

➔  **Permanent Farming Systems Based on Animal Traction: Farmers Handbook (GTZ, 1995, 183 p.)**

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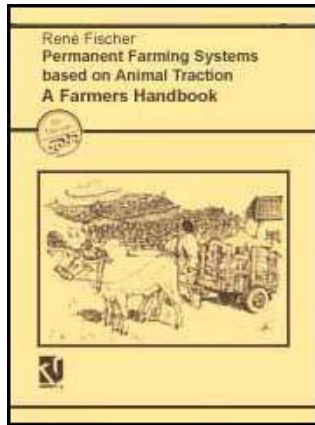
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PART VIII: Farm management

A Farmers Handbook

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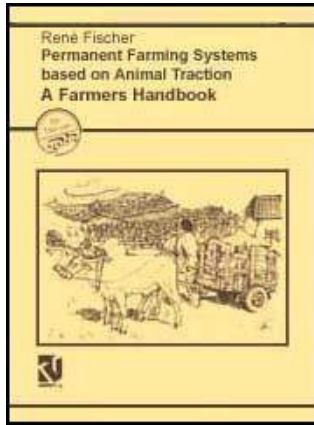
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PART VIII: Farm management



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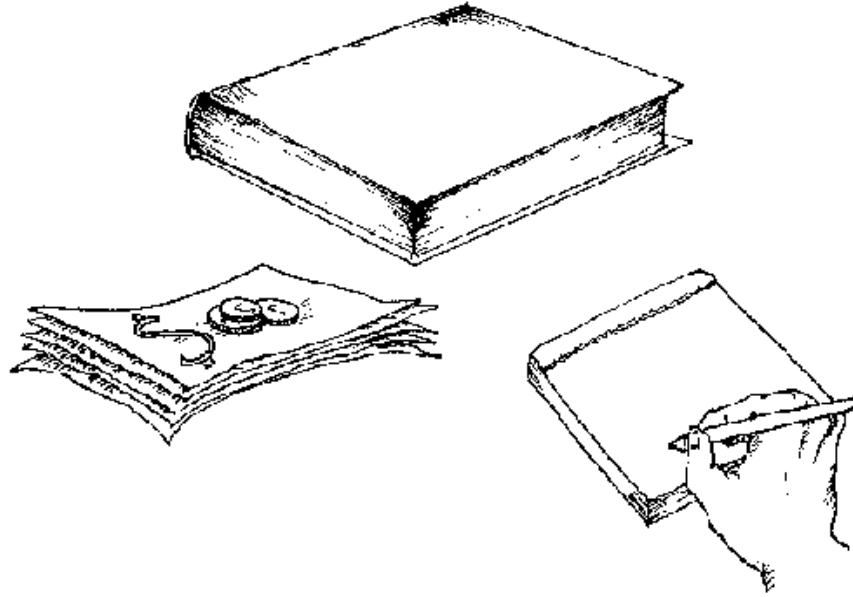
8.1 Introduction to management



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PART VIII: Farm management



Figure

It is very important for a farmer to understand that market farming is a business which can be very profitable but also includes the risk of failure and loss. Subsistence farmers who are producing to meet their own requirements, do not spend much time and money for their farms and they keep the risk of failure low.



Figure

Farmers who produce for the market, however, put more land, labour and money into their farms in order to gain more. To minimise the risk of failure and maximise profits, they have to judge markets and climate very carefully and balance the land, labour and money used for their farm: this is called "management".



Figure

8.1 Introduction to management

8.1.1 Definitions

- Farm:

One or more piece(s) of land where crops and/or animals are grown or reared as an agricultural enterprise.

- Farmer:

Someone who grows crops and/or rears animals for self-sufficiency and/or marketing.

Farm Management:

Includes planning, establishment, handling, control and evaluation of a farm. The main aim of farm management is to succeed in reducing loss and increasing profit. This depends on the ability of the manager to use effectively, the following available resources.

Available resources

- Land: size, shape, structure**
- Labour: manpower, animal power - oxen. tools/implements**
- Capital: input materials, seed, chemicals/fertilizer**

- Techniques: cultivating practices (land preparation methods, planting time and method, weeding, harvesting, processing and marketing).**

In short, a Farm Manager must know and decide - what, when, where, how and why to do anything on the farm to make the biggest profit.

8.1.2 Objectives

Improvement of the Farm Structures:

This includes the conservation and improvement of the farming land, the soil, farm roads, buildings, etc.

The farm size should be economical. To crop only 1 ha. with oxen is not economical. You will not be able to pay back your loan.

The soil should be fertile, productive and well protected. The way of farming will influence your soil. Protect and improve the soil by

means of contour and organic farming (see Part V of the handbook).

The farm should be accessible by carts to facilitate easy transport of inputs and harvest.

Installations like farm house, cowshed, stores, etc. should be convenient and long lasting.

Improvement of Farming Skills:

A good farm manager shows a lot of interest in new methods of production and processing.

He is eager to learn

-What kind of implements and tools to use, to improve effectiveness of work e.g. seed planter, oxen farming implements

-which farming methods are very productive and lasting, e.g. contour/organic farming

-how to prepare/process crops to find a good market, e.g. drying, storage, etc.

Improvement of Financial Situation:

A farm manager must reduce losses and maintain or increase the output (yield) at the same time to make profit. The farm profit is the money left from selling produce, after the deduction of expenditures like loan repayment, cost of seeds/fertilizer, cost of labour, etc.

8.1.3 Methods**-Studies & Analysis**

A farmer as a farm manager must know his or her environment: the climate, vegetation, topography, what crops/animal do well where, when and how, what markets are available when, where, and to what scale. Briefly, a farm manager must investigate the available resources and how they can be combined effectively.

-Planning

A farmer, as a farm manager should make plans on what to do, and how to do it

The farmer will have to think about different production methods and about the cost and benefits he will have when

using one or the other method.

-Decision Making

A farmer grows a crop. For this crop, he knows all the costs of inputs operations. Then he knows how much will be his income out of the yields of this crop (output) depending on the various methods of production he can use. This enables him to compare both, output and input with the different production methods so that he can choose the production method which gives the biggest profit. This choice the farmer makes is what we call decision making.

-Taking; Action

This is the actual stage of growing cross or rearing animals and keeping good records of all aspects planned. For instance, the land preparation planting of crops, caring for the crops/anneals, harvesting/processing marketing.

-Evaluation (Checking)

For the evaluation of his farm, the farm manager has to keep

records of activities, expenses and income. The evaluation of this data enables the farmer to know whether the farm is gaining or losing. (See section on farm records and accounts).

-Continuation

A farmer who is managing his farm successfully in the first phase has to think of how to maintain and how to increase his income in the following phase. He may decide to use his oxen to extend his farming area, or use the oxen for contract work in addition to his farm work. The farmer may also improve his storage facilities and his skills for better marketing.

8.1.4 Factors Influencing Farm Management

- Environment

Land, plot size, soil, climate, labour force and source, market, etc.

- Technology

Currently used practices and techniques, traditional and/or modern techniques and the appropriate implements.

- Manager's Qualities

It is necessary to have a good manager to succeed. A good manager must have the following qualities:

- 1. A good farm manager must be capable of controlling him- or herself.**
- 2. Must be determined and courageous.**
- 3. Must know how to plan and take timely good decision.**
- 4. Must know appropriate farming methods.**
- 5. Must know hue/her environment.**
- 6. Must be hardworking.**
- 7. Must be able to withstand failure.**
- 8. Must keep good records.**
- 9. Must constantly investigate new developments.**

8.2 Farm records

It is very important for any farmer to record all his/her farm operations. This helps the farmer to know the inputs used, the current situation of his farm and plan for the future.

8.2.1 Farm Record Book

There are many ways of keeping records of farm activities. In the table below, there is one example of a farm record book.

DATE	OPERATION CARRIED OUT	AREA	TIME hours	COST FCFA	REMARKS
15/02/95	Cleared one quarter of farm	0.25	3 1/2		self
20/02/95	Continued clearing on farm	0.55	5		w/ my sons
22/02/95	Completed clearing of rest of farm	0.2	3		alone
02/03/95	Ploughed 2 plots of farm	0.5	2		w/oxen
03/03/95	Completed ploughing	0.5	2		w/ oxen
12/03/95	Harrowed field	1.0	1		w/ oxen
15/03/95	Planted 1/2 of plot	0.5	1.45	500	invited relatives
15/04/95	Applied 3 bags of fertilizer (NPK 20/10/10) and did moulding on maize field	1.0	5	7000	w/ oxen

A farm record book will indicate the work done, the time taken and the cost incurred. It enables you to calculate your farm requirements,

e.g. working hours per week or month and expenses.

8.2.2 Accounts

It is very important for a good farmer to know the meaning of money, to keep simple accounts and an inventory of property owned.

What is the meaning of money?

- a means of expressing the value of a thing**
- all money, coins, paper notes are presented in gold**
- every country has its own currency, e.g. Cameroon- CFA
Germany - Deutsche Mark (DM)**

U.S.A. - Dollars France - French Francs

The value of money changes. This year you may buy a bag of fertilizer for 3,000 CFA, next year it may cost 3,500 CFA.

What use are accounts to a farmer?

Accounts

- are records of farming business**
- explain the farm expenses and income**

-show the gain or loss of farming business

Use of Accounts

-they help the farmer to evaluate the economics of his farm business.

-with the above, one can become master of any money.

Types of Accounts

-annual farm or production accounts e.g. (animals, crops).

-family accounts

-bank or credit union accounts .

-daily, monthly and yearly accounts

8.2.2.1 Annual Crop Account

Year 1994 (prices are just examples, not real)

Monica has a field of 2 hectares of maize. She hired the services of an oxen farmer to plough and ridge the land for 56,000 francs on the 1st of March. She sowed 60 kg. of selected seeds at 200 francs per kg. on the 15th of March. On the 15th of April, she bought 12 bags of

fertilizer 2-0/10/10 costing 2,000 francs each from the Cooperative. For transport, she hired a bullock cart for 2,000 francs from an oxen farmer.

On the 20th of April, she hired 20 women in her farm to do the weeding for 40,000 francs and bought food and drinks for 10,000 francs. On the 1st of August, the harvest was 60 bags. She sold 30 bags immediately at 5,000 francs each and stored 30 bags. Since she has a large family, for food she used 10 bags (value 5,000 francs each) then kept 1 bag for seeds (value at 5,000 francs) and sold the rest at the sowing period for 8,000 francs per bag, in March.

How much money has she gained or lost?

Draw up an annual crop account !

Year 1994

DATE	I buy, I sell, I give	INCOME	EXPENSE
1 st March	Hiring of oxen	-	56,000
15th Marc	Purchase of seeds 60 kg. at 200 CFA each	-	12 000
1st April	Purchase of 12 baas of baas	-	24.000

	(20/10/10) fertilizer at 2,000 CFA per Hiring of bullock cart for transportation of fertilizer	-	2,000
20th April	Purchase of foods and drinks hiring for women to weeding	-	50,000
1st August	Sales of 30 bags of maize at 5000 CFA per bag	150,000	-
	10 bags of maize kept for food (value 5000 CFA per bag)	50,000	-
August to beginning of 1995	1 Jag of maize kept for seeds (value 5000 CFA)	5,000	-
	19 bags of maize sold at the sowing period for 8000 CFA per bag	152,000	-
	TOTAL	357,000	144,000

Gain = Income - Expenses
= 357,000 CFA - 144,000 CFA = 213,000 CFA
Gain = 213,000 CFA

NOTE: If Mme Monica owned a pair of oxen she would not have hired

the services of an oxen farmer and women to do the weeding. She would have used her own oxen.

8.2.2.2 Family Account

John and Mary Shu are farmers in Bafut who bought a pair of oxen on credit. At the beginning of the year, that is 1st January, they had 300,000 francs from sales of crops.

On the 15th of January, they made their repayment of the loan to the Bank in cash of 50,000 francs.

On the 8th February, Mary went to the market to buy uniforms, canvas, shoes and socks for the children for the youth day for 20,000 francs. She also bought provisions for the household for 10,000 francs.

The agricultural research organisation introduced a good variety of maize. Since the family is interested to have a better yield, on the 1st of March, John Shu buys 60 kg. of unproved seed at 2,000 francs per kg. On the 12th of March, the father of John died. He spent 100,000 francs for the death celebration.

On the 1st of April, John went to Bafut market and sold a goat for 10,000 francs. He met some friends and bought drinks for 4,000 francs.

How much balance does the family have? You should make a cash book to know this!

Cash Book

DATE	TRANSACTION	IN	OUT	BALANCE
01/01/95	Sales of Crops	300,000	-	300,000
15/01/95	Repayment of loan	-	50,000	250,000
08/02/95	Purchase of uniforms, etc. for the children	-	20,000	230,000
	Purchase of provisions for the household	-	10,000	220,000
01/03/95	Purchase of 60 kg. of unproved maize seeds (200 frs/kg)	-	12,000	208,000
12/03/95	Death celebration of John's father	-	100,000	108,000
01/04/95	Sale of one goat	10,000	-	118,000
01/04/95	Purchase of drinks	-	4,000	114,000

The family balance is 114,000 francs!

This cash book is very useful. It enables you to know your daily income, expenses and the balance you still have. Some farmers spend more than they have which is not good.

By recording income and expenses in a Cash Book you can detect unnecessary expenses or losses and avoid them in future and you find out where you earn money easily and increase your income.

8.2.2.3 What is an inventory?

An inventory is a detailed statement of one's belongings, property or a descriptive list of one's goods which should be established and updated yearly.

Through an inventory, a farmer is able to know what is available on the farm and what he may need.

No. ITEM	QUANTITY	CONDITION
1. Oxen	1 pair	good
2. Plough	1	good
3. Rider	1	broken

4. Bullock Cart	1	good
5. Goats	10	5 young, 5 old
6. Farm House	1	needs repair
7. Hose	4	2 good, 2 broken
8. Crops	Maize 1ha.	good
	Coffee, 2 ha.	disease and pest
	Plantains, 1 ha.	good
9. Fertilizer	20/10/10, 10 . bags	

After you have made your inventory, you should also take note of Depreciation.

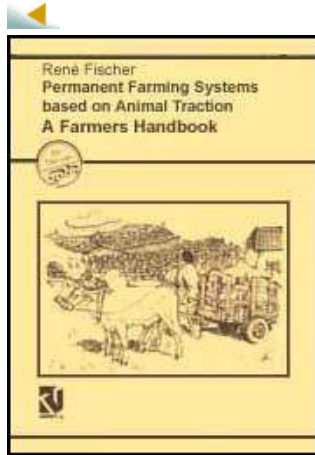
Depreciation accounts for the wear and tear of articles through use and age. If a farmer understands that his or her tools/implements are wearing out, he/she should save money to buy new ones. Depreciation indicates how much money you should set aside every year, if you want to be able to replace a certain item when is worn out.

Example:

A cart costs 80,000 CFA. If we assume that the cart can last for 10 years, you have to save 8,000 francs each year so that you will have enough money to buy a new one by the time the old one is worn out.

The first version of this handbook was produced in 1982 as a guide for the basic training of farmers of the North-West Province of Cameroon, in the use of oxen. Over the years, the focus of the project changed from introducing the use of draft animals to encouraging the development of permanent farming systems employing draft animals. Consequently handbook parts dealing with crops, soil, the permanent farming system, vegetables and farm management were added and amended in the subsequent editions. The most recent addition is the part on donkeys which are becoming increasingly important as draft animals in Africa.

In the meantime the book has found a much wider audience beyond the boundaries of the North-West Province through its distribution by GATE/ISAT, where it has become popular as a reference book for people who are practically involved in agriculture, farmers and extension workers. It now has a far more widespread application throughout tropical Africa and it covers a wide range of rural agricultural and livestock topics.



 **Permanent Farming Systems Based on Animal Traction: Farmers Handbook (GTZ, 1995, 183 p.)**

 *(introduction...)*

  **About this handbook**

- PART I: Draft cattle**
- PART II: Donkeys**
- PART III: Draft animal implements**
- PART IV: The soil**
- PART V: The permanent farming system**
- PART VI: Crops**
- PART VII: Vegetable gardening**
- PART VIII: Farm management**

About this handbook

The first version, the WADA Oxfarmers' Handbook, was produced in 1982 as a guide for the basic training of farmers of the North West Province of Cameroon, in the use of oxen. The Oxen Project was

initiated by Wum Area Development Authority, WADA. Over the years, the focus of the project changed from introducing the use of draft animals to encouraging the development of permanent farming systems employing draft animals and the project name changed to Promotion of Adapted Farming Systems based on Animal Traction, PAFSAT.

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This handbook spans 20 years of development policy and approaches and its style reflects the changing target audiences, from simple rural

farmers of the NW Province of Cameroon to agricultural professionals in West Africa. It now has a far more widespread application throughout tropical Africa and it covers a wide range of rural agricultural and livestock topics. It is therefore not possible to include every aspect of regional agroecological and cultural variation.

The specific drawings of animals, crops people and cultivation techniques, indigenous to the NWP of Cameroon serve as practical examples which should be easily adapted. The following publications were used for reference, information and illustration of the manual:

**INADES, Better Farming Series; A series of booklets about all aspects of practical farming;
Food and Agriculture Organization of the United Nations, Rome, 1970.**

Bergmann, H. Butler R. Primary School Agriculture Teachers' Manuals 1 - 5;

Deutsche Gesellschaft fur Technische Zusammenarbeit, 1980

FAO, The Employment of Draft Animals in Agriculture; Food and Agriculture Organization of the United Nations, Rome, 1972.

Jones, P A; Donkey Selection, Care and Training; Agricultural Engineering Training Centre, Harare and GTZ Eschborn, 1991.

AETC; Manuals on Draft Cattle Selection, Care and Training, Plowing and Crop Maintenance using Draft Animals; Agricultural Engineering Training Centre, Harare and GTZ Eschborn, 1986 -88.

Scheinman, D. Caring for the Land of the Usambaras; Soil Erosion Control and Agroforestry Project, SECAP, Lushoto Tanzania and GTZ Eschborn, 1986.



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➔  **PART I: Draft cattle**

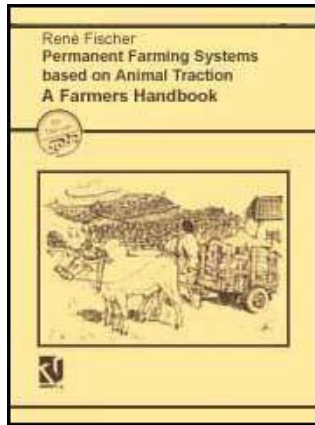
 **(introduction...)**

 **1.1 How to select your cattle**

 **1.2 Training of draft cattle**



1.3 Draft cattle management



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PART I: Draft cattle

Cattle will do well and are recommended as draft animals where:

- a farmer already owns cattle for milk and beef production**
- suitable local animals are available in the vicinity of the novice farmer**
- government's services or projects promote and support farmers the use of draft cattle**

1.1 How to select your cattle

Not all cattle are suitable for draft work. The suitable ones must be selected at the age of two to three years, when they are still growing. If they are well fed and properly cared for, they will grow into well built animals with a live weight of 400 kg or more at the age of five years. At that weight, one pair of suitable draft cattle is heavy enough to pull a plough working at 20 cm depth or a ridger.

The ideal draft animal is a healthy, docile male castrate (an ox) of local breed. He has a wide, deep chest, prominent hump and straight back and legs. He weighs at least 400 kg when grown up and has the stamina to do draft work for up to six hours a day.

1.1.1 Suitable Cattle Breeds for Draft Animal Use

Local cattle breeds are usually best suited for draft work because they are well adapted to the local climate, food and diseases. Exotic breeds which are not adapted to the environment, may not take the added stress of draft work well, they require good care and are likely to be sick more often than local cattle.

Cattle bred for meat production or for both, meat and milk

production, are generally well suited for draft work because they grow big and strong. Dairy breeds tend to be less well muscled and require better feed and management, they are therefore less suitable as draft animals, especially if they originate from temperate countries and are newly introduced into tropical countries.

The three Zebu cattle breeds of the North West Province can be used for animal traction:

The Red M'bororo

A heavy and strong breed. Quite resistant to diseases. Prefers the hillside to the valleys.



Fig. 1.1: M'bororo breed has Red Skin

The White M'Bororo or Aku

Often not as heavy as Red M'Bororo but calmer in temperament. Very resistant to diseases.

Appreciates the valley climate best.



Fig. 1.2: Aku breed has White Skin

The Gudali

A heavy and strong breed. Very good as draft animal, but more susceptible to diseases. Not as common as the two other types and more expensive to purchase.



Fig. 1.3: Gudali breed has Black and White or Brown and White Skin

1.1.2 Sex of Draft Cattle

A herd of cattle consists of different animals:

- a bull (bulls) is a grown-up, male animal**
- a cow (cows) is a grown-up, female animal**
- a calf (calves) is a young animal of less than 12 months**
- a heifer (heifers) is a young female which has never been pregnant.**
- an ox or bullock (oxen, bullocks) is a grown-up animal which has been castrated.**

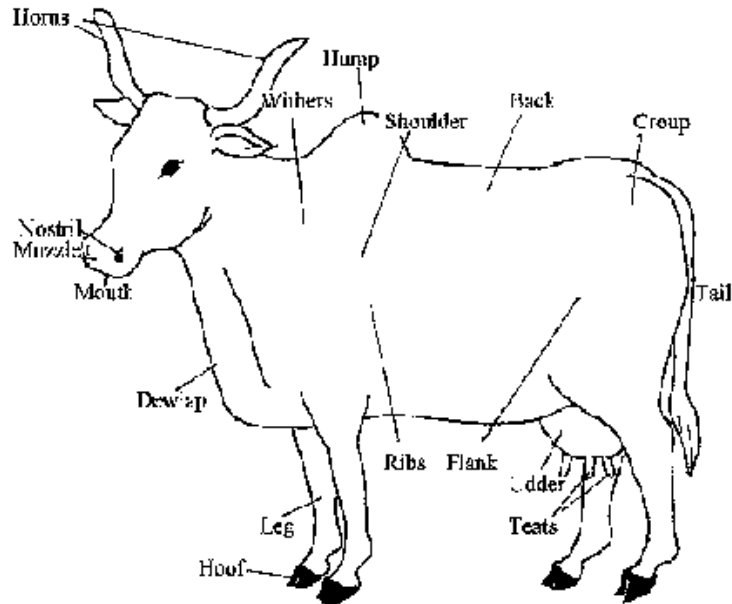


Fig. 1.4: Some parts of the body of a cow

The ox is the most suitable animal to begin with draft animal cultivation, because:

- he is as strong as a bull**
- he is less wild, hence easier to train and to handle than a bull**
- he is stronger and easier to maintain than a cow.**

However, an experienced oxen farmer can also train and work with bulls and cows and use them for reproduction at the same time.

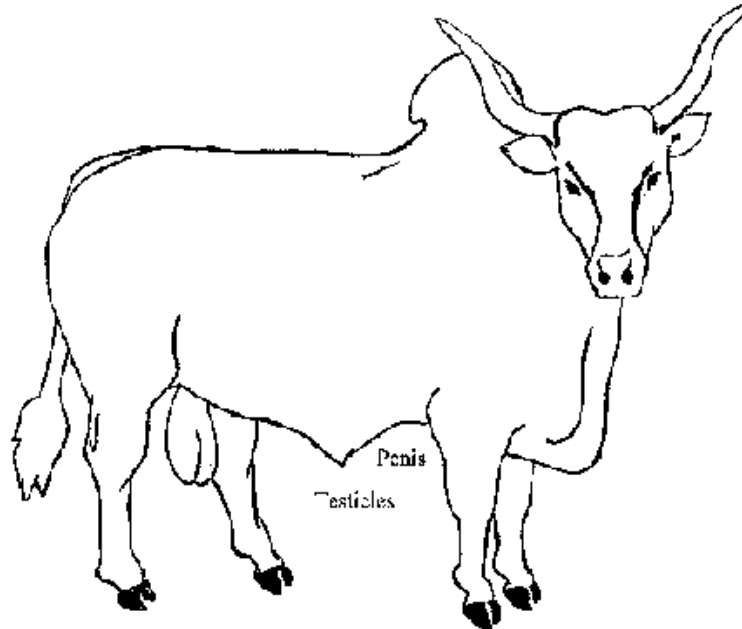


Fig. 1.5: Some parts of the body of a bull

1.1.3 What Does The Body of Good Draft Cattle Look Like (Conformation)

In general, the animals you choose for work should be strong, heavy, healthy, docile and intelligent. They should be calm but not lazy.

Which are the most important parts of the body of a draft animal?

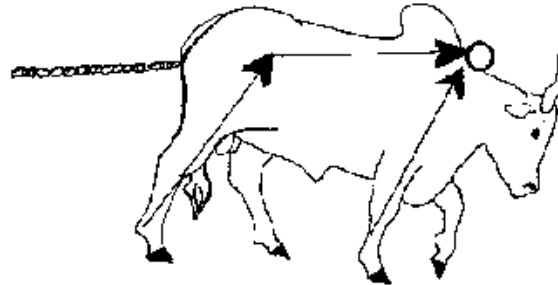


Fig. 1.6: A draft animal must have strong and well conformed legs, a straight back and the correct neck to carry the yoke.

The legs must be normal. If they are not normal the joints wear out soon.

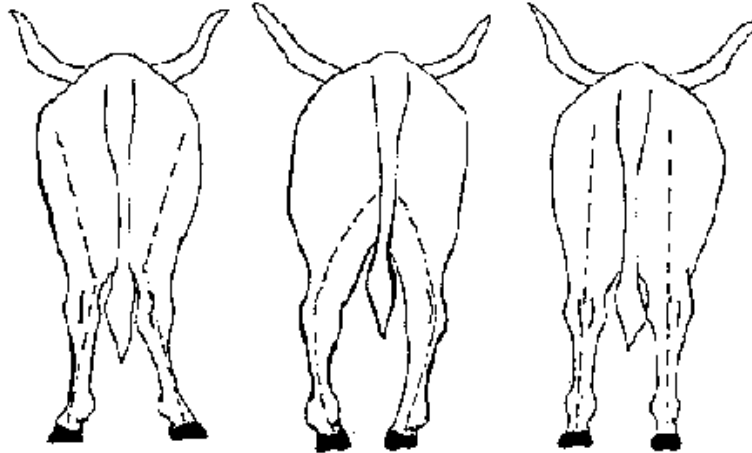


Fig. 1.7: No! It must not have X-legs!; Fig. 1.8: No! It must not have O-legs!; Fig. 1.9: Yes! The legs are normal



Fig. 1.10: No! The foot must not be too straight!; Fig. 1.11: No! It must not be bent too much!; Fig. 1.12: Yes! It must be slightly bent!

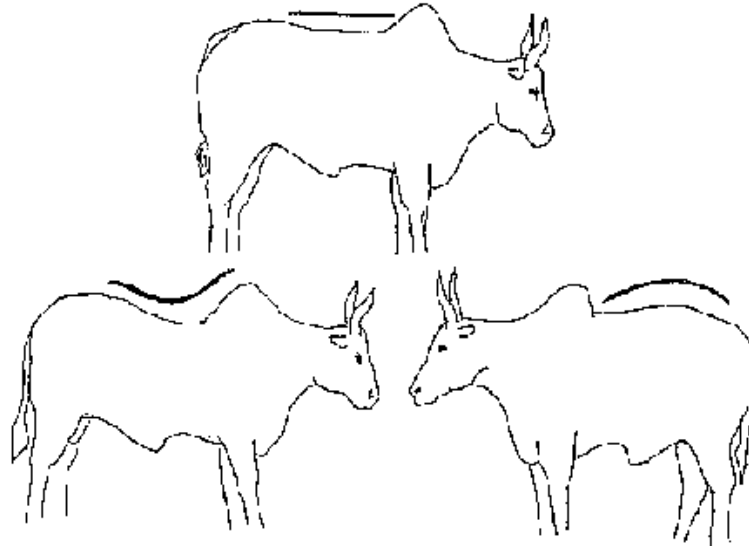


Fig. 1.13: Yes! The back must be straight!; Fig. 1.14: No! It must not be bent down or concave; Fig. 1.15: No! it must not be bent up or convex.

1.1.4 The Temperament of Draft Cattle

- A good draft animal should be active, intelligent and lively, but not wild and fierce.**
- An animal which is too calm and therefore easy to train can**

be lazy while working.

**- An active animal is more difficult to train than a calm one.
But later on during work, you only have to control it, you
don't have to push it forward.**

1.2 Training of draft cattle

**Before the oxen can be used for farm work, they have to be trained.
During training, animals learn to respond to human language and
how to pull the various implements.**

**A new oxen farmer can learn to train oxen with the help of other
farmers and extension staff.**

He may use experienced oxen to help.

An experienced farmer trains new oxen himself.

1.2.1 At what age should the Training start

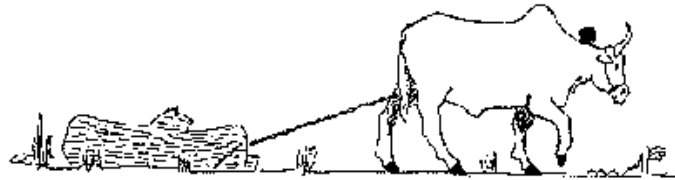


Fig. 1.16: The best age to start training the animal is between 2-1/2 and 3 years, because:

- animals which are younger than 2 years are not strong enough for the training and the tedious farm work, which follows the training**
- animals which are older than 3 years can be headstrong and wild. Also, because of their weight and their power, they are more difficult to train and can be dangerous.**

Young animals can be bought for a cheaper price than old ones. If well fed, they still grow and gain weight while they are working. When the farmer sells them because they are too old for work, he gets a higher price because they are heavier than when he bought them.

Moreover, the working life is longer for young oxen.

1.2.2 Basic Rules for the Training of Draft Oxen

- be patient with your oxen throughout the training**
 - start from the known to the unknown**
 - move from an easy step to a more difficult step**
 - return to the previous step if the oxen fail to learn the new step**
 - don't force the oxen if they cannot put up a constant performance every day**
 - give simple, friendly and clear commands**
 - avoid beating and hostility**
 - learn the speed, the temperament and the character of your oxen. Adjust to these.**
 - allow short breaks**
- try to understand the behaviour of the oxen. If they are not behaving the way you want, check first whether your own behaviour was correct and do not just punish them.**

1.2.3 How to Approach your Ox



Fig. 1.17: Approach your ox from the front and call his name!

Whenever you approach your oxen, you should:

- Come from the front, so that it can see you! Never come from behind.**
- call it's name, so that it -can hear you and respond to you!**
- lure it in the beginning with salt m your palm or with other food!**
- tickle it in the ears, dewlaps and flanks and talk in a friendly way to it!**
- be consistent and firm as you deal with your animals!**

Follow these rules whenever you approach your animals for any purpose. If you frighten the animal, it may try to defends itself with

its horns or hooves, eventually harming you.

If you follow these rules, your oxen will soon know their own names and they will become your friends, understanding the training stages well.

Teach all the members of the family, how to approach and handle the oxen and your oxen will become new members of the family.

1.2.4 Training Steps

Before the actual training of the oxen starts, the oxen are paired. They are trained as a team and have to work as a team.

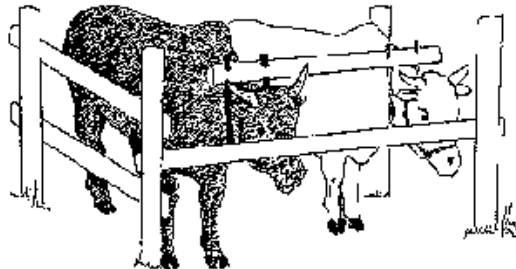


Fig. 1.18: A pair of oxen should be equal in size, weight, height and temperament. Here a new pair is tied in the dressing room or stock.

The training is divided into learning steps. Only when both oxen have learned one step, can you continue to the next.

STEP 1: Conditioning of the animals (about 3-4 days)

- tie the selected animals together in the dressing room.**
- put the yoke on the first day, but less than three hours.**
- don't allow the ox to lie down**
- put the complete harness: yoke and halter chain (or nasal ring), head joint and steering rope**
- allow the animals to get used to the harness in the dressing room on the third day.**

Every time you talk to your oxen, call their names, touch and tickle them, remove ticks, give salt but no grass to oxen under the harness. Stop giving salt as soon as possible. After the conditioning the farmers can:

- tie and pair oxen correctly**
- touch the oxen**
- remove ticks**
- feed them .**
- harness them the oxen are:**

- used to the voice of the farmer**
- learning their names**
- used to the dressing room**
- used to the harness**
- used to eachother**

Move to Step 2, when Step I was understood by you and your oxen.

STEP 2: Walking and Steering (about 3-4 days)

- harness the animals in the dressing room and check the adjustment of your harness**
- take the oxen out and teach them how to walk properly as a pair under the yoke**
- initially let them walk freely to adapt to a walking rhythm**
- your trainer will show you how to hold the steering rope, how to use commands, how to walk and control your oxen**
- teach them to go in line**
- use the steering rope to keep them in line**
- teach them to start and stop: use the command "go" and "stop"**

**-teach them to walk straight: use the command "go straight"
-teach them to no right and left. Use the commands "no right"
and "go left"**

**-continue to call the names and give simple commands until
the oxen master the art of starting, walking straight and
stopping**

-support your commands with the steering rope

**Allow short rests from time to time. Avoid shouting, give clear
commands, go slowly and steadily, never beat the oxen, be patient,
show no anger.**

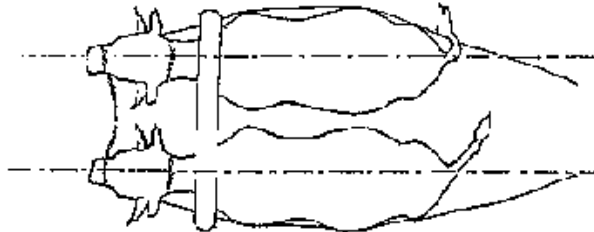


Fig. 1.19: Teach them to go in line!

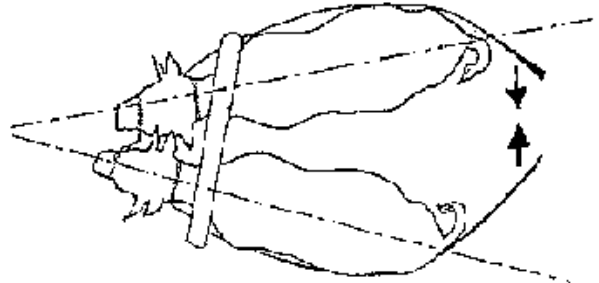


Fig. 1.20: Use the steering rope to keep them in line!

Change positions from time to time. Allow both the farmer and the partner to learn the handling exercise.

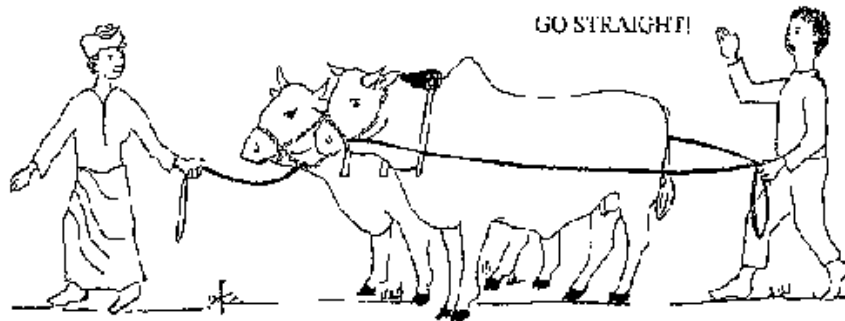


Fig. 1.21: Teach them to walk straight: use the command "go straight"!

Permanent Farming Systems Based on ...

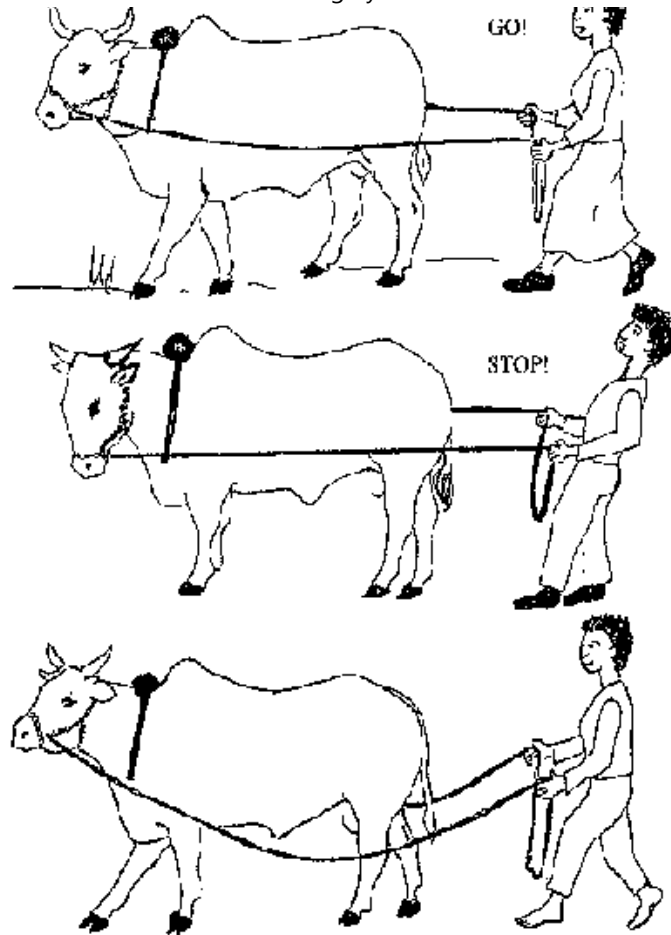


Fig. 1.22: Teach them to start and stop: use the commands "go" and "stop"!; Fig. 1.23: The steering rope should never hang down like this. You cannot control your oxen.

- continue to call the names and the commands until the oxen have learned to follow the commands.

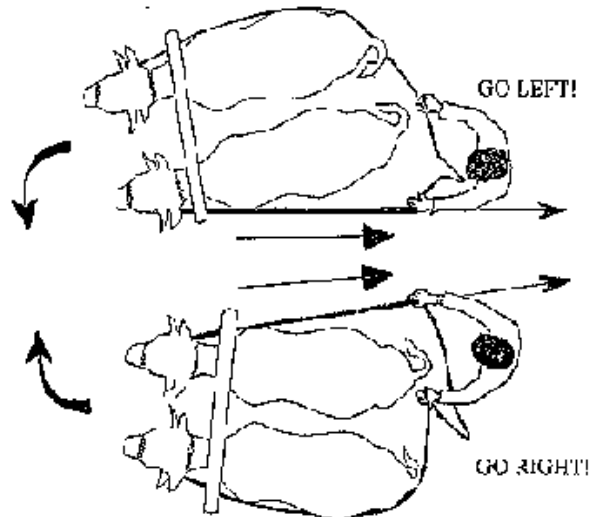


Fig. 1.24: Start to teach them to turn left and right by using the commands "go left" - "go right"!

At the beginning of the Training Step 2, one farmer may be in front of the oxen holding the head joint rope, while the second farmer behind the oxen gives commands and does the steering and vice versa (farmers change positions). At the end of Step 2, the farmers and their partners should be able to control the oxen alone.

