

A Summary of the Conservation Farming Unit's (CFU) Results and Experiences in the Promotion of Conservation Agriculture (CA/CSA), 1996 to 2021 in Zambia and East Africa

A. Introduction

The impetus to establish the CFU in 1996 in Zambia arose from the conviction among several donors that conventional farming systems which had spread among medium and small-scale farmers since the colonial era were unsustainable, undermining the natural resource base upon which farming families depended for their livelihoods and were contributing to land degradation, stagnant productivity, deforestation, food insecurity and poverty. Incipient programmes sponsored by SIDA and implemented by the Ministry of Agriculture in the mid 1980's were the first efforts to promote Min-till Conservation Farming in Zambia.

The repercussions of severe regional droughts in 1991/2 and 1994/5 reinforced the need to promote alternative farming practices that would arrest the further deterioration of soils, diversify cropping systems to the extent feasible, increase yields and productivity and enable farmers to withstand the effects of adverse rainfall patterns if not full blown droughts.

The conclusions presented in this summary are drawn from a comprehensive report of the results achieved, challenges confronted and experiences gained by the CFU over a 25 year period in the promotion of CA/CSA in Zambia and East Africa and independently appraised by the scientists *John Dixon* and *Eric Kueneman* in 2022.

Start-up in 1996 in Zambia was facilitated by the National Farmers Union (ZNFU) with initial basket funding provided by FINNIDA, SIDA and NORAD. Cumulative results are presented from successive programmes funded by Norway's Ministry of Foreign Affairs (MFA) and NORAD, and latterly UK's DfID/FCDO, with significant if modest support from private sector entities.

It is important to highlight that the CFU's work to promote CA/CSA focussed on domains in Central and East Africa where farmers produce rainfed grains and other crops described by FAO as '*maize mixed systems*' where maize is the predominant crop grown at row spacings of roughly 0.75 to 1.0 metre alongside a range of other crops including, millet, sorghum, cotton, sunflower, groundnuts, beans, cowpea, pigeon pea etc.

Longstanding support by Norway and latterly DfID/FCDO, provided the CFU with leeway to learn from mistakes and over time evolve strategies and tactics to resolve various obstacles confronting adoption.

Headline results for Zambia are presented in **Section B** below with more detailed information accumulated across successive programmes presented in **Section C**. The regional programmes are covered in **Section D** and key experiences summarised in **Section E**.

B. Headline Results: Cumulative Adoption of CA/CSA, in Zambia, 1996-2021

- Adopting HH's Min-Till (MT): 357,137.
- Total Beneficiaries: 1,950,000 at 5.5 persons per HH (CSO data).
- Total households in combined Programme Areas: 880,900.
- Percentage of Min-till adoption on portions of land versus total HH's: 40.5%.
- Total Area of Min-till (MT): 560,170 hectares.
- Min-till system: 49% applied hoe MT Basins, 36% ADP MT ripping and the balance combinations including Mechanised Tillage Service Provision (MTSP).
- Adoption of Conservation Tillage (CT): 43% of MT adopters, 153,570 HH's.
- Adoption of Conservation Agriculture (CA/CSA): 35% of CT adopters, 53,750 HH's, 15% of total adopters.

- Adoption by Female Headed HH's: 45% of the total number of FHH's.
- Mechanised Tillage Service Provision (MTSP): 2019, 310 operators and 21,003 ha for clients. In 2020 dropped to 187 operators and 6,166 ha, refer to *Section C.3* below.
- Average area converted to MT per Household: 1.58 hectares. Range < 0.2 to >20.
- Adoption of ADP-MT services excluding owners: 21,130 cash paying clients, 69,000 non-paying relatives/neighbours.
- Use of Herbicides: 208,720 HH's applied herbicides or 58% of adopting HH's. However, data is uncertain due to rapid parallel expansion among non-adopters and by adopters on non-converted fields.
- Among Non-Adopters 38.3% ploughed with oxen hired from neighbours often resulting in severely delaying planting.
- Yields: Adopters yields across all years including dry seasons, wet seasons and droughts, including FHH's significantly outperformed non adopters across all tillage categories.
- Emergence of yield benefits: Improved timeliness, precision and nutrient use efficiency (NUE) enabled by MT delivered yield benefits in first year of adoption, confirmed by on-farm trials and independent surveys over many seasons, and by 77% of 58,791 adopters canvassed.
- Climate smart attributes of MT enabled adopters crops to withstand seasons of adverse rainfall during which a significant proportion of non-adopters crops were poor or failed entirely.
- Adoption increased disposable income enabling HH's to invest in household improvements, in livestock, and improved HH nutrition with women spending less time on agricultural tasks.

The results of the 2021 study '*Understanding and Enhancing Adoption of Conservation Agriculture in Smallholder Farming Systems of Southern Africa (ACASA)*', by IITA, and CYMMIT, (CGIAR family), funded by NORAD and undertaken in Zambia, Malawi and Zimbabwe, showed full CA was highest in Zambia (**33%**), followed by Zimbabwe (**20%**) and least in Malawi (**>5%**). The adoption of MT was also higher in Zambia (**52%**) followed Zimbabwe (**43%**).

