LIVESTOCK PRODUCTION PROGRAMME
& CROP PROTECTION PROGRAMME

Final Technical Report

Improving production in the Teso farming system through the development of sustainable draught animal technologies (The DAP Weeding Project)

R7401 (extension 2003-2005)

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Executive summary

This project worked with farmers in the Teso farming system of Uganda to develop appropriate animal drawn implements, primarily for weeding but also for ridging (sweet potatoes), line planting and lifting (groundnuts). It was an extension of an earlier research project with an emphasis on the promotion and extension of tested and proven technologies. Activities included:

- Promotion of DAP technologies to farming communities in Teso (demonstration plots, radio broadcasts and field days (field schools and shows)
- Training of farmers
- Training of trainers
- The development of private sector capacity to manufacture appropriate implements
- Development and multiplication of promotional materials with the manufacturer
- Multiplication of extension materials
- Impact assessment

Project outputs:

- 2472 farmers were trained in DAP weeding, ridging, lifting and line planting technologies between 2003-2005
- 978 trainers (mostly employees of NGOs operating in the Teso region) were trained in the same technologies with a view to future sustainability of project outputs
- A farmer approved weeder is in commercial production and the manufacturer (SAIMMCO) has sold in excess of 200 units to date
- Three types of promotional (extension) materials have been produced and distributed. A manual for trainers, a poster for farmers and manual for trainers in the cotton industry

The impact assessment demonstrated that investment in DAP equipment and adoption of the recommended techniques increase gross margins, contribute to increased yields and reduce drudgery. This last outcome is of particular importance to women and children who were previously responsible for providing most of the weeding labour.

A rapid survey towards the end of the project revealed that approximately 45% of farmers trained in DAP technologies had adopted these practices during the past 2 years. Key approaches contributing to success include:

- Allowing rural communities to prioritise their problems before embarking on research and/or extension (undertake a Needs Assessment)
- Providing a range of options and allowing farmers to determine which technology best meets their needs
- Developing links with the private sector for sustainability (post-project) (continuing manufacturing involvement - production and promotion)
- Encouraging exchange of information between farmers (farmer-to-farmer extension)
- Developing partnerships and training trainers (with those organisations that are likely to continue to be active for the foreseeable future)

List of abbreviations

BMCO	Bululu Multipurpose Co-operative Society (NGO)
CBO	Community Based Organisation
CIDI	Community Integrated Development Initiative
COARD	Client Oriented Agricultural Research and Dissemination Project (DFID)
CPHP	Crop Post Harvest Programme
CPP	Crop Protection Programme
DAP	Draught Animal Power
DFID	Department for International Development
FFS	Farmer Field School
HORSU	Holistic Services Uganda (NGO)
LPP	Livestock Production Programme
NAADS	National Agricultural Advisory and Development Services
NAIL	Nanak Agro Industries Limited
NARO	National Agricultural Research Organisation (Uganda)
NGOs	Non-government Organisations
PAG	Pentecostal Assemblies of God (NGO)
PB	Participatory Budget
PRM	Pentecostal Reform Ministry
SAARI	Serere Agricultural and Animal Research Institute (Uganda)
SAIMMCO	Soroti Agricultural Implement and Machinery Manufacturing Company
SOCADIDO	Soroti Catholic Diocese Development Organisation
TFS	Teso Farming System
TWAM	Tools with a Mission
VSF	Veterinarios sin Fronteras (NGO)

1 Background

1.1 Introduction

The DAP weeding project extension promoted the outputs of the earlier project (R7401) to farmers in the Teso farming system (TFS) of Uganda (Kaberamaido, Katakwi, Kumi, Pallisa and Soroti Districts). The extension phase was jointly managed by the Serere Agricultural and Animal Research Institute (SAARI) of the National Agricultural Research Organisation (NARO) of Uganda and D Barton(UK)Limited. The Project was part of the portfolios of two DFID research programmes, the Livestock Production Programme (LPP) and the Crop Protection Programme (CPP). Original project activities took place between 1999 and 2002. The project was extended for 14 months (2003-2004) and benefited from a further extension for 10 months (2005).

The use of draught animals for land preparation (ploughing) was introduced to the Teso farming system during the colonial era (1920s) and was associated with the commercial production of cotton. The technique is therefore well established but there has been a shortage of draught animals following civil war and insurgency during the 1980s and cattle rustling in the 1990s. This constraint has been addressed by a number of 'oxenisation' or 'restocking' projects and many households are now able to open up land (plough) with oxen. The benefits of using draught animals however, will not be fully realised until animals are used for tasks other than ploughing (particularly weeding). Expansion of the area cultivated, following the re-introduction of oxen for ploughing often leads to a labour constraint for weeding which is undertaken by hand (mostly by women and children). The opportunity to open more land afforded by draught animals often leads to fields being abandoned to weeds as labour constraints emerge later in the season, resulting in very low yields or no yield at all from abandoned plots. The range of implements available for weeding and planting is limited and the original project addressed this issue by testing and evaluating with farmers, on their fields, a variety of implements likely to be appropriate to their circumstances.

Project R7401 was designed primarily to investigate ways of alleviating labour constraints associated with weeding annual crops[1] in the Teso Farming System (TFS). It tested 5 different implements on farmers' fields. The research confirmed that hand weeding of annual crops in the TFS is a major constraint to agricultural production. Moreover, this task is associated with drudgery (particularly for women), withdrawal of children from school during the weeding seasons, high costs if labour is hired to undertake the task, reduced yields (in poorly weeded fields) and poor returns (gross margins).

The DAP weeding project concluded that:

- DAP weeders reduce the labour and costs required for weeding sorghum and groundnuts and improve gross margins
- DAP weeders are a practical and effective alternative to hand weeding and they reduce the drudgery associated with this task
- DAP weeders have a positive impact on the lives of women and children who traditionally undertake weeding of annual crops.
- The SAARI weeder may improve groundnut yields as it improves infiltration and reduces run-off of rainwater
- Farmers prefer the SAARI type weeder (bolted to the existing plough frame)

[1] Ridging of sweet potatoes and lifting of groundnuts were also identified as tasks that required large amounts of hand labour and which could be mechanised

- The plough (minus its mouldboard) is an effective weeding tool
- The capital required for investment in DAP weeding is zero for those farmers (the majority) who have access to oxen and ploughs (ownership, hiring and or borrowing)
- Farmer-to-farmer extension is a practical, cheap and efficient means of extending this technology (provided there is some organisational support and training of trainers)
- Further extension and training of farmers (up-scaling) is likely to produce positive benefits and stimulate demand for DAP weeding tools.