STEP 3: Pulling (about 6 days)

When the oxen walk steadily and follow your commands you

- hook the pulling chain to the yoke and continue practising for the first day**

As soon as the oxen are accustomed to the chain

- attach a small light log to the end of the chain and pull**
- teach the animals to pull straight**
- give commands to turn left and right while pulling**
- increase the size of the pulling log**
- attach a harrow, first upside down and pull - then turn**
- give a short break after some minutes**

Try to control the oxen alone as far as possible. Change with your partner, to allow him to learn the exercise as well.

Check the adjustment of your harness before you start pulling. Wrong adjustment can hurt or wound the oxen.

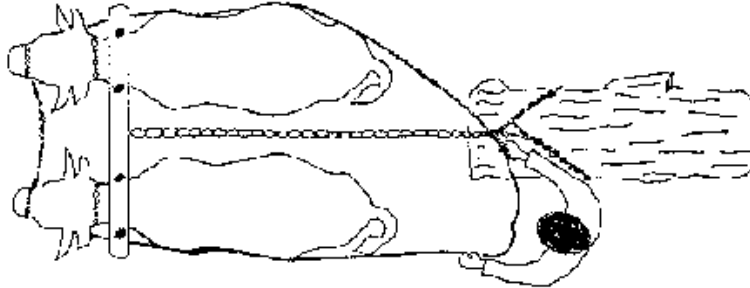


Fig. 1.25: Develop draft effort by pulling a log

STEP 4: Plowing (about 4 days)

Learning to plow is a very critical step for the oxen. They have to pull against a strong resistance for the first time. Before starting plowing check the adjustment of your harness and your prow.

-attach the plow and try to prow, but set the plow to a very shallow depth on the first two days

-do not exceed working time for plowing on the first two days: 30 minutes to 1 hour is enough depending on the strength and the progress of the oxen!

- continue and set the plow to work on average depth for the next two days .**
- continue and set the plow to work on maximum depth.**

Before starting plowing, one farmer is handling the implement, the other one is steering.

They change positions regularly.

STEP 5: Ridging (about 6 days)

Ridging is the most important exercise for the oxen farmer. He will use the ridger in the farm for ridging, weeding, reridging and moulding. Before starting ridging, check the adjustment of your harness and your ridger

- attach your ridger and try to ridge on a plowed, soft place**
- start with small ridges (adjust your ridger)**
- continue for 2 - 3 days and try to establish straight ridges**
- adjust the working width of your ridger and produce larger straight ridges for 2-3 days**
- adjust the ridger to maximum working width and produce very large straight ridges**

During ridging, one farmer handles the implement, the other one the steering. Change positions regularly.

STEP 6: Transportation (about 3 days)

- attach an empty bullock cart and pull along the road for 1-2 days**
- continue with a light load .**
- continue with a full load**

NOTE:

- master the loading technique (even distribution of the load on the bullock cart)**
- master the steering technique**
- master the braking technique**
- master the unloading technique**
- master the highway code**

STEP 7: Clearing with the Roller Cutter (about 3 days)

- attach the roller cutter and pull without load on a field with poor vegetation**

- accustom the animals to a heavier load (add some stones)**
- add load according to the pulling capacity of the oxen**

NOTE:

-avoid turning the cart on one spot which forces the oxen to walk sideways

The indicated days for the different training step are a guideline. If the training effort is more successful, continue with the following steps and repeat later on.

1.3 Draft cattle management

Healthy draft oxen can bring you a lot of benefits.

With the help of the oxen

- farm work becomes easier**
- farm work becomes faster**
- you can increase the size of your farm and produce more**
- you can produce manure**
- you can do contract work for additional income**

Only a healthy ox can give you all these benefits. Therefore you have to manage your oxen well. Draft oxen management includes:

- working technique**
- feeding / watering technique .**
- housing .**
- preventive and curative healthcare**

1.3.1 Working Technique

When you are working with your oxen you have to follow very important rules:

- start working with your oxen early in the morning**

Like yourself, your oxen have more energy during the cooler periods of the day

**harnessing should start at 6:30 am
actual work should start at 7:00 am**

- use only implements which are in good working condition**
- check your harness adjustment to improve traction and**

reduce the draft

- give a short rest of 1 minute every 5 - 10 minutes and a longer rest after 1 hour**
- never allow the oxen to eat during work or under the harness**
- give simple and clear commands, avoid shouting and don't beat at all**
- use the steering to guide the oxen**
- do not work longer than 4 hours**

stop working at 11:00 am (before midday)

-remove the harness immediately after work

-never allow another farmer, who is not accustomed to your oxen to work with your oxen without you

1.3.2 Feeding Technique

To perform the farmwork, the draft cattle have to be fed well. Sufficient and regular feeding and watering of the oxen is one of the main tasks of an oxen farmer.

Good feeding and watering is essential in improving and maintaining

the strength and the health of draft animals.

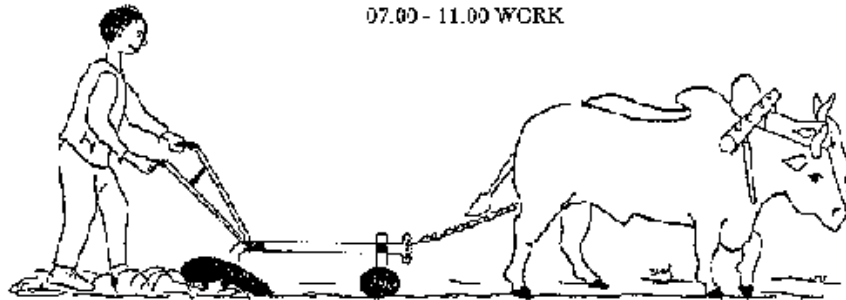
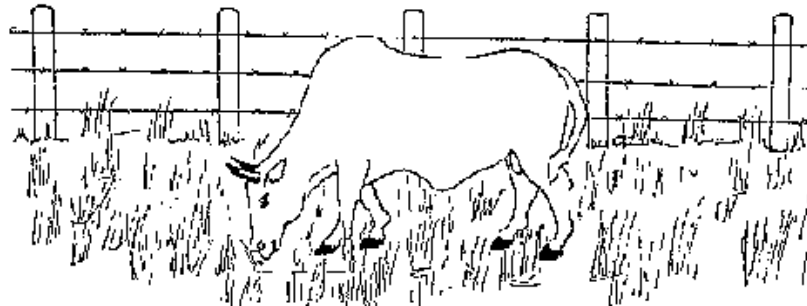
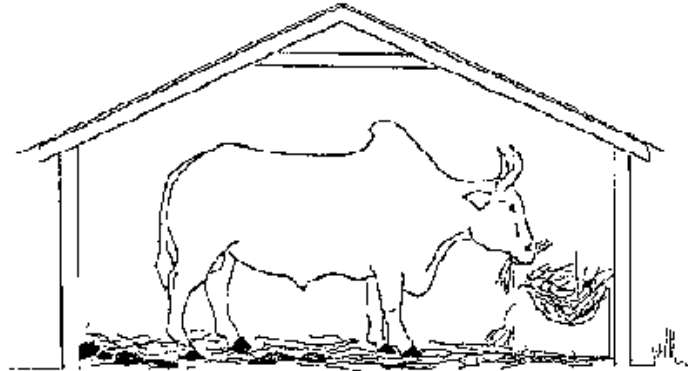


Fig. 1.26: OXEN TIME TABLE; 07:00 - 1 1:00 WORK



11.00 - 18.00 GRAZING



During the night feeding in the cowshed

**Food is the fuel an ox converts into pulling power to work the farm
Oxen that are not well fed with the right feeds, will lose the ability to
work, and are more susceptible to diseases.**

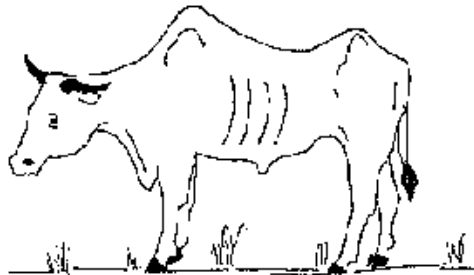


Fig. 1.27: This animal has not been well fed. It is very weak, often



Fig. 1.28: This animal is well fed. It is very powerful and healthy. It can do a lot of work.

1.3.2.1 How much Feed does an Ox need?

An Ox needs feed to

- keep alive (maintenance needs)**
- grow**
- work**

Maintenance needs:

To keep alive without doing work, the ox needs feed. These basic

needs are called maintenance needs. The maintenance needs depend on the weight of your ox The bigger your ox, the more feed he needs. Fed on a good pasture, an ox with

200 kg needs about 15 kg of fresh grass per day

300 kg needs about 20 kg of fresh grass per day

400 kg needs about 25 kg of fresh grass per day only to keep alive, without doing work

Growth needs:

When you receive your oxen for training, they will not be mature. They need additional feed to grow. The better you feed your ox, the faster he will grow and the more power he will develop.

To grow well, he needs about 2.5 kg of good fresh grass or supplementary feed like ricebran = 0.5 kg or crushed corn = 0.3 kg per day in addition to the maintenance needs.

Working needs:

During work, the oxen need a lot of energy. The heavier the work, the more energy or feed the oxen need.

In general, the working ox needs

2 x the maintenance requirements during normal work (weeding, ridging, transport, etc.)

For heavy work, like plowing, The working ox needs

2.5 x the maintenance requirements

For normal work, an ox with

300 kg needs 40 kg of grass and additional feed to grow. In the table

"Feed Needs For Your

Ox" on the next page, you can find out the needs for your working ox.

DAILY FEED NEEDS FOR OXEN OF DIFFERENT WEIGHT

Life-weight (kg)	Maintenance		Growth		Work Kende/Maize			Total Kende/Maize		
	FU	Grass (kg)	FU	Grass (kg)	FU	Grass (kg)	Ricebran (kg)	FU	Grass (kg)	Ricebran (kg)
200	2.0	13	0.3	2	2.0	10	0.5	4.3	25	0.5
250	2.3	15	0.3	2	2.3	12	0.5	4.9	29	0.5

300	2.6	17	0.3	2	2.6	14	0.5	5.5	33	0.5
350	2.9	19	0.3	2	2.9	16	0.5	6.1	37	0.5
400	3.2	21	0.3	2	3.2	18	0.5	6.7	41	0.5
450	3.5	23	0.3	2	3.5	20	0.5	7.3	45	0.5
500	3.8	25	0.3	2	3.8	22	0.5	7.9	49	0.5

VALUES OF SOME DIFFERENT ANIMAL FEED

FEED	NUMBER OF FEED UNITS (FU) PER KG/FEED	KG OF FEED EQUAL TO 1 FEED UNIT (FU)
1. Green Fodder		
Poor Pasture Grass	0.1	10
Good Pasture Grass	0.2	5
Average Pasture Grass	0.15	6.5
Fresh Corn	0.2	5

Feedstuff	0.5	5.5
Bracharia	0.3	3.5
Elephant Grass	0.2	5
Guatemala Grass	0.2	5
Cassava / Sweet Potato	0.2	5
Leaves	0.2	5
2. Grains		
Corn	1	1
Rice	1	1
Rice Bran	0.4	2.5
3. Oil Cakes		
Groundnut Cake	1	1
Soyabean Cake	1	1

Cotton Seed Cake	0.6	1.5
---------------------	-----	-----

1.3.2.2 How to feed Cattle

Your oxen need:

- enough feed**
- rich feed**
- regular feed**

A working ox that has not enough feed, cannot grow and cannot work. Cattle feed normally on grass. Non-working cattle are grazing all day. It selects enough and rich grass.

The working ox has limited time to eat, because he is working in the morning time. In the time remaining after work, he may not be able to find enough grass to replace the energy he lost during work. He may cover only his basic needs. When you continue to work without giving additional feed, he will lose weight and power.

A working ox needs rich feed. Different feeds have a different value.



Fig. 1.29: 1 kg. of maize has the same food value as 7 kg of grass.

That means 1 kg of maize gives as much power to an ox as 7 kg of grass.

A working ox needs rich feed in addition to grass. He needs supplementary feed. As fertilizer increases the production of crops, supplementary feeds increases the power of your oxen.

Supplementary feed like:

- ricebran**
- maize (good or weviled)**
- maizebran**
- cooked cassava, yam, potato give energy and protein for work.**

Supplementary feed like:

- groundnut cake**

- cottonseed cake**
- soyabean cake provide protein for the muscles of the ox.**

Minerals strengthen the bones and the health of your oxen. You can find minerals in the following products:

- natural salt**
- limestone**
- potash ash of bones**
- special mineral mixtures produced by fodder industries**

Vitamins help to develop the muscles of your oxen and improve their health. Vitamins are found in grass and fruits.

Apart from enough and rich feed, your working oxen need regular feed all the year round. In the rainy season, there is plenty of grass and it is easier to feed the oxen. In the dry season, the feeding of your oxen is more difficult. The grass becomes hard, scarce' the stems tall and leaves dry. Your oxen don't like this grass. They get thin and after the dry season when you start plowing for the new season, they have lost plenty of strength.

To conserve the strength of your oxen in the dry season you

- look for good grazing areas (valleys)**
 - cut additional fresh grass for them**
 - grow fodder crops like Guatemala Grass, Bracharia**
 - give them supplementary feeds**
- conserve green fodder as hay and silage and use later as feed
(ask your demonstrator how to do this)**

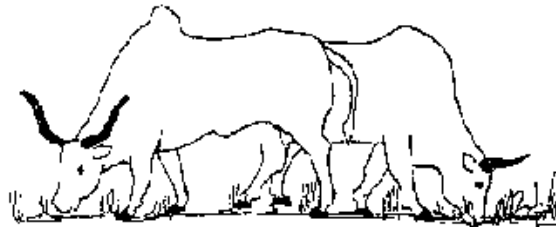


Fig. 1.30: Idle cattle can survive on good grazing, working oxen need supplementary feed.

General Rules for feeding

- 1. Use a fixed time for feeding and watering every day.**
- 2. Don't feed in the morning time before work.**
- 3. Unharness your oxen before feeding.**
- 4. Allow your oxen to graze from 11:00 am (before midday) to**

06:00 pm (before it is growing dark)

5. Choose an area with fresh and different grasses for grazing.

6. Choose a pasture where grasses are not too low and not too high.

7. If you tie your animal, change the position after some time (1 1/2 - 2 hours).

8. Never tie your ox in dangerous places (cliffs, roadside, etc.)

9. Allow your oxen to graze freely for at least 2 hours a day, so that they can select their preferred grasses.

10. Provide additional grass, supplementary feed (Maizebran, Ricebran and maize etc.) and minerals (salt) regularly.

11. Avoid dirty and mouldy feeds

12. Feed ad lib (as much as your oxen can eat). Your oxen are fed ad lib when they stop to pick grasses and rest to ruminate.

NOTE:

Oxen are different from goats.

Arrange with your family members, friends or other oxen farmers to watch the oxen during grazing. An accident can happen very fast, if you don't watch your oxen well.

1.3.2.3 Water Requirements of Draft Oxen

The water requirements of your ox depend on the

- size/weight**
- the work and**
- season**

A big ox needs more water than a small ox. A working ox needs more water than an idle ox, because he is losing water by sweating during work. In the dry season, your ox needs more water than in the rainy season. In the rainy season, the grass is fresh and the oxen can get part of their water needs from the grass. In the dry season, the grass is dry. The ox needs water from the river.

In general, your ox needs about 40 liters of water per day in the dry season, less in the rainy season.

NOTE:

Weight loss of your oxen can be due to poor watering

General Rules for Watering

- 1 Never allow your ox to drink immediately after work**
- 2 Water your ox at mid-grazing time.**
- 3. Allow your ox to take enough water. Water several times a day in the dry season.**
- 4. Avoid standing and dirty water sources.**
- 5. Avoid risky drinking points such cliffs and muddy spots.**
- 6. Avoid hand watering**
- 7. Water for oxen must be fresh and clean. Water from running rivers is preferable.**

1.3.3 Housing of Draft Cattle

During the night, your oxen are kept in a COWSHED. An oxen farmer without a cowshed is no real oxen farmer. The housing of your oxen will give you a lot of advantages.

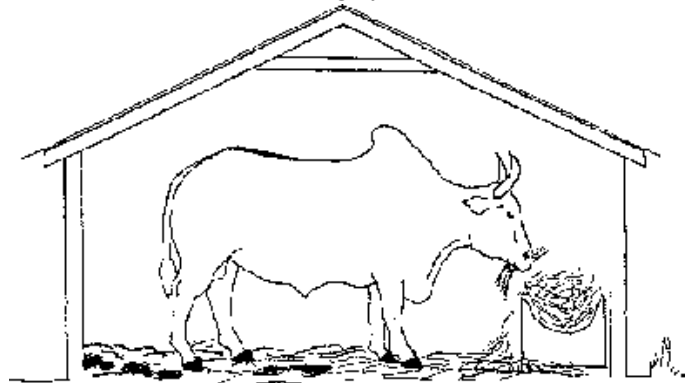


Fig. 1.31: A good cowshed

- is necessary to collect and produce manure**
- protects your manure against rain and sun**
- protects your oxen against theft**
- protects your oxen against poor weather conditions**
- allows your oxen to rest and ruminate well. This improves their strength and health**
- provides storage room for your tools, crops and additional feeds**
- avoids farm destruction by your own cattle in the night**
- allows easy harnessing of the oxen**
- allows easy treatment of the oxen (deticking, deworming)**

-allows your family members to get used to the oxen

1.3.3.1 How does a cowshed look like



Fig. 1.32: A good COWSHED is made up of three rooms.

Two rooms are for the oxen and the cowdung. You put your oxen into the first room until the manure heap has grown considerably. You change the oxen in the empty room and give time for the manure in the first room to rot. When the second heap has grown up, you remove the rotten manure from the first room and allow your oxen to stay inside while the second heap rots.

The third room is used for storage of tools and animal feed. You can also prepare a "banda" under the roof of your cowshed to store crops.

NOTE:

The cowshed should be near enough to the compound for you to hear any nod' from the cowshed. It should not be too near, to avoid flies in your house.

The cowshed is made of local materials like sticks and a straw roof.

A good cowshed needs to be sturdy. It needs a good roof that is not leaking. needs a strong gate with a lock.

1.3.3.2 How to manage the cowshed

The cowshed is the feeding and the sleeping place for your oxen.



Fig. 1.33: Put down enough litter (dry grass, banana leaves, residues etc.)

**litter provides good, dry bedding for your oxen
litter increases manure production**

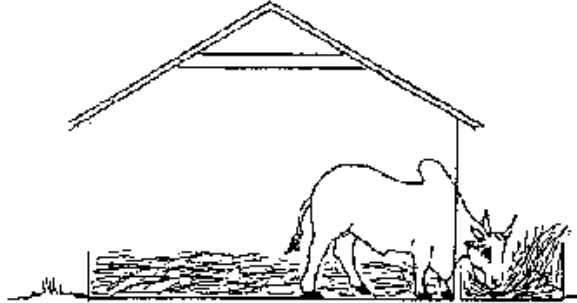


Fig. 1.34: Provide additional grass and supplementary feed to your oxen in the cowshed.

A cowshed needs maintenance. You have to protect your cowshed against destruction.

- Brush the sticks with solignum or old engine oil to protect white ant destruction.**
- Exchange rotten sticks.**
- Repair the roof when it is leaking.**
- Dig a ditch around your cowshed to avoid running water entering your cowshed.**

-Clear the area around your cowshed to avoid fire destruction.

1.3.4 Preventive Health Care of Draft Cattle

Preventive Health Care avoids diseases. Preventive Health Care is the key for successful draft cattle keeping. Preventive Health Care is a major task of the oxen farmer!

Preventive Health Care includes:

- 1. A rational working technique (see chapter 1.3.1)**
- 2. Sufficient feeding and watering (see chapter 1.3.2)**
- 3. Good housing (see chapter 1.3.3)**
- 4. Deticking of the cattle**
- 5. Deworming of the cattle**
- 6. Vaccination of the cattle**

Deticking of the cattle:

Ticks suck the blood of your oxen. The oxen will lose strength. Ticks make wounds that can cause other infections. Ticks transmit other dangerous diseases to your cattle. Ticks are a danger to the health of your cattle. Detick your cattle every morning before the work.

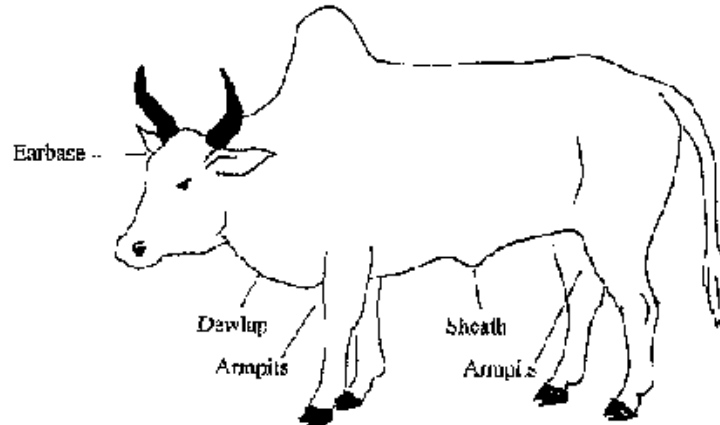


Fig. 1.35: Check the following arts of your ox very carefully and remove the ticks. Collect the ticks in a small container (tin) and burn them.

Deworming of cattle

You cannot see worms. They are inside your oxen. They affect your cattle mainly in two ways:

-They live in the digestive tract and damage it. They prevent your ox from digesting his food.

The ox gets thin and may die.

-They enter into some other parts of your ox. (e.g. lungs, liver) and damage them. Your ox will loose strength and may die.

To prevent worm problems, you have to present your cattle twice a year (March and September) to your extension or veterinary staff for deworming)

Vaccination of Cattle

There are some diseases that can kill your ox very fast. Vaccination can prevent such diseases. The cost of vaccination is very small in relation to the value of your oxen.

The veterinary services in some countries conduct regular vaccination campaigns. Present your oxen to the veterinary staff on the vaccination dates.

NOTE:

It is important to use all preventive methods to protect your oxen.

Keep records on deworming and vaccination of your oxen and present these records to your veterinary staff.

How does a healthy Ox look?

During daily detaching and work, you are continuously checking the outer appearance of your animal. Find out how it normally looks. Any change indicates a possible illness.

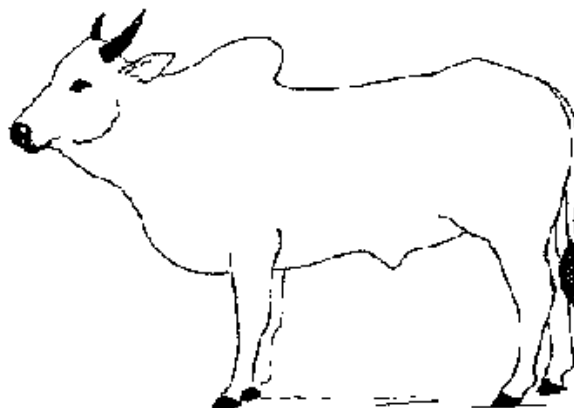
The ears should be upright and clean inside.

The neck must not have wounds of the yoke.

On the basis of the horn, there should be no wound.

The eyes must be bright and clear. The muzzle must always be cool and wet.

The mouth. The ox should be ruminating regularly.



The skin must be supple and the hair smooth, not standing.

Urine and Faeces must be normal.

Limbs. When the animal is limping, it must rest.

Find out the normal size of the belly when it is full and when it is empty.

Fig. 1.36

1.3.5 Curative Health of Draft Cattle

For a good farmer, it is important to recognize signs of poor health on his oxen in time. To distinguish between normal and abnormal, the farmer must know the normal condition of his cattle.

How does a healthy ox look:

- the eyes must be bright, clear and clean**
- the muzzle must always be cool and wet**
- the ox must chew the cud regularly**
- the ears must be upright and clean**
- the neck has no wounds from the yoke**
- the base of the horns have no wounds from the rope**
- the skin must be supple and the coat smooth and dense**
- the faeces must be of normal consistency**
- the urine must be a normal yellow colour**
- the belly must be of normal size**
- the ox must stand comfortably on all 4 legs**
- it must react on your voice or other disturbances**
- tail and ears must be active**
- the ribs cannot be seen**
- when lying down to rest, legs are turned inward**

How does a sick ox look:

- dull eyes, watering eyes, discharge, deposits**
- dry muzzle**
- no regular chewing the cud**
- ears are stiff or hanging**
- wounds from parasites, yoke or beating**
- the coat is poor and rough, hairs standing up**
- the faeces is of abnormal consistency, mixed with blood**
- the colour of the urine is red or dark brown**
- the belly is longer on the left side**
- the ox is not standing on all 4 legs**
- the ox is limping the tail is inactive or stiff .**
- the ribs can be seen**
- the ox is standing with an arched back**

In the case of abnormality, inform your nearest extension staff or veterinary officer immediately.

1.3.6 How to produce Grass for your Oxen

Grass is a complete feed for oxen. Non-working Oxen, which are idle or grazing do live on a grass diet and some salt and water in

addition. Therefore we have to find out how to produce a sufficient quantity of palatable grass for the oxen without spending much time and money on it.

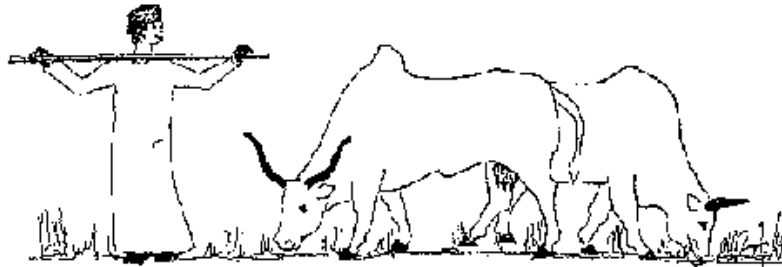


Fig. 1.37: Traditional herdsman are herding their cattle

HOW TRADITIONAL HERDSMEN FEED THEIR CATTLE

- A grazier is watching the cattle all the time**
- they need large grazing areas**
- they do transhumance: Grazing in special, wet areas during dry season.**

The oxen farmer cannot employ a permanent grazier. Instead he builds a fence around his grazing area. Fenced -in grazing land is called a "Paddock". The area of the paddock should be 2 HA for one

pair of oxen. With good knowledge of supplementary feed, one hectare will be sufficient.

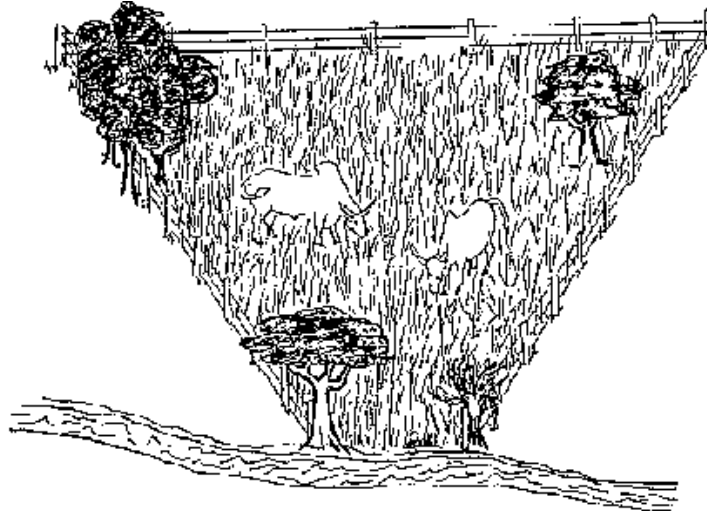


Fig. 1.38: The Paddock is a fenced-in grazing area. It should have free access to water. Plant trees in your paddock. They will produce fruits.

HOW TO BUILD A FENCE

Put the poles 3 to 4 meters apart. Use live poles if available. Plant

cuttings of sunflowers or similar bushes along the fence. Reinforce the end or corners of the fence as shown.

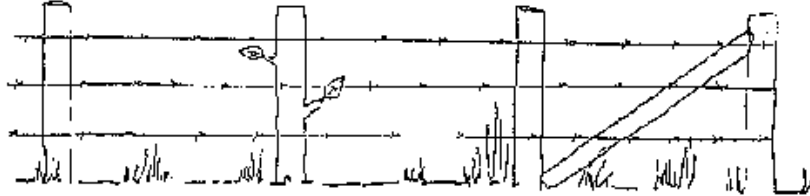


Fig. 1.39: Construct your fence of strong poles and reinforce the corner posts.

Each plot must have a gate. There are two different designs of gates shown below.

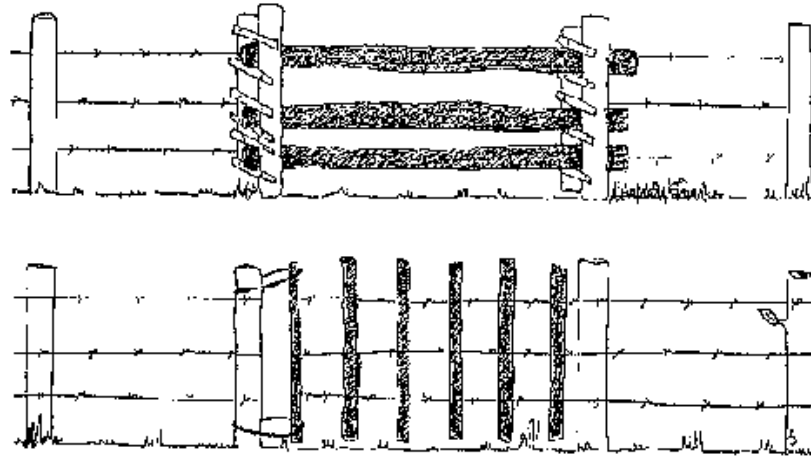


Fig. 1.40: Gates can be made of poles or wire.

The oxen farmer has only a limited grazing area because he needs a lot of land to plant his crops. Therefore, he must make intensive use of his grazing area. He is doing Rotational Grazing.

What is Rotational Grazing?

Rotational Grazing means, that the oxen are only grazing on one section of the total grazing area. While the animals graze on one section, the grass is growing rapidly on the other sections. When the grass on one section is finished the oxen start grazing on a fresh

section. They rotate around the plots.

Why do Rotational Grazing?

Due to Rational Grazing:

- 1. We can increase the grass production and reduce losses.**
- 2. We maintain the pasture in good condition for years.**
- 3. Erosion is checked**
- 4. The life cycle of certain animal parasites is broken.**
- 5. Valuable species of grass are maintained.**

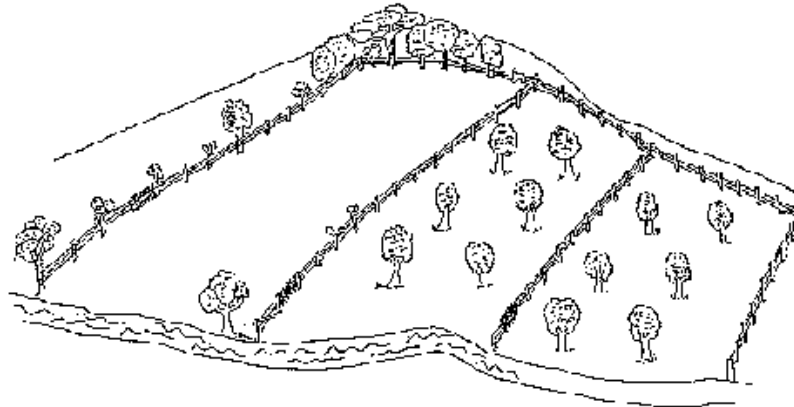


Fig. 1.41: For rotational grazing, you will have to divide your paddock

into equal parts. The different parts are called "Plots". Each plot has a gate.

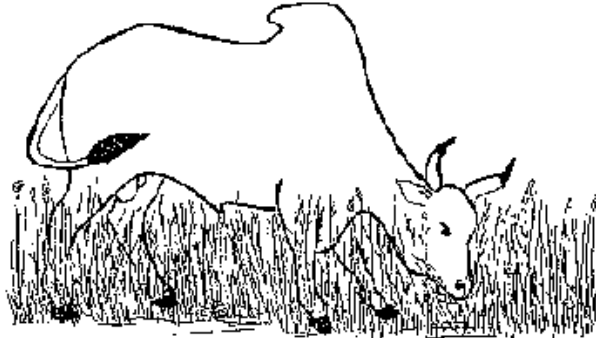


Fig. 1.42: Oxen like best the grass which is just about reaching their bellies in height (40 cm).

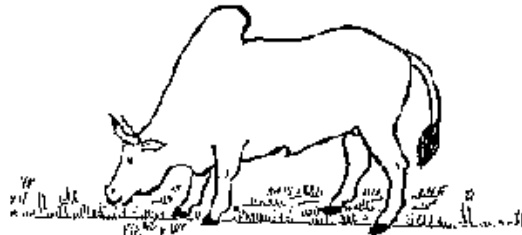


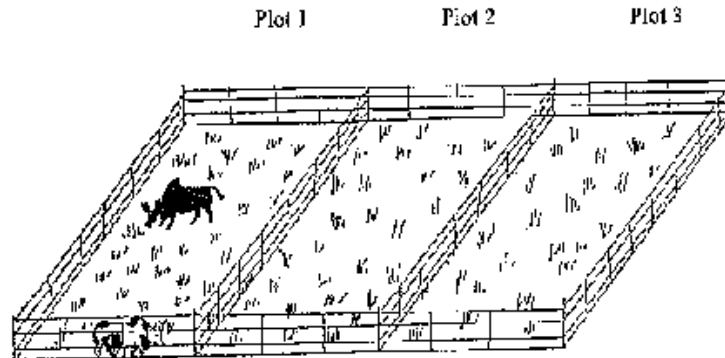
Fig. 1.43: When the grass is too short, the oxen cannot eat it. We have to take the oxen away from this plot and let the grass grow until it reaches their bellies again.



Fig. 1.44: When the grass is too high and too old, the oxen do not like it either. It is dry and stalky and bad food. We have to cut this grass in order to let young grass grow again.

HOW WE MANAGE OUR Paddock

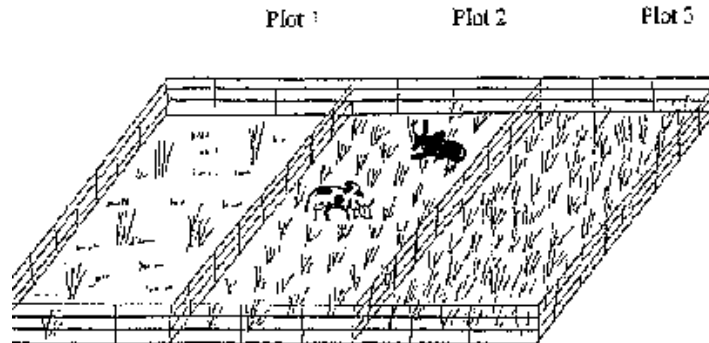
March



Figure

In March, when the rains make the grass grow again, we start grazing on that plot (1), where we have made a bush fire 4 weeks earlier.

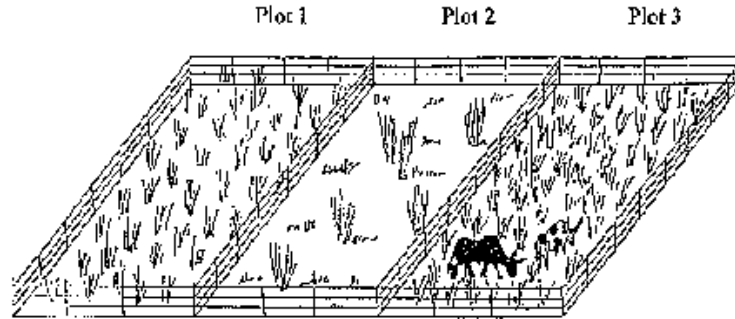
April



Figure

In April, when the oxen have eaten most of the grass down to the bottom, we start grazing Plot 2 and cut all the high grass in Plot 1, which the oxen did not eat.

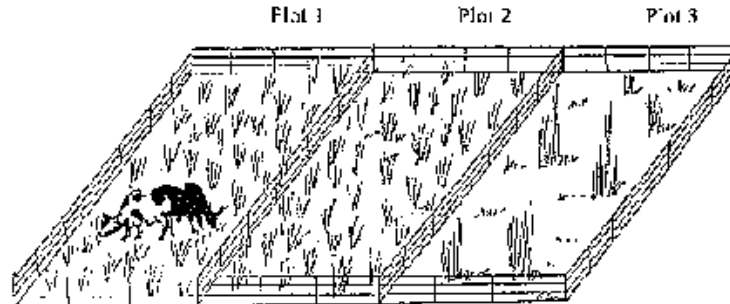
May



Figure

In May, when the oxen have finished Plot 2, we start grazing Plot 3, and clear Plot 2. If we don't clear, the grasses which the oxen don't like grow will stronger and stronger.

June



Figure

In June, when Plot 3 is empty, we start grazing Plot 1 again and clear Plot 3.

Continue like this, grazing your animals in one paddock after the other, until the rains stop.

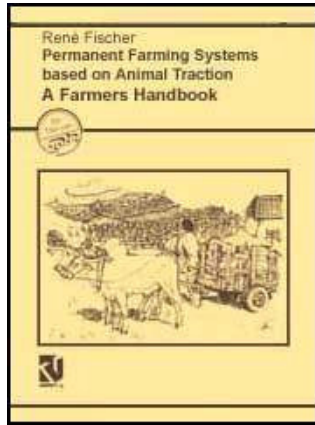
Preparation for dry season

One Paddock is closed 1 month before the rains stop, after the oxen have eaten all the grass on this paddock. Only the remaining paddocks are used for grazing as long as there is grass. The grass of the closed paddock is a reserve for the dry season. It can either be cut, dried and stored as hay or it can be grazed after all the others are empty.

If the area of the paddocks is not sufficient for the oxen, additional fodder supply (Elephant and Guatemala grass) is necessary.



Permanent Farming Systems Based on Animal Traction: Farmers Handbook (GTZ, 1995, 183



p.)

➔ **PART II: Donkeys**

(introduction...)

2.1 Introduction to Donkeys Relationship with Humans

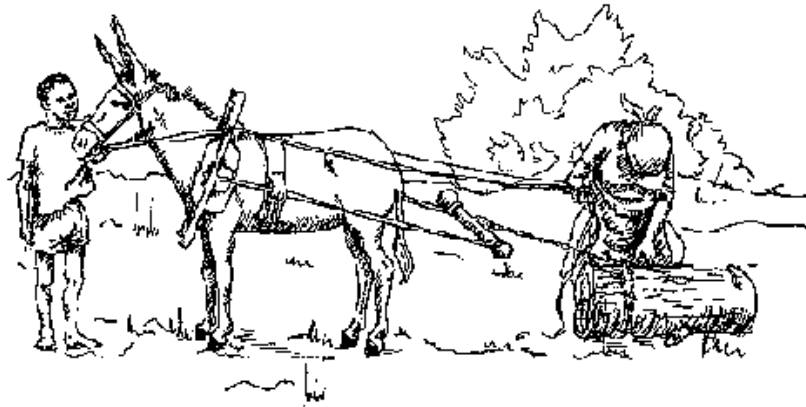
2.2 Selection of Donkeys for Draft Work

2.3 Training of Donkeys

2.4 Donkey Management

Permanent Farming Systems Based on Animal Traction: Farmers Handbook (GTZ, 1995, 183 p.)

