Handy bales save livestock keepers money

RIU

Validated RNRRS Output.

Working with farmers in Tanzania, researchers have developed a simple way of making bales by hand. Since transporting feed is a major cost for poor producers, the technique could have a major impact on their livelihoods—reducing transport costs by up to 60% in some cases. Using a bottomless box as a frame, and trampling the contents to compact it, farmers can quickly create bales from a wide range of crop residues, including maize and hay stover and bean stems. Not only can a lot more be packed onto a single pickup truck—reducing costs—it's also much easier for livestock owners to store feed when it's packaged in bales.

Project Ref: **LPP05:**
Topic: **2. Better Lives for Livestock Keepers: Improved Livestock & Fodder**
Lead Organisation: **Green, E. (Independent), UK**
Source: **Livestock Production Programme**

Document Contents:

Description

LPP05

Research into Use
NR International
Park House
Bradbourne Lane
Aylesford
Kent
ME20 6SN
UK

Geographical regions included:

Bangladesh, Ghana, Kenya, Tanzania, Uganda,

Target Audiences for this content:

Livestock farmers,

A. Description of the research output(s)

1. Working title of output or cluster of outputs.
In addition, you are free to suggest a shorter more imaginative working title/acronym of 20 words or less.

Manual box baling of maize stover and other dry forages to facilitate transport, storage and feed budgeting

2. Name of relevant Renewable Natural Resource Research Strategy (RNRRS) Programme(s) commissioning supporting research and also indicate other funding sources, if applicable.

Livestock Production Programme
Government of Tanzania

3. Provide relevant R numbers (and/or programme development/dissemination reference numbers covering supporting research) along with the institutional partners (with individual contact persons (if appropriate)) involved in the project activities. As with the question above, this is primarily to allow for the legacy of the RNRRS to be acknowledged during the RIUP activities.

R6619
University of Reading (Prof Emyr Owen);
Selian Agricultural Research Institute (SARI), Arusha, Tanzania (Dr Nicholaus Massawe);
Sokoine University of Agriculture, Department of Animal Science and Production, Morogoro, Tanzania (Prof Louis Mtenga);
Livestock in Development, Crewkerne, Somerset, UK (Steven Ashley, Sarah Holden);
Natural Resources Institute, University of Greenwich, Chatham, Kent (Dr Dannie Romney)

*4. Describe the RNRRS output or cluster of outputs being proposed and when was it produced? **(max. 400 words)**. This requires a clear and concise description of the output(s) and the problem the output(s) aimed to address. Please incorporate and highlight (in bold) key words that would/could be used to select your output when held in a database.*

Using PRA with smallholder-farmers in Northern Tanzania, in 1996-98, Project R6619 developed a simple method (**manual box baling**) of packaging **maize stover** to increase the payload when transporting the **fibrous crop residue** (over 10-20 km) from fields on the plains to homesteads on the slopes of Kilimanjaro. Stover (although of low feed value) is a major **dry-season forage** for dairy cattle and goats in Kilimanjaro and other regions of Tanzania, and also elsewhere in Africa.

Bales (ca.12 kg weight) were made by trampling stover into wooden frames (bottom-less boxes, 75 cm long, 50 cm wide, 45 cm high) placed on the ground. Bales were tied with sisal twine inserted in the frames, before the stover.

Using one man per bale, the time taken to make each bale was 17 minutes. Allowing for charges of hiring 1.0 tonne pickup vehicles and labour, the **cost of transporting baled stover was 33% less** than the conventional

method involving transporting loose maize stover in pickups. If the more nutritious fractions (leaves, leaf husk and sheath) were manually stripped from the stover and baled, and stems left in the field, the **cost of transporting baled strippings (per kg of metabolisable energy) was 60% less** than the conventional method of carrying loose stover.

Additional benefits from baling, perceived by farmers, were **reduced losses of the more nutritious (more digestible) leaf, husk and sheath fractions,** both in transport and in store, **increased storage capacity** (up to 50%) in the homestead, and **more accurate feed budgeting** (i.e. the number of bales were known, labourers and children could be told more explicitly how much stover to feed).

Farmers also found that **roadside hay and bean haulms were cheaper to transport if box baled**.

