

A Spatial Study on Fodder Markets in Nalanda, Gaya districts of Bihar in India

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Summary

Nalanda and Gaya, districts selected sites for dairy value chain program in Bihar State, were in South region of Bihar and both were agrarian districts. Rice and wheat were the main crops grown with cropping intensity of 150 and 139 per cent in Nalanda and Gaya districts. Quantification of fodder resources indicated that rice and wheat straw represents 52.2, 20.4 and 67.0 and 33.4% of the total crop residues available in Nalanda and Gaya districts, respectively. Both the districts were surplus in fodder and exporting paddy and wheat straw to North Bihar and Jharkhand State besides serving the local market needs. Chaffed paddy straw and wheat straw were locally called as paddy kutti and wheat bhoosa. Spatial study on fodder markets revealed the existence of rural, export, import and urban fodder markets in Bihar. The actors found along the fodder market value chain were agricultural farmers, rural, import and urban market agents, rural, urban, export and import market traders, retailers and dairy farmers. Role of each actor were defined in the report. Farmers were paid ₹ 2000 and 2500/t for paddy and wheat straw during the season by the rural agents who supplies fodder to export and urban market traders. During unseason if farmers sell paddy and wheat straw, they get ₹ 400-1000 more for paddy and ₹ 500-1000 more for wheat straw irrespective of type of fodder market.

Rural fodder market traders found in Jahanabad and Raghobpur villages of Bihar were trading paddy and wheat straw. They procure paddy straw and wheat bhoosa either directly from the farmers or through rural agents at ₹ 2000-3000 and 2500-3500/t and sell by keeping a margin of ₹1000 and 2000/t, with daily sale of 0.2 to 2.0 and 0.4 to 1.2 t, respectively. Paddy straw was traded at the same price with or without chaffing.

The price of paddy and wheat straw becomes 3 and 2.2 times by the time they reaches the dairy farmer through the actors in the export fodder market value chain. Transport cost was the single largest contributor for the price increase of paddy kutti (30.5%) and wheat bhoosa (23.3%) and lowest contributors were fuel cost for chaffing (2.3%) and rural agent margin (5.7%) for paddy kutti and wheat bhoosa, respectively along the value chain. Transport, labor and fuel cost put together accounts for 52.7 and 40 percent and agents (rural and import market), traders (export and import market) and retailers margin accounts for 47.3 and 60 percent increase in paddy kutti and wheat bhoosa price, respectively along the fodder value chain. Anecdotal evidence suggest about 87,500 t of paddy kutti and 45,600 t of wheat bhoosa were exported in a year from Nalanda and Gaya district fodder market zones to North Bihar and Jharkhand State which constitutes to 9.8 and 11.5 percent, respectively of paddy and wheat straw produced in both the districts.

Urban fodder markets were found in Chitkohra, Babu Bazar, Alakapur and Gardhani Bag area of Patna city (capital of Bihar) to which either farmers directly or rural agents supply the paddy straw, chaffed wheat and lentil bhoosa to the urban traders. Chaffed lentil straw was sold at higher price (90-100%) than paddy and wheat straw probably because of its high nutritional quality. The traders sell chaffed paddy, wheat and lentil straw by keeping a margin of 22 – 52 percent which includes, labor, processing and rent cost. Daily sale ranges from 80-800 kg by each trader in Patna urban market. Economic analysis of a paddy kutti trader in urban market revealed a monthly income of ₹ 16,260/-.

Laboratory analysis of chaffed paddy, wheat and lentil straw revealed *in vitro* organic matter digestibility (IVOMD) variation of 3.2, 5.4 and 11.6 percentage units, respectively but no price premiums were observed in the fodder markets for straw cultivars with higher IVOMD. Feed ingredients and commercially compounded feeds were marketed in rural and urban fodder markets of Bihar State. Oil cakes were traded at higher price in the market than other feed ingredients (energy supplements, basal feeds) and the most commonly traded oil cake was mustard. Nutrition quality of feed ingredients and commercially compounded feeds were reported. The protein content of commercially compounded feed was similar to labelled value for most of the feeds but energy content was not which needs attention.

Background

International Livestock research Institute (ILRI) had identified Bihar state for dairy value chain project under Livestock and fish (CRP 3.7) program based on socio-economic indicators for improving the dairy based livelihoods. Nalanda and Gaya districts were identified for initiation of the dairy value chain program in Bihar district. Scoping study in these two districts indicated the existence of crop residue based fodder markets. Both districts which were in Southern Bihar were surplus in crop residues and exporting to the deficit districts in North Bihar and Jharkhand state.

Geographical area, GPS coordinates and land utilization pattern in Nalanda and Gaya districts were described in Table 1 and 2. Mean annual rainfall in Nalanda and Gaya districts were similar and the respective rainfall was 1036 and 1034.6mm. Of the land area, cultivable area was 81.4 and 47.8, per cent in Nalanda and Gaya districts, respectively.

Table 1, Geographical area and GPS coordinated of Nalanda and Gaya districts

Parameter	District	
	Nalanda	Gaya
Geographical area (sq.km)	2367	4976
Latitude	25 ⁰ 13' N	24 ⁰ 16'30" N
Longitude	85 ⁰ 17'E	84 ⁰ 17' to 84 ⁰ 23'30"E
Altitude (m)	60	111

Table 2. Land utilization pattern in Nalanda and Gaya districts

Land use pattern	District	
	Nalanda ('000 ha)	Gaya ('000 ha)
Land area	234.9	493.7
Cultivable area	191.1	235.8
Forest area	4.4	77.3
Land under non-agricultural use	3.3	56.6
Permanent pastures	8.5	3.9
Cultivable wasteland	11.5	8.1
Land under miscellaneous tree crops and groves	3.5	1.8
Barren and uncultivable land	3.3	27.4
Current fallows	3.3	70.8
Other fallows	6.0	--

Cropping Pattern in Nalanda and Gaya districts

Agriculture is the main occupation and rice and wheat were the main agricultural crops cultivated by the farmers in both the districts (Table 3). Cropping intensity in Nalanda and Gaya districts was 150 and 139 per cent. Area under field crops given in the Table 3 was of all the three seasons, i.e. Kharif, Rabi and Summer. Extent of Irrigated and rain fed areas were 1,34,100, 97,500 and 1,00,300 and 61,100 ha, respectively in Nalanda and Gaya districts.

