Chapter 10

Development and adoption of conservation tillage practices in Zimbabwe

BACKGROUND

Land Resources

Zimbabwe lies within the tropics between 15°30'S to 22°30'S and 25°E and 33°E. The country is 389 000 km^2.

Three broad relief regions are generally recognized on the basis of elevation: the Lowveld (below 900 m), the Middleveld (900-1200 m), and the Highveld (1200-2000 m). In addition, a narrow belt of mountains (2000-2400 m), called the Eastern Highlands, runs north to south along the eastern border with Mozambique; and the deep cleft of the Zambezi River Valley forms the boundary with Zambia in the Northwest.

Climate is largely influenced by relief, rainfall increasing with altitude. Mean annual rainfall varies from below 400 mm in the extreme south of the Lowveld to above 2000 mm on isolated mountain peaks in the Eastern Districts. Middleveld rainfall ranges from 500 to 700 mm and that of the Highveld from 800 to 1000 mm.

The rainfall pattern is distinctly seasonal with approximately 90% falling in the six months from 1 October to 31 March. Much of the rain falls as intense tropical downpours and is characterized by its extreme variability in both space and time. Three seasons can be distinguished: (i) a hot and dry spring from mid-September to the onset of the rains; (ii) a hot but moist summer covering the rainy season; and (iii) a dry winter period consisting of cool nights and warm cloudless days lasting from April to September.

Analysis of the mean rainfall figures for the period October to April provided by the Department of Meteorological Services shows that the mean value for the last 30 years (1961-1990, 635 mm) is 41 mm lower than that for the previous 60 years (1901-1960, 676 mm).

The sandy, relatively infertile soils that cover some two-thirds of the country constitute the main soil type in the communal areas. Isolated areas of heavier more-fertile soils occur throughout the country, the largest pockets being on the Highveld. Fertile irrigable balsatic vertisols occur extensively in the southern Lowveld.

Agro-ecological Zones

Zimbabwe can be divided into five agro-ecological zones.

Zone I: comprises 5835 km^2 situated in the Eastern Highlands, where the climate is cool and moist and the high annual rainfall (>1000 mm) is relatively reliable. The land can be used intensively for dairy farming, forestry, orchards and plantations.

Zone II: embraces 72 745 km^2 of intensively cropped farmland in the northeast Highveld receiving 700-1000 mm of rain annually. It is the major dryland cropping area producing the highest yields of maize, tobacco, cotton, soybeans and other crops and is the main source of irrigated wheat.

Zone III: comprises 67 690 km^2 of semi-intensively cultivated land on the Middleveld and Highveld receiving 650-800 mm of annual rainfall. The area is used for ranching and cropping, the main crops being drought-tolerant varieties of maize, cotton, sorghum and soybeans. A large proportion of communal land falls in this region.

Zone IV: covers 128 370 km^2, mainly in the western and the northern areas of the country experiencing 450-650 mm of rainfall annually. The land is suited to semi-intensive animal husbandry and is marginal for cropping. A large proportion of the communal land falls in this zone.

Zone V: comprises 112 810 km^2 of very hot low lying land of the southern Lowveld and Zambezi Valley systems, where the annual rainfall is less than 650 mm. The area is suited to extensive ranching with intensive crop production using irrigation on pockets of fertile soils.

Agricultural Production

Annual farm output is valued at almost Zim $2 billion, about 20% of the gross domestic product. Three-quarters of the population depends directly on the land. Agriculture contributes 40% of the inputs to the manufacturing sector and supplies 40-50% of exports.

Production is diverse compared with many tropical countries. Tobacco, maize, cotton and sugar dominate crop production with wheat, coffee, sorghum, groundnuts, tea, citrus, coffee and vegetables making significantly smaller monetary contributions.

Maize dominates crop production, covering more land than all other crops (approx 1.5 million ha). One seasons's maize sales can earn more than Zim $100 million.

Tobacco production has steadily increased since 1980. Most Virginia tobacco is grown on large scale commercial farms north of Harare. Burley tobacco is favoured by small-scale communal farmers mainly because of the less rigorous curing required.

Dryland cotton grown in the central and northern parts of the country and under irrigation in the Lowveld, supplies the needs of the local textile industry and provides a 70% excess for export.

Cotton seed provides more than 50% of the vegetable oil in Zimbabwe.

Maize, sorghum and vegetables are the principal subsistence crops of the country. Production for family consumption remains paramount in the majority of peasant farming areas in Zones III and IV, but increasing quantities of maize and cotton are being marketed from communal areas in the more favoured agro-ecological zones. Communal farmers have increased their share of the maize crop from 6% in 1980 to 50% in 1988.

