



Conservation Farming Unit - Zambia

MECHANISED MINIMUM TILLAGE SERVICE PROVISION

THE NEXT STEP SMALL SCALE AGRICULTURE & CF

INTRODUCTION

Between the 1970's and mid 1980's numerous ***government sponsored*** mechanisation schemes aimed at providing ploughing services to small-holders were introduced in many countries across Africa.

Predictably these schemes failed and in general mechanised tillage is considered inappropriate for small-scale agriculture



Mention of mechanisation in the small-holder context lands on deaf ears!

- How can mechanisation be relevant to small-scale farmers?
- How can it help them?
- How can they afford it?
- How could it have a major impact?
- Small farmers use hoes and animal draft power what's in it for them?
- Why should it succeed when it has failed in the past

The Kenya example contradicts this assumption

In the Central highlands and Rift Valley areas of Kenya and to a lesser extent in other areas, hundreds of thousands of small-scale farmers rely on privately owned mechanised tillage services to prepare their fields for planting.

Mechanised tillage is also common in Arusha/Moshi in Tanzania

The problem is that the service involves ploughing and harrowing

Kenyan farmlands - Continuous overall soil disturbance



Typical landscape in Maize/Bean belt. Many thousands of hectares are **dug by hand or ploughed** ready for the onset of the rains.

Mechanised ploughing of small farms is big business

Thousands of farms of 0.5 ha upwards are ploughed by contractors who migrate across the country dry ploughing before the rains .



Many hundreds of tractors owned by small contractors and medium scale farmers provide this destructive service .

Dust and Damage

Diesel consumption: Ploughing 13 to 16 litres/ha. Harrowing 6 to 8 litres/ha



Some farmers have their fields ploughed only, some ploughed and harrowed. **Plough hire costs \$90/ha. Harrowing \$40/ha**

Zambia – Mechanised Ploughing



Tractor ownership by small & medium farmers in Zambia is minimal. **Perhaps 100 to 150 units?** Many are severely dilapidated.

Ploughing is done after the onset of the rains. Effective operating window is 2 to 3 weeks only. **Diesel consumption is 12 to 15 litres/ha. Cost US\$100 - \$120/ha**



Dry Ploughing - Damaging Class A Soils

In Zambia dry ploughing is less common. **Effective depth only 8cms to 10cms.** Disc harrowing may follow.



Conversion to Mechanised Minimum Tillage (MT)

The damage to soils caused by continuous overall soil disturbance of any kind including ploughing has been known for over 70 years

- Pulverisation and oxidation of top soil
- Wind and water borne soil erosion
- Soil compaction and panning

In addition mechanised ploughing consumes excessive amounts of fuel

In Africa 70% of arable and pastoral farmland is reckoned to be partially or severely degraded

The American Dust Bowl first made people think about the damage caused by intensive disturbance of the soil by continuous ploughing



The Dust Bowl of the 1930's in the Mid West wheat belt was caused by a combination of droughts, continuous ploughing and the loss of natural grasses that held the soil

CFU Mechanised Ripping Trials

Various rippers and modifications to these are being tested in search of the most suitable equipment for service providers

Key requirements :-

- Dry ripping to a depth of 20cms to 25cms max

(Due to shallow animal and tractor drawn ploughing and hoeing, compaction occurs mainly between 10cms and 15cms depth).

- No clogging of crop residues where these exist.
- Minimal surface soil disturbance and minimal draft requirement
- Minimal uplift of large clods to soil surface.

Technical Considerations

Clogging in Heavy Residues



The standard BP ripper from South Africa and the standard Ndume ripper, from Kenya (with crumblers) both clog up when operating in heavy residues

Ripping depth 20cms to 24cms satisfactory in both cases

Clogging in Heavy Residues



Much less clogging with the 3 tine ROVIC-LEERS ripper – but too expensive

Clogging in Heavy Residues

Performance of Modified NDUME Rippers:-



Both these options worked satisfactorily in heavy trash.

Issues:

Cutting discs used were very expensive.

