



AFRICAN CONSERVATION TILLAGE NETWORK

TECHNICAL BOOKLET

**A Guide for Farmers on Reduce Tillage:
*Animal Drawn Ripping Option for Smallholder Farmers***



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A. What is ripping?

Ripping is one of the important practices carried out in conservation agriculture technology, it involves mechanical manipulation of the soil to break up or pierce compacted, impermeable or slowly permeable surface or subsurface soil layers, or other similar kinds of restrictive soil layers. It is also done in some instances to create planting lines in un-ploughed land.

It involves the use of a tool called **ripper**, which causes minimum disturbance to the soil, helps increase water capture, protect water quality, and reduce soil erosion, especially in bare land which is susceptible to erosion.



Figure 1: Ripping with animal drawn ripper on un-tilled land, ACT photo

Reasons for Ripping:

- Break up compacted layer of soil to enhance seed germination, roots development and plant access to nutrients and water uptake
- Create planting lines in un-ploughed farms
- Enabled the farmers to do early land preparation and improved crops yields
- As a minimum tillage practice, it helps protect the soil and reduce hazardous soil erosion.

B. Detection of compacted soils

Soil Compaction

Soil compaction is seen as a problem of degradation in cropping land. It may be defined as the compression of a mass of soil into a smaller volume. This occurs when soil particles are pressed together, reducing the pore space between them. This increases the weight of solids per unit volume of soil, thus bulk density (densification). Soil compaction occurs in response to pressure exerted by field machinery or animals. The risk for compaction is greatest when soils are wet. Compaction can manifest itself as surface crusting or hard-setting, or hardpans such as a 'plough pan' immediately below the usual depth of cultivation, or as subsoil compaction deeper in the profile.

Practical identification of compacted soils and/or plough pans

Compacted soils can be identified by on-site field inspections through various methods. Commonly used methods include:

- **Visual observation:**



- ✓ **Soil pit:** Digging a small pit extending to a depth of 60 cm and pushing a knife blade into the side of the pit at various depths. *A hardpan layer will make it difficult to push knife blade into the soil and blade will then stick when removed.*
- Besides, by examining the **soil profile** it is possible to identify a compacted soil layer because it is physically harder and denser than the soil above or below it.

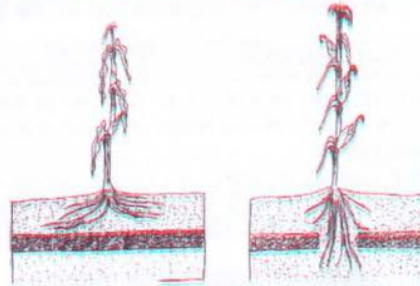


Figure 2. Roots deformed by hard/plough pan (left) and roots enabled to reach nutrients and water deeper when pan is broken (IIRR & ACT, 2005)

- ✓ **Plant indicators** include; poor root growth, swollen root tips and horizontal root growth as roots try to force their way through compacted soils. Roots growing through compacted soils can be confined to macropores, soil fractures or be at a reduced density.
- ✓ **Water ponding:** Occurrence of water logging in the farm indicates the presence of hard pan or compacted soils since it impedes infiltration and drainage. Roots deformed by hard/plough pan (left) and roots enabled to reach nutrients and water deeper when pan is broken



Figure 3. Left plant's tap root has failed to penetrate the pan, hence horizontal growth (ACT, 2010)

- **Hand probe:**

- ✓ Hand probes are basically steel rods that are pushed into the soil by hand. Compacted layers are more difficult to push through, and easier once past the compacted zone. This needs to be done when the soil is wet to depth (preferably the upper drained limit) as many soils become hard when dry regardless of compaction status. Hand probes can be made from steel rod (about 8 – 10 mm diameter) or heavy gauge (3 mm) fencing wire about 40 cm long with one end looped to make a handle. Depth increments can be added.



Figure 4. Checking penetration resistance using Cone penetrometer (ACT, 2013)

- **Cone penetrometer**

- ✓ A cone penetrometer works by the same principle as the hand probe except that it measures and records the force required to insert a standard sized cone into the soil profile. The penetrometer is inserted at a steady speed by hand and the instrument uses a gauge to measure the force required to penetrate the soil at a given depth, measured in



mega- (MPa) or kilopascals (KPa). The data are stored in a data logger and can then be downloaded and the strength of the soil profile assessed.

