RE-THINKING IMPROVED LAND MANAGEMENT PRACTICES THROUGH CONSERVATION AGRICULTURE

A CASE STUDY OF UGANDA

Prepared

By

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List of Acronyms

A2N	Africa 2000 Network
AEATRI	Agricultural Engineering and Appropriate Technology Research Institute
AT (U)	Appropriate Technology Uganda
CA	Conservation Agriculture
CAP	Community Action Plan
CBO	Community Based Organisation
CIG	Common Interest Group
FAO	Food and Agriculture Organisation of the United Nations
FFS	Farmer Field School
FITCA	Farming in Tsetse Controlled Areas
GO	Government Organization
HASP	Household Agricultural Support Programme
KARI	Kawanda Agricultural Research Institute
LC	Local Council
MFI	Micro Finance Institution
NAADS	National Agricultural Advisory Services
NARO	National Agricultural Research Organisation
NGOs	Non-Governmental Organizations
PMA	Plans for Modernisation of Agriculture
PDCO	Participatory Diagnosis of Constraints and Opportunities
RELMA	Regional Land Management unit, supported by SIDA and recently affiliated with ICRAF
SFI	Soil Fertility Initiative
SIDA	Swedish International Development Agency
SWOL	Strengths, Weakness, Opportunities and Limitations analysis
TCP	Technical Cooperation Project
ToR	Terms of Reference
ULAMP	Uganda Land Management Project

1.0 GENERAL DESCRIPTION OF THE AREAS IN UGANDA WHERE CONSERVATION AGRICULTURE PRACTICES ARE BEING TESTED AND ADAPTED BY FARMERS

Background

Reversing natural resource degradation and subsequently low productivity of the small-scale farming sector requires building the capacity of key stakeholders including farmers in approaches that enhance natural resource management along with building efficient and equitable markets for smallholder farmers. In Uganda there has been several programmes and projects initiated by both government and non-government organization geared towards reversing land degradation but with limited success and on a small scale. Therefore, the government of Uganda in 2002 sought technical and financial assistance from FAO to implement a pilot project, which aimed at introducing Conservation Agriculture (CA) principles through the Farmer Field School approach as an integral part of improved land management and livelihood strategies of smallholder farmers. The project focused on demonstrating the applicability of Conservation Agriculture systems in Uganda and its multiple benefits in terms of productivity (labour saving, income enhancement, diverse products), sustainable use of natural resources (biodiversity and resilient land use systems) and environmental services (water quality, reduced costs of erosion).

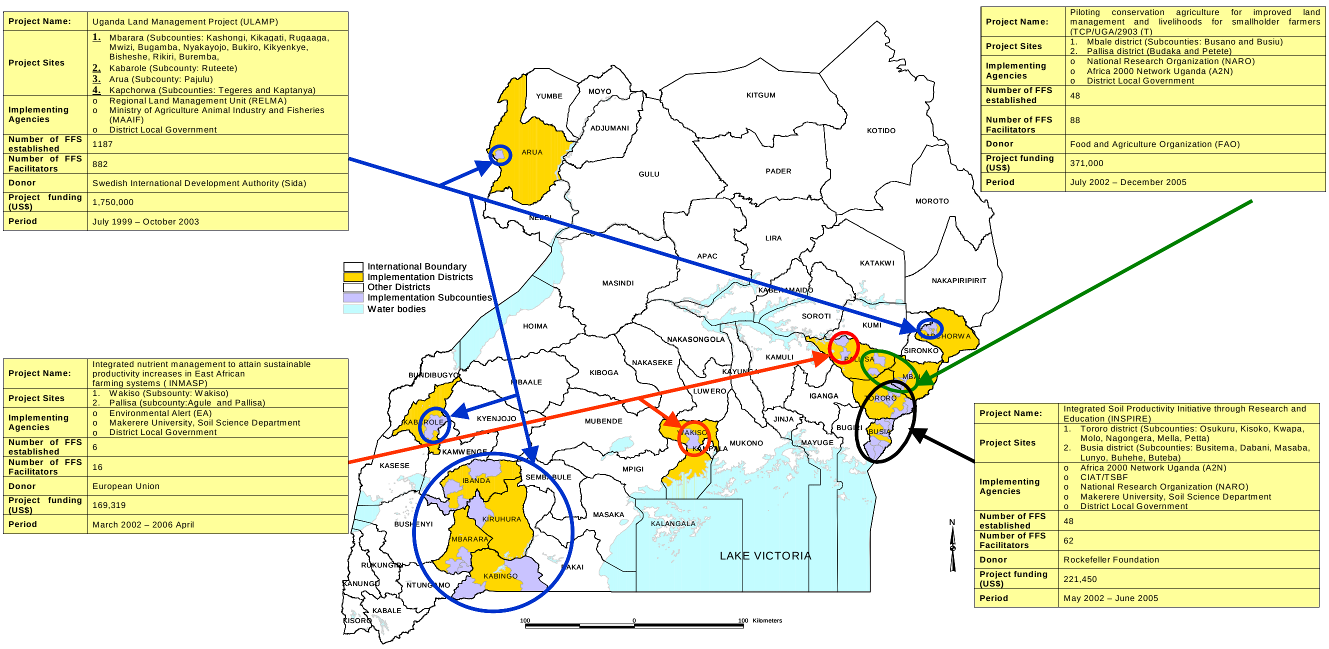

Figure 1. Land and water management projects implemented in Uganda using FFS approach.

This case study presents experiences and lessons learnt from two pilot Conservation Agriculture (CA)[1] projects implemented in three districts of Pallisa and Mbale in eastern Uganda and Mbarara in southwestern Uganda (figure 1). CA was introduced in eastern Uganda through a pilot FAO Technical Cooperation Project (TCP/UGA/2903) in 2002, while in Bisheshe sub-county, Ibanda district (formerly part of Mbarara district) it was through a SIDA funded project, Uganda Land Management Project, (ULAMP) in the year 2000. In Mbale and Pallisa districts, activities were piloted in four contrasting micro-catchments that represent areas undergoing accelerated land degradation in 4 selected parishes, two in Mbale (Busano and Busiu) and two in Pallisa (Budaka and Petete).

Activities of the projects with farmers were, to the extent possible, concentrated within the selected catchments with a view to facilitate monitoring and observation of aggregate benefits of better land management in terms of hydrological regime, water quality and better erosion control. This is possible through the elimination or reduction of tillage activities for land preparation and the introduction of efficient weed management technologies and fuel wood saving technologies. The population densities of Mbale, Pallisa and Mbarara districts are 487, 229 and 410 persons/km^2 in respectively, according to the 2002 population census, of which a majority are smallholder farming families.

Fig. 2a: Busano, Mbale Micro-catchment

Fig. 2b: Petete, Pallisa Micro-catchment

[1] Conservation Agriculture is a summary term for a farming concept that embraces three basic principles that should be followed when implementing the CA concept. Those principles are: (1) reduced or minimal moving of the soil (reduced or no-tillage practices); (2) permanent soil cover (either with dead mulch or with cover crops); (3) Useful crop rotations or associations that are in line with local preferences and circumstances

Fig. 2c: Bisheshe, Mbarara Micro-catchment

Mbale and Mbarara districts, are medium altitude zones lying between 1,200 – 2,100 masl, with high altitude, steep lands in Mbale in the footslopes of Mount Elgon. Pallisa is a lowland area lies between 1,000 – 1,200 masl characterized by lighter sandy soils and a gently rolling landscape with wide valleys draining into Lake Kyoga. The soils in Pallisa are generally sandy loams, low in soil organic matter, low in fertility and often acidic. The crops grown in Mbale on the steep, highly dissected slopes, include perennials like banana and coffee and annuals like maize, beans, Irish potatoes and vegetables. Mbarara is in a coffee-banana-livestock agricultural zone. The major crops grown are banana, coffee (Arabica), maize, beans, groundnuts, millet and sweet potatoes. Others crops grown on small scale mainly are cassava, Irish potatoes, field peas and yams mainly as reserve food. Exotic and local vegetables are grown on a small scale, mainly as a backyard activity by women. A limited number of livestock are kept, mainly cattle, goats, pigs and chicken. Most of the cattle are the local long horn Ankole cattle, but with introduction of zero grazing units, a large number of farmers have started keeping up-graded crosses of cattle. Local goats are also being up-graded with pure breeds of exotic species. In Pallisa district, major crops grown include cassava, sweet potato, sorghum, rice, cowpeas and groundnuts.

