DIRECT DRILLING AS A TOOL IN CONSERVATION AGRICULTURE FOR SMALL FARMERS

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Abstract

The practice of Direct Drilling has become widely used during the past few decades as a means of conserving soil moisture and combating soil erosion. The most progress has been in the development of suitable large scale planting equipment designed for use in crop production on big farms sometimes extending to thousands of hectares. This tackle requires the largest tractors of several hundred horse power to be able to operate it: something which puts it completely out of reach of the small farmer. The latter may rely on contractors to plough his crop area or even own a small tractor himself. Usually the pre planting operation is with a disc plough followed by a disc harrowing. This can be extremely bad for the soil causing a breakdown of soil structure, the formation of plough pans and accelerated soil erosion.

In the last two years a prototype small direct planter has been developed to replace the disc plough for use with smaller tractors, something which has been rather neglected until now. This has been tried with success in Kenya and this presentation discusses work done to date; the challenges faced and the requirements for a large extension input to overcome the inherent resistance to change by farmers and the reasons for the latter.

Africa can ill afford to repeat the destruction of soils which has occurred in some other parts of the world and this paper aims to outline one method by which this may be achieved.

Keywords: conservation agriculture, smallholder, mechanised, zero tillage

1. Introduction

Conservation agriculture can be broadly defined as having three main components:

- minimum soil disturbance,
- maintenance of an organic soil cover,
- rotation of crops (Derpsch & Friedrich 2009).

In order to meet these criteria a wide range of planting equipment has been developed especially to meet the first two components. Most development by manufacturers has been for large scale machines capable of being used with the most highly powered tractors which is not relevant to small farm situations.

Considerable work has been carried out in the development of simple machines to be used with animal power or with small engines for self propulsion. (Sims & Kienzle 2006). A common method of land preparation in Kenya is disc ploughing with regular tractors followed by disc harrowing. This can lead to one of the most brutal treatments of soil especially, as is often the case, when the weather conditions are not suitable. However there does not appear to be much in the way of simple reasonably priced direct planting equipment to provide a sound alternative to the commonly used 3 furrow disc plough. One such simple direct planter, which could provide the answer, is described below.

Abbreviations: ADC: Agricultural Development Corporation, CA: Conservation Agriculture, DPRK: Democratic People's Republic of Korea, FAO: Food & Agriculture Organisation.

2. History of mechanised conservation farming in Kenya

This section is very much based on the author's personal experience when working with the ADC on large farms in the Rift Valley province in the 1980's. In the previous decade there had been the initiation of minimum and zero tillage development simultaneously in Brazil and Australia with a different emphasis and objectives in both Countries. In the former it was generally the concern over soil erosion in areas which generally receive adequate rainfall for crop production. In the latter it was the retention of soil moisture which was the key factor. Both are important in Kenya and throughout Africa.

At this time large areas of land were being opened up to cultivation on the grass plains of Ngorengore on land leased from the Masaai which in addition to the large scale ADC farms and other pockets of large farmers in the Mount Kenya region and Mau Narok provided a ready market for suitable minimum tillage equipment. The latter, because most of the influence on development in Kenya came from Australia with retention of soil moisture the primary concern. (Kenya may have been able to be a good example to Brazil in soil conservation in the form of contouring, bench terraces etc!) As farmers from Kenya visited Australia under the sponsorship of a chemical company who were marketing the new herbicide 'glyphosate' which can be a critical component of CA, they began to import minimum tillage machinery and a local company was established at Gilgil to manufacture similar equipment in Kenya.

This became a very successful business with a big increase in demand for both cultivation equipment and pneumatic seeders. At that time there was very little opportunity for smaller farmers to gain access to the new technology.

The writer was based outside Kenya for the next decade. During that time he worked for a short period in DPR Korea and could see the potential opportunity for a transition to more sustainable farming in that beleaguered Country. It is not a surprise to him to see the rapid successful development in no till farming that has taken place there in the last few years. Previous experience in the Southern part of Malawi where monoculture, continued ploughing and lack of animal input has led to an alarming decrease in crop yield due to declining fertility, had helped to develop his perspective.

On resuming regular visits to Kenya over the past decade the huge step forward in CA has become apparent and just recently the attempt to convert more farmers to using soil sustainable types of implements has been impressive but generally on a large scale.

3. To plough or not to plough

During his spell with ADC the writer often visited an elderly relative who farmed on Mount Kenya and engaged in great idealogical arguments on the merits or otherwise of the plough. Being a ploughing judge and on the committee of the National Ploughing organisation, this farmer was not to be persuaded that the plough could be a bad tool. Open minded at the time, the writer has to confess that twenty years on he has been converted to realising the damage that the plough can cause. His appreciation of this fact does not extend to the belief that the plough should be eliminated altogether as some zealots of CA would have us believe. What better implement than the disc plough for bringing into cultivation recently cleared 'bush land' or the mouldboard for preparing land which has been under grass leys for the subsequent arable part of the rotation.

It is the much greater awareness of the damage we are doing to our soils, the increasing attention to how we may rectify this and great strides in the development of technology that has persuaded him to alter his opinion.

