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(Optimising Draught Animal Power for Cropping)

Project R7352

Ploughing demonstrations for smallholder farmers in Masvingo and Chivi districts

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Ploughing demonstrations for smallholder farmers in Masvingo and Chivi districts

A synthesis of dissemination of DAP technology through ploughing demonstrations for farmers

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Cover picture: Ploughing demonstration at Nyamai, 3 December 2001

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Introduction and purpose

The purpose of conducting ploughing demonstrations was to train smallholder farmers in correct setting, operation and maintenance of animal-drawn ploughs as part of disseminating draught animal power technology utilisation. The Optimising DAP for Cropping Project carried out on-farm ploughing trials with selected farmers in the last two growing seasons, 1999-2000 and 2000-2001, but the majority of farmers were not involved in the practical field work. This training exercise was carried out in order to impart, more widely, basic technical and practical skills in correct ploughing techniques to other farmers in the communities that hosted the on-farm trials. Demonstrations were conducted in three project areas in Masvingo and Chivi districts namely, Nyimai, Mushandike and Mutangi from 3rd to 7th December 2001.

Objectives

The overall objective was to impart technical skills, through training of farmers in the DAP project areas, in correct operation, setting and maintenance of single furrow, animal-drawn mouldboard ploughs by conducting one-day practical demonstrations in the farmers' fields.

Specific objectives for the demonstrations

By the end of the demonstration exercise farmers were expected to be able to:

- Identify and explain the different types of ploughs, and the respective manufacturers of ploughs and spares
- Inspect, in order to identify missing parts, breakages and faults on ploughs brought for demonstration
- Name the main plough parts and explain their functions
- Explain the correct plough setting procedure
- Explain repair and maintenance procedures of ploughs

Methodology

Demonstrations were conducted in three of the project areas - Nyimai, Mushandike, and Mutangi. Due to wet weather, the demonstration for Gari farmers was postponed. Farmers brought a plough that had previously been reconditioned by the project team and an ordinary plough in its usual condition for the training demonstration. A brief background to the project activities to date as well as the remaining field activities were given as introduction to each group of farmers before the demonstrations were carried out. After the purpose of the demonstration had been outlined, the group had a general discussion on plough types available, plough parts and functions, plough setting, maintenance and repair and common problems that farmers experience with ploughs. Lastly a practical ploughing demonstration was conducted using the paired-plot approach:

- Plough A- An ordinary plough in its usual condition with farmer's settings
- Plough B- A previously reconditioned plough

Two equal plots, 80 m long and 6 m wide were marked out and ploughed with each of the ploughs. Plot A was ploughed with the farmer's settings using Plough A and Plot B was ploughed using recommended setting procedures on Plough B. Each plot took about half an hour to complete. The same operator and draught animals were used on both plots. The operator's heart rate (HR) was monitored as an ergonomics assessment of the stress on the operator during ploughing. Times taken to complete each plot and depths of ploughing were recorded. Rates of work were determined.

Farmers made observations on the paired plots and compared ploughing depths achieved, soil inversion, burial of weeds, and the quality of ploughing between the two plots. The operator was asked to comment on the difference felt in controlling and manoeuvring the two ploughs and if he felt any discomfort. At the end of each demonstration farmers were given time to discuss observations made and any other general tillage issues and problems.

In the single case where plough A produced adequate cultivation (Nyamai), the paired plots were planted with SC513 maize, after row marking. The host farmer was to carry out all subsequent field operations and keep a record of all activities until harvest. A mid-season evaluation will be done by the same group farmers for them to note any differences in crop growth in the two plots resulting from the two ploughs. Yields from the two plots will be measured and compared at the end of the season. At the other two sites, tillage on Plot A did not justify planting maize.

Attendance of farmers

Table 1 below shows the number of farmers who attended the demonstration sessions.