5. What is the type of output(s) being described here?
Please tick one or more of the following options.

Product	***Technology***	***Service***	***Process or Methodology***	***Policy***	***Other Please specify***
	X		*X*		

6. What is the main commodity (ies) upon which the output(s) focussed? Could this output be applied to other commodities, if so, please comment

Milk

R6619 was principally concerned with increasing profitable milk production from cattle and goats through more efficient forage use, particularly during the dry-season periods of forage shortages.

The technology is also applicable to smallholder farmers producing meat and to service providers involved with the transport and trade of dry forages, and renting out draught animals.

7. *What production system(s) does/could the output(s) focus upon?*
Please tick one or more of the following options.
Leave blank if not applicable

Semi-Arid	***High potential***	***Hillsides***	***Forest-Agriculture***	***Peri-urban***	***Land water***	***Tropical moist forest***	***Cross-cutting***
X	*X*			*X*			

Box baling could apply in any production system involving use of dry, bulky forages.

8. What farming system(s) does the output(s) focus upon?
Please tick one or more of the following options (see Annex B for definitions).
Leave blank if not applicable

Smallholder rainfed humid	***Irrigated***	***Wetland rice based***	***Smallholder rainfed highland***	***Smallholder rainfed dry/cold***	***Dualistic***	***Coastal artisanal fishing***
*X**	*X**	*X**	*X*	*X*	*X**	

*Box baling would also be applicable for resource-poor smallholders in these farming systems

*9. How could value be added to the output or additional constraints faced by poor people addressed by clustering this output with research outputs from other sources (RNRRS and non RNRRS)? (**max. 300 words**).*

Please specify what other outputs your output(s) could be clustered. At this point you should make reference to the circulated list of RNRRS outputs for which proformas are currently being prepared.

Manual box baling has practical application whenever resource-poor people transport, store and stall-feed bulky dry forages (grass and legume hays, fibrous crop residues such as cereal stovers of maize, sorghum, millet, cereal straws of rice, teff, wheat, barley, oats, and haulms of beans).

In East Africa and Southern Africa, suggested clustering would be R6619, R5188, R7955 and R7351 (fibrous crop residues are deficient in available nutrients, particularly protein; R7351 output involves a source of low-cost protein supplement, hence its inclusion in this cluster).

In South Asia (especially Bangladesh) suggested clustering would be R6619, R6610.

Manual box baling (R6619) is relevant for ‘Community based goat production in Kenya’ (R7634) and also to ‘Wambui’ (R7425).

Manual box baling (R6619) is also likely to be relevant for the cluster ‘Promotion of crop residues for fodder’ (R8339, R7346, R8296) in India. Box baling is also likely to be relevant to `Smallholder dairying toolbox’ (ZC0261), `Adoption of planted forages for smallholder dairying in Kenya’ (R6153, R5732), ‘Strategies for the allocation to seasonally varying feed resources’ (R5690), ‘Small stock toolbox (ZC0243) and ‘Tropical forages CD rom’ (A Frost, M Peters, S Peters).

Validation

B. Validation of the research output(s)

*10. **How** were the output(s) validated and **who** validated them?*

Please provide brief description of method(s) used and consider application, replication, adaptation and/or adoption in the context of any partner organisation and user groups involved. In addressing the “who” component detail which

group(s) did the validation e.g. end users, intermediary organisation, government department, aid organisation, private company etc... This section should also be used to detail, if applicable, to which social group, gender, income category the validation was applied and any increases in productivity observed during validation ***(max. 500 words)****.*