Securing accurate data on the adoption of full CA, **15%** in the case of the CFU's results, is extremely challenging principally because compliance with FAO's threshold definition, (Minimum Tillage, 25% to 30% residue cover on converted land and 25% or more occupied by legumes), is dynamic as opposed to linear. After dry or drought years smaller farmers increase areas allocated to maize to secure HFS at the expense of legumes and after harvests, scant maize residues are entirely consumed by cattle. The scope of seasonal maize input supply and marketing subsidies set by government, the prevailing price of cotton and other commodities, the availability of legume seeds, labour requirements for these crops in particular groundnuts, market access and prices, all influence farmers decisions.

Nevertheless it should also be noted that in Zambia soya production increased from 2,350 tons in 2001 to 297,000 tons in 2020, expansion almost entirely by small and medium scale farmers and has undoubtedly increased land occupied by legumes.

C. Detailed Results of Successive Programmes in Zambia

C.1 Conservation Agriculture Programme Phase I (CAPI), 2007/2011 (including earlier years)

The results presented below summarise surveys undertaken by the Norwegian University of Life Sciences (NMBU) and Independent Management Consulting Services Ltd Zambia (IMCS).

- **Total Min-till (MT adopters)**
71,000 adopters of Hoe and ADP MT combined representing 60% of the incremental target of **120,000**

- **Average Area of Conversion to MT**
The average area under MT Basins was **0.52ha** per household and **1.21** hectares for ADP ripping. Among adopters **58%** in the 2009/10 season adopted MT Basins while **18%** practiced ripping, and the balance a combination. Area converted to basins being **41,180** hectares and **12,780** hectares for ADP ripping.
- **Adoption by Female Headed HH's**
Female HH's significantly outnumbered conversion to Basin MT than male headed households.
- **Plough Hire**
Among non-adopters practicing ploughing, **38.3% ploughed with hired oxen**, (*a highly significant statistic*). 36.1% ploughed with owned oxen with the balance applying various forms of conventional overall hoe tillage, principally ridge splitting as in Malawi and southern Tanzania.
- **Comparative Yields**
Field measurements of 129 farmers showed Maize yield levels of **1.8 tons/ha** for Conventional hoe tillage; **2.4 t/ha** for Ploughing; **4.4 t/ha** for MT-Basins and **3.8 t/ha** for MT-ADP Ripping. Ploughing took **3.8 hours** per hectare while dry MT Ripping took **0.8 hours** per hectare.
- **Homestead Improvements, Nutrition and Expenditures**
Results show a substantial increase from **23.3 % to 33.0%** of farmers that had a house with corrugated roof over the past four years. The proportion of farmers having a house with burnt bricks increased **from 33.6% to 47.3%**.

From 24 hour recalls, the percentage of households having a diet with pulses steadily increased from a baseline **46% to 62%** in 2010. Adopting households have prioritized increasing expenditures on medicines, remittances, groceries and other items that increased by 42%, 41%, 61% and 78% respectively over 4 seasons.
- **HIV/AIDS**
Across all the regions **85.4%** of the surveyed HH's were keeping non-working dependents primarily orphans mainly as a result of the **HIV/AIDS** pandemic.
- **Adoption Relative to Total HH in 13 Programme Districts**
Of the 459,400 HH's in the CAPI Districts **15.5%** had adopted MT on portions of their land.
- **Early Adopters**
A parallel MSc thesis undertaken by *Elli Borge 2010*, confirmed that it was smaller and poorer farmers who first adopted Basin MT contradicting the assumption in many publications on the subject that CA practices are too expensive for these households.
- **Agroforestry**
Farmers did not give adequate attention to the *Faidherbia albida* seedlings that were planted in CAP1. Poor farmers generally have a short planning horizon and were unprepared to wait for benefits that take 15 years or longer to emerge.
- **Standby Food Security Crops**
Farmers benefitted from the distribution of elite cassava and sweet potato varieties. The percentage of households engaged in cassava has substantially increased from the baseline 2.7% in 2007/8 to 10.9% in 2009/10 season with average production increasing from 166kg to 463kg among farmers supplied.

C.2 Conservation Agriculture Programme Phase II (CAPII) Zambia, 2011/2015

The results presented below summarise surveys undertaken by IMCS Zambia Ltd.

- **Total MT Adopters**
175,530 MT Adopting HH's including CAPI Baseline of 71,000 representing **73%** of the incremental target of **237,000** adopters, **60%** applied Basin MT and **37%** ADP MT and **3%** ADP ZT (Fitarelli planters, data uncertain), being **103,900**, **64,950** and **4,350** for Basin MT, ADP MT and ADP ZT adoption respectively.

