Green fodder from dual-purpose wheat—An impact narrative from Uttarakhand, India

V. Padmakumar, Purvi Mehta Bhatt and Keith R. Sones

Introduction

In the hilly areas of Uttarakhand state in India, a typical farming household has one or two cows, one buffalo and a bullock, and cultivates cereals and vegetables on tiny terraced plots. Livestock make important contributions to livelihoods but providing sufficient feed for them continues to remain a challenge, especially during the winter months.

A simple new technique using new varieties of cereals as dual purpose crops has recently been tested and shown to be capable of providing nutritious green fodder in January, when it is most needed, with no detrimental impact on the eventual grain and straw yields. This new approach can provide a welcome boost to food for people and feed for livestock.

The work, described below, which explored the potential of dual purpose crops, has been done under the auspices of the TATA–ILRI ELKS program. ELKS (Enhancing Livelihoods through Livestock Knowledge Systems) is a partnership between the Navajbai Ratan Tata Trust and the International Livestock Research Institute (ILRI). It aims to put the accumulated knowledge of advanced international livestock research directly to use by disadvantaged animal keeping communities in rural India. The partners involved in this work are the Cereal Systems Initiative for South Asia (CSISA), Vivekananda Parvatiya Krishi Anusandhan Sansthan (VPKAS), the Indian Council of Agricultural Research (Almora), the Directorate of Wheat Research (Karnal) and ILRI.

The problem

Much of Uttarakhand state consists of hilly terrain: more than 90% of the land is mountainous and two-third covered in forest. Just 16% of the state’s land area of 53,484 km\(^2\) is cultivated; of the cultivated land, just 14% is found in the hilly areas. Irrigation water is limited and more than half the land relies on rainfed agriculture.

Mixed crop–livestock farming systems predominate: arable agriculture is limited to valleys and small terraced plots where barley and wheat are the main winter crops. Livestock make a significant contribution to livelihoods, with animal traction, manure and milk production all important.

Farm sizes are small, typically less than one hectare per family of which around 0.1 hectare is allocated to wheat. On average each household has one to two cows, one buffalo and one ox, which are usually housed and their fodder is cut and carried. Major sources of fodder include leaves and grasses collected from the forest and crop residues, with very little use of purchased concentrates. Small farm size tends to preclude cultivation of specialized fodder crops.
Fodder is abundant in the forest during and after the monsoon season (June to November). During the monsoon season women spend up to five hours a day collecting a wide variety of tree leaves and grasses from the forest. Collecting fodder from the forest is time consuming and gruelling work, and it can also be dangerous as the women often climb trees to top the most succulent leaves and stems.

It also has environmental implications as fodder collection is a leading cause of deforestation and forest degradation in these areas. During the winter (December to March), however, tree leaves are not available in the deciduous forests. Important cereal crops in these hilly regions include wheat and barley; straw from these cereals forms an important source of fodder. During the winter, straw, which contains relatively low levels of energy and protein, can constitute up to 70% of the feed.

According to the 2003 census, Uttarakhand state has a population of 21.9 million cattle and 12.3 million buffaloes; in 2011 the human population was just over 10 million. It has been calculated that the annual requirement of green and dry fodder by these livestock is 19.78 million tonnes and 5.43 million tonnes respectively (total 9.39 million tonnes dry matter), while the total supply is 8.29 million tonnes of green fodder and 4.26 million tonnes of dry fodder (5.92 million tonnes dry matter). The total supply therefore represents only 63% of the amount required (in terms of dry matter)—an annual shortfall of 3.5 million tonnes of dry matter.

Careful analysis of the availability and quality of feed available during summer (March to June), the rainy (monsoon) season and winter has shown that cattle and buffalo are underfed in terms of quantity and quality year-round. During the winter months, when tree leaves are not available, there is a severe shortage of green fodder and livestock diets were shown to be especially deficient in dry matter, energy and protein. Feeding rations deficient in dry matter, energy and protein impose acute nutritional stress on the animals and severely limits their productivity: growth rates of young animals are reduced, milk yields low and the capacity to work limited. Ideally, what is needed is an inexpensive, locally available feed that is more nutritionally dense like straw, that can help make up the winter deficit in energy and protein.