PART II: Donkeys



Figure

2.1 Introduction to Donkeys Relationship with Humans

The donkey (or ass) was the first animal, after the dog, that humans domesticated for work and the first to do agricultural work. Because of its lone association with humans, the donkey seems actually to like human beings and to enjoy working for them (when conditions are right; otherwise it does no more than consent). It is one of the most intelligent of the animals that humans use for work.

Most donkeys are, by nature, gentle animals which makes them particularly suitable for being worked by women. The fact that most

of the farming work in Africa is done by women makes it doubly fortunate that the donkey is so well adapted to the African environment.

Advantages and Disadvantages of a Donkey

One of the most important things to be known about donkeys is that each one has its own personality and preferences, each donkey is different from every other. They easily recognise different people and know their ways and owners should, in turn, easily be able to recognise different donkeys and know their habits. The donkey is an animal that forms decided habits.

The donkey is one of the most rewarding animals to train, and once trained can be trusted to do many tasks without human supervision. A donkey will learn quickly both from other donkeys and from humans, and has a remarkable memory, especially for paths and routes.

At 120 - 300 kg, donkeys are not as big in size as cattle or mules and horses, thus not able to give as much pull. For their size, however, donkeys are actually stronger and work twice as hard as cattle each donkey giving an average pull of 25 kg for 3 hours. A pair has no

difficulty in pulling a plow at 20 cm depth through previously ploughed, light sandy soils.

For work in irrigation schemes, oxen are generally better suited than donkeys. There, soils are mostly heavy and also water and humidity make this environment uncomfortable for donkeys.

Donkeys can pull carts faster than oxen. It must be born in mind though that carts are not easily used off well-maintained roads.

Best work can be obtained from donkeys if they are worked as a pair. This is because any separation from its friend will cause a donkey unhappiness, and permanent separation may even cause it to die of heartbreak. This tendency to friendship and pairing is, therefore, both an advantage and disadvantage.

A donkey matures slowly and should not be used for work before it is 3 years old. A very well cared-for donkey can live beyond 50 years and give useful work for about 30 years.

Advantages

-Friendly towards humans.

- Willing to work.**
- Easy to train and need little supervision in work.**
- Strong relative to size.**
- Can turn in a small space.**
- Live/work more years in good care than other animals.**
- Comparatively cheap to buy.**
- Can utilise poor food well and need little water.**
- Not affected much by external parasites.**
- Can survive well in tsetse areas.**
- Milk good for humans, especially babies.**

Disadvantages

- Friends not easily separated and suffer from being alone.**
- Comparatively small in size.**
- Breed and mature slowly.**
- Need shelter from cold and damp.**
- Meat rarely eaten. .**
- Manure more fibrous than nutritious.**

2.2 Selection of Donkeys for Draft Work

Farmers need:

- to decide which donkeys may be used for which purpose**
- some guidelines for the purchase of new donkeys .**
- to decide which of the males should be castrated.**

It is the needs of the farmer which must, therefore, decide which characteristics are most desirable, and what further training may be done. Some of the characteristics listed here, such as speed and obedience, are often the outcome of training before the donkey is old enough to be used.

To some extent, a donkey will select itself. An owner will often know what kind of work his or her donkey will like doing best and be best at. A buyer should not choose a donkey until it can be seen regularly in use. A donkey's temperament can often be judged by the way its owner handles it.

Since donkeys often work in pairs, they should, if possible, be chosen in pairs pairs of friends - and that way they will do better work.

2.2.1 Desirable Characteristics

	Desired Characteristics for:		
Item:	Field Operations	Cartina	Carrvina

Size	large	large	large
Back	straight	straight	straight
Chest	wide		
Legs	straight, well	straight, well	straight, well
	muscled	muscled	muscled
Feet		concave, large,	concave, large,
		well angled	well angled
Eyesight		good	good
Temperament	calm	calm	responsive
Obedience	prompt	prompt	prompt
Speed		fast	

Above table summarises the desired characteristics for the three main tasks donkeys carry out.

All field operations require the strength to pull. The Dulling must be done by the chest or shoulder (depending on the type of harness), with the legs providing the power and the back taking the vertical force. since pulling carts is also a draft operation, the characteristics

needed are similar to the ones of field operations. However, since the animal will necessarily be operating on roads which other vehicles use, calm temperament becomes even more important. Speed also is important for pulling carts.

Strength of the back and legs are more important in carrying operations than the chest is, although endurance and therefore good breathing still play a vital part. Good feet become most important in carrying, because the whole weight of the load is canted by the donkey's feet.

2.2.2 Sex and Behaviour

The sex of a donkey influences its size and conformation and with a fully mature adult donkey, its reproductive hormones can change its behaviour in an undesirable way.

Female donkeys (mares, jennies), when on heat, will forget their work and friends and follow - if not actually pursue - male donkeys of their fancy. Even if there are no males around, they will be restless and disobedient for several days at a time, about once every one or two months when not pregnant. It is difficult to know when a donkey is pregnant. Towards the end of the pregnancy, which is 12 to 14

months long, she will be much more docile than isusual. If the pregnancy is so far advanced, that it can be obviously seen, then she should not be used for work. Once she has given birth, a mother should not be used for work until her baby is about three months old.

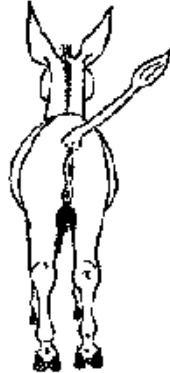


Fig. 2.1: The female donkey has two teats between the back legs and genitals below the anus under the tail.

Fully male donkeys (Stallions, jacks) become difficult to control when they are anywhere near a female in heat: The will leave their work and their friends to pursue her. In addition, they can engage in fights with other grown-up males. stallions are also a danger to very young donkeys who are still with their mothers; the males can bite and kick

the foal.

It is obvious, therefore, that the castrate male donkey (gelding is the best type to have for work. The gelding is big and strong but less excitable than jennies and stallions.

2.2.3 Age and Work

Although donkeys should be trained as young as possible, if donkeys do any heavy work before they are three years old, their bones which are still forming and hardening - particularly the backbone - will become deformed into the wrong shape.

A donkey cannot be considered mature until it is about 4 years old.. Mature weight is only reached at about 6 years. A donkey is too old to work only when it becomes a struggle for that work to be done. Donkeys can work up to about the age of 40 years if they are well cared for, but under common conditions it can be expected, that disease and/or parasites will shorten the period considerably.

2.2.4 Conformation

The backbone of the donkey should be level between 'shoulders' and

rump (withers and crupper) A slight sag just behind the shoulders or in front of the rump is acceptable, especially in a young donkey.

The legs, seen from front, back and sides, should be straight and nearly perpendicular to the ground.

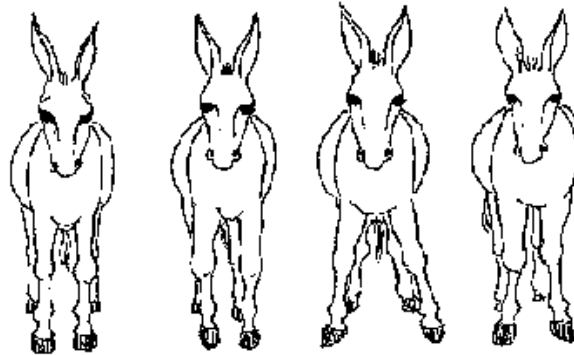


Fig. 2.2: YES! NO! NO! NO! The legs seen from the front must be straight

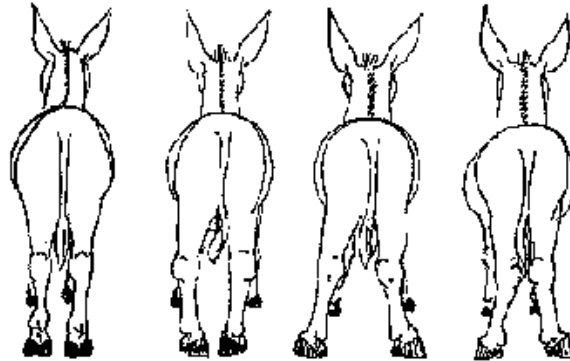


Fig. 2.3: YES! NO! NO! NO! The legs seen from behind must be straight.

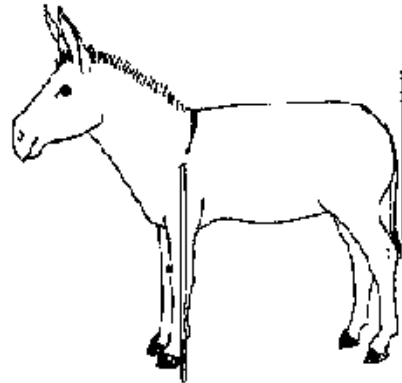


Fig. 2.4: The legs seen from the side must be straight and perpendicular to the ground.

The feet or hooves of the donkey must be well-angled, concave and of reasonable size. The angle of the feet is to a great extent the result of the care that is given to them, and from the side should form an angle of about 50 degrees.

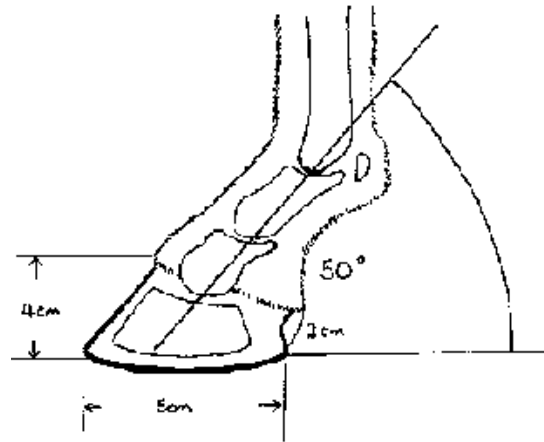


Fig. 2.5: Seen from the side, the feet should show an angle of 50 degrees between the fetlock and the ground. The back of the hoof should be at least 2 cm thick. The hoof should be about 5 cm across for an adult donkey.



Fig. 2.6: The hoof, seen from below, should be hollow or concave, so that the weight of the donkey is supported by the edges of the hoof

The chest of the donkey should be wide and deep to allow room for big lungs, big overall size and strong front legs.

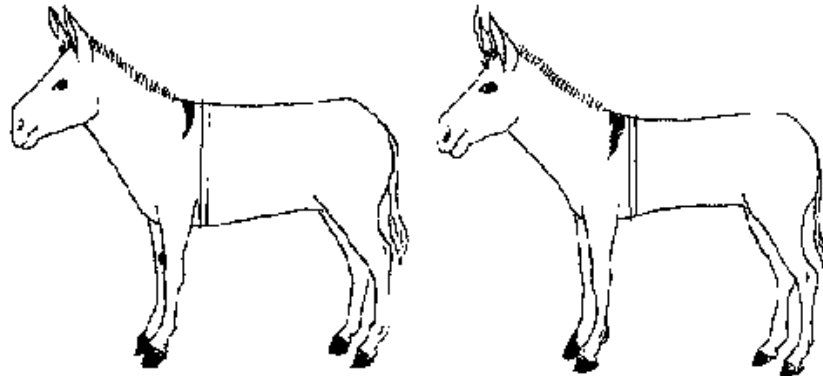


Fig. 2.7: YES! NO! The chest seen from the side must be deep

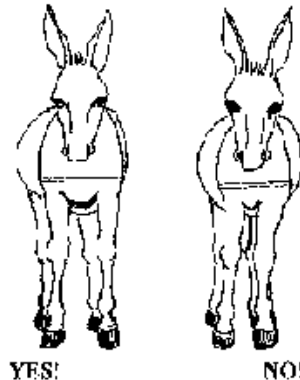


Fig. 2.8: The chest seen from the front must be wide, the width of one hand should be able to fit between a donkey's front legs where they meet the chest, from the time the donkey is about a year old.

A working donkey must have good eyesight. We test whether the donkey reacts to movements coming from the rear and on each side of the head, at a distance of about of 10 cm. Close inspection of the eyes is very important.

2.2.5 Behaviour characteristics

To a great extent, temperament can only be properly assessed by spending time with a donkey, and working with it. A donkey with a calm temperament would, in an open field allow a strange human (or

donkey) to come quite close before moving away, and when it moves, it will move slowly.

A responsive donkey will be very watchful and, although allow a stranger to come quite close in an open field, will be prompt in backing away from any strange movement.

An excitable donkey will run, probably kicking its heels in the air, when seeing a stranger in an open field.

A good working donkey should be obedient, this means the donkey knows the commands and responds to them quickly.

Especially for carting and carrying, the donkey must be nimble, it must not be clumsy. It should be able to turn round in a space only a little wider than itself and climb up and down steps at least 50 cm high.

2.3 Training of Donkeys

2.3.1 Basic Rules for the Training of Donkeys

In many places, where donkeys are used, it is noted that children

have most dealings with donkeys. So it is important, that where donkeys are being trained, children should participate in the training as well. The children should know all that is necessary about donkeys.

Children should learn not to throw things at donkeys, or to chase them. Such treatment will simply cause bad behaviour in donkeys.

Unlike oxen, a donkey does not give its best effort and behaviour to a person that it fears, but to one that it trusts and likes. It is, therefore, in the owner's best interest to get the donkey's trust and liking. This can take time, but, after that, working with a donkey is remarkably easy.

The main instrument in training donkeys is the human voice. The donkey's long ears are very acute, and even when it does not understand words, it is very understanding of personalities and moods. When working with donkeys, therefore, a human must talk as much as possible. Friends and neighbours will cease to think an owner is mad once they see how well the donkeys behave.

Of course a donkey will not understand the meaning of most of the words said around it, but there is a range of words and sounds that a

donkey can easily be taught to understand and associate with actions to perform. Such words or commands should be standardised in any area.

The earlier the process of training and familiarity starts, the easier for everyone. It can start the day a donkey is born, if the mother is sufficiently trusting. By the time the donkey is ready for full work three years later, no particular effort will be required.

The presence of any other well-trained donkey makes it much easier to train a new one.

There is no doubt that donkeys learn as much from each other as they do from humans.

2.3.2 Training Steps

The steps for training donkeys are basically the same ones as for training oxen. The donkey differs, however, to some extent, in its reactions to humans and environment and therefore the training approach has to differ as well.

Handling and confidence

Movement towards an animal will frighten it, and in early training anything that frightens the donkey must be avoided and all movements must be slow and careful. At first, the trainer tries - using some maize or other food to lure the donkey if necessary - to be allowed to stand next to the donkey and to touch it. Using some favourite food, the donkey will initially allow the trainer to touch it and after a few days will actually enjoy being stroked and scratched.

After this, it is very easy to get the donkey to allow itself to be touched all over, and to have a rope slipped around its neck. All this should happen within a few days to a week, and it is time well worth spending.

Once the donkey allows approach and handling, things like maize cobs do not need to be used as a lure, but should only be used as rewards for good behaviour in training. Praise words soon become enough reward for the donkey.

Tying and leading a donkey

Put a thick rope or strap which does not cut into the skin around the donkey's neck, as practised in handling. At first the donkey will resist being pulled by its rope. Use of its name and calm voice will soon

settle it, and in no time it will be walking obediently at the tug of the rope. That is the time to reward it using praising words like: Good! at the same time.

Once the donkey is being led, it must start becoming accustomed to other people. Additional people should be asked to stand still but talking, while the donkey is led up to them and is given time to sniff or try to taste their clothes. After such exercises, leading a donkey into crowds of people will be no problem.

Lifting feet and washing eyes

Lifting feet and washing eyes are important to maintain these parts of the donkey's body in good health and they have to be done to a donkey throughout its whole life.

The donkey may not allow the whole action to be performed right away, so training should proceed step by step, with each step rewarded when the donkey allows it. Steps could be seen as follows:

Lifting feet:

- running hand down leg**
- brief lifting foot from ground;**

- **lifting foot right up;**
- **keeping foot held right up;**
- **cleaning out sole of foot;**
- **rasping foot;**

Washing eyes:

- **touching eye (which will close);**
- **forcing eye lids open;**
- **squirting water on eye (which will close);**
- **squirting water into eye while eye lid held open;**

Once the donkey is used to these procedures, it seems to quite enjoy having its feet tended and its eyes washed, probably because this usually serves to relieve some discomfort.

Crossing water

Donkeys have a natural fear of water because they cannot swim. The relative size of their head to their body does not allow this. However, it can be readily appreciated that a donkey which will not cross water is something of a liability in the rainy season.

The sooner a donkey learns to cross running water, both by bridge and by wading, i.e. walking through water, the better. A baby donkey is still small enough to be pushed if necessary; an older donkey is almost impossible to persuade. So an effort must be made to find running water somewhere in the neighbourhood when the donkey is still very small, and a day or two should be spent persuading it back and forth across the water, and rewarding it accordingly. If the water can be progressively wider and deeper, even better.

Running

Once the donkey is used to people, a rope and being led, it must be taught a steady, sustained speed at the command of a human. The trainer (running) and the donkey will have to find a comfortable speed which the donkey takes up immediately when the command is given. Once the donkey is used to speeding up, maintaining a trot or a triple and slowing down again on command, longer and longer distances should be covered so as to build up stamina. For this exercise it is a good idea to accustom the donkey to run alongside a bicycle.

Carrying

Once the donkey is about six months old, it can start its training for lifetime work by handling very light loads. A fair rule is 1 kg for every month of its First just put a sack over its back. The donkey will Jump around at first and, if loose, will gallop away trying to shake the load off. As usual, the use of its name, calm words and reward will do the trick, and quite soon the donkey will make no fuss at all.

After that, two sacks tied together can be used, and then a brick put in each. The donkey will quickly allow the brick to be lifted in and out while the sacks are on its back.

Pulling implements

Once the donkey is 4 years old and ready to pull loads, it has to get used to the harness and pulling work. The method of introducing the use of different implements and the commands are the same as the ones-for oxen, as explained in Part I.

2.4 Donkey Management

2.4.1 Introduction

A happy, healthy donkey is one that will do most work for its human owner. If it is not healthy, a donkey cannot give good work. Housing

and feeding contribute to their health, so are just as important as the more direct care and prevention of ailments and injuries.

Companions

As already mentioned, a donkey should not be kept alone. It will have one special friend, which will be obvious, and less trouble will be experienced if the donkey is kept with its friend.

Where many donkeys are kept together, mares just about to deliver or with young foals, and stallions, should be kept separated from the herd and from each other - for obvious reasons.

Pregnant mares and young foals can easily be harmed by other donkeys, and stallions can be violent, If females are absent, however, stallions will not give much trouble.

Transport

Donkeys cannot easily be transported in lorries and trucks in the way cattle and sheep are and it is necessary for those selling and buying donkeys to be aware of this. Too often donkeys will die a couple of days after reaching their destination.

Such transport deaths could be for a number of reasons, one of which could be separation from friends, another the sheer terror of the journey. Both of these factors contribute to a nervous reduction in a donkey's blood sugar levels. A period without food will also contribute to transport stress though the donkey digests food slowly enough for it to tolerate a couple of days without food in normal conditions, despite not having a rumen. A donkey suffering from fear or any other nervous upset will also not eat, and the problem is thus compounded.

Just by itself, the drop in blood sugar levels can be fatal, but this can be prevented if the donkeys are given a glucose injection immediately before the gurney begins.

It is far better, and usually cheaper too, to have donkeys driven on foot across country than to have them taken in a motor vehicle. It may be slower, but it has a less disastrous effect on the donkey.

2.4.2 Feeding Technique

Pasture

Pasture is the best source of food for donkeys. So with donkeys the

same as with cattle it is advisable to practice rotational grazing, because a pasture which is used too long or too often may become not only exhausted of nutrition, but seriously infested with parasites. As has been said, pasturing sheep along with donkeys may control this to some extent, but no pasture should be used on a permanent basis.

Refer to Part I for information about rotational grazing.

Amount of pasture required: The donkey makes very good use of poor food but this does not mean it should be deprived of food. It will do well on plenty of dry grass, but grass is very far from being the only thing it eats.

If the owner observes what herbs, bushes, trees and fruit the donkeys like, then places can be selected where maximum nutrition is provided.

Donkeys should have at least six hours a day at pasture, but this should not include the hot hours of the day, when they will eat little and simply doze in the shade even if they are hungry. They do most eating in the early morning and late afternoon. Even if they have these opportunities, if they are also spending more than about two

hours a day at work, they will need some supplementary feeding if they do such work every day.

Supplements

Although donkeys do not have a rumen, they seem to make good use of the cellulose in plants and require a high proportion of it. Conversely an overbalance of proteins can actually be harmful to them. If a donkey is working and has no opportunity to graze, the following daily amounts are recommended:

200-300 kg donkey carrying 25- 70 kg load at 4 km per hour for 6 hours a day

1-2 kgs grain (e.g. unground maize or sorghum) and 5 kg chaff (waste matter from winnowing sorghum or millet) or groundnut shells. The grain should be eaten before the chaff. Some of the chaff can be substituted with straw. Half the amount to be given in the morning and half in the evening.

Supplementary feed should be provided in clean containers that cannot easily be knocked over by donkeys - and there must be sufficient containers that the donkeys do not fight for priority. If

there is one thing that really interests a donkey above all else it is food.

Old donkeys which cannot easily use their teeth should be allowed to have milled grain and chaff in lesser quantities if they are not working. Young pregnant or lactating donkeys may require another half kilogram of grain. And all fodder should be free of mould.

Even when well fed, donkeys will often seek out their own supplements if they have the opportunity. This is because of the different individual requirements of each donkey. They will search in rubbish heaps and fowl-runs for titbits but should be prevented from doing so.

They might take in substances harmful to their digestion like plastic and meatmeal. Also they might over-eat or eat decaying food with poisonous bacteria or fungi.

Sometimes it could be minerals that they are looking for. Calcium and phosphorous (the most important ones) can be obtained in powder form from farm suppliers and on the whole a 'lick' should not be used as it may encourage over-use and then too much intake of water.

Instead, to every kilogram of grate should be added:

2 teaspoons calcium

1 teaspoon phosphorous

1 very small pinch of salt.

If a block is used it should not include urea which can be poisonous to donkeys.

2.4.3 Water Requirements of Donkeys

A pregnant or lactating donkey, or one working in a hot dry environment may consume as much as 20 litres per day, usually it will be much less than this. It is almost unknown for a donkey to consume more than it needs. so it can be allowed to drink freely.

The main restriction is that a donkey should not be allowed to drink very cold water when it is still hot from working. The water must also be clean: donkeys can be very fussy about their water and may refuse to drink dirty water even when they need it.

Donkeys can go without water for up to three days, but this is not good for a working donkey

If, however, it comes to a choice between good pastures and access to clean water, then donkeys can be taken to the good pastures for two days and given access to the water on the third.

2.4.4 Housing Donkeys

A paddock is the best night accommodation for a donkey. A paddock, however, allows some grazing, although a donkey will not eat grass that has grown on manure or even urine. . As early mornings and late afternoons are important times for donkeys to be grazing, if they are kept in a kraal they must spend the minimum amount of time in it.



Fig. 2.9: A simple shelter, suitable for donkeys

Depending on the prevailing climate, some shelter must be provided. In the warmer parts of Africa a large, shady tree would be sufficient as shelter. In cooler climates shelter is necessary and the main

protection has to be against the rain. Where the winters or the rain are cold, however, some Protection against the night winds really must be provided. A roof supported by three walls backing on the prevailing wind, and with well- drained floor (see Figure 2.9) would allow ventilation and movement for the donkey, while providing sufficient shelter.

Barbed wire should not be used for enclosing donkeys. If they see enough space, many donkeys will try, and some succeed to get through or jump over a barbed wire fence, and can injure themselves. On the other hand a donkey will not use great force to get through a fence, so poles do not have to be very large or heavy.

TETHERING for grazing after pasture.

Where fences are absent and donkeys cannot be let loose because of the damage they might do to people's crops, then the only option that an owner may have is to tether his or her donkeys i.e. to tie them to a tree or post.

For this, the donkey must have a wide collar which will not cut its neck, and a rope which allows the donkey to move away from the tether point at least 5 times its own length.

There should be nothing along that length that will catch the rope and ideally the donkey should be able to move in all directions around the tether point. However if the tether point is a tree, the donkey could easily wind itself around it - thus limiting its grazing - and not all donkeys are intelligent enough to unwind themselves again. The presence of a fence is therefore often helpful.

Naturally the tether point must be chosen so as also to allow the donkey the maximum amount of eating: a good variety of plants that the donkey likes to eat (i.e. not only grass) must be within its reach.

Even when there seems to be plenty for the donkey to eat it should not be left tethered in the same place for more than 3 hours. Food can be brought to it but it is easier, of course, to move the donkeys.

2.4.5 Preventive Health Care of Donkeys

Like any other working creature, a donkey that does not feel well will not do good work. As for cattle (see Part I), the health of a donkey can best be checked by regular, daily contact and familiarity with the donkey when it is healthy. Then, when changes occur, they will quickly be seen and appropriate measures can be taken.

An owner's main task is to prevent any harmful effects of work on the donkeys. Regular, work because it is physical exercise, strengthens the muscles of the animal, improves its circulation and breathing and increases appetite.

On the other hand, overwork - such as pulling or carrying loads that are too heavy and for too many hours in the day without proper time for resting and eating - can be harmful.

Overworked donkeys will suffer from fatigue, loss of weight and general weakening which makes them susceptible to disease.

Castration (Gelding)

This is an operation that really must be performed on most male donkeys. It is usually not done before the donkey is about 10 months old. Because at that time the testicles have not yet descended, it will be necessary to cut them out. This creates an open wound that should drain and may take a couple of weeks to heal, so must be carefully managed to prevent infection. It is most unwise to perform the operation in the rainy season when bacterial and fungus infections are common, but even in the dry season the wound must be kept clean and disinfected twice daily until it closes (see under

"SKIN" for wound treatment).

From about the time a donkey is 2 years old it is possible to use a burdizzo which does not create an open wound if it is used over a clean cloth and so is less inviting of infection.

However, its results are not so reliable and it has to be very professionally used.

Also if the donkey is too mature it may retain the unwanted behaviour of a stallion even after it has been successfully castrated with the burdizzo.

Feet

Feet are a vital part of a donkey's working equipment because a donkey which cannot walk, cannot work.

The under-surfaces of each foot should be checked out daily during the rainy season, especially if ground conditions are sticky. They should be regularly cleaned with a hard sharp stick, to make sure no decayed matter stays lodged in them and that no stones or thorns remain to irritate them either. During the dry season, checking once a

week will be enough.

In wet conditions donkey hooves may get soft or overgrown, so the growth and condition of the hooves should be watched to ensure that the shape remains as it should be. If necessary, a hoof can be filed to the right shape, this may also be necessary in very young donkeys to correct the shape of the legs. The hoof and the frog (see illustration in module on 'SELECTION') can also be shaped straight with a very sharp knife.

In dry conditions, especially where surfaces are hard, donkeys' hooves may crack and split.

Regular rubbing with oil but particularly neatsfoot oil will help to prevent this and a nick made in the hoof at the top of the crack at right angles to it will help to stop the crack spreading.

Hoof knives and hoof-picks are obtainable in shops where horse equipment is sold but are also easily made by a local blacksmith.

If a donkey is lame and the hoof is hot to the touch something is causing inflammation. Look for a wound or a thorn. Very often the inflammation can be reduced by a hot soak (a rag soaked in hot salt

water pressed to the inflammation until the temperature equalises) or by soaking the foot in a solution of copper sulphate - blue crystals cheaply obtained from chemists or farmer suppliers. A plastic gallon bottle with the top cut off just enough to insert the hoof is the ideal thing for doing this.

A donkey seldom likes its feet to be wet but one way of keeping a foot standing in a bucket of water is to tie one of the donkey's front feet up with a belt.

Skin

A donkey easily bleeds and its skin is easily broken, so skin wounds (lesions) should be.

Prevented as much as possible by correctly using the correct equipment for work. This should ensure that anything that comes in contact with a donkey's skin is soft and does not rub or cut.

If prevention fails and a wound occurs it must be quickly dealt with. First of all it must be kept clean with twice daily washings. Hydrogen peroxide which is fairly cheaply obtainable in chemists is very thorough as an initial cleaner especially if decayed matter is in the

wound.

The wound should not be left wet but encouraged to dry as quickly and cleanly as possible. If it is to be covered with oil or vaseline (or insect-repellent 'stockholm tar') it must be thoroughly cleaned and dried first.

The application of a strong solution of common salt (sodium chloride) may sting the donkey but it promotes healing while it disinfects. The covering is better if the salt is mixed into a paste using clean water and very well-sifted wood ash. This is particularly suitable for wounds facing downwards such as castration wounds.

Mild alkalis such as cooking soda (sodium bicarbonate) or acids such as vinegar (acetic acid) diluted in water have a similar effect mainly discouraging fungus and bacteria. Brown sugar (not diluted) or honey can help if applied to a wound which has become septic i.e. inflamed and exuding pus

Eyes

Often, donkeys suffer from weepy eyes. This is most likely a bacterial inflammation spread by flies. If it is not soon remedied it can get

worse and eventually cause blindness for the donkey which would reduce the working effectiveness of the animal.

Washing out the eyes with a very mild antiseptic or even with clean water is usually enough to remedy this condition if caught early enough. Washing can easily be done with a plastic squeeze bottle such as those in which washing up liquid or toilet cleaner is sold. Before such a bottle is used for a donkey's eyes, its original contents must be very thoroughly cleaned out.

Effective mild antiseptics that can be dissolved in water are cooking soda, which is a mild alkali, and common salt.

The washing should be done twice a day. If the eyes do not improve within a week and completely recover within two weeks, then will be the time to use a commercial antibiotic eye powder or spray.

PARASITES

External parasites (ectoparasites)

The donkey's habits of mutual grooming, rubbing itself against trees and rolling in sand and ash indicate that it is sensitive to itches, but

these habits also rid the donkey of most of the important external parasites.

Parts of the donkey which may harbour parasites are under the tail, between the legs and inside the ears. Parasites in these places can often be removed by hand (but make sure they are properly killed) or by use of tick grease which is commercially available. A non-irritant insecticide such as 'Malathion' mixed with Vaseline is also effective particularly against the mange mite.

Only if absolutely necessary, and if the level of the dip allows them to keep their heads above water (because they cannot swim). donkeys can be dipped like cattle but some of the dip chemicals in use are harmful to donkeys such as 'Triatix'. Dipping should therefore only be used as a last resort.

Donkeys generally love to be scratched by people especially around and inside the ears. If done as a daily habit, this routine is also an effective way of parasite control.

Internal parasites (endoparasites)

Especially on poor and over-used pastures, donkeys can be very

seriously affected by internal parasites causing lung infections, diarrhoea, weight loss infertility, abortions and eventually an early death. These parasites, therefore, represent a serious economic threat.

Removing manure, rotation of pastures and ensuring that supplementary feed is always clean, are all things that can help keep parasitism under control particularly where donkey numbers are low.

In many countries a twice-annual anthelmintic programme (to control internal parasites) for donkeys, is recommended. Donkeys should be treated for parasites at the end of the rain and again at the end of the dry season. Foals as young as a month old can be included in such a programme.

Effective control is provided by the drug 'Ivermectin' and in its paste form 'Eqvalan' which is easy to administer through a donkey's mouth (see Drenching' below)..



Figure

2.4.6 Curative Health Care of Donkeys

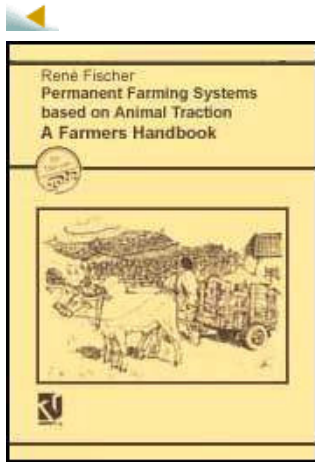
Some frequent diseases and ailments and their treatment

Symptoms	Ailment	Treatment
1 Limping muscle or joint hot to touch and/or swollen: possible inability to rise from living down.	Torn muscle or ligament sprain	Apply cold soak to swollen area. Rest from gentle exercise If donkey cannot rise from sleeping or rolling it must be helped up and during the day kept in a standing position, either in the crush pen or by means of a cloth sling round its belly hung from branch of a tree - the animal to be in the shade.

<p>2 Limping: no obvious muscular trouble; no obvious lesion; two or more feet hot; weight put on heels; some fever.</p>	<p>Laminitis (founder)</p>	<p>Reduction in diet protein. cold soaks for feet. Exercise, but not work. Antihistamines administered professionally</p>
<p>3 Persistent diarrhoea (scouring) abnormal rolling; stomach kicking.</p>	<p>Colic acidosis but needs professional diagnosis.</p>	<p>Restriction of diet but increase of liquid especially with cooking soda. If the donkey has taken in urea from a cattle lick. then diluted vinegar rather than cooking soda should be tried. Plenty of exercise but not work. If acute pain persists professional help should be obtained as soon as possible.</p>
<p>4 Prolonged constipation (more than several days)</p>	<p>Constipation</p>	<p>Molasses or 1-2 litres cooking oil. depending on the size of the animal. to be given as a drench (see below).</p>
<p>5 Avoidance of other donkeys and people; strange</p>	<p>Rabies</p>	<p>There is no cure. Once this is correctly diagnosed, the animal should be shot straight away and buried</p>

behaviour;
moving in tight
circles; eventual
paralysis.

Donkeys can share Nagana (trypanosomiasis) with cattle. But it is more likely that they get their own form of the disease known as dourine which is not spread by the tsetse fly, but by other flies. Many donkeys will not show symptoms of this even though they have it and so they act as carriers.



 **Permanent Farming Systems Based on Animal Traction: Farmers Handbook (GTZ, 1995, 183 p.)**

  **PART III: Draft animal implements**

 **(introduction...)**

 **3.1 Cattle harness**

 **3.2 Donkey harness**

 **3.3 The plow**

 **3.4 THE HARROW**

 **3.5 The ridger**



3.6 The tine-weeder/hoe



3.7 The cart



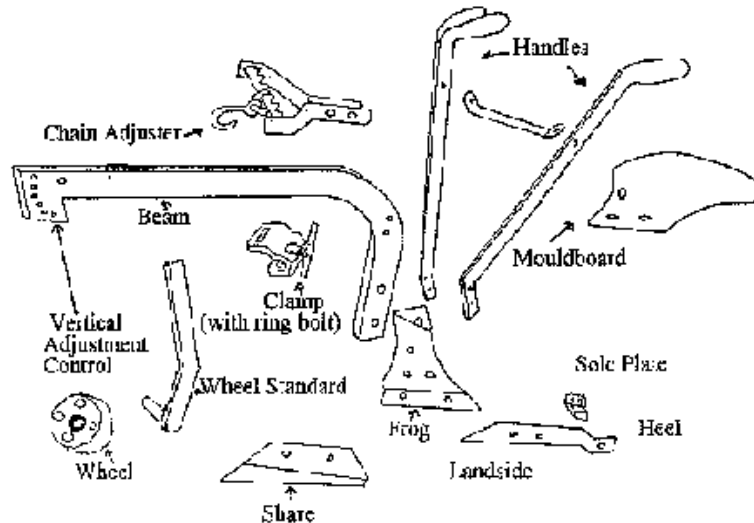
3.8 The roller cutter



3.9 The seed planter

Permanent Farming Systems Based on Animal Traction: Farmers Handbook (GTZ, 1995, 183 p.)

PART III: Draft animal implements



Figure

The farm implements help you to transform the power of your draft animals into work effort in the farm. Without proper tools, no efficient work.

The oxen farmer needs different tools for the different working operations. All working tools like prow, harrow, ridger and cart, etc., are attached to the draft animals by means of the harness.

Harness, we call that part of the equipment which is put on the animal. All other farm implements are attached to the harness. The harness allows us also to control the draft animals.

3.1 Cattle harness

The oxen harness consists of the following parts

- halter chain or nasal ring**
- yoke**
- head joint rope**
- steering rope**

3.1.1 Halter Chain or Nasal Ring

To tie the head joint and the steering ropes to the oxen, there are two systems:



Fig. 3.1: The Nasal Ring, made of steel and applied by the veterinary staff to the nose of the ox, is very effective. Oxen can be trained faster and are easier to control.

The Halter Chain, made of a chain and attached to the head of the ox, is less effective. Oxen are more difficult to train and to control with this system.

Adjust your Halter Chain correctly to the animals to avoid wounds at the eyes, muzzle or mouth.



Fig. 3.2: Correct adjustment of the halter chain

3.1.2 Head Joint and Steering Ropes

The head joint and steering ropes are attached to the halter chain or nasal ring to control the oxen. The steering rope is 12 mm thick and 20 m long, head joint rope is 6 mm thick and 2 m long.

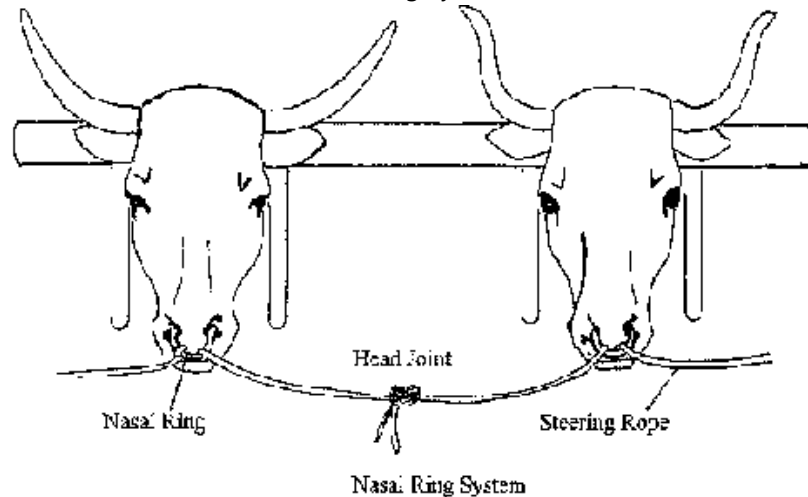


Fig. 3.3: The Head Joint joins the two animals and the Steering Rope leads round their rears to the driver.

Avoid wrong adjustment of the head joint.

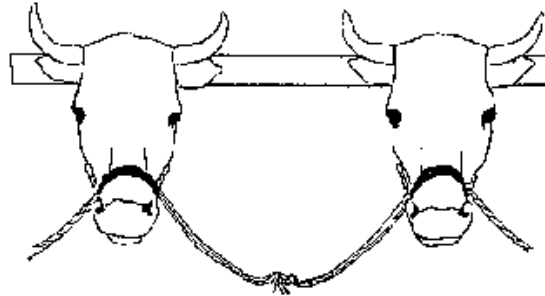


Fig. 3.4: No! The head joint is too long.

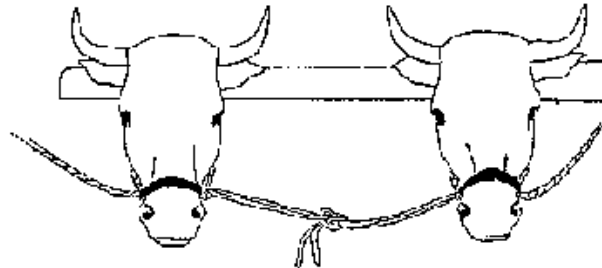


Fig. 3.5: Yes! Head Joint and Steering Rope are correct.

