

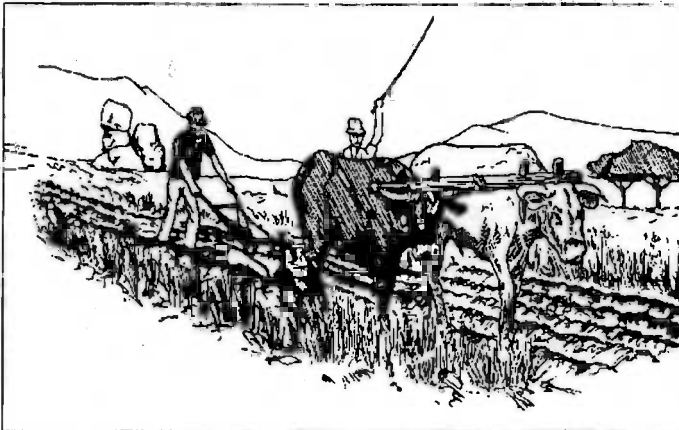
BEST PRACTICE GUIDELINES for EXTENSION WORKERS

Animal-drawn Ploughs

A technical manual for field staff for use as a training guide in the operation and maintenance of animal drawn ploughs



CARE
ZIMBABWE



DFID Department for International Development



Purpose of these Guidelines

These Guidelines have been developed to assist field workers and extension staff who help and advise farmers on the operation and maintenance of their animal drawn ploughs.

Acknowledgements

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The Plough

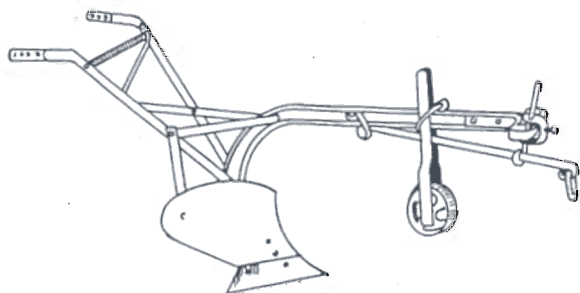
1. Introduction

The mouldboard plough is the most common tillage implement used by smallholder farmers in Zimbabwe. It is used for primary and secondary tillage. The plough is used for a number of different field operations that include ploughing, row-marking (for crop establishment), ridging and weeding. During ploughing, the plough cuts, breaks, loosens, inverts the soil and buries weeds, crop residues and manure.

In Zimbabwe, smallholder farmers generally use single furrow mouldboard ploughs called the Mealie Brand. Modified designs of plough, such as the Inkuzi Silver Medal and the Haka ploughs are also available. These modified ploughs have been designed to make them easier to set and adjust. Modifications were made to the hitch assembly, wheel assembly and the cross-braces on the handle-bars. Many plough parts are interchangeable. However, some plough spares currently available do not easily fit on old plough body assemblies because of small design changes to the frog.

All ploughs in Zimbabwe are available in three sizes: V8 or VS200, V10 or VS250 and V12 or VS300, with 8 inch (20 cm), 10 inch (25 cm) and 12 inch (30 cm) shares.

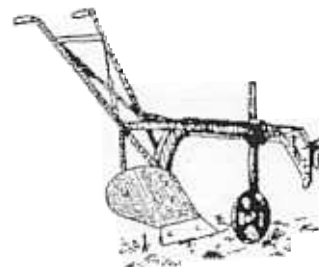
2. Makes of currently available ploughs



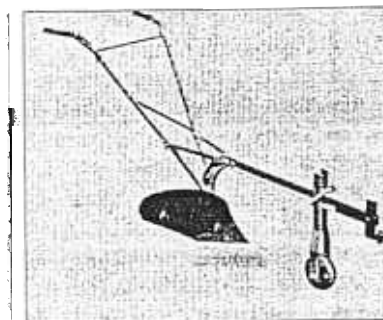
a) Mealie Brand VS Standard plough

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Modified ploughs



b) Silver medal plough



c) Haka plough

3. Plough parts and their functions

All parts of the plough have specific names, shapes, sizes and functions. It is important to know the functions of the different parts and how they fit together. All the parts need to be correctly fitted to work together for proper and efficient functioning of the plough.

The plough is made up of four assemblies attached to the beam. These are:

- a) the plough body assembly (sometimes called the "plough bottom")
- b) the hitch assembly
- c) the wheel and arms assembly
- d) the handle-beam assembly

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a) Plough body assembly

This assembly comprises the share, mouldboard, frog and landside (sometimes called the landslide).