Cotton, sunflowers and groundnuts are major cash crops for communal farmers. Peasant farmers now produce half the total cotton crop, 75% of the sunflower and 80% of the sorghum. Coffee has been promoted as a peasant crop in the Eastern Highlands but production remains small.

Farming Systems

Shifting cultivation

In the pre-colonial period, shifting cultivation was practised, predominantly in Zones I to III; while cattle rather than cropping was the major activity in Zones IV and V. Under shifting cultivation, the bush was cut at shoulder height (to allow it to regenerate quickly) and the branches burned to provide nutrients in the form of ash. A form of zero tillage was practised (holing out). The piece of ground was cropped for three or four years at the most and was allowed to revert to bush before the soil showed signs of degeneration. It remained fallow for about 20 years before it was considered fit for another cycle of cropping.

The mixed cropping technology used at that time was simple but maximized soil fertility, minimized erosion and weed labour and reduced the risk of crop loss. Isolation of lands, mixed cropping, long fallows and healthy plants minimized crop losses caused by pests and diseases.

This shifting cultivation was no threat to the environment and was sustainable in every sense but cannot now be practised because of the shortage of land brought about by the colonial Land Apportionment Act (which confined the indigenous population to 41% of the available land area) and the rapid increase in this population.

Ploughing and use of chemicals

The period of European settlement (1900-1980) saw the development of large-scale commercial farms using a combination of modern technological methods based on annual ploughing, inorganic fertilizers, insecticides and herbicides. Up to now these methods have served the short-term economic goals of the commercial farmer quite well. On the other hand the only technique communal farmers have been able to afford to any extent has been annual ploughing.

PLATE 26 Traditional shifting cultivation

PLATE 27 Contrast in vegetation between high population density communal land and low density commercial farms

Recent local experience has shown, however, that annual ploughing leads to rapid degradation of soil fertility and structure through loss of organic matter, giving higher input costs, increased runoff and excessive losses of soil and nutrients (Elwell 1989; Stocking,1986). Furthermore, evidence is accumulating in other countries that existing levels of chemical use lead to the destruction of the on-farm and wider ecology and endanger human health and life. A direct consequence has been the rapid lowering of soil fertility in the communal areas, resulting in poor yields, increased runoff and soil loss and widespread environmental damage. On commercial farms the liberal use of mineral fertilizers has offset to some extent the deterioration in potential soil fertility, nevertheless yields in this advantaged sector are considerably lower than the optimum and production costs significantly higher (Elwell 1991).

LAND PREPARATION

Traditional Land Preparation Methods

Truly traditional land preparation, an integral part of shifting cultivation, consisted of holing out with a hand hoe or sharp pointed stick. Minimal soil disturbance was involved in what, today, would be classified as a form of minimum or zero tillage. Weeds were hand-pulled or hoed.

In this century, communal farming has moved rapidly from shifting cultivation to intensive settled agriculture. But, because of lack of appropriate research and an inadequate resource base, the practices tend to be poor imitations of commercial methods.

Shallow mouldboard ploughing is widely practised but almost no crop residues are returned to the land. Levels of applied fertilizer are inadequate and industrial herbicides and insecticides cannot generally be afforded. Poor soil fertility, large soil losses, loss of nutrients and lack of plant available moisture and draft power are major constraints to production (Norton 1987a; Oliver and Norton 1988).

Today, ploughing with a single furrow mouldboard plough drawn by oxen is the most widely used land preparation practice in Zimbabwe communal areas. It is estimated to be used on 73-90% of the cultivated area (Contill 1990). About 5-25% of the remaining area is
estimated to be ploughed by hired tractor, 1-15% cultivated by hand hoe and less than 1% is under any form of conservation tillage, usually ridging parallel to the contour or ripping into bare ground.

The ox-plough was vigorously introduced by the Extension Services in the 1920s and quickly rose to become the most widespread land preparation method. Generally the ploughing is of poor quality (100-150 mm compared to the recommended depth of 200-230 mm) and is frequently done twice to control weeds, once during winter and a second time soon after the first rains. The recommended system of early ploughing is estimated to be practised by less than 50% of the farmers having access to oxen. Shortage of draught animals is one of the major ploughing constraints, with up to half the farmers in some areas having to hire oxen for land preparation (Norton 1987b). Under these circumstances ploughing is normally done once late in the season (Dec-Jan) after the rains have penetrated deeply enough to facilitate ploughing.

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