Table 3. Area under major field crops in Nalanda and Gaya districts (2012-13)

Major field crops	District	
	Nalanda ('000 ha)	Gaya ('000 ha)
Rice	112.1	124.8
Wheat	84.6	65.9
Maize	7.2	6.3
Other cereals	0.1	1.4
Pulses (green/black gram, lentil and chick pea, groundnut etc.)	17.9	14.2
Oilseeds (mustard)	2.0	3.0
Sugarcane	0.3	0.5

Source: Directorate of Economics and Statistics (2013)

Fodder base in Nalanda and Gaya districts

Fodder base available in Nalanda and Gaya districts based on food crops cultivated was calculated (Table 4) using grain/pulse yield (2012-13) and crop residue/grain or pulse yield ratio. Rice is the main source of fodder base (52.0-67.0%) followed by wheat (20.4-33.4%), maize (7.9-9.7%) and legumes (3.9-4.4%) in both the districts (Fig. 1 and 2). Cereal crops put together accounts for 96% of fodder base available from cultivated food crops.

Table 4. Fodder base available in Nalanda and Gaya districts based on cropping pattern (2012-13)

Crop	Crop residue available ('000 tons)	
	Nalanda district	Gaya district
Cereals		
Rice	365.28	530.57
Wheat	233.78	161.95
Maize	67.9	62.18
Other cereals (barley, jowar, pearl millet, small millet, finger millets)	0.28	3.47
Total cereal	667.24	758.17
Legumes		
Gram	10.48	15.24
Lentil	16.81	6.34
peas	1.08	0.67
Green gram	1.28	3.79
Pigeon pea	0.94	2.67
Black gram	--	0.96
Horse gram	--	0.92
Groundnut	0.12	0.16
Total legumes	30.71	30.75
Sugarcane tops (100% DM assuming 75% moisture)	1.54	3.04
Grand total	699.49	791.97

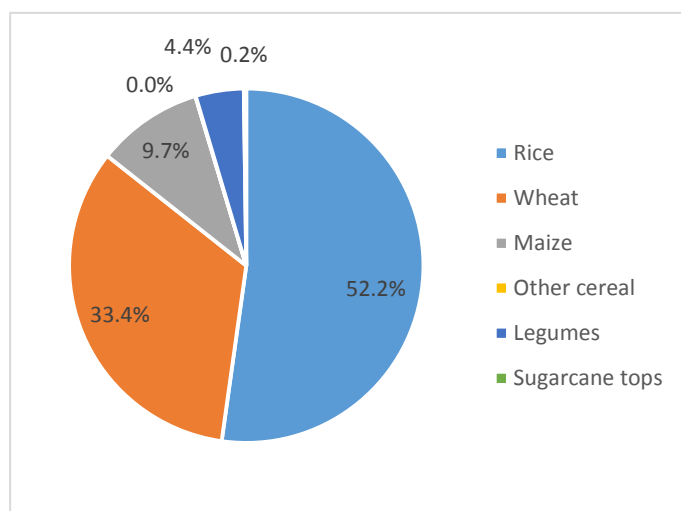


Fig. 1. Different crops contribution (%) to fodder base available in Nalanda district

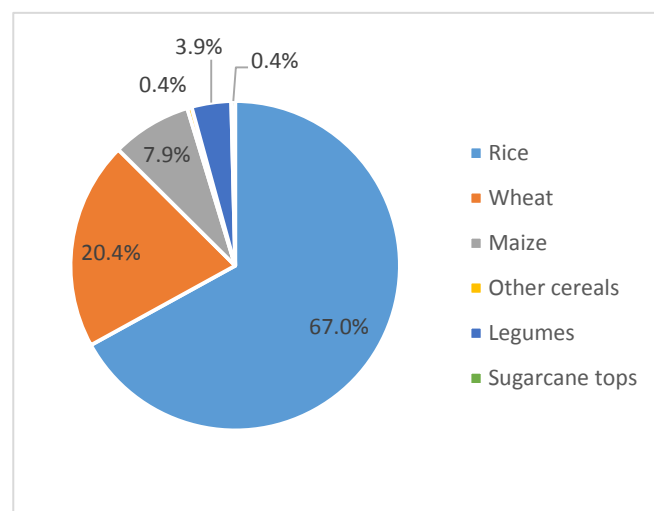


Fig. 2. Different crops contribution (%) to fodder base available in Gaya district

Methodology

To understand the existing fodder markets, rural and urban areas in Bihar districts were visited and the sites visited were given (Table 5).

Table 5. Feed and fodder market areas visited in Bihar

S. No.	Name of the site	Block	District	Type of market
1	Nima	Dhanarua	Patna	Rural
2	Jahanabad	Jahanabad	Jahanabad	Rural
3	Chitkohra	Patna	Patna	Urban
4	Babu Bazar	Patna	Patna	Urban
5	Gardhanibag	Patna	Patna	Urban
6	Bela	Belagunj	Gaya	Export
7	Raghopur	Bhaktiyarpur	Patna	Rural
8	Harnaut	Harnauth	Nalanda	Export
9	Giriak	Giriyak	Nalanda	Export
10	Rajgir	Rajgir	Nalanda	Urban
11	Silao	Silao	Nalanda	Export

Number of interviews conducted with fodder market stakeholders were given in Table 6.

Paddy and Wheat Straw Market Value Chain

The key players in the fodder market were agriculture farmers, agents, traders and dairy farmers. The value chain of paddy straw was depicted in Fig. 3.