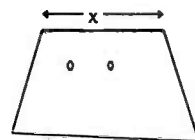
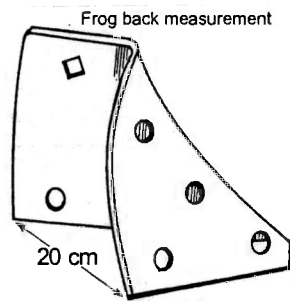
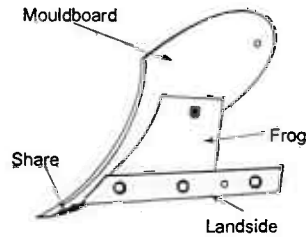
Frog
The frog carries all three body parts, i.e. the share, mouldboard and landside. It is shaped such that all three soil-engaging parts are correctly aligned when bolted in position, enabling them to perform their functions correctly and effectively. The frog is bolted to the beam by two bolts. The lower bolt (known as the king bolt) often becomes loose or gets broken. As a result, the plough becomes difficult to control and does not cut into the soil effectively.

The frog back measurement should be 20 cm for the V8 / VS200 plough. (See measuring scale on the back cover of this Guide). However, the frog can get distorted in use and this measurement may be reduced. This causes the width of cut to be reduced and inversion of the soil and burial of weeds or trash become poorer.

Farmers or blacksmiths may also distort the frog by increasing the frog back measurement to get a wider cut. This reduces the effectiveness of the plough and can increase the draught force requirement.

Share

The share is attached to the frog by two bolts. It cuts a slice of soil horizontally and starts lifting it to the mouldboard. The dimension X may be 8 inches (20 cm), 10 inches (25 cm) or 12 inches (30 cm) and this determines the plough size (see previous section).



Two types of share are available:- the flat and the upset. The upset share has an extended tip that enables the plough to work in rough and stoney field conditions. It will last longer than the flat share under similar conditions. Shares wear quickly in sandy soils, which are abrasive. A flat share would be expected to last about 5 acres (2 ha).

If the plough share is not replaced when it becomes worn, the plough will not cut or invert the soil effectively.

Landside

The landside is attached to the frog by two bolts. It passes the sideways and downwards thrusts from the mouldboard and the share on to the furrow wall and bottom.

Two types of landside are :- the plain one and one with a heel-piece attachment. This attachment is, however, very rare. The special design of landside to accommodate the heel-piece is also very rare.

One landside would be expected to plough about 37 acres (15 ha) in sandy soils and more in less abrasive soils. When the landside has been worn to the extent that the frog is exposed to wear, it must be replaced. As the landside becomes excessively worn, the plough becomes increasingly difficult to control.



Upset share



Typical wear pattern for a flat share .



Plain landside



Landside with heel piece

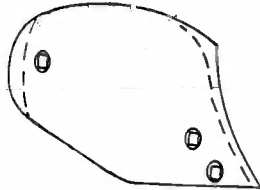


Typical wear pattern for a landside .

Mouldboard

The mouldboard is bolted to the frog by two bolts. The front edge of the mouldboard (the shin) cuts the soil vertically and the curvature lifts and inverts the soil. The shape of the mouldboard influences soil inversion and burial of weeds and trash.

Most of the wear takes place along the shin because this part cuts the soil. Wear also occurs at the rear part of the mouldboard from the soil passing over it.

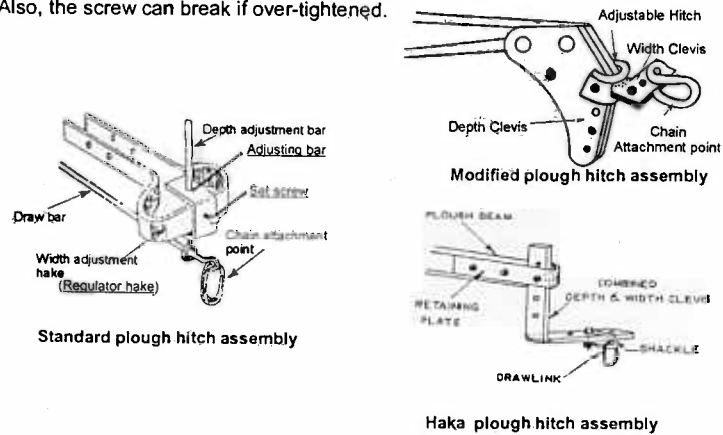


The mouldboard is also vulnerable to wear during handling operations, such as turning at the headlands and being dragged along the ground for transportation. The mouldboard would be normally expected to last for about 125 acres (50 ha), but this could reduce significantly if the plough is poorly treated, especially during transportation.

b) Hitch assembly

There are two types of hitch assembly, a standard and modified assembly. The hitch assembly is attached to the front end of the beam by two bolts. It is used to connect the plough to the animals with a trek chain and harnessing system. It allows the hitching point to be moved, thus allowing the plough to be set for depth and width of cut.