C. Parts of a ripper

Bursting of the hard or plough pans can be done by hand tools (such as hand hoe, *Chaka* hoe or pick axes) or animal drawn or tractor mounted rippers. Only the animal drawn rippers are discussed here.

Most common animal drawn rippers consist of three main parts: The main frame (in most cases ordinary plough beam); sub-frame (tine holder) and the ripper tine. However these depend on the models manufactured by different companies.

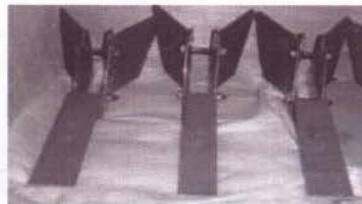


Figure 5. Low-Tech Venture ripper attachment



Figure 6. Magoye ripper attachment



Figure 7. Mealie Brand-Zimplot ripper attachments

Parts of Magoye ripper

The Magoye Ripper is a single chisel tine on a supporting frame. It is pulled by a pair of oxen in the same way as a common plough and can be attached to any common implement frame. The different parts of the ripper are shown in Fig 7.

Description of parts:

a The chisel tine

- The chisel tine is the most important part of the

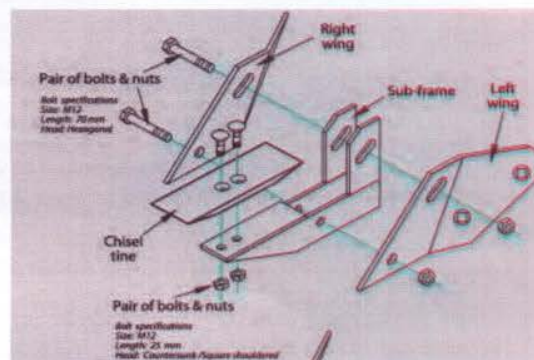


Figure 8. Parts of the Magoye ripper attachment



ripper. It has to break open the dry and hard soil. The tine must therefore be strong, wear resistant and bevelled at both ends to make it sharp. Once one end is worn out, the tine can be reversed for use of the other end.

b Wings

- The wings prevent soil dug by the tine from sliding back into the furrow. They push the loose soil and clods to either side of the furrow and keep it well open. Applying manure and lime into the open furrows is therefore easy. Opening of the furrows also helps to keep them visible until planting time.

c Sub-frame/ ripper body-tine holder

- The rigid sub-frame holds the chisel tine under the correct cutting angle and is fixed to the implement frame with the pair of long bolts and nuts

Assembly instructions for animal drawn Ripper

A). Ripper attachment:

- Bolt chisel tine to Ripper Tine holder assembly
- Bolt small ripper wings left hand (LH) and right hand (RH)

The ripper wings are added if there is need to make contours. Wing extensions can be bolted on the 2 holes shown in Fig 8. They also serve the purpose of making contours.

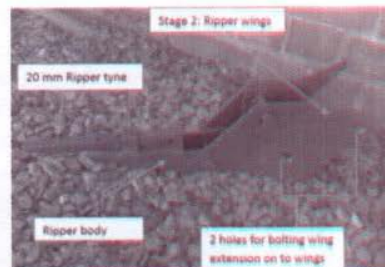


Figure 9: Ripper attachment assembly-Zimplot

B). Complete ripper assembly

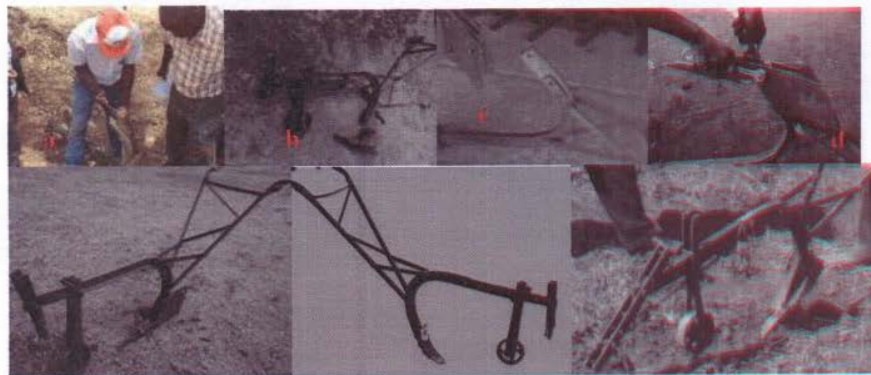


Figure 10: Steps for complete ripper assembly

The steps to assemble complete ripper (Magoye ripper) as above in fig. 10 can summarize as follows:

- Remove plough or ridging body from plough beam as in (a) and (b) above. Only plough beams with smoothly curved shanks are suitable for fitting the Magoye/Zimplot Ripper.