Table 1: Attendance at ploughing demonstrations

Site	Date	Attendance	Total
Nyimai Dam (CA)	03.12.01	24 women, 10 men, 9 girls, 16 boys	59
Mushandike (Irrigation scheme)	05.12.01	0 women, 11 men, 0 girls, 2 boys	13
Matangi Dam (CA)	06.12.01	9 women, 8 men, 0 girls, 3 boys	20
Gari Dam (CA)	07.12.01	Demonstration postponed due to rainy weather	Nil
CA = Communal Area		Total from 3 sites	92

Types of plough available

The majority of farmers own the standard Mealie-Brand plough with a small percentage owning the Inkunzi Silver Medal plough with a modified hitch assembly. The Haka plough, with a modified hitch assembly, is fairly new on the market and farmers in the project areas were not aware of its availability. The three types of plough have interchangeable parts. The main difference between the standard and the modified ploughs is in the design of hitching assemblies. The principles for adjusting for depth and width as well as the working principles are similar. Zimplow Limited in Bulawayo and Hästt Zimbabwe in Harare (and Norton) are the two main manufacturers of animal-drawn implements in Zimbabwe. Zimplow manufactures Mealie-Brand and Hästt manufactures Haka models of ploughs.

Plough parts and their functions

Although farmers knew the important parts on the main plough assemblies, many did not have good knowledge of the functions of parts. They did not know the primary design function of the frog even though they were aware of its importance. From the discussions held, it emerged that functions of the plough body and hitch assemblies were not well understood. This is one of the primary sources of problems associated with the use of ploughs.

Plough setting procedures

Farmers confirmed that they set ploughing depth by adjusting the position of wheel arms. Depth is the only adjustment that farmers are able to make on the plough since hitch assemblies (drawbar assembly, regulator hakes and adjusting bar holder) are removed from ploughs, even when ploughs are new. The use of the wheel in setting depth of ploughing causes rapid wear on the axle and wheel hub assembly. Even though some farmers were either trainee Master Farmers or certified Master Farmers, they were not confident in setting ploughs correctly. It was evident that most farmers lack basic concepts and practical skills in plough setting. It was noted that younger farmers in the groups were more confident in explaining plough setting procedures. Not all farmers who participated in the on-farm trials in the last two growing seasons could correctly explain plough setting. It was emphasised to farmers that wheel arms should not be used to set ploughing depth. All adjustments for plough setting should be done on the hitch assemblies.

Maintenance of ploughs

Ploughs were generally poorly maintained and there is a lack of knowledge in maintenance procedures. Daily and seasonal maintenance procedures were explained to farmers. The rising cost of plough spares and poor supply systems for spares are some of the constraints that farmers face. In general, farmers lack knowledge in basic preventive maintenance procedures. Farmers were encouraged to keep some stock of spares and bolts.

Demonstration of plough setting and operation

Comparisons between a poorly maintained plough and a reconditioned plough were made on the paired plots. Plough setting procedures were demonstrated on the two ploughs. Farmers noted improved depth and quality of ploughing when a correctly set plough was demonstrated. Plough operators confirmed that a correctly set plough was easier to control and were more comfortable with the handling of the plough. With the correctly set ploughs, there was a reduction in the operators' heart rates whilst the plough was in the soil but it rose slightly whilst turning at the headlands (Nyamai and Mutange – see Annexes 1 and 3). However, the operator's heart rate did not change between ploughing and turning (at Mushandike – see Annex 2) when using a plough that was in poor condition. These results indicate a reduction of operator workload when using a properly set plough compared to using one in poor condition and without hitch assemblies. At Nyamai (see Annex 1), the heart rate data indicate a lower workload for Plough B. With an effective plough, extra effort would be expected for turning at the headlands and this was reflected by the increase in heart rate at Nyamai and Mutange (see Annex 3),. It must, however, be noted that data was collected from a very small sample and there were many variations

from site to site (e.g. age, size and weight of operators, operator skills, plough conditions, soil conditions, forward speed, size of animals and traction systems used).

Discussions on observations made on the ploughing demonstrations
Discussions held during and after the demonstrations helped farmers to understand some of the problems they encounter while using ploughs, which are caused mainly by lack of knowledge and skills.

Issues raised and observations made by farmers
Detailed issues and questions raised by farmers are in Annexes 1-3. Some of the main issues raised were concerned with the following points.