Need another section to present threats

Threats in Mbale and Mbarara include loss of soil through erosion and landslides, intensified by loss of vegetative cover on the steep slopes through agriculture and deforestation. The soils in

Mbale have a moderate to high clay content and are productive if well managed; while those of Mbarara are predominantly sandy loam, which are prone to severe degradation due to soil erosion triggered by deforestation of the hills, overgrazing and poor land cultivation practices. There is a range of soils, those on the hilltops are shallow and sandy mixed with gravels, those on gentle slopes are predominantly sandy-loams, while the soils in the valleys are silty- loams that are fairly deep. In some parts of Bisheshe, there are underlying layers of limestone that make them unstable and prone to severe soil erosion. Due to the hilly topography and high population density in both Mbale and Mbarara, the land holdings per household are small, ranging from 0.25 to 1 hactares. Land fragmentation in all sites is a common practice and due to land shortage, the existing arable land is intensively cultivated. Most of the arable land is located on the foothills, three quarters of which are under banana and coffee. The degraded hillsides are gradually being increasingly cultivated for production of annual crops such as millet, maize, beans and sweet potatoes. Cattle are mainly grazed communally on the hilltops during rain seasons and in valleys during the dry season.

Farming system info is rather fragmentary

Mbale and Mbarara have average annual rainfalls of over 1,500 mm and 1,300 mm respectively, while Pallisa is receiving some 1,000 mm per year (Fig. 2e). All sites have a bi-modal rainfall pattern from mid February to end of May and from August to end of December. The rainfall season averages 100 rain days (Fig 2d). Most of the rainfall in Mbarara is experienced during the second rain season, from August to December (fig 2d and 2e). The heavy downpours, during this period, cause heavy runoff that triggers severe soil erosion, soil capping and occasionally landslides. High population pressure has led to encroachment of marginal lands and wetlands. Growing of rice in the wetlands has increased tremendously in these areas in the last thirty years. Due to land degradation in the upper zones, rivers and streams are highly silted and the zone experiences frequent flooding.

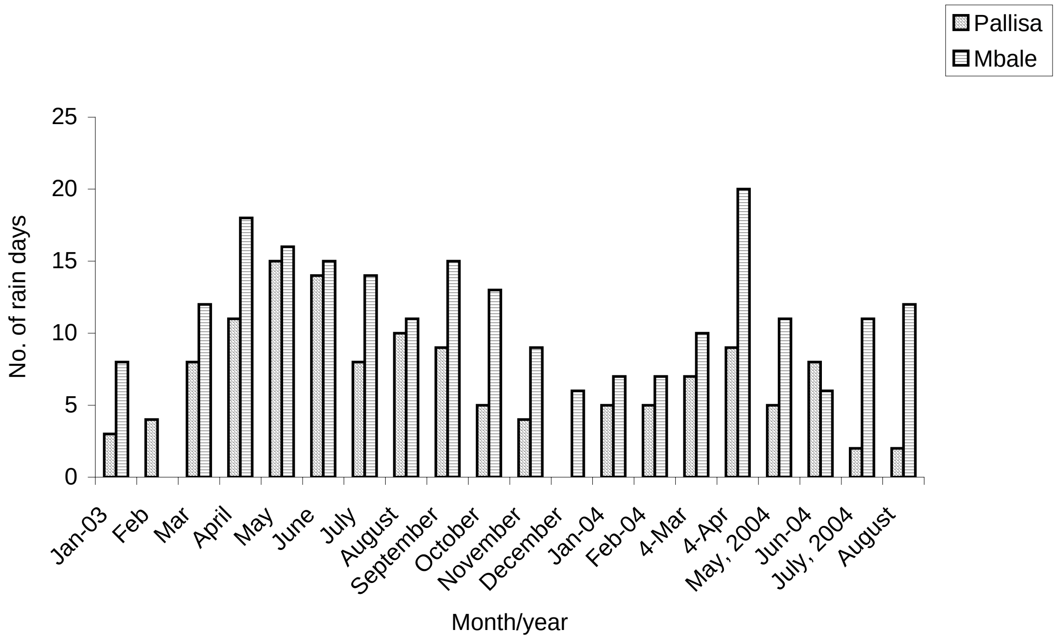

Fig. 1d: No. of rain days per month in Mbale and Pallisa catchments

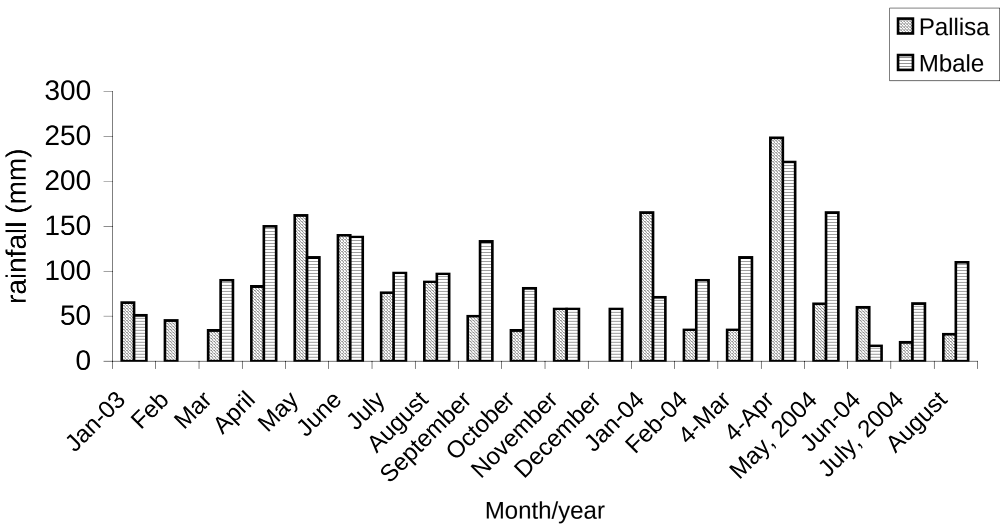

Fig. 2e: Total monthly rainfall in Mbale and Pallisa catchments recorded over a period of 18 months by the FFS groups

2.0 TYPE OF CA PRACTICES

Since there realization of the need to reverse land degradation, farmers in the project sites have been practicing improved land management practices such as establishment of soil and water conservation structures (Fanya and Fanya Chinni), use of cover crops as improved fallows and various forms of crop rotations and combinations. Despites these efforts there has been serious shortfalls in the individual practices in addressing soil fertility and land degradation, with resulting adverse consequences to crop and livestock productivity and the environment.

In order to address these shortfalls, CA technology was introduced as an alternative practice to land management. The introduced CA concept emphasized use of site (situation) specific combination of practices aimed at:

- Checking and minimizing soil erosion mainly through reduced or no-tillage practices.
- Building soil organic matter content through no burning of crop residues and hence improving the chemical and physical properties of the soil.
- Controlling and checking weeds
- Increasing soil cover to protect the soil from rainfall and/or heat hazards, improving water infiltration rate and conserving soil moisture during dry spells.

Its important to note that the entry point of CA in these micro-catchments varied greatly depending on site (situation) specific constraints in a given catchment and /or household type. Some of the considerations in the promotion of the CA package included differences in wealth status or resource endowment (rich, poor or medium), availability of household labour and crop and/or livestock farming system. CA practices were promoted as a package and not individual practices as this is what many farmers knew. Several combination of practices were demonstrated and field-tested depending on the field operation being carried out and cropping system as shown below:

A. Land preparation:

This is an operation carried out to mainly rid the fields of weeds and making a fine seed bed ready to sow annual crop seed. As a substitute to the use of a traditional hand hoe (Fig. 2a), weeds were sprayed with herbicide (Fig. 2b), slashed or smothered by legume cover crops like Mucuna (Fig. 2c and 2d), which were also either sprayed with herbicide or slashed before planting.