- Slide in the ripper body to the beam and bolt the attachment. Attach the wings if necessary.

D. How to do ripping?

❖ PREPARING EQUIPMENT FOR RIPPING

a. Choose a good beam:

If you have a choice of different beams, be aware that:

- A long beam helps for good penetration of the tine. Use the longest plough or ridger beam you can find.
- A ridger beam (of the common *high-wing ridger* type) is a good choice: it normally is a long beam and it is curved downwards in front. This downward shape brings the point for hitching the chain to a low position (see the section on implement adjustment why this is good).
- Do not select a beam that is damaged, especially if it got deformed such that the ripper tine will not be aligned or if the curve of the beam has opened up so that the position of the tine will be too steep.
- There are some beams on the market that are not suitable for the standard Magoye Ripper. Check figure 5. Although the Magoye/Zimplow Ripper might fit on those beams, it will be sitting too steep. As a result the tine will not work properly.

b. How to fit the ripper to the beam?

For fitting the ripper, use the same two holes in the beam where normally the plough or ridger body is fixed. Use a pair of long bolts and nuts, preferably size *M12x70* (see box 1). The same bolts and nuts also hold the wings. Fitting the ripper on the beam is easiest when the frame is turned upside down as in figure 9 (a). Pay attention not to fit the wing blades upside down, or left and right reversed.

✓ *Use proper spanners*

Use a pair of spanners that match with the nut and the head of the bolt for safe and apt work without causing any damage. Preferably use round instead of open ended spanners. For M12 bolts and nuts you need spanner number 19. Remember: do not over tighten the nuts.

✓ *Shorten bolts that are too long*

A protruding bolt end increases the draft force. You may therefore cut it short with a hacksaw if it sticks out more than e.g. 2 cm from the tightened nut. Be cautious not to cut the bolt too short!

- c. **Check the tine:** Never go to the field with a blunt tine. If not sharp, it should be sharpened. This can be done using a hand file or a grinder. Alternatively use the other end if it is still OK. If both ends are completely worn out, a new tine must be fitted.



- d. **Always use a hitch for depth adjustment:** Do not connect the trek chain directly to the beam. Use a hitch between the beam and the chain for setting the working depth. The original plough hitch can be used, if it is still there. But there is a simpler and stronger type of hitch available
- e. **Attach a long chain:** The trek chain should be as long as 3.5 meter. A long chain allows for a large working depth. Most trek chains on the market are only about 2.5 meter. So, add another piece of 1 meter, or connect two trek chains together.
- f. **Check the wheel:** A smoothly turning, not too wobbly wheel is required. The axle should not be worn out. The wheel should be adjustable in height. If possible, fit a *large* (about 20 cm diameter) wheel, as it will run easier over uneven land than the usually rather small plough wheel.
- g. **Use the right yoke:** ensure that you have the right yoke. This should be well-made with curved necks to make it more comfortable for oxen. Normally should measure either 150 cm or 180cm from the centre of each neck oxen depending on the spacing required between the rows (either 75 cm or 90 cm).

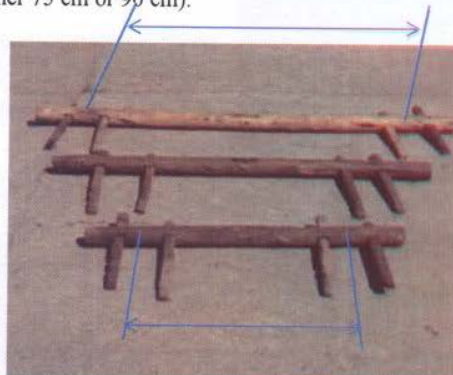


Figure 11. Distance from centers of ox-neck yokes equals twice the crop row spacing

❖ FIELD ADJUSTMENTS OF THE RIPPER

The effective working depth of the Ripper can to some extent be controlled by the adjustment settings on the implement. Adjustments are also necessary to make the implement going as steady and easy as possible, making work less tiresome for both the operator and animals as well as reducing wear and tear on the implement.