How it was addressed

Wheat is the main winter crop cultivated in hilly areas of Uttarakhand. The grain produced makes an important contribution to household diets and the straw is a major source of roughage for cattle and buffaloes during the winter when green fodder is largely unavailable.

In other states in India and beyond, introduction and use of dual purpose crops, which are purposefully bred to prioritize both grain for human consumption as well as fodder for livestock, has proven to be a successful strategy.

Trials were therefore conducted under the aegis of the ELKS project to test whether local and improved varieties of wheat could be managed so as to produce an additional output—green fodder.

It has been shown elsewhere that if wheat or barley is cut close to the ground before the second leaf node develops, that is between 60 and 85 days after sowing, the crop will grow back and go on to produce a grain yield similar to uncut crops. The green fodder harvested is a bonus, over and above the grain and straw produced under conventional husbandry practices.

To test this approach under local conditions, trials were undertaken in farmers' fields in villages in Tehri district (situated at 975 metres above sea level, masl) and Pithoragarh district (1500–1550 masl).

In both districts, local and an improved variety (VL829) of wheat were compared together with a number of soil fertility management options, such as application of nitrogen-rich chemical fertilizer (urea) or farm yard manure after the green fodder cut, and intercropping wheat with a locally grown nitrogen-fixing legume (berseem, a type of clover). For the trials, just a small proportion of the total wheat field was used. The results of the trial are summarized in Table 1.

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Tehri district</th>
<th>Pithoragarh district</th>
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<tbody>
<tr>
<td>Grain and straw yields</td>
<td>No significant impact irrespective of varieties</td>
<td>No significant impact on grain yield irrespective of varieties</td>
</tr>
<tr>
<td></td>
<td>But improved tended to yield more grain and straw</td>
<td>Significant impact on straw yield (1.5 t/ha more) in improved variety</td>
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<tr>
<td>Green fodder yield</td>
<td>1.73 t/ha (local variety)</td>
<td>2.36 t/ha (local variety)</td>
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<td></td>
<td>2.75 t/ha (improved variety)</td>
<td>1.70 t/ha (improved variety)</td>
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<tr>
<td>Soil fertility management</td>
<td>No significant impact irrespective of varieties</td>
<td>No significant impact irrespective of varieties</td>
</tr>
<tr>
<td></td>
<td>But improved tended to yield more grain and straw when sown with berseem and local with urea application</td>
<td>But improved tended to yield more fodder, grain and straw when farmyard manure was applied and local with urea application</td>
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</tbody>
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2. The improved variety VL829, released by VPKAS, is recommended for the hills of Uttarakhand up to 2000 masl for early sown rainfed conditions.
The overall conclusion in both districts is therefore that under irrigated fields, cutting green fodder from the wheat crop at between 79 to 85 days after sowing can be recommended to farmers because it produces bonus green fodder with no detrimental impact on yield of grain or straw (in rainfed situation, one critical irrigation, 30 days after sowing is essential for vigorous vegetative growth). It may also be worth adopting the improved varieties. Further, sowing berseem (25 kg/ha) along with wheat or application of urea (100 kg/ha) or farmyard manure (6 t/ha) will be desirable to compensate extra mining of soil nutrients by the crop to produce the additional green fodder of more than 2 t/ha.

Impact

For an average household in Tehri which cultivates 0.1 ha of land, assuming all this land was allocated to wheat and the improved variety was sown with best soil management option (sowing wheat with berseem application of urea and farmyard manure), 320 kg of green fodder, 532 kg of grain and 370 kg straw would be harvested. The green fodder is a bonus; fed at a rate of 10 kg/cow, buffalo or bullock per day to supplement straw, this would provide more than one month’s green fodder for one animal—with no detrimental impact on the harvest of grain or straw on the crop cultivated.

An earlier study undertaken by the National Dairy Research Institute assessed the nutritional value of wheat fodder. The researchers concluded that wheat fodder had a nutritional value similar to a good quality concentrate, such as mustard cake. They suggested that feeding 10 kg/day (fresh weight) of wheat fodder was a good source of nitrogen which would improve utilization of lower quality roughages such as straw and coarse grasses. This would support milk production of up to 5 kg/day in cows.