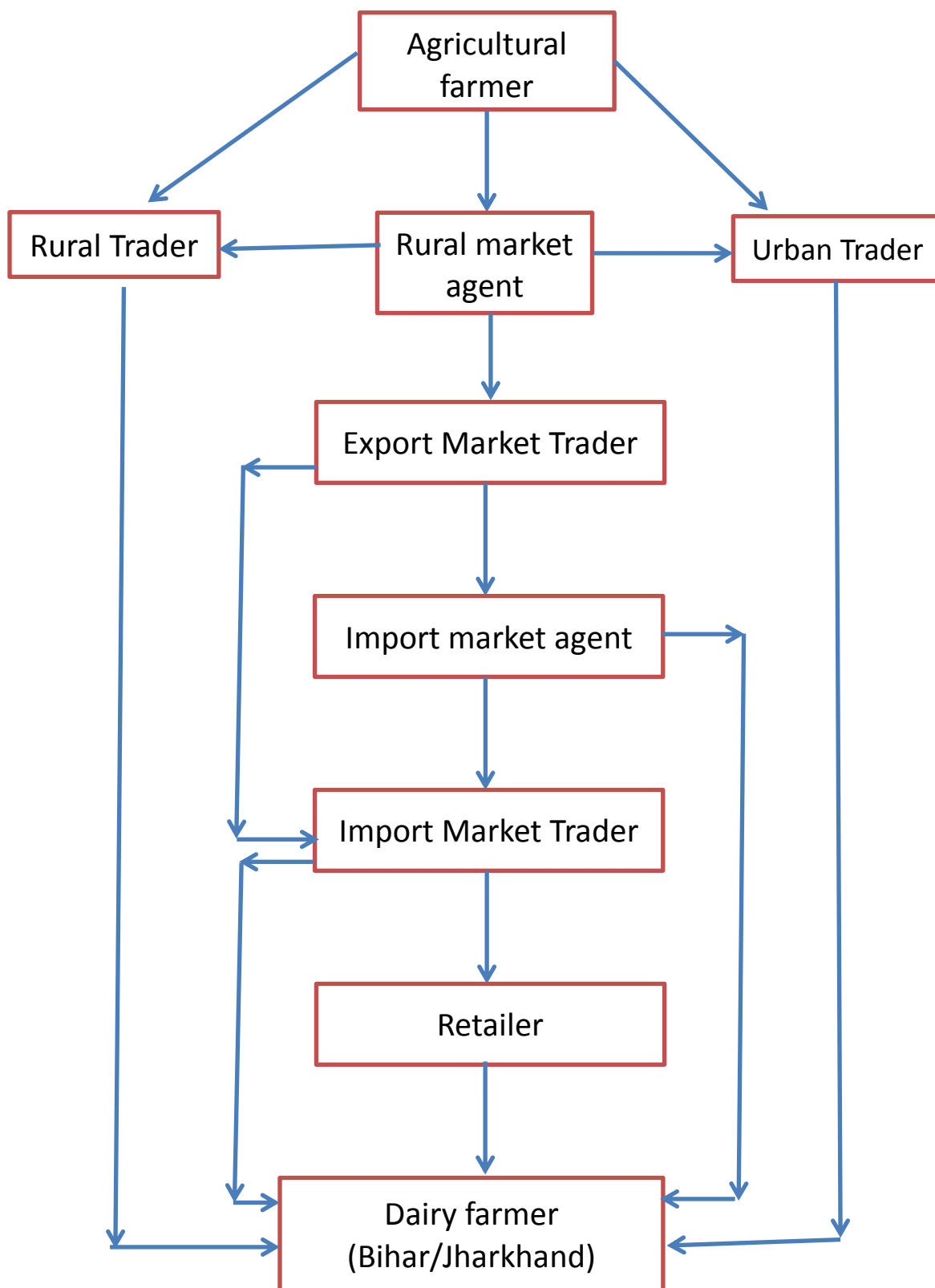


Fig. 3. Paddy and wheat straw market value chain in Bihar

Table 6. List of fodder market value chain stakeholders interviewed during the site visits in Bihar

Stakeholder	No of interviews conducted	Stakeholder	No of interviews conducted
Agriculture farmers	2	Export market agents	2
Rural agent	1	Urban market traders	5
Rural market traders	4	Dairy farmer (rural + urban)	2
Export market traders	6		

Farmers and fodder market

Interaction with farmers at Nima and Raghapur villages revealed that farmers usually store paddy straw after threshing grain and drying the straw. Paddy straw is made into small bundles called aati (local name; Fig. 4)) and stacked in a heap in the field (Fig. 5) or transported to home or fodder markets in bundles (Fig. 6) using either bullock carts or tractors In Nalanda and Gaya (South Bihar) districts. Each bundle comprises of 300-400 aatis. Each aati weighs 0.4-0.6 kg (mean 0.5 kg) and a bundle weighs 150-200 kg (mean 175 kg).



Fig. 4. Pile of Aatis



Fig. 5. Stockpile of aatis in the field



Fig. 6. Transport of paddy straw bundles by cart

Farmer price of paddy straw

The farmers either sell the paddy straw to the rural agents at ₹ 800 per 1000 aatis (₹ 1600/t) who procures and sell to traders in urban and export fodder markets or directly sell for ₹ 2000 and 2750/- per ton to rural and export market traders, respectively during the season. Seasonal variation in procurement price of paddy straw was observed. During the season (December to March) the agent pays Rs. 1600/- per ton whereas during non-season the agent pays (April-November) ₹ 2000-2400/- depending on demand in the fodder market and availability of paddy straw with the farmers.

Agents in fodder market

Two types of agents namely rural and import market agents were found in the fodder market of Nalanda and Gaya districts of Bihar. Rural market agent procures the paddy straw from the farmer and supply to the rural market, export market or nearby urban market (Patna) level traders without processing. Import market agent procures the chaffed paddy straw from the export traders and supplies to the dairy farmers of North Bihar districts (Begusarai, Dalsingh Sarai, Hajipur, Khagaria, Samastipur and Tazpur) and Jharkhand (Ranchi, Bokaro, Dhanbad, Domchanch, Hazaribagh, Barhi, Koderma, Tilaia) mostly through import market traders and occasionally directly. Tractors and small trucks (Fig. 7 and 8) are the mode of transport for the rural agents which carry 2000 and 1750 kg paddy straw without chaffing per load, respectively. Small or medium sized trucks which carry 3 and 5.5-6 tons per load were used by the import market agents to transport chaffed paddy straw. Unchaffed paddy straw was transported and marketed in a radius of 60 km and chaffed paddy straw was transported/exported from South Bihar districts to a distance of 150 (North Bihar districts) to an extent of up to 300 KM (Jharkhand state). Transport cost for various distances by different modes except bullock cart was presented in Table 7.