- **Average areas of Conversion to MT**
The average area converted to **Basin MT was 0.71 hectares** per HH and for **ADP MT 2.1 hectares** per HH representing a combined total area under MT of **211,168 hectares** being **85%** of the CAP II Target for these two Min-till systems.
- **Adoption of Conservation Tillage (CT) and Conservation Agriculture (CA)**
Within the pool of 175,530 MT adopters, excluding mechanised tillage Service Provision (MTSP), **24.9%** had converted to CT (at least 25% residue cover on converted land), or **43,000 households** being **43%** of the target. **89,520** retained some residues but less than 25%, pointing to a decline in the tradition of burning but at the same time reflecting the continued influence of uncontrolled communal grazing of maize residues. Among the pool of CT adopters **31,300** had converted to full CA with over 20% of land converted to CT occupied by legume crops. The adoption of CA being **44%** of the target of 71,000 households or **17%** of total adopters.
- **Adoption by Female Headed Households**
Among all adopters, female headed households, (being either widows, households where women made the farming decisions or where the male spouse was primarily engaged in off-farm activities), represented **22%** of total adopters or **38,600 HH's**.
- **Adoption of the Use of Herbicides**
The growth of farmers using herbicides to control weeds had increased from a modest baseline during CAPI to **99,400 HHs** representing **17%** of total farming HH's in CAPII Districts surveyed, with the proviso that application may have also been extended on fields that were conventionally tilled.
- **Adoption Relative to Total HH's in 16 Programme Districts**
Of the **585,230 HH's** in Programme Districts **30%** had adopted MT on portions but not all of their land, increasing from **15%** at the end of CAPI.
- **Agroforestry**
With no incentives to establish and protects the trees and 15 years for tangible benefits to emerge the continued promotion of *Faidherbia albida* during CAP II failed by a large margin (as in CAP I), to achieve the expected results.
- **Mechanised Minimum Tillage Service Provision (MTSP)**
The CAPII target was **150 MTSP's** servicing **13,000** small and medium scale clients with **38,700 hectares** converted to mechanised MT.

Potential opportunities to promote Min-till MTSP as a business arose from a visits to Kenya in 2007/8 where several thousand privately owned (and often dilapidated), tractors traverse the highlands disc ploughing for small and medium scale farmers. Toward the end of CAPI the CFU collaborated with NDUME Kenya Ltd to develop a ripper designed to operate in tough conditions through heavy Maize residues. Soon after the launch of CAPII a Mechanised Support Facility (MSF) was concluded with AFGRI Zambia (John Deere agents) through which medium term loans (lease/purchases) would be provided to candidates carefully screened by the CFU.

Of the initial 400 candidates, **16** were approved. The capital value was **£26,000**, initial borrower deposit \$5,200, balance \$20,800, loan term 3 years, interest rate at 14% - \$2,012, loan value \$23,712, repayment profile synchronised with seasonality of demand. No subsidies were involved and borrowers were exposed to US\$/ZMK exchange rate fluctuations.

By the close of CAPII the scheme AFGRI leases had increased to **25 operators** and as a result of the early success schemes proliferated provided by First National Bank for CFU screened borrowers and independently by Dunavant Cotton, its successor NWK-Agri/ZANACO Bank, Bunjimi Asset Plus and others providing **263 tractor loans** in total.

Field monitoring by the CFU's network of field staff and LF's showed that only **116 operators** were actively engaged in providing timely and professional MTSP services to farmers in the final year of CAPII with **8,700 farmers** paying for services to MT-rip a total of **19,140 hectares** representing **77%** of target operators and **67%** of targeted hectares being an average of **165 hectares** per service provider with a significant range from 30 to 400 hectares.

Third party schemes largely failed with substantial repossessions due to poor screening; delays in the timely delivery of equipment to enable operators to exploit the land preparation window; inappropriate equipment; insufficient

business and technical skills of operators; inadequate back up services for the provision of maintenance and spare parts, and the absence of training services to TSP clients on the use of herbicides.

C.3 Climate Smart Agriculture Programme Zambia (CSAZ), 2016/2021

The results presented below summarise surveys undertaken by the CFU's Results Management Team and LTS International Ltd (part of the NIRAS Group), in collaboration with Indaba Agricultural Policy Research Institute Zambia.

- **Total MT Adopters**
181,607 representing 96% of the target of 188,600 incremental adopters, of which 49% applied Basin MT, 36% ADP MT and the balance combinations being 88,990, 65,380 and 27,240 HH's respectively. The combined target for Basin MT and ADP MT of 154,370 excluding combinations of these practices represented 99% of the CSAZ target of 155,610 for these 2 categories.
- **Area of Land Converted to MT, CT and CA**
222,506 hectares was converted to MT alternatives being 101% of target; with 85,425 hectares converted to CT being 78% of the target and 41,080 converted to CA being 77% of the target. Total area converted was 349,000 hectares.
- **Comparative Maize Yields of MT alternatives versus Conventional alternatives**
Hoe MT farmers increased yields by 33.7%, ADP MT farmers by 83.5%, reflecting comparatively higher base yields for conventional hoe farmers compared to conventional ADP farmers. The yields for mechanised MT ripping over disc ploughing was 25.4% but considered insecure due to the dearth mechanised ploughing in Zambia resulting in an inadequate sample.
- **Comparative Production among Female headed HH's**
100% of non-adopting Female HH's produced between 1 and 3 tons of Maize. 52% of adopting FHH's produced within this range, with 18% producing between 3 and 4.5 tons and 30% producing over 4.5 tons.
- **Adoption by Female Headed HH's**
21.5% or 30,870 of sampled HH's or were Female Headed, of these 45% were adopters being 17,570 HH's.
- **Adoption of Animal Draft MT Service Provision**
21,130 HH's paid for ADP-MT services being 67% of the target. An additional 69,000 non-cash paying clients i.e. close relatives or extended family relatives benefitted from the services, totalling 90,130 HH's being 159% of the target of 56,585 hectares converted to ADP MT.
- **Adoption of the Use of Herbicides**
109,320 incremental HH adopters applied herbicides being 60% of the total and representing 95% of the target. Among the pool of Female HH's 38% utilised herbicides or 6,677 FHH's being 83% of the target of 8,050 FHH's.
- **Materialisation of Yield Benefits for Adopters**
During the 2020 field day season 58,791 attendees were asked if they had observed increased in yields during the first year of adoption, 77% said they had while 23% said they had not, contradicting the common assumption that benefits take several seasons to emerge.
- **Mechanised Minimum Tillage Service Provision (MSTP)**
During the CSAZ the objective was to increase MSTP operators from 116 achieved under CAP II to 400. In the 2018/19 there were 310 active MT operators declining sharply to 187 in 2019/20. The severe drought in 2018/19 which reduced rural liquidity in the following cropping season coupled with the experiences outlined during CAPII Section B.2 above were contributory causes. Significantly there were 241 cash acquisitions by project closure arising mainly from resale of repossessed equipment. Loan purchases during the CSAZ were minimal.
- **Impact on Household Asset Values**
The independent LTS/INDABA *Mid Line Evaluation* undertaken in 2019, showed that asset values had increased more substantially among adopters and that this trend was consistent across hoe farmers and female headed households.