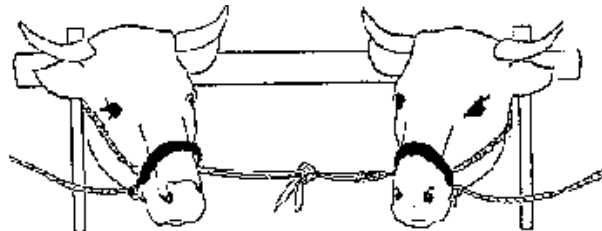


Fig. 3.6: No! The head joint is too short.**3.1.3 The Yoke**

The yoke connects the two oxen. All traction implements are attached to the yoke by the pulling chain (prow, ridger, harrow) or the beam (cart, roller cutter).

The yoke consists of the yoke beam, the yoke pegs and the peg beam.

You have two kinds of yokes:

-The short yoke with a length of about 1.3 m, used for plowing, harrowing, transport, clearing.

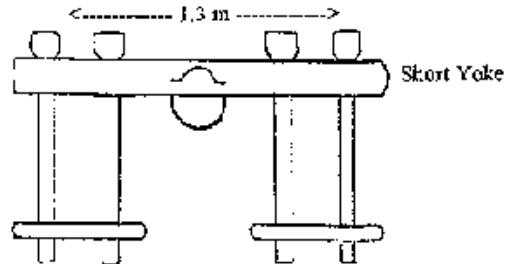


Fig:3.7: Use the short yoke for plowing and weeding rice and wheat (40 cm rows)

-The long yoke with a length of about 1.7 m and adjustable to different working distances, used mainly for ridging, weeding and moulding.

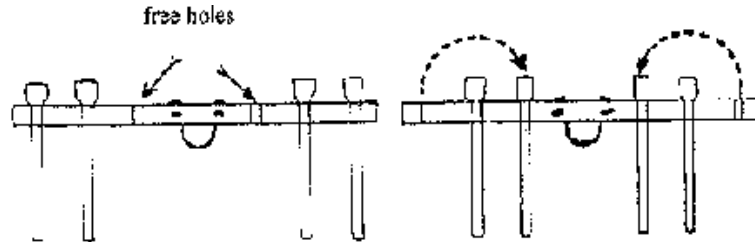


Fig. 3.8: Use the long yoke for ridging, weeding and moulding

Weeding/Ridging: Use the maximum distance between the oxen. Leave central holes of the yoke free (80 cm ridges).

Plowing: Reduce the distance between the oxen by changing the pegs
Weeding: of 60 cm ridges

3.1.4 The Pulling Chain

The pulling chain connects the implements with the harness. It is 3 m long and can be adjusted to different lengths.

3.1.5 Maintenance of the Harness

The Harness is made of wood. Wood is easily destroyed by water. A harness that is stored in a dry place like the cowshed can stay for 10 years.

If you expose your harness to rain and sun, it will rot and break after 1 year.

Proper storage of your harness will save you money.

3.2 Donkey harness

As for cattle, donkey harness is worn by the animals for the purposes of pulling implements or carrying loads and to control animals at work.

3.2.1 Leading and driving harness

Controlling a donkey's head is the best way to control a donkey's movements. When leading a donkey, it is necessary to keep its head well above the ground to prevent it from eating and to keep it going in the wanted direction. A rope attached to the donkey's head is necessary to achieve this.

3.2.1.1 Headrope and Halter

A headrope is very easy to make quickly and to slip on to the donkey. It is also easy to keep it in the pocket when it is not being used. Because the headrope is made of rope which can rub the skin, this should be for temporary use only.

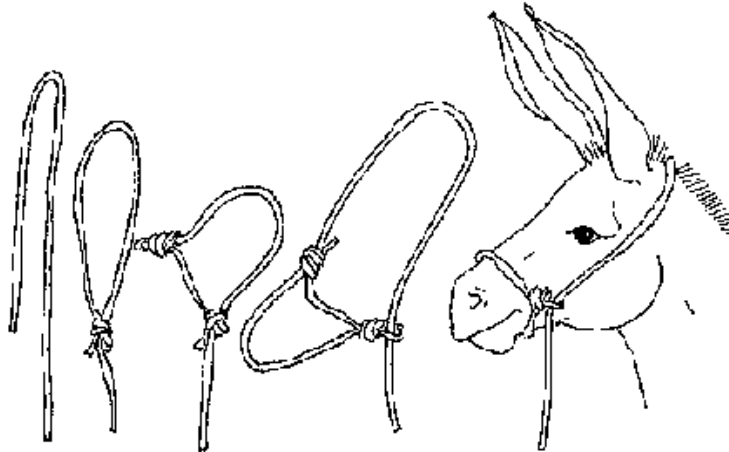


Fig. 3.9: How to make and fit a headrope

A halter should be made of leather or strong webbing - in any case some flat material so that a brow-band can be included, and even a throatlash, which prevent the donkey from rubbing the halter off.

The halter also has the advantage of having strong metal rings by the

donkey's mouth to which a lead rope or reins for driving can be attached.



Fig. 3.10: Parts and correct fit of a donkey halter

3.2.1.2 Bridle and Bit

For control from behind, the donkey's mouth is used. For this purpose a bit, a round piece of metal is inserted in the donkey's mouth. In many countries pony bridles (see Fig. 3.11) are sold which will fit donkeys, and also pony bits

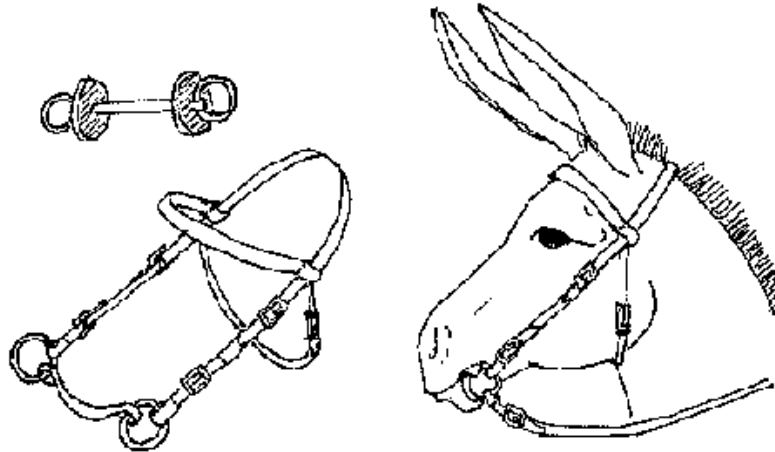


Fig. 3.11: The bridle and how to fit it correctly on the donkey's head, with a commercial bit and one made in a local workshop.

The bit must be buckled to the bridle by its rings. For each donkey, the cheekstraps of the bridle should be adjusted so that the bit fits snugly but not painfully at the top of the mouth, and the donkey cannot move it with its tongue. Inserting the bit into the donkey's mouth and fitting the bridle over its ears are all part of one smooth operation.

3.2.1.3 Reins (Steering rope)

The driver or rider is connected to the bridle and bit (or halter) through the reins or steering rope, which attach to the rings of the bit (or halter) on each side of the head. A strong leather strap is softer to human hands than a rope.

3.2.2 Pulling Harness

Pulling implements and carts are the main tasks of working donkeys. For draft work, therefore, a suitable harness is most important. A yoke is not suitable for donkeys, not only because it does not reach the shoulder where the donkey's horizontal force is exercised, but the donkey has no muscles to form a cushion at the withers like an ox and thus withstand the damage that a yoke can do. For draft work, therefore the donkey must be harnessed round the neck. There are two types of harness suitable for donkeys: The breastband and the collar harness.

3.2.2.1 Breastband

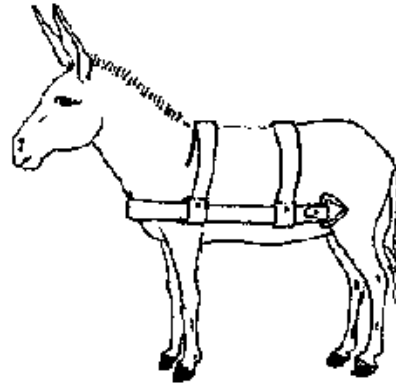


Fig. 3.12: The breastband is a simple and cheap design, which is usually made of thick rubber, old tyres, canvas belting, transmission belt or similar strong but flexible materials, joined together with bolts or rivets.

The breastband has the disadvantage of not only pulling on the shoulders, but also on the chest which may obstruct the donkey's breathing. Also, since the fitting is not very adjustable, this harness is often too loose on the donkeys, causing rubbing and wounds. In order to make the breastband more comfortable, the sharp edges of the belting have to be filed down and the heads of the bolts or rivets inside the harness have to fit smoothly into the belt material.

3.2.2.2 Collar harness

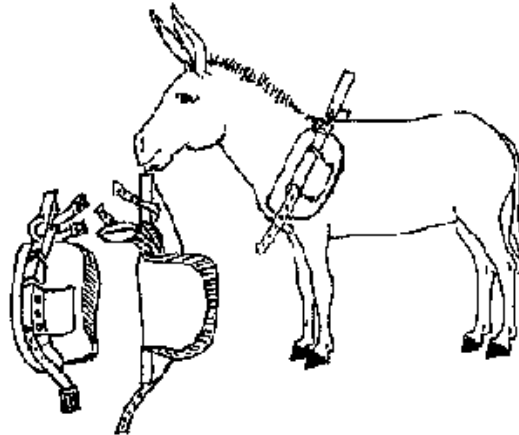


Fig. 3.13: The Collar Harness can be fitted exactly to the donkey's shoulders, and is adjustable for the donkey's comfort. Also it does not interfere with the donkey's windpipe so that it can breathe freely.

The collar harness is more comfortable, but it is more complex in design than the breastband, yet it can be made of materials that are easy to find in rural areas, such as wood, cloth, leather, some nails, stuffing for the cushions - best material for this being the tail brush of cattle or even the donkeys themselves. Anybody with reasonable craft competence can make a collar harness if provided with the

design.

3.2.2.3 Saddle and girth

A saddle over the donkey's back is necessary to take the vertical force or weight. Since the force is not very great, the saddle need be no more than a wide, strong strap, sometimes over padding. If the breastband is used, the saddle is included in the design..

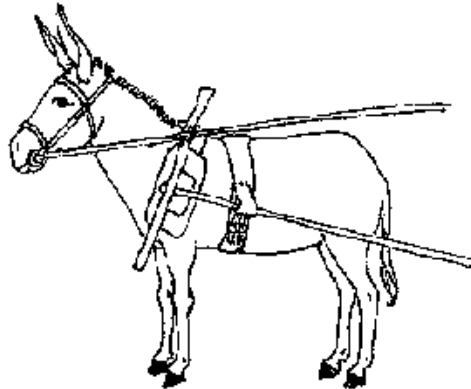


Fig. 3.14: The saddle takes the vertical force on the donkey's back

A collar harness does not provide for the vertical force, so if a collar is used, the saddle has to be provided separately - but then it can have the advantage of being made more stable with a girth or

bellyband under the donkey's belly. The girth also, should be a wide, soft strap which is adjustable to make the whole apparatus tight. The shafts of a cart should be attached to the saddle for the balance of the weight.

3.2.2.4 Breeching

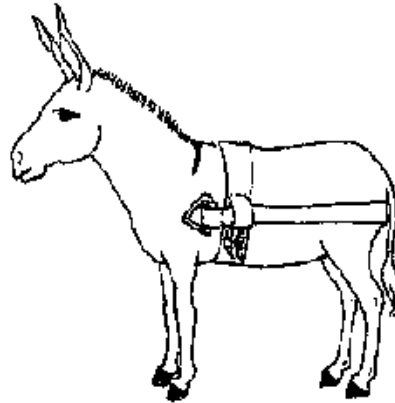


Fig. 3.15: Breeching acts as a brake when the donkey is pulling a cart.

Breeching is required when a cart is being used, as it acts as a brake, taking the force which is parallel to the ground when the cart is going downhill, when the weight of the cart becomes part of that

force.

The breeching strap is a wide strap of the same materials as the breastband that passes under the tail of the donkey. In the correct position the breeching strap does neither interfere with the donkey defecating nor with the movement of the legs.

When connected to the other parts of the harness, the breeching strap should be fitted snugly to the donkeys skin, it should never be loose to rub the donkey's skin. So as not to cut the donkey's skin, it must be wide and soft as well as strong.

3.2.2.5 Swingles, Eveners and Traces

The swingle allows the pulling harness to follow the donkey's uneven movements when walking, as it moves one leg after another.

The evener has a similar function like the swingle, only it compensates the uneven movements and pull where more than one donkey is pulling a load. The evener allows the animals at work more freedom to move and it can compensate for uneven pull if the animals are not equally strong by attaching the implement nearer to the stronger animal.

Both, swingle and evener are made of good, hard wood, which is both light and strong. Any farmer can easily make them.

They should not be thicker than a child's wrist

They should be long enough so that the traces through which the animal is pulling, are held clear of the animal's belly and legs as it moves.

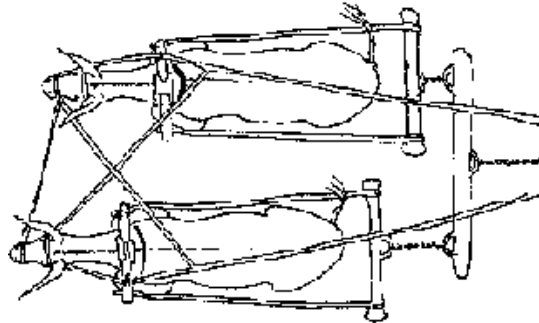


Fig. 3.16: Swingles and evener for two animals seen from above

The traces are the lines that transmit the pull from the breastband or collar to the cart or implement itself. Because of the strain they take, traces need to be strong and chains are often therefore used. At the correct length the traces can't get entangled with the legs of the animals.

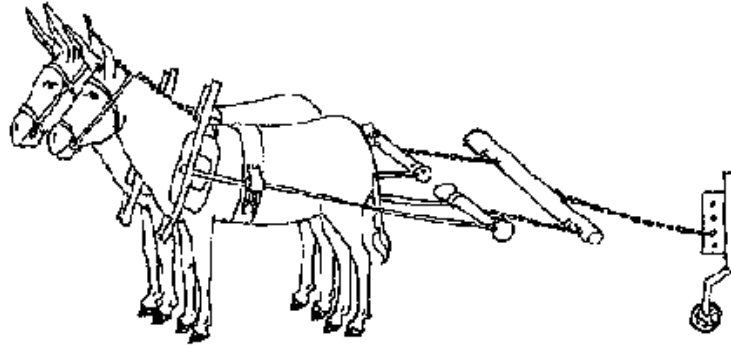


Fig. 3.17: Swingles, evener and traces in use with two donkeys pulling a plow.

3.2.3 Equipment for Carrying

The main requirements for carrying equipment are that it should be:

- able to keep the weight off the donkey's spine;**
- able to distribute the weight of the load onto the upper part of the donkey's ribs and close to the centre of gravity**
- light, so that it adds as little as possible to the load**
- of strong materials, to withstand being pulled against rocks**

and branches and thorns in narrow places;

-well-balanced, to ensure that the load is divided equally on both sides of the donkey's back;

-secure against sliding backwards or forwards when the donkey is climbing or descending slopes;

-not able to rub or cut the donkey;

-able to carry the correct weight;

-able to be tightly Packed, so that the load does not project too far from the donkey, and lies flat down its sides;

-reasonably high above the ground, so it is not encountered by the donkey's moving feet;

-far enough away back and front from the donkey's moving legs;

-possible to offload from the donkey within seconds in the event of an emergency

As a general rule, a folded blanket should come between the donkey's back and anything it carries, to prevent rubbing and

catching of hairs. It will also absorb the donkey's sweat and the dust from its back. Being separate, it can easily be washed and cleaned.

3.2.3.1 Bags and Soggies

Bags can be home made out of strong material such as canvas, they can easily be made and repaired.

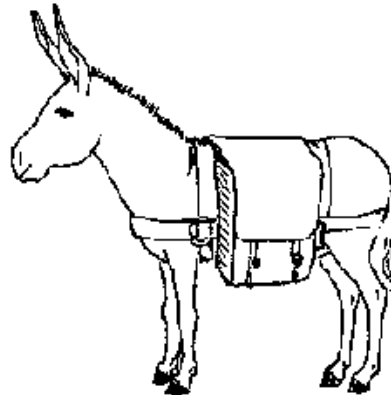


Fig. 3.18: A saddle bag with straps fastened under the chest, the tail and the belly of the donkey

Disadvantages of bags are:

-they are connected, so must be lifted together on and off the

donkey

-too much of the weight might be taken directly by the donkey's spine.

Straps under the donkey's chest, under its tail and under its belly should all have their fastenings close to one of the bees on the same side (traditionally on the left hand side) of the donkey, so that they can be undone without the need too move around the donkey.

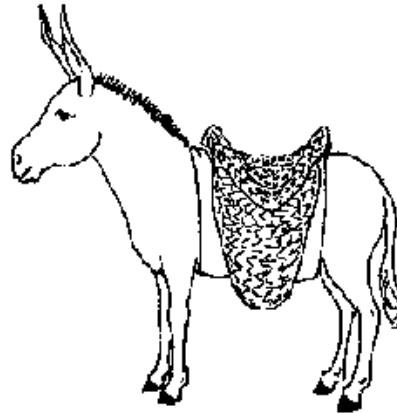


Fig. 3.19: The soggie is a kind of bag woven of rushes, grass or palm leaves.

The soggie is really just another kind of bag which is widely used in

East Africa, and has been found to be one of the best ways of loading a donkey. It has no straps to secure it, but nonetheless seems not to move once it is loaded. The soggie is usually woven out of strong and long lasting materials like rushes, but can equally well be made from grasses or palm leaves, and any competent basket weaver is able to make one.

3.2.3.2 Sawbuck Saddle and Pannier

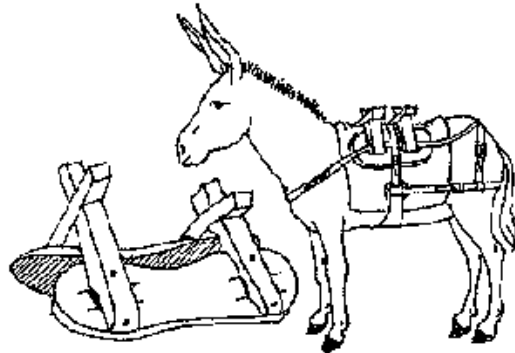


Fig. 3.20: The sawbuck saddle is used in many parts of the world and it can easily be made by a carpenter or wood carver.

A sawbuck has the advantage that it is suited to many types of load, even those of awkward shape, and one half of the load at a time can

be lifted on or off the donkey. Another advantage is that it serves to transfer the weight of the load from the donkey's spine to its ribs. Lashing is the safest way of attaching any load to the sawbuck saddle.

A pannier is a more rigid container than a bag or soggie, so that it incurs less risk of poor packing and shape to the load. Also it can be made of a stronger material, such as bamboo or reed basketwork, or even a light metal.

Panniers can be separate and so designed that they hook onto a sawbuck saddle, or they can be joined in such a way that they form a saddle of their own. Being rigid, this saddle can be shared so that the weight of the load is not taken by the donkey's spine, but its ribs. It should also be cushioned so there is no risk of any part of it digging into the donkey.

The safest way of tying loads to donkeys is shown in Figure 3.21, it is called lashing. This method of fastening a load has the advantages of:

- the load being secure at all points where gravity may cause it to slip**
- in an emergency, the load may be released within seconds**

and removed from the donkey.

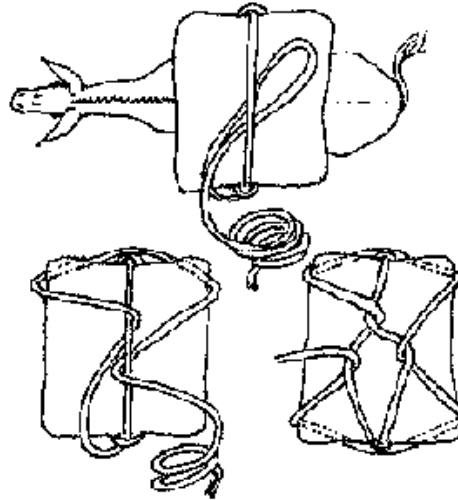


Fig. 3.2 1: Lashing, a safe method of tying loads carried by donkeys.

3.3 The plow

3.3.1 Why plow?

Plowing is a method of cultivating whose main purpose is to loosen the surface layer of the soil in which seed will be sown later. This loosening is achieved by turning over the furrow slice, thus exposing

it to air, rain and sun.

Plowing is carried out for the following reasons:

- to take virgin land into cultivation**
- to soften the soil for the establishment of the seedbed (ridges) .**
- to uproot weeds**

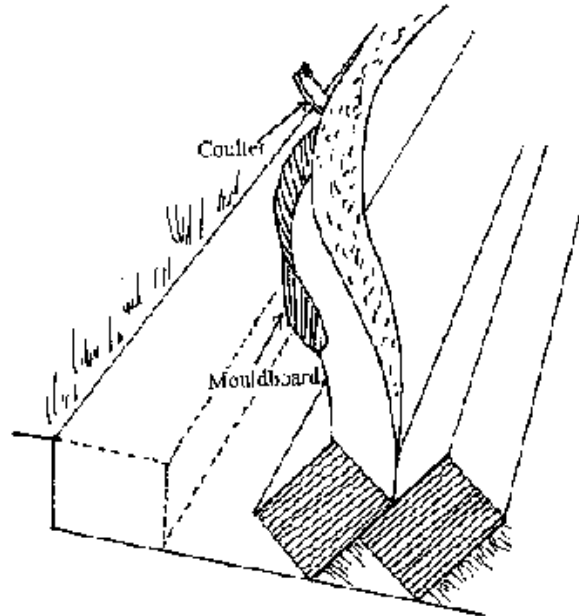


Fig. 3.22: The furrow slice is cut by the coulter and by the share and turned over by the mouldboard.

3.3.2 Parts of the Plow and their Function

The plow is the tool for the draft animal farmer to dig up the soil. It is made up of the following parts.

-The share, is one of the main parts of the prow. It cuts the slice of the earth horizontally and starts turning it over.

-The courter is a steel cutting blade which cuts the soil vertically along the furrow wall. The shaft of the courter is attached to the beam. The cutting edge of the courter is not exactly on the axis of the forward movement of the plow. It is turned slightly towards the furrow wall thus helping to keep the plow in the furrow. The courter must always be kept sharp.

-The mouldboard is the other main part of the plow which turns over the earth previously cut by the courter and the share. It is an extension of the share to the rear.

-The beam is the main frame of the plow to which all the other parts are attached, directly or indirectly.

-The stay is a part of the rear end of the beam to which are attached the main parts of every prow.

-The frog is the part attached to the lower part of the stay. Its front part is called the Sole Plate. It is to the frog that the mouldboard and the share are attached. It's rear end is the heel piece.

-The landside is another wearing part bolted to the frog. Its purpose is to prevent wear of the frog and of the stay, as a result of friction along the furrow wall.

-The handles enable the plowman to control the plow when working.

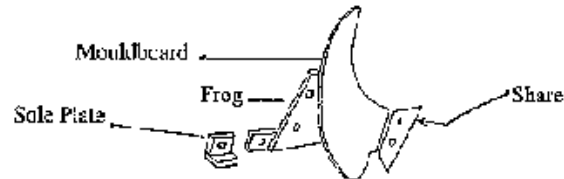


Fig. 3.22: Parts of the Plow Body which are fast wearing

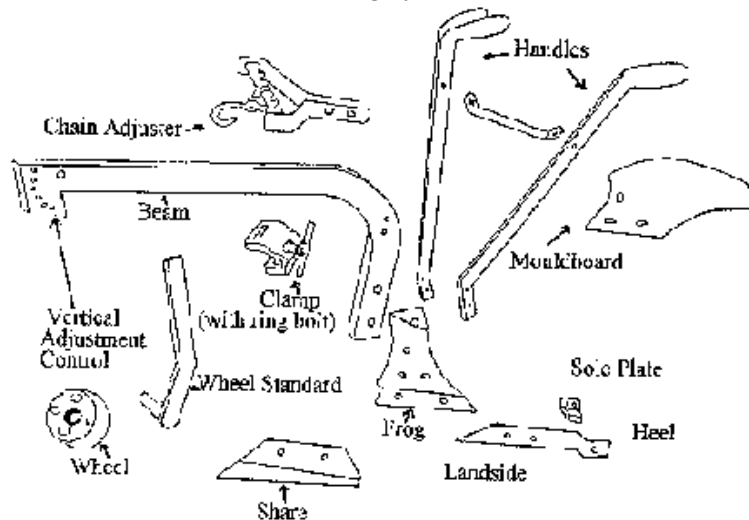


Fig. 3.23: All parts of the animal-drawn plow

3.3.3 Working Adjustment of the Plow

For good and easy plowing, it is important that the adjustments of your plow be correct.

The working adjustment of the plow can be done with:

- the pulling chain**
- the vertical adjustment control .**

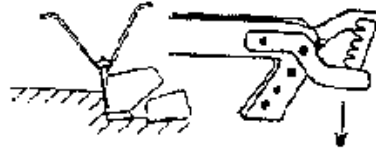
-the horizontal adjustment control

Problems

1. Plow not running upright, tips to the unplowed soil.

Solutions

Decrease length of pulling chain, lower hitching point of chain.

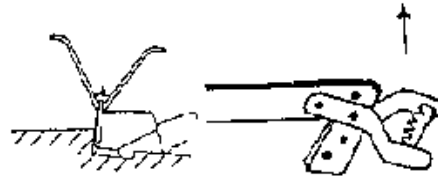


Figure

2. Plow not running upright, tips to the plowed soil

Solutions

Reduce length of the chain or raise hitching point of chain.

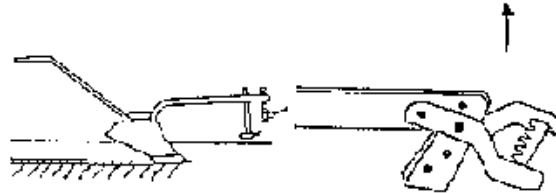


Figure

3. Landside is pressing on the ground, wheel is above ground

Solutions

Reduce length of the chain or raise hitching point of chain.

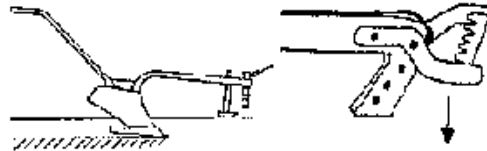


Figure

4. Landside is not touching the ground operator has to press down the handles

Solutions

Lower hitching point of the chain, reduce length of pulling chain

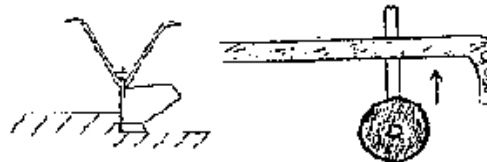


Figure

5. Plow is working too shallow not digging deep enough

Solutions

Raise hitching point of chain, extend length of pulling chain, reduce wheel standard

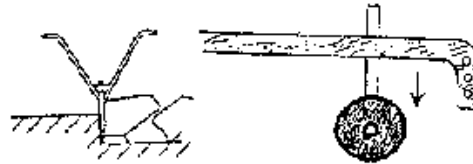


Figure

6. Plow is working too deep

Solutions

Lower hitching point of chain, reduce length of pulling chain, extend wheel standard

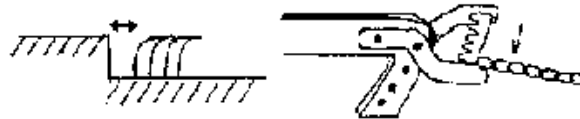


Figure

7. Working width is too small

Solutions

Shift chain to the end of chain adjuster where land is already plowed

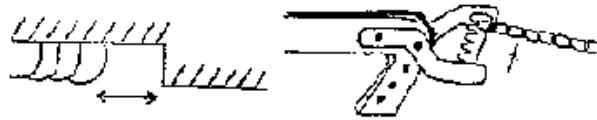
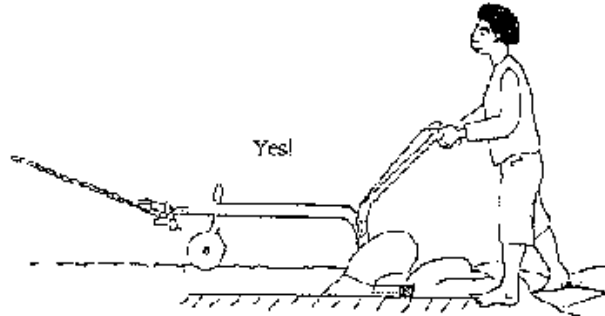


Figure

8. Working width is too wide

Solutions

Shift chain to the end of chain adjuster where land is not plowed

**Figure****Fig. 3.24: Do not work until your plow adjustment is correct!**

3.3.4 When to plow

If your soil is not hard, you start plowing during the dry season so that you can start planting as soon as the rains are steady.

On hard soils we start plowing as soon as the rains have softened the soil. Start plowing on the plots with heady soils (silt and clay). Once they are very wet, they stick to the mouldboard and make the work difficult.

3.3.5 How to plow

- 1. The whole area of the plot has to be plowed. Not one little piece remains unplowed!**
- 2. Always work the long side of the field, so that your furrows are as long as possible. You lose less time by turning round at the end of the field.**
- 3. Always plow across the slope! Plowing down the slope provokes damage by erosion.**
- 4. If your field is wider than 30 m divide up the area to be plowed into 'plots" so as to reduce walking at the ends of the furrow to a minimum.**

A contoured field divides the field already into smaller plots. There are two methods of plowing, depending on where you start and end work.

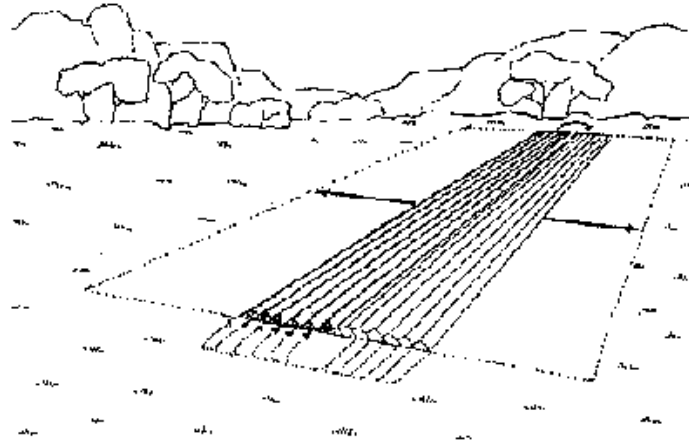


Fig. 3.25: The Gathering plowing method - you starts plowing in the middle of the land and you continue towards the edge of the land, one says you are opening Up or gathering.

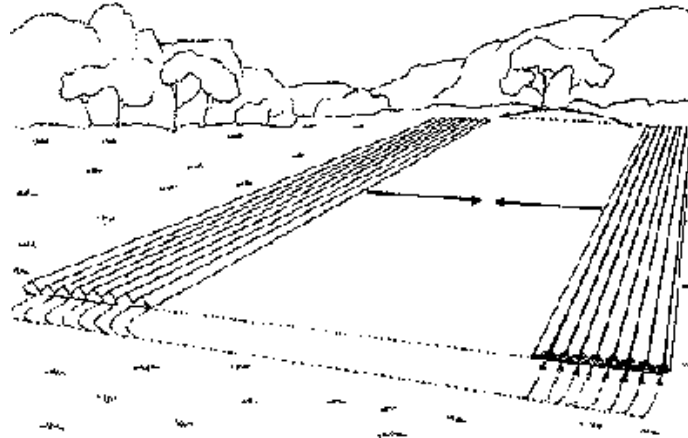


Fig. 3.26: The Casting plowing You start plowing at the corner of the land and work towards the centre of the land, one says you are casting or finishing off

You are finishing off where your field has been opened up the previous year.

You are opening up where your field has been finished off the previous year.

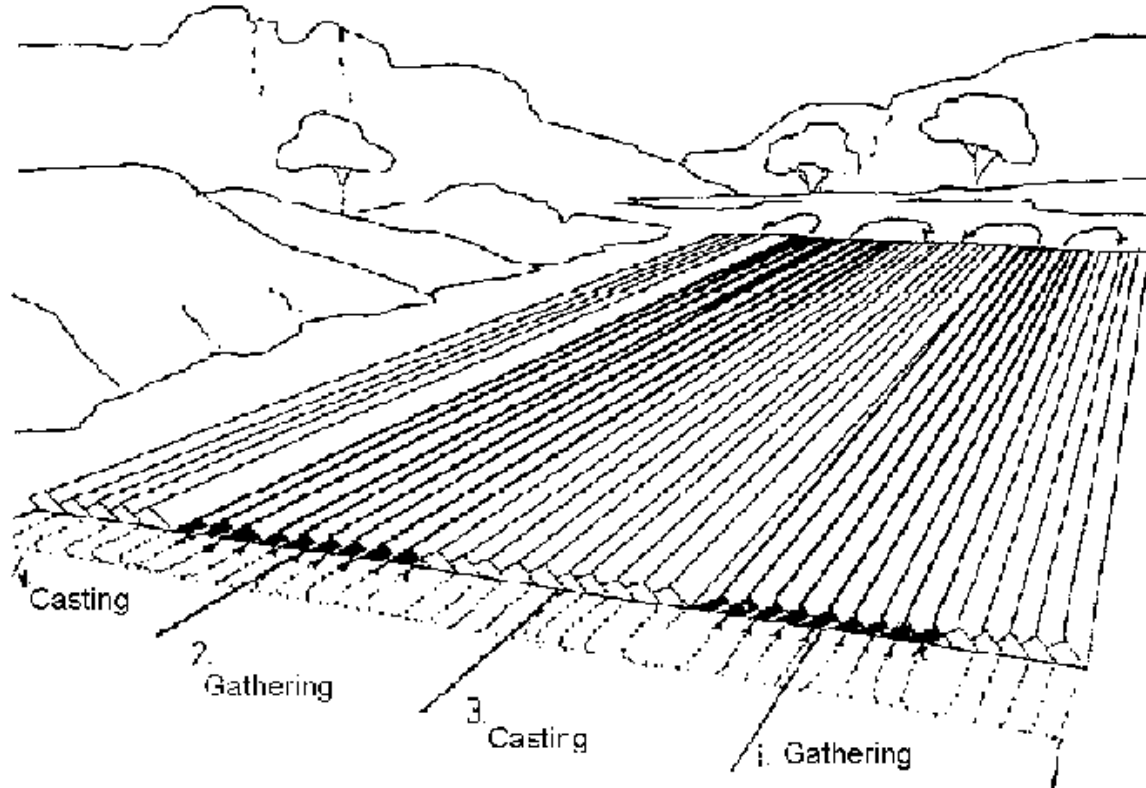


Fig. 3.27: A field with 4 plots being plowed one year

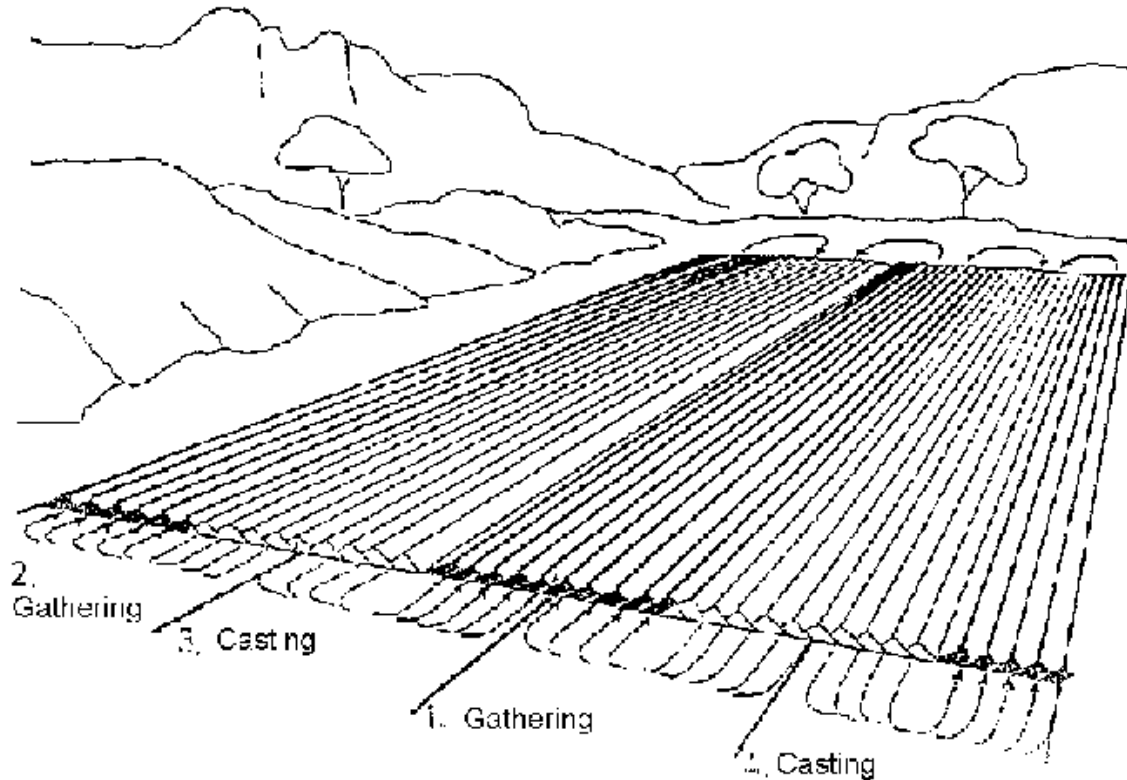


Fig. 3.28: The same field plowed the alternate year. Plots which were gathered last year are now cast. Plots which were cast last year are now gathered.

3.3.6 Disadvantages of Plowing

Repeated plowing can have negative effects on the soil. The organic matter of the soil decomposes faster. The soil is losing fertility and is more susceptible to erosion.

To reduce plowing, you ridgethe the ridges with the ridger - plow.

3.3.7 Maintenance of the Plow

To save money and work more effectively, you have to maintain and care for your plow.

- check and tighten all bolts and nuts of your plow before starting work**
- oil your plow, especially bolts and nuts every week end**
- grease your plow wheel regularly**
- store your plow in a dry place (cowshed) to avoid corrosion**
- don't file the share of your plow too often**

3.4 THE HARROW

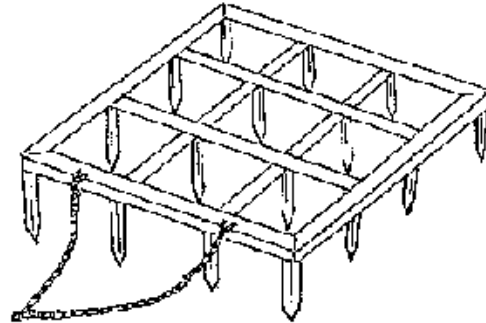


Fig. 3.29: The harrow is made of an iron frame with iron tines.