Fig. 7. Loading of truck with paddy straw bundles in rural area of Bihar for transport



Fig. 8. Loaded Truck with paddy straw bundles for transport to fodder markets

Selling price of paddy straw by rural agents

Rural agents procure paddy straw (unchaffed) from farmers in a radius of 2-20 km from export market area and sell at ₹ 2750 and 3250-3750/t to export and urban level fodder market traders, respectively during the season. Urban markets covered by rural agents were in a radius of 30-60 km.

Table 7. Transport cost of paddy straw

Type of Vehicle	Distance (km)	Quantity of paddy straw/load (kg)	Cost/load (₹)
Tractor [†]	15-20	1500-2000	600
LCV for small loads (small truck)	25	2000 [†] /3000 [‡]	900
	50	2000 [†] /3000 [‡]	1,250
	75	3000 [‡]	1,600
	100	3000 [‡]	2,000
	150	3000 [‡]	2,750
LCV for medium loads (medium truck) [‡]	100	6000	3,000
	150	6000	4,000
	300	6000	7,000

[†]Unchaffed paddy straw[‡]Chaffed paddy straw**Paddy straw (fodder) market traders**

Paddy straw (fodder) market traders in Bihar be classified as four categories viz. rural, export, urban and import market traders.

Rural paddy straw market traders

Traders in rural fodder market (Jahanabad and Raghapur villages) directly purchase the paddy straw from the paddy farmers in a radius of 2-30 km during season and agents during unseason. Rural trader in Jahanabad was purchasing at ₹ 2000 (December-March) to 3000 (April-November) and selling at ₹ 4000 (December-March) to 5000 (April-November) per ton after chaffing. Chaffed paddy straw was purchased by the dairy farmers in a radius of 2 km and holding 8-10 dairy cows. Labor and fuel cost for chaffing a ton of paddy straw was ₹ 500 and 90, respectively put together processing cost was ₹ 590/t. Daily the trader sells 2 tons and the margin for the trader in Jahanabad was 54% over the recurring cost. Whereas rural traders in Raghapur village, Patna district purchasing the paddy straw at ₹ 3000/- and selling at ₹ 4000/- per ton. The selling price is same for both unchaffed and chaffed paddy straw since the traders or their family member were used as a labor for chaffing. The Raghapur village traders sell from 200 to 400 kg daily with a margin of 33.3% over recurring cost (fuel cost is negligible) and 10-15 traders are doing this business for supporting their livelihoods.



Fig. 9. Paddy straw chaffing unit in Jahanabad



Fig. 10 Rural fodder market in Raghapur village

Export paddy straw market traders (Nalanda district)

Export market traders in Nalanda district were mainly concentrated in Harnaut (Fig. 11), Giriak and Silao which were small cities of respective blocks where as in Gaya district they were found in Bela town of Belagunj block.



Fig. 11. Export fodder market in Harnaut, Nalanda district, Bihar

About 110 paddy kutti export traders were found in Harnaut (15), Giriak (35) and Silao (60). Paddy straw was purchased from the rural agents @ ₹ 2750/- and processed in processing units (Fig. 12) by chaff cutters specially designed for paddy straw (Fig. 13). During chaffing water (80 l/t) was added to the paddy straw to reduce the dustiness. Fuel used for chaffing paddy straw was kerosene and 2.25 l of kerosene was required to chaff one ton of paddy straw. Kerosene price was ₹ 40/l. One machine with 4-5 labors chaff 3 t paddy straw per day. Labor and fuel cost for processing 1 t of paddy straw was ₹ 350/- and 90/-, respectively (Fig. 14). Labor cost includes bagging of chaffed paddy straw (paddy kutti) also but for loading the truck with bagged paddy kutti, the trader pay ₹ 80/t additionally. The export trader incur an