- **Proportion of Households Above Survival Threshold**

A *Survival Threshold* study undertaken by an M&E consultant supported by the CFU's *Results Management Team* showed that all adopting households were above the threshold of basic food energy (2,100 KCl per person per day) and basic living needs. The earlier *LTS Mid-line Evaluation* found that adopting households had higher dietary diversity scores, fewer months of hunger, and lower hunger scores. The finding was particularly relevant for the groups most vulnerable to food insecurity, female-headed households and hoe farmers. Female-headed households who practiced CSA at midline had a mean dietary diversity score that is nearly a full point (0.9) higher than female-headed households who practiced conventional tillage.

These findings mirrored the independent results of an April 2015 study exploring the potential of CA to improve nutrition carried out by *CONCERN Worldwide* showing that CF adopters had more varied and better diets and consumed more food and more frequently than did conventional farmers. Children's diets also improved after adoption. Extra income enabled mothers to enrich children's porridge with eggs, buy commercial cereal brands, and add cooking oil and fish to meals. Increased yields in Groundnuts, Soya and Cowpeas led to higher nutritional variation in children's diets, as it did for adults.

- **Margin of difference between the proportion of time women spent on on-farm activities**

LTS/INDABA surveys showed that female adopters spent significantly less time on farming tasks than non-adopters contradicting the assumption in some publications that CA/CSA increases the burden on women. The reduction in time spent by female adopters on farming tasks, improvements in food security and disposable income enabled women under the CSAZ and in previous programmes to actively engage as LF's, Tillage Service Providers, field day and training hosts, Crop Aggregators, and In-Community sales Agents and benefit from the extra revenue streams associated with these commercial operations.

- **Farming as a Business**

DfiD/FCDO placed considerable emphasis on deepening and broadening the engagement of the private sector entities in the provision of a range of services to CSAZ beneficiaries to provide pathways to enable more households to engage in agriculture as a business by exploiting the benefits from increases in crop yields, productivity and climatic resilience arising from conversion to MT - CA/CSA. Agroforestry and the provision of elite cassava and sweet potato varieties was withdrawn.

- **In-Community Sales Agents**

The transfer of Lead Farmers (LF's) in areas of Districts where programme services were discontinued to act as commission based In-Community Sales Agents for larger input suppliers aimed at increasing the penetration of services, was piloted under CAPII. On CSAZ completion, **705** agents were engaged by 67 Agri-dealers of whom **136** were women exceeding the CSAZ target in both cases. In the final CSAZ season Agents sold over **\$1.3m** worth of agricultural inputs.

- **Cooperating Agri-dealers**

The cumulative total of cooperating Agri-dealers selling CA equipment and other inputs increased from **119** in PY-1 to **221** linked to **494** rural outlets being **715** in total exceeding the CSAZ target of 600.

- **Crop Aggregation**

In 2018/19 a pilot was established to exploit the extensive presence of experienced staff and LF's to tap into a productive and captive audience resulting from training and field day services. Through organised aggregation, the aim was to enable crop buyers to purchase commodities in bulk thereby reducing transaction costs. By the 2020/21 season the amount bulked of a wide range of crops sold increased from **3,090** tons in 2018/19 to **55,750** tons valued at **\$8,390,000**, a highly significant increase over 3 harvest seasons.

D.1 Regional CA Programmes – Uganda, Malawi, Tanzania and Kenya, CARP & RCSAP

D.1 Introduction

In 2011, Norway's Ministry of Foreign Affairs (MFA) through their Embassy in Lusaka signed an agreement with the CFU, to implement the Conservation Agriculture Regional Programme (CARP) a 5 year investment to support

an initiative by the Common Market for Eastern and Southern Africa (COMESA) to demonstrate the benefits of CA/CSA to farmers involved in the production of annual of rainfed grains in Uganda, Kenya and Malawi, referred to as *anchor investments*.

