CONSERVATION AGRICULTURE ON SMALL FARMS IN HILLY AREAS OF AFRICA

Ashburner, J.E[1].

FAO Regional Office for Africa, PO Box 1628, Accra, Ghana. John.Ashburner@fao.org

Key words: Conservation agriculture, reduced tillage, water harvesting, indigenous plants, living fences.

Introduction:

A glance at a topographical map of Africa reveals a considerable area of highlands but it is difficult to estimate how much of these constitute "hilly" areas. Indeed, the lowlands also contain many hilly areas and it is thus extremely difficult to quantify their relative importance as a production area. But why are hilly areas often under cultivation anyway, given the incipient problems of protecting the slopes from runoff damage and the frequent shallow and degraded soils? Many hills have been occupied and cultivated for many years following historical events, the hills offering strategically defendable positions and being productive then when rainfall was more abundant. In other cases, people have been more recently physically displaced to these areas during the establishment of large-scale plantations (***Box 1***), dams and reservoirs and during other major construction or "development" activities. And population pressure on the land has increased dramatically in some regions, again leading to the need to exploit the hills, the normally more marginal lands. Most farmers living in hilly areas are small-scale, resource-poor and live at near subsistence levels. They have very restricted access to basic services, agricultural supplies, technical support and information, communications and markets. This said, hilly areas there are and their management problems are real (Shaxson, 1999).

Box 1: The community of Shewula stretches over a territory of about 15,000 ha on the Lubombo plateau in North-Eastern Swaziland. The community was relocated to the Lubombo plateau in the early 1980's when its previously owned lands on the fertile plains below the plateau were developed for sugar production by international consortia. The Shewula population of about 10,000 people is a typical Swazi rural community, characterised by low standards of income, a poor quality of service and difficult access to inputs. The Community's agricultural production area is now limited to between 10 and 12,000 ha and the remainder of the area mainly comprises steep hillsides. Shewula was the first community in Swaziland to set aside a portion of its land to create a natural reserve and was involved in the creation in April 1999 of the Lubombo Conservancy which includes a number of contiguous protected areas.

With this backdrop, how can the author attempt to encourage meaningful discussion on the topic at this Round Table? A number of experiences within the region will be reviewed and although the paper does not constitute a scientific presentation, it is designed to provoke thoughts as to the identification of possible "gateways" for future development approaches to improve the sustainability of farming systems in the region. It is suggested that one approach is through promoting the adoption of the principles of conservation agriculture (CA).

[1] The views expressed in this paper are those of the author and do not necessarily represent the official views of FAO

Conservation Agriculture

Before embarking upon the main subject matter of this paper and following advice from the preparatory workshop held at Siavonga, Zambia in May 2003 in preparation for this 2nd World Congress (ACT, 2003), it is appropriate to define what the author wishes to imply by the terminology "Conservation Agriculture". Briefly stated, he wishes to suggest that CA is the simultaneous practice of minimal soil disturbance, maintenance of a permanent soil cover and crop rotations/associations. It may be shown in diagrammatic form as illustrated in ***Fig.1***.

In this context:

- Minimal soil disturbance = zero tillage = no tillage = direct planting
- Permanent soil cover may be achieved by the crop itself, a cover crop, residues and/or mulch
- Crop rotations/associations may be achieved through crop sequences, intercropping, relay cropping and/or mixed crops
- The terminology "Conservation Tillage" is commonly used in Africa and covers a broader spectrum of tillage activities including ripping, tied ridges, basins, strip tillage and others. It thus encompasses a range of tillage practices that may be progressively reduced to achieve minimal soil disturbance as suggested as one of the three principles of CA.