- Lack of knowledge on wear limits of soil-engaging parts and their effect on handling and ploughing characteristics.
- Lack of knowledge on plough specifications and their influence on handling and control (e.g. pitch and land suction, beam clearance, common beam distortions that affect the geometry of the plough).
- Weak materials used in the manufacture of u-clamp plates, set screw, shares and landsides.
- Landsides that are incompatible with old frogs on the standard plough. Farmers have to saw off front tips of new landsides before fitting.
- Manufactures do not supply operators manuals with new ploughs.
- Implements and spares are becoming unaffordable as costs are increasing continually.

Conclusions
The main conclusions that can be drawn from the ploughing demonstrations are:

- The majority of smallholder farmers lacked knowledge of the functions of plough parts and hence ploughs are not used, handled and maintained properly.

- Farmers lacked skills and knowledge on the basic concepts on plough setting and correct operation. Removal of hitching assemblies and regulating mechanisms is a common practice that prohibits correct plough setting and use.

- Ploughs are poorly maintained as a result of the continuously rising cost of spares and poor spares supply systems in some areas.

- The manufacturing quality of some plough parts was an issue of concern among smallholder farmers. Specifically, farmers were concerned with the quality of shares and landsides that wear out quickly and the weak material used in the manufacture of u-clamp plates and the adjusting bar holder set screw on the Mealie-Brand standard plough.

- Farmers require training in operation, repair and maintenance of ploughs (and other implements).

- There is a need for farmers to be provided with self-instruction guidelines that will help them through the technical problems they experience with ploughs.

- The demonstrations made farmers aware of wrong practices, common technical problems and faults associated with ploughs and how these could be how overcome.

- The ergonomics (heart rate) results indicate that a correctly set plough in good working condition, reduces stress on the operator through the plough being easier to control and handle in the field.

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UZ:
A Senzanje, N Mhazo.

Agritex-Masvingo and Chivi:
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Annex 1

DAP ploughing demonstration

Date: Monday, 03 December, 2001
Location: Nyimai Dam
Host farmer: Mafa T
Village: Ruvhairo
Ward: 16
District: Chivi
AEW:
CARE Field Officer: Mutiwasekwa Z

Facilitators: T Koza and J Magumise

Composition of participants

Women	Girls	Men	Boys
24	9	10	16
Total of females:33		Total of males:26	
Total number of participants: 59			

Types of ploughs available locally
Most farmers were aware of one type of plough, the Zimplow standard plough with a drawbar hitching system and few farmers were aware of the Inkunzi Silver Medal with a modified hitching system. It was explained to farmers that the main difference in the ploughs was on the hitching systems and how the adjustments for depth and width were made, but the working principle was the same. Farmers were not aware of the Haka plough manufactured by Hästt Zimbabwe. The Haka plough has a modified hitch assembly and adjustments are similar to the silver medal plough. All the three types of ploughs have interchangeable parts.

Below are descriptions of ploughs brought for the demonstration.

Plough	Type	Description of plough and remarks on condition
A	Standard[1] plough	Old plough, missing drawbar assembly, no hake, no regulator bar holder, worn share, worn landside, worn mouldboard, worn wheel axle, broken wheel
B	Standard plough	Plough was repaired by DAP project team in December 1999, in a good condition, handle-moulboard stay wrongly fitted.
Other (C)	Modified[2] plough	Inkunzi Silver Medal plough, repaired by DAP project team in May 2000, plough in good condition

[1]Single furrow plough with drawbar assembly and hake regulator
[2]Single furrow plough with modified hitch assembly (depth and width clevis attachment)

Plough parts and functions
Farmers were able to identify most plough parts but were not confident in explaining their functions. Farmers thought that the frog (*chitende*) was the most important plough component. Farmers perceive the function of the plough body parts as that of protecting the frog. In fact, the frog is the component on to which the plough body parts are bolted in order for then to perform their specific functions. All plough parts and their functions were explained to farmers.

Plough setting procedure
Farmers were asked to explain how to set a plough using the available two types of ploughs. None of the farmers was confident to explain plough setting. A young man (who later operated the ploughs) volunteered to explain. Farmers confirmed that they set the ploughing depth by raising or lowering the wheel arms. Since most farmers remove hitch assemblies even when the ploughs are new, they did not know how to set the ploughing depth and width using the drawbar assembly mechanism. According to farmers, the main reason for removing the drawbar hitch assemblies from ploughs was to make them lighter for animals and the operators.

