Dissemination of low-cost technology for handling crop residues and dry forages for dry-season feeding in Northern Tanzania[1]

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Abstract

Livestock feeding is one of the most expensive components in the livestock production system. To maximise profit in any livestock enterprise (milk, beef or dual purpose) needs close management to ensure that feed resources are obtained at the lowest possible price. Investigation on the possibilities of increasing profit from milk production from cows and goats on smallholder farmers was carried out in Tanzania from 1996 to 1999 under a Livestock Production Programme (LPP) Project (R6619). The LPP Project hypothesised that feed resources were a major limiting factor to milk production in the high-potential areas of Tanzania and that by taking a farmer-oriented approach to technological research, practical solutions to pressing constraints could be developed and promoted. The project identified with farmers that crop residues and dry forages were important feed resources especially during the dry season, but these resources were constrained by high costs of transportation and storage of loose forage. Project R6619 developed, with farmers, the optimal size of the wooden box for baling maize stover. An economic evaluation of using the technology was undertaken and compared with the traditional method of handling loose maize stover and dry roadside grasses. Results showed a wooden box measuring 75 x 50 x 40 cm to be the most appropriate size, and hence considered as a low cost technology for handling feed resources for dry season feeding in Northern Tanzania. The low cost technology was then disseminated to farmers under a Tanzania Government funded project undertaken from 2001 to 2003. Preliminary impact assessment revealed an overall maximum adoption rate (MAR) of 78 per cent, of which 80 per cent was for the Highlands and 70 per cent for the Lowlands. The Business-Oriented Farmers had the lowest rate of adoption. The overall conclusion was that manual box baling technology gave greater economic returns than the traditional methods of handling loose, dry forages. Farmers concentrating on crop and livestock production adopted the technology to a greater extent than those involved in off-farm activities. It is recommended that a study be undertaken to quantify the amount of crop residues that should be removed from fields, for feeding animals, and how much should be incorporated into the soil as organic manure. Such a study would help resolve the existing conflict between the use of crop residues for livestock feeding and their use in conservation agriculture.

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Introduction

The Livestock Production Programme (LPP) Project R6619 **'**Husbandry strategies for improving the sustainable utilisation of forages to increase profitable milk production from cows and goats on smallholder farms in Tanzania' was undertaken from 1996 to 1999. The project hypothesised that feed resources were a major limiting factor to milk production in the high-potential areas of Tanzania and that by taking a farmer-oriented approach to technological research, practical solutions to pressing constraints could be developed and promoted.

Participatory rural appraisal (PRA) techniques were used with farmers to identify and prioritise constraints to using available forages (crop residues and other dry forages) for profitable milk production. Project R6619 also identified, from grey literature, technologies that could help smallholder farmers make more efficient use of feed resources available on-farm. Using PRA tools, the technologies were presented for participatory evaluation by farmers. Among the technologies presented for evaluation was the wooden box for manual baling of dry forages, reported by Onim *et al.* (1992). Farmers gave the wooden box technology a high ranking as a possible solution to the constraint of transporting and handling crop residues such as maize stover. The technology was also deemed feasible for women and children selling roadside grasses in the lowlands of Northern Tanzania. However, the grey literature did not specify the appropriate size of the wooden box nor indicate the economic implications of using the technology. Project R6619, therefore, developed, with farmers, the optimal size of the wooden box for baling maize stover. An economic evaluation of using the technology was undertaken and compared with the traditional method of handling loose maize stover and dry roadside grass. Results showed a wooden box measuring 75 x 50 x 40 cm to be the most appropriate size. Compared with traditional transporting (i.e. loose stover in a one-tonne pickup), box-baled stover increased the payload by 66 per cent and reduced transportation costs by 33 per cent. Baled stover also reduced the space required for storage and also facilitated feed budgeting. Towards the end of Project R6619 an extension message for farmers was prepared in the form of a leaflet entitled '*Cut costs of feeding stover*'*;* 18,000 copies in Swahili and 2,000 copies in English were distributed to farmers, non-governmental organisations (NGOs) and government extension officers. An extension poster, bearing the same title, was also produced; 13 copies in Swahili and 12 copies in English were distributed to disseminating organisations (including churches, for displaying on church notice boards).

