भाकृअनुप
ICAR

Fodder Resource Development Plan for Telangana

भा.च.चा.अ.सं.
IGFRI

ICAR- Indian Grassland and Fodder Research Institute
Jhansi-284 003 (UP) India

An ISO 9001:2015 Certified Institute

Sardar Patel Award for Outstanding ICAR Institute (Large) for 2015

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त्रिलोचन महापात्र, पीएच.डी.
सचिव एवं महानिदेशक
TRILOCHAN MOHAPATRA, Ph.D.
SECRETARY & DIRECTOR GENERAL

सत्यमेव जयते

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भारतीय कृषि अनुसंधान परिषद
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MESSAGE

It gives me immense pleasure to learn that the state specific "Fodder Resources Development Plan" has been developed by the ICAR-Indian Grassland and Fodder Research Institute, Jhansi, for Telangana in consultation with other stakeholders. Telangana is rich in livestock resources. The acute shortage of feed and fodder resources is a concern for the livestock productivity and dairy industries in the State. There is a 62% of green fodder deficit to the total requirement, but there is surplus of dry fodder in the State. This plan provides the technological options to enhance production, conservation and value addition of fodder. The document will serve as a guide in planning the fodder development activities in the State.

I complement the efforts of ICAR-IGFRI, Jhansi for preparing the document.

(T. Mohapatra)

Date: 24th March 2021
Place: New Delhi-110 001

Acknowledgement

Fodder plan is area specific strategy to be adopted to overcome deficiency of green and dry fodder of the region and also to provide executable plan for the state government and other agencies involved in livestock related policy and planning. The fodder resource development plan provides technological options available for enhancing production, conservation and value addition of fodder resources of the state.

Looking into shortage of green and dry fodder in the country the idea and vision of the development of state wise fodder plan for different states of the country was visualized by Dr. Trilochan Mohapatra, Hon'ble Secretary DARE and Director General, ICAR. During his visit to IGFRI-SRRS, Dharwad on 17th June 2019, he advised to develop state wise fodder resource development plan which covers the broad areas as per requirement of the state. We are highly grateful to him for his insight guidance, encouragement, continuous support and suggestions in preparation of this document. We are also thankful to Deputy Director General (Crop Science), ADG (FFC) and other officers of the ICAR who extended their support during the development of fodder plan of Telangana.

We express our sincere thanks to Government of Telangana, especially to Dr. V. Lakshma Reddy, Director of Animal Husbandry, Govt. of Telangana, Hyderabad who inaugurated the interactive workshop held online on 4th July 2020 in collaboration with Directorate of Animal Husbandry, Telangana. We also extend our thanks to Hon'ble Vice-Chancellor, PJTSAU, and Dr. Jagadeeshwar, Director of Research, PJTSAU, Hyderabad for their support in organizing interactive workshop and showing keen interest in developing plan for augmenting forage and livestock sector in the state with special focus on pasture development on waste lands and impart training to state government officers. We also thank to other participants including officials of state government, scientists of ICAR institutes, PJTSAU, KVK personnel, veterinary officials, etc., who actively participated in the workshop and provided their valuable suggestions for the improvement of plan.

The efforts made by our team from ICAR-IGFRI, Jhansi in preparation of fodder plan for the state and organizing interactive workshop are praise worthy. This fodder plan is prepared as a part of the activities of our programme 'National Initiatives on Accelerating Fodder Technology Adoption (NIAFTA)', whole team of the programme; and Coordinator, Dr. B.G. Shivakumar, Principal Scientist, and Nodal Officer, Dr. Purshottam Sharma, Principal Scientist, deserves special appreciation.

(Vijay K Yadav)
Director (Acting)
ICAR-IGFRI, Jhansi

Fodder Resource Development Plan developed as part of

National Initiative for Accelerating Fodder Technology Adoption (NIAFTA)

ICAR - Indian Grassland and Fodder Research Institute, Jhansi

Themes of NIAFTA

A. Developing State Fodder Resources Development Plan
B. Disseminating fodder production technologies for enhanced productivity and improved management.
C. Promoting alternate land usage
D. Focusing fodder based rationing
E. Utilizing fodder processing technologies for value addition.

