Enhancing livestock productivity through feed and feeding interventions in India and Tanzania

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Enhancing livestock productivity through feed and feeding interventions in India and Tanzania

Ben Lukuyu[1], Thanammal Ravichandran[2], Brigitte Maass[3], Germana Laswai[4], Julius Bwire[5] and Alan Duncan[6]

1. International Livestock Research Institute, Nairobi Kenya

2. International Livestock Research Institute, Hyderabad, India

3. International Center for Tropical Agriculture, Nairobi, Kenya

4. Sokoine University of Agriculture, Department of Animal Science, Morogoro, Tanzania

5. Tanzania Livestock Research Institute, Tanga, Tanzania

6. International Livestock Research Institute, Addis Ababa, Ethiopia

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Box 30709, Nairobi 00100, Kenya
Phone: + 254 20 422 3000
Fax: +254 20 422 3001
Email: ILRI-Kenya@cgiar.org

Box 5689, Addis Ababa, Ethiopia
Phone: +251 11 617 2000
Fax: +251 11 617 2001
Email: ILRI-Ethiopia@cgiar.org

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Introduction

The majority of smallholders in South Asia and sub-Saharan Africa who raise both crops and livestock keep dairy animals. Milk is an important commodity in both India and Tanzania, and rising demand, especially in the cities, is an opportunity for farmers to intensify their production. In both countries, many poor livestock keepers produce milk, and a variety of dairy production systems exist. But the lack of sufficient high-quality feed is a key constraint for the sustainable improvement of milk yields and smallholders' incomes. In Tanzania, many farmers face feed shortages and poor feed quality. Production is low: 5–10 litres/day for improved dairy cows, and only 1–2 litre/day for zebu cows. In India, average milk yields are also far below their potential and the national average milk yield is 3.6 litres/cow/day (Blummel et al. 2013). Tiwary et al. (2007) found that the feed given to animals in Uttarakhand, India, is deficient in dry matter, energy and protein. Because the availability of the main feeds, natural grass and other forages depends on rainfall, milk production is strongly seasonal, especially in Tanzania. Such problems are usually addressed by promoting improved feed technologies, but this has rarely been successful and uptake is low, so new approaches are needed.

The project "Enhancing Dairy-based Livelihoods in India and the United Republic of Tanzania through Feed Innovation and Value Chain Development Approaches"—or "MilkIT" for short—was a research for development project (2012–14) that focused on improving smallholder livelihoods through dairy feed innovations in India (Uttarakhand state—Figure 1) and Tanzania (Morogoro and Tanga regions—Figure 2).

Figure 1. Bageshwar and Sult districts in Uttarakhand, India

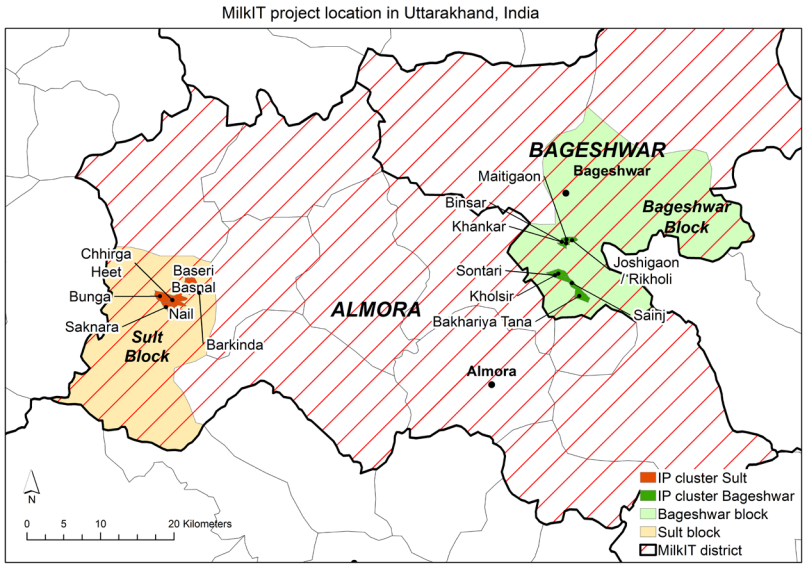
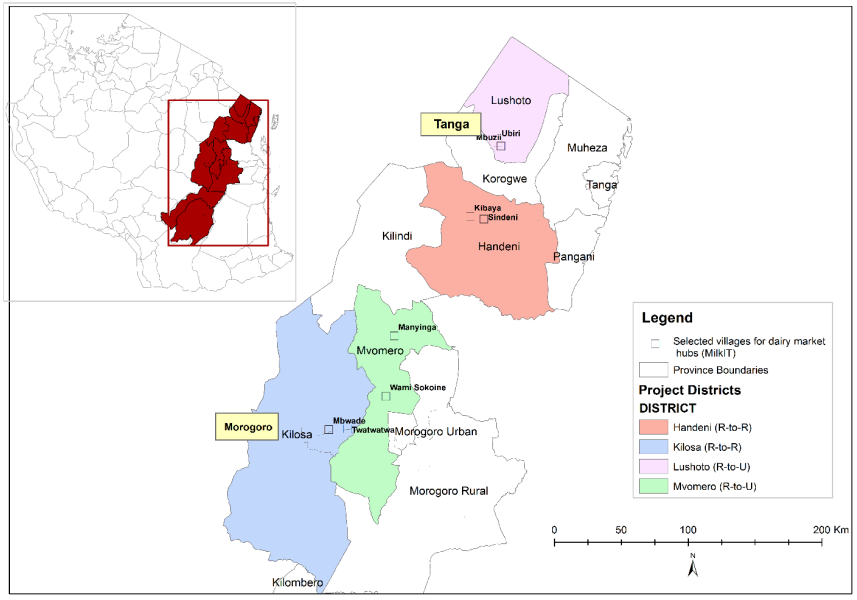


