# Double the benefits: using legumes to boost both milk and rice production

RIU

**Validated RNRRS Output.**

Growing forage legumes with rice, either together or in succession, has been shown to be one answer to the feed shortages that face dairy cattle keepers in Bangladesh—where intensive rice production leaves little land available for forage production. Plus, as an added bonus, growing legumes also increases soil fertility—which in turn boosts rice production. Since feed is the major outlay for dairy producers, making cheaper, higher quality fodder available in this way would have a real and long-lasting impact on the lives of the poor. Cheap, easy-to-make urea molasses blocks are another way of boosting milk production, as animals gain essential nutrients as they lick them.

Project Ref: **LPP08:**
Topic: **2. Better Lives for Livestock Keepers: Improved Livestock & Fodder**
Lead Organisation: **Bangladesh Agricultural University (BAU), Bangladesh**
Source: **Livestock Production Programme**

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**Document Contents:**



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## Description

***LPP08***

***A. Description of the research output(s)***

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

**Geographical regions included:**

**Bangladesh,**

**Target Audiences for this content:**

**Crop farmers, Livestock farmers, Forest-dependent poor,**

*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.*

**Leguminous forages and feed blocks for smallholder mixed farmers and landless dairy producers in Bangladesh**

**or**

**Forages and feeds for smallholder and landless dairy farmers in Bangladesh**

*2. Name of relevant RNRRS Programme(s) commissioning supporting research and also indicate other funding sources, if applicable.*

Livestock Production Programme

*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.*

R6610
Bangladesh Agricultural University (Prof. Ali Akbar)
D Barton (UK) Ltd (Dr David Barton)
Reading University (Prof. Emyr Owen)

R6619
Reading University (Prof. Emyr Owen)

*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.*

This cluster of outputs is primarily concerned with **alleviating forage and feed shortages for dairy cattle** kept by both smallholder farmers and landless households in Bangladesh. **Intercropping and relay cropping of legumes with rice** produces high quality forages for dairy cows and also **increases rice production**. **Box baling** facilitates transport, storage, feed budgeting and trade in leguminous hay/forage, and **Urea Molasses Blocks** (UMB) provide benefits for landless households (increased milk production).

Intensive rice cropping throughout Bangladesh leaves little land available for forage production. Smallholder dairy producers rely heavily on fibrous forages such as rice straw supplemented with roadside grasses, weeds and small quantities of wheat bran and oilcakes. Feed is the main cost item in milk production and it would add to profitability if cheaper ways of feeding can be identified. Lower costs of production would allow prices to fall and make domestic production more competitive with imports.

Project R6610 (Introduction of fodder legumes into rice-based cropping systems and their use as supplements to straw-based rations for dairy cattle in Bangladesh) (1996 to 2000) developed techniques for the integration of forage production into rice-based cropping systems. On-station and on-farm research identified two leguminous forages, African *Dhaincha* (*Sesbania rostrata*) grown in the *Boro* rice season and *Khesari* (*Lathyrus sativus*) in the *Aman* rice season. Integration of forage with rice production provides several advantages:

- It does not disturb the existing cropping pattern.
- It improves soil fertility and hence the subsequent rice yield.
- It provides good quality forage and increases the milk yield of dairy cows.

The system fits well with the predominant *Boro/Aman* rice cropping pattern in Bangladesh. These successes were carried into an extension phase 2003-2005 to promote technologies to farmers in 3 locations in Bangladesh and to train trainers.

Project R6619 developed a simple method of manually box-baling maize stover to increase the payload when transporting loose stover from fields on the plains to homesteads on the slopes of Kilimanjaro, northern Tanzania. Allowing for charges of hiring 1.0 tonne pickups and labour, the cost of transporting baled stover was 33% less than the conventional loose. Additional benefits from baling were reduced losses of more-digestible leaf and sheath, increased storage capacity in the homestead and more accurate feed budgeting.

This technique was successfully transferred to Bangladesh during the extension phase of R6610 as a means of storing leguminous hay. Added to this was Urea Molasses Block technology, a supplement considered most appropriate for landless dairy producers (i.e. those unable to grow forages).

