



World Association for Transport Animal Welfare and Studies

Workshop 2004
Common ground: moving forward with
animals

Reference No./1



Animal power for crop production: new tillage or no tillage? Benefits and constraints

Jim Ellis-Jones and Andy Whitmore

Reference No./2



Areas to be discussed

drawing primarily on SSA (Nigeria and Zimbabwe) experience

- Power sources availability in selected regions
- Evolution of tillage methods
- Advantages and disadvantages of conventional tillage
- Benefits and problems associated with conservation tillage
- Increasing use of transgenic crops in conservation agriculture
- Where to next?

Reference No./3



Proportional contribution (%) to total power use in selected regions- unchanging statistics

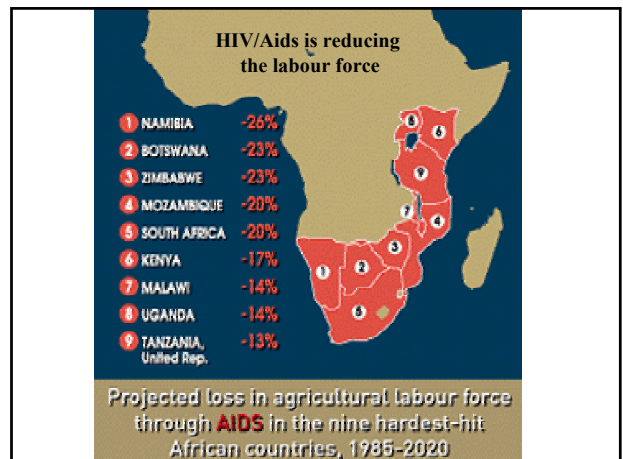
Region	Human	Animal	Tractor
N Africa	69	17	14
sub-Saharan Africa	89	10	1
Asia (excl China)	68	28	4
Latin America	59	19	22
Overall	71	23	6

Most households are dependant on human or animal power for tillage operations, especially in SSA

Reference No./4



Hand tillage is back breaking, and results in low labour productivity



Hand tillage, especially weeding is often undertaken by women



Ploughing is dependant on the availability of suitable animals and implements, with peak period demands



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ECONOMIC VALUE OF DRAFT ANIMALS Zimbabwe smallholder sector

ECONOMIC USE	% OF TOTAL VALUE	
	CATTLE	DONKEYS
Draft power	63.6	95
Milk	13.6	-
Manure	3.9	2
Meat	8.5	-
Herd growth	10.4	3-5
Social value	important	-
TOTAL	100	100

Draft includes, primarily, tillage and transport, with ploughing needing most power

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Evolution of tillage methods

- Intensive and continuous use of the plough
 - ➔ criticised, but widely practised
- Reduced tillage
 - ➔ Ripping or harrowing
- Green manuring and incorporation by plough or hoe
 - ➔ Especially in humid tropics and higher potential areas
 - ➔ More problematic in semi-arid areas
- Conservation agriculture (increasingly seen as the way forward)
 - ➔ Zero-tillage with direct seeding
 - ➔ Permanent soil cover (thru' green manure cover crops, or at least 30% crop residues)
 - ➔ Crop rotations (usually cereal-legume)
 - ➔ In field and between field soil and water conservation measures
 - ➔ Currently estimated to be 67 million ha worldwide
 - 9.2 m ha in Argentina
 - 13.5 m ha in Brazil
 - ➔ Areas increasingly associated with transgenic crops

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Advantages associated with conventional tillage

- Well known, trusted and tested technology
- Provides soil moisture conservation if undertaken at the right time.
- Means of controlling weeds
- Provides good seed bed for planting
- Land preparation can be combined with planting

Interestingly better resourced households often plough three times

- ➔ Immediately after harvest for moisture conservation
- ➔ During the middle of the dry season (especially if rain falls) for weed control
- ➔ Just prior to planting to prepare the seed bed

Reference No./11

Ploughing to control weeds prior to planting





Skewed ownership of draft animals in Zimbabwe (smallholder sector)

		% of farmers (n=248)	
No animals			37
Inadequate animals	Donkeys only	10	16
	Cattle and donkeys	2	
	Cattle only	4	
Adequate animals	Donkeys only	4	47
	Donkeys and cattle	12	
	Cattle only	31	

- Over 50% of households own inadequate draft power for primary tillage
- Draught animal ownership is associated with better resourced farmers

Reference No./13



Problems associated with conventional tillage

- Inadequate draft power, especially in poorer households
 - ➔ Non availability of ploughs, reliance on hand hoes
 - ➔ Reciprocal labour arrangements for weeding in return for often late ploughing
- Development of a plough pan (often at less than 10cm)
 - ➔ Increased run-off, reduced soil moisture
- Declining soil organic matter, loss of soil structure
- Increased soil erosion due to poor soil cover
 - ➔ Declining soil fertility, land degradation
- Increased fertiliser use, if funds permit
- Stagnating or declining yields

Reference No./14



Weeds can still be a major problem



Potential benefits for conservation tillage

- Saving in labour
- Reduction in draft power requirement
 - ➔ Poorer households can benefit
 - ➔ Longer period available for planting
 - ➔ Timeliness less critical
- Better soil moisture conservation
 - ➔ Resistance to mid season droughts
- Improved soil organic matter, soil structure and build up in soil fertility, less erosion and reduced land degradation
- Increased yields and productivity