The young man who volunteered to explain plough setting managed to explain how to adjust depth and was assisted to explain width setting by Messrs. Mafa and Pwanyai (these two farmers had been previously trained during on-farm testing of ploughs). Plough setting procedures for the standard and the modified plough hitch assemblies were explained. A few farmers tried out the different adjustments on the ploughs.

Maintenance of ploughs

It was noted that one of the main reasons why most ploughs were in bad condition was the lack of knowledge on basic preventive maintenance. Farmers cited the increase in cost of spares as a major problem, as they could not afford the high costs. It was also stressed to farmers that ploughs must be maintained regularly and it was important for them to keep some spares in stock. Farmers were advised to follow the following procedures to keep their ploughs in good working conditions and avoid wasting time repairing ploughs or looking for spares.

Daily maintenance procedure:

1. Remove/scrape off soil in the field
2. Tighten all nuts and bolts
3. Wash and apply some oil if the plough is not to be used in the next few days
4. Store under shed

Seasonal maintenance procedure (i.e. at the end of the ploughing season)
Farmers must carry out the following procedure:

1. Check plough body parts and wheel for wear
2. Obtain replacement parts if necessary
3. Strip the plough
4. Clean parts and paint if necessary
5. Replace worn out nuts and bolts
6. Re-assemble the plough and oil it if it was not painted
7. Store the plough is a safe and dry place (store under shed/store room)

Farmers were urged to keep spares as shown below:

Spare parts stock guide

1 share for 2 ha (5 acres)
1 set of wheel and axle for 10 ha (25 acres)
1 landside for 15 ha (40 acres)
1 mouldboard for 50 ha (125 acres)
1 king bolt
1 round head bolt

Demonstration of plough setting and operation

The three ploughs were used on three equal plots starting with Plough A, then Plough B and lastly Plough C. The harnessing system was checked and chain length was measured. Before ploughing with ploughs B and C, emphasis was on correct setting for depth and width and trial runs were made first until the desired depth and width were achieved. Explanation was given at every stage of adjusting the ploughs, particularly Plough C, that had the modified hitch assembly with which the majority of farmers were not familiar. A few women tried out the ploughs to have a feel of how the ploughs handled in the field.

Results from the demonstration

Location	Nyimai	
Operator	Kudakwashe Madzivamatatu	
Sex	Male	
Age	25	
Mass	68 kg	
Height	165 cm	
Arm length	70 cm	
Plough used	**Plough A**	**Plough B**
Mean ambient temperature	26.5°C	27°C
Rest HR	68	68
Final HR	118	108
Time for final HR to return to rest HR	541s	231s
Mean ploughing HR	109	103
Mean turning HR	108	108
Mean ploughing and turning HR	108	105
Mean depth of ploughing	9.8 cm	16 cm
Work rate	0.077 ha/hr (12.9 hr/ha)	0.12 ha/hr (8.33 hr/ha)
Operator's comment	Pain in wrist and arms; plough difficult to control	Plough easier to control and handle; no discomfort felt

HR = Heart rate (beats/min)

The heart rate (HR) recorded while ploughing with Plough B was 6 beats/min lower than with Plough A. Heart rates during turning were however the same for both ploughs. The operator's HR returned to the resting level more quickly after ploughing with plough B. This faster recovery rate implies that using plough B caused less fatigue. Ploughing depth and workrate increased by 63% and 55% respectively when plough B was used. It must be noted that HR is influenced by a number of variables that include weight of ploughs, depth and width of cut, speed of travel and ambient conditions as well as personal factors relating to the operator.

Discussion on observations made on the ploughing demonstration

The group mobiliser, Mr Pwanyai, led the discussion. Farmers clearly saw a marked difference in quality of ploughing, depth, soil inversion and burial of weeds between Plough A and the other two ploughs. The other two ploughs gave better results than Plough A. The operator confirmed that Ploughs B and C were easier to control than Plough A as he was forced to use extra effort to control Plough A and he was always leaning and pushing it towards the furrow.