The box-baling technology is used by dairy goat farmers belonging to the FARM-Africa project in Dareda Division of Babati District, Northern Tanzania The technology is also currently being used in LPP Project R6610 (2003-04) in Bangladesh for baling *Lathyrus sativus* hay and rice straw.

In March 2001 Tanzania Agriculture Research Project (TARP II) phase two considered the outcome of R6619 to be appropriate technology for farmers and agreed to fund a two-year project, NZ/TARP/LP 05 '*Dissemination of low cost technology of handling feed resources for dry season feeding in Northern Tanzania*'. The methods used and results of project NZ/TARP/LP 05 are presented in the remainder of this summary.

Materials and methods

Project site

The highlands of Northern Tanzania are described as areas with high dairying potential. Smallholder farmers in the highlands keep improved dairy cows and dairy goats in a stall-fed, zero-grazing system. This is necessary because farms are small and the area is densely populated. Feed resources in the highlands are limited and there is a high dependency for feeds from the lowlands. Feed resources from the lowlands include crop residues (maize and beans) and roadside grasses. The lowlands are 20 - 25 km from the highlands. As the available feed resources are bulky, they pose problems in transportation and storage. Project R6619 (Massawe,1999) developed with farmers a low cost technology of manual box baling of crop residues and dried forages, such as roadside grasses, that showed economic benefits. The technology was recommended for adoption by farmers in Northern Tanzania.

Project activities

The project (NZ/TARP/LP 05) had six major activities:

i) Selection of target villages in Hai, Moshi Rural and Rombo Districts

ii) Demonstrations of manual box baling of maize stover and grasses, the low-cost technology that was described in the leaflets which had been distributed

iii) Training of farmers on thinning, stripping and topping of maize as a tool for maximizing feed resources from the maize crop

iv) Dissemination workshop, allowing farmers an opportunity to express their views about the technology

v) Sensitise and encourage formation of farmer working groups to promote dissemination, and also facilitate the groups to transport baled stover in shared 7.0 t lorries, an activity unaffordable for individual farmers

vi) Impact assessment to evaluate the uptake and adoption of the technology.

Methodology

Selection of target villages was done in a participatory manner involving extension officers in Hai, Moshi Rural and Rombo Districts of the Northern Zone of Tanzania (Project Activity 1). Dissemination of the technology was carried out in a series of demonstrations. These were followed by farmer training on techniques for maximizing forage feed coming from the maize crop (Project Activities 2 and 3). Dissemination workshops and sensitisation meetings were held in each of the participating villages (Project Activities 4 and 5). Finally, an impact assessment (Project Activity 6) was carried out to evaluate the uptake of the technology.

Impact assessment to evaluate the uptake of the technology was done with two-dimension functions to calculate the adoption rate, as described by Hildebrand and Russell (1996) using the equation:

$MAR = [C_{f(1,n)} \times E_{f(1,n)}]/100$, where:

MAR = Maximum adoption rate (%); $C_{f\ (1,n)}$ = Frequency of farmer category; $E_{f\ (1,n)}$ = Frequency of production environment.

The equation is applicable when there are two farmer categories with three production goals. In the present study the farmer categories were:

i) Highlands (livestock keepers) and

ii) Lowlands (sellers of roadside grasses).

The three production goals were:

i) Off-farm activities like shops, transport or small businesses in town (business-orientated farmers),

ii) Growing of crops such as maize, banana and coffee (crop growers)

iii) Milk production from dairy cows and dairy goats (livestock keepers).