To produce the green fodder requires some additional labour. The green fodder is cut by hand and then needs to be carried to where the livestock are housed, which is usually close to the homestead. Traditionally this sort of work is done by women who work together in groups on each other’s plots. Even women who have not adopted the green fodder cut for their own plots reported that they were happy to help their extended family members and neighbours to cut their crops. The additional labour needed does not therefore appear to be a problem in the local context.

Having a source of good quality green fodder available on the farm during the winter would reduce the need to collect coarse grasses and other types of fodder from forests. In addition to reducing women’s workload, this also has the benefit of reducing the impact of fodder collection on forests, which can cause environmental degradation.

Introducing improved varieties of wheat also offer the potential for farmers to achieve higher yields.

Scaling out

Based on the encouraging results from the trial, the ELKS project team held a series of promotional seminars and produced printed literature and posters, and made a short film demonstrating the benefits of cutting green fodder. This led to around 600 farmers purchasing the improved dual-purpose wheat seed which they sowed in October–November 2012.

To enable more farmers to learn about this promising technology, a broader communication campaign is needed using a wider range of media and formats, including mass media such as radio and television. Local agrodealers also need to be recruited and trained in the green fodder method so they can not only stock seed of the improved varieties but also advise farmers how to get the best out of their investment.

The vast majority of seed used in Uttarakhand is farmer-saved. As the improved wheat varieties are non-hybrid, open pollinated varieties and the green fodder cutting approach is a simple technology that needs no additional inputs except labour, this approach is very amenable to farmer-to-farmer promotion. As farmers witness their neighbours cutting green fodder and feeding this to their animals they can readily adopt the technology themselves, either using local varieties or obtaining some improved seed from their neighbours. If permitted, farmers could produce and sell seed of the improved variety as an income generating activity. Farmers could also carry out simple trials on their farms by comparing plots with and without green fodder cutting under their own conditions. In this way they can test the technology with little or no risk before deciding whether to apply this approach to their entire wheat crop.

Although in the trial the different soil fertility management options did not result in significantly improved yields, continuous cultivation without addressing soil nutrients is likely to lead to gradually declining yields and long-term decline in soil fertility. Farmers should therefore be encouraged to practice integrated soil fertility management such as by intercropping wheat and berseem and/or applying urea or farmyard manure after the green fodder cut.

Policy requirements
Wheat is the most important crop cultivated during the winter in hilly areas of Uttarakhand. At its simplest the technology involves cutting local varieties of wheat 79–85 days after sowing and feeding the resulting green fodder to cattle and buffaloes. The use of improved varieties of wheat released by the local agricultural research institute combined with the green fodder cutting approach enables the benefits of the improved varieties to be enjoyed. So, no new policies are needed to support the adoption of this technology.

Potential impact and coverage
Currently there is an annual deficit of 3.5 million tonnes of dry matter for the entire Uttarakhand. The total area under wheat crop in Uttarakhand was about 370,000 ha in 2011–12. If all the state’s wheat farmers adopted the green fodder method using the improved variety, it would produce an additional 740,000 t of green fodder (148,000 t dry matter/year), which would make a useful contribution to filling the fodder deficit and improving the nutrition of cattle and buffaloes during the winter. In other words, the additional quantity of fodder produced will have 1.18 billion Mega Joules of metabolizable energy (at 8000 MJ/tonne dry matter) that can produce 236,800 t of additional milk (5 MJ metabolisable energy to produce 1 kg milk), worth 5.92 billion Indian rupees (INR). 4

India is the world’s second biggest wheat producer: in 2011/12, 95 million tonnes was harvested. There is therefore huge potential to promote the green fodder cutting technology more widely in the country, which could have a huge impact on fodder availability, and hence on livestock production during the winter.

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Enhancing Livelihoods through Livestock Knowledge Systems (ELKS) is a partnership program between Sir Ratan Tata Trust and its Allied Trusts (SRTT) and the International Livestock Research Institute (ILRI). This is an ambitious initiative to generate new livestock knowledge and put the accumulated knowledge directly to use by disadvantaged livestock rearing communities in rural India.

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.

4. USD 1 = INR 62.0225 at 27 February 2014.