The harrow is mainly used for

- raking**
- harrowing and**
- levelling**

You can use the harrow after clearing, to rake the grass before you start plowing.

After plowing, you use the harrow to break big clods of earth and to remove unrooted weeds.

In the rice fields, the harrow is used to level the plot for uniform

irrigation.

Some rules for harrowing

- 1. Harrow the field not more than 2 to 3 times.**
- 2. Use the harrow across the direction of the prow.**
- 3. Do the second harrowing across the first harrowing.**
- 4. Never park your harrow upside down. The tines can wound man and animal.**

3.5 The ridger

The adjustable ridger is one of the most important tools of the Farmer.

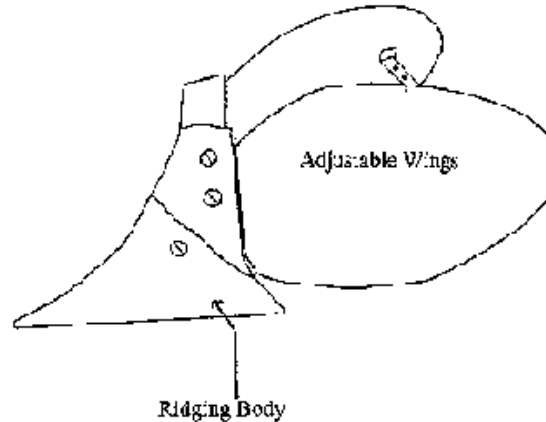


Fig. 3.30: The big adjustable Ridger

It is used for

- the preparation of the field ridges**
- reridging of ridges**
- weeding**
- line application of fertilizer**
- incorporation of manure**

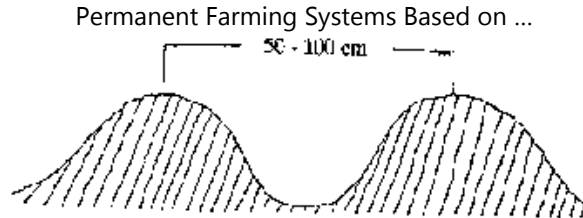


Fig. 3.31: The adjustable wings of the ridger allow the preparation of ridges with a distance of 50-100 cm.

3.5.1 Why make Ridges

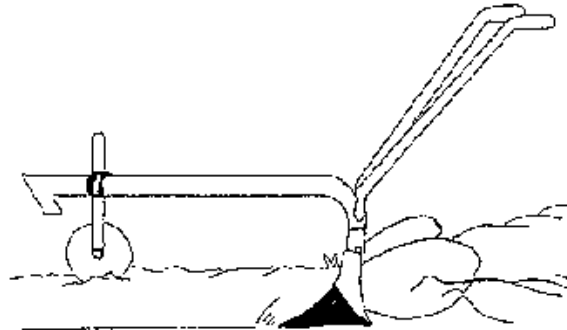
Traditionally, all crops are grown on ridges or mounds.

Cropping on ridges has many advantages

- erosion control**
- better growing conditions for young plants, especially root and tuber crops**
- prevents water logging**
- reduces spreading of fungal diseases**
- harvesting of tuber / root crops is easier**
- planting and weeding is easier**
- incorporation of large quantities of organic matter is easier**

3.5.2 How to make Ridges

When the soil is under cultivation or softened by plowing it is easy to make ridges with the ridger-plow. The adjustments of the ridger are done as for the prow. In addition, you can adjust the distance between your ridges by the adjustable wings.



Figure



**Fig. 3.32: No! These ridges are not correct, they have hollows on top.
Yes! These ridges are correct.**

The ridges must not have hollows on top! If they do not have the correct shape after ridging once, you ridge for a second tune.

3.5.3 Reridging, Weeding, Band Application of Fertilizer



Fig. 3.33: When the rain has washed down soil from the top of the ridges into the furrows and weeds have grown, the ridger is used for weeding and reridging.

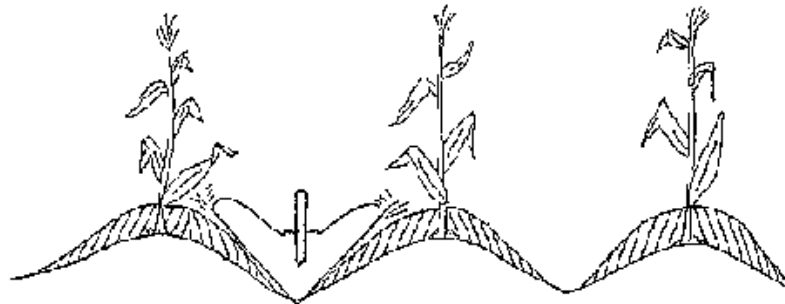


Fig. 3.34a: Reridging can be combined with weeding and band application of fertiliser.

-reridging gives the ridges a correct shape again and uproots

the weeds at the same time (weeding)

- reridging covers the surface roots with soil and protects them against drying out**
- reridging increases the ridges and the seedbed for root and tuber crops**

-reridging combined with fertilizer application mixes the fertilizer with the soil and places the fertiliser grains near the plants (band application)

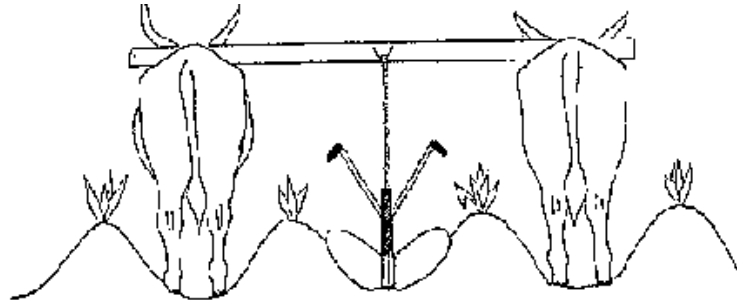


Fig. 3.34b: For reridging or weeding, the adjustable ridger is attached to the long yoke.

3.5.4 Splitting of old Ridges

When cropping on ridges, you don't have to plow after harvest. You use your ridger to split old ridges and mould new ones.

If you put organic matter (corn stalks, manure, etc.) into the furrows before splitting the old ridges, you can add plenty of manure to the soil.

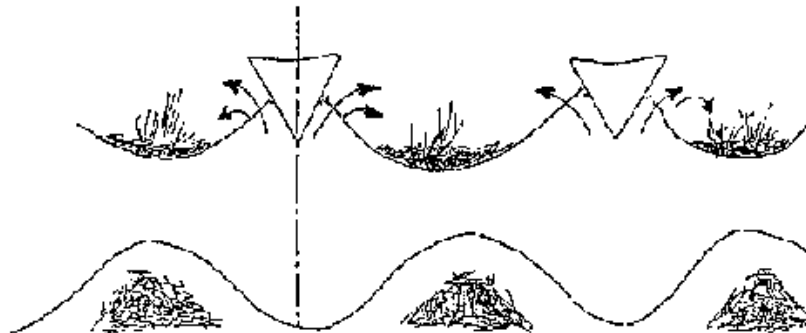


Fig. 3.35: Split the old ridges after the cultivation season and incorporate organic matter in the soil.

3.5.5 Maintenance of the Ridger

To save money, you have to maintain and care for your ridger

-check and tighten all bolts and nuts of your ridger before

starting work

-oil your ridger, especially bolts and nuts every week end

-store your ridges in a dry place (cowshed) to avoid corrosion

3.6 The tine-weeder/hoe

The tine weeder is a special implement for the weeding and hoeing of crops (inter- cultivation) which are planted on the flat, like rice and wheat.

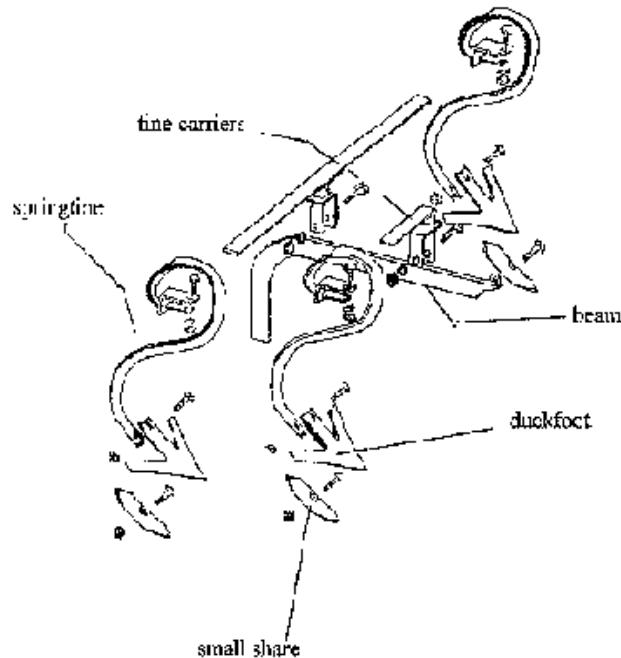


Fig. 3.36: The tine weeder/hoe consists of a tine carrier, that is attached to the plow beam and the spring tines with a duck foot or small share, which are attached to the tine carrier.

Inter-cultivation (weeding/hoeing between plant rows)

-uproots weeds

- breaks the surface layer of the soil to improve air and water circulation**
- increases the yield when early and repeatedly done**

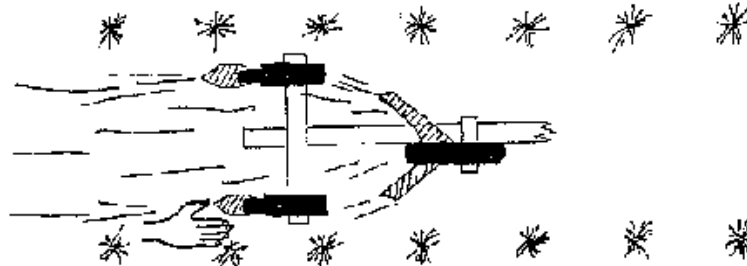


Fig. 3.37: When weeding crops, the distance between the tines and the plants rows should be as wide as your palm.

3.7 The cart

The cart consists of the iron frame with the loading platform, the axle with the wheels, the break system and the beam, to attach it to the harness.

The cart is used for transportation of

- manure from the cowshed to the farm**
- implements (e.g. roller cutter) from the compound to the**

farm

- fertiliser from the compound to the farm**
- produce from the farm to the compound**
- produce from the compound to the market**
- many other things (e.g. firewood, water...)**

The cart makes transportation easy and fast. You don't have to carry things on your head again.

You can use the cart to transport your things and for commercial purposes, e.g. transport of maize or rice for other farmers.

Don't use the oxen more than 4 hours a day for transportation.

The cart is a very expensive implement. To run it economically

- you will have to use it well .**
- you will have to care for it well**

3.7.1 Loading of the Cart

The cart has a loading capacity of about 500 kg. This corresponds to

-5 bags of maize .

-6 to 7 bags of paddy rice

Never overload your cart. It can damage the wheel drums and other parts of the cart.

If you have young oxen, do not load up to 500 kg. You will over-work your oxen.

Start loading in the middle of your cart. Extend to both ends evenly.

Always balance the load you are putting on your cart.

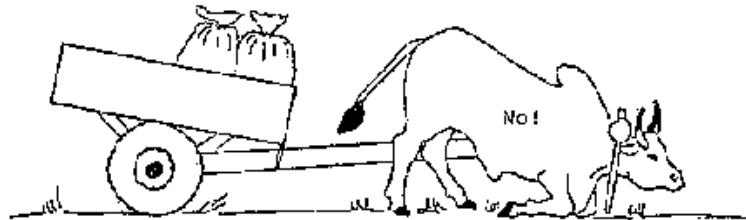


Fig. 3.37: NO! The load is placed at the front of the cart. The load will press down the neck of your oxen.

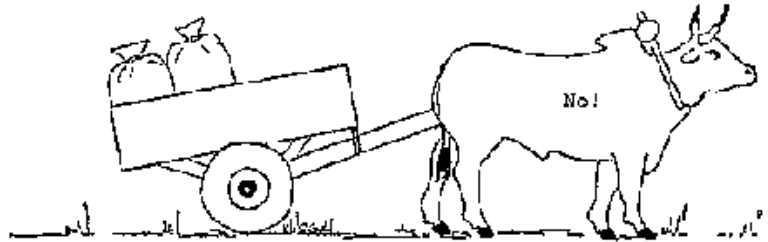


Fig. 3.38: NO! The load is placed in the rear part of the cart. The harness is lifting up and strangling your oxen.

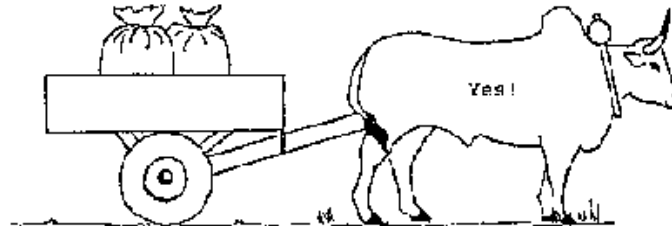


Fig 3.39: YES! The load is well balanced on top of the wheels. Your oxen will feel fine when pulling.

3.7.2 General Checks before using the Cart

- 1. Check the nuts and the tyre pressure**
- 2. Check the brake system**
- 3. Check your harness if it is well fitted**

- 4. Check if the cart beam is correctly attached to the yoke**
- 5. Check if your oxen are well.**

3.7.3 High-Way Code

When using the cart, you have to follow certain rules to provide safety for you and your oxen.

- 1. Keep right.**
- 2. Consider other road users.**
- 3. Before turning left or right, consider other road users.**
- 4. Remember to indicate with your hand before you turn.**
- 5. Shout or hoot to warn other road users.**
- 6. Do not stop at corners, junctions, bridges or narrow roads.**
- 7. Never overtake at those places in six above.**
- 8. Do not transport with oxen at night because there are no lights.**
- 9. Do not overload the cart.**
- 10. Tie your ox or oxen at every long stop.**
- 11. Tie and brake your oxen when loading.**
- 12. Do not use untrained or stubborn oxen.**
- 13. Do not use oxen for more than 4 hours even during**

transporting.

14. When you drink, do not drive with your oxen.

15. Obey all the road signs and signals.

16. Brake your cart on slopes.

17. When you have a breakdown, put a sign on the road to warn other road users.

18. Do not leave your oxen loose on the highway.

3.7.4 Maintenance of the Cart

The cart is expensive. You have to care for it well to avoid high repair cost.

-Do not overload the cart to avoid damage, especially to the wheel drums.

-Park your cart in the cowshed to avoid rotting of wooden parts and corrosion of the iron parts.

-Check and tighten all nuts regularly.

-Grease the brake system from time to time.

-Check the tyre pressure. Never use the cart with a flat tyre. The tyre, the inner tube and the wheel drum can be damaged.

-Protect the tyres against direct sunlight.

3.8 The roller cutter

The Roller Cutter is an implement for clearing pulled by the oxen. In addition it can be used to break up earth lumps (harrowing) and to puddle.

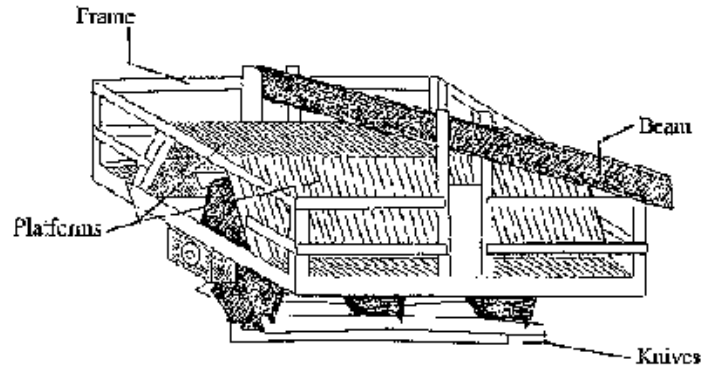


Fig. 3.40: The roller cutter consists of an iron frame with the platform on which to put load, the axle with the rotating knives to clear and the beam to attach it to the harness.

In action, the roller cutter pushes down grass, small bushes or harvest residues, which are overrolled and cut into small pieces by

the rotating knives. The resulting mulch (cut organic matter) is easily covered with soil by using the plow or ridger.

The roller cutter

- makes the clearing of the fields easier and faster**
- enables the oxen farmer to extend his cropping area and to prepare his field for timely planting**
- can be used for harrowing and puddling (swamp rice)**

- promotes organic farming. Grass or harvest residues are cut into small pieces, which can be easily buried in the soil**

3.8.1 How to use the Roller Cutter

To avoid breaking the beam and other damage to the roller cutter, never turn on one spot when loaded. Allow a larger turning circle, operate as indicated in Figure 3.41.

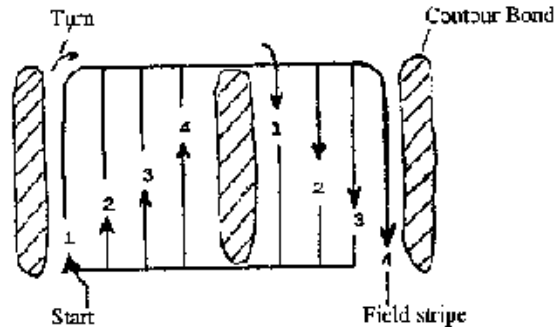


Fig. 3.41: If the space between two contour bonds is too narrow to allow the roller cutter to turn round, work on two fields at the same time.

Depending on the type of work, you add different quantities of load (stones or sandfilled bags) to the platform of the roller cutter:

- no load for puddling of swamp-rice fields**
- small load for harrowing**
- medium load for dry harvest residues .**
- heavy load for wet residues and tall grass**

For optimum performance, you may need several passes. Time required to clear hectare is about 3 days.

3.8.2 Maintenance of the Roller Cutter

The roller cutter is an expensive implement. You have to care for it well to avoid costly repairs.

- 1. Clean the knives after use.**
- 2. Tighten all nuts before use.**
- 3. Store it in a dry place (cowshed).**
- 4. Do not use it in a stony fields.**

- 5. Transport of the roller cutter from the compound to the farm is done by cart. If you roll the roller cutter on stony or firm farm roads, the knives become blunt or broken.**

3.9 The seed planter

This Planter is used to plant the following seeds:

- Maize**
- Beans**
- Soyabeans**
- Groundnuts**
- Cowpeas**

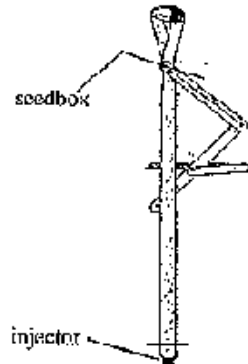


Fig. 3.42: This Seed Planter has three different kinds of adjustments:

- Adjustment of the seed distribution hole according to the different kinds of seed you want to plant.**
- Adjustment of the planting distance, from 0 to 30 cm.**
- Adjustment of the planting depth, from 0 to 8 cm.**

For the adjustment of the distribution hole, three distributors are given:

- 1. A distributor with a distribution hole of 16.5 mm diam. used for planting conditioned maize (over 8 mm) and beans.**

- 2. A distributor with a distribution hole of 13 mm diam. used for planting conditioned soyabeans (over 6 mm).**
- 3. A distributor with a distribution hole of 18.5 mm diam. which is thicker and used for planting of conditioned groundnuts (over 8 mm).**

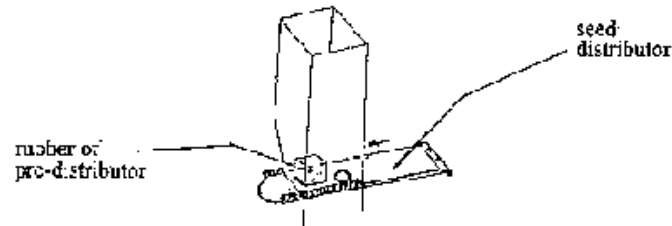


Fig. 3.43: Details of the seed metering mechanism

Here are the adjustments for the different crops:

CROPS	CONDITIONMENT	DISTRIBUTION HOLE	PLANTING DISTANCE	PLANTING DEPTH
Maize	Sieved (> 8 mm)	16.5 mm diam	25 cm.	5 cm.
Beans	Not sieved	16.5 mm diam	10 cm.	3 cm.
Soyabeans	Sieved (> 6 cm)	13.0 mm diam	10 cm.	3 cm.
Groundnuts	Sieved (> 8 cm)	18.5 mm diam	15 cm.	3 cm.

For the conditioning of the seeds, two sieves are provided:

- 1. One sieve with holes of 8 mm diam. for sieving of maize and groundnuts.**
- 2. One sieve with holes of 6 mm diam. for sieving of soyabeans.**

Special adjustment for groundnuts:

- The distributor is thicker (12 mm thick) with a distribution hole of 18.5 mm diam.**
- Since the seeds are very fragile there are two adjustments:**

1. Inside the seed box, there is a predistributor rubber which is too strong for groundnuts.

Remove the seed box, take away this rubber and replace it with a very soft one which is provided with the planter, then install the seed box in its place.

2. Normally the injector pushes the seed inside the soil, but for groundnuts, the injector will break the seeds. To stop the injector,

put a bolt with a nut (which are provided with the planter) in the hole which is at the above part of the Planter.

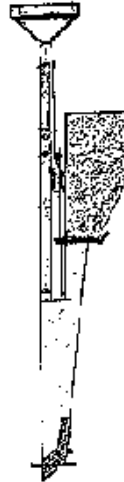


Fig. 3.44: Lateral view of the seed planter.

General Observations:

-When you are planting, do not go too quickly, so you can hear the sound of the seed falling down into the collector. If you don't hear any sound, it means the seed has not fallen, and you have to repeat the injection. If you are going too

quickly, it may affect the regularity of the distribution of the seeds.

-If the mechanism is rubbing, put some oil in the different places of the mechanism.

-Do not completely fill the seed box: better fill it halfway.

-When you are adjusting the planting depth, be careful that the piece of the sheet closing the bottom of the planter is well adjusted (it must be well closed when the injector is up).

-From time to time, check if the bottom of the planter is closing well (no mud or no seed preventing it from closing).



 **Permanent Farming Systems Based on Animal Traction: Farmers Handbook (GTZ, 1995, 183 p.)**

➔  **PART IV: The soil**

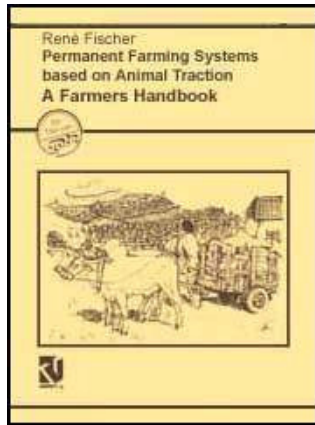
 **(introduction...)**

 **4.1 What is soil?**

 **4.2 How is the soil made up?**

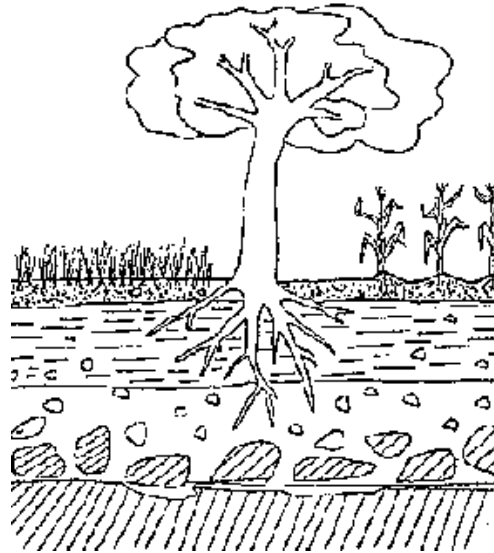


4.3 Soil composition



Permanent Farming Systems Based on Animal Traction: Farmers Handbook (GTZ, 1995, 183 p.)

PART IV: The soil



Figure

4.1 What is soil?

In general, soil is the upper layer of the earth e.g. soil of the bush, soil of roads, soil of the fields.



Fig. 4.1: A farmer will only call soil, all those soils which are cultivated or which can be cultivated (virgin or fallow land).

The soil is essential for the production of crops. It provides the structure the plant is standing in. It supplies minerals and stores water and air for the plant.

Depending on the natural fertility of the soil, you can have high and low yields.

After clearing, the soil is fertile and the harvests in the first one or two years are good.

If you don't care for your soil, the soil gets poor and the harvest becomes smaller. Your soil has to rest. Soil at rest is called fallow.

The fertility of the soil is destroyed by

- too much cultivation without soil conservation and soil improvement**
- too many animals kept on an area (overgrazing) .**
- fire which can destroy vegetation and soil life**

How to conserve and improve your soil. Read Chapter V.

4.2 How is the soil made up?

The soil is made up of the following layers the top soil - cultivated soil

Can be worked with a hoe or prow. The roots of nearly all the plants are found in this layer. the plant soil

Lighter in colour than the top soil because it is less rich in humus. Only deep roots are found.

There are often pebbles at the bottom of this layer. the sub soil Is often very thick. It is hard and difficult to dig. From this layer, the roots of big trees get their water during the dry season. the parent rock

Is very hard and full of stones and rock. It transforms itself very

slowly into soil.

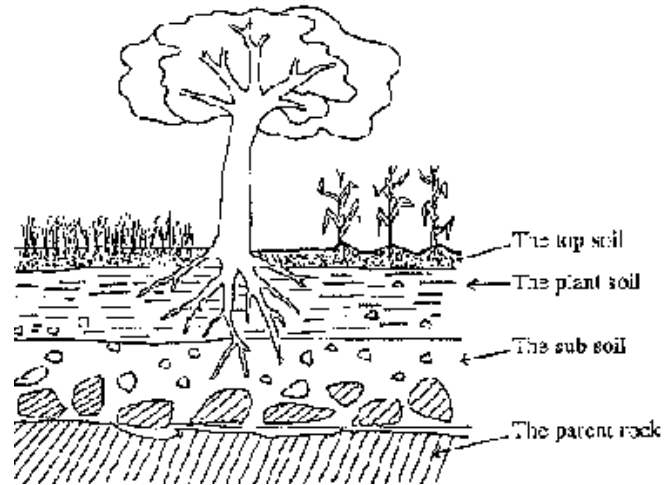


Fig. 4.2: The soil is made up of the following layers

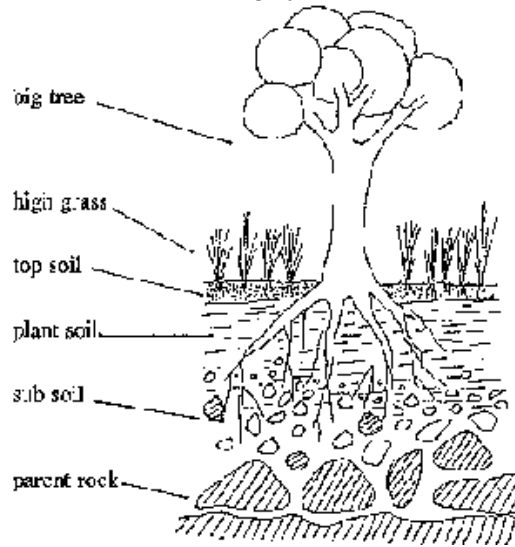


Fig. 4.3: RICH SOIL is characterized by:

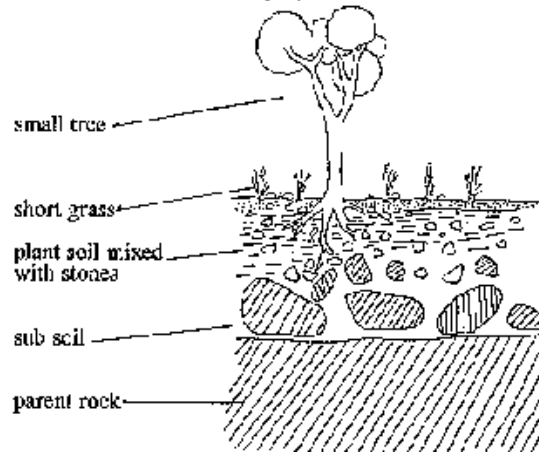


Fig. 4.4: POOR SOIL is characterized by:

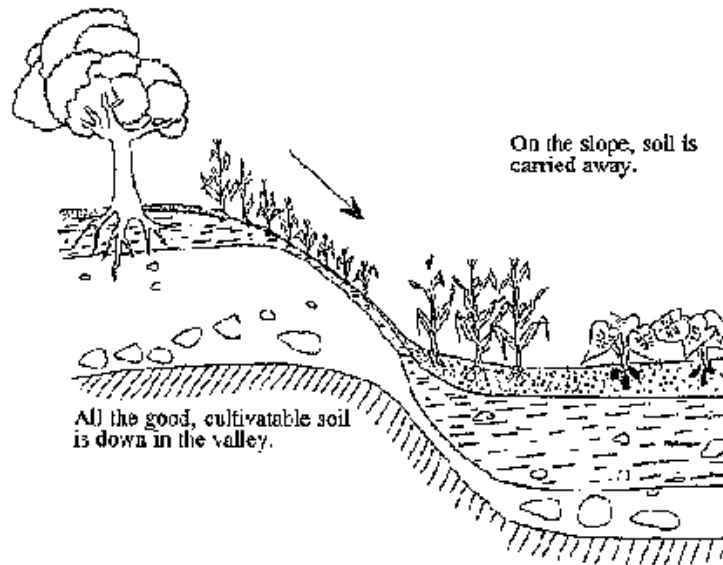


Fig. 4.5: Soil in a hilly Area

The soils along a slope typically vary in quality. On top of the hill, there are shallow layers of the top soil and of plant soil. In the steep parts of the slope, most of the cultivated soil has been washed away. At the foot of the hill, all the good soil is deposited. We find thick layers of top soil and plant soil.

4.3 Soil composition

The top soil of our fields is a mixture of sand, silt, clay, organic matter and humus.

4.3.1 Sand

Sand consists of small grains which are very hard. Sand is found everywhere, rain carries the sand into hollows and into streams.

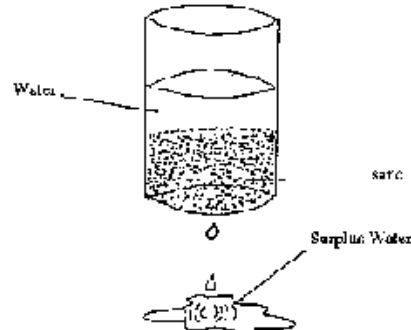


Fig. 4.6: Sand is permeable: Take a tin. Make a hole in the bottom of it. Fill the tin with sand. If you pour water on to the sand, it goes through.]



Fig. 4.7: Sand is unstable:

Take some dry sand in your hand, let it run. Sand runs like water. You cannot make a ball of sand.

Soils that contain a lot of sand are sandy soils.

Like sand itself, sandy soils

-are permeable, water passes through easily and can carry away the food (minerals) of the plant.

-are unstable and easily washed away by rain, water or carried away by wind.

-store water and mineral salts (NPK) badly.

-are light and loose and easy to work.

-do not stick to tools after rain like clay.

-wear out the tools more than other soils when you work

them.

**Groundnuts, Cassava, Yam and Potatoes grow well in sandy soils:
The roots penetrate easily.**

4.3.2 Clay

Housewalls and earthenware pots are made of clay. Clay has mostly a red colour. Clay is usually found in deeper layers of the soil. Wet clay takes whatever shape it is given. Wet clay sticks to the fingers, it makes mud. When it is dry, it forms hard lumps. When a lump of clay is crushed, it forms dust.

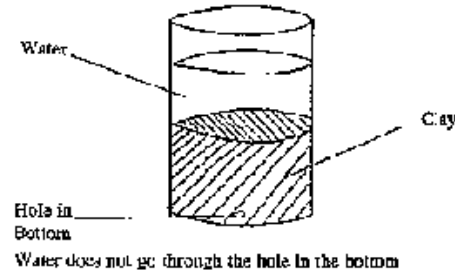


Fig. 4.8: Clay is impermeable

Take a tin. Make a hole in the bottom of it. Fill the tin with clay. If

you pour water on the clay, it does not go through.

Water does not go through the hole in the bottom

Soils that contain a lot of clay are called clayey soils.

Like clay itself, clayey soils

-are impermeable, water does not go through very easily. The water takes a long time to disappear.

-Store water and mineral salts (NPK) well.

-are not so easily carried away by water or by wind when moist.

-stick to the tools and are difficult to work after the rains. Clayey soils are called heavy soils.

-become very hard in the dry season. Cracks form in them.

-dry lumps are difficult to break.

Rice, Maize, Wheat and Cocoyams grow well in clayey soil.

4.3.3 Silt

Some soils are neither sandy nor clayey soils. They are made up of silt.

Silty Soils:

-are not as light as sandy soils, water does not go through so easily.

-do not dry quickly and are not easily carried away by water and wind. They store water and mineral salts well.

-are less heavy than clayey soils and easier to work.

Palm Trees, Yam and Cassava grow well in silty soils.

4.3.4 Organic Matter and Humus

Many worms and insects and other living things you cannot see (microbes) live in the soil and in rotting organic matter. They feed on organic matter and break it into small particles (decomposition). The result we call Humus. Humus you cannot see like sand or clay. To form good soils, the sand, clay and silt must be mixed with humus. Soil without humus is no good soil.



Fig. 4.9: Bad soil structure

Clay, Silt and Sand form big hard lumps. Air and water cannot pass, roots cannot penetrate.



Fig. 4.10: Good Soil structure

Clay, Silt and Sand form small lumps which are joined together by humus. Air and water circulate in the holes and roots penetrate well.

Humus improves sandy soils:

- sandy soils with humus hold water better.**
- sandy soils with humus store minerals better.**
- sandy soils with humus are less easily carried away by wind and water.**

Humus improves clayey soils:

- clayey soils with humus are less hard.
- Air and water circulate better.

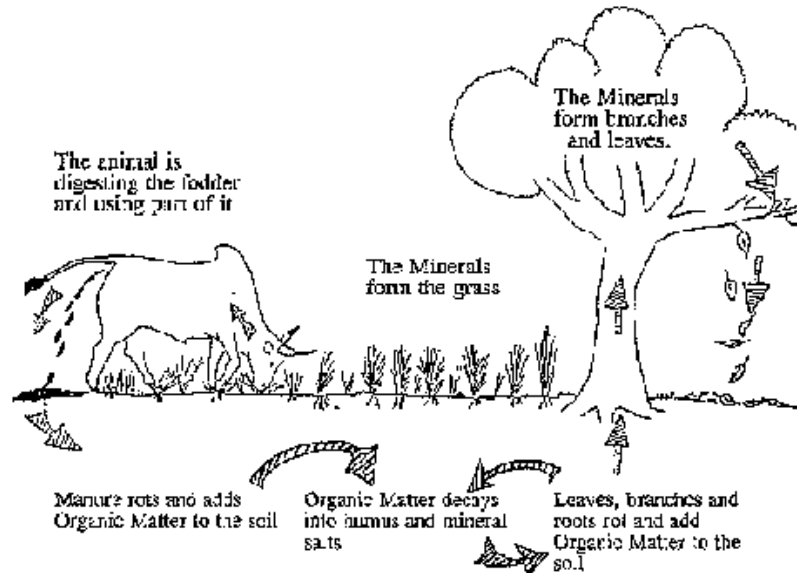
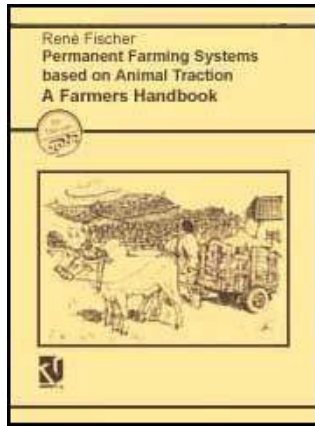


Fig. 4.11: Humus makes soil richer. Humus returns Mineral Salts (Plant Food) to the plants and improves the soil structure





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PART V: The permanent farming system



(introduction...)



5.1 Meaning and objectives of a permanent farming system



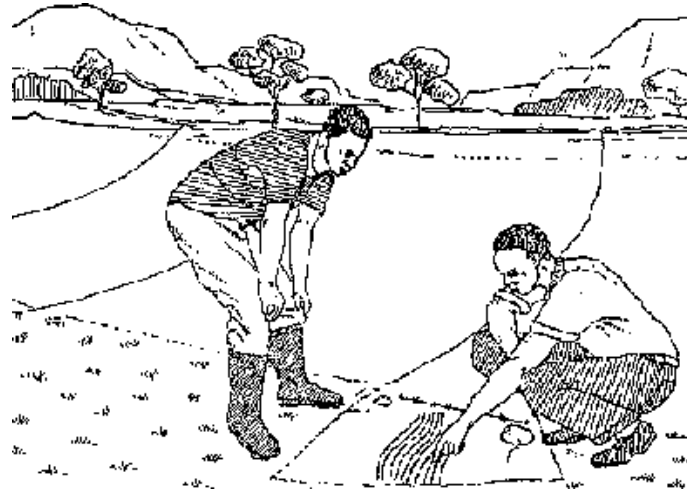
5.2 Conservation of the soil



5.3 Improvement of the soil

Permanent Farming Systems Based on Animal Traction: Farmers Handbook (GTZ, 1995, 183 p.)

PART V: The permanent farming system



Figure

5.1 Meaning and objectives of a permanent farming system

-A Permanent Farming System is adapted to ecological, social and economic conditions:

adapted to ecological conditions means: farming methods, which reduce erosion and h iron tines soils;
adapted to social conditions means: the farming methods are acceptable to the farmers and appreciated

**by the farmers;
adapted to economic conditions means: the farmers
can afford the new farming methods and can increase
their income by using the new farming methods.**

**-A Permanent Farming System is mechanized by the use of
draft animals in order to:**

**reduce labour burden,
accelerate farm work,
increase the farm area, production and income of the
farmers**

**Permanent farming methods should improve the living conditions of
farmers.**

Improvement of living conditions means:

**-having less and easier work,
-having more time for themselves
-having more and better food, and
-having more income for school fees, health care, etc.**

5.1.1 THE ELEMENTS OF THE PERMANENT FARMING SYSTEM

The new permanent farming system has a lot of elements, which are working hand in glove to improve farming:

-Making Contour Bonds (trig ridges) along contour lines prevents erosion;

-Planting of permanent and seasonal crops reinforces the contour bonds and produces a lot of food and income;

-Small ridges prepared by oxen between the contour bonds prevent erosion and provide optimum growing conditions for seasonal crops;

-Mixed cropping and crop rotation of seasonal crops conserves the soil, protects against diseases and guarantees good yields;

-Planting of legumes improves the soil fertility for higher yields;

-Draft oxen, used for farm work reduce the labour burden and accelerate farm work;

- With the draft oxen, you can increase the size of your farm,

your production and your income;

- Keeping of draft oxen in the cowshed during the night protects the oxen and allows &e production of cowdung;**
- Use of cowdung and green manure reduces the expense of mineral fertilizer, improves the soil and increases the yields;**
- Vegetable gardening improves the family diet and produces additional income by marketing of surplus vegetables;**
- Working of one big farm with the family reduces the labour burden for the individual family members and guarantees continuation of farm activities when one family member is sick.**

5.1.2 What is a Permanent Farm and why do we practise Permanent Farming?

A permanent farm is a farm, where you crop every year continuously and forever without shifting to another farm.

