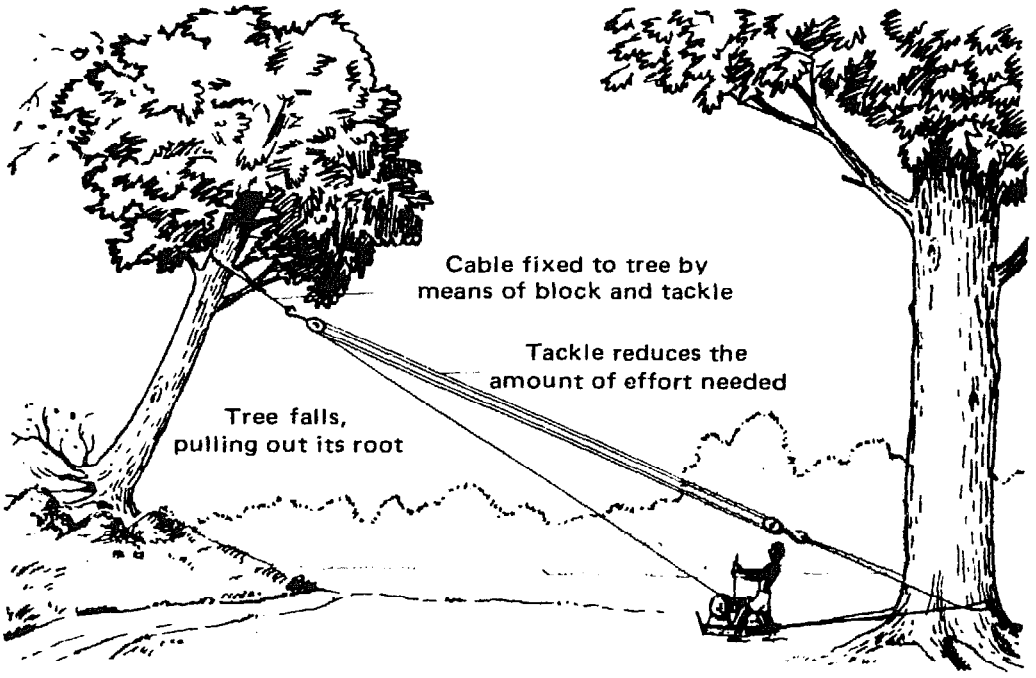
Tie a thick, very strong rope
to the tree trunk,
about half way up.
The rope should be longer
than the height of the tree.

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 a tractor,
or with a winch.





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.

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 30 000 less 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.
Each year he pays part of his donkey, cultivator,
fertilizers, chemical pesticides: 29 000 francs.
So he earns 66 000 less 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.

SUGGESTED QUESTION PAPER

FILL IN THE MISSING WORDS

A modern farmer gives his field ..... or .....

In this way he gives the soil .....

He improves the ..... of 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 must ..... and .....

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?

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