Figure 2. Tanga and Morogoro districts in Tanzania



Source: Pham et al. (2014)

The project combined a series of approaches to improve feed supply, including:

- Organizing producers with other actors in the dairy value chain into 'innovation platforms'(see Box 1)
- Applying simple diagnostic tools for feed within the broader context of the production system to guide intervention strategies
- Identifying and dealing with value chain constraints.

Box 1: MilkIT innovation platforms

MilkIT established a series of 'innovation platforms' in each country (Pham et al. 2014; Subedi et al. 2014). These are forums of different stakeholders who together want to address constraints facing the dairy value chain.

In **India**, such platforms were established in Sult block, Almora district, and Bageshwar block, Bageshwar district. These were in areas where a previous rural development programme supported by the International Fund for Agricultural Development had been active. In each district, two platforms focusing on feed were formed, each covering a cluster of four to six villages. A third platform focusing on the dairy value chain covered both village clusters in that district and involved 700–750 households.

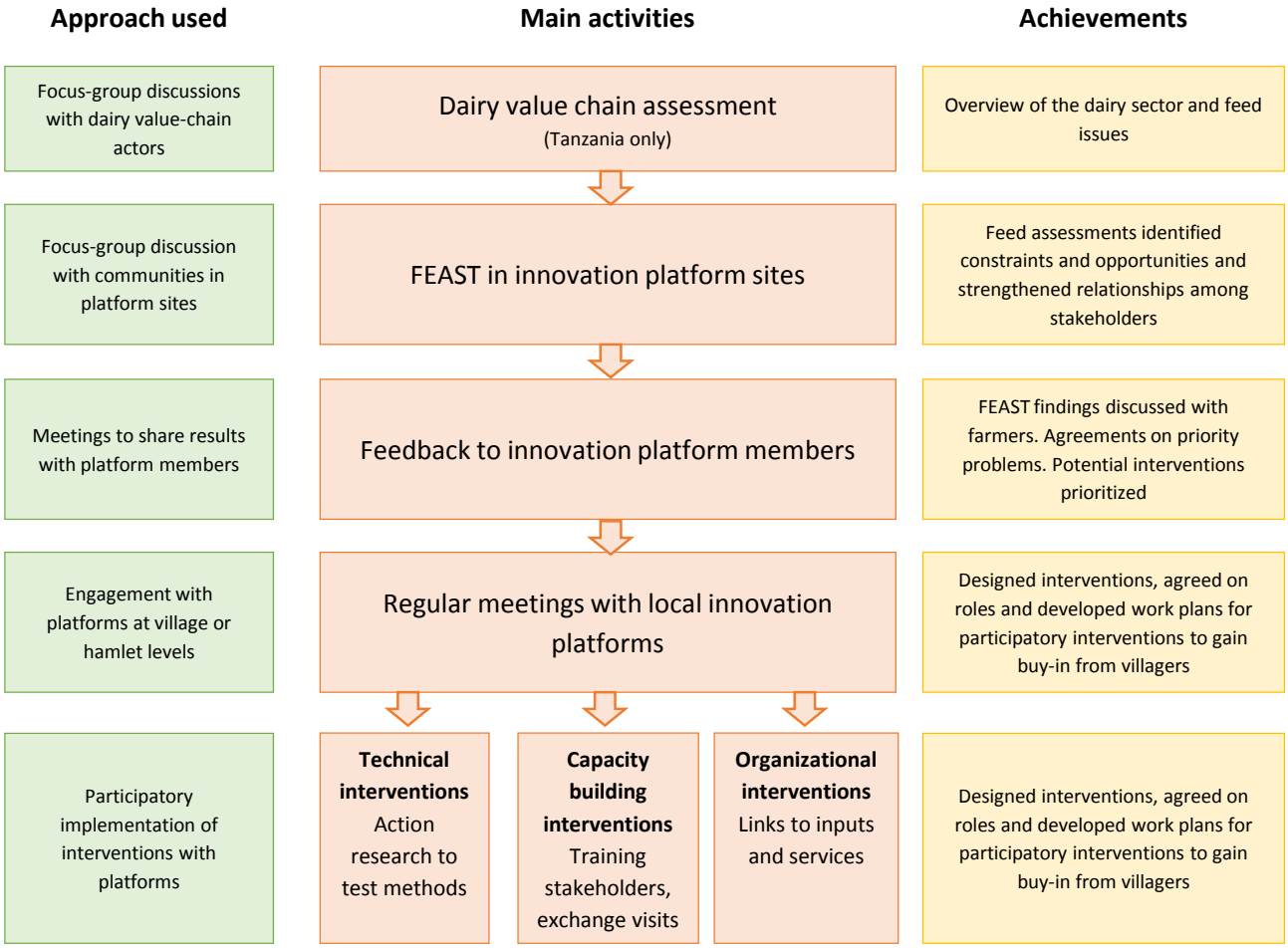
In **Tanzania**, village platforms were set up in each of eight villages selected by the MilkIT project, dispersed across Tanga and Morogoro Regions. These villages were a subset of a larger set of villages selected by the CGIAR Livestock and Fish Research Program (http://livestockfish.cgiar.org/) for start-up activities on dairy in Tanzania. The group of four village platforms per region were each connected to a regional platform. In Tanga, the existing Tanga dairy platform was used, while in Morogoro a new regional platform was established.