The farmers trained by the project expressed great enthusiasm for DAP technology and had begun training neighbouring farmers in 2002. Such was the potential demand for, and benefits of, the technology that a project extension was sought to promote DAP technology to a greater number of farmers in the TFS.

1.2 Demand for the extension

Market research was undertaken during the early part of 2003 to determine the potential demand and market for DAP weeding equipment. This research concluded that the major constraints to uptake and adoption of DAP weeding in the TFS were shortages of knowledge and implements. This study also established that in excess of 1000 farmers had been trained in DAP weeding (many of them by other farmers) and there was growing interest in, and demand for, the technology.

It was established therefore that there was a need for further extension to alleviate labour constraints and create demand for commercially produced machines. To achieve the latter required the development of sustainable batch production of a SAARI type weeder (by the private sector) to satisfy this latent demand.

Added to the above were three further labour-saving technologies, line-marking using a plough, ridging of sweet potatoes using a plough and lifting of groundnuts (also using a plough but with the mouldboard removed). Both these tasks require large amounts of human labour and are associated with drudgery. Labour shortages also reduce the area of these crops that can be cultivated with consequences for household income and food security[2].

[2] Both groundnuts and sweet potatoes are important food and cash crops

2 Project purpose

2.1 LPP and CPP Purpose

LPP "*Benefits for crop/livestock farmers generated by the application of new knowledge on the management of livestock in semi-arid production systems"*

CPP "*Benefits for poor people generated by application of new knowledge of crop protection in cereal-based semi-arid cropping systems"*.

In this context the project purpose was to extend and promote knowledge of draught animal technologies (weeding, planting, ridging and harvesting[3]) to smallholder farmers in the Teso farming system in order to improve the contribution draught animals make to the crop/livestock farming system. The primary objective was to promote weeding equipment to address the weed management (crop protection) difficulties faced by farmers, the negative yield effects of poor weed management and the labour constraints and drudgery associated with hand weeding. However, related technologies, line marking (to facilitate row planting), ridging and harvesting were also promoted, as these are complementary activities that can be undertaken without any investment in new machinery. For example, a plough (minus mouldboard) or weeder can be used to mark parallel lines on a field prior to sowing, a plough can be used to ridge and weed sweet potatoes and a plough minus its mouldboard can be used to lift groundnuts. Promotion of these additional operations was also likely to have a major impact on the drudgery experienced by the farming population.

[3] Originally the project planned also to investigate transport constraints and solutions but the time, cost and effort required to manage on-farm trials left insufficient time for the research team to investigate this aspect of draught animal power.

3 Extension and promotional activities

3.1 Extension and promotion

3.1.1 The first activity was to identify sites and partners for demonstrations and training of farmers. Those selected included sites that took part in the original research (see Table 1) and, in addition to these, NGOs, local government and government (NAADS) partners were sought to assist in the identification of communities that had expressed demand for DAP technology. Another group benefiting from promotion were cotton growers working with CPP Project (R 8197)[4]. The COARD Project[5] provided additional funds for farm-to-farmer extension.

3.1.2 The original nine sites throughout Teso (three in each agro-ecological zone) were selected because they had a core of experienced farmers willing and able to promote DAP technology to their neighbours. It was important therefore that the project take advantage of this expertise for rapid promotion and adoption of the technology.

3.1.3 New locations for promotion included those suggested by NGOs plus responses to requests from local government for training and, latterly, farmer groups established to receive extension advice via NAADS which had requested assistance with DAP technology. In addition collaboration with the Linking Project (R8281) resulted in promotion and training in Tororo and Arua Districts.

3.1.4 Once identified the following types of promotional activities took place:

- Identification of trainers (both NGO staff and farmers elected by their communities to act as trainers of other farmers)
- Training of these trainers in DAP weeding, ridging, line marking and groundnut lifting
- Selection of suitable sites for establishing demonstrations (field schools) for wider dissemination of the technology
- Backstopping support to those communities where the technology was reasonably well established
- Multiplication and distribution of extension materials to trainers (manuals) and farmers (posters)
- Distribution of a limited number of DAP weeders to be used on demonstration plots
- The organisation of field days (agricultural shows) in strategic locations to further promote DAP technology
- Radio shows to promote and report on field days

[4] 40 farmers at Kamuda, Katine, Kanyumu and Mukura in Soroti and Kumi Districts were trained in DAP weeding as part of a cotton IPM package

[5] This project was a DFID bilateral project (1999-2004) located at SAARI charged with commissioning client oriented research and technology dissemination to the Teso and Lango farming systems. Their contribution to DAP promotion included training of artisans in implement repair and the manufacture of spare parts for ploughs and weeders.

3.2 Implement manufacture

3.2.1 A crucial part of the Project has been the involvement of private sector manufacturers in the technology development process. Two manufacturers were identified SAIMMCO and Nanak Agro Industries Limited (NAIL), both located in Soroti[6]. This was an early activity and a simplified SAARI weeder design, the one identified by farmers as best meeting their needs, was shared with both firms.

3.2.2 Prototypes were built that both matched the needs of farmers and minimised costs of production and therefore retail price. Prototypes were tested by farmers during the second rains in 2003 and minor adjustments made before the production of a first batch. This batch of 20 weeders (10 from each manufacturer) was distributed to farmers for testing in advance of the first rains in 2004. A second batch was commissioned during October 2004 and a third in March 2005 for new sites involved in training and promotion.

3.2.3 A farmer-marketing agent system was established whereby prominent farmers in those communities that had received training and extension were selected as agents for manufacturers' products. The objective of this activity was to facilitate access to weeders by the farming community while at the same time assisting the manufacturer's business development. Agents are therefore intermediaries and should receive a commission on sales.