Setting crumblers close to tines breaks off trash but there is no room for 'kick back' of tines if obstacles encountered and shear bolts snap.

Clogging in Heavy Residues

Performance of Modified BP Ripper



BP Ripper with crumblers set close to tines also performed well in heavy trash but again no space for 'kick back' of tines

Ripper Tine Design Draft Power and Fuel Consumption

60 HP TAFE 2WD TRACTOR. GEAR SELECTION 4 LOW. SOILS CLAY LOAMS.



The Ndume shanks and tines are a parabolic shape, whereas the BP is more vertical and narrower. Test showed that the **Ndume Ripper** used **8.2 litres/ha** diesel whereas the **BP** used **5.8 litres/ha**

Ripper Tine Design Soil Disturbance and Clods



Both BP and NDUME rippers produce large clods in heavy soils, although the BP somewhat less.

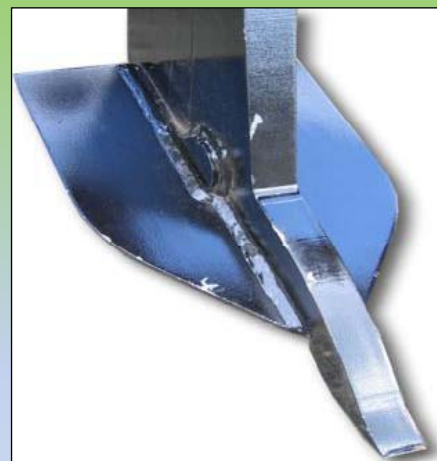
In these conditions in Zambia crumblers will not break up clods.

Clods are **not necessarily a problem** with the exception of dry planted Cotton, For other crops planting by any method would be done after early heavy rains.

Ideally however soil disturbance should be minimised with CF



Could Sub-Lift Tines provide a better solution?



They are claimed to minimise draft, minimise surface soil disturbance and crack pans more effectively?

POSSIBLE TECHNICAL SOLUTION - ZAMBIA

- CUTTING DISCS IN FRONT OF TINES?
- LOW DRAFT SUB-LIFT TINES?
- PRICE NOT ABOVE \$3,500 FOR 2 TINE VERSION?

Ripping Tests: Fuel Consumption and Costs per/ha

All Ripping Tests: 60HP 2WD Tractor. Gear 4 Low

Test 1: Dry Ripping	BP 2 Tine Ripper with Close Set Crumblers	
Condition	Soil Dark Hard Clayey Loam. Heavy residues 60% cover	
Time/ha - Hrs	1.29	
Fuel/ha litres	5.8	
Cost Fuel/ha on site	\$8.12	ZMK 40,600
Cost Fuel Including Return Travel to Site + 50%	\$12.18	ZMK 60,900
Charge to Client Fuel x 3.5	\$42.63	ZMK 213,150
Depth	21cms- 24cms	
Clogging of trash	NIL	