Fig. 2a: Conventional practice - hand hoe

Fig. 2b: Soil cover (Mucuna) sprayed with herbicide then plant

Fig. 2c: Soil cover (Mucuna) slashed then plant

Fig. 2d: Soil cover (Mucuna) knocked down by an oxen drawn knife Roller before direct planting

b. Planting

i). Different planting tools for reducing tillage, traffic (soil compaction) in the field and labour requirement during planting namely, planting stick (Fig. 2e and 2f), jab planter (Fig. 2i and 2j) and ox-drawn ripper planter (Fig. 2g and 2h)

Fig. 2e: Kasimire, plants in a mulch with a planting stick locally known as a 'Jobbe', Bisheshe, Mbarara

Fig. 2f: Farmers plant a demo with a stick in a mulch in Busiu, Mbale

Fig. 2h: Demonstrating Calibration of a triton planter

Fig. 2i: Demonstrating direct seeding using a Jab planter

Fig. 2j : Farmers in Bulumbi FFS learning how to use a Jab planter

Fig. 2k: Conventional planting using a hand hoe

ii). Permanent Oblong Holes (Planting Stations).

This method was demonstrated on the production of maize and is similar to Zai method used in Zambia. In this case the planting pits (Fig. 2l and 2m) are dug (approximately 35 cm long, 15 cm wide and 15 cm deep), spaced at an interval of 70 to 90 cm. Each hole is then filled with1-2 kg of compost manure, which is mixed with topsoil and planted with nine seeds of maize per hole, thus giving an optimum seed rate of 25 kg/ha of maize longe 5 variety

Fig. 2l: Maize at one week after planting in a permanent planting station

Fig. 2m: Maize established in permanent planting stations intercropped with cover crop

c. Weed control

Planting cover crops in banana (Fig. 2n, 2o and 2p), coffee (Fig. 2p) and vanilla (Fig. 2q) plantations in combination with soil and water conservation structures, mulching and *manure application. Several cover crops tried out include, Mucuna, Lablab, Canavalia, Bush beans, Pumpkins, and the yellow passion fruit.*

Fig. 2n: Banana interplanted with Mucuna cover crop and well managed- providing a complete cover and not interfering with the bananas.

Fig. 2o: Banana interplanted with Mucuna cover crop but NOT well managed- the Mucuna has grown up and smothered the banana plants – farmer decided to weed them out

Fig. 2p: Banana/coffee interplanted with Mucuna cover crop and well managed

Fig. 2q: Vanilla interplanted with Mucuna cover crop but NOT well managed

d. Soil and water management

Water harvesting pits constructed in trenches aligned on contour in which new banana stools are planted (Fig 2r and 2s). The raisers are mulched and planted with cover crops.

Fig. 2r: Newly established banana plants in water harvesting pits constructed in trenches or furrows

Fig. 2s: An established banana plantation in which the ridges, formed between the trenches or furrows, are mulched for protection and organic matter supply.

e. Soil fertility improvement

Permanent narrow based terraces on which vegetables are planted after application of compost manure and mulch (Fig 2t and 2u). Cover crops are later planted to cover the surface of the terraces after harvesting of the vegetables.

Fig. 2t: Preparing permanent narrow based terraces for planting

Fig. 2u: Permanent narrow based terraces planted with onions

f. Use of different crop rotations and associations.

A participatory diagnosis of constraints and opportunities with regards to crop rotation and associations was carried out in two different cropping systems namely, banana-coffee for Mbale and cotton – cereal in Pallisa districts. This revealed that:

I. Most farmers were practicing no crop rotations and/or inappropriate rotations especially with their annual crop. For example farmers plant maize in the first season (March to June) and in the following season (July to December) they plant cotton that as similar crops pests and diseases. The neglect of alternative potential crops in the rotations was attributed by farmers and extension officers to a number of reasons including the traditional attachment to certain crops like beans, food security risk aversion, land shortage and suitable soils for certain crops, lack of alternative crop seed or germplasm, and market/income forces and ignorance of the need for, and benefits of, improved rotations and available opportunities.

II. In some cases farmers were practice appropriate rotations but they are too short either to break pest/disease cycles, or to maintain or improve soil fertility.

Fig. 2v: A typical vegetable crop rotation field (beans and cabbages) on permanent narrow based terraces, in Busano Mbale

Fig. 2w: Cotton interplanted with Canavalia – compatible association

Fig. 2x: Cotton interplanted with lablab – cotton was completely suppressed

Fig. 2y: Cotton interplanted with Cajanas cajan - compatible association

The FFS learnt that it is important for farmers to choose appropriate crop combinations and associations to avoid possible competition between different plant species. For example, through their study plots, farmers in Petete and Sapiri micro-catchments have learnt that Mucuna and Lablab are not suitable for intercropping with cotton, whereas pigeon peas (Cajanas cajan) and Canavalia make beneficial associations. Farmers also found that appropriate crop rotations and combinations were also important in weed management. Crop combinations and rotation of crops with morphologically (variable plant size and form) and physiologically (variable response e.g. to nutrients and moisture stress) different habits were seen to suppress weeds and to break pest and disease cycles. Optimal plant spacing of different crop associations/combinations minimized opportunities for weed establishment and suppressed weed growth.

Farmers had high preference for cover crops with multiple uses including use as food and fodder for livestock. Farmers disliked those that had pest problems such as *Chrotalia grahamian*.

Fig. 2z: Maize intercropped with *Cajana cajan*, both providing food

Fig. 2z1: Banana interplanted with pumpkins, both providing food

3.0. IMPACTS, BENEFITS AND RESULTS OF CA PRACTICES

During the FFS learning process, the farmers' groups were assisted to establish study plots or experiments in their own fields with a view to test the CA practices and principles through a process of discovery-based learning by doing. The simple studies/experiments centred on the three principles of CA: i) permanent soil cover through cover crops or mulch, ii) no- or minimum- tillage with direct seeding, and iii) improved crop rotations. The studies were carried out for three (3) seasons in sixteen (16) FFSs, each FFS representing a replicate of the experiment, using maize (variety longe 5H as a test crop). [BT1]

The FFS assessed the following aspects, through season-long monitoring and evaluation of the studies:

- Agronomic crop performance in terms of germination %, crop vig, weed profiles, grain and stover yield;
- Economics in terms of labour efficiency, cost of inputs and out puts per treatment;
- Farmers' qualitative assessments.

Some of the results of these studies are presented below.

a) Results from the FFS experimentation with CA

The CA-FFS, through the study plot experiments, exposed farmers to a variety of options for land preparation that can reduce labour for land preparation and weeding. These are the most time consuming tasks for households. Before the introduction of CA-FFS, farmers only knew one option for land preparation and weeding which involve a great deal of turning the soil (tillage) using either the hand hoe or the ox-plough. During the FFS studies, farmers tried out and evaluated several other options that would minimize soil disturbance and, at the same time, reduce the labour demand on the household. These options/practices include use of herbicides, slashing and cover crop management. The practices were evaluated, in terms of labour requirements, productivity (crop yield), weed prevalence and overall economic assessment.

Timeliness & labour requirement for field operations per hactare of maize

Given the low and erratic rainfall scenario in this area, timeliness of field operations is very critical in achieving good crop yield. The situation is further aggravated by the labour bottlenecks caused by the HIV/AIDS scourge and rural-urban migration of the youth. An assessment of the timeliness and labour requirement for field preparation of one hectare of maize was carried out with 8 FFS comparing conventional use of a hand hoe or an ox plough with CA practices. Results of the evaluations showed that options involving cover crop management required four (4) times less labour compared with the other options – herbicides and weed slashing on their own and conventional ploughing and hoeing of weeds, as shown in table 1. Since herbicides are perceived by farmers to be expensive and not readily available, the option of managing cover crops by slashing was found to be the most feasible among others.