Farmers were asked to go through the main plough parts and their functions. The share and landside were removed and two women took turns to replace the parts respectively. This was done to ensure that women had grasped some practical skills in replacing parts correctly.

As a summing up the following points were reiterated:

- The importance of all plough parts especially the soil-engaging parts and the need to make checks on the wearing parts so that the frog is not exposed to wear
- Never to oil the wheel and axle assembly
- Not to use the wheel for setting ploughing depth

Issues raised by farmers/Questions and Answers/Observations

- Mr Mafa was assisted to fit a handle-to-mouldboard stay correctly on to his plough. He had not realised that he had fitted it the wrong way round.
- Farmers requested if manufacturers would be informed of the problems they are facing with the new Mealie Brand symmetric share that bends easily and wears out quickly.
- The u-clamp plate material is weak and bends easily, even when new. Plough B (Mr Mafa's) had two clamp plates on the right side to take up the force when tightening.
- The farmer with Plough A had improvised the u-clamp assembly by using a clamp plate on either side of the wheel arms.

Although it was noted that the clamp plate was of weak material, farmers should not need to over-tighten the clamp if they did not use the wheel for setting depth. Using the wheel assembly in this way imposes unnecessary (and excessive) forces thereby causing the wheel arms to slip out of position.

Annex 2

DAP ploughing demonstration

Date: Wednesday, 05 December, 2001
Location: Mushandike Irrigation Scheme
Host farmer: Mr Tenda
Village: 12
Ward: 16
District: Masvingo
AEW: Kumbulani Hlongwani
CARE Field Officer:

Facilitators: T Koza and J Magumise

Composition of participants

Women	Girls	Men	Boys
0	0	11	2
Total of females:0		Total of males:13	
Total number of participants: 13			

Types of plough available locally
Not all farmers were aware of the two main types of ploughs. Most farmers were familiar with the standard plough with a drawbar hitching system and just a few were familiar with the Inkunzi Silver Medal with a modified hitching system. The former Bulawayo Steel Products (BSP) implement brochure was used to show the Silver Medal plough. It was explained to farmers that the main difference in the ploughs was on the hitching systems and how the adjustments for depth and width were made, but the working principle was the same. Farmers were not aware of the Haka plough manufactured by Hästt Zimbabwe. The Haka plough has a modified hitch assembly and adjustments are similar to the Silver Medal plough. All three types of plough have interchangeable parts.

Below are descriptions of ploughs brought for the demonstration.

Plough	Type	Description of plough and remarks on condition
A	Standard plough	Plough in fair condition, worn wheel hub and axle, hake bolt replaced with wire, missing beam-mouldboard stay, frog round head bolt replaced with ordinary bolt-this was causing square holes on frog to become rounded, regulator hake was put the other way round and always gave farmer a wide cut and farmer confirmed that he always had to lean to force plough down and towards the furrow.
B	Standard plough	Plough was repaired by DAP project team in November. 2000, in a good condition, except a piece of wire used to support the drawbar (indicating farmer (Mr Ngesi) had problems with the set screw).

Plough parts and functions
Farmers were able to identify most plough parts but were not able to explain their functions. They thought that the frog was the most important plough component. Farmers perceived that the function of the landside was to protect the frog and failed to explain the primary function of the frog (i.e. the frog is the component on to which the plough body parts are bolted in order for then to perform their specific functions). All plough parts and their functions were explained to farmers.

It was stressed to farmers that they needed to get into the habit of showing their children the correct way of replacing parts so that children would grow up knowing the correct procedures and practices only, since skills and knowledge are passed from father to son.

Plough setting procedure
Farmers were asked to explain how to set a plough using the available ploughs. None of them was confident to explain plough setting. A young farmer, (Elias Charumbira) volunteered to explain how to set a plough. He correctly explained how to set depth but was not confident in explaining width setting. Although he gave the

correct procedure for width of cut adjustment, he was not confident in what he had said. Farmers confirmed that they set the ploughing depth by raising or lowering the wheel arms and removed the drawbar hitch assemblies to make ploughs lighter. Plough setting procedures for both the standard and the modified ploughs hitch assemblies were explained.

