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An approach to select locally appropriate feed technologies to support livestock intensification—An impact narrative from Uttarakhand, India

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This is one of seven briefs from the Enhancing Livelihoods through Livestock Knowledge Systems (ELKS) partnership program in India. It sets out an impact narrative for different interventions, showing how project activities are translating research outputs to development outcomes.

Introduction

In Uttarakhand where smallholder mixed farming is the mainstay of livestock production, feed is one of the most limiting constraints to intensification, particularly of large ruminants such as cattle and buffaloes. Presently, feed is obtained from a wide range of sources: crop residues, grazing on common and private lands and agricultural fallows, forages collected from forests, cultivated fodder crops and bought-in concentrates. Inadequacy of feed can be manifest as year-round lack of feed of the right quality and/or in the right quantity, or seasonal shortages.

Although many nutritional technologies are available to improve the quantity and quality of feed and fodder, or plug seasonal shortages, farmers seldom use them. The reasons for this include: women, who rear the animals, are already fully loaded with existing work; farmers lack access to credit for feed-based investments; the absence of required inputs; the economic benefit due to the change in feeding is too low to justify the required investment in cash and labour; and uncertainty as to which is the most appropriate technology for any given situation.

However, the fast growth in the demand of animal source foods especially milk, provides excellent opportunities for poor smallholders to invest in livestock production for the betterment of their livelihoods. Feed being the most limiting constraint, the problems related to non-adoption of better feed strategies are critical.

One approach is to select feed technologies and interventions in a more systematic manner-based on careful assessment of technical, institutional, social and economic parameters. This paper discusses such a systematic approach that can help farmer-based organizations, development agencies and government departments to make better decisions on feed interventions/investments.

This work is based on field research by ILRI scientists and partners through various projects, including the TATA–ILRI partnership program implemented in Uttarakhand. A set of simple spreadsheet-based tools has been developed that combine built-in expert knowledge about more than 50 different feed technologies with information about the local context. By matching the attributes of the technologies available in terms of land, water, labour, cash/credit, inputs and level of knowledge required for their successful adoption with the local availability of these parameters, a shortlist of the most appropriate technologies is generated. The combination of expert and local knowledge provides a powerful and cost-effective approach to make more informed decisions about the most appropriate feed technologies that could benefit local livestock keepers.

The different steps involved in the process—feed resource assessment, identification of nutritional gap, technology prioritization and cost–benefit analysis—are detailed below:

1. Feed resource assessment

The availability of various feedstuffs in a given location can be roughly estimated using a tool called the Feed Assessment Tool/FEAST (www.ilri.org/feast), developed by ILRI and CIAT scientists. The tool comprises of:

- A focused participatory rural appraisal (PRA) exercise to collect information from a group of farmers
- A quantitative questionnaire to collect information from 9–10 experienced farmers.

To analyse the feed situation, data collected from the PRA and quantitative questionnaire are entered in a macro-driven Excel worksheet. Output from FEAST consists of a short report with information on:

- farming system
- livestock production system/commodity
- availability of breeding and health care facilities
- delivery mechanisms available for input/services
- market potential (of livestock products)
- type of feeds available in the three seasons in the locality
- quantity, surplus/deficit of the feeds available (season wise)
- purchased feeds, quantity and price (season wise
- availability of land and water for additional fodder production, required, if any (score)
- availability of additional household labour, required, if any (score)
- credit facility (feed purchase, animal loan) available (score)
- availability of feed inputs (score)
- knowledge level of farmers on feeds and fodder (score).

2. Identification of nutritional gaps

If a more detailed understanding of the feed gap in terms of dry matter (DM), energy (ME) and protein (CP) is needed, then a nutritional gap analysis can also be carried out (otherwise move to step 3, technology prioritization). For this exercise, the nutritional status of animals is first estimated.

About 5–10 cows/buffaloes at the same stage of lactation are identified and the quantity of various feeds offered per day weighed and recorded. The quantity of milk produced in the same day together with its fat content also needs to be measured. Samples of feeds and fodder offered to the animals are collected and analysed in a nutritional lab; alternatively, if nutritional information is available 'book values' can be obtained from standard tables. The data is then entered in a user-friendly Excel sheet and analysed. This will give a general idea about the nutritional status of animals.