We practice permanent farming because:

- with the increase of population, the land becomes short and shifting to a new farm becomes difficult,**
- when shifting to a new farm you have a lot of work to clear**

new farm land and if land is short, you have to shift to very steep hillsides, which are tedious to work and subject to erosion;

-a permanent farm is better protected against bushfires;

-a permanent farm allows continuous production, a permanent farm reduces transport or walking time to scattered traditional farms;

-after some time, you know your permanent farm very well and you know which crops to grow on which plot of your permanent farm

5.1.3 Why do we use Draft Animals?

The traditional way of farming with the hand-hoe is tedious and not very efficient. With the help of draft animals you can mechanize nearly all farm works, like clearing, plowing, harrowing, planting, ridging, weeding, moulding and transportation. With the draft animals you:

-reduce your labour burden: farm work becomes easier;

-accelerate working operations: farm work becomes faster;

- can increase the size of Your farm land: production increases;**
- can produce manure and increase yields without buying expensive mineral fertilizer**
- can do contract labour to help other farmers and increase your income.**

5.1.4 How to Farm permanently

When the traditional farmer his fallow period or starts to crop permanently on one farm, he will soon recognize, that: the soil becomes less fertile and yields decrease.

In addition, bush fires or the farming method of bury and burn as well as the heavy rains, which carry away the soil, reduce the soil fertility.

To make a farm permanent, we therefore have to protect, conserve and improve our soil, to have a good yield every year.

5.2 Conservation of the soil

The soil is a living thing like man, animal and plant. Conservation of soil means, keeping its power active to produce food. If you don't

protect it against "soil diseases" or if you overwork your soil without adding soil food, it will have no Power to produce and will die". The most important enemies of the soil are fire and erosion.

5.2.1 flow to Protect the Soil against Fire:

Destruction of soil by fire can be caused by the farming method of bury and burn of organic matter or by wild bush fire.

Practise fire dressing to avoid bush fire in your farm. Bush fire can destroy your

-farm

-cowshed

-house and can be dangerous even to your own life and the life of your family.

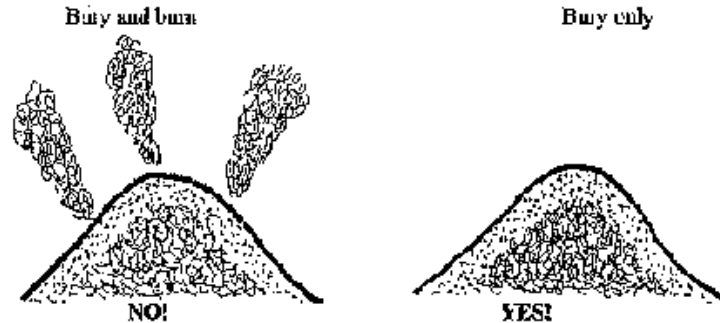


Fig 5.1: Do not practise bury and hum of organic matter hut bury your organic matter only

If you clear your farm at the beginning of the dry season and bury all the organic matter, bush fire cannot enter your farm because bare soil cannot burn.



Fig. 5.2: Clear your farm at the beginning of the dry season and bury all the organic matter.

Only when you leave crop residues (maize stover, etc.) or grass on your farm, can bushfire enter and destroy your soil life.

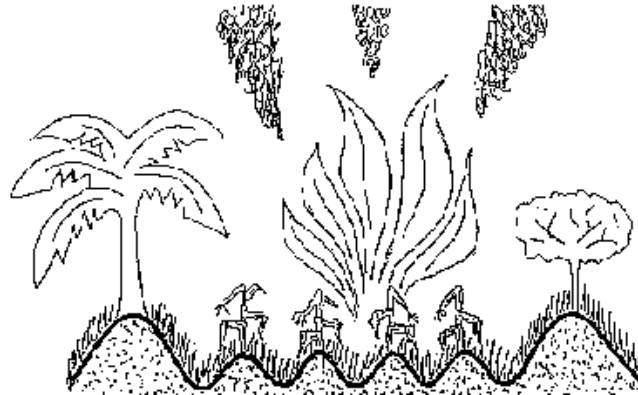


Fig. 5.3: Any fire on your farm will burn organic matter (grass, etc.) which is important as food for the soil.

Fire will also destroy the life in the soil such as microbes which act like a stomach and change organic matter into plant food. Fire will also destroy the structure of the soil. The soil will lose its strength and will easily be carried away by wind and water.

Apart from fire, erosion can destroy your soil. If the soil is carried away by water, we call it water erosion. If the soil is carried away by wind, we call it wind erosion.

5.2.2 How to protect the Soil against Water Erosion

Only running water can carry away soil. Running water you find on sloping land. The steeper the slope, the more power the water develops and the more soil it washes away. We have to stop the power of running water to prevent erosion.

To stop running water on a slope, we have to cultivate along contour lines and build dams or ridges along the contour lines.

A contour line is an imaginary line running across the slope, where all points on this line are on the same level of altitude. This means: If you make a dam according to this line, water will stop and will not continue in any direction but will seep into the soil.



Fig 5.4: Do not cultivate in the direction of the slope. Water flows fast between the ridges and carries away the soil; Fig. 5.5: Plant along contour lines when ridges are made across the slope water cannot run and carry away the soil.

How to determine the contour line:

The contour line will follow the topography (surface) of the land. You cannot determine the contour line with your eyes. To determine the exact contour line, we use a special instrument, The Rauch Contouring Instrument:

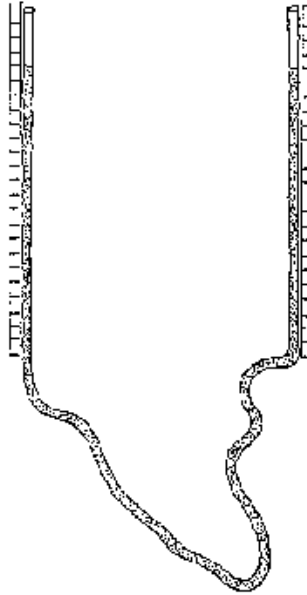


Fig. 5.6: The Rauch Contouring Instrument consists of a transparent plastic tube fixed to two wooden sticks with centimetre marks ranging from 0 to 120. With this instrument, you can determine the slope of the land and the contour line.

How to determine the slope:

You fill the transparent tube with water. Take care that no air

bubbles remain in the tube. Put the sticks upright on level ground near each other and add water until the water levels reach the marks "one hundred" on the sticks.

Put the sticks 1 m apart following the direction of the slope. Read the difference of the water levels at the marks on the sticks. The resulting figure is the slope of the land.

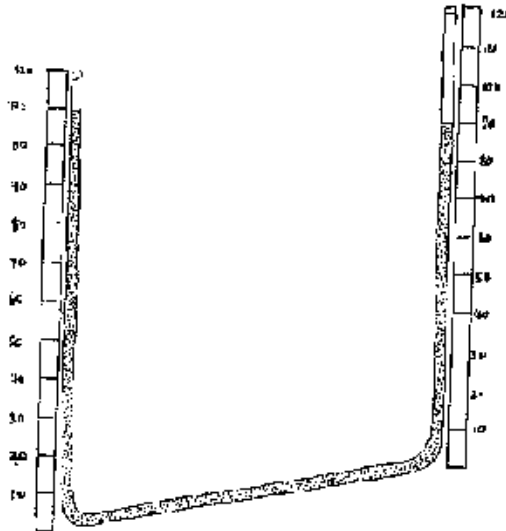


Fig. 5.7: Example for determining the slope %age using the Contouring Instrument.

Example:**Reading on stick 1 = 110 cm****Reading on stick 2 = 90 cm****Difference = 20 cm****Slope = 20 %**

The percentage of the slope determines the distance between the contour lines. On steep slopes, the distance decreases. Apply the following distances between contour lines, according to the slopes.

Below 5 % = 10 m**5 - 10 % = 8 m****10 - 15 % = 7 m****Above 15 % = 5-6 m**

Prepare sufficient sticks to peg the contours on your field and support your field extension worker, because he cannot do the work alone. Invite your family members and other oxen farmers to finish the exercise as fast as possible, because the extension worker has a lot of fields to contour for other farmers.

How to establish contour bonds:

To accelerate the layout of contour lines for a field, you establish a

reference contour line and measure out the other contour lines at the distances given the corresponding slopes.

But before you start to determine your reference contour line, you have to survey your field and answer the following questions:

-is the topography of the field uniform or do I have to divide the field into subplots with individual reference contour lines?

-how many reference contour lines do I need?

-where do I start my reference contour line?

You start the reference contour normally in the middle of the field or the subplot and measure the other contour lines outwards from the reference contour. If you still have a fault in your reference contour, the multiplication factor for the fault is less when you start in the middle of the field.

For the layout of the reference contour, you fill your contouring instrument as indicated above. You fix a starting point and keep one stick at the starting point. With the second stick, you shift ahead by the length of your tube. When the water level has calmed down, you read the mark on the stick at the starting point and compare it with

the reading on the second stick. If the second stick shows a higher figure, you move up the slope. If the second stick shows a lower figure, you move down the slope. When the reading on the sticks correspond, the sticks are on the same level of altitude. You mark the points and take the point of the second stick as reference point to continue the exercise on the whole width of the field.

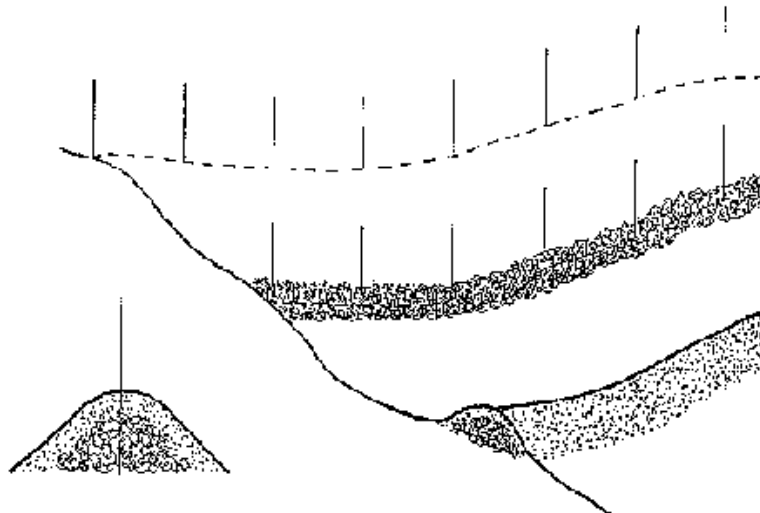


Fig. 5.8: Collect the organic matter and put it along the contour lines. Cover the organic matter with soil.

When you have determined the reference contour line, you have to adjust the line to correct sharp bends and corners, to enable your oxen later on to follow easily the contour line during work.

For the layout of your contour line, contact your extension staff.

After the laying out of the contour lines, you have to establish big ridges along these lines to stop running water. These big ridges we call contour bonds.

For the establishment of the contour bond, you need a lot of organic matter. Therefore, don't burn the organic matter after clearing.

The establishment of a contour bond is a tedious job, but you do it only once, at the beginning of your farm establishment.

To reinforce the contour bonds and make them permanent, we have to plant permanent crops as soon as the rains start.

The contour bond protects your soil against erosion and contributes to your farm income.

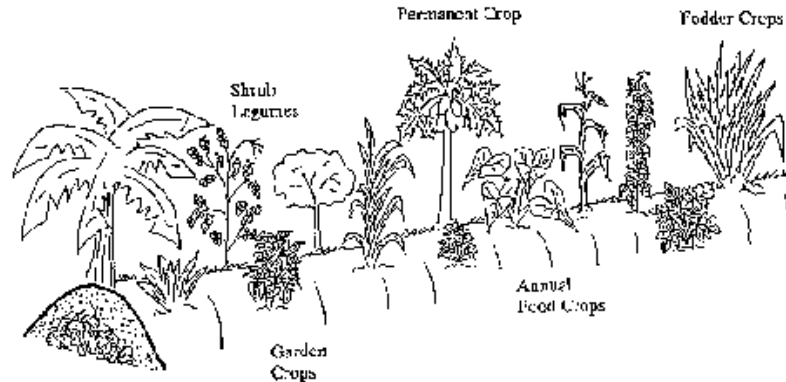
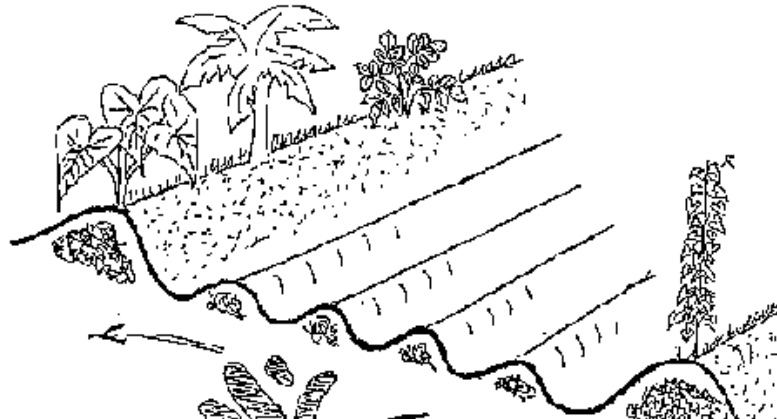


Fig. 5.9: Apart from permanent crops which guarantee a long-term income, you can plant seasonal crops like: beans, soya beans, ground nuts, corn, bitter leaves, pepper, okra, etc. for fast income.



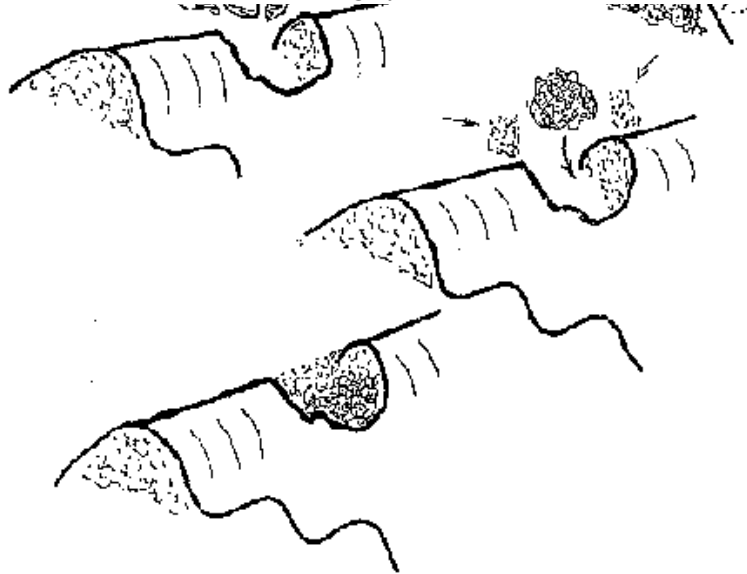


Fig 5.10: Planting root and tuber crops on contour bonds is only reasonable on flat slopes.

After harvest of root and tuber crops, you have to refill and reestablish your contour bonds.

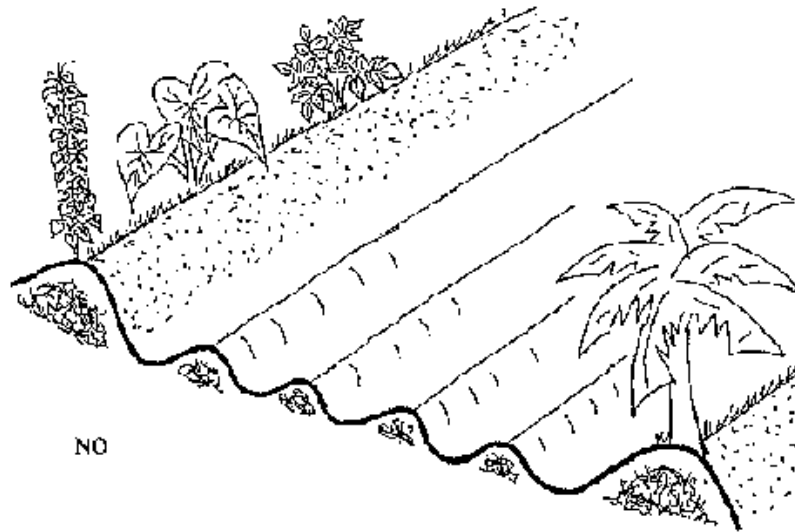


Fig. 5.11: Plant permanent crops on the contour bonds to reinforce them.

NO ! Don't plant root and tuber crops on the contour bond; when you have a steep slope

YES ! Plant permanent crops to reinforce the contour bond

How to control erosion between the contour bonds:

During heavy rains, erosion can occur between the contour bonds and destroy your young plants when planted on the flat.

To prevent erosion between the contour bonds, we plant on ridges

prepared along the contour bonds. Planting on ridges has several other advantages in addition:

-The plants have a better seed bed,

air and water are stored better in ridges;

your plants germinate better;

the roots of the young plants can develop better.

-Ridges can easily be filled with a lot of manure for higher yields.

-Weeding is easier on ridges, especially when you use the ridger.

-The soil on ridges dries off faster and prevents especially fungal diseases from spreading.

-Harvest of root and tuber crops is easier.

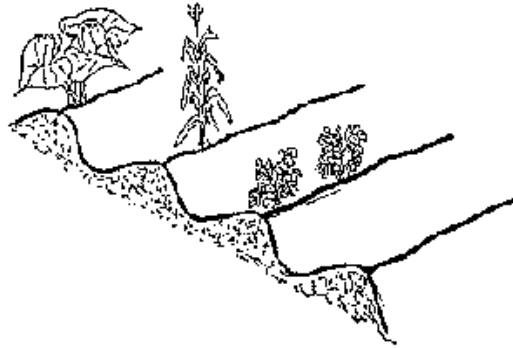


Fig. 5.12: Small ridges prepared by oxen along the contour bonds prevent erosion between the contour bonds and provide optimum growing conditions for seasonal crops.

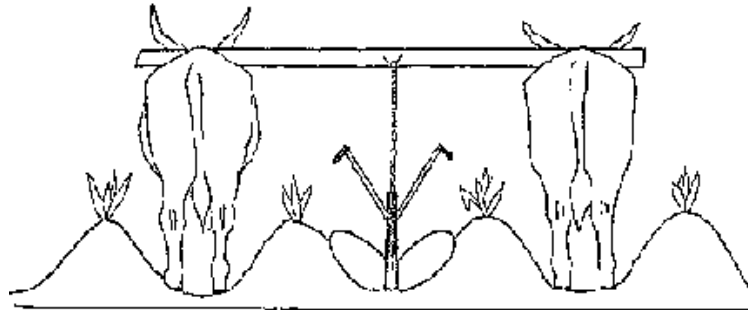


Fig. 5.13: The field ridges between the contour bonds are established with the help of the oxen and the ridger.

Other methods to prevent water erosion:

Apart from the establishment of contour bonds and planting on ridges, there are additional methods to prevent erosion.

Erosion can be reduced by covering the soil.

You will hardly find erosion on soil completely covered by plants like on good pastures or in forest areas.

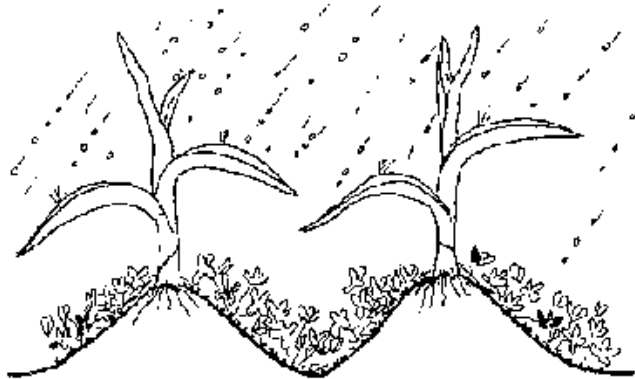


Fig. 5.14: Covering the soil with plants or mulch reduces erosion. The rain drops cannot fall directly onto the soil. They fall onto the leaves, then they run gently down to the earth and have no power to carry away the soil.

On our farms, we cover the soil with farm crops. To achieve a good, permanent soil cover during the rainy season, we practise mixed cropping and double cropping.

Mixed cropping means: We combine different plants in one field to get a higher plant density that covers the soil better.



Fig. 5.15: A mixed crop of maize and beans on one ridge.



Fig. 5.16: Double Cropping means: Planting a second crop immediately after the harvest of the first season crop.

Mulch is another method to cover the soil and protect it against erosion.

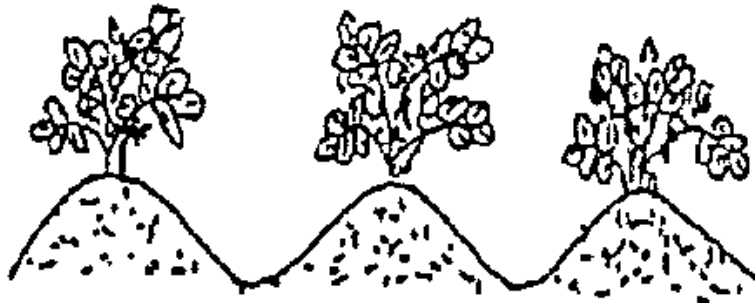
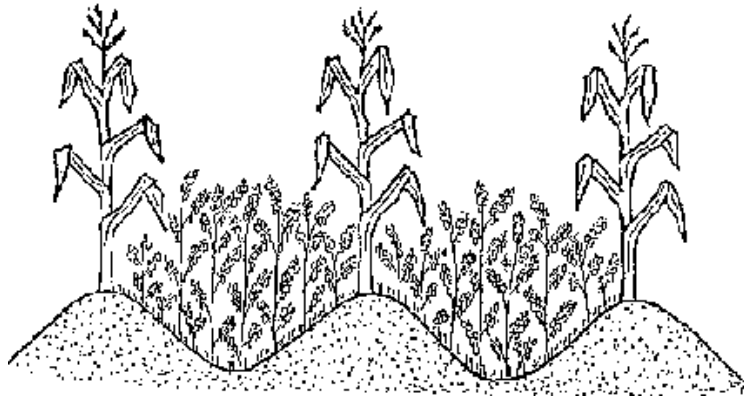


Fig. 5.17: Living mulch like Crotalaria or Desmodium can be used on the farm.

Maize on the ridge and a cover crop (e.g. Crotalaria) in the furrow.



Figure

Surface mulch like crushed grass and plant residues should be used on smaller herds like gardens. It involves a lot of work and time.

5.2.3 How To Protect your Soil against Wind Erosion

Wind can attack the soil only when:

- the wind is powerful;**
- the soil is bare, and**
- the soil structure is damaged.**

To break the power of the wind, you have to establish wind breaks.

A well established contour bond with permanent crops can reduce the power of the wind. In addition, you can establish wind breaks at the comers of your farms with trees and hedges to break the wind. Trees and hedges can also serve as a living fence for your farms, to protect them against destruction by cattle.

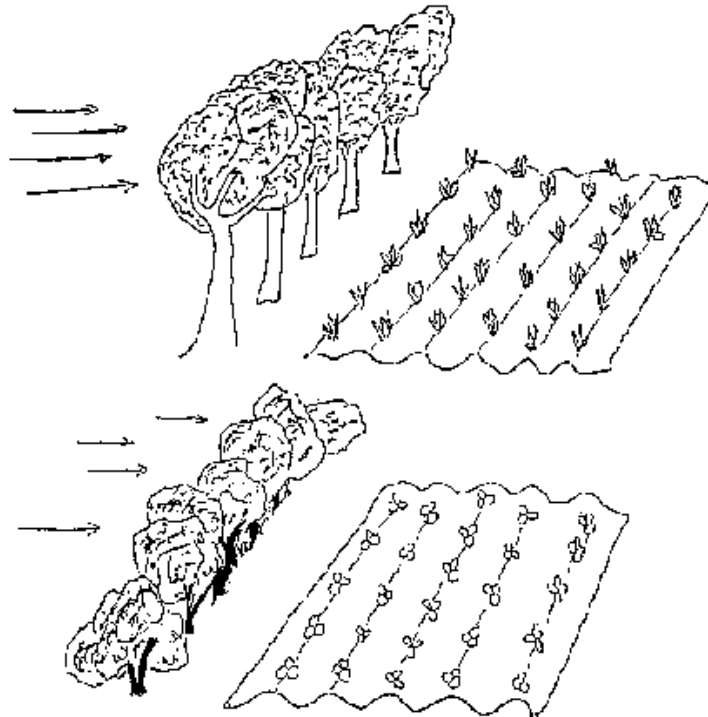


Fig. 5.18: Wind cannot attack the soil easily, when the soil is covered by plants, which break the power of the wind and strengthen the soil structure with their roots. A good plant canopy, covering the soil, reduces wind erosion.

Practise mixed cropping with a high plant population and double cropping to have a good soil protection.

A soil with a poor structure is easily attacked by wind erosion. Therefore you have to protect and improve your soil structure:

- avoid bush fire;**
- cover the soil with plants or mulch to protect it against sun,**
- add cowdung, plant residues (corn stalks, etc.) and green manure to the soil; and reduce soil preparation (reridging instead of plowing and harrowing).**

5.3 Improvement of the soil

To allow permanent farming activities on a farm with good yields, you have to improve the soil. The use of manure, organic farming, mixed cropping, crop rotation and use of mineral fertilizer will help you to improve your soil for steady and high yields.

For a draft animal farmer, dung is the most important manure. It is free of charge because it is produced by his draft animals. When applied sufficiently on the farm, dung will improve the soil and

increase the yields of the crops. The crops will produce more food for man and animals.

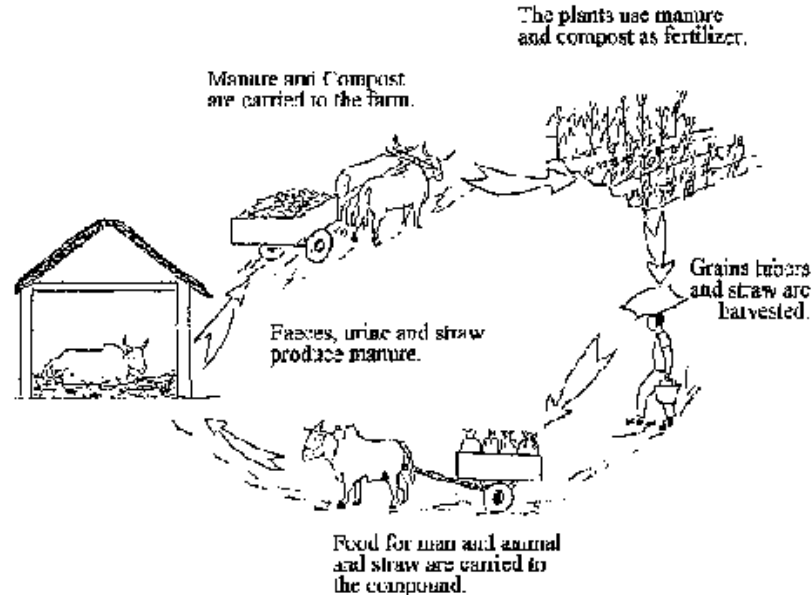


Fig. 5.19: Manure and compost help to return organic matter to the fields.

5.3.1 How to Produce Cowdung

To produce cowdung, it is necessary to keep the animals in a cowshed during the night to collect faeces and urine. Dung from animals which roam around is lost to your farm

The quantity of your cowdung depends mainly on:

- the size of your cattle**
- the feeding of your cattle**
- the amount of litter in your cowshed**

A larger animal produces more dung than a smaller one. A well-fed animal produces more dung than a poorly fed one.

Allow enough grazing time during the day and add 10 kg of fresh grass every day, when you put your oxen into the cowshed.

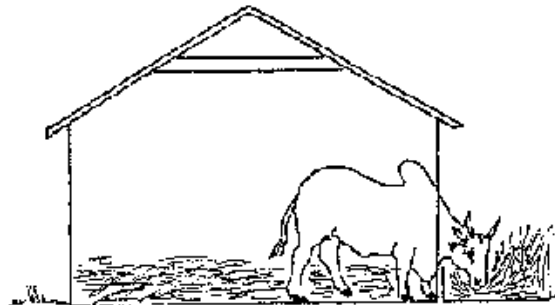


Fig. 5.20: The litter you put into the cowshed gets mixed with the dung, rots and produces manure. In addition, it collects the urine.

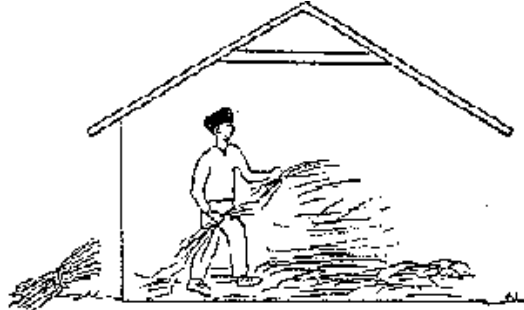


Fig. 5.21: Dry litter must be added every day

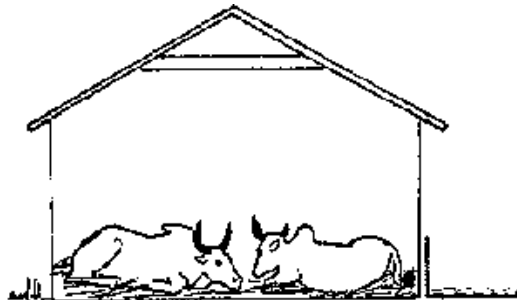


Fig. 5.22: Litter provides dry bedding for your animals and increases the amount of manure you produce.

Cowdung will save you a lot of money. You don't need to buy fertilizer. In addition, it will improve your yields.

A pair of oxen can produce about 4 tons of rotten manure per year when

- kept in the cowshed during the night**
- well fed**
- enough litter is applied**

This corresponds to about 8-10 cart loads per year.

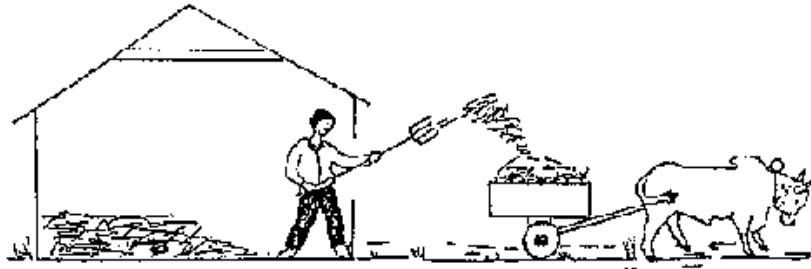


Fig. 5.23: When the manure is well rotted, it can be transported to the field.

Before the cowdung can be brought to the farm, it must be rotten. A

reasonable oxen farmer has two rooms for his oxen. He will keep his oxen in one room until the manure heap is large enough. He will then change the oxen to the second room, while the cowdung in the first room is left to rot.

5.3.2 How to produce Compost

All organic waste materials (kitchen waste, weeds, grass, crop residues, etc.) can be used for compost. Compost can be used as organic fertilizer on the farm and especially in the garden.

Choose a cool place for the establishment of your compost heap. Peg a square with 4 poles at a distance of 2-3 metres.

Throw all available organic waste materials on the ground within the four poles. When the layer of organic matter is about one handspan high you spread a thin layer of humus soil or manure. You continue to put organic matter (1 handspan) and manure (thin layer) until your compost heap is about 1 metre high.

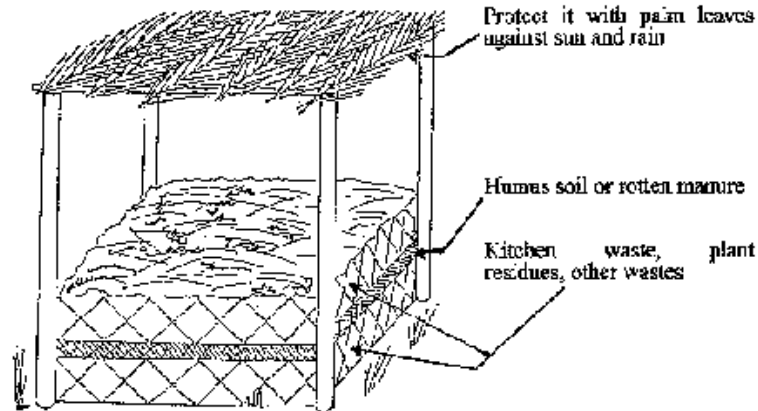


Fig. 5.24: Keep your compost moist throughout. Adding well rotten compost to manure and organic wastes speeds up the rotting process.

Compost must be moist. In the dry season, you have to water your compost and protect it against the sun. Cover your compost heap with leaves or grass and leave it for some time to rot before applying to the field.

For complete rotting, you have to turn your compost after some time (4-6 weeks after complete establishment). Mix the organic matter and put the outer layers inside and the inner layers of the compost outside. Especially when you use your compost for gardening, it

needs complete rotting

5.3.3 How to produce Green Manure

As a draft animal farmer, you crop a large farm. You may not always have enough dung or compost to improve all plots of your farm. To keep all plots fertile, you need green manure in addition.

Green manure is manure from special manure plants or crop residues.

Many Green Manure Plants do not produce direct food, but they improve the soil. Plants that are cropped after applying green manure produce a lot of food.

Some popular green manure plants are the following ones:

- Tephrosia**
- Sesbania**
- Crotalaria**
- Leucaena**
- Pidgeon Pea**

In addition, green manure plants have many other advantages:

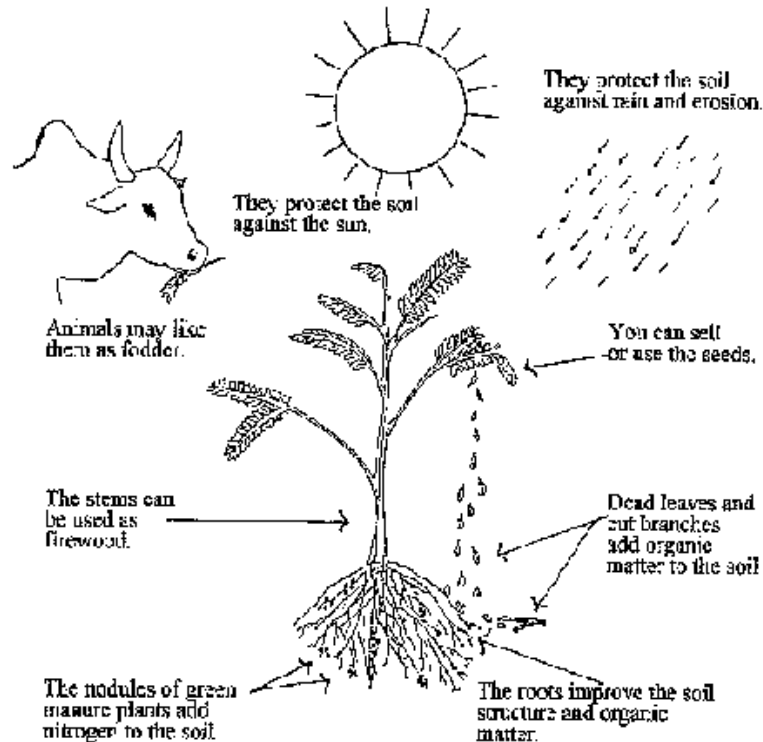


Fig. 5.25: Green manure plants have many benefits..

Green manure plants are planted:

- in mixture with food crops;**
- on contour bonds, and .**
- as a sole crop on fallow areas.**

If you mix green manure crops with food crops, you produce food and manure at the same time. You may not have the same yield as with sole cropping of food crops in the first year, but in the following years, you will harvest more on the green manure field, because you conserve and improve your soil by this method.



Fig. 5.26: A mixed crop of maize and sesbania

The planting of green manure crops on the contour bonds has the following advantages: you reinforce and enrich your contour bonds

through the root system of the green manure crop (tephrosia, sesbania, etc.) the green manure plant can be left for seed production after the seed harvest, the green manure plant can be pruned and used as manure for the field between the contour bonds.

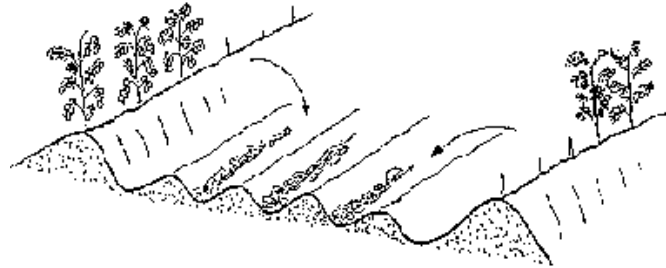
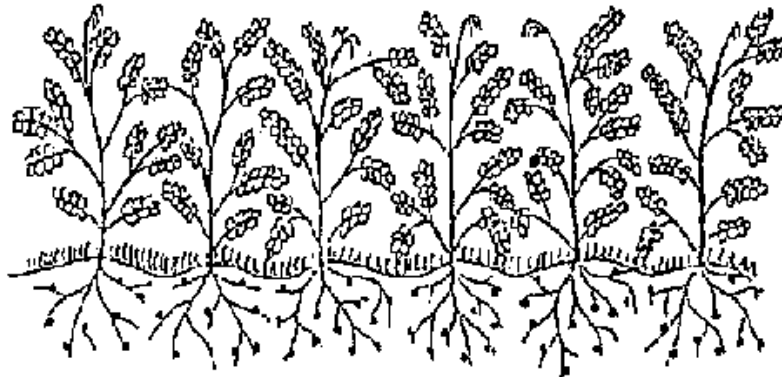


Fig. 5.27: Fresh branches and leaves of the green manure crop can be cut and spread as mulch in the field.

If you have a very poor soil, you may have to fallow your farm Under natural fallow, it will take long time until the soil becomes fertile again



natural fallow



planted fallow

Fig. 5.28: Under a planted fallow with Green Manure Plants, the soil becomes fertile again within 1 or 2 years.

Green Manure Plants can give 20-80 tons of fresh organic matter per hectare per year. This will save you a lot of fertilizer.

5.3.4 How to bury Organic Matter

To avoid loss and improve the decomposition of organic matter from plant drop, we have to mix it with the soil. The oxen farmer uses the cart, the roller cutter and the ridger for this exercise.

With the cart, he transports the manure to the farm.

With the roller cutter, he can clear plant residues.

With the ridger, he buries the organic matter into the soil.

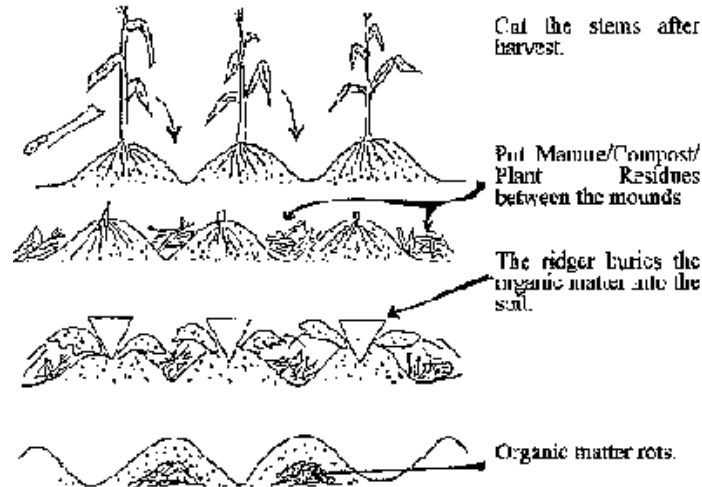


Fig. 5.29: How to bury organic matter in a ridged field.