Coordination Team

- Dr VK Yadav, Director — Chairman
- Dr. Purushottam Sharma, PS — Nodal Officer

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- Dr. AK Mishra, Head, Plant Animal Relationship Division
- Dr. Sunil Kumar, Head, Crop Production Division
- Dr. RV Kumar, Head, Grassland & Silvipasture Management Division
- Dr. PK Pathak, Head, FMPHT Division
- Dr. Khem Chand, Head, Social Science Division
- Dr. Shahid Ahmad, Head, Crop Improvement Division

Telangana State Fodder Resource Development Plan Committee

- Dr. RV Kumar, Coordinator
- Dr. BG Shivakumar, Chairman
- Dr. K Sridhar, Member
- Dr. NS Kulkarni, , Member

Document Formatting and Cover Design

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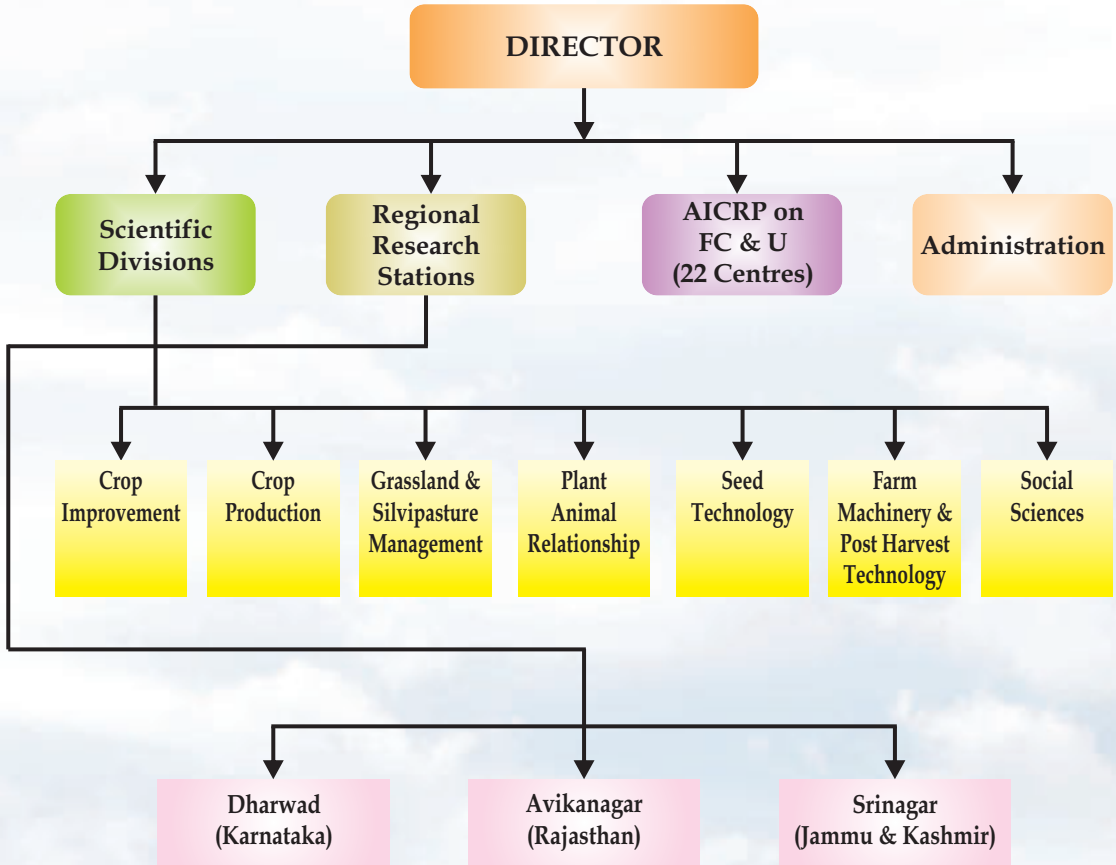
Organogram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ICAR-IGFRI - A Profile

ICAR-Indian Grassland and Fodder Research Institute, Jhansi (U.P) India

The ICAR-Indian Grassland and Fodder Research Institute (ICAR-IGFRI), Jhansi, was established in 1962 to conduct organized scientific research on grasslands and fodder production, conservation and their utilization. On 1 April, 1966, it became part of the Indian Council of Agricultural Research (ICAR). Subsequently All India Coordinated Research Project on Forage Crops and Utilization was started in 1972 with ICAR-IGFRI, Jhansi as head quarter for multi-location testing of forage varieties and technologies in different agro climatic zones of the country through 23 coordinating centers and 15 as volunteer centre's at various State Agricultural Universities/NGO/ICAR under the National Agricultural Research System. The institute consists of seven multi-disciplinary division *viz.*, Crop Improvement, Crop Production, Farm Machinery and Post-Harvest Technology, Seed Technology, Social Science, Grassland and Silvipasture Management and Plant Animal Relationship. It also has five units *viz.*, PME, HRD, ATIC, ITMU and AKMU and facilities like Library, Central Research Farm, Dairy and Central Instrumentation Lab. The institute has three regional stations located in Avikanagar (Rajasthan), Dharwad (Karnataka) and Srinagar (Jammu & Kashmir) to conduct focused forage research on arid, semi-arid and temperate climatic conditions, respectively and a grassland center at Palampur (Himachal Pradesh).