The aim was to achieve adoption among a sufficient number of farming (HH's) to catalyse momentum for further adoption. To achieve this, the CFU established sub-contracts with experienced In-Country Partners (ICP') in each country responsible for implementation with direct support and oversight by the CFU through the establishment of a Regional Services Unit (RSU). In 2012 the programme was extended to include Tanzania.

Following the completion of the CARP in 2015, which coincided with the closure of the Norwegian Embassy in Lusaka, an agreement was signed between NORAD, a semi-autonomous directorate of the MFA and the CFU in May 2017 for the implementation of a subsequent initiative the Regional Climate Smart Agriculture Programme (RCSAP) which mirrored the (CARP) involving sub-contracts signed with In-country Partners. Support to Malawi was discontinued due to a highly complex picture with the promotion of alternative CA technologies by numerous NGO's and agencies operating in the field providing inconsistent advice to farmers.

D.2 Headline Results: Cumulative Adoption of CA/CSA, 2011/2021

Total MT Adopters: 126,618 adopting HH's

Total Area of MT Adoption: 52,807 hectares

Total Area of Adoption by MT Alternatives: Hoe MT 28,112 ha; ADP MT 16,775 ha; Mech. MT 7,920 ha.

Overall average area converted to MT: 0.56ha

Total Number of ADP Service Providers: Incremental total - 23,772 client HH's served by 17,604 service providers converting 16,775 ha. Average ha per client 0.7ha.

Total Number of Mechanised MT Service Providers: Incremental total - 205 providers serving 5,717 client HH's converting 7,920 hectares. Average ha per client 1.39. Average clients HH's 39 per MTSP.

Adoption by Female Headed HH's: Among all adopters female headed HH's, (being either widows, households where women made the farming decisions or where the male spouse was primarily engaged in off-farmer activities represented 16% of all adopters or 20,258 HH's.

Comparative Yields Differences for Maize, Adopters and Non Adopters, 3 seasons: Uganda adopter 3,534 kg/ha, non-adopter 1391 kg/ha. Kenya adopter 1,992 kg/ha, non-adopter 1,363 kg/ha. Tanzania adopter 3,749 kg/ha non-adopter 2,103 kg/ha.

Compared with Zambia annual rainfed cropping systems are more diverse with significant markets for beans, garden peas, cowpeas, green gram, groundnuts and other legumes and non-legume crops. Bimodal rainfall in the Lake Victoria Basin in Tanzania, in the Kenya highlands and Uganda excepting the northern region, also amplify the accumulation of post-harvest biomass. The emphasis in these countries therefore focussed principally on promoting MT alternatives and the retention of residues (no burning) with less emphasis on diversification which was already prevalent.

E. Key Experiences

Although the metrics summarised in *Section B and D.2* are essential measurements of progress, they reveal little of the evolution of the CFU's strategies, tactics, successes and failures experienced in its efforts to promote CA/CSA over many years.

➤ Social and Practical Considerations

▪ Minimum Tillage Drove Adoption

In 2000, FAO coined the definition Conservation Agriculture (CA), '*a farming system that promotes the maintenance of permanent soil cover, minimum soil disturbance and diversification of plant species*' with the objective of unifying the assorted labels describing efforts to reverse soil depletion including SLM, GAP, CF, CSA.

More recent labels include Conservation Agriculture Sustainable Intensification (CASI), and Regenerative Agriculture (RA) a more holistic approach, refer to *page 12 below*.

In Maize mixed systems CA required farmers to apply the prescriptive template of *reduced tillage and residue retention or the use of cover crops, with about 30% of cultivated land occupied by legumes*. Although the CFU vigorously promoted the three inviolable tenants of CA it was clear that farming families had different priorities propelled by their immediate needs and aspirations,- staple food security, increased crop yields and surplus production providing cash to pay for school uniforms, books, mobile phones, solar panels, TV's, bicycles, household furnishings, home improvements, livestock and much else.

In 2000, the CFU disaggregated the package into its component parts Minimum Tillage (MT), Conservation Tillage (CT) and Conservation Agriculture (CA) in an attempt to establish through field surveys which elements were prioritised and achievable by farmers and which were of less significance to them for numerous reasons, including prices, market access for alternatives to Maize, labour requirements for different crops, communal grazing and national incentives to produce Maize etc. As the results over many years show it was MT alternatives which through timeliness and improved resource use efficiency delivered the immediate benefits they sought;- higher yields, the survival of crops in dry seasons, improved food security and increased disposable income.

▪ **Earliest Adopters – Hoe MT**

The earliest pioneers in the adoption of CA based MT Basin practice *were women* on the smaller plots they cultivated independently or households where they had significant influence over farming decisions which focussed on HFS and family nutrition. Plots converted to the practice were generally small ranging from 0.20ha to 0.4ha. The assumption in some publications that MT-CA is too costly to adopt is misguided. For them a sharp hoe and a piece of rope with bottle tops squeezed along its length to mark out Basin positions was all they required to get started and test the practice with conventional alternatives for themselves.