Fig. 12. Paddy straw chaffing unit in Harnaut



Fig. 13. Chaff cutter for chaffing paddy straw

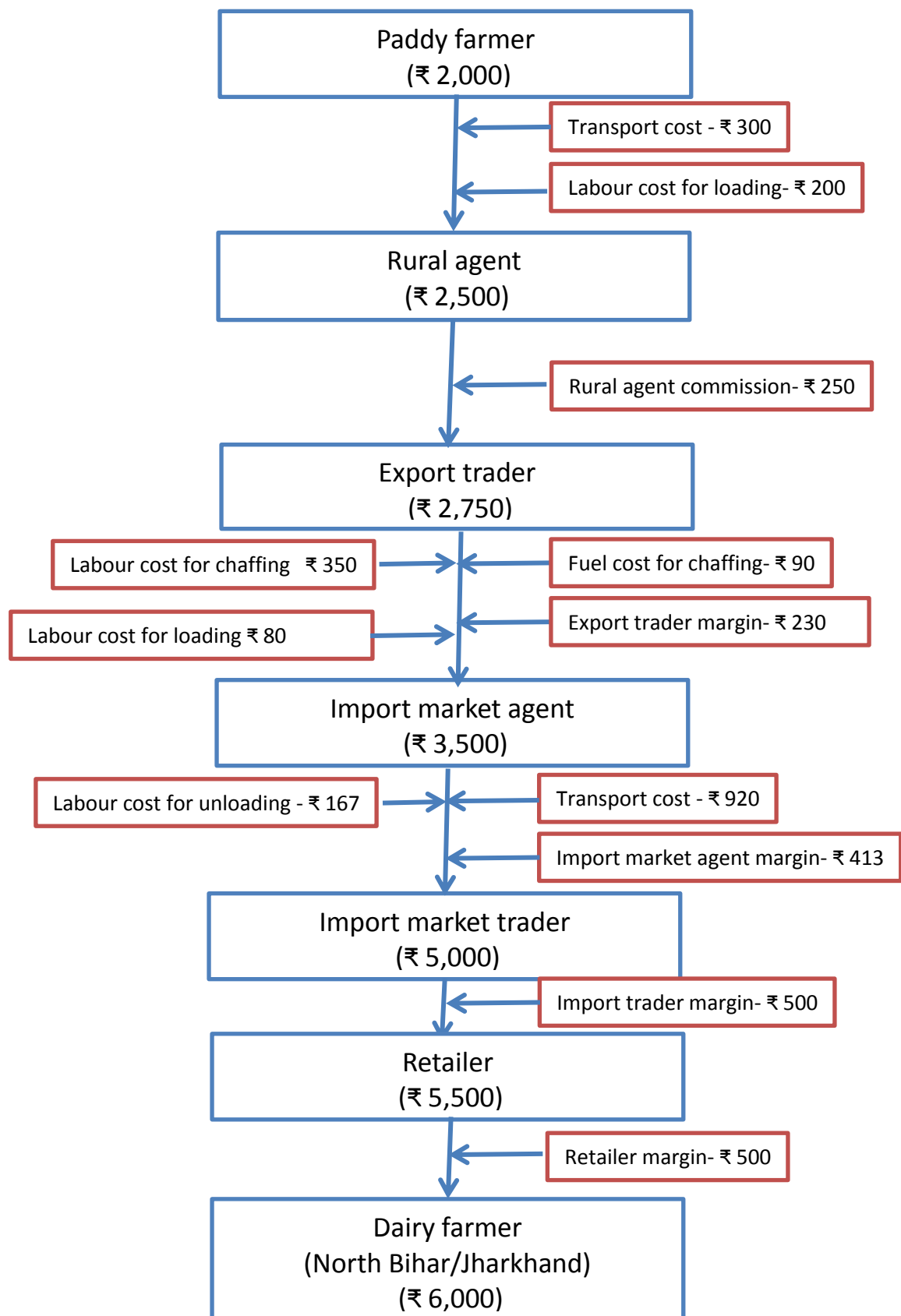


Fig. 14. Flow of paddy straw price (₹/t) along the fodder value chain

of ₹ 3270/- per ton of paddy kutti and sells it @ ₹ 3500/- by keeping a margin of ₹ 230/t to import market agent. Import market agents either directly supplies to large dairy farmers or to import market traders at ₹ 5000/- per ton with a margin of ₹ 413/t (Fig. 14). He incurs an amount of ₹ 920 towards transport and ₹ 167/- towards labour cost for unloading and emptying of one ton of paddy kutti from the bags. Import market trader keep a margin ₹ 500/t and sell to either dairy farmer or retailer who in turn supply paddy kutti to dairy farmer by keeping a margin of ₹ 500/t. The price of import market trader and retailer was ₹ 5500 and 6000/t, respectively. Sometimes the import market agent himself may also be an import market trader. In such case paddy kutti to dairy farmers or retailers will be sold at a lower price eliminating the import market trader margin or import market trader and retailer margin.

Transport cost was the single largest contributor for the price increase of paddy kutti (30.5%) in the value chain (Table 8) followed by labor cost (20%), traders (export and import) margin (18.3%) and agent (rural and import market) margin (16.6%). Fuel cost was the least contributing factor for increase in price of paddy kutti (2.3%) along the value chain. Transport, labor and fuel cost put together accounts for 52.7% and agent, trader and retailer margin accounts for 47.3% increase of paddy kutti along the value chain. About 17-20 people get their livelihoods for at least 4 months in a year through paddy straw trading.

Table 8. Contribution to increase in paddy straw price along the fodder market value chain by different factors

Factor	Contribution to increase in paddy straw price (₹/t)	Contribution to increase in paddy straw price (%)
Transport cost	1,220	30.5
Labour cost	797	19.9
Rural agent commission	250	6.3
Import market agent commission	413	10.3
Total agent commission	663	16.6
Fuel cost	90	2.3
Export trader margin	230	5.8
Import trader margin	500	12.5
Retailer margin	500	12.5
Total trader + retailer margin	1,230	30.8
Total agent + trader + retailer margin	1,893	47.3
Transport + labour + fuel cost	2,107	52.7

Anecdotal evidence suggest that around 70, 000 t of paddy kutti (turnover of ₹ 420 millions) was exported from Nalanda fodder market export zone to North Bihar and Jharkhand State in a year which nearly comes to 20% of the paddy straw (see Table 4) produced by the Nalanda district farmers. No paddy straw trading was done by the export traders during the 4 months of rainy season.

Wheat straw trading

Rural wheat straw traders

Wheat straw is available in chaffed form at the farmers level due to combined harvesting of wheat straw. Labor engaged either by the farmer or rural market agent fill the bags and supplies either to the rural, export or urban market traders. Labor were paid ₹ 20/for filling and bagging and loading 60 kg of chaffed wheat straw. Rural fodder market traders in Jahanabad and Raghapur village procure chaffed wheat straw either directly from the farmers particularly in season (April to July) or agents particularly in unseason (November to March) at ₹ 2500 and 3500/t and selling at ₹ 4000-5000 and 5500/t during season and unseason, respectively. Margin for the rural fodder market traders on wheat straw trading was ₹ 1500-2500/t in season and ₹ 2000/t in unseason. Rural fodder market traders in Jahanabad and Raghapur village were selling 1.0-1.2 and 0.4-0.6 t/d during season and unseason, respectively.

Export wheat straw market traders (Nalanda district)

Similar to paddy straw export traders of wheat straw were found in Harnaut and Giriak but not in Silao area of Nalanda district. Wheat straw traders in fodder market export zone of Nalanda district (Harnaut and Giriak) were about 40 in number and export wheat straw to North Bihar (Hazipur, Samasthipur, Begusarai, Dalshingh Sarai, Khagaria) and Jharkhand State (Barhi, Bokaro, Dhanbad, Hazaribagh, Ranchi etc.). Wheat straw was not exported from Silao export fodder market zone since it was burnt by the local farmers in the fields. The value chain of wheat straw was also similar to that of paddy straw (Fig. 3). Rural market agent procure chaffed wheat straw (called wheat boosa) at ₹ 2500/t from the farmer, incur an amount of ₹ 330/t for labor cost towards filling, bagging and loading of one ton of chaffed wheat straw and sell at ₹ 3000/t by keeping margin of ₹ 170/t as commission to the export trader without bearing transport cost. Sometimes either farmer or rural agent deliver to the point of export trader shop at a cost of ₹ 3500-4000/t during season and ₹ 4000-5500/t during unseason by bearing transport and labor cost for local sale in the export fodder market zone. Local sale in export fodder market zone (Giriak) was 0.4-0.6 t/day.

