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Round the year fodder production model

for small and marginal farmers of Bihar

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Bihar relies heavily on agriculture as its primary source of wealth, playing a crucial role in the overall development of the state's economy. The state government has given utmost priority to the advancement of agriculture. However, the insufficiency of fodder and feed resources in the state has been acknowledged and articulated on numerous occasions. A shortage of feed and fodder stands as a significant obstacle to sustainable livestock development in the state, directly impacting the income and livelihoods of numerous resource-poor livestock keepers. Various constraints, such as the scarcity of feed, fodder, and concentrates, hinder the potential of livestock, leading to substantial losses in terms of production and depletion of livestock resources. In view of this, KVK Banka has promoted village based round the year fodder production model by integrating various approaches to overcome the shortage of fodder and ensuring a consistent supply of green fodder throughout the year for livestock keepers. It has been observed that integrating more green fodder into animal diets has the potential to lower milk production costs. Also, many farmers start relying on common property resources to fulfil their animals' fodder needs after intervention by the KVK.

Keywords: Bihar, Green fodder, KVK, Livestock

BIHAR is basically an agricultural state and nearly three-fourth population depends on agriculture, livestock and allied sectors for livelihood. Livestock is a key source of supplementary income and livelihood especially for small land holdings and landless rural poor households. In 2013, about 93% of milk producers were marginal and small, possessing less than 2 hectares (ha) of land, and together contributed about 90% of total milk production in the state.

About 80% of the total milk produced in Bihar comes from landless poor agricultural labourers and small and marginal farmers (ILRI 2014).The state currently represents the eight largest dairy market in India and produced 11,502 thousand tonnes of milk production during 2020-21 (AHS, GoI). If we see the impressive growth of dairy sector alone, the productivity of milk in Bihar was 0.7 MT per lactating animal comparatively low as compared to other states like Punjab, Gujarat, Uttar Pradesh and Madhya Pradesh productivities, where it is 2.4 MT, 1.1 MT, 1.0 MT, and 0.8 MT per lactating animal, respectively. This lower productivity of milk is attributed to many factors and to a large extent on the availability of feed and fodder to the dairy animals. The availability of concentrate and fodder are directly linked with agricultural crop production system of a particular area in the state. Availability of crop residues is further declining due to adoption of high-yielding dwarf varieties / hybrids and field wastage due to extensive use of grain picker / mechanical harvester in cereal crops. The main reason for green fodder deficit is the low green fodder yield and lesser allocation of lands for cultivation of fodder and pastures.

Importance of green fodder in village-based production system

Traditionally, green fodder is natural feed stuff and it serves as a cost-effective nutrient source for majority of the dairy animals contributing to their overall health and enhancing breeding efficiency. It is highly nutritious, palatable, rich in minerals, vitamins and an economic source of macro-and micro-nutrients. The primary sources of animal feed in the village area of Bihar consist of rice straw, wheat straw, and certain pulse residues without much provision of green fodder. Recent studies conducted in the Indo-Gangetic Plain of the state have

brought attention to the challenge of inadequate fodder and the low nutritive value of available feed resources. This issue becomes more pronounced in the eastern parts of the region, where agricultural resources, especially arable land and water, are increasingly scarce. The scarcity of fodder has a widespread impact on farmers, but it is especially severe for those who are landless or have access to only small plots of land. Similarly, the availability of green fodder round the year especially during summer months for sustained and economical milk production in these areas is of utmost importance. The dairy farmers have been looking forward to improved technology for continuous flow of green fodder throughout out the year. In general, the dairy farmers are suggested to harness the below mentioned fodder cycle (Table 1) for round the year fodder production at their farms. However, in absence of fodder land, they can use the innovative approaches mentioned below as per the feasibility of land and resources.

Innovative approaches for round the year fodder production model

Horti-pastoral system

Table 1. Schedule for round the year green fodder availability

Crop	Area (ha)	Sowing time	Fodder availability	Production (q)
Maize/ Multicut Sorghum + Cowpea/ Guar/Ricebean	0.50	February–March	April-July	500
Multicut sorghum/ Napier grass/ paragrass + Cowpea/ Guar/Ricebean	0.50	June-July	August-November	500
Barseem + *Oat (Multicut)*	0.50	October-November	December-April	600
Maize + Cowpea/ Guar/Ricebean	0.25	March-April	May-June	150
Maize + Cowpea/ Guar/Ricebean	0.25	May-June	July-August	150
Multicut sorghum + Cowpea/Guar/ Ricebean	0.50	June-July	August-November	600
Barseem + *Oat (Multicut)*	0.50	October-November	December-April	600
Napier grass + Cowpea/Barseem (Rabi)	1.00	March-April	Round the year	2000