▪ **ADP Plough Farmers**

Across Africa numerous publications over the years confirm the longstanding tradition of *ADP borrow/hire* and also confirm that significant fluctuations in the availability of draught power due to the reoccurrence of contagious diseases, do not necessarily translate into a proportional decline in ploughing, but result in excessively late planting with the majority of this group subsequently weeding sown fields by hand. *Zambia 1950 – 'I must work on my neighbours field for one week while I can borrow oxen for only one day in return. This is a big loss of labour and time for my field'*. This pool of farmers consistently suffer lowest yields and in adverse seasons often experience total crop failure.

▪ **Moving to ADP MT**

To progress the adoption of dry season ADP-MT tillage as highlighted in previous sections, required an intensive effort to introduce the effective use of herbicides since crop and weeds emerged simultaneously whereas after ploughing a window of 3 to 4 weeks enabled the crop (primarily Maize) to grow sufficiently to withstand deep cultivation of emerging secondary weeds through banking up crop rows with ploughs, or ridging bodies.

Time and Costs: Dry ripping 1 hectare took one pair of oxen 4 hours compared to about 14 hours for ploughing. The charge for ripping was about \$15/ha whereas for ploughing was \$26/ha. The cost of the ripper attachment fitted to a standard plough beam was \$30-\$33. The effective ripping window was about 3 months whereas for ploughing was 3 weeks and the investment in a ripper through service provision could be recovered within a month or two.

▪ **Hoe MT and Weeds**

For conventional hoe farmers two forms of tillage predominate. In Eastern Zambia, across Malawi and in Southern Tanzania farmers form ridges in the late dry season by splitting the previous seasons ridges and sowing seeds along the top a practice first enforced in Malawi in the 1930's by the British government. With the onset of the rains, *weeds emerge alongside the crop* as they do for farmers who convert to Basin-MT. In Northern Tanzania, Kenya and Uganda early weeds are eliminated by hoeing over the whole field after which seed is usually planted in holed out rows. On friable soils hoe tillage is often completed before the rains. For both groups of these farmers conversion to Basin-MT neither increased overall labour inputs for weeding nor the time spent eliminating them by hand over a cropping season.

- **Adoption of Herbicides**

Weeds are a problem for all farmers including adherents to conventional practice and the results show that with intense practical training usage spread to hoe farmers including FHH's reducing labour inputs and benefitting women and children. However for smallholders the use of herbicides remains a choice. Publications suggesting that *'if herbicides are not available the labour burden for hand weeding under CA is strongly increased'* are misleading.

- **Mechanised Min-till**

At the close of the Zambia DfID sponsored CSAZ programme, 187 operators using 60KW- 4WD were providing MT ripping services to farmers both small and medium scale from zero in 2010. Relative to the expansion of Basin and ADP MT and the target of 400 mechanised operators the results were disappointing despite the potential economic and environmental benefits. Refer to *Section C.2* above for further detail.

Time and costs: Ripping at customary 0.9m spacing takes 1.0 to 1.25hrs/ha and fuel consumption is 5.0 to 7.0lt/ha. Disc ploughing (scarce in Zambia SSA) takes 3.5 to 4.5hrs/ha and fuel consumption is 13.0 to 15lt/ha. The cost of ripping to the client is \$40 to \$45/ha. The cost of ploughing is \$95 to \$105/ha. The depth of ripping is 20cm to 30cm and the depth of ploughing is 10cm to 15cms and in east Africa much of this work is done before the onset of the rains and the advantage of eliminating early weeds is not achieved.

- **Zero-till**

Under CAPII Zambia, the CFU imported a number of ADP and mechanised Zero-till planters from Brazil to determine their practicability for larger and more experienced farmers. The equipment was found to be excessively fragile to survive punishing field conditions in Zambia, was unsuited to service provision and too expensive for the majority of farmers to purchase.

- **Front Line Extension and Training Services**

In the early years in Zambia, the CFU prompted hoe MT-CA conventionally through sponsored demonstrations, (1,000 by 2001), to exhibit the benefits of residue retention (no burning) and rotations of maize with legumes and cotton/sunflower where the latter were grown.

With a sufficient pool of experienced adopters by 2002, demonstrations were abandoned in favour of peer to peer training services provided by Lead Farmer's (LF's) identified by neighbouring HH's, in conjunction with CFU and MOA technicians. Across the 3 main programmes (2007-2020) LF numbers continued to increase peaking at 2,700 in 2019 with each LF providing interactive hands-on training sessions between July and October (the dry season) for 90 to 100 household members in separate groups of 25 to 30, with each group provided the opportunity to attend 3 to 4 sessions on a range of interrelated but discrete practical topics which gradually evolved as farmer's experiences progressed. Larger farmers, 5ha to above 20ha with different needs were provided training by CFU staff.

The enduring attendance of women, 40% to 45% of the total as spouses or FHH's reflected their commitment and influence in the uptake of MT-CA.

Between 2017 and 2020 over 243,000 members of farming HH's were attending training sessions annually including repeat attendance, and 20% of the LF's were women. The model reduced costs, enabled rapid expansion of quality services into new areas and was considered instrumental in the adoption of CA.