The buried organic matter gives humus to the soil. We call this organic farming. It improves your soil and the following crop will produce a lot of food.

5.3.5 Mixed Cropping

To conserve and improve our soil, we have to practice mixed cropping. Mixed cropping is the planting of two or more crops on the same field at the same time.

To keep the soil in balance, we combine (mix) crops which make the soil poor, with crops which improve the soil.

Crops which make the soil poor are:

- **maize**
- **rice**
- **wheat**
- **yam**
- **cassava**
- **cocoyam**
- **potatoes**

Crops which improve the soil are legumes like:

- **ground nuts**
- **beans**
- **soya beans**
- **peas**
- **green manure plants**

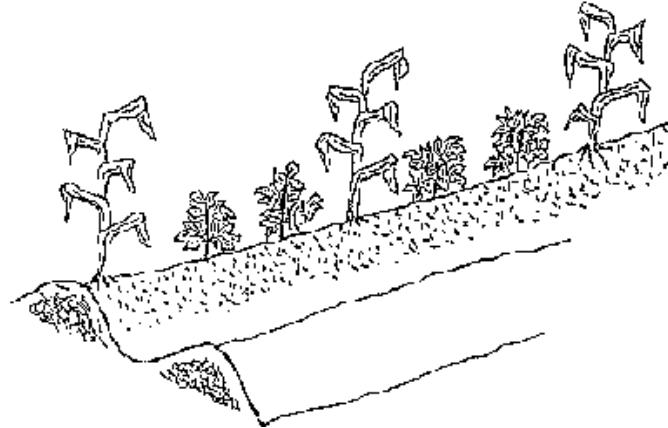


Fig. 5.30: A crop of maize mixed with beans:

Apart from soil conservation, mixed cropping has a lot of other advantages: a mixture of crops with different root systems will use the different layers of the soil better, that means: they use the available water and nutrients better.

- mixed crops with different preferences for nutrients, use the different minerals available in the soil better.**
- mixed cropping results in a higher plant population per unit area and increases yields.**
- the higher plant density in mixed cropping reduces soil**

erosion and suppresses weed growth.

- mixed cropping reduces the risk of pests and diseases infestation.

- mixed cropping diversifies the food supply. You have different quality food for your family diet.

- mixed cropping reduces the risk of complete crop failure. If one crop fails, the other crops can still produce enough food for the farmer family.

5.3.6 Crop Rotation

If the same crop is grown in the same field every cropping cycle:

-the soil becomes poor;

-pest and disease infestation increases;

-the harvest gets smaller.

If the crops change on the same field every cropping cycle:

-the soil does not become poor;

-pests and diseases do not increase easily; .

-the harvest can stay good.

To change crops on the same field every cropping cycle is called crop rotation. The advantages of crop rotation are similar to mixed cropping: Crop rotation:

-conserves the soil fertility: Crops which make the soil poor are followed by crops which enrich and improve the soil; e.g. Maize followed by beans.

-controls pests and diseases; Pests and diseases developing on one crop cannot affect a crop of another family; e.g. Cocoyam followed by Cassava.

-improves the use of different layers of the soil; Crops with a shallow root system are followed by crops with a deep root system; e.g. Beans followed by Cassava.

-improves the use of different minerals available in the soil; e.g. Cereals need more nitrogen while tuber crops need more potassium.

To get all possible advantages, combine mixed cropping with crop rotation. Recommended crop rotations with mixed crops for different areas of altitude are indicated on the following pages.

[TREATMENTS - CROP ROTATION ON MEDIUM ALTITUDE (lower than

1500m)

INDIVIDUAL PLANTING ARRANGEMENTS

Treatment 1 or Plot 1 (between first and second contour bond)

Maize and Green Manure:



Fig. 5.31: Maize and Green Manure on alternate ridges.

Distance between ridges: 80 cm.

Distance between maize plants on the ridge: 25 cm.



**Fig. 5.32: Maize on ridges, green manure in the furrow.
Distance between ridges: 80 cm.**

Distance between maize plants on the ridges: 30 cm.

Green Manure Crops can be Tephrosia, Sesbania, Crotalaria solely or as a mixture.

**Treatment 2 or Plot 2 (between second and third contour bond)
Maize and Beans and Cocoyam:**

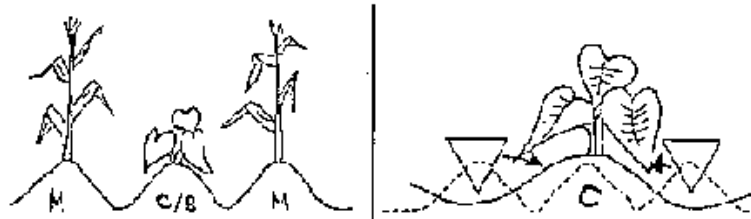


Fig. 5.33: Maize and Cocoyam/Beans are planted on alternative ridges.]

Distance between the ridges: 80 cm.

Distance between maize plants on the ridges: 25 cm.

Distance between the cocoyam: 60 cm.

Beans interplanted between cocoyam: 10-15 cm distance

NOTE: - Split maize ridges after harvest and add soil to Cocoyam edge.

Treatment 3 or Plot 3 (between third and fourth contour bond)

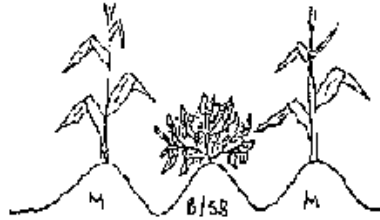


Fig. 5.34: Maize and Food Legume are planted on alternate ridges.

First Season

Maize and Food Legume: (Beans, Soyabeans, Groundnut)

Distance between the ridges: 80 cm.

Distance between the maize plants on the ridges: 25 cm.

Distance between the food legumes: 10-15 cm. (see Chapter 6.4.)

Second Season:

Food Legume and maize on 80 cm. ridges or

Food Legumes on 50 cm. ridges or

Food Legumes and potatoes on 80 cm. ridges or

Potatoes or Sweet potatoes only or

Green Manure.

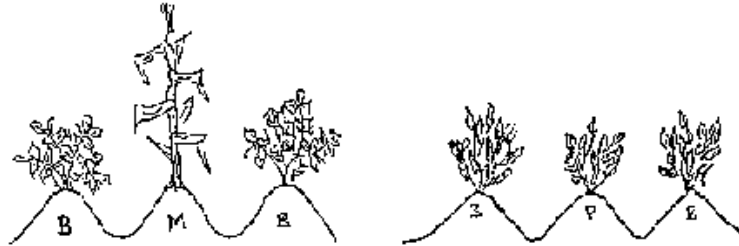


Fig. 5.35: Legumes and maize mixed - Food legumes and potatoes mixed.

Treatment 4 or Plot 4 (between fourth and fifth contour bond)

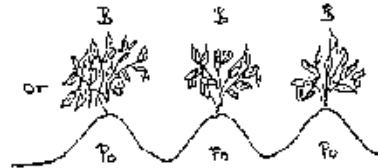


Fig. 5.36: Potatoes are cropped solely on ridges or on alternate ridges with food legumes.

First Season:

Food legumes (Beans, Soyabeans, Groundouts).

Food legumes are cropped solely on ridges.

Distance between the ridges: 50-60 cm.

Distance between the plants on the ridges: 10-15 cm.

Or Potatoes (high altitude areas):

Distance between the ridges: 80 cm.

Distance between the plants on the ridges: 30-40 cm.



Fig. 5.37: Cereals are planted flat. The planting method is drilling.

Second Season:

Cereals: (Upland Rice, Wheat)

The distance between the rows: 20-40 cm, depending on the weeding implement used.

The recommended seed rate for cereals is about 100 kg/ha.

Tubers:

Plant Sweet Potatoes after harvest of first season crop. Re-ridge and

plant 3040 cm long cuttings.

Planting distance between ridges: 70-80 cm. Planting distance between the plants on the ridges: 50-60 cm.

Food Legumes:

Planting distances: see first season.

Green Manure:

Broadcast available legume seed, preferably *Crotalaria* after harvest of first season crops.

NOTE: Select your season crop according to the climate of your area and characteristics of the crop.

5.3.7 Mineral Fertilizer

The use of dune, compost and green manure crops help to maintain and improve the soil fertility, but every year a part of the crops is either consumed by the farmer's family or sold.

The nutrients of these crops are lost to the soil. They have to be replaced. We can give back these nutrients (plant food) to the soil m

the form of mineral fertilizers.

Mineral fertilizers are artificial fertilizers, which can add nutrients to the soil and increase the yield of crops.

There are three main plant nutrients which are necessary for plant growth: nitrogen (symbol N) phosphorous (symbol P) potassium (symbol K)

Each of these nutrients has special effects on the plant.

Nitrogen (N): makes the plant grow quickly. gives the plant a nice green color . makes the plant grow strong,



Fig. 5.38: When Nitrogen is lacking, plants are generally weak and pale.

The main Nitrogen Fertilizers are:

- Sulphate
- Nitrates
- Urea

Not only these mineral fertilizers add Nitrogen to the soil, but also the Leguminous Plants.

(Beans, Soyabeans, Groundnuts, Cowpeas, Mucuna).

Phosphrus(P):

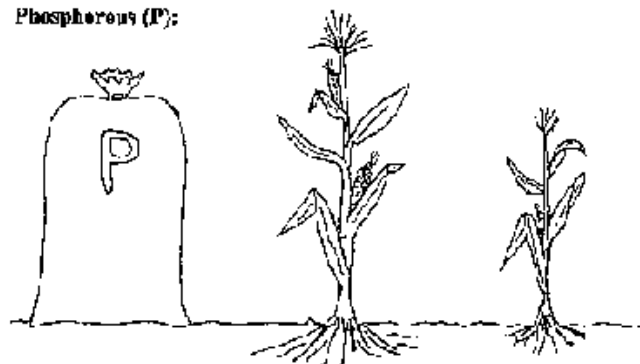


Fig. 5.39: Phosphorous makes the stem and the roots strong.

Phosphorous helps the plant to form flowers and fruits.

The main Phosphorous Fertilizers are

- Natural Phosphates
- Super Phosphates.

Potassium(K):

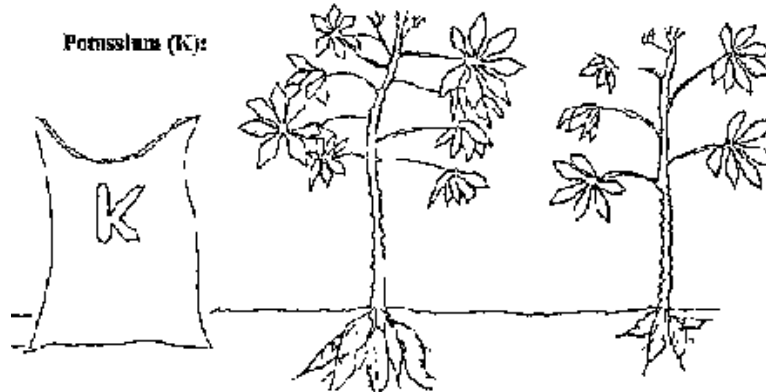


Fig. 5.40: Potassium helps plants to build up reserves and to resist drought and diseases.

The main Potassium Fertilizers are:

- Natural Potassium**
- Potassium chloride**
- Potassium sulphate**

Common commercial fertilizers

1. N P K 20/10/10

The figures indicate the percentage of the different nutrients in one bag.

e.g. 1 bag 20/10/10 with 50 kg. contains:

20% Nitrogen = 10 kg.

10% Phosphorous = 5 kg.

10% Potassium = 5 kg.

2. N P K 10/30/10

3. Ammonium-Sulphate

This fertilizer contains about 21% Nitrogen. It is not recommended, because it will make the soil acid. Acid soil is not good for plant growth.

4. Urea

This fertilizer contains about 46% Nitrogen. It is good for top dressing to support heavy plant growth.

How to apply fertilizer

The fertilizer has to be applied at the correct time and the correct place.



Fig. 5.41: We give fertilizer as a basic application before or at planting time. Spread your fertilizer before ridging or reredging. When you mould up your edges, fertilizer is mixed with the soil.

Fertilizers for basic application are NPK 20/10/10 and NPK 10/30/10.

After plant establishment (3-5th week after germination) we support the plant development with a top dressing. The top dressing can be combined with weeding to save a working operation. Apply the

fertilizer in the furrow. When earthing up the ridges or rerothing, the fertilizer will be mixed with the soil and moved near the plant roots.



Fig. 5.42: Top dressing, application of fertilizer into the furrows

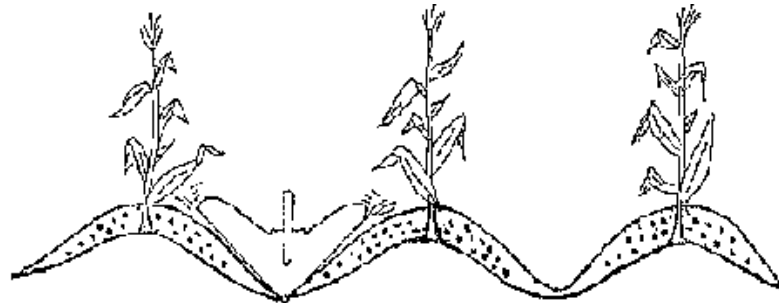
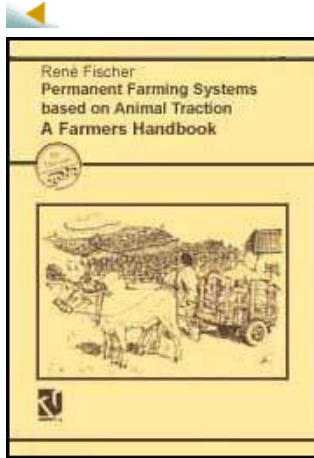


Fig. 5.43: After applying the fertilizer in the furrow the fertilizer is mixed with the soil and moved nearer to the plants with the ridger-plow






Fertilizers for top dressing are Urea and 20/10/10.

For the recommended rates of fertilizer, see Chapter VI for the specific crops.



 **Permanent Farming Systems Based on Animal Traction: Farmers Handbook (GTZ, 1995, 183 p.)**

  **PART VI: Crops**

-  **6.1 General recommendations**
-  **6.2 Cereals**
-  **6.3 Root & tuber crops**
-  **6.4 Leguminous crops**
-  **6.5 Permanent crops**

Permanent Farming Systems Based on Animal Traction: Farmers Handbook (GTZ, 1995, 183 p.)

PART VI: Crops

6.1 General recommendations

6.1.1 Site Selection

Choose a good site for your farm. Avoid extremely hilly and stony areas. Choose fertile land which not overworked.

The different plants have different preferences with respect to soil and climate. Find out which crops can do well in your area. Observe the growth of your plants on Your farm. Grow the different crops in the plots where they perform well. This needs time and observation, but you will benefit from this experience.

More details about the preferred soil types of the different plants are given in the following chapter.

6.1.2 Seed Selection

If you use your local varieties, the risk of having a crop failure is very small. Improved varieties can give higher yields, but you must first find out if they can do well in the climate and soil of your area. Prepare small trial plots and test them, before using them on the whole farm.

Note that improved varieties are often:

- more easily attacked by diseases**
- use more fertilizer to perform well than local varieties.**

Select your seed material well:

- the seed must be big and powerful**
- the seed must germinate well**
- the seed must not be damaged, mouldy or attacked -by diseases or pests (weevils) .**
- dry your seed carefully, and store it particularly well.**



Fig. 6.1: Use seeds from strong, healthy and well performing plants.



No! Yes! No!

Fig. 6.2: Choose seeds from the middle part of a maize cob.

6.1.3 Germination Test

Before planting the seeds, you must be sure that they germinate well,

that means that plants come out of nearly all the grains.

If only few plants come out of the grains you

-waste seed material (you need more seed which costs money).

-waste time (you need to replant)

-waste money, because you will have a low yield.

A germination test before planting will indicate what percentage of your seeds can give plants.

How to make a germination test.

1. Take a sample of your seed material, by pushing your hand into the bag or bucket and picking out one handful.

2. Count 100 seeds (grains) out of the sample and plant them in damp sand. To keep the sand damp, cover it with a wet cloth or wet straw until the seeds start to germinate.

3. Depending on the seed type, you have to observe for some days. Always keep the soil damp.

4. Count the number of seeds which have germinated well

(seedlings).



Fig. 6.3: Count the number of seeds which germinate to find the germination rate

If there are 80 or 90 plants out of 100 seeds, they have a good germination rate.

If there are only about 40 plants out of 100 seeds, the germination rate is low and you had better not use these seeds to plant your field

6.1.4 Soil Preparation

If you want high Yields you have to give your crops an easy start. Plant them in fertile, loose soil, where they germinate and grow well.

The first operation after stumping and clearing is ploughing. Ploughing uproots weeds, loosens the soil and incorporates the organic matter. Do not burn the organic matter (grass, etc.) before

ploughing. Try to dig it into the soil, it will turn into compost.

To break clods, harrow the ploughed field. Clods will disturb planting and germination of your seeds.

If you plant on the flat as for rice and wheat, You apply fertilizer (20/10/10) before harrowing.

The harrow will mix the fertilizer with the soil.

All other plants like maize, beans, cocoyam, etc. you plant on ridges. Use the ridger plough to prepare the ridges (see Chapter 2.5).

Before ridging, you apply fertilizer (20/10/10) and manure (cowdung, grass, etc.). With the ridger you can easily dig the manure into the soil.

6.1.5 Planting

All the crops are planted in lines. The lines run according to the contour bonds.

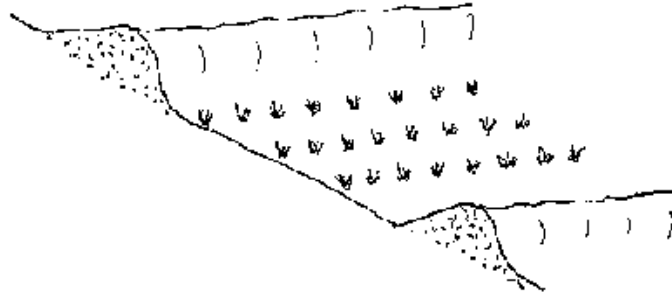


Fig. 6.4: All crops are planted in lines on the contour bonds

Planting in lines (rows) has several advantages:

1. Planting distances are regular.

2. Mechanization of working operations is easier (e.g. Reridging, Moulding, Weeding).

4. Equal application of fertilizer for the different plants.

For all plants there is an optimum plant density, this is a certain number of plants per unit area, which allows the plants to grow best.

To ensure optimum use of soil, minerals and light, plants need optimum spacing.

The planting distances between the rows (lines, ridges) and between the plants in the rows are indicated in Chapter 6.2 - 6.4.

6.1.6 Planting Time

Planting at the optimum planting time is very important for high yields. Any delay will result in reduced yields or even complete crop failure.

Crops of the first growing cycle (first season) are planted as soon as the rains are steady.

Some crops like yam and potato you can even plant before the rains.

To ensure timely planting, you have to prepare your field before or immediately at the beginning of the rainy season.

Planting late is a risky game. If the rains were to stop early you would have no yield, but you would have wasted seeds, fertilizer and labour.

If you are late, decide to plant a crop where the risk of failure is low, like beans and sweet potatoes.

6.1.7 Moulding, Weeding, Fertilizer Application

Moulding, is easily and quickly done with the ridger. It increases the yield (see Chapter 3.5.3)

During moulding, the ridger uproots the weeds in the furrows and buries the weeds at the sides of the ridges.

Before moulding, apply fertilizer as top dressing:



Fig. 6.5: During moulding, the ridger will mix the fertilizer with the soil and place it near to the plant.

Early moulding or weeding with the ridger is necessary to control weed growth and support your crop.

It will also avoid or reduce tedious and time consuming, hand weeding.



Fig. 6.6: Once the crop has developed a heavy canopy, the shade of your crop suppress weed growth and further weeding will not be necessary.

6.1.8 Harvesting

Choose the correct time to harvest your crops, to achieve high yields and good quality produce.

If you harvest your crops too early, they will not store well.

If you harvest them too late, they may get spoiled in the field or birds and insects may eat them.

6.1.9 Organic Farming

After the harvest you have to clear the field and incorporate (dig) all residues (maize, stalks, etc.) into the soil. Use the roller cutter or the

cutlass and your ridger as described in Chapter 2.5.4.

Burying of residues, etc. will:

- manure your soil**
- reduce labour for clearing before the next season**
- avoid bush fire in your farm**
- reduce damage by cattle (cattle will not enter a farm where there is no grass but bare soil).**

6.2 Cereals

6.2.1 Maize

Maize is a staple food in many part of Africa. It is rich in carbohydrates and gives a lot of energy, but not enough protein. Maize is used to prepare flour, meal, roasted maize, pap, beer, etc. It can also be used as feed for animals.

Maize likes soil which is:

- fertile**

- well drained .**
- rich in organic matter**

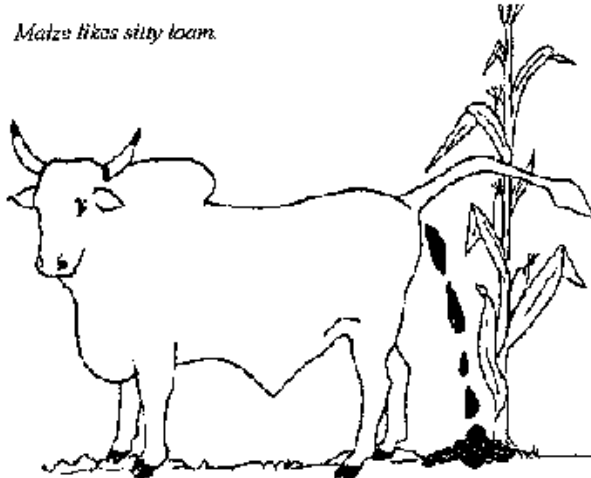


Fig. 6.7: Add a lot of manure (cowdung, tephrosia, residues, etc.) to the soil when planting maize. Plant your maize on ridges.

Varieties

Apart from the local varieties, there are improved varieties, e.g. in the NWP the following improved varieties are available:

MLC for medium to high altitudes

Ikona white and yellow for low altitudes

Bocoa for medium altitudes

Coca for high altitudes

Yellow maize is used as animal feed and has a good market.

Planting Distances

1. When planted as a single crop, the number of plants should be between 45,000-50,000 per hectare.

The planting distance for maize as single crop is:

- 80 cm. between the ridges**
- 25 cm. between the plants in the ridges**

2. In the permanent fanning system, maize is preferably intercropped (mixed) with crops like beans, soyabeans, tehprosia and cocoyam (see Chapter 6.5.2.6)

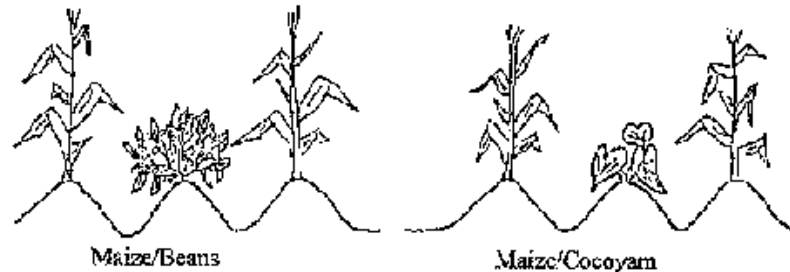


Fig. 6.8: In the permanent farming system, maize is preferably intercropped (mixed) with crops like beans or cocoyam

When intercropped with beans, etc. on alternate ridges, the population (number of plants? is between 20,000 and 25,000 maize plants per hectare.

The planting distances for maize intercropped are:

- 160 cm. between the ridges .**
- 25-30 cm. between the plants on the ridges**

When intercropped with beans on the same ridge, the population is between 30,000 and 40,000 maize plants per hectare.

Planting Depth

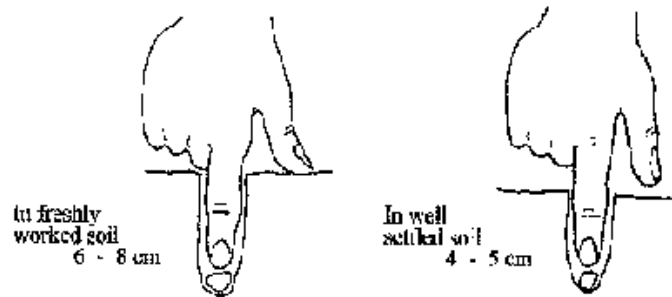


Fig. 6.9: Recommended planting depth

Planting Time

In general, maize is planted as a first season crop at the beginning of the rains. In some areas (e.g. Bali), a second season maize crop is possible. Often late planted and second season, maize is heavily attacked by stem borer.

Manure/Fertilizer Needs

The general recommendations are:

-a basic application of 2 bags (1,00 kg.) NPK - 20/10/10 or

10/30/10 per hectare before planting

-a top dressing of 3 bags (150 kg) NPK 20/10/10 or Urea per hectare before the last moulding/weeding operation, when the maize is about 80 cm. to 1 m. high

-at least 1.5t of organic manure (cowdung) per hectare before ridging. More manure will still be beneficial for your crop.

Harvest



Fig. 6.10: Harvest your maize when the cobs are dry. If you don't have time to harvest it when it is ripe, bend down the stalks to protect the cobs against water and birds!

Storage

Dry your maize sufficiently before you store. Follow some rules before and during storage:

1. Clean your storage facilities (banda, bamboo box, etc.)

- remove old grams**
- remove any other dirt, etc.**
- There are local leaves you can burn to drive away insects**

2. Put only dry, weevil-free grains into the store

3. Use all available methods to protect against insect and rat attack

e.g. cowdung ash	10 kg. per 100 kg (bag) of maize
vegetable oil	1litre per 100 kg (bag) of maize
actellic powder	50 grs.per 100 kg (bag) of maize
local leaves with repellent smell	
thorny plants against rat attack	
cats in the storage room, etc.	

Ask your demonstrator for more advice.

6.2.2 Wheat

Wheat is a cereal like rice and maize. Like rice and maize, wheat can be used as a staple food. It gives energy for work and contains important minerals and protein, which are good for your health.

Wheat (like maize) likes high altitude areas and fertile soil. Wheat is planted on the flat.

Wheat can be used to make bread, pap, etc. Visit cooking demonstrations by the Extension Staff to get more information on the use of wheat.

Varieties

The varieties available in the NWP can be divided into three groups:

1. Short mature varieties

- Mexipac**
- Jutapeco**

2. Medium mature varieties

- Ble Bresil 418, 420, 431,**
- Chris Mutagenese**

3. Long mature variety

- Hard winter**

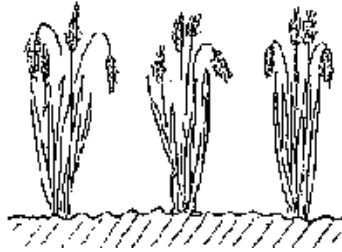


Fig. 6.11: Wheat plants

In general, long maturing varieties have a higher yield than short maturing varieties.

Planting

Wheat is grown as a sole crop. The planting method is drilling.

The seed rate per hectare is about 100 kg

The distance between the rows is 40 cm.

The planting depth is about 2-3 cm.

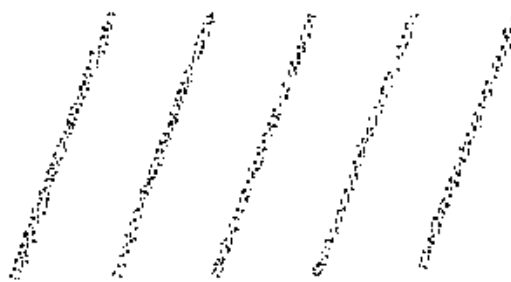


Fig. 6.12: Planting method drilling. Seeds are not placed one by one along the planting line, instead they are dribbled along the line to meet the recommended seed rate per hectare.

Wheat is a second season crop. The planting date varies with the variety. In general, in the NWP wheat should be planted middle to end of August.

Fertilizer/Manure Needs Wheat has similar needs to maize (see Chapter 6.2.1).

Weeding

Wheat needs careful weeding. As soon as weed growth is discovered, use the dugfoot or ridger to weed. Repeat the weeding immediately when the need arises. Practice selective hand weeding in the row.

Harvesting & Processing

Harvest your wheat when fully mature. You can recognize this, when the

- stem has lost all the leaves**
- whole plant is yellow**
- grains are difficult to split by finger nail**

Cut the wheat, tie it in small bundles and put it in a dry and clean place. Thresh when the grains are dry. Put the wheat on very firm ground. The threshing place must be clean and dry. Thresh on a cemented floor or cover the ground with mats or plastic sheets.



Fig. 6.13: Beat the heads of the wheat plant with a stick or a threshing-flail until the grains are off; Fig. 6.14: Beat the heads against a sieve on top of a basket to collect the grains.

Use the above traditional methods for threshing your wheat or use a

pedal operated thresher.

After threshing, remove stones, earth and husks by sieving and winnowing.

You can use traditional methods or a pedal operated Winnower.



Fig. 6.15: The wind blows the dirt husks away.

Storage see Chapter 6.2.1 - Storage of Maize

6.2.3 Rice

Rice is a very good food. It gives energy and protein, is easy to prepare and can be sold or a good price. Basically, there are two

types of rice: The Swamp Rice and the Upland Rice.

Upland Rice is cropped like wheat.

Swamp Rice

Swamp Rice is grown in flooded fields. It can give very high yields.

To get good swamp rice yields, the farmer must:

-be in control of the water

have enough water when the rice is growing

add more water at the right time

take away water at the right time.

-make good nurseries

to have fine seedlings for transplanting

-transplant at the right date

-prepare the soil well and level it

-tend the rice field carefully

do timely weeding

**apply fertilizer in time
protect the rice from pests**

-harvest with care and dry the grains well.



Fig. 6.16: The rice plant

The Nursery

The size of the nursery should be one tenth (1/10) of the size of the rice field to be planted.

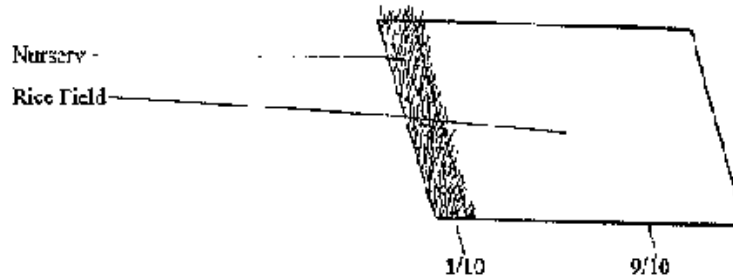


Fig. 6.17: The nursery should be near the field to avoid long transport.

The soil of the nursery must be tilled very carefully. It must be:

- soft**
- moist**
- weed-free**
- fertile**

Add 200 kg. (1/2 cart) cowdung per 100 square meters. Add wood ash.

Pre-germinate the seed before sowing into the nursery

- leave the grains in water for 24 hours**

- put the grains into a basket and leave them for 1 or 2 days**
- never pre-germinate for more than 3 days**

Sow the rice grains in the nursery 1 month before the date of transplanting. Use 5 kg. of paddy seed for 100 square meters.

Cover the nursery bed with straw to protect the baby seedlings against birds and sun.

Clearing of the Rice Field

In the NWP, rice is a second season crop. Often, the rice field is fallowed in the first season.

Before the planting of rice, you have to clear the upgrown grass. This will take you up to 150 hours per hectare.

If you practice double cropping in your rice field (e.g. crop a legume like beans or soya beans before the rice cultivation) you can have the following advantages:

- reduced work for clearing**
- additional food**
- additional organic manure (fixed Nitrogen).**



Fig. 6.18: If the rains allow you should grow two crops per year

Soil Preparation

Swamp Rice needs careful soil preparation:

- plough to uproot weeds and mix organic manure into the soil**
- level the soil by using your harrow or the roller cutter**
- flood the field with a little water and use a levelling log.**

In a well prepared rice field, you have the same depth of water everywhere and the rice plants can develop uniformly. The growth of weed is controlled.

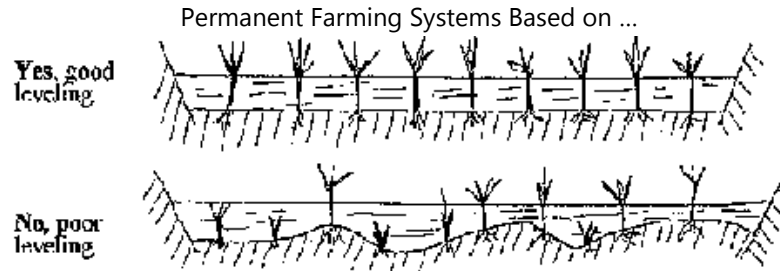


Fig. 6.19: A well prepared rice field is level with even water depth throughout

Transplanting

- Take out the seedlings from the nursery bed, when they have 4 or 5 leaves (about 4 weeks after planting).**
- Water the nursery before taking the seedlings to avoid damage.**
- Seedling selection.**

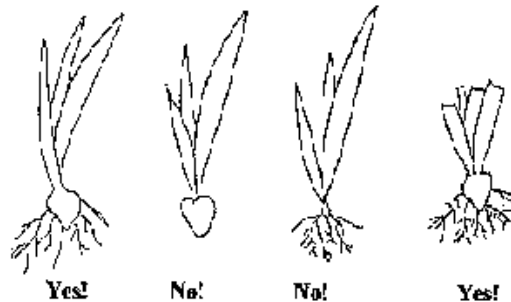


Fig. 6.20: Transplant the seedlings at the right time, select good seedlings and prune the leaves of the seedling

- transplanting is done into the mud**
- plant the seedlings in rows 20 cm. apart**
- leave 20 cm. between the plants in the row**
- plant 2 or more seedlings per stand.**

Crop Care

Apply fertilizer two weeks after transplanting. Drain the water before you apply. For the recommended rate, ask the demonstrator in your area.

In order to produce high yields, the rice must be flooded continuously at different depths. Ask the demonstrator of your area

when to flood and drain.

Weeds can be controlled by the watering scheme. Some strong weeds have to be uprooted with the hand or hoe. When the grains start to ripen, you have to protect the rice against bird destruction.

Harvesting & Processing see Chapter 2.5.2-Harvesting/Processing of Wheat

6.3 Root & tuber crops

What are Root & Tuber Crops?

-Root Crops are crops with enlarged roots, that can be used as food, e.g. Cassava.

-Tuber Crops are crops with enlarged underground stems used as food, e.g. Cocoyam, Yam, Potatoes.

6.3.1 Cocoyam

Cocoyam is a staple food giving energy but not sufficient protein. It is used to prepare boiled tuber. The leaves can be used as

vegetables.

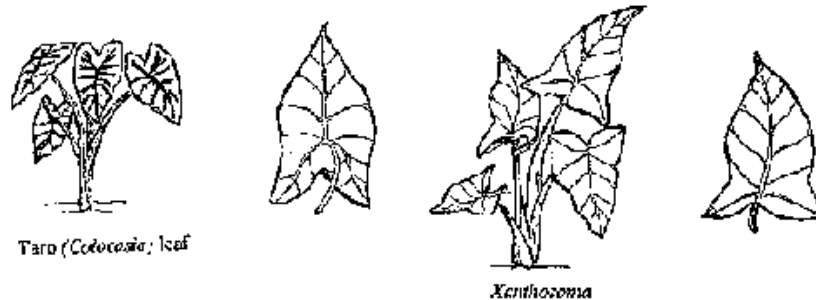


Fig. 6.21: Cocoyam is of two varieties - the Xanthosoma or Macabo and the Colocasia or Taro.

Land Preparation



Fig. 6.22: Cocoyam is cropped on humus rich ridges In the permanent farming system, you dig organic matter into the edges using the

ridge plough (see Chapter 5.5.2.4-How to Bury Organic Matter).

Selection & Preparation

- Cocoyams are usually propagated from small tubers or pieces of tubers. Sometimes suckers or new shoots are used**
- Select planting materials from healthy, well producing plants**
- The tubers or pieces of the tubers should be 10-15 cm. long**

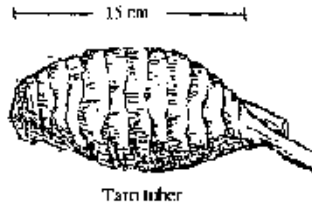


Fig. 6.23: Select 10 - 15 cm long tubers from healthy plants

Planting

Cocoyam is planted at the beginning of the rains, in rather shallow holes (about 10 cm.).

When grown as sole crop, the distance

- between the ridges is 80 cm.
- between the plants on the ridge is 60 cm.

When grown in mixture with maize and beans as recommended, the distance

- between the ridges is 80 cm. (cocoyam every second ridge).
- between the plants on the ridge is 60 cm.



Fig. 6.24: Planting pattern for cocoyam (C), maize (M) and beans (B)

Crop Care

- 1. Weeding/Moulding with the ridger plough immediately when weed growth starts.**

- 2. Earthing up of ridges, 1 to 2 months after the first weeding, with the ridger plough to enable tubers to grow well.**
- 3. Splitting of harvested maize-ridges to add to the cocoyam ridge.**
- 4. Use preventive measures for pest and diseases control**
 - select healthy vigorous planting material**
 - plant in time**
 - follow the recommended planting distances**
 - practice mixed cropping**
 - remove and burn infected (diseased) plants .**
 - clean weeding**

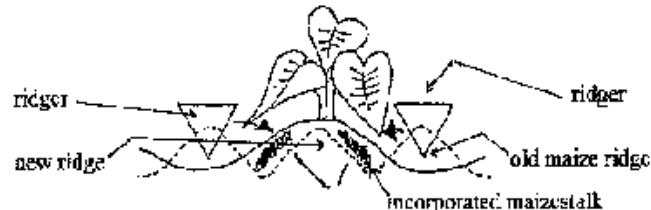


Fig. 6.25: After harvesting maize, we split the maize ridges and add crop residues and soil to the cocoyam ridges,

Harvesting

Harvest when mature (leaves turn yellow). Practice selected harvesting. Avoid wounds on the tubers.

Storage

Select only healthy tubers for storage. Remove damaged and rotten tubers. Put the tubers on dry ground or on boards, boxes, shelves in a well-aired, dry and cool place.

6.3.2 Cassava

Cassava is a staple food giving energy but not sufficient protein. The tubers are prepared in various ways, ea. boiled, mashed and fried . The leaves of the plant can be used as vegetable.

Cassava is of two varieties - the sweet or red cassava and the bitter or white cassava (best for flour).

Cassava is easy to grow because the

- planting material (stem cuttings.) is easily available and easy to handle**
- plant can grow on very poor soil**
- plant is very tolerant to drought**

- roots (cassava) are left in the soil until harvest. You don't need a store.**
- plant once established does not need much weeding again.**

But Cassava has also several disadvantages

- the harvested roots cannot be stored for long**
- you have to destroy poison in the root before you eat it**
- preparation of Cassava involves a lot of work**
- Cassava exhausts the soil. After cassava, you have to fallow the soil or you have to add a lot of manure to the soil**
- the price for cassava is generally low**

Soil Preparation

Prepare large ridges with plenty of organic matter inside. Use the ridger plough with several passes to get larger ridges.