Mandate

- Basic strategic and adaptive research on improvement, production and utilization of fodder crops and grasslands.
- Coordination of research on forages and grasslands for enhancing productivity and quality for enhancing livestock productivity.
- Technology dissemination and human resource development.

The institute has successfully served the country for 58 years achieving several milestones in generation of fodder technologies. Institute was conferred with "Sardar Patel Outstanding ICAR Institution Award in the year 2015" for his remarkable progress and contributions in the field of forage research, capacity building and infrastructure development. Institute is an ISO 9001: 2015 certified institute. The institute is endeavoring in basic and applied research in both cultivated as well as range species in the fields of intensive fodder production systems, alternative fodder sources, grasslands, silvi and horti-pasture systems, seed production technology, farm mechanization, post-harvest conservation and utilization, livestock feeding and

management, etc. Institute is striving through numerous research projects at various levels like institute, inter-institute, externally funded national and international collaborative projects to address the persistent problems of fodder shortage and lack of quality forages. The institute is undertaking several new initiatives in forage research in new frontier areas.

Proven Technologies of Institute

- No. of forage varieties released: >300
- Climate resilient forage production systems under rainfed situation
- Round the year fodder production system (Irrigated situation)
- Round the year fodder production system (Rainfed situation)
- Fodder on Field boundary/Bunds/Channels
- Alternate land use systems
- Silvo-pasture model for highly degraded/ waste lands
- Horti-pastoral model for higher income in rainfed ecosystem
- Azolla as supplement feed for livestock
- Silage for sustenance of livestock production
- Community pastureland development
- Fodder production in mango orchards
- Improved varieties of grasses and cultivated fodder
- Seed production technology for all important forages
- Seed quality and field standards of forage crops
- DUS guidelines for forage crops.