Table 1: Timeliness & labour requirement for land preparation per hectare

Activity/operation	**Treatments**									
	Conventional		**Herbicide use**		**Slashing**		**Cover crop + Slash**		**Cover crop + Herbicide**	
	man days*	oxen days**	man days	oxen days	man days	oxen days	man days	oxen days	man days	oxen days
Time spent bush clearing	17.5	5	17.5	5	17.5	5	0	0	0	0
Time spent on 1st ploughing	37.5	2	0	0	0	0	0	0	0	0
Time spent on 2nd ploughing	18.7	1	0	0	0	0	0	0	0	0
Time spent on spraying herbicide	0	0	5	5	0	0	0	0	5	5
Time spent on slashing weeds/cover crop	0	0	0	0	5	5	5	5	0	0
Total	**73.7**	**8**	**22.5**	**10**	**22.5**	**10**	**5**	**5**	**5**	**5**

*1 human workday = 4 hours of effective working, **1 oxen day = 6 hours of effective working,

Farmers learnt that the cheapest options (that is within their resources) was slashing and use of cover crops as indicated in table 2 below. From the knowledge and skills obtained in these FFS studies, 60% of the FFS members subsequently adopted the option of slashing and use of cover crops. The use of cover crops (in this case Mucuna) was specifically appreciated for their ability to suppress weeds effectively.

Table 2: Land preparation costs (UgSh) per hectare of maize

Activity/operation	Land preparation (Treatments) cost				
	Conventional	Herbicide Use	Slashing	Cover crop + Slash	Cover crop + Herbicide
Bush clearing	37,500	37,500	37,500	37,500	37,500
Cost of 1st ploughing	37,500	0		0	0
Cost of 2nd ploughing	37,500	0		0	0
Inputs					
Cost of herbicides - Round up max	0	50,000	0	0	90,000
Cost of herbicides - Laso atrizine	0	45,500	0	0	0
Cost of hiring a spraying pump	0	2,500	0	0	2,500
Cost of labour for spraying	0	7,000	0	0	7,000
Total	**112,500**	**142,500**	**37,500**	**37,500**	**127,000**

Weeding labour requirement and the associated costs

Weeding takes up over 50% of smallholder farmers' production cost. It also occurs at critical periods of labour demand. Farmers found that adoption of CA practices greatly reduces their labour requirement for weeding as evidenced in this FFS study. It was noted that options involving use and management of cover crops, either by slashing or herbicides, required less labour and hence are more cost effective compared to the other practices, as indicated in table 3 below.

Table 3: Weeding labour requirement and cost per hectare of maize

Activity	Treatments									
	Conventional		Herbicide use		Slashing		Cover crop + Slash		Cover crop + Herbicide	
	Labour (workdays)	Cost (UgSh)	Labour (workdays)	Cost (UgSh)	Labour (workdays)	Cost (UgSh)	Labour (workdays)	Cost (UgSh)	Labour (workdays)	Cost (UgSh)
1st weeding	17.5	37,500	0	0	17.5	37,500	9	12,500	9	12,500
2nd weeding	17.5	37,500	0	0	17.5	37,500	0	0	0	0
3rd weeding	0	0	0	0	17.5	25,000	0	0	0	0
Total	**35**	**75,000**	**0**	**0**	**52.5**	**100,000**	**9**	**12,500**	**9**	**12,500**

In terms of productivity, options involving use of cover crops gave higher yields (table 4) because the cover crops provided more fertility through nitrogen fixation and restoration of organic matter (roots and leaf litter) besides better weed suppression, as indicated in table 4 below. Data presented was collected by farmers with guidance's of FFS facilitators and no scientific statistical analysis was carried out.

Table 4: Yield of maize (kg/ha) as influenced by the land preparation practice in the FFS plots.

Land preparation option (Treatments)	Grain yield (kg/ha)
Conventional	2,458.6

Land preparation option (Treatments)	Grain yield (kg/ha)
Herbicide Use	2,618.6
Slashing	2,453.8
Cover crop + Slash	3,126.0
Cover crop + Herbicide	3,008.0

b) Results from individual farmer monitoring and evaluation

Mr. Kasimire of Bisheshe, Mbarara district, is one of the farmers who monitored changes on his farm in terms of plant growth and vigour, pests and disease occurrence, weed prevalence, soil conditions and yields. Table 5 gives results of CA and non – CA practices as reported by Mr. Kasimire.

Table 5. Field observations of CA and non – CA practices on maize and beans, as reported by Mr. Kasimire after 4 cycles (seasons) of CA use

Factor	CA plots	Non-CA plots (control plots)
Plant health and growth	The crop of maize and beans were growing with vigour. Each plant of maize was able to produce 2 cobs. The average podding of beans was 35 pods of K 132 variety.	The maize crop remained weak and stunted. Some failed to put cobs. The bean crop showed some vigour but the numbers of pods on each plant were far less than those in CA plots, with an average of 10 pods of the same variety.
Pests and diseases	Cutworms at the seedling stage destroyed some plants. They were replaced at the start of rains and there was no more damage. Maize streak disease was widespread and caused great crop damage	There was no pest invasion at seedling stage. Maize streak was observed on many plants.
Weeding	No serious invasion of weeds except “Wondering Jew” which was removed during weeding from the planting sites.	Many weed species occurred and required intensive weeding at two times during the growing period.
Soil conditions	The soils remained moist and soft even during dry spells. Accumulation of organic matter and litter on the topsoil led to the presence of earthworms. Topsoil particles had a smooth feel, which were sticky on rubbing (indicating moisture).	The maize plots were affected by soil erosion as the land remained bare. After rain, the soils dried quickly and the topsoil particles remained separate (loose, dry and prone to erosion).
Yield: Maize	No. of cobs 3,800 from which the farmer obtained 28 basins of dried maize seeds. Equivalent to 452 kg or 4.5 sacks of 100 kgs.	No. of cobs 2,625 from which the farmer obtained 13 basins of dried maize seeds. Equivalent to 260 kg or 2.5 sacks.
Beans	The farmer obtained 105 kg (1 sack) of beans.	The farmer got 97 kg (1 sack) of beans.
Income: selling price of maize is 250 UgSh/kg and beans 400UgSh/kg	maize: 452 x 250= 113,000/- beans: 105 x 400= 42,000/- Value of produce: 155,000/-	maize: 260 x 250 = 65,000/- beans: 97 x 400 = 33,800/- Value of produce: 98,800/-

4.0 ADAPTATION AND ADOPTION OF CONSERVATION AGRICULTURE

The Farmer Field School (FFS) approach was chosen as an alternative to the traditional extension approach in which farmers are passive recipients of externally formulated extension messages. The FFS approach involves a discovery-based learning, and the extension agents act as "facilitators", to support the learning process as well as the adoption of new technologies that are tested directly by the farmers. The FFS approach was adapted for use in the promotion of CA through development of a curriculum that address CA and other related livelihood related issues.

Fig. 3a: Farmers and extension facilitators together plan a demonstration/experiment in Sapiri, Pallisa district

Fig. 3b: A FFS in Bisheshe, learning how to construct planting pits for banana establishment

The FFSs were coordinated in each micro-catchment via an elected FFS Network whose roles included farmer mobilization towards FFS activities, networking and information sharing, conflict resolution among members within the groups, revolving fund management and local policy influence and advocacy.

Table 6. Typical example of a CA curriculum for FFS (see details in appendix 1)

Phase	Duration	Learning themes
Pre-experiment phase (Before the season starts preferably)	11 weeks	Concepts and principles of FFS
Experimental phase	20 weeks	Experimentation with technology, Agro-ecosystem analysis

Post-experiment	9 weeks	FFS graduation, second order generation FFS, linkages to other development initiatives

The knowledge and skills that farmers acquired through the experiential learning process enabled them to adapt CA on their farms and this was observed mainly among innovative farmers. Some innovative farmers tried to apply the knowledge acquired in diversifying their agricultural activities through setting up high value enterprises such as pineapple, vanilla and banana plantations among others. The soil fertility improvement and improved moisture management led to the improvement in production that eventually led to a good crop harvest and therefore food security. In the long run, farmers feel that there will be more available food for a range of household types that will in turn impact on the household nutritional status. Box 1, 2 and 3 give testimonies farmers of experience with CA under different situations.