The project thus placed feed in a broader context. It recognized that enhancing feed supply has both technical and institutional dimensions.

Process and approach

The study followed a similar approach in the two countries, with minor differences adapted to local contexts (Figure 3).

Figure 3. The research processes in India and Tanzania



In **India**, the Feed Assessment Tool (Box 2; FEAST) was used to collect quantitative data to assess the project impact. A lot of effort went into rigorous sampling; FEAST was used in both target and control communities. This allowed the resulting data to be used as a biophysical baseline. The assessment tool was used again at the end of the project with the same households; this made it possible to assess changes in their feeding practices. Qualitative assessment using focus group discussions helped to identify the most important feed issues and initiated the discussions on how to solve them.

Box 2 - What is FEAST?

The Feed Assessment Tool (FEAST) is a rapid, systematic method to assess the availability and use of local feed resources. It helps in the design of intervention strategies that will optimize feed utilization and animal production.

FEAST differs from conventional feed assessment approaches that focus on the feeds and their nutritive value. FEAST takes a broader approach by taking account of the importance of livestock in local livelihoods, the relative importance of feed problems locally, and the local situation related to labour, input availability, credit, seasonality, and markets. The International Livestock Research Institute (ILRI) along with the International Center for Tropical Agriculture (CIAT) has been developing this tool over the past six years (Duncan et al. 2012). It has been used extensively in sites across Africa and South Asia.

In **Tanzania**, FEAST was used early in the project to characterize the livestock production system and identify the various feeding issues in the study sites. The results of the assessment were reported to the innovation platforms so they could discuss possible intervention strategies. From these discussions emerged a series of feed interventions that were then applied in the project sites. Using the assessment tool stimulated engagement with farmers and other stakeholders and built their sense of ownership for the interventions that were later tried. These interventions included improving private pastures and planting forage.

FEAST is a ready-made tool that poses questions that have been tried and tested, so it could be applied relatively quickly and easily. Although the tool was used differently in India and Tanzania, it allowed project staff and partners in both countries to quickly identify key feed issues and move forward with some practical interventions. It helped to get conversations going and engage local stakeholders in deciding on interventions.

Study sites

In **India**, the selection of study sites took into account variation in the bio-physical and socio-economic characteristics in Uttarakhand (Subedi et al. 2014). Two intervention blocks, Sult (in Almora district) and Bageshwar (in Bageshwar district), were selected based on the extent of dairying and the experience and local integration of potential project partners. Within these two districts, further data were collected on variables such as dairy animal population, cropping patterns, feed availability, accessibility to roads and linkage with dairy marketing institutions. This made it possible to select blocks that are underdeveloped but that have potential for dairying. Two clusters in each block, Baseri and Saknara in Sult, and Sainj and Joshigaon in Bageshwar containing four to six villages were selected.

In **Tanzania**, MilkIT worked with the CGIAR Research Program on Livestock and Fish, which in Tanzania focuses on developing the dairy value chain. Two regions, Tanga and Morogoro, were selected. Four districts from these regions were chosen for their potential for developing dairying and because they represented two types of value chains: those serving urban consumers, and those serving rural consumers (Pham et al. 2014).

- Two districts, Lushoto in Tanga Region and Mvomero in Morogoro Region, were chosen to represent areas where rural producers serve urban consumers. These districts are dominated by semi-intensive/intensive mixed crop-livestock systems. The four participating villages in these districts were Ubiri and Mbuzii (Lushoto district) and Wami Sokoine and Manyinga (Mvomero).
- Another two districts, Handeni in Tanga Region and Kilosa in Morogoro Region, represented areas that serve mainly rural consumers. They have mainly extensive pastoral and agro-pastoral production systems. The four villages in these districts were Kibaya and Sindeni (Handeni district) and Mbwade and Twatwatwa (Kilosa).

Identifying feed constraints in the study sites

In **India**, the innovation platforms in Sult and Bageshwar were convened in all village clusters and used FEAST to assess the feed situation. The main constraints identified in the two locations were shortages of green fodder especially in summer (May, June) and winter (December, January), a lack of concentrate, and fodder wastage. Other constraints identified in Bageshwar were the lack of knowledge on feeding dairy animals, limited artificial insemination service (especially for buffaloes), limited and low-quality grassland for grazing, and the high cost of grass sourced from other areas.

In **Tanzania**, the MilkIT project sites were included in the CGIAR Livestock and Fish Research Program. That made it possible to assess the dairy value chain as a whole.