Selection & Preparation of Planting Material

- select stems from healthy and high producing plants**

-cut off the extreme bottom and the top of the stem and use the middle part of the stem for cuttings

-tie the selected stems in bundles and keep them in a cool dry place before planting

-prepare cuttings shortly before planting

-the cuttings should be 2 to 4 cm. thick about 20 to 30 cm. long with 4 to 6 buds (avoid cuttings from the top part of the plant).

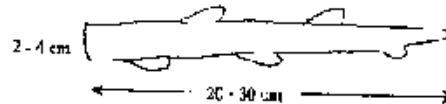


Fig. 6.26: Select cuttings 2 -4 cm thick and 20 - 30 cm long, from healthy plants.

Planting

Plant on ridges at the beginning of the rainy season. Cassava as a sole crop is planted at a distance of

0.8 - 1.5 m between the ridges

1.0 m between the plants on the ridge

Cassava as a mixed crop, with oxen cultivation, is planted at a distance of:

1.6 m between the ridges

1.0 m between the plants on the ridge

**After harvest of intercropped maize and beans, support the cassava by moulding up ridges
(see Chapter 6.3.1-Cocoyam)**

Planting Method

Push the cuttings well into the earth, leave 2 to 3 buds above the ground.

Put into the soil the end of the piece of stem, that was nearer to the ground.



Fig. 6.27: You can plant straight or slanting

Crop Care see Chapter 6.3.1-Cocoyam

Harvesting

Once mature, lift up the tubers carefully in order not to wound them. Harvest only when you want to eat or sell the root because it is difficult to store.

NOTE:

Cassava is a heavy feeder. It leaves poor soil. Plant cassava together with legumes. Plant legumes after cassava!

6.3.3 Irish Potato

Irish Potato is mainly grown in the high altitude areas. The Irish Potato is a good energy food but is poor in protein.

Potatoes like well- drained, sandy loam soils that are rich in organic matter.



Fig. 6.28: The Irish Potato plant and the tubers

Land Preparation

Irish potatoes are cropped on humus-rich ridges. In the permanent farming system, you prepare these ridges with the ridger plough (see Chapter 5.5.2.4- To Bury Organic Matter).

Selection and Preparation of Planting Material Seed potatoes are obtained from healthy, well producing, fully mature plants.

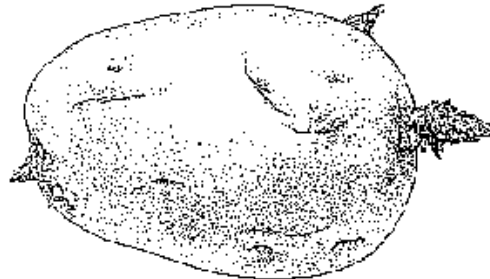


Fig. 6.29: Select tubers with a weight of about 45-55 grams and several "eyes", which are not wounded or infected by diseases.

Keep the seed potatoes in a well-aired, cool and dry place for about 2 weeks. Seeds obtained from fresh plants need to rest before they sprout.

When they start to sprout from the eyes, then you have a good seed

for planting.

Use whole tubers for seed, because cut tubers may rot in the soil. If you use cut tubers, rub the cut surface with woodash.

After storage, do final selection. Remove rotten or infected tubers before planting.

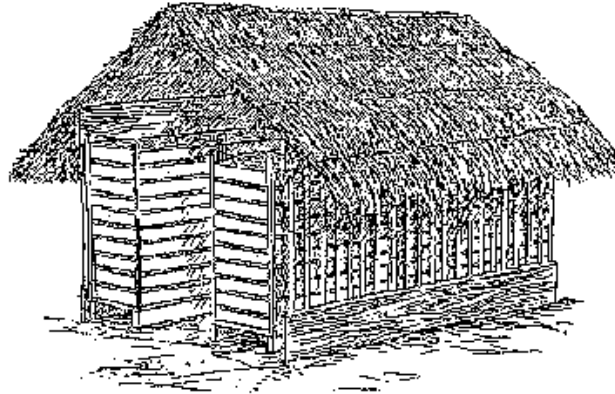


Fig. 6.30: A Storage House for seed potatoes

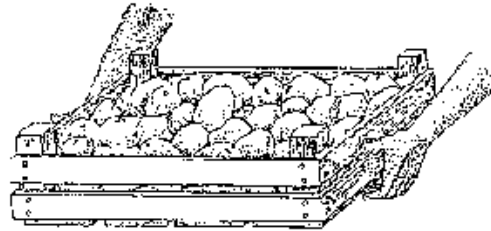


Fig. 6.31: A Storage Box for seed potatoes

Planting

Planting of Irish potatoes is commonly done twice a year.. For the early crop it is preferable to plant before the onset of the rains to escape attack by late blight. The crop will mature before the really heavy rains.

The second season crop is planted mid to end of August.

The planting depth on ridges is about 8-10 cm. When planted as a sole crop, the distance between

-the ridges is about 80 cm.

-the plants on the ridge is 25-30 cm. corresponding to a plant population of about 41-50,000 plants per hectare.

On traditional ridges, potatoes are intercropped (mixed) with maize,

etc. However, the potato does best, when exposed to the sunlight.



Fig. 6.32: If you mix potato with other crops such as maize, choose alternate ridges for the individual crops or plants that do not overshadow the potatoes.

Crop Care

Potatoes do best on soils rich in organic matter. This can be achieved by the use of cowdung, compost, green manure, etc. (see Chapter 5.5.2-Improvement

If you don't have enough manure, you may apply fertilizer like 20/10/10 or 15/15/15. The recommended rate for high yields is 10 gr. per plant, corresponding to 400-500 kg. (8-10 bags) per ha when planted as a sole crop.

Practice Band Application (see Chapter 2.5.3). Apply when plants are about 25 cm. high.

For a good yield, you have to remould the ridges. An efficient Farmer combines weeding and remoulding and even fertilizer application. He uses the ridger plough (see Chapter 3.5.3- Reridging, Weeding, etc.).

Practice crop rotation and choose good seed material as well as optimum planting time to avoid disease attack.

Harvesting

Harvest when the crop is fully mature. The leaves and vines turn yellow and die.

Avoid wounds during harvesting. The oxen fanner can use the plough or the ridger to dig the potatoes. He splits the ridges. Leave the potatoes on the surface for some time to dry. Select wounded potatoes for immediate consumption. Store only good tubers.

Storage

Potatoes can be stored for up to 5 or 8 months, if the following conditions are observed:

- 1. They must be fully mature before harvesting.**
- 2. The skin must be allowed to dry out.**

3. The store must be clean, dark, cool, dry, airy and if possible, disinfected.

4. They are stored on shelves or in trays (15 cm. high), arranged one on top of the other in a storage house.

6.3.4 Other root and Tuber Crops

Of importance are Yams and Sweet Potatoes. Ask your extension worker for handout notes on these crops in case of need.

6.4 Leguminous crops

Leguminous Crops are crops that can fix nitrogen from the air.



Fig. 6.33: A groundnut plant with the nitrogen fixing nodules on the roots

These nodules are filled with bacteria, which can fix Nitrogen from the air and give it to the plant.

The nodules live for some time. When they die, they decompose and add Nitrogen to the soil.

Leguminous plants do not need much fertilizer. They can manage on their own and can still improve the soil.

There are two groups of legumes.

The food legumes like

- Beans**
- Groundnuts**
- Pigeon Peas**
- Soyabeans**
- Cowpeas etc. and the green manure/fodder legumes like**
- Tephrosia**
- Crotalaria**
- Calliandra**
- Sesbania**
- Leucena**
- Desmondium, etc.**

The farmer normally prefers food legumes to conserve the fertility of his soil, because he cannot eat the green manure legumes.

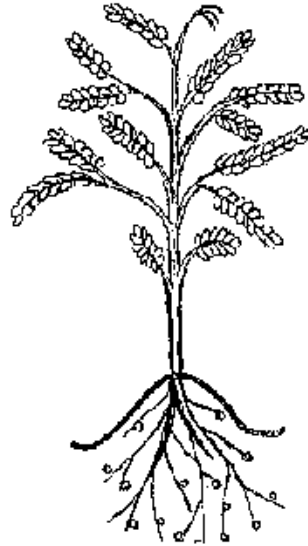


Fig. 6.34: The green manure legumes have a better effect on the soil than the food legumes.



Figure

Compare Tephrosia with Beans!

The tephrosia has more organic matter and more nodules. The whole plant remains in the field to add manure.

The soil will benefit a lot.

The bean plant is smaller has fewer leaves and nodules. Only the roots remain in the soil to make manure.

The seeds are eaten or sold.

During threshing, a lot of organic matter (leaves, etc.) gets lost.

A reasonable farmer has to think for the future and conserve the soil. If his soil is very fertile, he may keep his soil in balance by planting food legumes. If his soil is not very fertile, he has to plant green manure plants to keep his soil in balance and the yields steady.

To have the benefit of the green manure legumes and the advantage of a food crop, combine (mix) both in one field.

6.4.1 Soyabeans

Soyabeans are a rather new crop in many African countries. They are very rich in proteins with high nutritional value, comparable to that of meat, fish and eggs. Soyabeans can replace meat, fish and eggs in the diet.

Soyabeans are good food for everybody, especially for:

- growing children**
- pregnant women**
- sick people**
- hard working people**

1 kg. of soyabeans contain as much protein as

- 30 to 40 kg. cassava**
- 3 kg of meat**
- 13 liters of cattle milk .**
- 60 eggs**

How to use soyabeans (preparation, cooking methods) you can learn by attending cooking demonstrations.

Soil Preparation

The soil should be well drained and loose. Prepare ridges rich in organic matter.

Selection of Seed Material Select big and whole grains from healthy well producing plants.

Do not use old seed material. The viability of grains reduces quickly with time. Choose varieties which are adapted to your area. Especially in high altitude areas, sometimes only vegetative growth is observed.

Planting

Soyabeans can be planted in the first and second cropping cycle.

In the first season, you plant at the beginning of the rainy season. In the second season, you avoid the heavy rains.

When planted as a sole crop, the distance between the

- ridges is about 50 cm. .**
- plants on the ridges is 7-10 cm.**

When planted in a mixture with maize or cocoyam, the distance between the

- ridges is about 80 cm. .**
- plants on the ridge is 5-8 cm.**

Do not intercrop soyabeans with maize on the same ridge. Plant on

alternate ridges to provide sufficient sunlight for the soyabeans.

The planting depth of the soyabean is 2-3 cm.

Crop Care

Soyabean is a legume. It does not need fertilizer to grow. However, organic manure and/or a basic application of NPK 20/10/10 increases the yield.

Practice timely weeding with the ridger and repeat if necessary.

Harvesting/Processing

The cropping cycle of soyabean is between 95-115 days. In high altitude areas, it can be longer.

Harvest when mature:

- the leaves turn yellow and fall off,**
- the pods become breakable, and**
- beans lose the green color.**

Harvest the whole plant and expose to sunlight for at least 2 hours before threshing. Winnow and dry before storage.

Soyabeans are good for home consumption. They have protein and can replace meat. Use them for your daily diet. Surplus soyabeans have a good market. They are used for the production of animal feeds, soyabean oil, soap, etc.

6.4.2 Beans

The cultivation technique for beans is similar to the one of soyabeans. Though the yield of beans is lower than that of soyabeans, they have other advantages like:

- a good local market**
- availability of different varieties adapted to the different areas**
- higher security of yield, even when planted late or mixed with maize on the same ridge.**



Fig. 6.35: Common beans: Seed, pods and plant.

6.4.3 Groundouts

The cultivation technique for groundnuts is similar to that of soyabeans, but note the following differences:

- Groundouts have generally only one cropping cycle. Planting starts at the beginning of the rainy season.**
- The distance between the plants on the ridge is 15 cm.**
- Depending on the variety, the distance between the ridges is 50 cm. for the upright type, 80 cm. for the creeping type, planted as a sole crop. .**
- Moulding of ridges is important for pod development.**

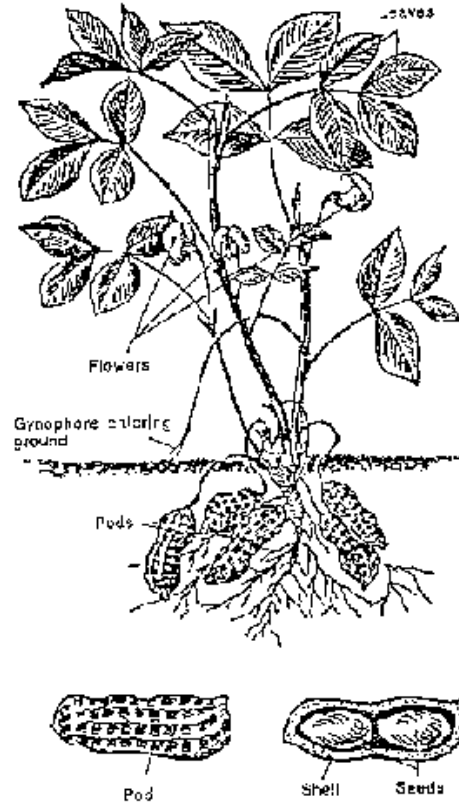


Fig. 6.36: Groundnut plant with pods and seeds.

6.5 Permanent crops

6.5.1 Fencing Plants

In the permanent farming system, you find permanent crops and seasonal crops in the same farm.

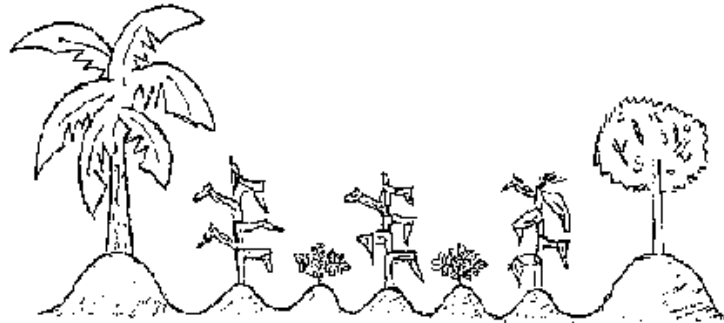


Fig. 6.37: The permanent crops are planted on the contour bond while the seasonal crops are planted on the ridges between the contour bonds.

The permanent crops on the contour bond:

- reinforce the contour bond with their root system: The contour bond cannot be attacked by erosion easily.**
- make a permanent farm structure: They remain in the rainy and dry season throughout the years.**

-provide additional food: After the harvest of seasonal crops, permanent crops, e.g. plantain, pineapple, sugarcane can provide food in the dry season.

-provide additional income: e.g. planting of coffee.

There are many permanent crops, you can plant on the contour bond,

e.g. cash crops like coffee

food crops like plantain, pineapple, sugar cane, paw paw

fodder crops like guatemala grass

green manure plants like tephrosia, pigeon pea, sesbania

Choose permanent crops that can do well in your area and can give good benefits to you.

Generally, most of the permanent crops take some time to establish. As long as the permanent crops are small, make good use of your contour bond by planting of

-green manure which can provide shade and manure for your permanent crops and reinforce the contour bond until

permanent crops are well established

-seasonal crops, which can produce food.

6.5.1 Fencing Plants

Due to the existing transhumance of Graziers and their cattle, especially in the dry season, your permanent farm may become subject to destruction by straying cattle .

To avoid destruction through cattle as far as possible, try to

-practice incorporation of organic matter (grass, maizestalks, etc.) before the dry season.

Bare soil is not very attractive for cattle.

-plant your permanent crops as soon as possible in the rainy season, so that they have grown up at the beginning of the dry season.

-communicate with the neighbouring graziers and explain to them your permanent farming.

-protect your farm by fencing.

Fencing of your farm is the most tedious but also the most effective way to protect your farm.

You can fence your farm with barbed wire, but barbed wire is costly and needs maintenance and replacement. The poles for the barbed wire are subject to white ant and fire destruction.

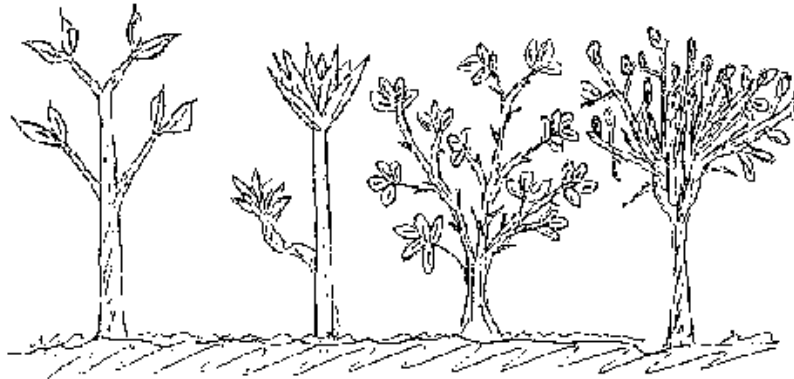


Fig. 6.38: The cheaper and longer lasting solution to fence your farm is live sticks and fencing plants.

Many fencing plants are locally available and easy to propagate. The

knowledge how to use them is locally available. Some newly introduced shrubs and trees can be made available by your extension services. Some of these new plants need special seed treatment to nurse or plant them successfully.

The following table will give some basic information how to treat these plants for successful propagation.

NAME	TREATMENT OF SEEDS	PLANTING	PROPAGATION
Tephrosia	no seed treatment	direct planting	by seeds
Sesbania	heat treatment; 1 min. boiling; soak in normal water for 1 day	direct planting	by seeds
Leucena	heat treatment; 3 min. in hot water; soak in normal water for 2-3 days	nurse in small plastic bags and transplant when 25 cm. high	by seeds
Acacia Mangium	heat treatment; 1 min. in hot water; soak in normal water for 1 night	nurse in small plastic bags and transplant when 25-30 cm. high	by seeds
Ervthrina	5 heat treatment: 10	nurse m small plastic	bv seeds bv

	min hot water, soak in normal water overnight	bags and transplant	cuttings
Mimosa	heat treatment; 5 min in hot water; soak in normal water overnight	nurse in small plastic bags and transplant	by seeds

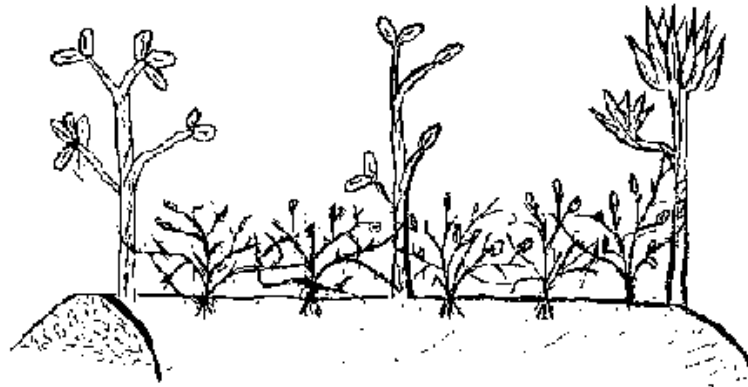
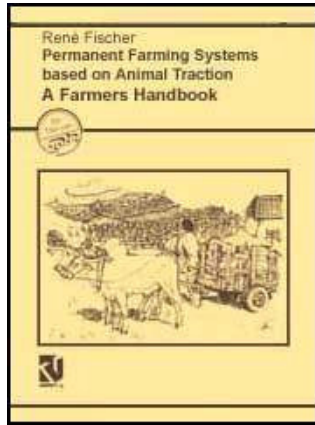


Fig. 6.39: Ensure that your fencing material is available when the rains are steady. Prepare ridges and transplant/ plant on the ridges to give them a good start. Combine several plants for your live fence, e.g. trees with hedge plants.



Permanent Farming Systems Based on Animal



 **Traction: Farmers Handbook (GTZ, 1995, 183 p.)**

➔  **PART VII: Vegetable gardening**

 **(introduction...)**

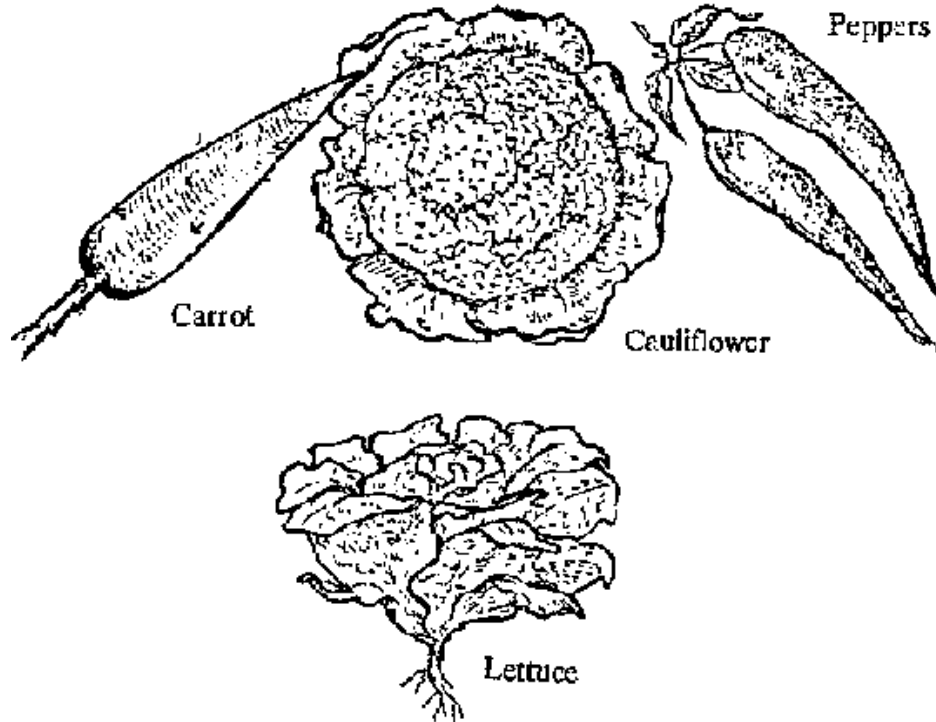
 **7.1 General recommendations**

 **7.2 Special gardening activities**

 **7.3 General cropping data for the most important vegetables**

Permanent Farming Systems Based on Animal Traction: Farmers Handbook (GTZ, 1995, 183 p.)

PART VII: Vegetable gardening



Figure

WHY GROW VEGETABLES ?

Vegetables are mainly grown for 2 reasons:

- for home consumption: they add minerals and vitamins to the diet and improve the health of the farmer family.**
- for the market to earn money. Surplus vegetables can be sold on the market for a good price.**

7.1 General recommendations

7.1.1 WHAT VEGETABLES TO GROW

There are many different vegetables. Some are grown for their:

- leaves and stems, e.g. lettuce, onions, leeks, cabbage**
- roots, e.g. carrots, turnips**
- flower heads, e.g. cauliflower .**
- fruits, e.g. tomatoes, green pepper, okra.**

Depending on the market situation, you have to decide which vegetables to grow. If You live in a rural area, the traditional vegetables will have a better market. If you live near a town, the production of "modern" vegetables can be profitable.

For better marketing, you grow:

-different vegetables: if there is a poor market for one variety, the other one may have a better market.

-vegetables of good quality: vegetables that are not fresh looking and of good quality are difficult to sell.

-regularly: you have to practice timing. It is a waste to grow a large quantity of one vegetable type at one time, if you are not sure of the market. It is easier to market smaller quantities regularly.

7.1.2 HOW TO CHOOSE THE SITE

The vegetable garden should be situated as near as possible:

-to the house: if you want to harvest a lot of vegetables of good quality, you will have to look after them very well.

-to a water source: vegetables need a lot of water to grow well. If your water source is far, you have a lot of work to carry the water.

The vegetable garden should be well protected against destruction by goats, etc. The site must not be exposed to wind, sun and rain.

Choose a level place with loose, well drained and fertile soil. Improve

your garden site with organic manure.

7.1.3 HOW DOES A VEGETABLE GARDEN LOOK

Like a field consists of plots, a vegetable garden consists of beds. A bed is the name for a small plot on which vegetables are grown.

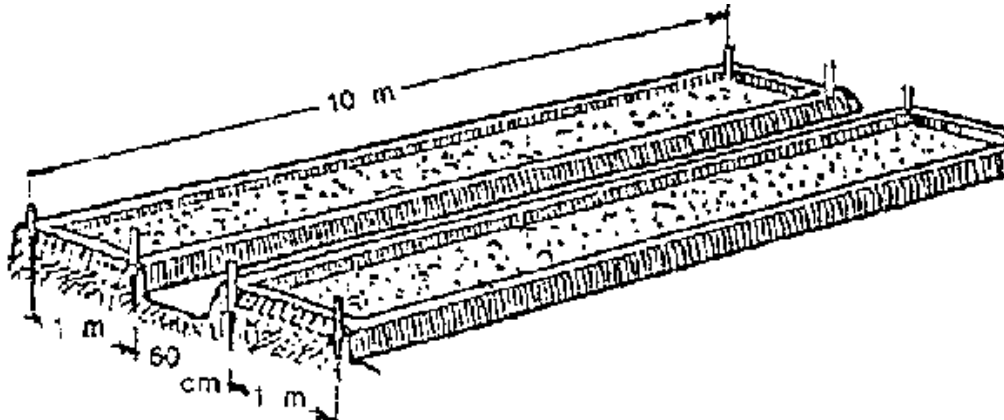


Fig. 7.1: A vegetable bed should be about 1 m. wide and 10 m. long. Leave a path of 60 cm between every two vegetable beds.

Mix the soil of 1 bed with at least one wheel barrow of manure or compost. Remove stones, break up the clods of earth and make the surface of the bed flat.

Some of the vegetables you cannot plant directly, you need to nurse them and transplant them, e.g. lettuce, tomato, leek, cabbage. For these vegetables, you need a nursery bed.

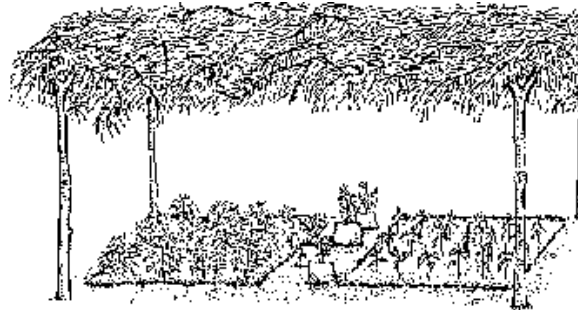


Fig. 7.2: In the nursery bed, you need very fertile soil to give a good start to the seeds. Build a shade to protect the seedlings in your nursery against hot sun.

Most vegetables grow best on soils which are rich in organic matter. Before planting, you have to add manure or compost to your soil: Mix the manure or compost well with the soil, so that it does not come into direct contact with the roots of the vegetable crop.

Manure and compost must be properly rotten - this takes three to six months. Always use your oldest heap first.

7.1.4 WHICH TOOLS TO USE IN THE GARDEN

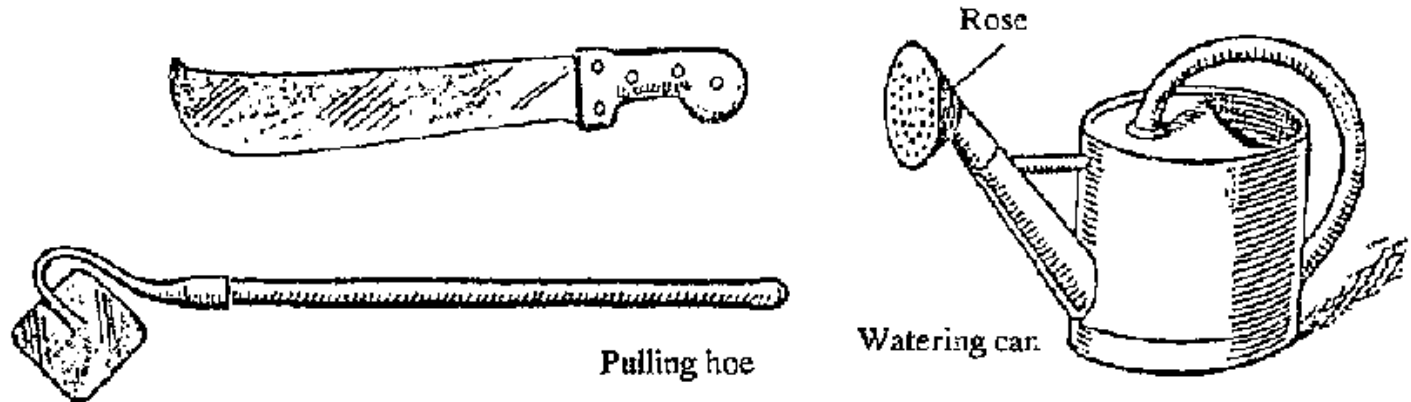


Fig. 7.3: Basic tools for your garden are the:

- cutlass: to clear the garden and prepare mulch.**
- hoe: to prepare the soil. .**
- watering can: to water the vegetables.**

An advanced vegetable farmer will have some additional tools like a:

- dibber: to transplant the seedlings**
- rake: to break up clods, level the beds and cover seeds after sowing**

- wheel barrow: to carry his manure/compost**
- fork: to carry and spread the manure/compost**
- pulling hoe: to weed and inter-cultivate between the rows**
- wooden tamper: a wooden board to make the soil firm after sowing**
- knapsack-sprayer: to spray chemicals against certain diseases**

The knapsack-sprayer is very expensive and should be bought by a group of farmers.

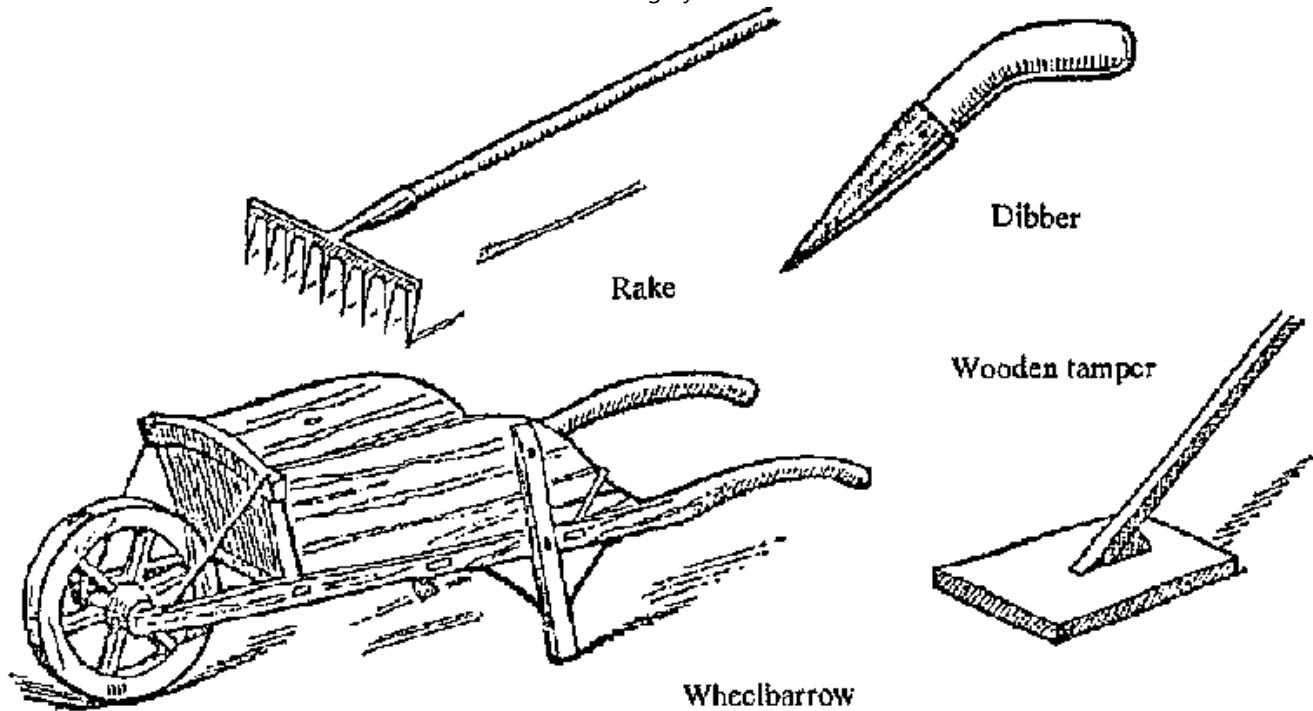
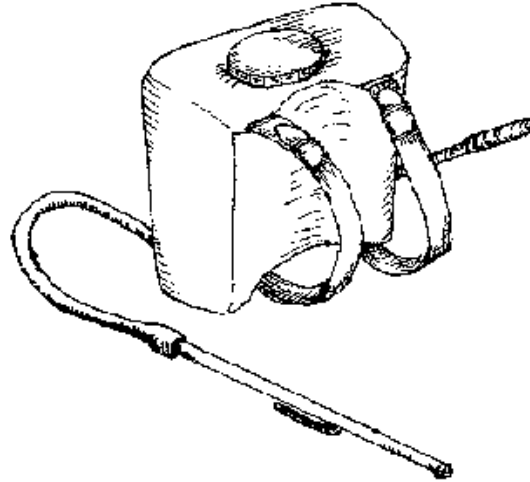


Fig. 7.4: Additional gardening tools



Figure

7.2 Special gardening activities

Gardening includes some activities you may not know from your normal farming activities.

To make gardening successful you must have a basic idea of these activities.

1. Nursing of seedlings

Some vegetable seeds are nursed before transplanting. You have to establish a seed nursery and provide shade for the young plants.

2. Thinning Out

Some vegetable seeds are very small. You have to broadcast or sow them in lines. Once the seedlings are a few centimetres tall you may have to pull some of them out and throw them away to give the others more room.



Fig. 7.5a: Remove weak and surplus seedlings.

3. Hardening of seedlings

Seedlings are ready for transplanting, when they have 4 true leaves. About 1 week before transplanting, give less water and shade to the seedlings than before. This will "harden" them so that they can

survive when transplanted.

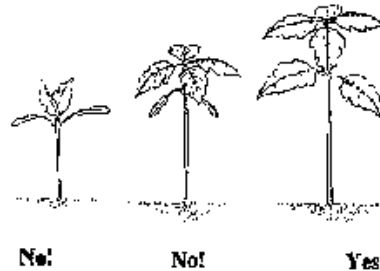


Fig. 7.5b: Transplant seedlings at the right stage

4. Transplanting

Transplant in the evening or on a cloudy day so that the plants are not immediately exposed to hot sun.

The best way to transplant seedlings is to:

- thoroughly water the nursery bed, so that you can lift the seedlings more easily**
- be very careful not to break the roots of the seedlings**
- choose only those seedlings that have grown well**
- prepare the seedlings by trimming off some roots and leaves**
- transplant into well prepared holes**

- pad the earth down well around the plant
- water the transplanted seedling thoroughly

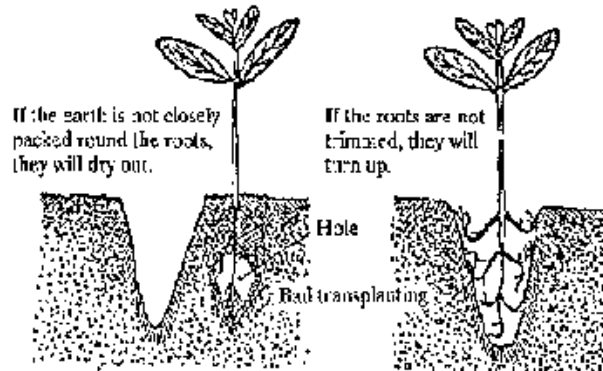
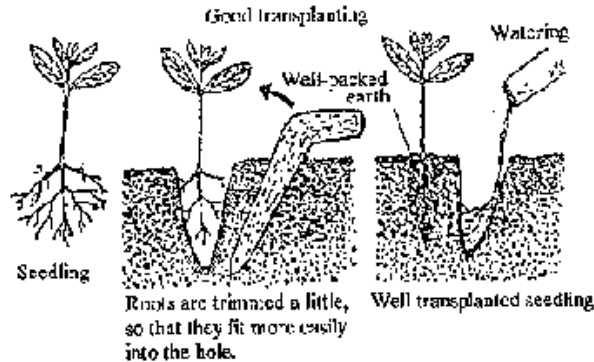


Fig. 7.6: Seedlings must be transplanted correctly.



Figure

5. Mulching

In the dry season, mulching is very important in both the nursery and the vegetable beds, because it helps:

- to keep the moisture in the soil**
- to add nutrients when the mulch rots**
- to prevent the soil from getting too hot**



Fig. 7.7: Chopped grass is useful as mulch, but do not use grass that has flowered to avoid weed infestation.

Thin the mulch in the nursery as soon as the seedlings appear. Mulch should not touch the stem of your plants to reduce pest attack.

6. Watering

Vegetables need a lot of water to develop their roots and leaves. They will only do well in moist soil. In the dry season, a bed of 10 square metres needs about 6 to 7 watering cans full of water every day. Water preferably in the morning and afternoon.

Watering can either be done with a watering can or by irrigation.

7. Staking

Some vegetables with long and weak stems, e.g. climbing beans, tomatoes, need stakes. A stake is a stick firmly put into the earth. It

is best to use hard wood, which does not rot and can stay for some years.

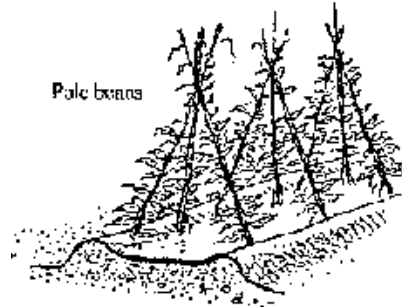


Fig. 7.8: Vegetables which have weak stems can be trained along stakes.

8. Pruning

Certain vegetables like tomatoes and eggplants need pruning. Nip off surplus buds. After pruning, there will be more fruits and they will be bigger.



Fig. 7.9: Pruned plants grow stronger and produce more fruit.

9. Garden Care

The vegetables are frequently attacked by diseases and insects. There are chemical and natural methods to control insect and disease attacks.

Chemical control is easier but expensive and risky. The poison of the chemical remains in the vegetable time between treatment and harvest is not long enough. You will then eat the chemical with the vegetable. Natural methods are more tedious and need a lot of

observation and experience The easiest natural methods to control diseases are:

- good seed/seedling selection**
 - disinfection of nursery bed (10 watering cans of boiling water for 10 m2)**
 - uprooting of infected plants and burning them**

 - practising mixed cropping; combine plants where the smell, etc. of one plant affects or protects against diseases of the other plant, e.g. tomato - cabbage, carrot - onion**
- In general, carrots, celery, onions, garlic, leeks are good partners to most of the other vegetables apart from pulses, e.g. beans, peas, groundnuts, etc.**
- practising crop rotation**

 - putting sufficient manure to improve growth, because strong plants are more resistant to disease**

 - choosing resistant or tolerant varieties**

7.3 General cropping data for the most important vegetables

The following table will give you summary information on planting/transplanting time and planting distances, etc. for most vegetables grown in your area:

NOTE: This is a scheme to guide you but a lot depends on climate, altitude, rainfall, season, etc...

All vegetables are multiplied by seeds, only shallots, onions, by bulb and ginger by the roots (rhizomes).

The planting distances depend on the varieties (e.g. cabbage), use your discretion.