3.3 Multiplication of extension and other promotional materials

3.3.1 An earlier COARD funded project undertaken by Veterinarios sin Fronteras (VSF) had produced DAP extension materials. Materials were multiplied for both trainers (manuals) and farmers (posters) in three languages, English, Ateso and Kumam and distributed to stakeholders[7].

3.3.2 Both manufacturers were assisted with the production and multiplication of sales literature to promote their products (see Appendix 3).

3.3.3 In addition to the above a trainers manual was prepared outlining the use of DAP in cotton production (jointly produced with Project R8197).

3.4 Impact assessment

3.4.1 This was commissioned from an independent Ugandan researcher/consultant. The assessment investigated the adoption and demand for DAP weeding and the effectiveness of the farmer-to-farmer extension process. The methodology is shown in Appendix 2.

[6] NAIL relocated to Mbale during 2004 and has since folded.
[7] Unfortunately VSF refused to release electronic copies of these materials and consequently they are only available as printed manuals and posters

4 Outputs

4.1 Logframe outputs

4.1.1 The logframe had 3 outputs (Appendix 1):

1. Farmer-to-farmer extension methods and activities established

2. Commercial production of farmer approved DAP weeders established

3. Extension material produced for different stakeholders

4.2 Farmer-to-farmer extension methods established (output 1)

4.2.1 Partner organisations for DAP technology training are shown in Table 1. Once identified, 5 days of training was provided in collaboration with these organisations in order to train both farmers and trainers. Further support and back stopping were provided on request. Weeding tools were provided when available, otherwise trainers made use of existing technology (ploughs) for, weeding (Figure 1), line marking (Figure 2), ridging and groundnut lifting. A total of 879 trainers and 2472 farmers were trained between 2003 and 2005.

4.2.2 Those groups wishing to set up demonstration plots for wider dissemination were assisted by the project. The locations and numbers of these plots in the 5 seasons available for promotional activities are outlined in Table 2. A total of 125 demonstration plots were prepared during the life of the project.

Figure 1. Demonstrating how to train oxen for weeding

Table 1. Number of trainers and farmers trained 2003-05

Site	District	Partner organisation	No. of trainers trained[8]	No. of farmers trained[9]
Abalang	Kaberamaido	DAP Project	20	356
Kachede	Kumi	DAP Project	17	110
Kaler	Kumi	DAP Project	17	45
Kibale	Pallisa	DAP Project	10	75
Koritok	Katakwi	DAP Project	10	63
Obule	Soroti	DAP Project	30	125
Obur	Katakwi	DAP Project	20	210
Pingire	Soroti	DAP Project	21	150
Orungo	Katakwi	DAP Project	20	57
Apapai	Kaberamaido	VSF/HORSU	15	85
Ongeroi	Kaberamaido	VSF/HORSU	15	54
Ojukot	Kaberamaido	VSF/HORSU	17	61
Odoot	Kaberamaido	VSF/HORSU	15	57
Ogwolo	Kaberamaido	VSF/HORSU	15	42
Ayola	Kaberamaido	VSF/HORSU	15	49
Ocelakur	Kaberamaido	VSF/BMCO	15	60
Gome	Kaberamaido	VSF/BMCO	15	53
Kimbomo	Kaberamaido	VSF/BMCO	15	40
Katakwi	Katakwi	Action Aid	50	58
Mulando	Tororo	COARD/Linking Project (CPP/LPP)	15	25
Kedesok	Palissa	COARD	26	19
Omatapiki	Palissa	COARD	19	15
Mukura	Kumi	COARD	20	20
Kikota	Soroti	COARD	15	10
Kasilo	Soroti	COARD	16	8
Bugondo	Soroti	NAADS	48	54
Kongoto	Soroti	NAADS	57	25
Kamod	Soroti	NAADS	56	19
Agule	Soroti	NAADS	54	15
Ogera	Soroti	NAADS	63	10
Anyara	Kaberamaido	Local government	20	19
Inera	Kumi	Local government	18	7
Kadami	Kumi	Faith Action	13	75
Tukende	Hoima	Tukende Mumaso	5	55
Katakwi	Katakwi	Transport Group CPHP	10	20
Kamuda	Soroti	Rockerfeller	5	6
Bukedea	Kumi	Rockerfeller	6	3
Ofaka	Arua	Linking project	19	-
Madibe	Arua	Linking project	16	-
TIFO (Arapai)	Soroti	TSF COARD project	20	6
Akodafarmers	Soroti	CIDI	3	15
Opucet	Soroti	CIDI	-	18
Akoboi	Soroti	PAG	3	53
Ojama	Soroti	PAG	-	72
Kikota	Soroti	PAG	-	20
Asamuk	Wera- Amuria	Women farmers (Linking Project LPP/CPP)	-	21
Suguru	Wera- Amuria	Women farmers (Linking Project LPP/CPP)	-	19
Makiteko	Kaberamaido	Women farmers (Linking Project LPP/CPP)	-	28
Kalaki	Kalaki-Kaberamaido	Women farmers (Linking Project LPP/CPP)	-	23
Aliat	Mukura- Kumi	Women farmers (Linking Project LPP/CPP)	-	22
Atapar	Apujan- Katakwi	Women farmers (Linking Project LPP/CPP)	-	20
TOTAL			**879**	**2472**

Table 2. Location and number of demonstration plots 2003-05

[8] No of trainers trained between August 2003 and December 2005 by project staff

[9] No of farmers trained by both other farmers and project staff between January 2002 and December 2005

Location	District	Season 2 2003	Season 1 2004	Season 2 2004	Season 1 2005	Season 2 2005
Asuret	Soroti	4	4	2	3	2
Pingire	Soroti	2	3	2	4	3
Kaler	Kumi	2	4	2	3	2
Kachede	Kumi	2	2	2	5	3
Kibale	Pallisa	2	2	2	2	1
Abalang	Kaberamaido	-	2	6	5	3
Apapai	Kaberamaido	-	1	2	2	2
Anyara	Kaberamaido	-	1	2	2	1
Orungo	Katakwi	-	1	2	-	-
Koritok	Katakwi	-	1	2	2	-
Asamuk	Katakwi	-	1	2	2	1
Kadami	Kumi	-	2	2	1	1
Kadesok	Palissa	-	1	1	2	1
Mukura	Kumi	-		3	2	1
TOTAL		**12**	**25**	**32**	**35**	**21**