- Based on previous research in Kenya by Onim et al (1992) (Annex 2, Reference 16), the manual box baling technology was developed and validated in 1997, using PRA directly with the beneficiaries who are Moderate Poor, smallholder maize-coffee-dairy farmers on the slopes of Mount Kilimanjaro. The validation involved researcher-managed male farmers (Moderate Poor) and their hired male labourers (Extreme Vulnerable Poor), freshly harvested maize stover and stripped stover (leaves, husk and sheath), and commercially-hired pickups (see Massawe, 1999, Annex 1, Reference 6). The benefits of manual box baling were clear – large reductions (33-60%) in the cost of transporting stover, reduction in losses of the more nutritious fractions (leaf, husk and sheath), increased storage capacity (50%) at the homesteads, and easier and more accurate feed budgeting.
- Following the initial development and validation of manual box baling by men, women became interested in the technology and they collaborated in the validation by undertaking the stripping of stover (removal of leaf, husk and sheath), leaving the men to bale the strippings.
    - The manual box baling technology was promoted by preparing an extension leaflet and posters '*Cut costs of feeding stover'* (Annex 1, References 7 & 8) which were distributed to various stakeholders including institutions, farmer groups, CBOs, churches and individuals.
- Similar results were obtained when researchers of Sokoine University of Agriculture (acting as an intermediary organisation and aiming to improve livelihoods of small-scale dairy farmers through an integrated livestock production system approach) further validated manual box baling during 2001-2004, using PRA at farm level, with 29 Moderate Poor farmers and Women Headed Households in Njombe and Makambaku, Iringa, Southern Highlands of Tanzania (see Annex 2, Reference 15). Separate Extension leaflets were prepared by both Sokoine University of Agriculture and the Ministry of Livestock Development in Tanzania (Swahili – JAMHURI YA MUUNGANO WA TANZANIA Wizara ya maendeleo ya mifugo. Utengenezaji wa Hei kwa kutamia Kasha la Mbao) and distributed to extensionists and farmers.
- Soil Conversation and Agroforestry Programmes (SCAPA) in Arusha also promoted the manual box baling technology to its target farmers.
- Smallholder farmers (Moderate Poor) growing rice and producing milk in three districts near Mymensingh, in Bangladesh, also validated manual box baling of legume hay and straw (R6610). The technology was also demonstrated to Extreme Vulnerable Poor (landless women participating in Action Research of Project R8109).
- The validity of the box baling technology was confirmed by researchers and extensionists at scientific meetings and in peer reviewed project publications (Annex 1, References 2, 3, 4, 5, 9, 10). [420 words]

11. ***Where and when*** *have the output(s) been validated?*

Please indicate the places(s) and country(ies), any particular social group targeted and also indicate in which production system and farming system, using the options provided in questions 7 and 8 respectively, above ***(max 300 words)****.*

- The manual box baling technology was initially validated at the Livestock Training Institute, Tengeru, near Arusha, in 1997 and subsequently in Njombe and Makambaku, Iringa, Southern Highlands of Tanzania during 2001-2004.
- The production systems involved Semi-Arid, High Potential and Peri-Urban. The farming systems were

Smallholder Rainfed Highland, and Smallholder Rainfed Dry/Cold.

- The social groups targeted were Moderate Poor (smallholder dairy farmers) and Extreme Vulnerable Poor (hired workers of dairy farmers).
- In effect, box baling has been validated in Kenya, as it is promoted and used by FARM Africa's Meru Goat Breeders Association (R7634). Early research by Onim et al. (1992) (Annex 2, Reference 16) also provided some validation for the technology for packaging forages.
- Validation by researchers occurred by conference/workshop presentations In Kenya (Annex 1, Reference 2), Tanzania (Annex 1, References 3, 4, 5, 9) and Uganda (Annex 1, Reference 10).
- Manual box baling has also been validated in R6610 for packaging legume hay and rice straw in Bangladesh, in 2003-2005.

Current Situation

C. Current situation

12. ***How and by whom*** *are the outputs currently being used? Please give a brief description* ***(max. 250 words****).*

- Manual box baling of hay, maize stover and bean haulm, to reduce costs of transport and storage, and facilitate feed budgeting for dairy cattle and goats, has been used by Kilimapunda FFS (30, Moderate Poor farmers) north Tanzania, since 2004.
- Urban/Peri-urban smallholders (Moderate Poor) rent fields in West Kilimanjaro and box bale wheat and barley straw to facilitate transport to homelands for feeding dairy cattle. Farmers employ boys and girls (Extreme Vulnerable Poor) to box bale. Similarly, rice straw is box baled in Kahe (lower Kilimanjaro) by urban/ peri-urban farmers renting fields.
- In northern Tanzania, because of peri-urban dairying, forage-selling stalls operated by resource-poor young people are increasing and using baled stover as this is more acceptable to town-council officials than heaps of loose material.
- Box baling is used to reduce costs of transport and storage of crop residues by smallholders (Moderate Poor) in Njombe, southern highlands of Tanzania. Intensification of livestock keeping has been promoted in Mvomero district in Morogoro region; some farmers are using box baling.
- Chalinze Youth Group, near Dar es Salaam, started box baling grass hay in 2004.
- Box baling of dry forages and crop residues is used to reduce production costs by facilitating transport, storage and feed budgeting, by dairy goat farmers (Moderate Poor) in FARM Africa's Meru Goat Breeders Association (R7634), in Kenya. Similarly, Farm Africa's project farmers in Babate, northern Tanzania, and Mbale Sironko in Uganda, are using box baling.
- Box baling is being used by rice/dairy farmers (R6610) for packaging legume hay to facilitate storage, transport and feed budgeting in three locations, near Mymensingh, Bangladesh. 269 words