Horti-pastoral system involves growing of fruit trees and grasses in combination. Fruits tress usually takes about 4-5 years to develop maximum canopy and hence allow cultivation of fodder intercrops in the initial years. Fruit trees form the 1st tier whereas grasses are grown as ground crop. Perennial forage grasses and legumes like *Stylosanthes hamata, Styloasanthes scabra, Cenchrus ciliaris, C. setigerus*, etc and annual fodder crops like copwpea, horsegram, sorghum, oat etc. are ideal crops for horti-pastoral system in semi-arid areas. Natural grasslands are main source of fodder to about 500 million animals in India mainly because the area under fodder production is low (4.4% of total cultivated area). Krishi Vigyan Kendra Banka have grown oat in *rabi* and ricebean, sorghum in *kharif* season in 5 mango orchards of average 2-2.5 acre in Amarpur block of Banka district in 2016. Presently, in Banka district, approx. 31 orchards were used for cultivating green fodder. During the intervention, it was observed that leguminous green fodder like rice bean require less water for growing and act as mulch and green fodder. After 2nd cutting when leave for fruiting, its seed fall down and regenerate in orchard after October. Due to rice bean crop, sunlight does not directly heat the soil of orchard, thereby preventing loss of moisture. Rice bean is a leguminous crop which fixes the nitrogen and improves the fertility of soil.

Intercropping with traditional crop

In rainfed situation, where limited area has facility of irrigation, intercropping of short duration forages in long duration food crops such as potato, which are widely spaced and offer good scope for accommodating legume and cereal forages in inert-row space in additive series was promoted by the KVK. As a result, in potato field about 40% area (av. 17424 sqft/acre) is vacant which was now used for fodder production by farmers. Intercropping of oat with potato is now a common practice in Banka district. In this, there are two types of cultivation practices followed which includes earthing up before and earthing up afterwards. In before earthing up cultivation, oat were sown with potato and cultivated in 30-40 days before earthing up of potato. In after earthing up cultivation, oat was sown after earthing up of potato and harvesting after 45 days. Production was higher in after earthing up cultivation (36.42 q/acre) practice than before earthing up cultivation (25.09 q/acre) practice. Some other examples include grain sorghum where intercropping of cowpea is done. In grain pigeon pea, intercropping of forage sorghum, maize, bajra and

Table 2. Green fodder production (q)/acre mango orchard

Year	Free space (Sq.ft)	Oat	Rice bean	Sorghum	Sorghum + Rice bean
1st	43,387	196.7	123.8	241.85	322.58
2nd	43,117	195.4	122.9	240.34	320.58
3rd	42,723	193.6	121.8	238.15	317.65
4th	42,391	192.2	120.9	236.30	315.18
5th	41,320	187.3	117.8	230.32	307.21
Av.	42,588	193	121	237	317

Sorghum in mango orchard

Oat in mango orchard

Rice bean and sorghum

Mixed grass in mango orchard

cow pea is done. The forages are harvested 50 days after sowing thereby allowing pigeon pea to grow free of competition and produce grain on residual soil moisture. Alternatively, the productivity of these soils could be raised through intercropping of short duration forages in long duration rainy season food crops such as sorghum and pigeon pea, which are widely spaced and offer good scope for accommodating legume forages in inter-row space in additive series. This work has started from farmer of Dhoraiya block of Banka district in 0.5 acre potato field and extended to more than 50 acre potato field of Banka district.

Intercropping of oat green fodder with potato

Use of waste land / bund of ponds for perennial forage production

The intervention taken up by the KVK banka involving one acre pond having a perimeter of 1163 ft. Plantation of Hybrid Napier of av. 233 slip/acre pond at distance of 5 ft were done which resulted in av. yield of 102 q/year and when intercropped with rice bean, yield increased to 139 q/year. Water canal in villages, water channel cum drainage system, irrigation channel and waste land around dairy farm were promoted to be used for fodder production by the farmers. In last five years, fish production have been fast growing in Banka district by more than 200 new fish ponds constructed with the help of fishery department and also farmers self-investment. Around 23 ponds were integrated with dairy farming with cultivation of green fodder at bund of ponds.

Use of top part of harvesting maize crop

It is observed that, among the maize growing countries, India ranks 4th in area and 7th in production, representing around 4% of the world maize area and 2% of total production. During 2018-19 in India, the maize area has reached to 9.2 million ha (DACNET 2020). The average productivity of maize was 3032kg/ha

Hybrid Napier on bund of pond

Water channel cum drainage Guinea grass (*Megathyrsus maximus*)

Around dairy farm (Hybrid Napier)

Irrigation channel Paragrass (*Brachiaria mutica*)

and annual production (grain yield) was 28.72 million tonnes (Agriculture Statistics at a glance 2018). As per the intervention of the KVK, farmers were apprised to use top part of maize as green fodder for their livestock. For this, they are advised to harvest the top part of green maize straw, 15-20 days before harvesting of grains. Dairy farmers were also suggested to preserve this fodder by making silage for scarcity period. The green fodder yield was 34.59 q/ha from maize grain producing crop.