Box 1: Mr. Kasimire's testimony of the impact/benefits of CA on his livelihood

Kaanama common interest groups (CIG) was one of the CIGs in Bisheshe, Mbarara district, that received demonstrations on CA. Mr. Kasimire, one of the active members in the CIG, lives on sloping land whose soils are gravelly and barren. As these gravelly soils could not hold water for long, crop growth was very difficult. This barrenness of the land had frustrated Mr. Kasimire, who wanted to sell off the piece of land but he could not find a buyer, nor did he have enough money to buy an alternative plot of land. As head of family, Mr. Kasimire failed to provide for the family. He could not manage paying school fees for the children. Finally quarrels with his wife became frequent. Mrs. Kasimire on the other hand spent most of her time working at other people's farm for food and money. She felt jealousy of women in the village that had better land and could grow good crops, sell and buy themselves nice clothes. The Kasimire children also suffered their fate. They did not only fail to get school fees but also were fed poorly and suffered from malnutrition. As a coping mechanism, some of the children were sent to live with distant relatives with the aim to get enough to eat.

However, the CA opportunity that Kasimire learnt through Kaanama CIG transformed his livelihood and shaped his own destiny and also helped others. Using CA (permanent planting stations and Mucuna cover crop), Kasimire planted maize (Longe 5 variety) on the most degraded piece of land that was equivalent to an eighth of an acre. From that alone he was able to harvest 100kgs. The 2nd season he planted beans (K132) on the same piece of land and he harvested 60kgs of beans. The 3rd season he planted one and a half acres of maize (Longe 5) and harvested 4 bags estimated to weigh 450kgs. The 4th season he planted climbing beans; from 1 plastic cup full of climbing beans he obtained 100kgs. Mr. Kasimire kept record of his production in an exercise book.

Mr. Kasimire also planted onions using CA principles on another part of his farm. He harvested 14 basins from two plots each measuring 1.5m x 8m out of which he sold 12 basins for 120,000UgSh. In the following season he planted tomatoes on the same piece of land and harvested 97 basins and sold each at UgSh. 3,000, he earned UgSh. 291,000 /=. Before the season ended he planted cabbage seedlings and sold 140 heads, not including what the family consumed. On the other half of the plot, he planted carrots and sold them at UgSh 14,000. In the 3rd season, he planted 9 lines of onions and harvested 40 basins. In all he earned UgSh. 286,700.

By practicing CA, Kasimire has abandoned his plans of selling his land or migrating. During the three years of practicing CA he has been able to pay school fees of up to UgSh 200,000/= per term and also purchased all scholastic material for his one child in secondary school and 4 in primary school, mainly through the sale of crop produce. In addition, he has managed to renovate his house and put it in a better shape.

Mr. Kasimire has now bought more land that includes banana and coffee plants. He has also bought a cow at UgSh. 140, 000 from sales of honey. Mr. Kasimire has bought household utensils and other equipments. He is now a member of a credit and savings group and he is up to date with his subscriptions.

Mr. Kasimire has noted some changes in his plot where he is applying CA technology. The soils have become darker in colour and the stones are now covered and the top soil layer has increased in thickness. He has also noticed some changes in the family welfare, and no more quarrels with his wife. They now use less labour compared to the old days before they practiced CA. Also the children are willing to participate in the family chores. They are no longer throwing away household waste as they know it has to be used as a source of compost to be used in CA. Family income has improved, the area cropped has reduced but with and increase in productivity, and he feels he has controlled soil erosion on his farm. He has learnt to integrate CA with goat rearing and bee keeping. The animals provide manure for his gardens while bees pollinate his crops for better yields. CA in Bisheshe started with 10-14 people and now it has spread to over 80 more farmers.

Source: Anthony Nyakuni, ULAMP Project Manager

Box 2: Mr. Mukari's testimony of the impact of CA to his and the villagers livelihood and farming practice

Nabikyenga Farmer Field School is one of the 16 farmer field schools initiated under the FAO funded CA project in Mbale district, Busano sub county, Busano parish and Nabikyenga village located 400Km from Kampala. The area here is characterized by steep slopes, up to over 60^{o}, with congested households with an average family size of 10 persons, cultivating small tracks of land of between 0.25 and 1 acre. The main crops grown are bananas, field peas, beans, onions, cabbages, carrots, Irish potatoes and coffee. The area has a bimodal rainfall with the first rains from March to July and the second rains from September to November.

Emmanuel Mukari is a member of Nabikyenga Farmer Field School. With a family of 8 children (six boys and two girls) deriving their livelihood from 1 acre of land, he is considered as one of the richest in the village. However, the current and future survival of his family is a big concern to him, notably meeting the family needs such as health and education. Mr. Mukari is much bothered by the future of his 6 boys because he hardly believes that his one acre can support them, and their children in the future.

Apparently the introduction of the CA approach to land management has given him some hope. The learning by discovery that occurs in their FFS using the Agro Ecosystem Analysis (AESA) tool, with guidance from their FFS facilitator, has made a miraculous impact. *'I volunteered to give my land as a study plot for our FFS. We then took record of the problems on the 1/4 acre of coffee field which included low soil fertility, extreme erosion and poor agronomic management practices. As the FFS study plot I implemented a number of practices namely water harvesting, soil stabilization with grass bunds, and mulching that we agreed upon with the group. After 2 seasons of practicing CA, I and the group made observations through AESA. My plantation now looks better. I used to get 1 bag (70kg) from the ¼ acre but now I get 2 bags (140 kg). The size of the coffee berries has increased and now I get 1 kg of processed coffee from 2 kgs of raw coffee, implying that I now get the same kgs of processed coffee from less of raw coffee. Therefore I never intend to sell raw coffee again at Shs 500 per kg (and get only Shs 2000 from 4 kgs) but would rather process my 4 kgs of raw coffee, get 2 kg of processed coffee and sell at Shs 2000 per kg and get Shs 4,000. My revenue from the ¼ acre coffee has doubled……… all we need now is a coffee processing machine for the group to cater for the increased demand of its services'……says Mukari.*

The CA practices have spread in the whole village like a bush fire and to-date over 80% of the members in the 4 FFSs and about 50% of non-FFS members in the micro-catchment have adopted the CA practices which mainly comprise water harvesting using trenches (Fanya juu and Chinni), trench stabilization using grass bunds and tree shrubs, rain water run off capture from roads and courtyards, and mulching with both live and dead mulches. " …….farmers on this footslope have now become serious about practicing CA, they are now forming groups and consulting us to advise them on what to do"…. says Mukari.

Mukari has a daughter at Makerere University whose fees he is paying privately and he says she has drained his small resources to the extent that he is not able to pay for education of the other children. He however believes and hopes that from the results he has seen so far, his worries will be no more and all his children will be able to attend school.

Source: John Peter Opio, Agric. Training Expert (TCP/UGA/2903 Project)

Box 3: Catchment Level Assessment of CA – Sapiri micro-catchment

Poor roads were perceived by the Sapiri community (in Budaka sub county, Pallisa district) and the local leaders as one of the priority problems in the area. As such, farmers would get a raw deal when they market their produce since buyers would not reach them due to the poor road infrastructure. The budget allocation for road maintenance by the local administration unit (sub county) was over 40% according to the Chief of Budaka, Mr. Shiny. The road would require repairs and maintenance twice every year. Mr. Shiny noted that it would cost the sub county 4 million shillings every year to repair/maintain a 10 km road that passes through Sapiri parish. The major cause of the destruction of the road is rainwater runoff.

However, adoption of CA by several farmers brought a significant change in Sapiri micro-catchment in a period of two years. The CA practices which were initially perceived to improve water harvesting for crop use, also provided significant positive benefits in terms of road maintenance. These CA practices for soil and water conservation were initially implemented by only members of the FFSs in the micro-catchment but later spread over to other non-FFS members following the evident benefits they noticed from the farmers who had adopted earlier. The CA practices include Fanya Juu and Fanya Chinni, water diversion channels for runoff from roads, grass bunds, water basins locally known as 'Bafus'. Farmers who own land along the roadsides also learnt to divert water from the road to their crop fields, a practice they copied from the road maintenance workers.