4.2.3 Each training group was also assisted by the project with the selection of suitable sites for establishing demonstrations (field schools) for wider dissemination of technology. In addition project staff provided the following services:

- Backstopping support to those communities where the technology was reasonably well established
- Distribution of extension materials to trainers (manuals) and farmers (posters)
- Distribution of a limited number of weeding tools
- The organisation of 10 field days (agricultural shows) in strategic locations to further promote DAP technology
- Radio shows to promote and report on field days (10 radio programmes on Voice of Teso FM and 4 on Continental FM)

Figure 3. Line marking with oxen

Field days and radio shows resulted in 20 requests for training/information from CBOs, NGOs and Local government councils of various sub-counties, including:

- 5 local government councils (LC II)
- 4 Parishes
- 4 Farmer groups
- 3 NGOs
- 2 CBOs

4.2.4 An impact assessment was undertaken by an independent researcher during November 2004[10] (Aliguma, 2004). The methodology used was a participatory farm management technique known as Participatory Budgets (PBs) (see methodology in Appendix 2). The technique encourages farmers to cost all inputs and outputs and to produce a simple budget including a balance (gross margin) for a single enterprise. The technique can be used to explore before and after scenarios to assess the impact of new technology or changes to the management of an enterprise. The results of this exercise are summarised in Table 3. Both family labour and draught animal power costs (hire charges) were included in the budgets (at the request of participants). Although the individuals whose enterprises were explored during the participatory exercise all owned oxen, DAP costs were included at the request of other members of the group who did not own oxen and need therefore to hire them to undertake ploughing and weeding operations. For each PB and each site cash balances are higher for enterprises where DAP is used for weeding. The participants attributed this to the lower costs associated with DAP weeding (when compared with hand weeding), and the higher yields that result from DAP weeded crops (improved infiltration of rainwater following mechanical weeding)[11].

Table 3. Summary of the Participatory Budgets (PB) completed during the Impact Assessment

Site / Village	Apapai	Akotodao (Abalang)	Kachede	Amuria (Pingire)	Obule	Kibale	Kaler
Type of enterprise	Maize	Groundnuts	Sunflower	Groundnuts	Groundnuts	Cotton	Cow peas
Estimated size of enterprise (acres)	1	1	1	1	1	1	.75
Cash balance with DAP (Ug. Shs)							
Direct Cash Expenditure	48,000	433,000	63,400	184,800	184,000[12]	84,000	11,250
Family labour costed	62,000	51,000	9,400	50,000	31,000	3,000	13,000
Animals costed	40,000	162,000	40,000	79,000	62,000	91,000	8,000
Total Expenditure	150,000	646,000	112,000	313,000	277,000	178,000	33,000
Value of output	400,000	1,600,000	341,000	800,000	540,000	300,000	50,400
Cash balance	250,000	954,000	228,000	487,000	263,000	122,000	17,150
Cash balance without DAP (Ug. Shs)							
Total Expenditure	200,000	743,000	76,000	458,000	241,000	220,000	39,500
Value of output	300,000	1,000,000	210,000	600,000	360,000	240,000	360,000
Cash balance	100,000	257,000	134,000	142, 000	119,000	20,000	8,700
% increase with DAP	**250%**	**370%**	**70%**	**340%**	**220%**	**600%**	**200%**

[10] The report is available as a standalone document and a summary of the results is shown here

[11] DAP weeding increases infiltration of rainwater but also allows more timely and efficient weeding which may also improve yields (when compared with poorly weeded fields)

[12] Participants included the cost of seed although it was provided free

4.2.5 A rapid survey was carried out during November/December 2005 of a sample of trained farmers to establish how many of those trained during the period 2003 - 2005 were using DAP technologies (weeding and ridging). The results are shown in Table 4 and indicate that approximately 45% of those trained have adopted DAP technologies. The survey was designed only to establish the level of adoption, as time and resources did not permit a more detailed study and the reasons for non-adoption are unclear. It would appear that further demonstration and training may be necessary to popularise further these technologies. The promotion of ridging as a labour saving technique in sweet potatoes has been a resounding success (Figure 3) along with the use of DAP weeders in groundnut crops (Table 4). Information collected during the survey indicated that DAP technology is appropriate for a wide range of crops (i.e. many more than the 2 crops in which DAP technology was tested during the first phase of the project, sorghum and groundnuts).

Figure 4. Demonstrating how to make ridges

Table 4. Number of farmers trained and using DAP technologies (2003-05)

Site	Partner organisation	No. of farmers trained	Number of farmers using DAP technologies (weeding and ridging) in the following crops									
			Groundnut	Cassava	Cotton	Sweet potatoes (ridging)	Simsim	Maize	Sunflower	Soya bean	Beans	Total
Abalang	DAP Project	413	34	7	5	15	18	34	16	3	1	133
Kachede	DAP Project	198	38	10	4	100	0	21	25	0	0	198
Kaler	DAP Project	123	23	2	0	27	0	0	0	0	0	52
Kibale	DAP Project	75	15	0	10	7	0	5	0	0	0	37
Obule	DAP Project	159	16	5	15	23	0	16	3	0	2	80
Pingire	DAP Project	195	24	0	5	10	0	14	0	0	0	53
Apapai	VSF/HORSU	101	10	0	0	12	0	8	1	6	0	37
Gome	VSF/BMCO	64	1	0	0	12	1	5	0	1	2	22
Mukura	COARD	120	20	0	2	45	0	0	0	0	0	67
Kikota	COARD	45	9	0	0	3	0	0	0	0	0	12
Bugondo	NAADS	72	13	0	0	2	0	0	0	0	0	15
Kongoto	NAADS	25	5	0	0	3	0	2	0	0	0	10
Kamod	NAADS	19	7	1	0	2	0	0	0	0	0	10
Agule	NAADS	15	3	0	0	6	0	0	0	0	0	9
Ogera	NAADS	10	4	0	0	4	0	2	0	0	0	10
Anyara	Local government	78	8	1	2	4	0	1	2	1	2	21
Kadami	Faith Action	25	13	0	0	0	0	1	0	0	0	14
TIFO (Arapai)	TSF COARD project	18	6	0	0	3	0	0	0	0	0	9
Kamuda	Cotton IPM project	10	2	0	3	2	0	1	0	1	0	9
Katine	Cotton IPM project	7	3	0	3	1	0	0	0	0	0	7
TOTAL		1770	254	26	49	281	19	110	47	12	7	805