13. ***Where*** *are the outputs currently being used? As with Question 11 please indicate place(s) and countries where the outputs are being used* ***(max. 250 words).***

- The answer to Question 12 also, in effect, answers Question 13.
- Manual box baling is being used in the following countries:
  - Tanzania: Kilimapunda Farmer Field School (north Tanzania), West Kilimanjaro, Arusha, Kahe (lower Kilimanjaro), Babate (north Tanzania), Njombe (southern highlands), Mvomero district (in Morogoro region)**,** Chalinze Youth Group (near Dar es Salaam)
  - Kenya: Meru Goat Breeders Association (R7634)
  - Uganda: FARM Africa's project in Mbale Sironko
  - Ghana: Smallholder farmers in northern Ghana (personal communication from Dr E.L.K. Osafo, University of Science and Technology, Kumasi, based on information from former Director of Animal Production)
  - Bangladesh: Three locations near Mymensingh (Fulbaria, Muktagacha and Delduar Upazillas) (R6610)

14. What is the scale of current use? Indicating how quickly use was established and whether usage is still spreading ***(max 250 words).***

- We are unable to provide a precise answer to Question 14.
- Project R6619 developed the manual box baling technology, in 1997, in Arusha, northern Tanzania. Although extension services etc. in Tanzania were made aware of the technology, the scale of current usage by smallholder farmers is probably small – probably less than 500 farmers. Dr Nicholaus Massawe (Selian Institute of Agricultural Research) and Professor Louis Mtenga (Sokoine University of Agriculture) both consider that usage of the technology is still spreading in Tanzania.
- Current usage of manual box baling in Kenya is greater than in Tanzania. The Meru Goat Breeders Association has about 3000 members in two districts and each member will be aware of the technology and encouraged to use it *(*Camillus Ahuya, FARM Africa, 2006, personal communication)*.*
- Current usage of manual box baling in Bangladesh is also unknown, but many of the farmers participating in R6610 will be using it.

15. In your experience what programmes, platforms, policy, institutional structures exist that have assisted with the promotion and/or adoption of the output(s) proposed here and in terms of capacity strengthening what do you see as the key facts of success? ***(max 350 words).***

- Platforms
  - Universities and Livestock Training Institutes e.g. LITI Tengeru in Tanzania included box baling technology in teaching
  - At Arusha Show, August 2006, stripping leaves off maize stover and box baling were exhibited; the President of the United Republic of Tanzania and several Ministers attended the exhibition. Agricultural shows in Kenya have assisted FARM Africa promote its technologies (including box baling) for improving milk production from goats
  - Stakeholders' Forum were important in promotion and adoption of FARM Africa technologies (include box baling)
  - Awareness of box baling was created via WRENmedia Agfax interview with Nicholaus Massawe "*Transporting maize stover*" which was sent to 25 national and FM stations in Anglophone Africa and 10 national stations in Asia, in July 1999. A press article "*Transporting the ideas of success*" was published Nov/Dec 1999 in *Far Eastern Agriculture* (circulation 9,224), *The Farmers Voice*, Cameroon (circulation

6,000) and *Agritopia*, newsletter of Ethiopian Agricultural Research Organisation.