Most of the problems facing farmers are associated with the adjusting bar and set screw on the standard plough hitch assembly. The screw threads on both parts can become easily damaged and, as a result, the screw is unable to fix the holder firmly. Also, the screw can break if over-tightened.



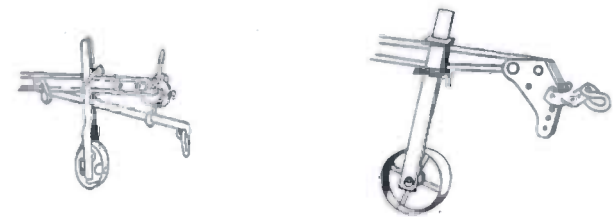
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c) Wheel and arms assembly

The plough is fitted with a wheel which helps in manoeuvring the plough but it is not intended as a means of depth control. This assembly comprises the wheel, its axle, the arm(s) and a clamp to attach them to the plough beam. There are two types of wheel and arm assembly, one for the standard plough and one for the modified plough. Both types are bolted to the beam immediately behind the regulator hake (on the standard plough) or behind the depth clevis (on the modified plough). There are various types of wheel design and two sizes – 15 cm and 18 cm in diameter.

When farmers use the wheel to set the plough depth, excessive forces are generated and the result is undue wear on the axle, holes in the wheel arms and the wheel hub. The clearance between the axle and wheel hub should be less than 5 mm (i.e. 1/4 cm). Excessive play of the wheel on the axle results in damage to the whole assembly, not just these two components. When wear permits foreign matter to enter between the wheel axle and hub, the wheel does not turn so easily and, eventually, the wear will be accelerated. Both the wheel and axle should last for 25 acres (10 ha) of ploughing under normal conditions with a properly set plough.

The wheel axle should never be oiled as this will attract soil particles which are likely to form a grinding paste causing the axle and wheel to wear out faster.



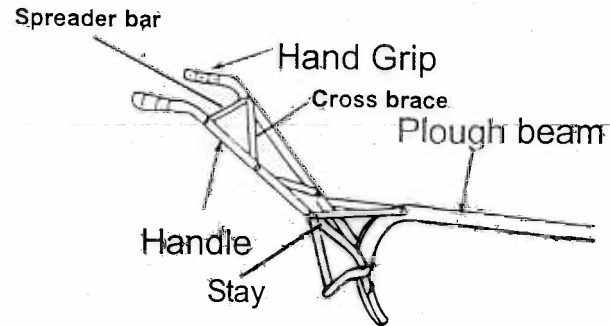
Standard plough wheel and arm assembly

Modified plough wheel and arm assembly

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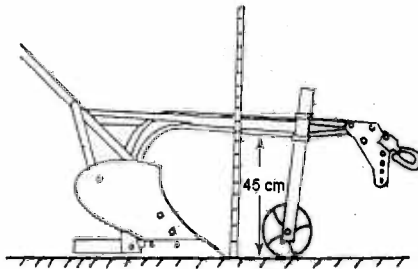
d) Handle-beam assembly

The beam is the main part of the plough to which all other parts of the plough are attached, directly or indirectly. This assembly comprises the handles, spreader bar, brace, stays and beam.



4. Plough beam clearance

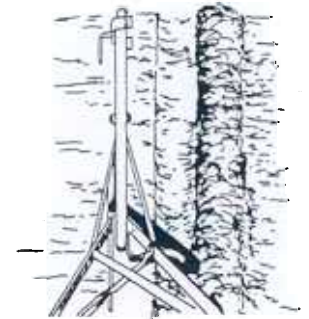
The vertical distance from the ground at the share tip to the lower surface of the beam should be 45 cm with the plough free-standing on its wheel and plough body assembly.



If this clearance is less than 40 cm, the plough is unlikely to penetrate the soil well. If it is greater than 50 cm, the plough is likely to dig too deep.