*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* | | | | |

*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, Rice (forages and UMB can also be used for meat production)

*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* | | | | | | |

*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* | | | | |

*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.*

The benefits associated with inter and relay cropping of leguminous forages with rice (R6610) and the storage of leguminous hay (box baling) (R6619) have been clearly demonstrated. Value could be added by promoting the livestock production benefits together with the rice yield enhancing benefits of inter and relay cropping of leguminous forages. Linking with national institutes (Bangladesh Rice Research Institute [BRRI], Bangladesh Agricultural Research Institute [BARI] and the Department of Agricultural Extension [DAE] and NGOs promoting the outputs of projects such as the DFID funded Poverty Elimination Through Rice Research Assistance (PETTRA) project (www.petrra-irri.org/) would add considerable value to RNRRS outputs. PETTRA's experience with private sector seed companies may be of particular relevance as seed shortages are one of the major constraints to uptake and diffusion of *Dhaincha* technology.

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## 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)**.*

Four types of validation were undertaken. A financial analysis by project staff (1999). Bi-weekly monitoring of 75 farmers (users of the technology) in 3 locations (2003-2004). A participatory assessment (PRA) by project staff 2004 (Annex 1) and an Impact Assessment (IA) by an independent researcher during November 2005 (Annex 2).

**Financial analysis**
The average additional milk yield/cow/month due to feeding *Dhaincha* was 16 litres (additional income of Tk.320). *Khesari* produced an average additional milk yield of 12.5 litres/month (additional income of Tk. 250). Higher

yields of *Boro* rice resulting from the cultivation of leguminous forages averaged 0.13 t/ha providing additional profits (margins) of Tk.3846/ha. Higher yields of *Aman* rice averaged 0.44t/ha providing additional profits (margins) of Tk3312/ha.

**Monitoring**

Data collected during monitoring demonstrated a good response in terms of milk yield, reduction in the period of post partum heat and overall condition and health of cattle (Tables 1 and 2). Best results are achieved with combinations of UMB and forages; although UMB alone also shows a good response and farmers remarked that straw intakes increased. Marketing of milk posed few problems for farmers.

**Table 1. Average yield increase (kg/cow/day) with different feeding systems**

| Feeding system | Yield (kg) | Increase (kg/ day) | % increase | Value (Tk) |
|---|---|---|---|---|
| UMB | 3.5 | 0.6 | 24.0 | 11.10 |
| UMB/*Dhaincha* | 5.3 | 1.1 | 28.7 | 21.50 |
| UMB/*Khesari* | 3.7 | 0.8 | 27.5 | 12.82 |

**Table 2. Reduction in number of days to post-partum heat for different feeding systems**

| Type of household | *Dhaincha* | *Khesari* | UMB | UMB-*Dhaincha* | UMB-*Khesari* | Mean |
|---|---|---|---|---|---|---|
| Female Headed | | | 22 | | | 22 |
| Landed | 30 | 16 | 27 | 27 | 33 | 28 |
| Landless | | | 18 | | 30 | 19 |
| **Mean** | **30** | **16** | **22** | **27** | **32** | **25** |

**PRA**

Using a matrix scoring technique farmers provided high scores for all technologies with few, if any, constraints reported (Annex1). In brief, forage cultivation is compatible with existing cropping patterns, there are few labour constraints associated with forage production, the technologies are affordable, incomes from cattle have increased and the majority of farmers expressed an interest in continuing to use the technologies.

**Impact Assessment (IA)**

Methods used during the IA included participatory techniques with end users of the technology (participatory budgets, focus group discussions, individual interviews) (Annex 2). Semi-structured interviews were held with key informants from organisations (representatives of DAE and NGOs) that had received training (training of trainers) to gauge uptake of technologies. In summary this assessment concluded that:

- Average milk production increased at the rate of 0.5 to 1.0 kg/cow/day through feeding *Dhaincha*, *Khesari* box bales and UMB. This led to increased incomes.
- Milk production was profitable (mean of Tk15,700/cow /year) (£142/cow/year).
- Technologies promoted were compatible with farmers' existing practices and there is scope for wider diffusion.
- Employment opportunities for women have increased as they are involved in preparing UMB, drying *Khesari*,

preparing box bales and feeding cows.

- There is some evidence of the spread of the technologies (diffusion) beyond those farmers trained by the project.
- Extension organisations expressed continued interest in further promotion of technologies but were hampered by a shortage of seed, particularly for *Dhaincha*

*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)**.*

In 3 locations in Bangladesh (Fulbaria, Muktagacha and Delduar Upazillas). Validation took place with women headed households, landless livestock keepers and landed smallholder farmers (1999-2005).

Production system – High Potential
Farming system – Wetland rice based

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## Current Situation

### *C. Current situation*

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

Smallholder farmers in the areas where promotional activities took place continue to use project outputs. They are growing both *Dhaincha* and *Khesari* forages. *Khesari* seed is available in the local market but *Dhaincha* seed of the required quality is in short supply and only available from the Bangladesh Agricultural University (BAU). Those farmers using UMB (fewer in number than those growing forages) prepare the blocks themselves after purchasing ingredients from the local market. In Delduar Upazila of Tangail District farmers are better organised and have begun to produce their own seed of both *Dhaincha* and *Khesari*. There is some evidence of diffusion of these technologies from farmer to farmer in the three locations where promotion took place, notably in Delduar Upazilla.