- Policy
  - The Livestock Policy of Tanzania (Annex 2, Reference 20) promotes use of crop residues and recognises bulkiness as a limitation for transport
  - In Kenya, FARM Africa involved government policy makers in formulating the FARM Africa model for dairy goat smallholders
- Institutional structures
  - In Kilimanjaro and Arusha, churches promoted the technology by allowing posters to be displayed on notice boards
  - Promotion and adoption were assisted by CBOs, e.g. Meru Goat Breeders Association (Kenya) and Kilimapunda Farmer Field School (Tanzania)
  - Promotion and adoption were assisted by NGOs such as FARM Africa (Kenya, Tanzania and Uganda), Land O'Lakes (Kenya, Tanzania and other African countries), Soil Conversation and Agroforestry Programmes (SCAPA) (Arusha, Tanzania). In Bangladesh (R6610) NGOs (BRAC, Proshika) played a role in promotion of the technology
- Capacity strengthening
  - A key to success was linkage between university teachers, researchers, extensionists and farmers which resulted in capacity strengthening for all concerned
  - Farmer-to-farmer visits was a key to success in technology transfer
  - R6619 provided a platform for one member of the team to undertake a PRA-based PhD based on the research (Massawe, 1999, Annex 1, Reference 6).348 words

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Current Promotion

D. Current promotion/uptake pathways

*16**. Where** is promotion currently taking place? Please indicate for each country specified detail what promotion is taking place, by whom and indicate the scale of current promotion **(max 200 words).***

- Promotion of the box baling technology is being (indirectly) promoted as part of the FARM Africa model (R7634) for improving milk production from goats in the FARM Africa projects in Kenya, Tanzania and Uganda; promotion involves farm visits (farmer to farmer), pamphlets, participation and demonstrating in agricultural shows, teaching, conference and other presentations at local, national and international meetings, media sensitisation by radio in Kenya and Tanzania
- Sokoine University of Agriculture is promoting the technology in the Southern Highlands
- Selian Agricultural Research Institute, Arusha, is promoting in northern Tanzania
- The Ministry of Livestock Development in Tanzania is also promoting the technology
- The follow-up to R6610 involves promotion of the technology by NGOs in Bangladesh. (119 words)

*17. What are the current barriers preventing or slowing the adoption of the output(s)? Cover here institutional issues, those relating to policy, marketing, infrastructure, social exclusion etc. **(max 200 words)**.*

- Policy issues
  - Tanzania Government Livestock Policy (Annex 2, Reference 20) objective is to promote efficient conservation and utilisation of crop residues for increased productivity of livestock, but there appears to be no clear strategy to see that the Policy is implemented
- Marketing
  - In Tanzania (e.g. Kilimanjaro) market access with respect to milk is a barrier. A similar picture occurs in Ghana (e.g. Kumasi, Annex 2, Reference 12). Farmers argue that there is little point in increasing milk production as marketing often a problem
- Infrastructure
  - Inadequate infrastructure regarding refrigerated milk collection points and inaccessible roads are barriers to increasing milk production (hence uptake of new technologies) in Kilimanjaro and other locations in Tanzania
- Social exclusion
  - Women sometimes socially excluded making it difficult for women-headed households to access new technologies
- Other barriers
  - Availability of labour due to HIV Aids is barrier to adoption in affected households
  - In Arusha some roadside sellers of dry forages don't like bales because they sell on volume; bales appear to be less material. Some buyers also have same perception. Misconception will disappear when forage is sold on basis of weight, not bulk
  - Insufficient use local language (e.g. radio broadcasts) when promoting technology

18. What changes are needed to remove/reduce these barriers to adoption? This section could be used to identify perceived capacity related issues ***(max 200 words).***

- Promotion of technology by greater involvement of endusers, i.e. fostering and training farmer groups, as has been done by FARM Africa, in Embu, Kenya (and elsewhere) when promoting a package of technologies for improving milk production from goats (R7634)
- Although the Tanzania National Poverty Reduction Strategy Paper (PRSP) (Ministry of Cooperatives and Marketing, 2003, Annex 2, Reference 14) stresses the need for formation of groups "…….farmers will be encouraged to organise themselves in groups or cooperatives with a view to improving their prospects for economic and social development…...", **there is need to build mechanisms to enable farmer groups to be formed and trained** to so that they are the vehicle for upscaling. Such groups need to devote time to educate their members with emphasis on the social and economic implication of the technology
- Roadside sellers (and buyers) of dry forage in Arusha and other towns in Tanzania need to be educated regarding the merits of trading by weight rather than volume
- Uptake of the technology in Tanzania would be assisted if politicians and religious groups (honest brokers) were more involved in articulating and disseminating the information.