In a period of two and half years, the local leaders together with the entire community have noted that gullies and potholes, water ponding in law lying areas and impassable bridges in the road caused by running water, are greatly reducing due to the practices of managing rain water runoff on the roads.

Mr. Shiny say that the sub county road maintenance budget for Sapiri parish has drastically reduced by half, since their roads are now repaired/maintained only once instead of twice in a year as it used to be two and half years ago. Farmers are directly benefiting from the water diverted from the roads and their compounds/courtyards into their crop fields. '*We have recommended to the sub county council that a bye law is passed by the council for community members to adopt CA practices that prevent destruction of roads. We would rather spend money to support farmers on such CA practices than hire or buy expensive equipment for road construction and maintenance……….*' say Mr. Shiny.

Source: Paul Nyende, Land Management Expert, (TCP/UGA/2903 Project)

5.0 KEY CHALLENGES AND LESSONS

a. Providing and Managing a Permanent Soil Cover

1. Through the CA study plots, farmers in the FFS groups experimented with and learnt that cover crops have both positive and negative attributes. The choice of cover crop to use will depend on site-specific needs to be addressed. Table 7 gives a summary of an assessment of some cover crops by the FFS in Mbale and Pallisa by the farmers and facilitators[BT2]. Earlier studies by Nyende and Delve (2002), in Tororo district which is in close proximity with Pallisa and Mbale revealed that farmers' preference for cover crops is quite site specific and

Table 7: Farmers assessment of local cover crops (LCCs) and shrubs for soil fertility improvement

LCC/shrub	Positive aspects	Negative aspects
Mucuna pruriens	✓ Improves soil fertility ✓ Suppress weeds effectively ✓ Produces high biomass ✓ Quick maturing ✓	x Not edible x Not good for intercropping (climbs the crops) x Requires high labour for clearing and incorporation x Can harbour snakes and wild cats if planted near the home
Canavalia ensiformis	✓ Improves soil fertility ✓ Has fodder value ✓ Suppresses weeds ✓ Easy to multiply (high seed production) ✓ Good for intercropping	X Not edible
Crotalaria paulina	✓ Improves soil fertility ✓ Suppresses weeds ✓ Leaves are used as a vegetable	
Crotalaria grahamiana	✓ Improves soil fertility ✓ Suppresses weeds	x Has pest problem – caterpillars
Tephrosia vogellii	✓ Improves soil fertility ✓ Controls mole rat	x Has pest problem - that eat the pod, hence lead to poor seed formation
Lablab	✓ Very good fodder ✓ Edible by humans ✓ Improves soil fertility ✓ Suppresses weeds	x Poor establishment
Sesbania sesban	✓ Very good fodder ✓ Improves soil fertility ✓ Provides firewood ✓ Suppresses weeds	x Produces too many seeds which can turn into weeds
Pigeon peas	✓ Improves soil fertility ✓ Has food and fodder value ✓ Suppresses weeds ✓ Easy to multiply (high seed production) ✓ Good for intercropping	
Pumpkins	✓ Has food value ✓ Suppresses weeds ✓ Easy to multiply (high seed production) ✓ Good for intercropping	X Does not improve soil fertility

Source: Nyende and Delve, 2002

2. For effective mechanical management of cover crops by the animal drawn knife roller developed by AEATRI, equipment trials conducted by AEATRI within the FFS showed that it is important that the cover crop is at its final vegetative cycle stage. For legumes this is between full flowering and formation of the first pods, for grass species during the milky stage and for other species, like oil radish, between flowering and maturation of the seeds. If a mixture of cover crops is used, it is important to choose those species with a more-or-less uniform growing cycle. Under Ugandan conditions, however, (as farm size is small and may not allow legume and grass rotations as, for example, in Brazil), the knife roller will also be used in knocking down and chopping of cereal crop-straws (maize, sorghum and finger or pearl millet stables) and other agricultural residues ready for direct planting through the dead-mulch.

3. Local evaluation of the alternative to cover crops of dead mulches showed:
    - Shortage of appropriate and sufficient biomass for mulching and lack of regulatory framework (bye-laws) on wild fires. The widespread burning destroys available material that could be carried and used for mulch. Besides which there is a fear by farmers that mulched gardens would be burnt.
    - The invasion of predators like rats and pests, such as cut-worms that destroy the early germinated plants under mulched fields, causing loss and uneven growth.
    - Due to land shortage, grazing animals often invaded the cover crops in conservation agriculture plots especially during the dry periods of the year (there is a need to introduce and ensure sustained control of livestock).

    For wider adoption of the use of cut and carry of dead mulch, farmers fields would have to be in proximity of land that could produce mulch material, i.e. fallow land, low lying grazing lands or road margins or poor uncultivated lands. Livestock grazing and burning across the community territory would have to be controlled and where possible rats controlled (e.g. baits or encouraging birds of prey). Pest damage such as by cutworms could be expected to reduce with improved soil health and crop rotations.

b. Modifications and adaptations of CA tools and equipment

1. <u>Animal drawn knife roller</u>.

The AEATRI knife roller model consists of a metallic frame with a 4mm-thick cylinder having up to 10 sets of cutting knives axially attached. The cylinder is provided with an opening with a plug. This enables the drum to be filled with either water (up to 100 litres) or dry sand (up to 160 kgs) to appropriately increase its weight, but matching the weight to the size and capacities of the animals in use. To-date, four units each of knife roller-models with 0.30, 0.35 and 0.40 meter-diameter cylinders and a working width of 1.20 meters, have been fabricated and are already being tested with farmers. A typical unit has a working weight of 200-220 kg while empty, with a maximum of 380 kgs if fully loaded with sand. This is adapted to the East African Zebu oxen, which weighs 200-250 kg on average. In contrast, the Brazilian knife-roller model weighs over 1,000 kgs and is suited to their buffalo type of bulls each of which weighs 800-1,000 kg (Source: AEATRI TCP/UGA/2903 project terminal report, 2004). Fig 1 shows samples of the AEATRI-knife rollers.

Fig 4 a: A three-size set of AEATRI-adapted animal-drawn knife rollers.

Adaptation and field-testing of the animal drawn knife roller revealed the following limiting factors to its use and performance:[BT3]

- *Non uniformity in establishment of the cover crops*: It was observed that in areas where the cover crops were not uniformly established, the knife roller did not effectively chop the cover crops especially Canavalia. Therefore, to aid effective management of weeds and cover crops using the knife roller, the cover crops should be uniformly established.
- *Wet soils:* In areas where the soils were extremely wet, the knife roller simply bent the cover crops but did not sufficient damage to the stalks to facilitate fast desiccation. The knife roller should be used when the soils are relatively dry, for example before the onset of rains.
- *Uneven ground surface:* In areas where the ground surface was uneven and irregular, the knife roller could simply roll over the cover crops without causing injury to the stalks as required. For effective weed and cover crop management, the ground surface should be relatively flat.

- *Untrained oxen and ox drivers:* In order to effectively use the knife roller for mechanical management of the cover crops, adequate training and practice of both the oxen drivers and work animals is fundamental and cannot be over-emphasized. There is also need to match the weight of the knife roller to the capacity of the animals used and to the type of cover crop being handled.

2. Jab planter.

Two types of hand-operated jab planters (one for dropping seed only and the other dropping seed and fertilizer) known as "matracas" in Brazil were imported and tested with maize and beans at all FFSs in the two districts. At all the sites, farmers preferred a jab planter that drops seed and fertilizer since it reduces the number of field operations and ensures timeliness in operations. In order to ensure planting in straight lines, a string was used. On the string, internodes were marked at appropriate intervals corresponding to the plant spacing recommended for the crop. The person using the jab planter would follow the string while carefully jabbing the soil at the marked intervals.