Diesel ZMK 7000/litre. Rate ZMK 5000 = \$1

All Ripping Tests: 60HP 2WD Tractor. Gear 4 Low

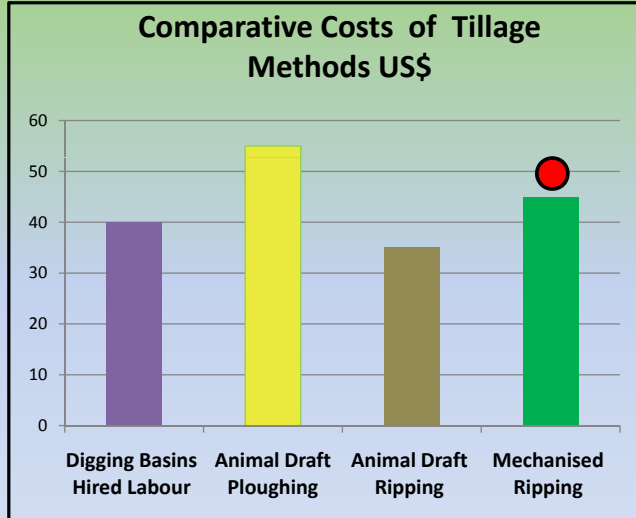
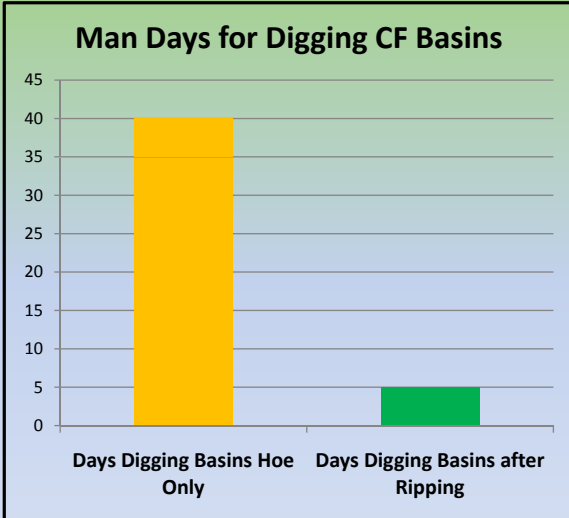
Test 2: Dry Ripping	NDUME Ripper with Narrow Tines & Close Set Crumbles	
Condition	Soil Dark Hard Clayey Loam. Heavy residues 60% cover	
Time/ha - Hrs	1.61	
Fuel/ha litres	8.2	
Cost Fuel/ha on site	\$11.48	ZMK 57,400
Cost Fuel Including Return Travel to Site + 50%	\$17.22	ZMK 86,100
Charge to Client Fuel x 3.5	\$60.27	ZMK 301,350
Depth	21cms- 24cms	
Clogging of trash	NIL	

Diesel ZMK 7000/litre. Rate ZMK 5000 = \$1

Wet Ploughing Test : Fuel Consumption and Costs per/ha

Test 3: Wet Ploughing	Baldan 2 Furrow Disc Plough	
Condition	Moist Brown Clayey loam. 3 days after full irrigation. No residues	
Time/ha - Hrs	3.15	
Fuel/ha litres	12.79	
Cost Fuel/ha on site	\$17.91	ZMK 89,530
Cost Fuel Including Return Travel to Site + 50%	\$26.86	ZMK 134,295
Charge to Client Fuel x 3.5	\$94.00	ZMK 437,032
Depth	19cms - 20cms	