Maintenance of ploughs

It was noted that one of the main reasons why most ploughs were in bad condition was due to lack of knowledge on basic preventive maintenance. Farmers cited the increase in cost of spares as a major problem. It was emphasised to farmers that ploughs must be maintained regularly and it was important for them to keep a stock of spares. Farmers were advised to follow the following procedures in order to keep their ploughs in good working conditions and avoid wasting time repairing ploughs or looking for spares.

Daily maintenance procedure:

1. Remove/scrape off soil in the field
2. Tighten all nuts and bolts
3. Wash and apply some oil if the plough is not to be used in the next few days
4. Store under shed

Seasonal maintenance procedure (i.e. at the end of the ploughing season)
Farmers must carry out the following procedure:

1. Check plough body parts and wheel for wear
2. Obtain replacement parts if necessary
3. Strip the plough
4. Clean parts and paint if necessary
5. Replace worn out nuts and bolts
6. Re-assemble the plough and oil it if it was not painted
7. Store the plough is a safe and dry place (store under shed/store room)

Farmers were urged to keep spares as shown below:

Spare parts stock guide

1 share for 2 ha (5 acres)
1 set of wheel and axle for 10 ha (25 acres)
1 landside for 15 ha (40 acres)
1 mouldboard for 50 ha (125 acres)
1 king bolt
1 round head bolt

Demonstration of plough setting and operation

The regulator (hake) on plough A was removed, turned around and bolted so that the longer end was on the left side of the beam, in the direction of travel. Initially Plough A was set at maximum depth while the wheel was set for shallow ploughing by the owner. This was explained as the possible reason why the axle was badly worn due to downward forces being exerted on the wheel assembly. This setting was corrected by re-adjusting the plough and the setting procedure was explained. The owner of the plough then tried out the plough and, it was seen that it had poor penetration due to a worn share. Plough B was set and then demonstrated. Depth of ploughing and heart rate measurements of the operator were recorded. No comparisons were made between the two ploughs since Plough A failed to penetrate.

Results from the demonstration

Location	**Mushandike**	
Operator	Enerst Mapanzure	
Sex	Male	
Age	40	
Mass	60 kg	
Height	160 cm	
Arm length	73 cm	
Plough used	**Plough A** (no readings taken)	**Plough B**
Mean ambient temperature		28°C
Rest HR		79
Final HR		107
Time for final HR to return to rest HR		62s
Mean ploughing HR		107
Mean turning HR		107
Mean ploughing and turning HR		107
Mean depth of ploughing		12cm
Work rate		0.072ha/hr (13.8 hr/ha)
Operator's comment		Some discomfort in the wrists, handle bars out of alignment

An average depth of cut of 12 cm was achieved with Plough B and the mean heart rate for the operator was 107 beats/min. There was no difference in HRs for ploughing and turning. Plough A was not demonstrated as it did not penetrate the soil.

Discussion on observations made on the ploughing demonstration

Farmers appreciated the explanations given during the demonstration and confirmed that they had gained some knowledge in correct setting and functions of plough parts.

As a summing up the following points were reiterated:

- The importance of all plough parts especially the soil-engaging parts and the need to make checks on the wearing parts so that the frog is not exposed to wear
- Never to oil the wheel and axle assembly
- Not to use the wheel for setting ploughing depth

Issues raised by farmers/Questions and Answers/Observations

Q: One farmer wanted to know why plough operators tended to lean and push the plough while ploughing.

A: This is caused by a combination of factors that include harnessing specifications, implement condition and setting and the operator's skills. If the landside is worn, its contact area with the furrow wall is reduced and it will not take the side forces. This causes instability and the operator has to force the plough down for it to remain in the furrow. Also if the yoke centre distance is wider than 90 cm the plough will tend to follow the central position taken by the trek chain and the operator will have problems with controlling the plough.

Q: Farmer with Plough A: He had removed all parts from another plough that had failed to penetrate and assembled the plough he brought for this demonstration which he was now using. He did not know why the plough couldn't penetrate.