- **Payment to LF's:**

For the provision of training sessions, 9 to 12 per season in Zambia, recording attendance by gender and arranging field days, *see below*, LF's were initially provided bicycles and a package of inputs and tools. In 2008 the delivery of inputs was abandoned and replaced by paper vouchers discountable at cooperating rural agri-dealer outlets for CF-MT related hardware, legume seeds, herbicides, lime and soya inoculates. In 2009 the CFU discarded paper vouchers which had weak security features and pioneered electronic vouchers in collaboration with Mobile Transactions Zambia Ltd (MTZL) taking advantage of the broad cellular network coverage across

Zambia. The use of electronic voucher databases enabled tracking in real time, follow up on how the system was performing and trouble shooting.

In addition to remunerating LF's for their services the aim was to augment the availability of CA related inputs for the beneficiaries of training services and stimulate apex dealers to expand their networks of linked rural outlets. As noted in Section C.3 above, rural outlets under the CSAZ programme increased from 119 to 715 by 2020.

▪ **Field Days**

Field days in Zambia were held annually between February and April each season on adopter's fields were a key aspect of the CFU's training and extension strategy with the aim of engaging a wider audience than targeted trainees to include non-adopters, MAO field staff, traditional and administrative leadership, and representatives from NGO's and Agri-dealerships. The venues provided opportunities for farmers to ask questions and discuss the benefits and challenges of CA among themselves with the host farmer, CFU staff and the audience. Much emphasis was placed on providing women opportunities to fully engage. In general, farmers signalled that field days acted as the principal driver in encouraging them to attend technical training sessions.

Field days both large and small increased yearly from 1,193, attended by 108,260 individuals in 2007, to 26,167 attended by 1,139,037 individuals of whom 518,943 were women in 2020.

▪ **Agroforestry**

Faidherbia albida: Throughout the Zambia CAP I&II programmes 2007-2015, the CFU undertook an ambitious effort to promote agroforestry by encouraging adopters to raise and plant *Faidherbia albida* a leguminous tree with reverse phenology, indigenous to the plateaus and valleys of central and southern Zambia and renowned for its potential once mature to rejuvenate deficient soils, recycle nutrients and maintain reasonable cereal yields grown under its canopy without the need for the addition of fertiliser.

Four years of comparative trials *under and outside* mature trees with zero fertiliser undertaken by the CFU and analysed by the *University of Zambia Dept. of Soil Sciences* showed average maize yields of 5.14 tons/ha and 2.65 tons/ha respectively. As expected there was no benefit for groundnuts or soya and cotton yields were suppressed.

However, waiting for 15 years or longer for tangible benefits to emerge was too long for farmers whose concerns and priorities focussed on the outcome of each cropping season. As a result the programme failed by a large margin to achieve its objectives. Consultants appointed at the time to review the feasibility of the initiative were of the view that the extreme complexities involved in verification procedures to access carbon credits were insurmountable concluding that *"from the standpoint of the individual farmer, the economic benefits of potential carbon sales were far outweighed by the yield improvement resulting from conservation farming practices"*.

Jatropha curcas: Prior to the launch of CAPI (2007), there was considerable commercial interest in the establishment of *Jatropha* plantations for the production of bio-diesel spurred by high oil prices and speculative opportunities to benefit from brokering carbon credits through various emission trading facilities that had begun to emerge. During CAPI in Zambia, the CFU engaged in a programme to encourage adopters to demarcate their boundaries with *Jatropha* as a drought resistant live hedge with the advantages of being unpalatable to cattle and goats, fast growing and easily propagated by seeds or cuttings. However after the steep decline in crude oil prices in 2009, commercial interest in *Jatropha* collapsed. Farmers who had assumed they could generate future income from the sale of seed lost interest in planting and the CFU abandoned the initiative.

➤ **Some Research Issues**

▪ **The Need for Adaptation and Context Specific Research**

This assumption has arisen from scepticism among some scientists regarding FAO's 'fit-all' definition of CA and is reflected in many publications on the subject.

This premise leads to the notion that conventional agriculture as practiced today is subtle, diverse and informed by longstanding indigenous knowledge which is disregarded and disrupted by the imposition of alien practices such as CA.

This idea conflates *conventional agriculture* with *traditional agriculture*. Over the past century the latter has more or less been supplanted across much of Africa by practices which would be largely unrecognizable by the forefathers of contemporary farmers. What we see today in maize mixed systems in East and Central Africa (ECA) upon which millions of households depend is the predominance of maize and homogeneity in the manner in which the soils are continuously disturbed to establish annual and biannual crops.

The crop mixes grown in different agroecological domains where CFU promoted CA varied considerably but all without exception were suited to and benefitted from conversion to Min-till alternatives.

▪ **CA Versus Conventional Alternatives**

Much of the research focussed on CA highlights the obstacles that apparently deter potential adopters, however the numerous challenges experienced by conventional farmers to establish and tend their crops which often result in the unnecessary accumulation of losses from land preparation to harvest and all too often produce disappointing results are seldom considered in sufficient detail.

▪ **CA is Knowledge and Labour Intensive**

While understandably alien to new farmers, conversion to hoe and ADP Min-till is not knowledge intensive as sometimes suggested and successive surveys by the CFU revealed no correlation between adoption and level of education. Surveys by LTS/INDABA during the CSAZ programme refer to *Section C.3* above also showed that female adopters spent significantly less time on farming tasks than non-adopters.