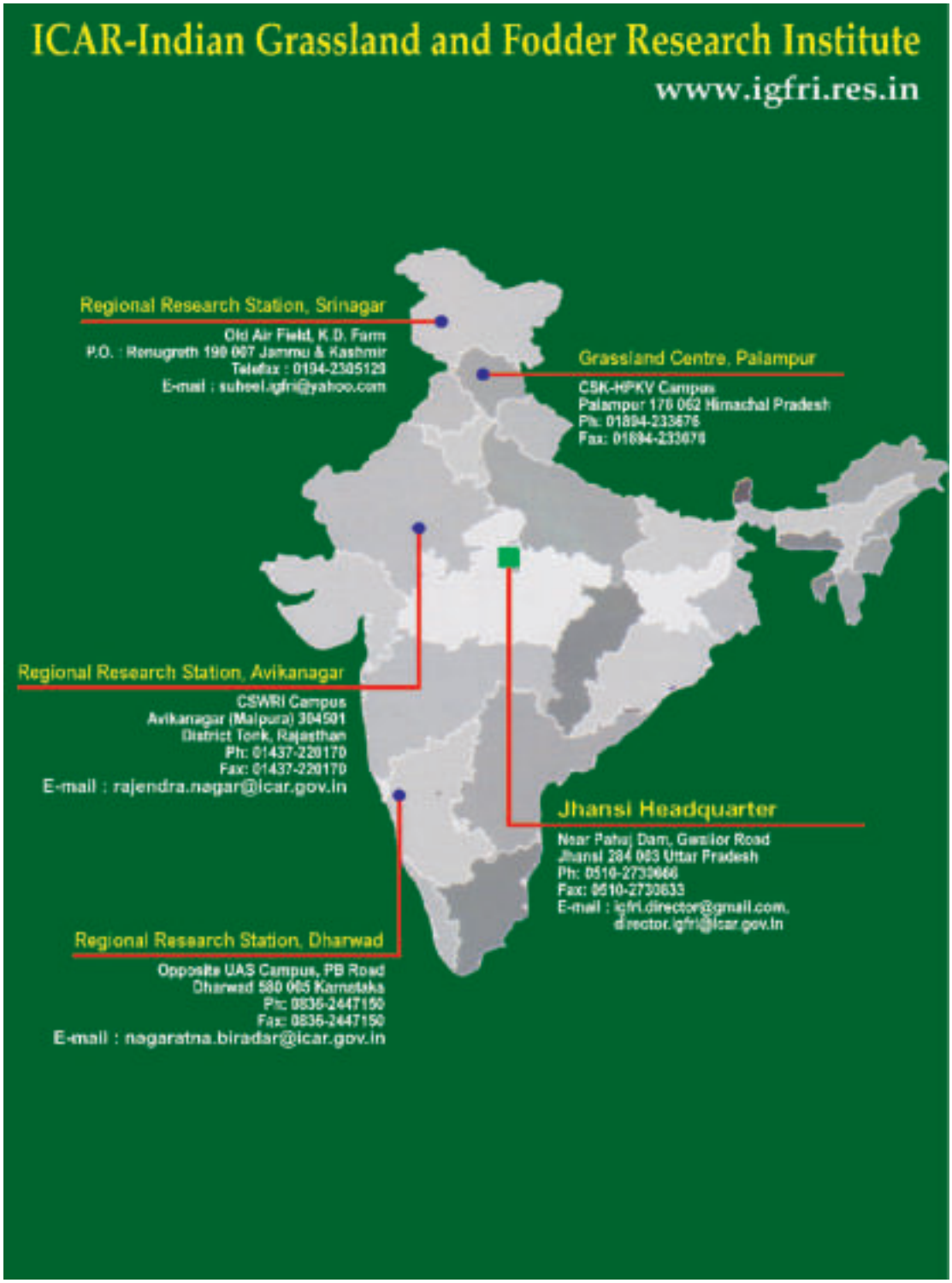
Accelerating Fodder Technology adoption

Transferring knowledge and skills are the essential component required for execution and implementation of resource conservation based projects in the country. The institute is organizing training and skill development programmes regularly of varying duration for farmers, students, state government officials, field functionaries in the field of soil and water conservation The research institutes has signed MoUs with more than 20 Gaushalas for transfer fodder production technologies. Field demonstration on validated technologies for resource conservation and productivity enhancement in red soils of Bundelkhand region are operating at full fledge. Several outreach programmes such as Adarsh Chara Gram A cluster of three villages, Mera Gaon Mera Gaurav (MGMG), National Initiative on Fodder Technology Demonstration (NIFTD), Network Project on Bhadawari Buffaloes, Participatory Fodder Production in Mango Orchards, Farmers FIRST Programme, NICRA, TSP, SCSP, NEH, DFI-Kisan Mitra and NIAFTA have been initiated and implemented.

ICAR has established in institute the Agri-Business Incubation Centre (ABIC) to provide technical knowhow to farmers, educated rural youth and develop entrepreneur.

NIAFTA: New Initiatives

Institute has initiated "National Initiative for Fodder Technologies Adoption (NIAFTA)" to formulate an implementable fodder resource development plan for each state/UT of the country suitable to specific niches which can utilize the potential of available resources to achieve self-sufficiency in fodder production and utilization. NIAFTA also aims for extension of latest research findings/technologies with the policy planners, management personnel and field level functionaries for enhancing country's fodder productivity, capacity building and skill enhancement of the fodder producers and livestock keepers on emerging technologies and also provide opportunity to interact with scientists and managers and impact assessment on fodder supply and farmers livelihood.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Part-I : Agriculture, Livestock and Fodder Scenario

A. Introduction

Telangana is one of the youngest states carved out of erstwhile Andhra Pradesh on 2nd June 2014. It consists of 33 districts spread across 1,12,077 sq. km (Figure 1). It is the 12th largest state in terms of geographical area. It has a population of 3.5 crores as per the census carried out in 2011. Telangana lies between 15° 46' and 19° 47' N latitude and 77° 16' and 81° 43' E longitude, and is bordered by the states of Maharashtra in the north and north-west, Karnataka in the west, Chhattisgarh in the north-east and Andhra Pradesh in the south and east. As per the latest records there are 33 districts in the state. A large population of Telangana resides in rural areas and mainly depends on agriculture for their livelihood. Agriculture and allied sectors contribute to 14.8% of the gross state value added during 2017-18.