5. Correct beam shape

The beam should be straight and parallel to a line from the end of the landside to the tip of the share. If this line is not straight the beam may be twisted. Twisted beams can be straightened by a blacksmith or by the farmer using cold forming techniques without reheating.



The beam should also be parallel to the ground and the furrow wall. When the plough is set and correctly aligned, the draught requirement is at a minimum.

6. How to set a plough

It is important to know the plough parts and functions so that we can adjust and set it properly. A correctly set plough reduces stress on both the operator and draught animals.

Three adjustments are necessary to correctly set a plough.

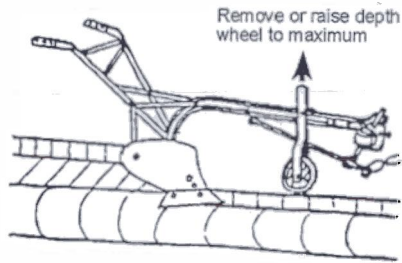
These are made in three steps below in the following sequence.

- i) Depth of furrow
- ii) Position of wheel
- iii) Width of furrow

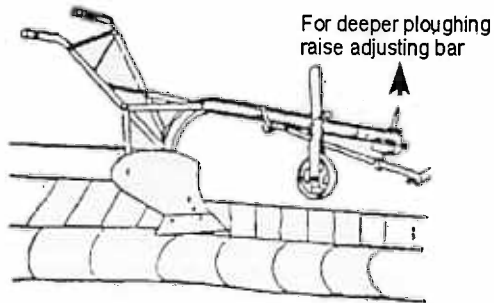


7. Setting depth of ploughing on the standard plough

1. Remove the wheel or raise it to be clear of the ground

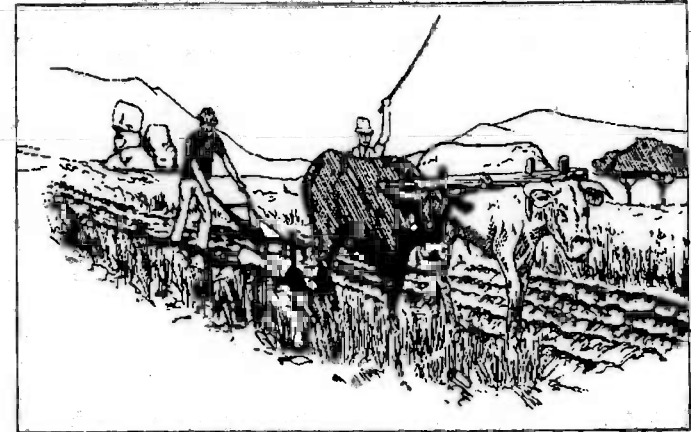


2. For deeper ploughing raise the adjusting bar. Do not adjust the wheel.

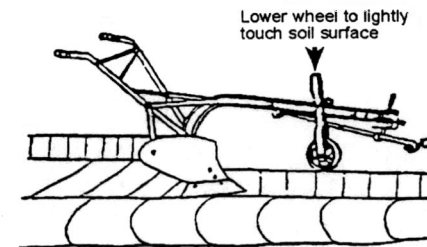


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3. Plough for at least 20 paces or so and reset the adjusting bar until the required depth is achieved. This is an iterative process and it is likely that it needs to be repeated more than once to obtain the desired depth.



4. Lower the wheel until it just touches soil, for uniform depth of ploughing.

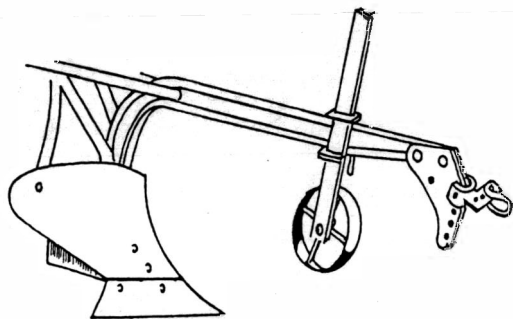


5. For shallower ploughing repeat step 1, lower the adjusting bar and then repeat step 3, and lastly lower the wheel as in step 4.