Crucial agronomic tasks, including targeted application of FYM and lime in MT Basins and rip lines, measured fertiliser application on maize, pre-application of Soya inoculates, correct seeding rates and depths for different crops and correct backfilling, i.e. GAP, are all simplified by conversion to MT and ideally suited to hands on training sessions.

Conversely, the effective and safe use of herbicides required intensive hands-on training on appropriate herbicides, timing of application for different products, calibration and mixing, correct nozzles for different products, appropriate walking speed, clean water, sprayer maintenance, safe disposal of used containers etc. Suppliers of herbicides lacking the capacity to provide adequate training on the scale required had in the past led to many errors by farmers and a widespread assumption that the products poisoned soils.

▪ **The Benefits of MT-CA Take Time to Emerge**

There was, and remains, little evidence to show that the practices sequester carbon but much evidence from surveys and the views of many thousands of proficient adopters that benefits arose in the first year of adoption, had a positive effect on their livelihoods, enhanced resilience to climatic variability and addressed their most pressing needs and aspirations.

➤ **Some Wider Issues**

▪ **National Input Supply and Marketing Programmes**

In Zambia continued late delivery of subsidised inputs by the Farmer Input Support Programme (FISP) and late payment for crop receipts by the Food Reserve Agency (FRA) hindered adoption predicated on dry season land preparation, early planting and liquidity to finance purchases of inputs and other services in good time. Nevertheless, many households found ways and means to bypass these impediments by offloading their crops to traders, purchasing inputs from speculative beneficiaries of the FISP who cornered large quantities for resale or securing inputs from commercial dealers at the full price.

▪ **Stop-Start Development**

The longstanding support from Norway in particular and latterly the UK, will not be lost on those involved in Ag-dev which enabled the CFU to learn from mistakes, test various innovations and overcome the scepticism of naturally risk averse small farmers.

Over the past four decades the agricultural development arena has become increasingly complex, competitive and fragmented. Programme life cycles are generally confined to 4 or 5 seasons and too often results are inconclusive provoking more questions than answers. Uncertainties prevail, donor priorities constantly shift and the knowledge to drive tangible results on the ground seldom accumulate.

- **Lack of Integration**

The lack of integration between discrete programmes with contrasting expertise but similar objectives eliminates opportunities to leverage impact, avoid confusing signals to farmers and unnecessary wastage of resources.

- **Farming Systems**

Conventional husbandry in maize mixed systems is unnecessarily wasteful and irrespective of whether African smallholders have access to input and marketing subsidies, improved varieties and seasonal finance, productivity has remained stubbornly low, yet this is not bad news since unlike farmers in the west who already exploit a large measure of the genetic potential of plants and seek marginal productivity gains through the application of a range of advanced technologies, African farmers who adopt MT-CA still have the leeway to achieve significant yield increases by minimising value losses which accumulate from land preparation to harvest.

- **Cost of Promoting Adoption**

The cost of adoption relative to the total cost of programme implementation varied considerably across seasons and between the programmes in Zambia and East Africa. The overall cost across the CSAZ programme in Zambia for example was \$23.5 per HH beneficiary less than the full cost of 1 bag of fertiliser at the time. However, the spike in adoption in the 2019 reduced the cost relative to total expenditure during that year to \$11 per HH beneficiary.

In Kenya, Tanzania and particularly Uganda, self-managed and cohesive Civil Society Organisations (CSO)'s developed during earlier programmes to foster bulk marketing and the establishment of credit/savings accounts provided ideal platforms during the RCSAP to introduce alternative and more cost effective training services. By comparison RCSAP cost was around \$7.8 per HH beneficiary. The entrepreneurial mind set of farmers in general also led to innovations such as spray and hoe tillage service provision.

- **Regenerative Agriculture (RA)**

At present there is considerable interest in RA focussed on aspirations to revitalise soil health, augment biodiversity and regenerate ecosystems for the benefit of farmers and the landscapes they occupy. Nevertheless, promoters of any set of novel agricultural practices have first to deal with people, as individuals and families with all the social and economic challenges confronting them on a regular basis. Offering solutions that stabilise and enhance small farmers livelihoods are crucial first steps if wider environmental challenges such as deforestation and encroachment into important natural habitats for agricultural purposes are to be reduced.

- **Voluntary Carbon Markets (VCM)**

Since the launch of the African Carbon Markets initiative (ACMI) at COP27 attention has focussed on the rapid growth of voluntary carbon markets, estimated to increase to \$20 billion or more by 2030, through which mainly 1st world corporates can offset unavoidable emissions by purchasing credits from projects aimed at removing atmospheric carbon, in Africa principally but not entirely through tree planting as evidenced by the many organisations launching new projects, i.e. mitigation. The merits or otherwise of the VCM are addressed in many publications and remain hotly contested.

Suffice it to stress that African farmers contributions to global carbon emissions are miniscule compared to amounts emitted elsewhere yet they are likely, if not already, suffering the most from the effects of CC. It is therefore essential that a proportion of VCM resources should also be applied to enable farmers to adapt to the current and accumulating effects of climate change for which they are not responsible. Scaling up adoption of MT-CA on the foundation already established by the CFU and many other organisations would make a significant contribution to this crucial aim.

For a wealth of information visit the CFU's website conservationagriculture.org