If the trader was exporting, he purchases chaffed wheat straw at ₹ 3000/t, incur an amount of ₹ 700/t towards transport cost and deliver to import market agent at ₹ 4000/t with a margin of ₹ 300/- as his commission (Fig. 15). No fuel and labour cost were involved in wheat straw processing since combined harvesters were used to harvest grain during which wheat straw was chaffed. Import market agent either directly sell to the large dairy farmers or import market traders at ₹ 4500/t by incurring ₹ 170/t towards labor charges for unloading and unbagging of chaffed wheat straw and keeping a margin of ₹ 330/t as commission. Import market trader sell the chaffed straw at ₹ 5000/t by storing in his shop either to the small dairy farmers directly or to the retailer in the import fodder market who again sell the chaffed wheat straw by storing in his shop at ₹ 5500/t to the small dairy farmers with a margin of ₹ 500/t in North Bihar or Jharkhand State. Sometimes the import market agent himself was an import market trader and retailer. In such case either large or small dairy farmers get chaffed wheat straw at a lower price due to the elimination of margins of import market trader and retailer.

Factors which contribute to wheat straw price along the fodder value chain were, transport/labor cost, trader/agent/retailer margins (Table 9). Single largest contributor for price increase of wheat straw transport cost (23.3%). Labor cost, agents (rural and import market) and retailer margins were equally contributing to increase (16.7%) in the price of wheat straw along the value chain. Rural agent commission was the lowest contributor (5.7%) to price increase of wheat straw in the value chain.

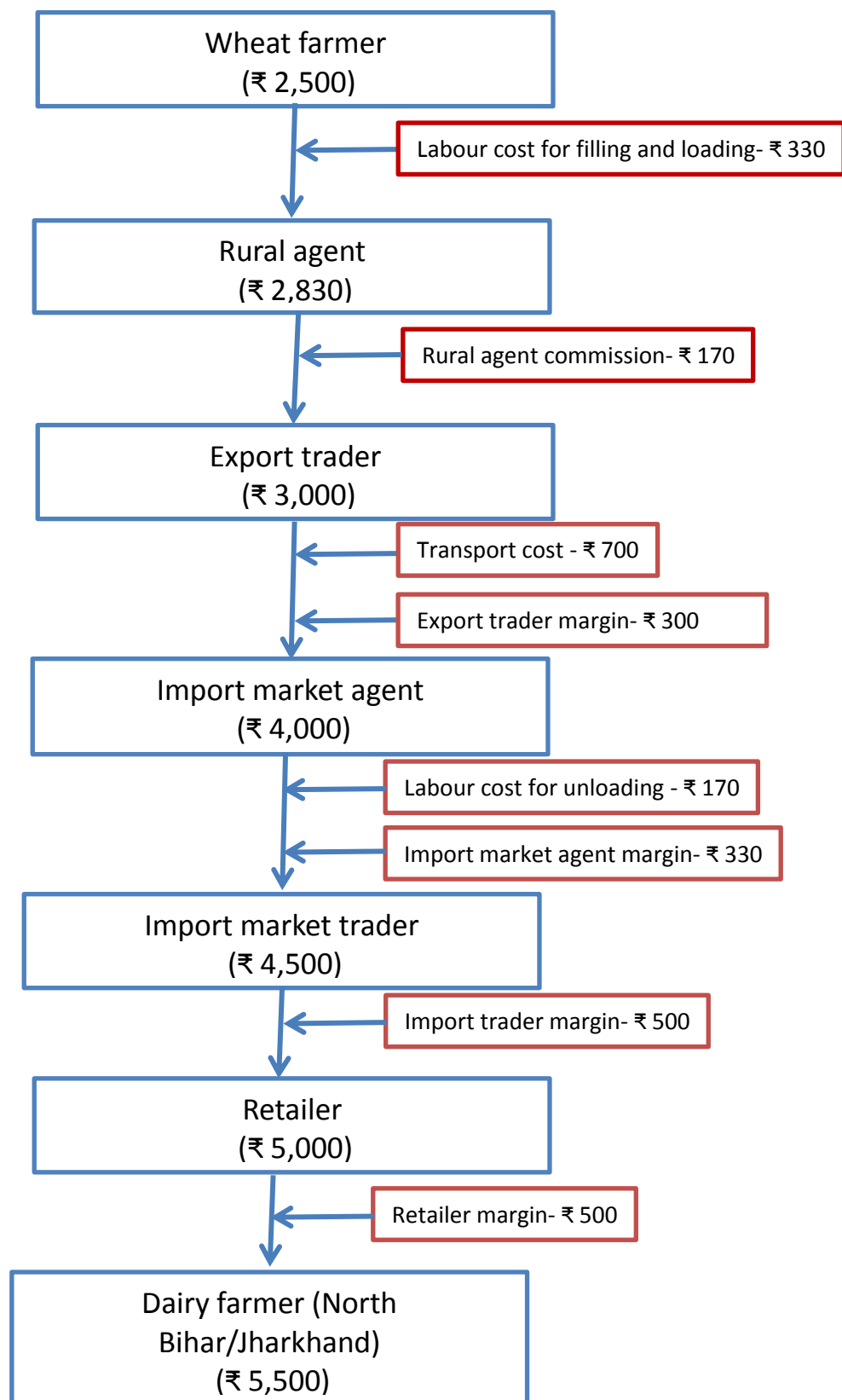


Fig. 15. . Flow of wheat straw price (₹/t) along the fodder value chain

Margin of agents, traders and retailer accounts for 60% and transport and labour cost accounts for 40% increase in the price of wheat straw along the value chain.