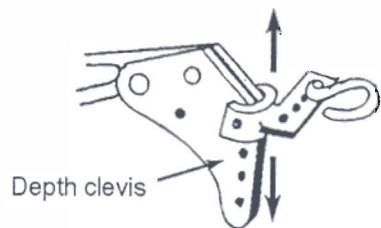
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8 Setting depth of ploughing on the modified plough

1. Remove wheel or raise it to be fully clear of the ground

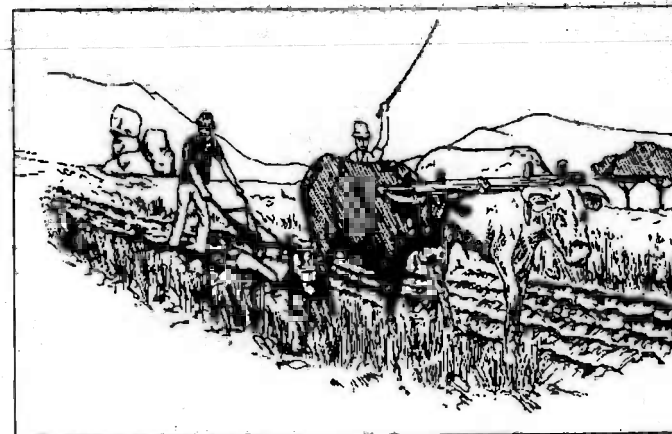


2. Raise or lower width clevis on depth clevis to preferred depth.

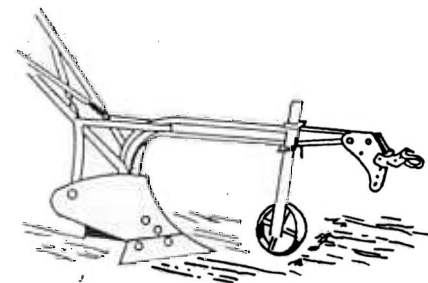


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3. Plough for at least 20 paces or so and reset the position of the width clevis on the depth clevis until the required depth is achieved. This is an iterative process and it is likely that it needs to be repeated more than once.



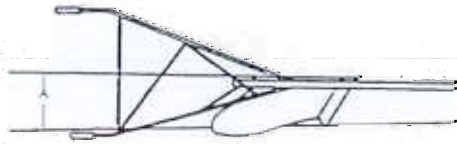
4. Lower the wheel until it just touches soil, for uniform depth of ploughing.



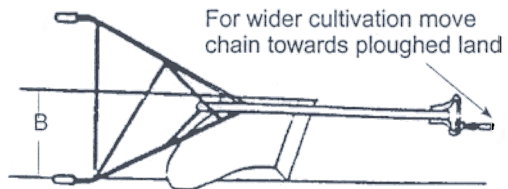
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9 Setting width of ploughing on the standard plough

1. After setting the plough depth, adjust the width of cut (A).

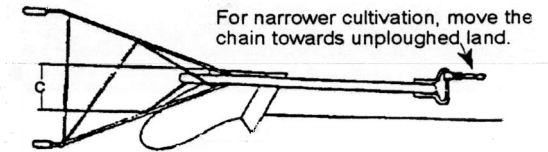


2. For wider width of cut, move the adjusting bar holder along the hake regulator towards the ploughed land. This will cause the beam front to move towards the unploughed land and cause the share to make a wider cut, i.e. the distance B (in the diagram below) is greater than the distance A in the diagram above.

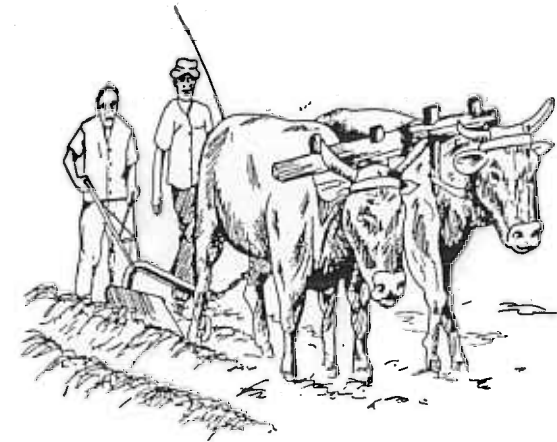


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3. For a narrower width of cut, move the adjusting bar holder along the regulator hake towards the unploughed land. This will cause the beam front to move towards the ploughed land and cause the share to make a smaller cut, i.e. the distance C is less than the distance A.