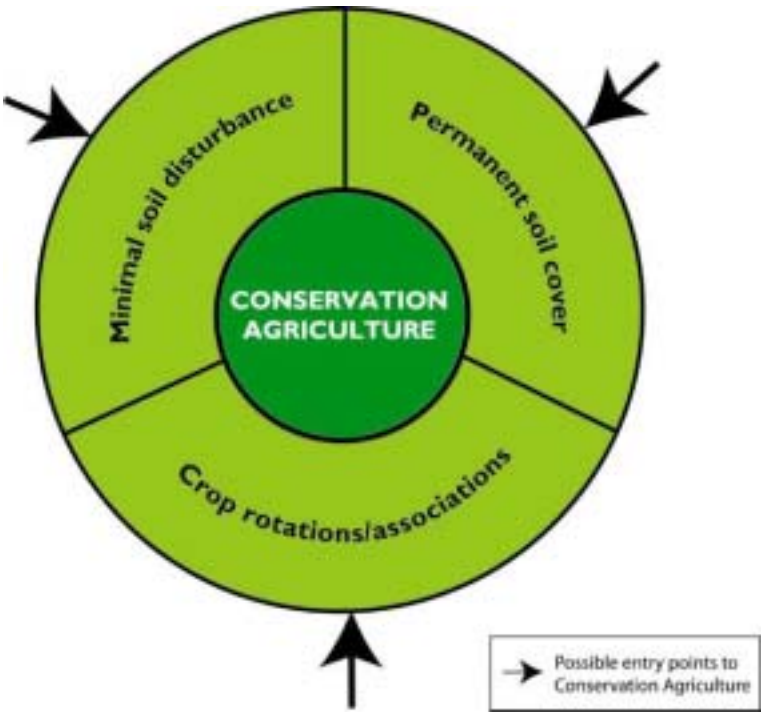

Fig.1 The three basic principles of Conservation Agriculture, as defined for the purposes of this paper

Reduced tillage in Algeria:

An FAO project was conducted for five years on the high plateau of Western Algeria in the early 1980's. Entitled "Integration of Cereal and Livestock Production", it conducted applied research on large state farms ("domaines") and organised training sessions through field days and a series of extension publications. Although not strictly a "hilly" area, two key elements in the programme are of relevance to this discussion:

- Focus was placed on reducing tillage operations, in particular the predominant soil tillage method using disked implements – the use of chisel ploughs and tined cultivators was promoted;

- Efforts were made to increase forage production through sowing cereals together with legumes and to improve forage conservation through making both silage and hay.

The results obtained from moving to the use of tined tillage equipment were exasperatingly variable in their effect (Ashburner, 1984). But herein lay a dramatic illustration of why it is essential to satisfy all the principles of CA if a sustainable solution is to be achieved. In this experience, the concept of a permanent soil cover was totally ignored and the author now believes that even the use of tined equipment was causing devastating and unnecessary losses of soil moisture in this low rainfall region.

Reduced tillage and ripping in Niger:

Subsequent experience was gained due South of Saïda, Algeria and over the Saharan sands to near Tahoua, Niger. Here the project, amongst other various activities, attempted to improve soil tillage methods and to promote the use of draft animal power in an even drier region (around 200 mm but with variability and erratic distribution). A tined "ripper" was fabricated after studying a report prepared some years previously by a Swiss engineer. Although the ripper was tested, results were not convincing. Neither were any of the conventional tillage trials, looking at reducing tillage operations. The author's reflection today, again leads to the conclusion that unless all the principles of CA are considered, results will never be sustainable. The importance of permanent soil cover had been overlooked.

Fig.2 Ripper planter

But the concept of the ripper continued to be intriguing and may also have influenced the successful development of the "Magoye" ripper and the "Palabana" planter (LAMP/SCAPA 1999, ***Fig.2*** and ***Box 2)***. The Round Table might find it interesting to discuss how these two pieces of equipment have played a successful role in improving the sustainability of agricultural production in Eastern Africa.