The major constraints concerned the inefficiency of forage seed systems, inefficacy in the supply of compounded feeds, and limited access to and quality of water. However, the assessment also showed potential opportunities in the emerging feed and fodder markets. On farms, the two main constraints identified were strong seasonality effects and problems in land ownership and use.

The FEAST technique was used in the four districts to investigate major constraints to livestock production at the farm level. It identified four broad key constraints:

- Insufficient forage for livestock.
- Poor livestock housing.
- Land shortage.
- A lack of improved breeding bulls.

These topics were entry points for discussion by village innovation platforms, making it possible to explore their effects on feed availability. The platforms identified several major constraints that limited feed production:

- Strong seasonality, resulting in fluctuations in feed quality, quantity and access to drinking water over time (Figures 4 and 5).
- Overstocking by pastoral communities, resulting in degraded pastures and a lack of grazing reserves for the dry season.
- Poor quality of pasture, fodder and crop residues.
- A limited supply and access to forage seed and planting materials.

Figure 4. Feed resources and rainfall distribution in a semi-intensive and intensive system: estimated by farmers from Manyinga village, Mvomero District, Morogoro Region, Tanzania

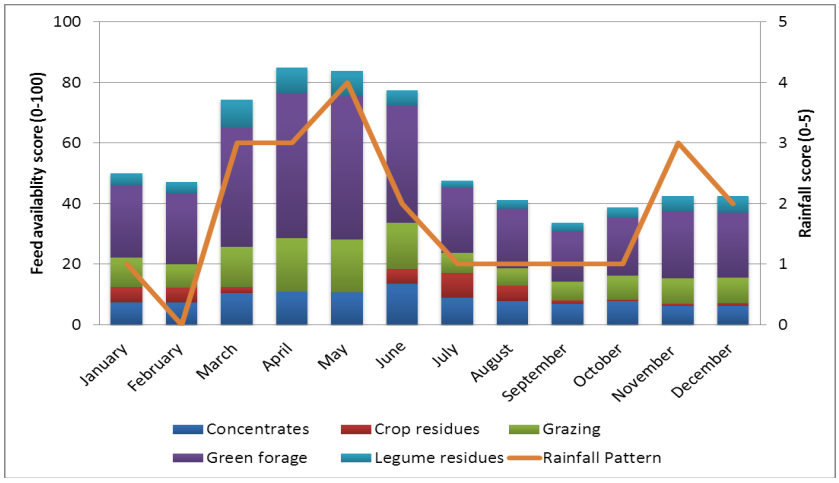
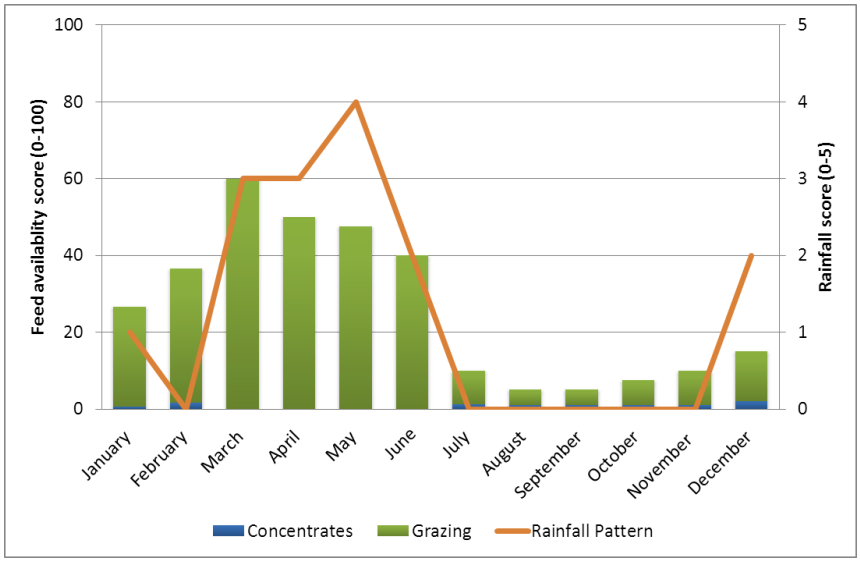


Figure 5. Feed resources and rainfall distribution in an extensive system: estimated by livestock keepers from Twatwatwa village, Kilosa District, Morogoro Region, Tanzania



Identifying feed interventions

In India, a series of village innovation platforms were convened to discuss constraints and conceptualize ideas for interventions to overcome them. The interventions that emerged are summarized in Table 1.

Table 1. Interventions emerging from feed innovation platforms in India

Intervention	Aim
Improved feed troughs	Reduce feed wastage during feeding
Dual purpose crops (winter cereals)	Increase fodder availability in winter
Fodder grasses	Increase green fodder availability in summer Increase milk production
Improved chaff cutters (smaller, women-friendly model)	Overcome problems faced by women in operating the usual mechanized, wheeled model
Training and awareness-raising on using concentrate	Encourage concentrate feeding to increase production
Establishing links with private feed companies	Increase access to and reduce cost of concentrate

In **Tanzania**, the village platforms identified various technical and capacity-development interventions to improve year-round production: The interventions that emerged are summarized in Table 2.