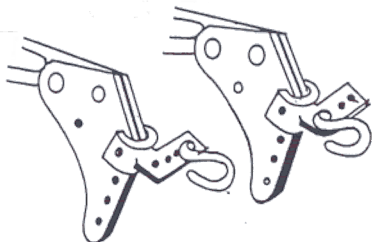
4. Plough for at least 20 paces or so and reset the adjusting bar until the required width is achieved. This is an iterative process and it is likely that it needs to be repeated more than once.



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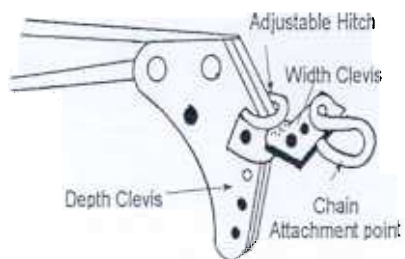
10. Setting width of ploughing on the modified plough

1. To increase the width of cut move the chain hook towards the inner hole on the width clevis (to the right, from behind).



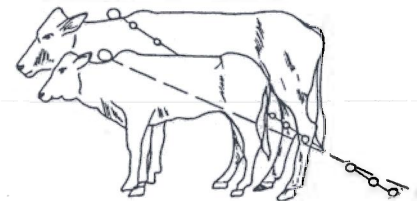
2. To narrow the width of cut move the chain hook towards the outer hole (to the left, from behind).

The hitch assemblies of the modified ploughs are easier and faster to set because adjustments can be made without using a spanner.



11. Chain length and animal shoulder height

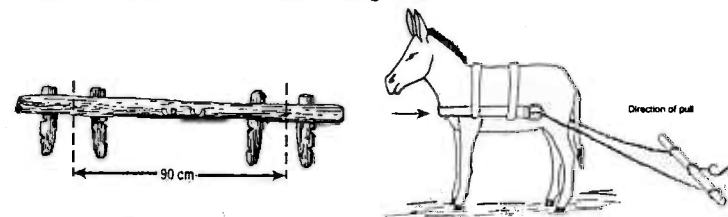
It is important to use the correct length of trek chain. A three metre chain is required for larger oxen but a 2½ m length of chain would be appropriate for smaller oxen or cows (e.g. less than 350 kg animal mass).



If the chain is too short, the plough will be lifted and the operator will have to push the plough down to try and achieve the depth required. This can stress both the operator and draught animals.

12. Harnessing of draught animals

Always use the correct harnessing devices



Double neck yoke for cattle

Breast band harness for donkeys

Some farmers harness donkeys and cattle together using the double neck yoke. However, the neck yoke is designed for cattle only and causes discomfort and injury to donkeys. Try and avoid using mixed spans, but when donkeys and cattle work together in a draught team, spans must be either donkeys or cattle only. It is preferred that donkeys are put in front and harnessed using appropriate donkey harnesses.

Spanning a donkey with an ox or a cow in a single span should be avoided at all times.

13. Maintenance of the plough

Some parts will need to be checked daily and others need to be checked seasonally.

Farmers should keep essential spare parts to avoid delays when repairs have to be carried out during cropping activities.

Daily plough maintenance procedure

- Remove soil from the plough while in the field
- Tighten all loose nuts and bolts
- Check all wearing parts
- Wash and oil plough if it is not to be used for the next few days
- Store under dry conditions in a shed

Seasonal plough maintenance procedure

- Strip the plough completely
- Check all plough parts, bolts and nuts for wear
- Obtain replacement and spare parts as appropriate.
- Clean all parts, oil or paint them if necessary.
- Re-assemble the plough
- Store the plough in a dry shed.



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14. Spare parts that a farmer should keep.

By keeping the plough well maintained and ready for use at all times, farmers will reduce breakages when they are busy ploughing, planting or weeding. Breakages during these periods can be costly in having to stop operations at a critical time while spare parts are bought. Each day's delay in planting can mean yield losses far worth far more than the cost of the parts.

Farmers should always keep at home those parts, which will need replacing during the season. Replacement frequency will depend on the area of land they plough, plant and weed using the plough. Spares kept at home can be divided into essential and desirable depending on the amount of work expected to be undertaken.

Essential spares

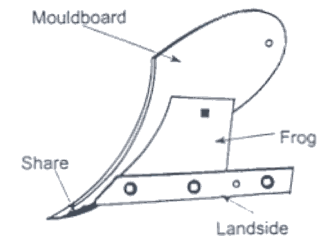
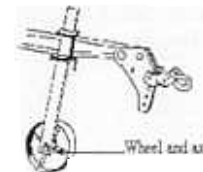
- 1-2 shares as these last for only 5 acres (2 ha)
- 1 wheel, 1 axle and axle nuts as these last for 25 acres (10 ha)
- 1 king (flat head) bolt and 1 (round head) bolt for attaching the plough beam to the frog.