19. What lessons have you learnt about the best ways to get the outputs used by the largest number of poor people? ***(max 300 words).***

- Start with group that is interested in adoption

- Need for bottom-up approach, even when formulating policy issues
- Make farmers see positive part of policy – work with them to see the benefits before going into technicalities
- Politicians, NGOs, churches, and schools need to be involved
- Technology must be affordable and not labour intensive
- Build a mechanism by which farmers/farmer groups be the vehicle of scaling-up the technology (e.g. FFS)
- Linkage needed between farmers and research partners in dissemination of technology
    - Constant contact must occur among all stakeholders during the technology transfer linkages. Make full use of the comparative advantages of people involved in the linkages.

Impacts On Poverty

E. Impacts on poverty to date

20. Where have impact studies on poverty in relation to this output or cluster of outputs taken place? This should include any formal poverty impact studies (and it is appreciated that these will not be commonplace) and any less formal studies including any poverty mapping-type or monitoring work which allow for some analysis on impact on poverty to be made. Details of any cost-benefit analyses may also be detailed at this point. Please list studies here.

- No impact studies on box baling per se have taken place. However, three studies (Tanzania, Kenya, Bangladesh) have involved box baling as one of the technologies being assessed.
    - A project (with Moderate poor smallholders) to reduce the problem of insufficient feeds for dairy cows during the long dry season was conducted in Njombe district, Iringa Region, Southern Highlands of Tanzania during 2001-2004. Several technologies (improved pasture establishment, making hay bales, use of crop residues) were tested. A survey of farmers was done in 2005 to evaluate impact ((TARP ll SUA Project 2005, Annex 2, References 17 &18).
    - In Kenya (R7634) formal poverty impact assessments of FARM Africa's goat improvement model were done by Karen Tibbo, in November 1998. FARM Africa's package of technologies for improving milk production from goats includes box baling of dry forages
    - In Bangladesh (R6610) no formal poverty impact studies were undertaken, but four studies/assessments were completed: Financial analysis (1999), Monitoring (bi-weekly) (2003-04), Participatory appraisal (2004).

21. Based on the evidence in the studies listed above, for each country detail how the poor have benefited from the application and/or adoption of the output(s) ***(max. 500 words):***

- *What positive impacts on livelihoods have been recorded and over what time period have these impacts been observed? These impacts should be recorded against the capital assets (human, social, natural, physical and, financial) of the livelihoods framework;*
- *For whom i.e. which type of person (gender, poverty group (see glossary for definitions) has there been a positive impact;*
- *Indicate the number of people who have realised a positive impact on their livelihood;*
- *Using whatever appropriate indicator was used detail what was the average percentage increase recorded*

- In Tanzania, the survey in Njombe district (TARP ll SUA Project 2005, Annex 2, Reference 18), the “basket of technologies” (improved dry season feeding using baled hay and crop residues) increased milk production from 7.5 to 12 litres of milk per cow per day. Incomes of 92% of farmers increased from 276000 to 459000 Tanzanian Shillings per year (224 to 373 US$). Using conserved forages during the dry season meant that less time was spent collecting feed for cattle; there was an average saving of 4 hours per day over almost 5 months. As well as increasing incomes, farmers concluded that the project had positively improved other aspects of livelihoods (food, inputs, implements, nutrition, health, skills development and social credibility)
    - In Kenya, FARM Africa’s goat improvement model (R7634) resulted in very positive impacts on the participants involved (improvements in household incomes to pay bills from sale of dairy goats, better nutrition from drinking goat milk, improved crop production from use of goat manure, acquired knowledge and leadership skills)
    - In Bangladesh (R6610) the four studies/assessments showed human capital to increase. Benefits spread among smallholder landed farmers (75 received intensive training over 18 months; 50 continue to use the technologies; about 1200 farmers attended field days), women headed households and landless cattle keeping households. Other major beneficiaries were extension workers (more than 1000) and others that received training. Women, particularly (being responsible for managing livestock at the homesteads), gained social capital due to less underemployment, greater confidence and greater involvement in income earning activities. Natural and physical capitals were enhanced due to soil and cow fertility improvements. Contributions to financial capital increased income from both cattle and rice production for those adopting the technologies. The box baling technology facilitated storage and preservation for year-round feeding of high quality forages and feed budgeting for optimum utilisation. Benefits have mostly accrued to the moderate poor and women headed households. (For further details, see Proforma R6610).