During un-season the procurement price of wheat straw goes up by Rs. 500/t which will continue along the wheat straw value chain in the fodder market.

Table 9. Contribution to wheat straw price increase along the fodder market value chain by different factors

Factor	Contribution to increase in wheat straw price (₹/t)	Contribution to increase in wheat straw price (%)
Labour cost	500	16.7
Transport cost	700	23.3
Rural agent commission	170	5.7
Import market agent commission	330	11.0
Total agent commission	500	16.7
Export trader margin	300	10.0
Import trader margin	500	16.7
Retailer margin	500	16.7
Total trader + retailer margin	1,300	43.3
Total agent + trader + retailer margin	1,800	60.0
Transport + labour cost	1,200	40.0

Calculations (anecdotally) based on interaction with export traders revealed that about 45,000 t of wheat straw was exported in a year to North Bihar and Jharkhand State from export fodder market zone (Harnaut and Giriak) of Nalanda district and the annual turnover was ₹ 248 million. Similar to paddy straw around 20% of wheat straw (see Table4) produced in Nalanda district was exported by the export fodder market traders. Export market traders were not trading wheat straw during the rainy season (4 months) in a year similar to that of paddy straw.

Bela export fodder market (Gaya district)

Paddy straw trading

Export traders in Bela market purchase paddy straw at ₹ 2250/t during the season (₹ 2500/t during un-season). The farmers transport and deliver by tractor at the trader shop. The trader chaff the paddy straw using paddy chaff cutters. Fuel used for chaffing was kerosene and the fuel required for chaffing one ton of paddy straw was 2-2.5 l (mean 2.25 l/t) which costs ₹ 90 (@₹ 40/l). Labor charges for chaffing a ton of paddy straw was ₹ 500. Total cost for processing one ton of paddy straw was ₹ 590/-. The export trader also incur an amount of ₹ 80/t towards labor cost for loading of chaffed paddy straw

into a carrying vehicle. Export trader sell paddy kutti at ₹ 3500/t during the season (₹ 4500 during unseason) to the import market agent. The margin for the export trader was ₹ 580/t (19.9% over recurring cost). On an average export trader sell 4 t/d and his income per day was ₹ 2320/day during the season.

Import market agent purchase paddy kutti at ₹ 3500/t in the season (during the season 4500/t during unseason), transport for a distance of around 250 km using trucks which carry 6 t/load by paying ₹ 6500/load including unloading charges (₹ 1000/load). Transport and unloading charges per ton works out to be ₹ 1083/t. Import market agent sell paddy kutti to either import market traders or directly to the large dairy farmers at ₹ 5000/t during the season in Bokaro, Dhanbad, Hazaribagh and Ranchi city of Jharkhand state. Some agents were also acting as import market traders. Import market trader sell paddy kutti at ₹ 5.50/kg to either retailer or dairy farmers of Jharkhand cities by storing. Retailer sell paddy kutti at ₹ 6/kg to dairy farmer. Margin for import market agent, trader and retailer was ₹ 417 (9%) 500 (10%) and 500/t (9.1%) over recurring cost and their daily income depend on the number of loads transported by the import market agents per day and quantity of paddy kutti (kg) sold per day by the import market traders and retailers.

There were 12 export traders in Bela (Pachmahla road) market who trade 17500 t paddy kutti in a year. Turnover through paddy kutti trading was approximately ₹ 105 millions in a year. About 3.3% of paddy straw produced by the Gaya farmers in a year was exported from Pachmahla export market zone of Bela, Gaya district.

Wheat straw trading

Bela wheat straw export market value chain and price flow along the value chain was similar to that of Nalanda district wheat straw export fodder market. There were four traders put together export to maximum of 100 truckloads (each truck load 6 t) to Jharkhand State in a year with a turnover of ₹ 3.6 million only from Pachmahla export fodder market zone in Gaya district.

Urban fodder market (Patna)

Urban fodder markets in Patna (capital of Bihar state) were found in Chitkohra, Babu Bazar, Alkapuri, and Gardhani Bag. Farmers or agents of rural area collect and transport paddy straw, chaffed wheat straw and lentil straw to the fodder market called Chitkohra Mandi from where the urban traders purchase and sell from their shops to the urban dairy farmers. There were about 10-11 fodder traders in Chitkohra, Babu Bazar, Alkapuri and Gardhani Bag fodder market area in Patna. Paddy straw, chaffed wheat (wheat bhoosa) and lentil straw (lentil bhoosa) were traded and the prices of these straws during season and unseason were given (Table 10).

Table 10. Procurement and selling price of fodders by traders in urban (Patna) fodder market of Bihar during season and unseason

Name of the fodder	During Season		During unseason	
	Procurement price (₹)	Selling price (₹)	Procurement price (₹)	Selling price (₹)
Paddy straw/kutti	3,500	5,000	4,500	5,500
Wheat bhoosa	3,750	5,000	4,500	5,500
Lentil bhoosa	6,250	9,500	7,500	11,000

Traders were selling by keeping a margin of 42.9, 33.3, 52.0 per cent during season and 22.2, 22.2 and 46.7% during unseason on paddy, chaffed wheat and lentil straw, respectively. Paddy straw was sold at the same price with or without processing. Season and unseason for paddy straw, chaffed wheat and lentil straws were, December to March, April to July, and June to October, and April to November, August to March and November to May months, respectively. The traders daily sale ranges from 80-800 kg for paddy straw, 400 to 500 kg for wheat boosa and 400 to 840 kg for lentil bhoosa. Sometimes owner himself do the labor work when daily fodder sales were low (80-160 kg). Economic analysis of one trader who sells paddy straw (unchaffed/chaffed) throughout the year was furnished in Table 11.