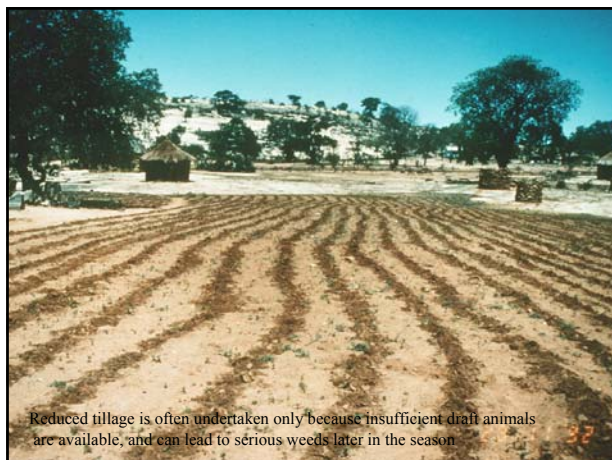
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Problems associated with conservation tillage

- Need to build up a permanent cover with green manure or crop residues
 - ➔ Problematic in drier areas, or
 - ➔ Where crop residues are required for fodder, or
 - ➔ Residues are consumed by termites
- Where land/food is scarce, households are unwilling to grow a green manure
 - ➔ A legume (soybean, cowpea, ground or bambara nut) may be more suitable grown in rotation with cereals
- Problem of weed control
 - ➔ Need to use herbicides, possibly in initial stages (3 years)
- Build up in crop pests, especially when a rotation is not used
 - ➔ Stem borer and cutworm in maize
- Need to destroy crop residues, especially cotton

Reference No./17



Reduced tillage is often undertaken only because insufficient draft animals are available, and can lead to serious weeds later in the season

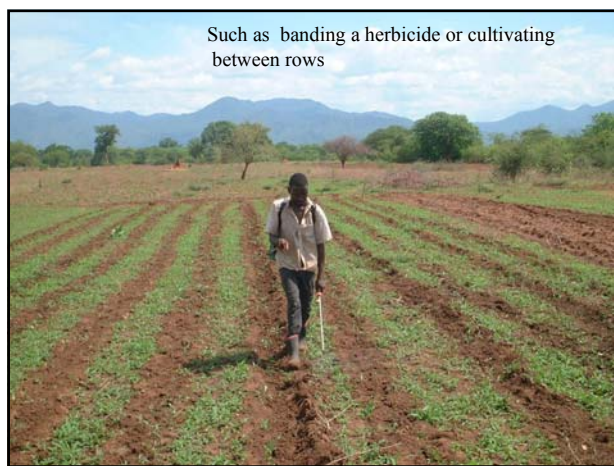
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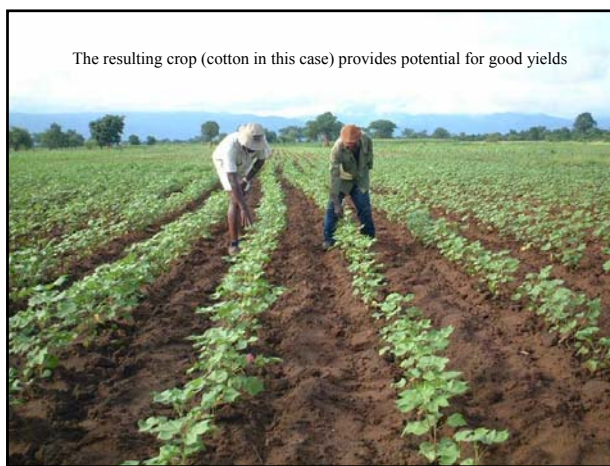
Weeds have completely overtaken this reduced tillage maize crop



Ploughing planting lines requires additional measures for weed control



Such as banding a herbicide or cultivating between rows



The resulting crop (cotton in this case) provides potential for good yields



Spraying *Imperata* with glyphosate before planting



Mucuna used to suppress *Imperata* is proving popular in some areas



Use of transgenic crops by country (often used in conservation agriculture)

Lead countries	Area (million ha)	% of total
USA	42.8	63
Argentina	13.9	21
Canada	4.4	7
Brazil	3.0	4
China	2.8	4
South Africa	0.4	1
India	0.1	<1
Other	0.3	<1
Total	67.7	100

Reference No./25



% of area planted to transgenic crops often in soybean-maize no tillage systems

Crop	% of global total (2003)
Herbicide tolerant soybean	61
Herbicide tolerant maize	5
Herbicide tolerant canola	5
Herbicide tolerant cotton	2
Bt/Herbicide tolerant maize	5
Bt/Herbicide tolerant cotton	4
Bt maize	13
Bt cotton	5
Total	100 (67 m ha)

Reference No./26



Where to next?

- Reduce or eliminate draft power requirements for tillage allowing animals to be used more productively
 - *for transport, for milk, for meat*
- Reduce labour input
 - *To increase labour productivity and provide time for other activities*
 - *To mitigate the effects of HIV/Aids*
- Identify legumes for food, fodder, biomass and weed control
- Reduce weed competition and pest damage
 - *Improve the effectiveness of herbicides with reduced applications and safer products*
 - *Multi purpose control systems*
 - Such as push-pull (Napier and *Desmodium* for stemborer, *Striga* and soil fertility)
- Is there a role for transgenic crops ? (arguments for another day)

Reference No./27