Box 2: The Golden Valley Agricultural Research Trust (GART) has been publishing informative and well-illustrated Yearbooks since 1999. In the 2001 edition it was observed that "*It is assumed that conservation tillage will be part and parcel of a more comprehensive conservation farming approach. Conservation tillage is not expected to raise yields considerably or improve soil structure or organic matter status all by itself. This requires proven measures such as crop rotation, residue management, and use of cover crops, all non-mechanical means unlike soil tillage. Improved tillage however can provide the conditions to make such technologies worthwhile and acceptable. Early on-the-row ripping for instance is a way to harvest water from the onset of the rains, right where you need it and want to keep it. This will benefit particularly the many soils that suffer from hard pans at shallow depths, e.g. as a result of plowing."* (GART, 2001)

Water harvesting in Niger:

Before leaving the topic of Niger, the amazing developments made through the "Keita" project both on very steep "hills" or on flatter areas must be mentioned. The project focused originally on the extremely marginal lands in the Tahoua Department near Keita. Heavy machinery including, 4WD and conventional tractors and excavators, animal traction and human labour were all harnessed to bring back into production land that had been completely denuded of all vegetation and probably was without any chance of ever being rehabilitated by the local populace. Investment costs were very high but results spectacular (Carucci, 1990*)*. There is no doubt that the success achieved was mainly due to choosing as a "gateway" the introduction of "water harvesting" techniques (***Figs.3*** and ***4***). Interestingly, permanent soil cover in this semi-arid area never seems to have entered into the equation and yet the results regarding overall agricultural production in the region are highly respected.

Fig. 3 President Kountché Hill, Keita, Niger showing reforestation in progress in deep trenches (FAO, 1994)

The challenge with improving soil moisture management and utilization is to maximize the capture, infiltration and storage of rainfall water in the soil. In practice, this can be achieved not only by water harvesting, but more importantly by promoting farming systems that enhance the physical and biological condition of the soil. These need to cause it to become more porous, absorptive, rich in organic matter rich and biologically diverse and active. The potential of CA to achieve this merits being another topic worthy of debate by the Congress, particularly for the low rainfall regions that constitute a significant proportion of Africa.

Fig.4 Water harvesting on the plateau region of Keita, Niger (FAO, 1994)

Indigenous plants in Swaziland:

Let us focus now on the hills of North Eastern Swaziland where initial awareness creation activities have been undertaken regarding the concepts of conservation agriculture, with particular emphasis placed on the potential use of indigenous legumes and cereals as cover crops. A series of practical training exercises with lead farmers was carried out during the year 2002. The Shewula community has now established a nursery (***Fig.5***) and several of the farmers have also made their own collections of

local seeds, planting them out on small plots on their own farms. The response of these farmers to the training can only be described as truly remarkable, tremendous enthusiasm being shown and great dedication to the tasks entrusted to them (Calegari, 2002). The rapidity with which they seem to have grasped the significance of the techniques being promoted leads one to realise that it is difficult to predict how farmers will react – in this case a mere 4 weeks of training inputs have already had significant results. The problem of "Mindset" (***Box 3***) noticed only recently during an advisory mission to the FAO CA project in South Africa (Derpsch, 2003), does not appear to be relevant for this particular Swazi community. This reaction and the different "gateway" of indigenous crops are the two aspects that the author wishes to underscore in this example.

Fig.5 Opening the nursery for indigenous plants and cover crops at Shewula, Swaziland

A third issue is also of considerable importance within the Shewula community as the effect of the HIV/AIDS pandemic is particularly serious. The significant and increasing numbers of orphans and women-led households mean that there is a very real labour constraint. CA offers an appreciable alleviation of this problem, a fact that has also been thoroughly understood by the lead farmers participating in these preliminary activities.

Box 3: "Mindset (defined as attitude, frame of mind, or fixed direction of thought) seems to be the major constraint to the introduction of Conservation Agriculture into the different Agro-ecologic Zones of South Africa. Mindset is essentially ignoring things that are already common knowledge in this country and other parts of the world. For instance there is a lack of understanding of the laws that govern water infiltration into the soil. Sometimes researchers, extensionists and farmers believe that tilling the soil increases water infiltration into the soil. There is enough scientific evidence that shows that soil cover is the major factor that governs the water infiltration process and that when the soil is bare most rainfall water is lost because of runoff. Therefore attention has to be paid to this fact and information has to be generated and disseminated on "understanding the process of erosion and water infiltration", directed to scientists, researchers, extension officers and farmers". (Derpsch, 2003)