4.3 Commercial production of farmer-approved DAP weeders established (output 2)

4.3.1 Both manufacturers produced prototype weeders based on the SAARI configuration identified by farmers as their preferred design during the first phase of the project (Figures 4). This final design was a simplified version of the (more adjustable) SAARI weeder (re-designed jointly by project staff and manufacturer) to minimise cost of production (thereby keeping the retail price to a minimum) while retaining the features desired by farmers.

4.3.2 By March 2005 only one manufacturer (SAIMMCO) remained in business as there appeared to be insufficient business for two companies producing similar equipment.

Figure 5. SAIMMCO-SAARI Weeder

4.3.3 In December 2005 the price of these weeder attachments was around USh80,000/-[13]. This is considered to be affordable by many farmers. However, those that are unable to find this amount can easily share the tool with neighbours. As DAP weeding is a relatively rapid task, one tool can easily meet the weeding needs of 5 or 6 households, thus making the machine very affordable.

4.3.4 Marketing of DAP equipment represents a serious challenge for the manufacturers as they have limited contacts with the agricultural community. Also decision making at SAIMMCO is controlled centrally by the Alam Group of companies (owners of SAIMMCO) that limits investment in a marketing strategy and has led to a dependence upon large government and NGO orders for business. However, some progress had been made with the establishment of a market-agent system (see below) to give the company a foothold in rural areas where little marketing has been carried out in the past.

[13] Weeders are available both as a bolted attachment to the existing (and widely owned) plough frame, or as standalone machine (which is more expensive – around USh250,000/-)

4.3.5 By December 2005 SAIMMCO had sold in excess of 200 weeders (not including those commissioned by the project for promotion and demonstration). This would not have occurred without the support and intervention of the project. Although most of these weeders have been sold to organisations rather than individuals (farmers) this is considered a major achievement of the project as this company now has a product that can be manufactured as and when demand occurs.

4.3.6 SAIMMCO will be well placed to take advantage of future demand for these tools. To assist them the project drafted sales literature (Appendix 3) which was distributed at field days (shows) and whenever these companies identified a commercial opportunity.

4.3.7 A farmer-marketing agent system has been established whereby prominent farmers in those communities that had received training and extension were selected as agents for manufacturers' products. A total of 7 farmers in 6 locations were selected to act as agents. A meeting in Soroti with the manufacturer (SAIMMCO) during August 2005 agreed a modus operandi for market agents (see Appendix 4)

4.3.8 The COARD funded part of the project contributed to the sustainability of project outputs by training 30 artisans in those locations where DAP weeding is reasonably well established. To facilitate this three tonnes of blacksmith's hand tools were ordered from Tools with a Mission (TWAM) a UK based NGO which exports recycled tools from the UK. These were distributed in the following locations (Table 5).

Table 5. Sites that received blacksmith's tools

Location	District
Asuret	Soroti
Pingire	Soroti
Kaler	Kumi
Kachede	Kumi
Kibale	Pallisa
Abalang	Kaberamaido
Apapai	Kaberamaido
Asamuk	Katakwi

4.4 Extension materials produced for different stakeholders (output 3)

4.4.1 Two types of extension materials were produced, manuals for trainers and posters for farmers in three languages (English, Ateso and Kumam).

4.4.2 A total of 2500 DAP trainers manuals (Ateso 1000, Kumam 500 and English 1000 copies) were produced and distributed to trainers of trainers, CBOs, NGOs (Action Aid, Self Help Development International-Uganda, SOCADIDO, Church of Uganda-Soroti Diocese, SG2000, TERUDO, Christian Children's Fund, Tugende Omumaiso-Rural Development Programme of Hoima Catholic Diocese, Pentecostal Assemblies of God and CIDI), NAADS, farmer field

schools or groups, schools and Local Governments (at sub-counties) and Government extension workers. There is high demand for these DAP extension materials both within and outside the Teso Farming System.

4.4.3 5000 posters were produced and distributed to farmers and local councils.

4.4.4 Promotional materials were designed for SAIMMCO (see section 4.3 and Appendix 3).

4.4.5 A manual outlining the use of DAP technology in cotton production (with an emphasis on mechanical weeding) was produced in association with CPP Project R8197. 1000 copies of this manual are expected to be ready for distribution during January 2006.

5 Contribution of outputs

5.1 Beneficiaries of this research

5.1.1 The major beneficiaries of this research have been the farming families (2472 households) who have been trained and have adopted DAP technology. Benefits include:

- Reduced drudgery for women and children particularly those who formerly undertook weeding, heaping (ridging) of sweet potatoes and groundnut lifting
- Less withdrawal from school of children during the weeding season
- Expansion in the area cultivated in many cases, and enhanced food security and increased incomes
- 879 trainers have been trained (mostly NGO employees). Some of these trainers will be expected to continue to train other farmers and trainers post-project and some may be able to take advantage of their skills as private sector service providers as part of the NAADS programme of agricultural extension
- Manufacturers have been provided with a prototype weeder design, opportunities to market this and other products (design and printing of sales literature and display of their equipment at field days and shows), and a small network of market agents for their DAP products

5.1.2 The major reason for the success of this project is due to its demand-led nature. A comprehensive Needs Assessment for Agricultural Research in the Teso Farming System (Akwang et al, 1998) was undertaken in 1998 and farming families identified labour constraints as a major impediment to development. Secondly, a period of research and testing allowed the identification (by farmers) of their preferred design of weeding tool. Adoption has been aided by the decision, early in the first phase of the project to promote weeding with a plough (minus mouldboard). In many cases it is not necessary for farmers to invest in a new piece of equipment, although many prefer to use weeders if these are available.