The plough pan is probably the most deleterious of the disc plough's effects. It causes impeded soil drainage leading to poor crop growth, soil erosion and degeneration of soil structure. In order to combat this, one solution has been to resort to subsoiling and even development of machines such as the 'shakerator' which 'batters the soil into submission'.

It is essential to carry out preliminary work to break up the plough pan especially in the worst cases before the direct drilling system can be properly executed. In addition the amount of trash on the soil surface will almost certainly have to be reduced somewhat, though it is essential to maintain some cover.

The alternative to this former ill treatment of soils are tined implements which simply open up the crop rows. Thus effectively one is only disturbing a small proportion of the soil but the effect of pulling a tined implement at depth through the soil helps to improve the porosity and enable the microorganisms to act more efficiently. Where soils are damaged severely a remedial action such as subsoiling will be necessary before this equipment can be effectively used. What farmers have to appreciate is that although the work done is not as obvious as with disc ploughing, where the movement of the soil can be easily seen, the amount of tractor power required is similar in pulling the tines through the soil. This is a psychological factor that needs to be overcome through extension.

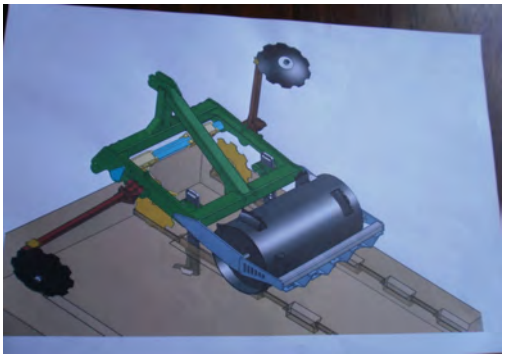
2. The Kenya small farmer's access to CA equipment

In the County of Yorkshire in England, a manufacturer of farm equipment has for a number of years been producing conservation farming equipment including direct seeders. Some of their large scale equipment has already been successfully introduced onto large farms in Kenya. A UK farmer who appreciates their benefits, having retired and handed over to his son, has now teamed up with some of the large scale farmers in Kenya in an attempt to introduce a specially adapted small scale version for using with the most common tractors.

Although there are some planters already on the market, this machine is very simple in providing minimum disturbance to the soil yet breaking through the pan and making fracture lines in the soil for moisture infiltration and improved plant root development. A two row machine with a disc opener to break through the surface layer of trash followed by a narrow tine which although it 'lifts' the soil is counteracted by a heavy roller on the back to minimize soil disturbance. The roller is fitted with flanges which are spaced so as to cause indentations in the soil into which the seed may be hand placed.

The Sumo 2 row planter

Rows 90cm apart, 25cm within row



The planting holes are set for maize – the main smallholder crop

This machine was first tried in 2010 in the Mara and Ngorengore and then more extensively in 2011 and 2012 again in the Mara, at Kiboko and in Eldoret and Kitale. The most successful crop was in the Mara and the farmer involved was prepared to use it again in the following season. He was unwilling however to pay the going rate equivalent to the cost of disc ploughing. This again highlights that principal difficulty of changing the mindset: the power used in opening the soil at depth to produce two lines for the crop rows is equivalent to that of ploughing. However the results are not as 'spectacular' on the eye as that of total soil inversion as is the case with disc or mouldboard ploughs.

Ngorengore, Kenya – November 2011

National Ploughing Final U.K. – September 2011

Another difficulty in promoting C.A. is in demonstrating that crop yields usually improve over time. It may take several seasons before this fact becomes apparent to farmers. It is also important to realise that in order to justify improvements in one part of the crop production that all the other inputs must be optimum to go from a really base level of crop yield to the sort of yields that large farmers are able to obtain, which may be up to five times or more the average.

A holistic approach is necessary rather than a marginal gain by only improving the cultivation which has been the practice in some other C.A. ventures.

Very often CA practice is farmer led. Such an example is the British immigrant farmer to Brazil, John Landers OBE, who is one of the founding fathers in that Country where over 25 million ha are now under some form of CA. He is a regular contributor to a magazine 'Direto no Cerrado' which is published in that Country. (www.apdc.org.br)

Planter at Shimo ltd, Mara river Nov 2011

Good penetration in the crop row

Compare that to Kenya where the figure is something like 33,000ha. In fact it is estimated that in the South American Countries of Brazil, Argentina and Paraguay about 70% of arable land is under some form of CA compared to less than 0.5% in Africa. This has taken about 40 years to achieve but there is no reason why similar progress should not be possible in Africa.

The work described here has been carried out so far by farmers with the support of some willing entrepreneurs which has required a considerable input in terms of finance and time. It now requires the wider community to provide finance and for research and extension officers to take on board the need for such technology and to assist with persuading farmers the necessity of adopting CA practices. As a Malawi colleague remarked to me: 'the plough was imported into Africa from western Countries and now you are telling us that we should stop using it!'

3. Conclusions

An example of an economic alternative to the disc plough/disc harrow system which is common throughout much of the African continent has been described. The difficulty of persuading farmer that it is a viable system has been highlighted partly because of the long term nature of the benefits to become apparent. Perhaps this may be easier to demonstrate in environments where more damage to the soil has already been the case, such as in some of the more eroded areas in Kenya or in South Malawi with pronounced decline in soil fertility.

4. References

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