Environmental Impact

H. Environmental impact

24. What are the direct and indirect environmental benefits related to the output(s) and their outcome(s)? ***(max 300 words)***

This could include direct benefits from the application of the technology or policy action with local governments or multinational agencies to create environmentally sound policies or programmes. Any supporting and appropriate evidence can be provided in the form of an annex.

- Box baling will reduce environmental pollution by road vehicles because of the reduction in journeys facilitated by the technology
- Box baling (along with uptake of R7955 and R5188) will mean greater use of crop residues for animal feeding and thus reduce biomass burning in situations where residues are not used and considered a waste
- Adoption of outputs of R6619, R5188 and R7955 will help reduce erosion because of improved soil organic matter content and fertility

25. Are there any adverse environmental impacts related to the output(s) and their outcome(s)? ***(max 100 words)***

- In (exceptional) situations where crop residues are completely removed from crop land and land not manured (e.g. maize stover in northern Tanzania produced on rented land) there is concern that soil organic matter content will decrease with increased risk of erosion. Stripping leaves from stover in the field and leaving the less digestible stem for soil incorporation would be a preferred strategy in such situations.

26. Do the outputs increase the capacity of poor people to cope with the effects of climate change, reduce the risks of natural disasters and increase their resilience? ***(max 200 words)***

- Conserving crop residues and dry forages by proper storing (via box baling) for subsequent use obviously increases the capacity of poor people to cope with forage shortages during dry-season droughts
- Future climate changes in Africa are likely to mean that more drought resistant cereals such as millet and sorghum are grown. Box baling is applicable to the crop residues of these cereals, as well as maize.
- In case of complete crop failure in the middle of growing season due to shortage of rains, the wilted crop can be box baled and stored for feeding livestock or sold to offset the costs of land preparation and purchase of seeds.

Annex

ANNEX 1

R6619: Husbandry strategies for improving the sustainable utilisation of forages to increase profitable milk production from cows and goats on smallholder farms in Tanzania

Final Technical Report on a Research Project Funded by the Department for International Development's Livestock Production Programme (March 31, 2000)

Nicholaus Massawe
Emyr Owen
Louis Mtenga
Steve Ashley
Dannie Romney
Sarah Holden

EXECUTIVE SUMMARY

This project was designed around the hypothesis 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 the most pressing constraints could be developed and promoted.
There was little evidence that the dairy production constraints facing poorer farmers in Tanzania had been

adequately identified or addressed prior to this project. This project therefore applied participatory appraisal techniques so that farmers could identify and prioritise their constraints and participatory evaluation techniques so that farmers could evaluate experimental technologies for themselves. Finally, farmer-to-farmer learning and evaluation permitted the transfer of potentially beneficial technology from one group of farmers to another. The adoption of a participatory approach to all stages of the technology generation and dissemination cycle is rare in livestock research and this project serves as an example of the benefits which may accrue from this approach.

The technology of manual box-baling of maize stover has shown that real economic benefits can be gained from simple applied technology. Allied with stripping the more digestible portions from maize stover prior to baling, the cost of transported forage reduces from 10 Tanzanian shillings per mega Joule of metabolisable energy to 4 Tanzanian shillings. This same technology can be applied to the roadside grass trade and provide benefits to both sellers and buyers of this forage.

Farmer-to-farmer visit and learning showed promise as a means of technology transfer and may have benefits over either training and visit approaches or local farm open days.

The project has contributed to DFID's development goals by engaging in dialogue with poorer farmers, learning from their experiences and circumstances and allowing them to select and test technologies so that farmers become empowered to improve their own productive opportunities and hence alleviate poverty

R6619 PUBLICATIONS

1. Massawe, N.F., Owen, E., Mtenga, L.A., Romney, D.L., Ashley, S.D. and Holden, S.J. 1997 Developing sustainable forage utilisation to increase profitable milk production on smallholder farms in Tanzania: approach using Participatory Rural Appraisal (PRA). *Proceedings of the 23rd Scientific Conference of Tanzania Society of Animal Production* **23** (1996), 23-31.

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