Do not use wire in place of the correct nuts and bolts, otherwise other parts of the plough will wear very quickly.

Desirable spares

- This depends on how much land is ploughed, planted and weeded.
- 1 landside. These can be expected to last for 40 acres (15 ha)
- 1 mouldboard. These can be expected to last for 100 acres (40 ha)

Always keep old parts for checking that a new part is the same as the old one. Old parts can also be kept for repair by a local blacksmith.



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15. Sourcing spares and repairs

Extension workers should familiarise themselves with who is able to supply spare parts and carry out repair work in the localities in which they work. Rather than having just a list, they should be able to make recommendations based on reliability and quality. For example, if some dealers carry very little stock, the extension worker should be able to advise the farmer. This may save the farmer from making an unnecessary journey.

Extension workers should also be aware of the capabilities and skills of local blacksmiths to advise farmers where to get good quality repairs and spares. Farmers' decisions, however, may be based on other considerations such as, cost (time and distance), family or community relationships, etc. Farmers will have their own views on these subjects, so extension workers should discuss with farmers and reflect farmers' views in reaching their judgements.

The extension worker should aim to always supply up to date and relevant information.

16. Budgeting for spares

Always find out what spares cost and budget for keeping spares in stock. Check prices at local stores and dealers comparing these with the nearest main centre. By buying out of season it is often possible to save money, as prices are lower and trips to town can be combined with other shopping needs.

Always make sure that your plough is in good condition before the season starts by following the maintenance schedule set out in this guide.

Extension workers can guide farmers in developing a maintenance plan such as that shown below to spread costs and avoid costly delays in making repairs. This will ensure the plough is in good condition for winter ploughing and when the new season starts.

	O	N	D	J	F	M	A	M	J	J	A	S
Time when plough is in use	X	X	X	X			X	X				
Buy parts					X	X			X	X		
Daily maintenance	X	X	X	X	X	X	X	X	X	X	X	X
Seasonal maintenance						X					X	X

NOTES ON PRICES OF PARTS, CONDITION AND COST

Part	Date	Condition	Cost
Share			
Mouldboard			
Hake regulator			
Wheel			
Axle			
Wheel arms			
Landside			
Frog			
U piece and screw			
U clamp assembly			
Left Handle			
Right handle			
Hitch assembly			
Stay beams			
King bolt			
Plough beam			

17. Common problems that farmers experience

Parts removed from ploughs:

- Drawbar assembly
- Regulator hake
- Adjusting bar holder

These are parts of the hitching system which are generally not well understood by farmers. Farmers are not aware of the functions of these parts and believe they can reduce the weight of their ploughs by removing them. In fact, a properly set plough with these parts, is lighter for the animals to pull and the adjustments on the hitching system enable the implement to match the capabilities of different animals.

Do not remove the drawbar, regulator hake or the adjusting bar holder.

Stays

Farmers do not understand the function of the stays and so remove them. This reduces the weight only slightly but increases instability, making the plough more difficult to control and so making ploughing harder work for the farmer and his draught animals.

Do not remove the stays.

Broken parts:

- Wheel and arm assemblies
- Handles

Farmers allow these parts to deteriorate, as they do not have a good understanding of their contribution to effective ploughing.

Replace them when they are worn or broken.

- Set screw on adjusting bar holder

The set screw is damaged if the wrong size of spanner is used because the "flats" become rounded. This makes the screw very difficult to turn. Even with the correct spanner, there is a risk of the screw being over tightened, which will soon cause it to break. If the screw flats become rounded, replace it.

If the screw breaks, the farmer must seek assistance in its removal.

Loose parts:

- Nuts and bolts
- King bolts

For all the plough parts to be firmly in place, the securing and retaining nuts and bolts must be kept tight. They should be checked for tightness every day. If they are left to work loose, the parts will shake, which leads to damage of parts and the screw threads, as well as making the plough more difficult to control. Eventually the bolts will fall out and get lost. When lost bolts are replaced by wires, the plough will always shake and be difficult to control.

Check nuts daily and use the correct spanner for tightening.

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Setting of ploughing depth using wheel arm position

This is not a recommended practice and leads to excessive wear of these components and can make the plough more difficult to control.