5.1.3 Farmer adaptation has been observed in several locations with the use of a plough (minus its mouldboard) for lifting of cassava. This suggests that the research and extension process has assisted farmers to begin their own innovations with the DAP equipment.

5.1.4 The impact assessment concluded that introduction of DAP technologies has had the following impact on livelihoods:

- It has made women feel less oppressed and men have become involved is this task as it is mechanised
- It has greatly reduced drudgery
- It has improved food security and led to higher incomes.

- Women are now able to pursue more rewarding activities and are experiencing a better quality of life.
- Children are no longer withdrawn from school during the weeding seasons (April-May and October-November).
- Farmer-to-farmer extension may be one of the more effective means of effecting rapid adoption of technology; as most farmers in rural Africa have little contact with formal extension services. Their main source of information and knowledge – which they trust – and the results, of which they can easily observe, are the activities of neighbouring farmers.
- It is anticipated that in the longer-term even the poorest of economically active households will benefit from mechanisation as hire markets develop for DAP services (weeding, groundnut lifting and potato ridging) – they already exist for ploughing and to a limited extent weeding.

Figure 6. Demonstrating DAP weeding

5.1.5 Key approaches contributing to success include:

- Allowing rural communities to prioritise their problems before embarking on research and/or extension (undertake a Needs Assessment)
- Providing a range of options and allowing farmers to determine which technology best meets their needs
- Developing links with the private sector for sustainability (post-project) (continuing manufacturing involvement - production and promotion)
- Encouraging exchange of information between farmers (farmer-to-farmer extension)
- Developing partnerships and training trainers (with those organisations that are likely to continue to be active for the foreseeable future)

5.2 Promotion pathways

5.2.1 Both NGO-based trainers and farmer trainers have benefited from extension activities which have enhanced their skills. They should be in a position to train others if the necessary support can be provided through existing NGOs, NAADS service providers and local governments. There is scope to begin the

process of promoting the technology in other parts of the TFS as the benefits are clear and measurable to farmers, and adoption is likely to be relatively rapid.

5.2.2 Two members of the project team have already undertaken contracts for NAADS in Soroti District as private sector service providers.

6 References

Akwang, Agnes, Dan Kisauzi, Charlotte Boyd, and Joseph Oryokot 1998 Needs Assessment for Agricultural Research in the Teso Farming System. NARO/DFID.

Aliguma, Lucy 2004 Impact Assessment of weeder technologies in the Teso Farming System (TFS). Report commissioned by the DAP Project, SAARI. November 2004

Appendix 1. Logframe

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Goal			
Benefits for discreet groups of landed and landless livestock keepers generated by the application of new knowledge on the sustainable management of livestock in semi-arid, agro-pastoral, forest-agriculture, high potential and peri-urban production systems within an enabling environment.	To be completed by LPP Programme Manager	To be completed by LPP Programme Manager	To be completed by LPP Programme Manager
Purpose			
Strategies, technologies or policies which sustainably improve survival and/or productivity of livestock species of relevance to the livelihoods of poor livestock keepers, developed, validated and disseminated	To be completed by LPP Programme Manager	To be completed by LPP Programme Manager	To be completed by LPP Programme Manager
Outputs			
1. Sustainable extension pathways established (Teso FS)	65 demonstration plots established by end of project 2000 farmers trained by end of project 80 trainers trained by end of project Lessons learnt inform future NAADS and NGO activities (post project)	Quarterly and Annual reports Post project Impact Assessment Quarterly and Annual reports	Adverse weather conditions (poor rainfall) limit demonstration activities Manufacturers consider long-term commercial investment in weeder production high risk
2. Sustainable commercial production of farmer-approved DAP weeders established (Teso FS)	100 weeder units sold to private buyers by end of project 1500 weeder promotional materials (sales literature) printed and distributed by end of project 10 farmer-agents receive commission by end of project Manufacturer continues building equipment post project	Post project Impact Assessment Quarterly and Annual reports	Weeder price too high for farmers Low risk, most materials already available, and require editing and multiplication only
3. Extension and promotion for different stakeholders (Teso FS)	200 trainer materials printed and distributed by end of project 500 DAP & Cotton Production manuals printed and distributed by end of project 2000 farmer extension materials printed and distributed by end of project		
Activities	**Inputs**	**Means of Verification**	**Important Assumptions**

1.1 Identify sites and partners for demonstrations and training of farmers 1.2 Training of trainers 1.3 Set up demonstrations and field days			
2.1Develop and multiply sales literature 2.2 Commission and fabricate weeders 2.3 Develop farmer-market-agent system			
3.1Design and multiply extension materials for different stakeholders 3.2 Radio broadcasts 3.3 Distribute extension materials			

Appendix 2. Impact Assessment Methodology

Background

Project R7401 (Draught Animal Weeding or DAP Weeding) was designed primarily to investigate ways of alleviating labour constraints associated with weeding annual crops in the Teso Farming System (TFS). It tested 5 different implements on farmers' fields. The research confirmed that hand weeding of annual crops in the TFS is a major constraint to agricultural production. Moreover this task is associated with drudgery (particularly for women), withdrawal of children from school during the weeding seasons, high costs if labour is hired to undertake the task, reduced yields (in poorly weeded fields) and poor returns (gross margins). The DAP weeding project concluded that:

- DAP weeders reduce the labour and costs required for weeding sorghum and groundnuts and improve gross margins
- DAP weeders are a practical and effective alternative to hand weeding and they reduce the drudgery associated with this task
- DAP weeders have a positive impact on the lives of women and children who traditionally undertake weeding of annual crops.
- The SAARI weeder may improve groundnut yields
- Farmers prefer the SAARI type weeder (bolted to the existing plough frame)
- The plough (minus its mouldboard) is an effective weeding tool
- The capital required for investment in DAP weeding is zero for those farmers (the majority) who have access to oxen and ploughs (ownership, hiring and or borrowing)
- Farmer-to-farmer extension is a practical, cheap and efficient means of extending this technology (provided there is some organisational support and training of trainers)
- Further extension and training of farmers (up-scaling) is likely to produce positive benefits and stimulate demand for DAP weeding tools.