To estimate the nutritional requirement, first the body weight of each of the animals should be estimated. This can be done using the formula $W = (G2 \times L) \times 0.45$ (where W = weight in kg, G = heart girth in inches and L = length from the point of shoulder to the point of pin bone in inches). Dry matter and nutritional requirement of the same breed in the same environment for the estimated body weight under optimum feeding situation may be taken from a standard textbook, such as Ranjhan 1998[1]. The difference between the required and available nutrients will be the gap. An example is given in Table 1.

To find out the seasonal variation of the nutritional gap, the same exercise needs to be repeated with same animals in the three seasons: summer (April–June), monsoon (July–October) and winter (November–March). This analysis will help in identifying the right technology to fill the shortage of dry matter and nutrients.

However, it is acknowledged that accurate estimation of feed intake by the above method is difficult. As there is close link between productivity and nutrient intake, one can also estimate the gap by backward calculation if the production per animal per day is known. But this will not help to understand what nutrient is in short supply and whether there is overfeeding of any of the nutrients or not.

1. Ranjhan, S.K, 1998. Nutrient requirement of livestock and poultry. New Delhi, India: Indian Council of Agricultural Research.

Table 1: Nutritional gap of lactating buffaloes

				Nutrient requirement			Nutrient supplied			Deficit (%)		
Buffalo No.	Body weight (kg)	Milk yield (kg/d)	Fat (%)	DM (kg/d)	CP (g/d)	ME (Mcal/d)	DMI (kg/d)	CPI (g/d)	MEI (Mcal/d)	DM (%)	CP (%)	ME (%)
1	500	8.25	9.40	12.75	1737	32.02	10.81	1456	27.80	15.22	16.20	27.36
2	500	8.56	8.17	12.50	1659	30.75	9.01	1246	19.28	27.90	24.90	37.28
3	510	8.50	5.00	12.50	1436	26.10	8.77	778	16.80	29.83	45.80	35.62
4	640	8.50	7.80	12.75	1641	30.44	13.21	1245	24.92	–3.63	24.13	18.14
5	510	9.00	7.90	16.00	1835	33.29	13.90	1287	27.99	13.10	29.88	15.92
Average	532	8.562	7.654	13.3	1661.6	30.52	11.141	1202	23.359	16.5	28.2	26.9

More on the tools

The FEAST methodology comprises a guide and questionnaire, a data template, and a data template manual. These can be downloaded from http://ilri.org/feast-methodology. The TechFit tool and its various filters are under development and can be downloaded from the project workspace at http://techfit.wikispaces.com.

3. Technology prioritization

In the past, conventional research has tended to focus on technologies in isolation, without looking at 'enabling factors' that are required for successful adoption. Many researchers are wedded to certain technologies, which they are either exposed to or have worked on throughout their careers: they tend to promote these for field implementation without always looking at the economic, social and gender implications of their application. Experience tells us that, despite some successes, many of the technologies developed remained in the research stations with little impact in the field.

Realizing this limitation, the International Livestock Research Institute has developed a tool called TECHFIT (http://fodderadoption.wordpress.com/tag/techfit/) to screen technologies using an Excel-based TechFit Score sheet. It starts with a Universal Score Sheet, in which scores are to be entered on (1) core feed issue (2) applicable commodity (3) applicable farming system and (4) context, based on information gathered in FEAST.

- As a first step, in the Universal Score Sheet, scores from '0' to '4' ('0' means none; '4' means very high) are entered against core feed issues such as seasonal scarcity, overall shortage and quality.
- Secondly, score '0' (applicable) or '1' (not applicable) are entered against the commodity (cattle breeding or cattle fattening or dairy or others).
- Thirdly, score '0' (applicable) or '1' (not applicable) are entered against the farming system (pastoral, agropastoral, mixed, intensive).
- In another sheet (Context Score Sheet) scores are entered from '0' (low) to '4' (high) under two categories (farmers' score and experts' score) against availability of six technology attributes (land, water, labour, cash/credit, input and knowledge), based on information gathered in FEAST.