Weak parts on ploughs

- U-clamp plate (bends easily)

This is primarily a manufacturing problem. However, if the wheel is not used as a depth control, this plate may not need to be made more rigid.

Do not use the wheel to set the ploughing depth.

- Shares and landsides wear out quickly

Correct use and maintenance reduces rates of wear. Higher quality material also reduces wear but this is controlled by the manufacturer.

Replace shares and landsides as they become worn.

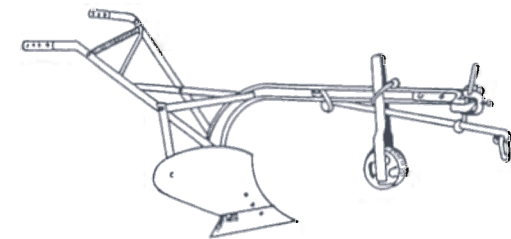
Other problems

- Bent handles and braces
- Twisted or deformed beams

These problems arise over time from poor treatment, use and maintenance, through a lack of awareness of the correct practices. The remedy is to take greater care of ploughs in all these respects.

- Failure of some new ploughs to penetrate the soil

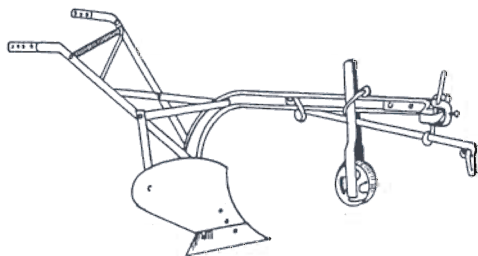
Some farmers have complained that when they buy a new plough it does not cut into the soil properly. This is because the implement has left the factory without being correctly adjusted for suction, and needs to be returned to the manufacturer to be replaced.



-Ploughs 27-

18. Manufacturers and sources of ploughs and spares in Zimbabwe

Name	Address	Implements available
ZIMFLOW LIMITED	P O BOX 1059 BULAWAYO TEL: 09 71363/5 FAX: 09-71365 e-mail:mdsec@zimflow.co.zw 2 TILBURY ROAD WILLOWVALE HARARE TEL: 04 612099	PLOUGHS CULTIVATORS RIPPER TINES HARROWS PLANTERS
HASTT ZIMBABWE	77 COVENTRY ROAD BOX 2356 WORKINGTON HARARE TEL:04 620380-9 FAX:04 620389	PLOUGHS CULTIVATORS HARROWS



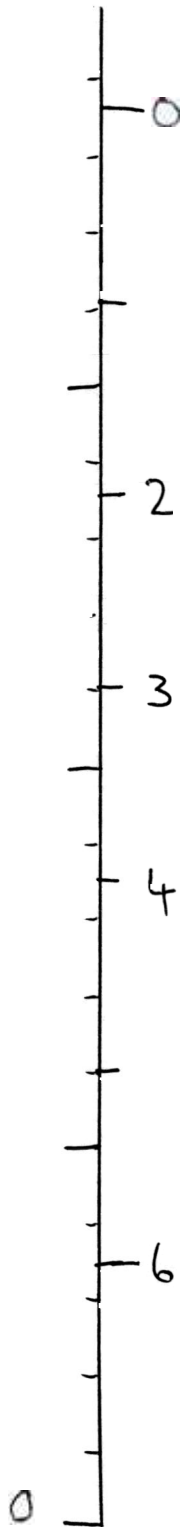
FARMERS CAN SOURCE PLOUGHS AND SPARES FROM RURAL BLACKSMITHS, GENERAL DEALERS AT LOCAL BUSINESS CENTRES, HARDWARE SHOPS AND WHOLESALEERS IN TOWNS THAT ARE NEAREST TO THEM. IT IS BEST FOR FARMERS TO COMPARE PRICES AND PURCHASE FROM A RELIABLE SELLER

Ruler

The measurement on the back is 20 cm long. You can use it to check the frog back measurement (20cm) and beam clearance (45cm) if you do not have a ruler. Extension staff are expected to advise farmers to use objects that match this measurement when checking the above measurements. Straight objects like a stick or a piece of wire can be used. Note that when checking the beam clearance, the object must be at least 2 times the length of this ruler.

For further information, please refer to manufacturers' publications, in particular "Agricultural Implements and Genuine Spares" (Zimflow Ltd., Bulawayo) for more details on plough parts.

cm



inches