Further promotional work since Oct 2003 has been undertaken to popularise DAP weeding and to assist the private sector with commercial manufacture of appropriate implements. Promotion and extension has involved:

- training of trainers (partner NGOs, LCs, other research projects etc.)
- training of farmers (50 demonstration plots over 2 seasons), farmer-to-farmer extension
- 5 agricultural shows (field days) and radio shows to further promote the technology and to allow the manufacturers and artisans to promote their products
- production and dissemination of extension materials for both farmers and trainers
- the production of a commercial weeder prototype (field tested by farmers), based on SAARI design, and 2 commercial batches of weeders by SAIMMCO (manufacturer based in Soroti)
- the introduction of a farmer-agent marketing system to assist the manufacturer with marketing of the weeder which will allow farmer-agents to earn a small commission on sales they arrange (also improves communication between users and manufacturers)

Objectives

The objectives of the impact assessment are:

- to gauge the social and economic impact of DAP weeding on farm households in project areas (Soroti, Kumi, Kaberamaido, and Pallisa)14
- to assess the role and sustainability of farmer trainers in promoting the technology (training)
- to measure the uptake of the technology by those farmers receiving training from other farmers
- to assess the future potential demand for the technology

Methods

The following sub-counties were visited for the exercise of impact assessment: Abalang, Asuret, Kachede, Kaler, Kibale, Pingire, Otuboi (Apapai)

In each community meet LC1 to ask about population of the Parish and his or her opinion about the use of DAP for ploughing, weeding and heaping, how popular it is and the impact on lives and livelihoods. Collect from LC1 the number of households in the parish[15]

Undertake participatory budgets (PBs) with groups of DAP weeding farmers (see method below)

Conduct semi-structured interviews with groups of women to explore the impact of DAP technology on their lives and livelihoods

PB Methodology

Participatory Budget methods were first developed by Galpin et al (2000)[16]. They allow poor households to examine resource use in livestock (and other) enterprises in a simple and visual manner and are therefore appropriate for use with semi-literate and non-literate farmers. Moreover they facilitate a simple financial appraisal of a particular enterprise where inputs and outputs are costed and a balance for the enterprise determined (see Figure 1). They also allow the identification of economic and social constraints to production and of key aspects of the production process that require further intervention. Changes to production systems can be easily investigated once a budget has been constructed and the implications of these considered by the household.

Recent work in Uganda by NIDA in association with the DFID funded COARD Project have further tested and developed these techniques with both livestock and non-livestock enterprises. Following this exercise Participatory Budgets were selected as the most appropriate for use with poor and semi-literate or non-literate farmers and particularly useful for assessing the impact of technological interventions (by both farmer and researcher/extension worker) on the livelihoods of these poor households.

[14] Katakwi has been excluded because of internal displacement of many beneficiaries during 2003. Many are only now beginning to return to their homes.
[15] This information will be used later to estimate number of households in the Parish who have adopted DAP weeding technology
[16] These methods were first developed by Mark Galpin, Peter Dorward and Derek Shepherd (2000) Participatory Farm Management methods for agricultural research and extension: a training manual. Department of Agricultural Extension and Rural Development Department, University of Reading.

Procedure

Identify an enterprise in which DAP technology (weeding or heaping) has contributed
Identify a volunteer (a farmer who is happy to discuss his or her enterprise) this will be the example to be studied although other members of the group will be encouraged to participate and comment[17]

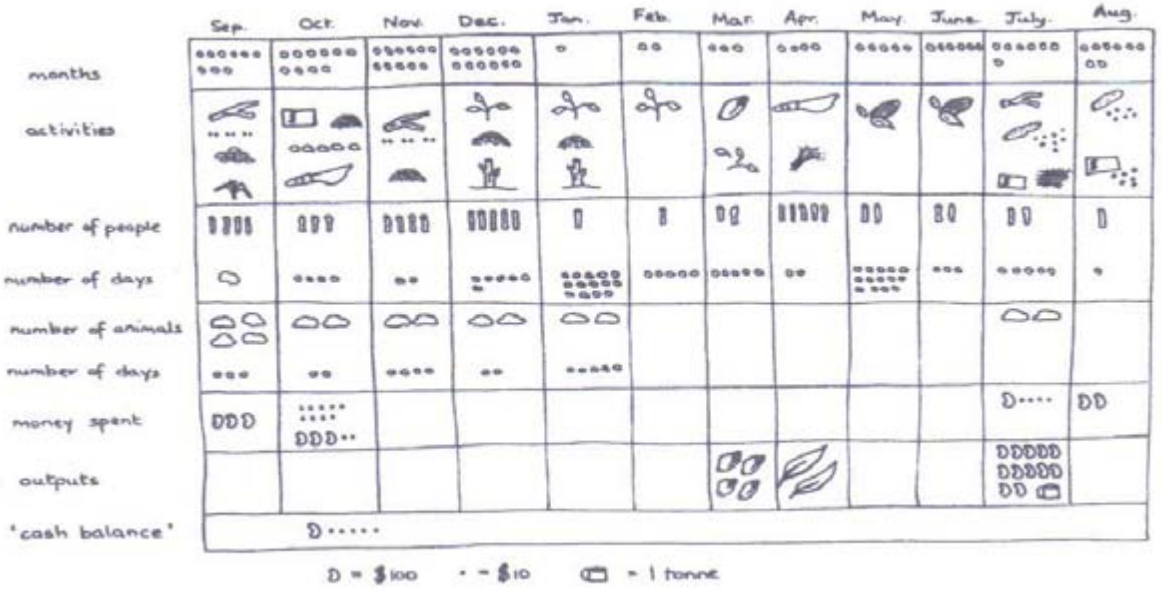
- Establish a timeframe (e.g. a season)
- Clarify the size of the enterprise (are of the garden)
- Draw out a large grid on the ground (number of columns equals the number of time periods (e.g. months)
- Ask the farmer/s to symbolise the different months in the top row of the grid
- Farmer/s indicate the different activities involved in the enterprise in each time period (place symbols in the second row on the grid)
- Discuss with the farmer which resources s/he considers important and would like to include in the budget (seed, labour, cash etc)
- Identify different counters to represent each of these
- Identify the units the farmer uses to measure each resource (e.g. labour by number of people and number of days)
- Farmer indicates the quantity of each resource in each month
- In the same way indicate the outputs and income that the farmer will receive from the enterprise, including any by-products (e.g. fodder)
- Ask the farmer to work out the end balance by comparing resources used (expended) and products received (income)
- All the outputs and inputs of the enterprise should be included in the balance and not just those given cash values
- Final balance may be expressed as bags of maize and/or cash