Labour and Cost Comparisons

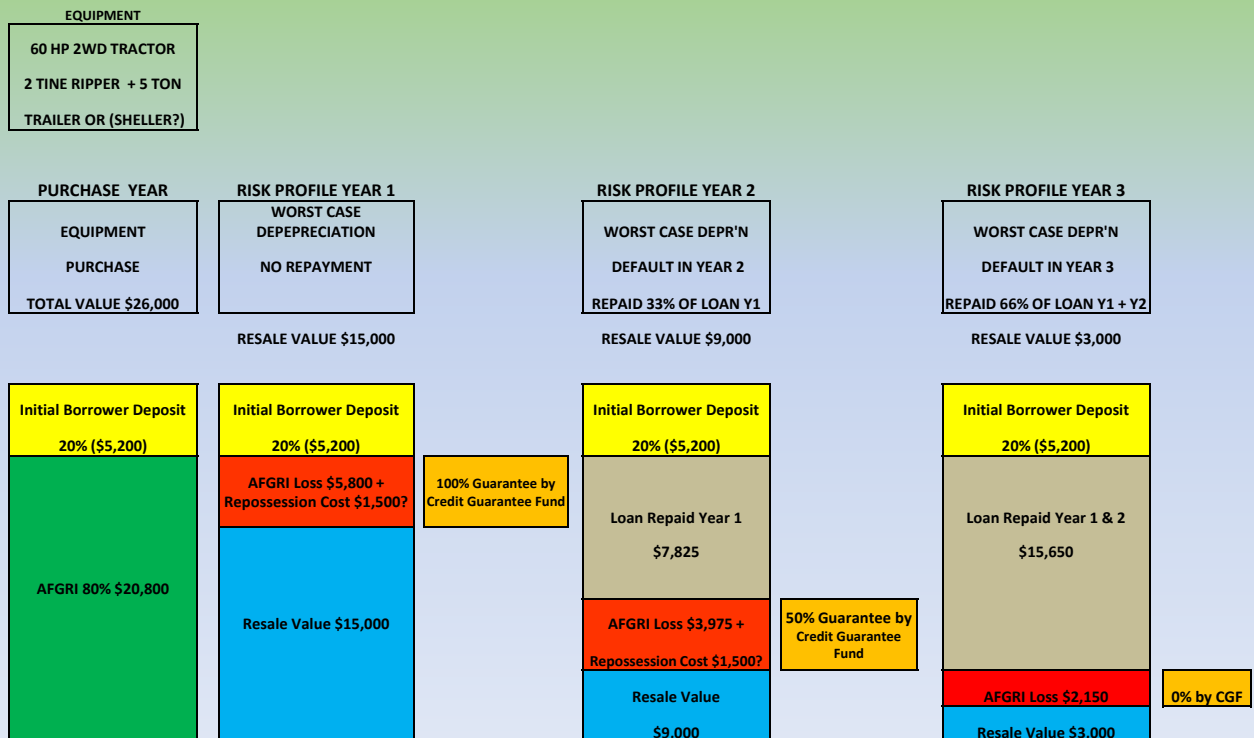


● Can fuel consumption be reduced further with more efficient tines?

AFGRI/CFU EMERGENT FARMER EQUIPMENT LEASING SCHEME MODEL FOR SERVICE PROVISION - MINIMUM TILLAGE, HAULAGE, (MAIZE SHELLING)

RISK PROFILE: WORST CASE SCENARIO ON RESALE VALUE OF REPOSSESSED EQUIPMENT

Acknowledgement: Modified from PROFIT modelling



EMERGENT FARMER EQUIPMENT LEASING SCHEME MODEL FOR SERVICE PROVISION – MINIMUM TILLAGE, HAULAGE, (MAIZE SHELLING)

Additional Requirements:-

- **Service contract built into lease/purchase model**
- **Individual beneficiaries grouped in close localities**
- **Careful pre-screening and final selection**
- **Comprehensive business and technical training**
- **Regular monitoring and support**

Target 5 Years

Kenya: 600 to 1000 operators convert from ploughing to MT?

Zambia: 300 to 350 MT service providers financed?

Tanzania: ?

Uganda: ?

Carbon Finance?

**For each 20,000 hectares of conversion from ploughing to MT
140,000 litres of fuel saved**

If disc harrowing included saving is 260,000 litres

Much easier verification than biological systems

Combining MT and Herbicides

In Zambia the CFU estimates that 1 million families spend in total **60 million SPD's hand weeding crops each year**. Much of this work is done by women and children.

The situation in Kenya and elsewhere is no different. Weeds are a major problem consuming millions of hours of labour, competing for water and nutrients and reducing crop yields, FS and income.



Kenya

WEED CONTROL AND COSTS – GLYPHOSATE	\$-HA
Maintenance/Depreciation Sprayer (20 ha)	4.0
Cost of Glyphosate 360 at 3 litres/ha	30.0
Total Cost:	34.0 (ZMK 170,000)
Hand Weeding late weeds (15 man days)	14.0 (ZMK 70,000)
TOTAL	48.0 (ZMK 240,000)
HAND WEEDING ONLY	\$-HA
Man Days Hand Weeding, 3 Rounds (60 to 70 days)	
Cost of Hand Weeding Hired Labour	\$60.0 (ZMK 300,000)

WEED CONTROL AND COSTS – MAIZE SELECTIVE

\$-HA

Maintenance/Depreciation Sprayer (20 ha)	4.0
Cost of Atrapac Plus at 3 litres/ha	33.0
Total Cost:	37.0 (ZMK 185,000)
Hand Weeding late weeds (10 man days)	9.3 (ZMK 46,500)
<u>TOTAL</u>	<u>46.3 (ZMK 231,500)</u>

HAND WEEDING ONLY

\$-HA

Man Days Hand Weeding, 3 Rounds (60 to 70 days)

Cost of Hand Weeding Hired Labour **60.0 (ZMK 300,000)**

Examples of Effective Herbicide Use



With careful training small-scale farmers can use herbicides effectively.