Get quickly used to the effects of different implement settings under different working conditions by trying and observing. There are two adjustment settings:

1. The length of the chain.
2. The height of the hitch point.
3. The height of the wheel.



Do the adjustments in the above order, so begin by finding a satisfactory chain length. Be aware that there is no universal setting for a certain working depth. Much depends on the resistance of the soil in a particular situation and on the sharpness of the tine. The aim is to try and balance the implement at a certain desired *and* comfortable working depth as well as possible. Here is how it goes:

Get started

To begin, choose an average chain length as well as an average height of the shackle on the hitch. Or set the hitch and chain length according to any previous experiences in order to get started. Lift the wheel up high such that it will initially not interfere with the actual depth setting. Try out this setting and observe what happens.

Adjust the chain length

Be not necessarily satisfied immediately. Try also another chain length. A general rule of thumb for a particular situation is: *the longer the chain, the deeper the ripper tries to dig (and the shorter the chain, the shallower it will go).*

Adjust the hitch point height

Once you have found a reasonable depth, also try another hitch setting.

A *lower* hitch point makes the ripper to move into a flatter position. This will reduce the draft force, and make the tine run more steadily and smoothly. However, if *very flat*, the tine may not easily penetrate into the soil, or jump out.

A *higher* hitch point makes the ripper to go at a steeper cutting angle. In this setting, the chisel tends to penetrate the soil more aggressively. However, a steep tine requires more draft force and does not necessarily lead to greater working depth.

Adjust the wheel height

After you have found an acceptable chain length and hitch point height, you can now position the wheel such that it will turn by the soil. Do this by lowering the wheel onto the ground *while the implement is in working position.*

Ideally the wheel just touches the surface of the soil (most of the time) without much pressure on the axle. It is not a problem if during work the wheel momentarily hangs in the air. But the wheel should not dig very hard into the soil. If it does, then put it up a bit.

❖ RIPPING

It is best to do ripping when the soil is dry to avoid compacting the soil further, and ensure that the hardpan is broken. If the field has a cover crop, slash it (or use herbicide to kill it). When it has dried out, you can use a ripper through the mulch. The mulch protects the soil surface from heavy rain and prevents weeds from growing.

If your field is on a slope, rip along the contour (at right angles to the slope). This will help control erosion. Heavy clay soils will be difficult to rip when they are dry. You may have to rip the field twice to make sure the soil is loosened enough. Ripping heavy clay soils will



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produce large clods, especially if the soil has been compacted. It is a good idea to rip such soils immediately after harvest and before the soils are too dry. A secondary alternative (not the most preferred) is to leave these soils until the first rains have moistened them a little before ripping them.

How far apart to space the ripped furrows?

This depends on the optimum row width for the crop you want to plant. It could be 50 cm row to row for beans or 75 to 90 cm for maize. Animals are generally trained to follow the previous furrow, so the row width will be determined by the length of the yoke between the animals.

❖ RIPPING PATTERN

Opening furrow in the middle of the field

When ploughing, the oxen may have got used to turning every time to one and the same side at the end of the field — the case when only one of the oxen is used to follow the furrow and lead. You can let them keep this custom for ripping. In that case the opening furrow should be in the middle of the field. The subsequent furrows will then be made at *both* sides of the opening furrow in alternating order. This is illustrated in figure 9.

The turns grow wider and wider. If the field is very broad, they will become too wide and time consuming. On such a field, you should consider to start from one side of the field.

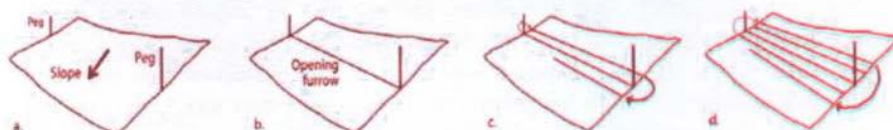


Figure 12: Ripping stages when the opening furrow is in the centre of the field. Marking pegs help to walk in a straight line. The furrows are made across the slope.