Results

Demonstrations and dissemination workshops showed that farmers liked the technology. Calculations of cost savings were carried out with farmers selling roadside grasses in the lowlands. One head load of grass costing Tsh 500 to 800/= (USD 0.5 – 0.8) yielded two bales which were each sold for Tsh 500, giving a surplus of Tsh 200 – 500/ per head load (Table 1). The grass sellers commented that the low purchasing-power of people and the lack of confidence of buyers were the only problems. Baled forage was easier to store for future selling.

Table 1 *A comparison of the costs of transporting equal weights of traditionally handled and box-baled forages in two areas of Northern Tanzania and the likely savings Tsh 100 = US$1)*

Transportation type	Highlands		Lowlands	
Bulky transportation	2 trips using a 2-tonne Toyota Stout pick-up	Tsh 55,000	1 head load	Tsh 650
Baled	1 trip using 2-tonne Toyota Stout pick-ups	Tsh 27,500	2 bales	Tsh 1000
Net profit gain in baled form		Tsh 27,500		Tsh 350/= (54%)

Preliminary impact assessment revealed an overall maximum adoption rate (MAR) of 78 per cent, of which 80 per cent was for the Highlands and 70 per cent for the Lowlands. The Business-Oriented Farmers did not adopt the technology (Table 2).

Table 2 *Analysis of the maximum adoption rate (MAR) of box baling by three groups of farms (% adopting in brackets) in two areas of Northern Tanzania*

	Highlands	Lowlands
No	80	20
Business-orientated farmers	16 (0)	6 (0)
Crop producers	28 (100)	12 (100)
Livestock keepers	36 (100)	2 (100)
MAR (%)	80	70
Overall MAR (%)	78	

The adoption analysis shows that the technology was not appreciated by business-oriented farmers but was found suitable by crop producers and livestock keepers.

Conclusions and recommendations:

Manual box baling technology gave greater economic returns than the traditional methods of handling loose, dry forages. Farmers concentrating on crop and livestock production adopted the technology to a greater extent than those involved in off-farm activities.

However, it is recommended that a study be undertaken to quantify the amount of crop residues that should be removed from fields for feeding animals and how much should be incorporated into the soil as organic manure. Such a study would help resolve the existing conflict between use of crop residues for livestock feeding and use in conservation agriculture. Scientists in conservation agriculture advocate soil-incorporation of all crop residues for better nutrient cycling, but crop-livestock farmers practising stall-feeding cannot accept this philosophy. In the case of maize, stripping the leaves and sheath, and manually box-baling them would allow about 50 per cent of maize stover (i.e. stems) to remain in the field for soil-incorporation. The question is, would this be sufficient? Another option that would allow more residues to be harvested for livestock feeding and yet leaving sufficient biomass for soil conservation would be to grow cover crops such as *Lablab* and *Mucuna.*

Box baling has been introduced to farmers in Bangladesh. Competitions (e.g. make the best bales) are used to train farmers in box baling techniques. Credit: Emyr Owen

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Discussions questions/comments on the presentation

Question: *This technology is popular with dairy farmers in the Northern Highland zone of Tanzania, but a bale weighing 18 – 20 kg is required. Is this possible, as it may encourage scaling-up of the technology?*

Answer: A prototype has been developed with greater compression of the forage. The 'Jua Kali' group in Tanzania is making an improved manual baler based on this prototype.

Comment: A high-tech baler, costing approximately US$ 700, was developed by the Caribbean Agricultural Research Development Institute (CARDI). The metal hay baler has a wheel so that it could be used like a wheelbarrow, and a lever mechanism to increase the pressure applied to the conserved material.

Question: *Box balers are being used in Uganda but sisal string is expensive. What do farmers in Tanzania use to tie the bales?*

Answer: Farmers use sisal strings but the overall cost of the bale is still low.

Question: *Why do roadside forage traders in the Northern part of Tanzania not sell baled forage? If the buyers of forage demanded baled material to reduce transport cost, traders would have to supply it.*

Answer: Traders are being made aware of the technology and demand is increasing.