Once the above two score sheets (Universal and Context) are scored using information from FEAST, the system will automatically compute a total score for each of the feed interventions in the TechFit Score Sheet (Table 2), where almost 50 interventions are given.

The system calculates the total score by considering:

(1) Experts' score on:

- potential of the intervention to mitigate the feed issues
- applicability to commodity
- applicability to farming system
- technology requirement for land/water/labour/cash/inputs/knowledge
- potential to impact production

(2) Context score on:

- core feed issue
- applicability to commodity
- applicability to farming system
- availability of land/labour/cash/inputs/knowledge

(3) Weighting for:

- core feed issue
- commodity
- farming system
- attributes (land/water/labour/cash/inputs/knowledge)
- potential to impact production

Table 2: Sample TechFit scoresheet (dairy animals in mixed farming system)

Feed intervention/ technology	Potential to mitigate core feed constraint	How relevant to commodity	How relevant to farming system	How closely intervention matches context attributes	Potential production impact	Total score	Rank
	Total score						
Machine operated—chaff cutter	0.45	4	4	4	1.5	43.2	39
Manual (hand) operated—CC	0.45	4	4	6.2	1.5	66.96	36
Chemical treatment of crop residues (e.g. urea treatment)	0.90	3	2	4	3	64.8	37
Grasses—for cut and carry systems	6.15	4	4	5.1	6	3011.04	1
Soaking in water	0.45	3	1	5.7	1.5	11.5425	41
Wet by-products—horticultural waste, pineapple/citrus waste	2.70	4	4	4.8	3	622.08	25
Distillers and brewers' waste—local and industrial	4.35	4	4	4.8	4.5	1503.36	11
Enset/banana leaves	3.30	4	4	5.8	3	918.72	23
Fodder trees and shrubs	5.40	4	4	4.9	4.5	1905.12	5
Cereal by-products—rice bran, maize, wheat etc.)	3.75	4	4	4.4	6	1584	10
Supplementation using protein by-products	4.20	4	4	3.3	6	1330.56	13

By looking at the total scores, the top ranked five or six technologies are subjected to a cost–benefit analysis. Based on this, one or two most appropriate, cost-effective technologies for the local context are taken into further action research approaches with communities to ensure they suit local agro-ecological and socio-economic contexts.

Cost–benefit analysis

To calculate costs and benefits a simple Excel format can be used. Costs consist of expenses incurred minus costs saved because of the technology use. Similarly, benefits consist of income earned minus income forgone (see Table 3).

Table 3: Calculation of costs and benefits of feed-based intervention

Costs	Qty	Price	Total	Benefits	Qty	Price	Total
1. Costs added				1. Income earned			
Land				Change in productivity (milk, weight gain)			
Labour							
Inputs				Change in reproductive efficiency (calves, litter size)			
Energy (fuel, electricity)							
Equipment							
Transport				Change in mortality			
Water				Change in quality			
Other				Other			
Total				Total			
2. Income foregone				2. Costs saved			
Reduced price				Labour			
Reduced quality/quantity				Inputs quality/quantity			
Other				Other			
Total				Total			
Costs grant total				Income grant total			
Cost–benefit ratio							

Conclusion

In commercial production, large-scale livestock farmers are able to access technologies and can take risks, but the smallholder context is very different. The analytical framework suggested in this paper to identify the best-fit feed interventions in a given context has been successfully tried out in different project locations including Uttarakhand. This approach is aimed at research and development practitioners who work in the smallholder livestock sector and need a more systematic means to identify feed-based solution to benefit their clients.

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ELKS aims to support SRTT and its Allied Trusts and their partners to enhance their capacities to improve livestock-based livelihoods in the hilly/tribal areas in Nagaland, Mizoram, Arunachal Pradesh, Uttarakhand and Jharkhand by (1) conducting research to fill technical knowledge gaps, (2) strengthening institutional mechanisms and (3) facilitating pro-poor policies.

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