*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).***

In 3 locations in Bangladesh, Fulbaria, Muktagacha and Delduar Upazillas where project outputs were actively promoted between 2003-05. Other than these three locations the outputs are being used by some farmer clients of those organisations trained by the project between 2003-05 at various locations throughout the country including the trainees of:

- BRAC (NGO)
- Proshika (NGO)
- Youth Training Institute (YTI)

- Bangladesh Livestock Research Institute (BLRI)
- Farmers of Baghabarighat milk shed area (Milk Vita cooperative members)

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

Current use is limited to those farmers that received training from the project although there is evidence of some diffusion of technology in Delduar Upazilla. More than half of the 75 original trainees continue to use the technology along with isolated trainees of organisations trained (training of trainers) by the project. Usage is however spreading very slowly in the absence of any formal extension and promotion.

The farmers of Delduar Upazilla adopted the technology of forage production quickly compared to other areas. They have also slightly modified the system of cultivation of *Dhaincha* to fit into their farming system. The use of box baling is widespread among adopting households (for *Khesari* hay) as they face shortages of fodder in the monsoon season being a low lying area susceptible to flooding.

*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).***

To date most promotional efforts have involved the government extension service (DAE) and NGOs who support and manage their own projects and programmes in rural Bangladesh. Field days, demonstrations and regular visits during the project period, and the provision of printed extension materials have all been demonstrated to be a successful means of promoting technology. However, promotion has tended to emphasise the livestock production benefits of the technology at the expense of the positive impacts on rice production. Promotion has also been isolated and sporadic and there is a need for a coordinated approach over a wider area. There is also a need to raise awareness of policy makers, planners and local government and to involve the private sector more directly in promotion and extension.

The future role of DAE (government extension service) and NGOs is crucial and more involvement of these organisations is needed, in particular leadership and endorsement from senior management to ensure future success. There is a need for high profile marketing or promotional campaign to include the dairy processing companies/cooperatives (private sector) and a multiplication scheme for *Dhaincha* seed. Private sector companies may be the best option for seed multiplication and the manufacture of UMB. It may also be worthwhile exploring the use of successful farmers as extension agents (farmer-to-farmer extension).

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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).***

A limited amount of promotion is taking place in Bangladesh. Extension workers of five organisations were trained to promote the outputs of the project to farmers – DAE (at sub-assistant agriculture officer [SAAO] level [1]), the Bangladesh Livestock Research Institute (BLRI), BRAC (NGO), Proshika (NGO) and The Youth Training Institute (YTI), a government body providing vocational training to unemployed youths. Of these DAE, BLRI, BRAC and Proshika are promoting the outputs in various locations throughout the country.

Proshika distributes extension leaflets and folders to both their trainers and client farmers. BRAC trainees are showing interest in *Dhaincha* cultivation. BLRI is promoting forage technology to farmers in Baghabarighat milk shed area. However, to strengthen the promotional activities of these organisations more motivation, demonstration, training and regular monitoring will be essential. Overall numbers of trainees are small and field demonstrations may be an essential part of any promotional campaign.

[1] These are the field workers in Bangladesh, i.e. the lowest level

*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)****.*

The main barrier to further adoption in Bangladesh is institutional – that there is inadequate capacity [capability] and understanding of the potential benefits of the technology and therefore weak commitment to its promotion. Promotional activities at the national level such as radio and TV programmes and agricultural shows/field days are required. Awareness of the potential of these technologies and their role in increasing dairy and rice production is limited both among policy makers and extension organisations, and links have not been established to crop scientists and extension workers. Most of the current promotion involves livestock production scientists and extension workers. Marketing of surplus milk is not considered a major constraint by producers although the lack of a cold chain in some rural areas is arguably a constraint to the further development of the industry.

Links between researchers, extension workers and the private sector are weak and there is a need to involve the private sector in both manufacture (UMB), multiplication (seeds for inter and relay crops) and extension (dairy processing companies and cooperatives). The Project extension impact assessment (R6610) identified the following constraints to further adoption and adaptation:

- Limited availability of *Dhaincha* seed which has yet to be multiplied by significant numbers of farmers or on a commercial basis.

- Reluctance by farmers to manufacture their own UMB. Ingredients are generally available but farmers appear to find the manufacturing process both tedious and time consuming.