Once the budget is complete consider changing it to look at the situation before the introduction of DAP weeding. Major changes will be to the labour used but yields may have changed. Calculate the balance for this budget also and consider any differences.

- How are these differences explained?
- It this a true reflection of what has happened in most households (those present)
- What has been the impact on women and children
- How many farmers have been trained by other farmers in this location
- Who uses the technology (men or women)
- Impact on their (women's) livelihoods
- Impact on children (i.e. do they continue to weed crops or are they now relieved of this task)

[17] It is useful to consider the average size garden for the enterprise (e.g. half an acre or an acre as appropriate)

Figure 1. Example of a PB from Zimbabwe



Checklist for semi-structured interviews

- How has DAP technology affected labour inputs to crop production?
- Has the cropping pattern changed?
- Have areas cultivated increased (if so by how much i.e. 50%, 100% cross check to ensure the figures are reasonably accurate)
- Is it possible for most households to expand their area of cultivation or not?
- Have incomes/well being improved or not (if yes please give examples)?
- If so in what way?
- What has been the impact on children?
- Have yield increased? How does this affect labour for harvesting?
- Is it possible to sell surplus produce? Or is marketing an issue?
- Any problems created by DAP technology?
- Is it possible to earn money hiring out oxen for weeding? (what are the rates)
- How many farmers have been trained in this parish (how many have adopted)

Appendix 3. Sales literature (example)

ALAM GROUP

Soroti Agricultural Implements
Machinery Manufacturing Company
(SAIMMCO) Ltd

THE SAIMMCO WEEDER
Saves the Modern Farmer Time and Money

Developed and tested by NARO scientists from Serere in partnership with farmers throughout Teso

THE SAIMMCO WEEDER

(suitable for oxen or donkeys) greatly reduces weeding time for Sorghum and Groundnuts

Features:

Large front tine for semi-ridging of groundnuts and for tackling perennial grass weeds, 2 adjustable rear tines for different row widths
Easily fitted to your plough beam

Also suitable for cassava, cowpeas, beans, maize, and any other crop grown in lines.

Price:

NARO

Developed in association with NARO (Serere) and available from SAIMMCO, Cemetery Road, P.O. Box 280 Soroti, Uganda.
Tel. 045 61361 Fax. 045 61363

Appendix 4. Market-Agent's Workshop Report

This workshop was held in Soroti on 28th July, 2005 with the main aim of bringing together farmer representatives and DAP equipment manufacturers to discuss and agree on operationalising a simple marketing agent system.

Objectives of the workshop

- Agree on a simple business plan and establishment of marketing agents at community level for DAP implements
- Agree on modalities of operationalising the marketing system of DAP implements
- Confirming the names of the agents

Presentation by participants:

1. **Limitations to wider adoption of DAP weeding technologies**

- Lack of skills and knowledge in use of the DAP implements and oxen
- Unavailability of weeders locally
- Lack of linkage between farmers and the manufacturers of DAP implements (thus need for marketing agents)

2. **How to make DAP weeding technologies become available:**

- Creating of marketing agents (qualities of agents)
  - Agents should have knowledge in use of DAP implements (weeders)
  - Staying within the farming community
  - Trust worthy
  - Can advertise the implements
- Training of farmers (to stimulate demand)

3. **How to institute and operationalise informal marketing system:**

- ***Discussion on how the marketing system should be operated***. After exchange of views and suggestion, the following were arrived at:
  - The shop/place be along the road
  - Adverts be made over the radio, churches, markets (should be done by agents).
  - Shop be in the trading centre
  - Agents always be updated on price changes in time

- ***Suggestions on the conditions that should be in place in order to make this informal marketing system a success*.** The following suggestions were put forward for consideration both sides:
  - Transport should be taken care over (under 10%). SAIMMCO agreed to take care of this by giving 10% commission of the price on each DAP equipment taken by the agent.

- Payment be done in instalments (50% on order and 50% on delivery). After discussions, it was agreed that for the start, cash on delivery system will be used, then after wards when trust has been built between the two parties, part payment system will be used.
- Affordable prices be offered. The Manager SAIMMCO informed the marketing Agents that they will get the equipment at factory price. This is normally determined from the head office in Jinja and normally affected by world prices on steel products.
- Organizing marketing shows (should be considered, agents should advertise the implements)
- Orders should be answered within a short time (it can be handled)
- A good commission be offered (10% of the total cost)
- Monitoring to be done (feedback = SAIMMCO, SAARI and Agents is welcome). This was agreed on.
- Sharing experiences through meetings (net working)

• ***What should be avoided in this marketing system in order to make it a success***:

- Avoid forcing the agents to take implements that are not on demand
- Inflation of prices should not be there (SAIMMCO should not change prices because there is high demand)
- Harassments should be avoided

Marketing agents (the following people were selected as the agents):

Place	***Name of person***
Kaler/Mukura	Omoding Stephen
Kachede/Bukedea	Ijamerit Stephen/Ekuma David
Pingire	Dinah Okurut
Obule/Asure	Ediau Raymond
Abalang/Alwa	Engulu Alex
Anyara	Epiku Simon Peter