A: Again there are a number of factors that influence penetration characteristics of a plough. A well set plough with no defects should be self-penetrating. The farmer was advised to check beam clearance; check beam curvature-compare with another good beam- if beam is deformed/distorted it can be straightened by cold working; check if the beam lower tip did not protrude beyond the frog i.e. it is not in contact with the ground, if it is, then it tends to lift the plough. The other factor could be lack of 'pitch'- a plough must have down suction and land suction for it to penetrate. These aspects were shown to farmers. Pitch and land suction reduce gradually as the share and landside wear. Mr Ngesi had the same problem with a new plough. A quick check on the pitch and land suction revealed that his plough did not have neither pitch nor land suction. This plough should have been a factory reject. Mr Gesi requested if this problem could be brought to the attention of the manufacturer (Zimplow).

Farmers were advised to use the correct size of king bolts. The king bolt acts like a shear bolt and protects the plough from deforming if it hits a root, stump or rock. However, some farmers fit large bolts to replace broken king bolts. These large bolts will not shear to protect the plough if it hits a big obstacle and the beam usually deforms.

A point was raised by farmers about new landsides that do not fit easily on to frogs. Farmers have to saw off part of the front tips of landsides before fitting. This was a common problem and farmers expressed their concern. Farmers were advised to keep spares to avoid work stoppages and incurring transport costs to service centres or towns as breakages occur unexpectedly.

Annex 3

DAP ploughing demonstration

Date: Thursday, 06 December, 2001
Location: Mutangi Dam
Host farmer: Chirove N (Mrs)
Village: Tambu
Ward: 10
District: Chivi
AEW: Madzore A (Mrs)
CARE Field Officer: Mutiwasekwa Z

Facilitators: T Koza and J Magumise

Composition of participants

Women	Girls	Men	Boys
9	0	8	3
Total of females:9		Total of males:11	
Total number of participants: 20			

Types of plough available locally
The farmers who were present were aware of one type of plough, the standard plough with a drawbar hitching system. The modified ploughs, Inkunzi - Silver Medal and the Haka ploughs, were shown to farmers using pictures in respective brochures. It was explained to farmers that the main difference in the ploughs was on the hitching systems and on how to make adjustments for depth and width of cut. The working principle was the same for all ploughs. Farmers were not aware of the Haka plough manufactured by Hästt Zimbabwe. The three types of plough have interchangeable parts.

Below are descriptions of ploughs brought for the demonstration. Both ploughs belonged to Mrs Chirove.

Plough	Type	Description of plough and remarks on condition
A	Standard plough	Very old plough, missing drawbar assembly, no hake, no adjusting bar holder, worn share, worn landside, worn mouldboard, worn axle, broken wheel. Plough was not being used.
B	Standard plough	Plough was repaired by DAP project team in December 2000, in a poor/fair condition, worn shin of moulboard, worn axle and hub, kingbolt and other nuts and bolts loose, very worn frog and holes for landside exposing bolts, new share and new landside.

Plough parts and functions
Farmers were able to identify most plough parts but lacked confidence in explaining their functions. Farmers thought that the frog (*chitende*) was the most important plough component. "The frog is the plough", said the farmers. Farmers could not explain the primary functions of the plough body. They perceived the function of the plough body parts (share, landside and mouldboard) as that of protecting the frog. In fact, the frog is the component on to which the plough body parts are bolted in order for then to perform their specific functions. One lady described the hitch assembly as the "controller", which was correct in a way. All plough parts and their functions were explained to farmers. Farmers confirmed that they removed the drawbar hitch assemblies in order to reduce the weight of ploughs.

Plough setting procedure
Farmers were asked to explain how to set a plough using the two ploughs. None of the farmers was confident to explain plough setting. Farmers confirmed that they set the ploughing depth by raising or lowering the wheel arms. Since most farmers remove hitch assemblies even when the plough is new, they did not know how to set the ploughing depth and width using the drawbar assembly mechanism. Farmers just did not possess the basic concepts of adjusting ploughs correctly.

Plough setting procedures for the standard and the modified plough hitch assemblies were explained. A few farmers later tried out the different adjustments on the ploughs during the demonstration.

Maintenance of ploughs

It was noted that one of the main reasons why most ploughs were in bad condition was due to lack of knowledge on basic preventive maintenance. Farmers cited the increase in cost of spares as a major problem as they could not afford the high costs. It was also stressed to farmers that ploughs must be maintained regularly and it was important for them to keep a stock of spares for emergencies that may occur. Farmers were advised to follow the following procedures in order to keep their ploughs in good working conditions and avoid wasting time repairing ploughs or looking for spares.