Opening furrow along one side of the field

Perhaps the oxen have no problems with turning in any direction, left or right. This is the case if the oxen are well trained and any one of them can be the furrow ox. In that case you may start the opening furrow at one side of the field. Each subsequent furrow is then laid out along the previous one (figure 10).

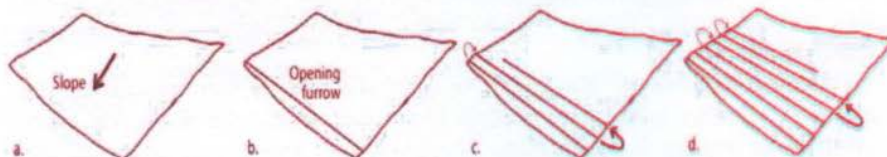


Figure 13: Ripping stages when the opening furrow is on the side of the field

E. Some cautioning remarks on ripping



1. **Always use a ripper in dry soil;** Start ripping as soon as possible after harvest. Try to finish all ripping before the first rains. Note that ripping in dry soil is much harder than in moist soil. Still you can reach a good depth (of not less than 20 cm) by repeated ripping in the same line. Remember: do not rip in wet soil.
2. **Focus on regular work:** Rip in straight or smoothly curving lines along the contour (so, not down the slope). Keep a constant distance between the lines. This distance is equal to the preferred crop row distance (for example 90 cm or 75 cm). Adapt the working depth to what the animals can pull. Do not force them, but gradually improve work over time.
3. **Adjust the ripper for best results:** Fit the ripper on the longest plough or ridger beam you can find. Always use a hitch. This can be the common plough hitch. Attach a long trek chain (3.5 meter). Or connect two chains together. Normally, a longer chain gives an increased working depth. Use the yoke that the animals are most comfortable with. Often this is the ploughing yoke. Have a proper wheel to stabilise the implement. Do not set the wheel too much down. It restricts the ripping depth and puts too much pressure on the wheel causing the axle to wear quickly. On the other hand, if the wheel is too high up, it will just be hanging in the air. So try to set the wheel such that during work it just touches the surface of the soil most of the time.
4. **Always keep the chisel tine sharp:** It is very important to always work with a sharp tine. Without sharpness the ripper cannot penetrate and not break open the dry soil. But if properly sharpened this will be easy. Always start ripping with a new or well-maintained chisel tine. Check the tine daily during the ripping season and sharpen it before it gets too blunt. When sharpening make sure the tine end gets back its original straight sloping angle and ends in a smooth cutting edge (which should be sharp but not razor sharp, as this would weaken the tip). Compare it with a new tine (or the unused other end of the same tine) to do it right. Do no longer use a tine that has worn more than 5 cm (2 inches), as otherwise the ripper frame will start wearing. Either, turn the tine and use its other end, or replace the tine for a new one.
5. **Rip in the previous crop lines:** If possible always rip in the same old crop lines. However, you may find that in certain cases you have to rip between the lines. This can for instance be when planting narrowly spaced crops or for inter-cropping. You can add lime and manure into the furrows immediately after ripping. Then just wait for the rains to come.
6. **Plant directly in the ripped furrows:** Hand plant into the ripped furrows in the recommended planting period once the soil is wet enough. You probably first need to clear the winter ripped furrows with the ripper. Maintain a regular planting distance within the furrows.
7. **Manage the early weeds:** Weeds must be controlled from the very beginning of the season, if necessary even before planting. If not done timely, the weeds will easily overgrow the crop and drastically reduce the yield or even lead to complete crop failure. Also new (virgin) land can be ripped, as long as it has first been cleared from the weeds in one way or another.



F. Care and maintenance of tools and equipment

- Always scrap off soil fragments from the ripper tine attachment to retain its efficiency in ripping the soil
- Replace worn out tines and keep the ripper in good working conditions
- After use, store in favourable conditions, that is in a shade and protect against the sun and rain
- Check for loose bolts and nuts and tighten them every time going to the fields for maximum efficiency of implements



Figure 14: Animal drawn ripper (Magoye ripper) being used in the field (GART)



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