The cry that *'herbicides poison soils'* is because farmers use the wrong products in the wrong manner at the wrong time. NO TRAINING.

Knowledge and absolute attention to detail is critical

Silent Chibinga: 2 litres/ha *Glyphosate 460*. Post weed/Pre crop treatment . First time user!

Examples of Effective Herbicide Use

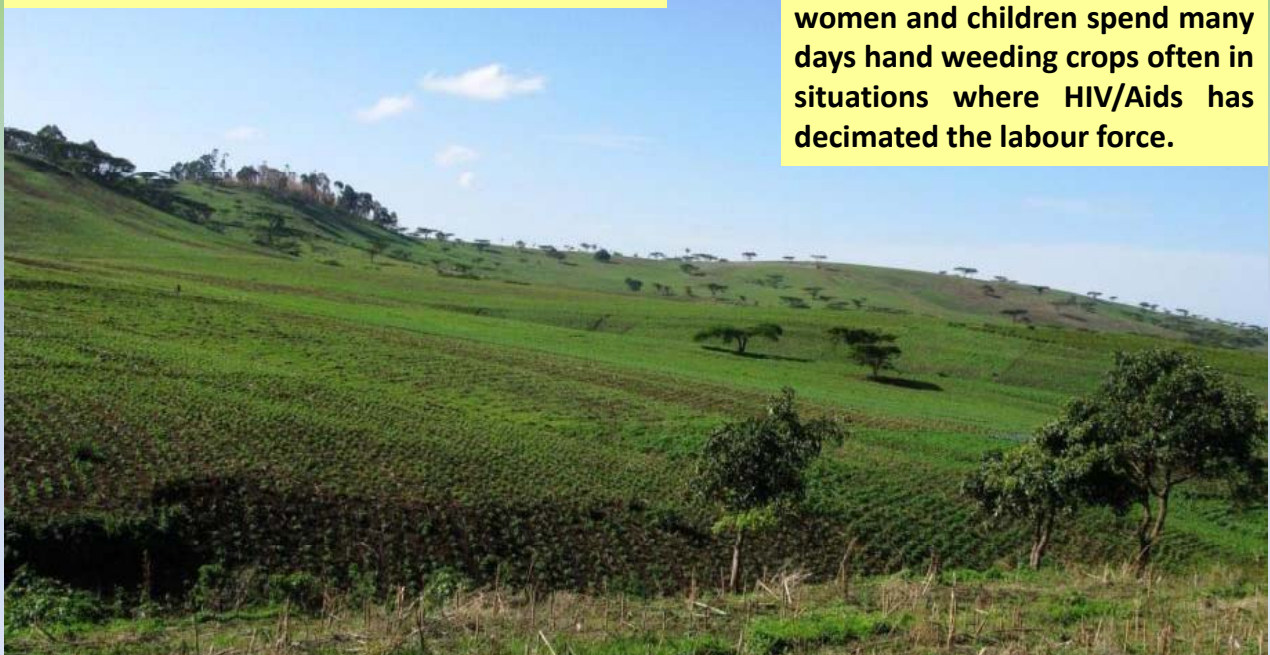


When properly used herbicides slash labour inputs, cut costs when labour is hired for weeding, increase yields and enable farmers to expand cropped area.

Mr Inranchimimsa. Post emergence with 3litres/ha Atrapack Plus Maize selective. First time user!

The anti-herbicide lobby

Herbicides are not perfect but continuous overall soil disturbance is far more damaging



Those who campaign against herbicides should recognise the social implications of their actions. In Africa millions of women and children spend many days hand weeding crops often in situations where HIV/Aids has decimated the labour force.

In Zambia weeding tasks commence as early as 5am and coincide with the school term, hardly a recipe for children to be in a fit state to absorb knowledge!