Table 2. Interventions emerging from village innovation platforms in Tanzania

Intervention	Aim
Introducing improved cut-and-carry forages	Improve herbage production in intensive systems
Improving agro-pastoralists' dry-season grazing reserves (locally known as *ololili*) and feed-conservation strategies	Overcome dry season feed shortages in extensive systems
Feeding adequate feed rations	Increase milk production and make use of the cattle's genetic potential
Training on feed rations, forage establishment, management and use	Encourage adoption of introduced technical interventions to increase production
Training on feed conservation	Overcome dry season feed shortages in intensive systems
Introducing new designs of cattle sheds	Improve cattle husbandry and enhance feed utilisation

Implementing interventions

Feed choppers/chaff cutters (India)

Previously, a local non-government organization in Uttarakhand had distributed hand-operated, wheeled chaff cutters to farmers. But the farmers did not use them because the cutters needed at least two people to operate. Labour is limited because many men migrate to the cities to find work, leaving the women to handle farm operations. The chaff cutters were heavy and needed a lot of strength to operate, so many women could not use them.

The innovation platforms identified the need for a low-cost, simple and easy-to-use chaff cutter. Simple chaff cutters in the form of weighted knives and mounted scythe cutters were sourced from Gandhi Ashram and Gujarat dairy cooperative (AMUL). These were tested with farmers, who found them easy to use to chop grass (Figure 6). A local entrepreneur was identified to supply the Gujarat model.

Figure 6. Demonstrating a simple chaff cutter to women in Besar Bagarh village

Improved feed troughs (India)

To reduce feed wastage on farms, the innovation platforms started participatory trials using improved feed troughs. A total of 118 farmers (80% of them women) from seven villages took part. Before the intervention, 99% of the farmers had no feed trough; they put the feed on the ground, leading to very high wastage. They were reluctant to make a trough because of the high cost: about INR 4,000 (USD 67). With help of local builders, the project designed a cheaper trough costing INR 2,000–2,500 (USD 33–42) (Figure 7). The farmers were offered a loan and subsidy through the innovation platforms to encourage them to make such troughs. The IFAD-funded Integrated Livelihood Support Programme and the National Bank for Agricultural Rural Development subsidized 60% of the cost and offered loans to cover the remaining 40%.

The farmers said the troughs reduced wastage by 20–30%, and participatory research also found that the troughs reduced fodder wastage (Table 3). Reducing wastage cut the amount of work women had to do in several ways: they had to collect less fodder from the forest, they no longer had to rearrange fodder around the animals to stop them from trampling on it and soiling it, and there was less waste fodder to clear out from the cattle sheds. Clean fodder, free of urine and dung, reduced the risk of infections (especially respiratory problems) for the animals.

Figure 7. An improved feed trough on a farm in Almora, India

Photo: IFAD, Almora

Table 3. Effects of improved feed trough on feed wastage in Uttarakhand, India

Treatment	Households	Total number of feedings observed	Mean fodder wastage (%)	S.E. for mean fodder wastage
Without feed trough	50	872	22	0.26
With improved feed trough	68	1234	11	0.06

A total of 130 farmers built the improved troughs, and another 225 farmers adopted the women-friendly feed choppers. A cost-benefit analysis of these technologies showed that they were profitable for small-scale farmers (Table 4). A promotional leaflet was developed on the improved feeding practices to create awareness in the neighbouring villages.

Table 4. Cost-benefit analysis of using improved feed troughs and choppers for five years

		INR/year
Costs		
Investment costs	Feed trough, construction cost	625
	Feed chopper	225
Recurrent costs	Maintenance, trough and chopper	300
	Labour cost for cutting chaff	1916
	Opportunity cost of using waste as compost/fertilizer	1825
Total cost		4891
Benefits		
Additional fodder gained through less wastage		3285
Labour saved for arranging fodder		1272
Reduced animal health expenses		600
Increased production		273
Total benefits		5430
Net profit for first year (benefit minus total costs)		539
Net profit for consecutive years (benefit minus recurrent costs)		1389

Improved forages (India)

The innovation platforms discussed the shortage of green fodder in summer (May/June) and winter (December/January). With help of technical experts, the farmers agreed to introduce dual-purpose crops and temperate grasses to increase green fodder in winter, and improved forages (Napier grass, setaria and berseem clover) for the summer (Table 5). The animal husbandry department of the state ministry of agriculture provided seed of temperate grasses, while Vivekananda Parvatiya Krishi Anusandhan Sansthan (a national agriculture research centre based in Uttarakhand) supplied seeds of the dual-purpose crops. Finding Napier planting materials was easy: they came from other farmers and development departments. Some farmers already had received planting materials of Napier grass from the State Animal Husbandry Department and had planted them around their fields and along roadsides and in other public places. Setaria and berseem seeds were sourced from the agricultural university at Palampur, in neighbouring Himachal Pradesh.