- Occasional labour shortages for harvesting and drying *Kheshari*.

*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).***

Very few farmers adopt this technology without some form of training and demonstration from development

organisations (DAE or NGOs). Commitment from donors to develop the capacity of organisations providing agricultural extension and training services, to facilitate further uptake and upscaling, may be essential if more smallholder farmers are to benefit from this technology.

Future efforts should therefore concentrate on developing partnerships for extension, promotion and manufacture between the government, non-government and private sectors while seeking endorsement/support from senior managers in DAE, BRRI, BARI and NGOs.

*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).***

Demonstration plots (farmer field schools), printed extension materials, local agricultural shows/field days and training of trainers in the field alongside their client farmers, have all been demonstrated to be effective ways of promoting technology. Agricultural shows and field days stimulate interest and demand for technology and lead to requests for training, particularly from NGOs. The resources available during the project extension were insufficient to respond to all these demands for training. Resources currently available are also insufficient.

The above suggests that training of trainers may not be sufficient for upscaling. There is a need for practical demonstrations and other field activities (farmer field schools) to persuade both farmers and extensionists of the value of these technologies.

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## 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 formal poverty impact studies have been undertaken. Four studies/assessments have been completed (see answer to question 10):

- Financial analysis (1999)
- Monitoring (bi-weekly) (2003-04)
- Participatory appraisal (2004)
- Impact assessment (2005)

*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*

Benefits have been spread among smallholder landed farmers, women headed households and landless cattle keeping households. Other major beneficiaries (stakeholders) include those extension workers and others that received training (BLRI, BRAC, Proshika, YTI and DAE).

**Human capital** has increased as participating farmers and extension institutions received training. 75 farmers received intensive training over a period of 18 months and 50 of these farmers continue to use the technology. A further 1200 (approx) farmers attended field days and demonstrations. More than 1000 extension workers were trained in the use of project technologies.

Benefits in terms of **social capital** accrue mostly to female members of households adopting technology as they are often responsible for managing livestock at the homestead. This results in less underemployment, greater confidence and greater involvement in income earning activities

**Natural and physical capital** has been enhanced as soil and cow fertility has improved.

Contributions to **financial capital** are increased income from both cattle and rice production for those adopting technology.

Benefits have mostly accrued to the moderate poor and women headed households.

On average rice yields have increased by 13% as a result of adoption of inter and relay cropping of leguminous forages. Feeding UMB and forage produces an average increase in milk yields of 26% and improved fertility of cows (the number of days to post-partum heat decreased on average by 25 days), implying higher fertility as result of adoption of these technologies. Box baling technologies facilitate storage and preservation for year-round feeding of high quality forages and feed budgeting for optimum utilisation.

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## 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.*

Benefits include enhanced soil fertility and a reduction in the use of chemical fertilisers and the associated risks of environmental pollution.

Leguminous forages improve the digestibility of straw and the resulting increase in intake and milk production improve efficiency thereby reducing methane production (a greenhouse gas).

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

None anticipated.

*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)***

Yes, inasmuch as they contribute generally to improved livelihoods. i.e. increased incomes and asset accumulation along with better access to education and health services.

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## Annex 1

**Annex 1. PRA Results**
**Average scores from PRAs exploring impact of feed technologies**

| Impact | Score | | |
|---|---|---|---|
| | *Khesari* | *Dhaincha* | UMB |
| Milk yield | 8.3 | 8.4 | 7.5 |
| Animal health | 8.8 | 7.6 | 7.9 |
| Dairy income/household income | 7.7 | 8.0 | 7.5 |
| Compatibility with farming system (crop rotation) | 10.0 | 10.0 | - |
| Costs acceptable/affordable | 9.8 | 10.0 | 10.0 |
| Impact on labour use (is labour available) | 10.0 | 10.0 | 8.6 |
| Will technology be used post-project | 8.5 | 9.7 | 8.6 |
| Have neighbours shown interest | 8.0 | 8.6 | 8.4 |
| Reduction in postpartum heat period | 8.4 | 7.8 | 8.6 |
| Box baling system (easiness) | 9.6 | - | - |
| Are ingredients available locally | - | - | 9.9 |
| Preparation process (easy to prepare) | - | - | 8.6 |

Note: The maximum score allowed for each objective was 10.

## Annex 2

**Promotion of Integrated Rice/Forage production and UMB Technology to Poor Dairy Producers in Bangladesh (R6610)**
**Final report on Impact Assessment**

*Click below to view the related information ....*

**PF_LPP08_Annex2.pdf**