Daily maintenance procedure:

1. Remove/scrape off soil in the field
2. Tighten all nuts and bolts
3. Wash and apply some oil if the plough is not to be used in the next few days
4. Store under shed

Seasonal maintenance procedure (i.e. at the end of the ploughing season)
Farmers must carry out the following procedure:

1. Check plough body parts and wheel for wear
2. Obtain replacement parts if necessary
3. Strip the plough
4. Clean parts and paint if necessary
5. Replace worn out nuts and bolts
6. Re-assemble the plough and oil it if it was not painted
7. Store the plough is a safe and dry place (store under shed/store room)

Farmers were urged to keep spares as shown below:

Spare parts stock guide

1 share for 2 ha (5 acres)
1 set of wheel and axle for 10 ha (25 acres)
1 landside for 15 ha (40 acres)
1 mouldboard for 50 ha (125 acres)
1 king bolt
1 round head bolt

Demonstration of plough setting and operation

Plough A was demonstrated first to show the problems with a plough in poor condition and without a drawbar hitch assembly. Plough B was used with the farmer's setting first. The harnessing system was checked and rear chain length was measured. Initially the front chain was connected to the clamp on the rear yoke shaft. This was corrected so that the front chain was connected to the rear chain. Two runs were made before making the correct depth and width adjustments and relieved the force acting on the wheel. Explanation was given at every stage of adjusting on the plough. Ergonomics assessments included heart rate readings taken whilst working with the correctly set plough. Soil inversion and weed burial were poor due to the worn mouldboard.

Results from the demonstration

Location	**Mutangi**	
Operator	Taurai Chirove	
Sex	Male	
Age	19	
Mass	66 kg	
Height	180 cm	
Arm length	75 cm	
Plough used	**Plough A (no readings taken)**	**Plough B**
Mean ambient temperature		28.5°C
Rest HR		92
Final HR		114
Time for final HR to return to rest HR		64s
Mean ploughing HR		118
Mean turning HR		122
Mean ploughing and turning HR		119
Mean depth of ploughing		19 cm
Work rate		0.09 ha/hr (11.11 hr/ha)
Operator's comment		No discomfort felt

An overall mean heart rate of 119 beats/min was recorded while ploughing at an average depth of 19 cm. The average HR for ploughing only was 118 and this increased to 122 beats/min during turning.

Discussion on observations made on the ploughing demonstration
Farmers saw a marked improvement in depth of cut and quality of ploughing after the plough was properly set. The operator confirmed that the plough was easier to control after correct setting as he did not need to force the plough down.

Farmers made the following comments:
- They had learnt a good lesson from the demonstration
- Plough handling was easier after correct setting
- They had learnt how to connect the front chain to the rear chain correctly.

As a summing up the following points were reiterated:
- The importance of all plough parts especially the soil-engaging parts and the need to make checks on the wearing parts so that the frog is not exposed to wear
- Never to oil the wheel and axle assembly
- Not to use the wheel for setting ploughing depth

Issues raised by farmers/Questions and Answers/Observations
One farmer commented that they lacked knowledge on plough setting because there were no instructions provided by the manufacturers when they bought ploughs. It was explained to farmers that this DAP project was in the process of preparing guidelines for farmers that would assist them in solving some of the technical problems that they encounter.

Another farmer who had inherited a plough from his father thought that his plough, which did not have a drawbar hitch assembly, was quite normal as it has always been in that condition for many years. No one had told him that a drawbar assembly was missing and he never knew its function. He remarked, "You should have taught us a long time ago. Where were you all along?"

Annex 4

DAP ploughing demonstration

Date: Friday, 07 December, 2001
Location: Gari Dam
Host farmer: Mr Nhubu
Village:
Ward: 23
District: Chivi
AEW: B Mupumha
CARE Field Officer: N Mutemachimwe

Facilitators: T Koza and J Magumise

Demonstration was postponed to a later date in January 2002, due to rainy weather conditions.