Table5. Fodder innovations in summer and winter, Uttarakhand, India

Winter season interventions	**Summer season interventions** (local names in parentheses)
Dual purpose crops	Temperate grasses
Wheat, *Triticum* sp.	Tall fescue, *Festuca arundinacea* (*dholni*)
Oats, *Avena sativa*	Orchard grass or cock's-foot grass, *Dactylis glomerata* (*kucchi*)
Barley, *Hordeum vulgare*	Perennial rye grass, *Lolium perenne*
	Smooth brome grass, *Bromus inermis*
	Other forages
	Setaria grass, *Setaria sphacelata* var. *anceps* (*sita grass*)
	Berseem clover, *Trifolium alexandrium*
	Napier grass, *Pennisetum purpureum*

Although seed of the dual-purpose crops cost 1.5 times more than common local crop varieties (wheat, oats and barley), farmers adopted them quickly because they could collect and sow the seed for three to five years without a significant drop in yield. Also, the dual-purpose varieties could be harvested as fodder at 79–85 days after sowing in the winter to produce bonus green fodder. The crop then re grew and was taken to maturity with no detrimental impact on final yield of grain or straw.

The forage grasses were successful only in the areas where there was enough water. The setaria grass failed to germinate in all sites, and it anyway requires a lot of water. The seed was expensive, casting doubt on its suitability in this area. Farmers also complained that the seed of the temperate grasses was expensive and it performed poorly.

Berseem clover was successful in Bageshwar, where farmers have irrigation, but failed in Sult, where access to water is limited. Farmers in Bageshwar who had crossbred cows preferred to plant more berseem because it improved milk yields. Farmers with local breeds showed less interest in planting fodder because of the cost of seed and the fact that their animals do not produce enough milk to make the investment worthwhile. Table 6 shows that farmers who had planted improved forage were able to feed their cattle for longer than the control group, who relied on local forage. Uptake of the forage depended on farmers having high-yielding animals and their benefiting in monetary terms.

Table 6. Impact of improved forage as planted fodder in Uttarakhand, India

Clusters	No. of households	Mean no. of days fed with improved forage	SE
Non-intervention clusters	96	11[1]	4
Intervention clusters	96	50[2]	8
Total	192	61	5

[1] Forage such as Napier grass collected from around wheat fields, along roadsides and other public places
[2] Improved planted forage

Linkages to improve access to concentrate feed (India)

Another initiative aimed to improve feeding practices with supplementary commercial concentrates. Concentrate is scarce and expensive in the project area because it has to be transported from far away. Demand for concentrate was higher in Bageshwar because of the high-yielding crossbred animals there. The Jeganath dairy cooperative, a group established through the innovation platform, collaborated with a private feed company to obtain concentrate in bulk at a reduced cost. This additional concentrate boosted milk production.

In Sult some farmers received subsidised concentrate from Aanchal, the state dairy cooperative, through the innovation platform. Here, however, the concentrate did not increase milk production much because most farmers there have low-yielding local breeds and little incentive to feed the concentrate. The farmers did not trust Aanchal and said that the concentrate was low quality, so they did not buy it.

Introducing and improving forages and pastures (Tanzania)

In Tanzania, different technologies were introduced in different types of production systems. In zero-grazed intensive and semi-intensive systems, the innovation platforms decided to plant improved forages on demonstration plots on selected farms. They used various combinations of improved Napier grass varieties and legumes. Fodder trees and shrubs were also planted as hedges. Groups of farmers planted the plots and learned how to establish and manage forages (Figure 8). The demonstration plots served as a source of vegetative planting materials for the platform members and as places for farmers to learn and check on the trials. Silage making was introduced as a way to conserve feed and reduce seasonal fluctuations in availability.

Figure 8. Planting forage grass on demonstration plots in Tanzania

Farmers planting Napier grass in a forage demonstration plot for cut-and-carry production, Tanga Region

Maasai agro-pastoralists planting buffel grass to improve dry-season feeding in a fenced area, Morogoro Region. Photos: F.J. Wassena (left) and W.E. Mangesho (right).

The farmers were interested in forages that produce a lot of herbage and are compatible with food crops. The demand for forage technologies had to do with the farmers' desire to overcome the scarcity of land and labour. They wanted forage technologies that fit in their existing farming systems. Farmers appreciated the new forages because they would save them the work of collecting natural forage from roadsides or fields. The number of farmers who initially received forages in early 2014 and those who had planted forages by the end of the project a year later are shown in Table 7. In Ubiri, the new forages spread rapidly: more than three times the number of farmers planted them a year later, reflecting a strong demand for more feed. In Mbuzii, the platform decided to distribute the planting materials only among its members; other farmers would get planting materials later from these members or from the demonstration plot.

Table 7. Number of farmers planting new forages at two sites in Lushoto district, Tanga, Tanzania

	Ubiri		Mbuzii	
	Early 2014	End of project	Early 2014	End of project
Women	11	38	9	9
Men	14	49	19	19
Total	25	87	28	28

Improved forages introduced:

- Both locations: Napier hybrid, Napier Kakamega II, green leaf desmodium, mulberry
- Ubiri only: Gliricidia sepium
- Mbuzii (demo plot only):Canavalia brasiliensis

A few plants of the local Napier grass used as a local check were infected with stunt disease. This underpins the importance of promoting the improved, tolerant varieties and educating farmers how to manage infected fields to reduce the spread of the disease. Diversifying with other forages would reduce reliance on Napier grass.