Relay cropping of green fodder oat and berseem with paddy

Traditionally mono-cropped in rainy season as the

Table 3. Comparison of production and cost of production

Crop	Production (q/ha)		% increase	Cost (₹/kg fodder)		First cutting after harvesting (days)		% decrease
	Ploughing	Relay cropping		Ploughing	Relay cropping	Ploughing	Relay cropping	Ploughing
Oat	395	573	45.06	0.80	0.48	56	35	37
Berseem	315	412	30.79	1.56	0.91	56	35	(21 days)

residual moisture is low to support winter season crops in sequential system. Failure of *rabi* fodder was due to late sowing and late harvesting of paddy. In *rabi* season, low irrigation facility was another cause of not sowing of green fodder. Oat/ Berseem seed was broadcasted 5-6 days before harvesting of paddy in the field having moisture. It saved irrigation, ploughing cost and green fodder was ready for harvesting 21 days before than sowing of green fodder after ploughing. Production improved by 45.06 and 30.79% respectively in oat and berseem. More than 15-acre green fodder in *rabi* season were grown through relay cropping in Banka district of Bihar.

Decrease wastage by planned sowing

In most of the area of Bihar, it was observed that the average time taken to complete harvesting of green fodder from field was 15-20 days. Therefore, the first day harvest of the immature fodder and last day harvest over mature fodder resulted in less nutritions fodder. So, sowing of fodder at interval of 5 days and area decided according to animal rearing which fullfill the fodder requirement for only 5 days. So, sowing of green fodder in six groups resulted in 2nd group in mature stage after harvesting of first group and first group fodder again ready for harvesting after harvesting of last group. So planned grazing land were developed under front line demonstration programme at five goat farms in Banka district. It helps in natural grazing, saving of labour for harvesting of green fodder and movement of goat. It enables land use for dual purpose.

Use of non-conventional feed resources

In the state districts, there is scarcity of green grasses

Frontline demonstration of planned grazing land at farmer's field

in March-June. However, palas (*Butea monosperma*) has new green leaves during this time. Hilly area of Katoria, Chanan, Belhar, Fullidumar and some part of Banka block of Banka district have forest of Palas *(Butea monosperma)*. So, use of palas leave as green fodder may combat the deficit of green fodder during scarcity period. The feeding trial on palas leaf as green fodder was also performed under on farm trial (OFT) by the KVK Banka and it was found that palas leaf was palatable upto 200 g/day and increased in weight gain by 630-640 g and average daily gain increased by 8.5-10 g/day. Farmers also successfully made silage by mixing with 50% sorghum.

Low-cost hydroponic green fodder production

Hydroponics is the scientific way of growing plants/ crops in water without any soil, but generally in controlled conditions/ environment. Fodders including maize, barley, wheat, oats, rye, alfalfa and triticale can be produced by hydroponics. Others, including cowpea, horse gram, sun hemp, ragi, bajra, foxtail millet and Jowar have also been grown successfully by the use of hydroponics. Production of hydroponic fodder under low-cost management can be an alternative to traditional fodder production. Feeding of hydroponically grown maize and wheat fodder can improve productive and reproductive efficiency of lactating cows with better economic return. In the same line, a trial conducted by KVK Banka in which daily production of 75 kg hydroponic maize and wheat green fodders from 52.5 sq ft tray area was recorded. On day 14, 1.89 kg maize and 1.10 kg wheat green fodder/ ft^2 area were harvested. The height of maize and wheat green fodders were 20-23 cm and 15-17 cm, respectively. Each kg of maize and wheat grains produced 5.7 kg and 4.4 kg fodder, respectively. The milk production of the dairy cattle was also increased by 5% and the cost of per kg milk production was reduced from ₹13.30 to ₹12.70. After feeding of hydroponic fodders, the animals became regular in heat after 2 months of parturition and most of the animals conceived in first or second oestrous cycle. An increment of net profit of ₹25.50/animal/day was recorded by the farm woman. The present case study may be a pathway for its large-scale adoption by the small holder farmers for sustainable dairy farming. Seventeen dairy farmers are following the low-cost hydroponic green fodder production and two automatic hydroponic system were installed at KVK banka and Uparama village of Banka district.

SUMMARY

Production of green fodder intercropping with potato, on bund of pond, mango orchard provides round the year green fodder to small and marginal farmer. Use of non-conventional green fodder was helpful in providing green fodder to marginal and landless farmers. Production of hydroponic fodder under low-cost management can be an alternative to traditional fodder production.

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