Limitations were experienced with the Fitarelli hand jab planter that are recognised as requiring further investigations, namely:

- The fertilizer drop rate was rather excessive (twice as much as recommended) with no adjustment provisions in the tool. Feedback is required for manufacturers (locally established or foreign suppliers) in order that they provide for fertilizer adjustments in the new jab-planter designs.
- The wood used in making the jab-planter tool frame is rather weak and was not able to sustain the forces exerted when planting. This aspect also requires reinforcement;
- When the soils are wet, or heavy clays, there is tendency to clog the jab planter, which negatively affects operations. The moisture content of the soil for planting requires careful attention but even so, such tools could prove difficult for clay soils.
- The planter can only be used effectively with larger seeds (maize, beans, soybeans, ground nuts) and not small seeds like millet and sorghum.
- On initial trials, the jab planter was tricky to operate. This aspect was solved through regular practice and training.

Despite the above shortfalls with the jab planter, farmers appreciated its positive attributes:

- It reduces drudgery and time by three times compared to using a stick for direct seeding, since only one person is required to make the hole, drop seed and even fertilizer.
- It is possible to attain timeliness of field operations during the season.

- The tool is affordable by ordinary smallholder farmers.
- The ideal conditions for the effective use of the jab planter were identified as relatively dry soils and light soils (sandy loams)

c. CA Equipment calibration, repair and maintenance

So as to ensure that given CA equipment operates to its maximum capacity and expectation, there is a need for calibration of pesticide and chemical applicators, direct planters, etc. Though the calibration procedures were explained and demonstrated on farm, this still presents a serious challenge to farmers as procedures seem be complicated for farmers and facilitators.

Local blacksmith artisans can readily satisfy the immediate requirement for the repair and replacement of soil-acting parts, such as planter shares and discs These artisans (for example those at Kibuko village near Mbale) have generations of experience and are well known and respected in their localities. The facilities available are quite basic. Metal is heated on a charcoal-fired forge and temperatures are raised with hand-operated fans. The main demand is for repair of agricultural tools, animal drawn implements and bicycle parts. Items repaired and replaced principally include hoes, axes, ploughshares, landsides, plough handle supports and, sometimes, mouldboards. Hand tools (hammers, files, hacksaws, spanners, drifts and punches) are used, but generally, electricity supply is not available. Raw material is in short supply and forays are made by artisans to Kampala for materials, especially mild steel sheet (3 and 4 mm) and carbon steel for soil acting parts exposed to abrasive soil conditions.

Fig 4 b: Local artisans in Kibuko village, Pallisa at work

d. CA equipment acquisition and financing

In terms of CA implement development in Uganda, NARO-AEATRI has been involved in prototype development and testing and in the manufacture of new equipment such as hand hoes, animal drawn implements and processing equipment. However, poor linkages with the markets and high production costs pose a serious challenge to the transition to large-scale production. Current production and supply in the private sector is limited to Soroti Agricultural Implements and Machinery Manufacturing Co (SAIMMCO) in Soroti district and Agricultural Engineering Industries Ltd (AEIL) in Kampala.

Generally, manufacturers prefer to work with development projects (NGOs and GOs) on a batch production basis. Traditionally there has been little contact with the end users. The FAO – TCP/UGA/2903 project sought with little success to change this situation by involving all stakeholders, including private manufacturers, in the process of community level demonstrations, field days and technology fairs. Local private manufacturers' fears include the fact that they are not aware of the demand for the products and so commercial production is too risky without a firm order from an intermediate organization.

The adopted CA tools and equipment will in the long run have to be bought by the farmers. Realistic appraisal of the costs associated with the acquisition of CA tools and equipment was not available and has not yet been clearly thought through with farmers. The practices have to be introduced and tested and CA equipment adapted and manufactured by suppliers before such costs can be estimated with any accuracy. Only then can farmers be sure that they will be able to afford the initial outlay and that their increased output will cover the ongoing costs.

e. Dissemination approach for CA practices and principles[BT4]

Though the FFS approach used requires much effort to establish, it clearly strengthens farmers' 'voice' for advocacy and enhances their ability to demand for services and assess value for money, which is in line with the Uganda Government Plan for Modernisation of Agriculture.

Group establishment of FFSs was strengthened with training provided in group dynamics, registration of the FFSs and developing constitutions. This has built farmers' confidence and trust among each other. For second generation FFSs to be formed, there has been capacity built in the community to guide in these areas, and this has added to the strength to the district FFS networks.

Farmers preferred the short module training method used as this enabled them carry on with their daily activities. There is, however, an identified need for trainers to provide farmers with handouts and/or farmer training guides, especially farmers that qualify as trainers, for future reference. Unfortunately, such materials were not available in this pilot project. These could be in English and local language of farmers' choice.

f. Fund mobilisation - savings, revolving funds and loans

As much as farmers yearn for knowledge, ways of acquiring income plays a big role in strengthening the groups. Farmers liked the fact that the CA – FFS project tried to address their economic situation through the revolving fund. Credit institutions existing in the areas seem not to favour agricultural enterprises especially when considering the repayment period. The risks and uncertainties involved in agricultural enterprises deter farmers from accessing or being eligible for loans at appropriate interest rates. Having the group revolving fund increased CA technology acceptance by participating farmers and enhanced their ability to adopt CA technologies. FFS farmers have developed confidence in utilising loans and have a desire to acquire larger individual loans.

Despite farmers' participation in decision making on loan implementation and repayment, the FFSs need to work out strict repayment methods to avoid high repayment failure that can lead to loss of the revolving fund and disintegration of the FFSs.

Farmers make weekly group savings as a way of raising funds for their respective groups. Some FFSs have also initiated other mechanisms of raising funds for individual members on a weekly basis. This has strengthened the groups in that the initial desire by some members to have individual loans for own activities is being addressed by group effort. The FFS capacities to mobilise their own resources is a good initiative that deserves to be strengthened and replicated in other FFSs.

The FFS members, FFS network, local councils and the local government are avenues that farmers perceive as important in scaling out of the CA activities. These are inter-linked, especially when it comes to drawing up of work plans and budgeting. The bottom up planning system adopted in the district could easily support CA activities if the grassroot farmers at local council level are able to incorporate their requirements in the subcounty action plans.

g. Policy issues

The land tenure system whereby land (especially on the hills and in valleys/swamps) is owned communally and also where other farmers' hire land, makes it difficult for some farmers to practice/invest in conservation agriculture on such land since they have no security of tenure.

All the CA-FFS development initiatives documented in this case study are donor supported, with very limited measures in place to ensure their sustainability and scaling up and out. Consequently, without government investment and support the programmes/projects are likely to collapse almost immediately following the end or withdraw of donor support. Therefore, there is need for wider scaling up of CA-FFS initiatives at national level through linkages with the NAADS programme and other development partners including the private sector and NGOs.

6.0. CONCLUSIONS AND RECOMMENDATIONS

The following recommendations need consideration:

(a) Strengthen the FFSs for self-reliant, improve access to CA tools and equipment and other inputs and encourage establishment of facilities like micro finance to facilitate farmer purchase of the required tools and equipment.

(b) The three pilot districts should use the FFS experiences and structures to advocate for and mobilize the communities for development, scale up and out success stories.

(c) MAAIF through NAADS should consider turning the pilot project into a programme and be extended to other sub counties within the pilot districts and also other districts.

(d) The pilot districts should consider including CA-FFS in their annual budgets at all levels (district and sub counties) for continuity and sustainability of the CA-FFS initiatives.

(e) There is a need to carryout CA-FFS campaign in the country to sensitize civic leaders and entire public about the role of CA-FFS in modernizing agriculture

(f) MAAIF/NAADS and FAO should consider mobilizing funds to produce the CA-FFS training manuals so that CA-FFS can be disseminated by the NAADS extension service providers.