In extensive systems, the innovation platforms opted to improve the agro-pastoralists' dry-season grazing reserves. This is a traditional forage-conservation method used by the Maasai and other pastoralists in Tanzania (Mwilawa et al. 2008): they fence off enclosures around their homesteads (Figure 9) so they can use them during the dry season when feed is scarce, normally from August to October (Goldman et al. 2013). The enclosures are usually meant for lactating, heavily pregnant and weak animals as well as calves that are left behind when the herds migrate to greener pastures. The fences are made of traditional materials (Isinika et al. 2010). In Morogoro Region, the reserves are known by the Maasai name, ololili. Because the ololili provides pasture during extreme dry periods it helps to avoid having to graze animals on cropland, which can spark disputes between the crop growers and livestock keepers. The issue of land ownership and rights remains a thorny, unresolved issue in pastoral areas of Tanzania.

The agro-pastoralists were trained in pasture establishment, management and utilization. Buffel grass (*Cenchrus ciliaris*) and legumes were introduced to improve the quality of the conserved pastures for grazing).

Figure 9. Ololili dry-season grazing reserves in a pastoral system in Tanzania

A fenced ololili in Morogoro Region
Photos: B.L. Maass.

Outside the ololili

Adequate feed rations (Tanzania)

Farmers in Tanzania claimed low milk yields more on poor breed quality than on inadequate feeding. A study in Manyinga village, Mvomero district, investigated the idea that the lack of feed was the cause. Researchers from Sokoine University of Agriculture found that lactating cows suffered a deficit of over 30% in both metabolizable energy and crude protein—supporting the underfeeding hypothesis rather than blaming the cattle breed.

A follow-up study in the same village, coordinated by the platform leaders, checked the above issue further. Eighteen lactating cows (in their first to fourth months of lactation) were fed enough to meet their requirements for body maintenance and milk production, assuming a genetic potential of 15 litres of milk per cow per day. The owners of the cows were given training on feeding, a tape measure to estimate their animals' body weight, scales to weigh the feed, containers to measure the amount of milk produced, and additional feed supplements for their cows. As a result, the cows produced about 106% more milk—an increase from initial yield of 6.6 to 13.6 litres/cow/day. The final milk yield was 90.6% of the assumed genetic potential.

Farmers were trained on different methods of feed conservation. One was the use of a box-baler (Figure 10) to make hay from natural grass or maize stover. As a result, some farmers in Mbuzii, a village in Lushoto district, made their own baler and experimented with making hay by themselves. They also demonstrated the technology to other farmers at a district agricultural show. Cross-visits among platform members stimulated farmers in Ubiri, another village in the same district, to make their own hay balers. So far, 28 farmers in Mbuzii and 40 in Ubiri have started using this method.

Figure 10. Farmers learning how to use a hay box-baler

Photo: F.J. Wassena

To improve cattle husbandry and reduce feed wastage, farmers in Manyinga, Ubiri and Mbuzii were given designs for cattle sheds that have feed troughs and crushes to handle animals. Some 24 farmers in Manyinga and 25 in Lushoto have modified their sheds as a result.

Discussion: What worked, what did not work, and why

The importance of context

When implementing interventions, it is important to consider the context. India and Tanzania are dissimilar, and the sites within these countries had distinctive production systems and agro-ecological conditions. So the approaches used and solutions developed were different in each place. Innovation platforms were a good way to adapt to these different situations, identify entry points and develop context-specific interventions.

In **India**, the two districts had different production systems. Farmers in Bageshwar had irrigation water from local rivers, while those in Sult depended on the seasonal supply of rainwater. This influenced the adoption of feeding practices. The improved feed troughs were adopted widely in both sites, whereas improved grasses and crops were popular only in Bageshwar, where they grew well because they were irrigated. Development workers and researchers provided the required resources, technical backstopping and information to the farmers. This support proved to be a key to the success of the interventions. Marketing was the main entry point: when farmers found they could earn money, they became more interested in increasing their production, so started demanding and applying new technologies.

In **Tanzania**, the big difference was between the extensive and the intensive production systems. Agro-pastoralists in extensive systems were interested in dry-season grazing reserves; farmers in more intensive systems were interested more in planting forage crops. In both locations, production was the entry point: farmers first needed to increase their output, and so got interested in marketing.

Innovation platform participation

The types of institutions involved in an innovation platform will also depend on the context. They must be relevant to the situation. They should not be included just in order to have them there; rather, they should be able to contribute to solving the problems. Having the right stakeholders around the table is key to solving the identified problems. In both countries, it was best to start off with a lot of institutions, then to identify the main focus areas for the platform. Then only those institutions that were relevant needed to become members. As new topics emerged, other members could be brought in as required.

In India, an analysis of the history of innovation around livestock feeding in the area made it possible to select the initial participants in the platforms. In Tanzania, a stakeholder analysis helped identify the initial participants.

Topics covered

The topics identified by the innovation platforms were not obvious. For example, in Tanzania a standard research and development approach might not have identified the issue of land rights or been able to deal with it. In India, conventional approaches might not have prioritized women's difficulties in using the big chaff cutters and the lack of feed troughs. The innovation platforms identified these issues and could do something about them because they brought in the right people and institutions at the right time. They make it possible for interested stakeholders to identify issues collectively and to consider and implement solutions.

Trying things out quickly

It is best for the innovation platforms to 'get their hands dirty' quickly by trying out a range of promising technologies. Some of these will not work—so can be dropped. But other ideas that do work can be tested and adapted further. In India quite a few interventions were tested early on: planted forages did not take off, but forage choppers did. Such early 'quick and dirty' interventions build a lot of momentum that can lay the foundation for future collaboration.