Fencing in Burkina Faso and Eritrea:

The issue of fencing to protect fields where uncontrolled grazing is a traditional practice merits discussion and again, results can be quite surprising. Recent experiences in Burkina Faso and in Eritrea have been unexpected and highlight the fact that farmers certainly understand far more than that with which they are sometimes accredited. The first step in Burkina Faso was to secure the straw residue from the previous harvest with guards at all five project sites but considerable delays occurred before the metal fencing was erected and on only one site was the residue maintained. Some 6 months later and in

the absence of any further rainfall, the farmer was shown that appreciable soil moisture still remained under the straw cover on this field. Word got around and soon farmers were visiting from up to 10 km away to check the veracity of what they had heard.

Fig.6 A living fence starting to grow, inside a mesh fence in Burkina Faso

The crops were eventually established during the 2002 season and despite only this field having been reasonably managed throughout the dry season, production results were impressive on all sites. A series of field days were arranged for an expected attendance of perhaps 20 farmers at each of the 5 sites. Over 800 participants were welcomed, including many local dignitaries. The installation of the fences had been expected to provoke considerable resistance and yet this has now proven to be the essential "gateway" in this region of South West Burkina Faso (***Fig.6***). Indeed these farmers are now considering how to establish their own living fences directly, without the need for the expensive erection of a temporary metal fence.

CA project activities only commenced in Eritrea in December 2002 and all residues were overgrazed at the 3 sites, before the fences could be erected in February/March 2003. But it was the acceptance of the concept of the fences that was the most surprising, in this country where uncontrolled pasturing is a deeply established traditional right. The second surprise was on a site in the highlands where one of the farmers guessed that the project was going to suggest leaving the straw residues on the field and this, before any explanation of the project objectives had been made. Could it be that this community had already considered this option previously? Had they already considered alternative feed sources for their many animals?

In conclusion, the foregoing remarks have not been rigorously restricted to "hilly" regions but the author believes they illustrate some of the wide range of factors that can influence the eventual adoption of CA according to the specific local socio-economic and agro-climatic conditions. The concept might be better sold as a water-harvesting exercise, the exploitation of local indigenous plants or the physical protection of production plots with fencing. Each case is likely to differ from previous experiences and surprises always seem to await the promotion effort. It is pleasing to experience that these surprises can often be very enriching.

References:

ACT (2003) Flyer produced at the African preparatory workshop for the 2nd CA World Congress, Siavonga, Zambia, 19-23 May 2003. Workshop report (in preparation). RELMA, Nairobi

Ashburner, J.E. (1984) Dryland tillage practices and studies in Algeria. FAO Panel of Experts on Agricultural Mechanisation, 6th Session, Adana, Turkey, October 1984. 22p.

Calegari, A. (2002) Report on the Africa consultancy for FAO. RAFA, FAO Regional Office for Africa. October 2002. 36p.

Carucci, R. (1990) Aperçu sur l'approche territoriale et méthodologies d'interventions dans la lutte contre la désertification de l'arrondissement de Keita. In: *Les actes du séminaire national sur l'aménagement des sols, la conservation de l'eau et la fertilisation à Tahoua*. A. Berrada. February 1989. INRAN, Niamey. pp. 15-28.

Derpsch, R.W. (2003) South Africa Mission Report, Promotion of Conservation Agriculture, TCP/SAF/2902, FAO Representation, Pretoria, March 2003. 35p.

FAO (1994) Le projet de développement rural intégré de Keita. FAO, Rome, Italy (available at http://www.fao.org)

GART (2001) GART 2001 Yearbook. Golden Valley Agricultural Research Trust, Lusaka, Zambia.

LAMP/SCAPA (1999) Manual on Animal Draught Power for Conservation Tillage. December 1999. 124p.

Shaxson, F. (1999) New concepts and approaches to land management in the tropics with emphasis on steeplands. FAO Soils Bulletin No. 75. FAO, Rome. 125p.