7.0. LIST OF APPENDICES

Appendix 1. CA FFS curriculum

Period (weeks)	Topic	Contents	Practical exercise(s)
a) Pre-experiment phase (11 weeks): Before the first rain season starts (preferably December - March)			
Week 1-2	Farmer Field School (FFS) methodology	• Concepts & principles of FFS • Steps in establishing a FFS • Organization & management of FFS	• Energizer development • Music, dance, drama • Group dynamics
Week 3-7	Participatory Diagnosis of Constraints and Opportunities (PDCO)	• Tools for PDCO • Problem prioritization analysis • Solution prioritization analysis	• Transect walks, • Resource maps • Institutional diagrams • Problem trees, etc.
Week 8-9	Community Action Planning (CAP)	• Problems/potential solutions synthesis • Participatory selection (agreement) on specific constraints to address with specific technologies, within project mandate • Commercial enterprise selection • What, who, when, where, how to do	• Community and individual household dreams • Visioning
Week 10 – 11	Participatory Technology Development (PTD)	• Objectives and rationale for PTD • Designing on-farm experiments • Selection of test crop • Review of constraints • Treatment/ technology • Monitoring & evaluation of experiments	• Field experimental design & lay out
Exposure/field visit to a functioning FFS, to observe group dynamics and application of PDCO, CAP, PTD			
b) Experimental phase (20 weeks) during which the study crop(s) is growing i.e. planting to harvesting, processing and storage			
Week 12 –13	Agro-ecosystem analysis (AESA)	• Principles and concepts of AESA • Developing PME (AESA) indicators	Making observations in the field on crop growth cycle, soil improvement, etc.
Week 14 –15	Soil properties & functions	• Physical • Chemical • Biological	Simple, field soil testing
Week 16 –17	Local indicators of soil quality (LISQ)	• Terminologies/language to describe soil processes/characteristics	Field observations of LISQ
Week 18 – 19	Land use planning	• Land suitability classification	Farm tour
Week 20 – 24	Agro-forestry (AF)	• Role of AF in environment management • AF shrubs and trees for soil fertility improvement • Tree nursery establishment & management • AF technologies (fodder banks, woodlots, improved fallows, etc) • Fruit tree establishment & management	• Set up a tree nursery • Grafting fruit trees
Week 25 –26	Crop husbandry	• Pest and disease management • Agronomic practices	Field identification of soil borne diseases
Week 27 – 32	Conservation Agriculture (CA) Principles & concepts	• Tillage systems • Cover crops • Weed management • Soil & water conservation • CA farm machinery & power • The catchment approach	• Field observation of cover crops • Practical handling of CA tools & equipment
Exposure/field visit to a functioning FFS, research station, individual farmers, etc. to see success stories			
c) Post-experiment phase: After experimentation, and includes period after FFS graduation			
Week 33 – 34	Adoption/&adaptation of CA	• Challenges to adoption/ adaptation of CA in farming systems	Micro-catchment transect walk

Period (weeks)	Topic	Contents	Practical exercise(s)
		• Cost benefit analysis of CA technologies	
Week 35 – 36	FFS networking & advocacy	• Importance of FFS networking	Exposure visit
Week 37 -38	FFS sustainability & up-scaling	• Revolving fund	Exposure visit
Week 39 – 40	Market research	• Group marketing	Market visit
Week 41 – 42	Graduation of FFS	• Review of what has been learnt • Challenges, learning process & way forward • Graduation preparations	Party
Exposure/field visit to a 2nd generation FFS to see success of adoption, adaptation, networking and sustainability			

Appendix 2: Checklist for Household and Group Case Study Interview

Checklist for Household Interview

A. Location:

District:……………… Subcounty:………………… Parish:…………………… Village:…………

B. Farm household type

Name of household head………………………………… Sex……….

Number of household members……………………………………..

Number of household members involved in agriculture:………………………

Highest educational level in household:………………………………………

C. Asset base

1. Physical capital (buildings, tools, machines)………………………
2. Natural assets (land, water, forests-woodlot)………………..
3. Social assets (groups, associations)
4. Financial capital (access to credit, savings, remittance, goats, cattle, chicken)

1) What was your understanding of the CA project's purpose?
2) Have there been any changes in your project expectations over time? If so, in which way?
3) What CA – FFS technologies and practices were you trained in? (give examples of what you have learnt)
4) What do you think was the most relevant CA technologies and practices to your situation among those you learnt about? Why?
5) Which technologies and practices do you consider not very relevant to your situation? Why?
6) How was project knowledge and information shared among household members?

7) What have you managed to adopt/adapt among the technologies and practices learnt? Any indicators?

8) What problems has the household experienced in implementing these CA practices and technologies? How can these be solved?
9) What has been your main farming system (technologies and practices) before practicing CA?
10) In what ways has CA impacted or will impact on your land management, and hence farming system?
11) Are there any changes and impact experienced on livelihood (food security, income levels, basic needs access) as a result of practicing CA?
12) In what ways has the CA project impacted or has potential to impact on socio-cultural patterns and perceptions? (gender and social relations)
13) What specific assets and capital does your household own that are relevant for the adoption and adaptation of CA? (Any problems with the assets/capital experienced?)
14) What tools and equipment demands are necessary to adopt/implement the new CA technologies and practices?
15) In what ways can the household acquire the necessary capital, tools and equipment?
16) How do you think your neighbours and other community members who are not members of the FFSs/CIGs will adopt CA technology?
17) What have been the effects of adoption of CA technologies and practices on:
    a. Gender and age group relations: Labour, time, culture, resources
    b. Enterprise (crop-livestock) selection and mix
    c. Social relations within the community
18) How do you think you are going to adopt /continue the CA activities on your farm? What opportunity exists?
19) What negative benefits/impacts have you observed so far as a result of practicing CA? (cause/reason)

Appendix 3: Checklist for Focus Group Discussions

A. Farmer Group Identification

Name of group…………….

Number of members: male………., female………….youth………….

Date of formation………………..

Group goal, mission, vision………………………………

B. Farmer group knowledge of conservation agriculture principles and concepts

1. How did you come to know about CA?
2. What does CA mean to you?
3. What are your roles and responsibilities in implementing CA the project?
4. Who are your partners and what are their roles and responsibilities?
5. What CA technologies and practices have you learnt and/adopted?
6. What CA technologies and practices have you learnt BUT NOT adopted? Why?

C. Group benefits/impacts as a result of practicing/adoption of CA

1. What have been your benefits and fears about CA? (Household, group and community benefits/fears)
2. What future benefits do you hope to achieve from CA in future e.g. 5 - 10 years' time?
3. What changes have occurred within and around the group as a result of practicing CA?
4. What general changes have occurred that were not planned?
5. What are the unintended/unexpected benefits/changes?
6. What are your fears/threats about CA?

D. CA continuity and sustainability

1. What opportunities exist within the group/community for continuity of CA initiatives?
2. What organisations/institutions exist in the community that have potential for further promoting?
3. How can CA initiatives be scaled out to the entire community? What will be your roles and responsibility?

Appendix 2: List of persons met in preparing the case study

Name	Designation	Address			
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Appendix 3: References and Bibliography[BT5]

FAO, 2003. Piloting Conservation Agriculture and Improved Land Management for Enhanced Livelihoods of Small holder Farmers using FFS approach (Project No. TCP/UGA/2903 (T)). Guidelines for Monitoring and Evaluating Impact

, 2004. Piloting Conservation Agriculture and Improved Land Management for Enhanced Livelihoods of Small holder Farmers (Project No. TCP/UGA/2903 (T)). Adaptation and promotion of conservation tillage equipment with smallholder farmers in Mbale and Pallisa districts. Final Report by Wilfred R. Odogola, Samuel Okurut, Joshua Wanyama and Alphonse Candia

FAO, 2005. Piloting Conservation Agriculture and Improved Land Management for Enhanced Livelihoods of Small holder Farmers (Project No. TCP/UGA/2903 (T)). Short term Impact Case Study Report by Christine Alokit-Olaunah

TCP/UGA/2903 (T) and ULAMP various project progress reports, mission reports and documents.

Nyende, P. and Delve, R.J. (2004). Farmer participatory evaluation of legume cover crops and biomass transfer technologies for soil fertility improvement using farmer criteria, preference ranking and logit regression analysis. Experimental Agriculture, volume 40, pp. 77-88. Cambridge University Press.