Linking interventions to pull factors

Aligning or linking interventions to 'pull factors' is critical for success. In India, the project first helped the farmers to sell their milk. The chance to earn money acted as a pull factor, making them interested in investing in productivity. Farmers in Bageshwar became interested in feeding with concentrates, investing in feed troughs and chaff cutters, and improving their breeds once they had got together as groups to sell their milk in the nearby town for a higher price. The institutional improvement in market linkages was important in enhancing productivity.

In Manyinga, the producers received the highest milk prices of the eight villages in Tanzania. Demand was there, and therefore the opportunity to produce more and sell it. This was much less the case in Lushoto district, where producers depended more on the prices set by the only milk factory—Tanga Fresh.

Multiple interventions

In the semi-intensive/intensive systems in Lushoto and Manyinga, improving feeds and feeding practices may have the biggest direct impact on livestock performance. But such improvements have to be aligned with other interventions such as general husbandry, especially housing and feed troughs to avoid feed wastage and related health issues. Animal houses in Tanzania are often very poor, making them difficult to clean and lowering the animals' performance. Poor feed troughs result in a lot of waste. The innovation platforms provided a means to train smallholders on general husbandry and improved structures. In Handeni, some farmers upgraded their cow sheds after they were given improved designs and some training. In Manyinga, all 24 farmer members of the innovation platform modified their cattle sheds and feed troughs.

Seed supplies

The lack of improved seed and other planting materials was a serious constraint in both countries. A shortage of seed meant it was not possible to expand legume growing in Tanzania. A lack of good-quality planting materials at the right time resulted in the poor establishment of fodder crops. The shortages seem to be because of poor coordination in the supply chain, discouraging potential adopters from taking up the technology. Similarly, the high cost of seed and low germination rates hindered the adoption of improved forages in India. Clearly, such constraints need to be overcome to increase farmers' use of forages in both countries.

Demonstration plots

When they visited the forage demonstration plots, the pastoralists in Handeni district in Tanzania had difficulty appreciating the benefits they might obtain: the plots were too small to be of much use to them. In India, financial constraints meant that the research institutions were able to offer only limited technical support in the field. The demonstration plots were also small as a result. This underscores two important points:

- The objective of demonstration plots needs to be clearly explained to innovation platform members beforehand.
- It is important to consider the size of demonstration plots carefully so they can show benefits and catalyse adoption.

In areas where land is a constraint, it might be sensible to use small demonstration plots. But where land is not limiting, it might be advisable to use larger plots that producers can relate to in terms of benefits in feeding cattle. For example, in Handeni district, producers harvested grass from demonstration plots, made hay using a box baler, and fed it to their animals. Such hands-on practice is likely to result in more adoption than if the farmers had no such experience.

The location of some demonstration plots hindered producers from learning about the technologies or feeling they were relevant for them. In one case in Morogoro, demonstration plots were sited on a large-scale commercial farm, forcing the producers to be ferried there. The contrast between the demonstration site location and their own situation meant that small-scale livestock keepers felt the technologies might not apply to them.

Tanzanian pastoralists rarely cultivate land themselves (Goldman et al. 2013): they often rely on hired labour for land preparation, planting and weeding. Where trials were set up on individually owned land, the owner got other members of the innovation platform to help with tasks such as fencing. But where the trials were set up on communal land (for example in Mbwade village in Mvomero district), no one felt responsible for maintaining the plots or for preventing goats and sheep from grazing there. In the ololili dry-season reserves, uncontrolled, illegal grazing was the most important challenge, especially for women-headed households. In Handeni, platform members decided to move a demo plot that had been invaded to another site that was more controllable.

Innovation platform organization

The MilkIT project brought into focus the issue of sustainability of technologies and the innovation platform approach itself. In both countries, participating institutions seemed to concentrate on disseminating the technologies emerging from the innovation platforms, rather than embracing both the technologies and the innovation platform approach itself. This was attributed to institutional priorities and mandates. In India some issues could not be addressed in the project's short time frame. For example, researchers were not interested in addressing grassland improvement because of their own institutional priorities. In Tanzania, the national research partner could not intervene in matters concerning land rights and conflicts because these were not part of its mandate. Organizations that might have been able to act were not represented locally; they were located at a higher regional or national level. Solutions to some problems may not be found among the members of the innovation platform; it may be necessary to involve other actors at higher levels.

Summary

Feed interventions often do not work due to the 'top-down' approach and blanket promotion irrespective of the context. The MilkIT project's innovation platforms demonstrated a new way of addressing feed issues. Rapid assessments and the platform discussions ensured producers were strongly engaged in designing and implementing interventions. Participatory action research and training helped to address the problems identified, while the action research centred on introducing improved forages, pasture improvement, reducing feed wastage, feeding adequate rations, and feed conservation. Producers tested different practices, while local researchers monitored the trials.

The types of institutions and actors involved in an innovation platform will depend on the particular situation. Innovation platforms may identify issues that a standard research and development approach might not. The entry points will depend on the situation and on the needs of the platform members. It may be important to link interventions to 'pull factors' such as markets. As solutions emerge and are tested and accepted, their sustainability must be considered: the trials must be located in the right place, and local communities (and especially women) must have ownership of the process.

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