Table 11. Economics of trading paddy straw by a trader in Patna, Bihar

S. No.	Parameter	Price
1	Purchasing price of paddy straw (₹/kg)	3.50
2	Selling price of chaffed paddy straw (₹/kg)	5.25
3	No of labor engaged for processing and selling paddy straw	2
4	Labor wage (₹/labor/d)	300
5	Monthly rent for trading shop (₹)	2,500
6	Daily sale of chaffed paddy straw (kg)	700
7	Daily expenditure on purchase of paddy straw (₹)	2,450
8	Daily expenditure on labour (₹)	600
9	Daily rent for trading shop (₹)	83
10	Daily income through sale of chaffed paddy straw (₹)	3,675
11	Daily profit to the trader (₹) [10-(7+8+9)]	542
12	Monthly income to the trader (₹)	16,260

Nutritional quality of straws

Dry matter content of paddy, wheat and lentil straw samples collected from different fodder markets were similar whereas protein, energy content and *in vitro* digestibility (IVOMD) of lentil straw was higher than the paddy and wheat straw probably because of which chaffed lentil straw was traded at higher price (90-100%) in the fodder market (Table 12). Variation of 3.2, 5.4 and 11.6 percentage units in IVOMD was observed in paddy, wheat and lentil straw samples, respectively collected from different fodder markets of Bihar. However, no price premiums for paddy wheat and lentil straw based on quality was noticed in any type of markets existing in Bihar state. Straws from different fields was mixed, transported and supplied to the traders and dairy farmers.

Table 12. Dry matter, protein, energy and *in vitro* digestibility values of chaffed paddy, wheat and lentil straw collected from different fodder markets of Nalanda, Gaya and Patna districts in Bihar

Name of the straw	DM (g/kg)	CP (g/kg DM)	ME (MJ/kg DM)	IVOMD (%)
Chaffed paddy straw	948	51.0	6.71	46.2 (45-48.2)
Chaffed wheat straw	938	57.7	6.82	45.3 (43.3-48.7)
Chaffed lentil straw	943	105	7.50	51.9 (47.9-59.5)

Feed Ingredients/commercially compounded feed trading

The prices of different feed ingredients usually purchased by the dairy farmers in Rajgir (small city) area of Nalanda district and Patna (city) area of Patna district were given (Table 13 and 14) along with their dry matter (g/kg), protein (g/kg), energy (metabolizable energy, MJ/kg DM) content and *in vitro* digestibility (IVOMD) values. 2 traders were interviewed and samples collected in Rajgir and average price and nutritive values were tabulated (Table 12). Whereas in Patna only one trader was interviewed and his price and nutritive values were given in Table 13. Different categories of feed ingredients such as energy (cereals) and protein (oil cakes) supplements, basal feeds (wheat bran, chunnis of different pulses) and commercially compounded feeds were traded by the traders in Bihar State. Prices of oil cakes were highest followed by the cereal flours and basal feeds. Main oil cake traded in the feed and fodder markets of Nalanda, Gaya and Patna districts of Bihar State was mustard.

Table 13. Price and nutritional quality of feed ingredients/commercial feeds in Rajgir, Nalanda district

Name of the feed ingredient/ commercial feed	Price (₹/kg)	DM (g/kg)	CP (g/kg DM)	ME (MJ/kg DM)	IVOMD (%)
Kisan bypass feed (CP 26%, TDN 75% or ME 11.35 MJ/kg DM)	17	925	240	8.24	63.4
Wheat bran	20	909	189	10.9	76.1
Maize flour	16	912	146	12.4	85.1
Mixed cereal flour	15	922	185	11.2	77.5
Lentil chunni	15	907	133	8.93	62.3
Nilkanta feed (CP 20%, ME 10.5 MJ/kg DM))	15	929	235	7.92	61.5
Kamal feed (CP 20%)	15	941	209	6.26	52.6
Super cattle feed	15				
Kesari (Lathyrus) chunni	14	892	160	8.85	61.9
Doodh dhara cattle feed	15	898	194	9.11	66.3
Mustard cake (grade II)	18	910	419	9.71	74.3
Mustard cake (grade I)	20	910	447	10.2	77.8
Wheat flour	18	905	161	12.3	82.8

Table 14. Price and nutritional quality of feed ingredients/commercial feeds in Patna, Bihar

Name of the feed ingredient/ commercial feed	Price (₹/kg)	DM (g/kg)	CP (g/kg DM)	ME (MJ/kg DM)	IVOMD (%)
Chickpea flour	26	916	238	11.8	82.0
Mustard cake	20	920	447	8.90	71.5
Sesame cake	40	925	370	8.90	69.5
Maize flour	18	931	137	12.6	84.0
Lentil chunni	16	910	153	9.46	65.4
Pigeon pea chunni	19	913	139	9.79	66.6
Green gram chunni	18	903	165	9.32	65.1
Wheat bran	18	909	179	11.1	77.1
Kapila cattle feed (CP 20-22%)	16	903	205	10.2	71.9

There were about 6 commercially compounded feeds traded in the fodder markets with different brand names viz. Kisan bypass, Kamal, Nilkanta, Super, Doodh dhara and Kapil cattle feeds. All the brands were maintaining the labelled protein content except Kisan bypass where protein content was lower than the labelled value. But, energy content of commercially compounded feeds (ME range 6.26 to 10.2 MJ) were lower than the labelled values (Kisan bypass and Kamal feed) which was also reflected in the form of *in vitro* digestibility. Generally commercially compounded feeds manufactured for feeding of dairy animals should have at least 10.6 MJ ME/kg DM. Non-protein nitrogen (NPN) content predicted by NIRS ranged from 0.05-0.13% in commercially compounded feeds.

Farmer feeding practice in Patna

One dairy farmer in Chitkhora, Patna city making a compound feed on his own for feeding his crossbred dairy cows by purchasing the feed ingredients from the local market. The farmer formula was chickpea flour 10 kg, maize flour 2 kg, wheat bran 3 kg and pigeon pea chunni 1 kg. The cost per kg of home-made compound feed was ₹ 19.75. The farmer's formula feed was analyzed and its dry matter (%), protein (g/kg) and energy (ME, MJ/kg DM) content were 91.7, 205 and 11.42, respectively. The farmer was feeding 8 kg of his own formula feed to crossbred cow yielding more than 10 kg milk/day and 5 to 6 kg for those yielding less than 10 kg milk/day in addition to 5 to 6 kg paddy kutti or wheat bhoosa and 0.5 kg jaggery.