Figure 1. Geographical location of Telangana in India

Climate

Telangana is centrally located in Deccan Plateau in semi-arid zone and has a hot and dry climate. The adjoining areas of Deccan Plateau experience hot summers with relatively mild winters. The state of Telangana has historically been prone to drought conditions. Summers start in March and peak in May with average high temperatures in the 42°C range. The south-west monsoon arrives in June and lasts until September with about 755 mm of rain. The north-east monsoon starts in October. The average rainfall of the State is around 905.3 mm and about 80% of annual rainfall is received from the south-west monsoon and remaining 20% is received from the north-east monsoon. A dry, mild winter starts in late November and lasts until early February with little humidity and average temperatures in the 22–23°C range. The State is also prone to hailstorms in the month of April and May, occasionally.

Land use scenario

Out of the total geographical area of 112.08 lakh hectares, forest occupies 26.98 lakh hectares, accounting for 24.07% of the total geographical area of the State. Barren and cultivable land accounts for 6.07 lakh hectare accounting for 5.42% of total geographical

area. About 8.52 lakh hectares land is put to non-agricultural uses and fallow lands (including current fallow and other fallow land) is spread over 15.03% of the total geographical area in the State (Table 1). Permanent pastures and other grazing lands occupy 2.99 lakh hectares. The state has 45.59% of the area under agriculture accounting for 47.74 lakh hectares. There is sizeable area under cultivable wastes (1.82 lakh ha), land under miscellaneous use *viz*. tree crops and groves (1.12 lakh ha) total fallow lands (both other and current fallow) has 16.84 lakh hectares accounting for 15.03% total geographical area (DES, 2019). These barren, waste, permanent pasture and grazing lands along with fallow lands provide ample scope for fodder resources development in the state. Using suitable interventions like introduction of suitable short duration varieties of grasses, a major chunk of fallow lands (both current and other fallows) can be exploited for increasing the green fodder availability from private primary grazing areas (Raju *et al,*. 2002).

Table 1. Land use pattern in Telangana in 2016-17

S.No.	Pattern of Land Utilization	Area (Lakh ha)	% Share in total geographical area
1	Forest	26.98	24.07
2	Barren and uncultivable land	6.07	5.42
3	Land put to non-agricultural uses	8.52	7.60
4	Cultivable waste lands	1.82	1.62
5	Permanent pastures and other grazing lands	2.99	2.67
6	Land under misc. tree crops and groves	1.12	1.00
7	Other fallow lands	6.69	5.97
8	Current fallow lands	10.15	9.06
9	Net area sown	47.74	45.59
10	Total	112.08	100

(**Source**: SEO, 2018)

There were 55.54 lakh holdings in the state of Telangana as per the Agricultural Census, 2010-11 and area held by them was 61.97 lakh hectares (DES 2017). They are predominantly marginal in nature (34.41 lakh) followed by small (13.27 lakh). The large holdings are very few (0.16 lakh). The average size of the holding in the state is 1.12 ha, which is highly uneconomical to operate. Another area of concern is that 62.0 percent of the holdings are marginal (<1 ha) and percentage of small holdings (1-2 ha) is 23.9 percent. Thus marginal and small land holdings constitute 85.9 percent of total agricultural holdings in the state (DES 2016). The farmers having these holding are more diversified and look for other enterprises of agriculture especially animal husbandry and poultry etc. to increase and stabilize their income (Table 2; Figure 2).

Table 2. Land holding pattern in Telangana

S.No.	Category	No. of holdings	Area operated	% of total holdings	% of total area operated
1	Marginal (0.5-1.0 ha)	3441087	1566779	61.96	25.28
2	Small (1.0-2.0 ha)	1327362	1869352	23.90	30.17
3	Semi Medium (2.0-4.0 ha)	602925	1585135	10.86	25.58
4	Medium (4.0-10.0 ha)	166833	926760	3.00	14.96
5	Large (>10 ha)	15775	248799	0.28	4.01
6	Total	5553982	6196824	100.00	100.00

(**Source**: Agriculture Action Plan Inner, 2019-20)

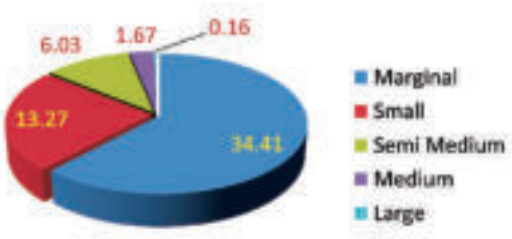

Figure 2. Land holding pattern in Telangana

The average size of the operational landholding in the state is 1.12 ha in 2010-11, declined from 1.30 ha in 2005-06. The operational landholding size of marginal and small farmers, who constitute about 80% of the total operational holdings in the state, remained the same. However, there had been a decline in landholding size of semi-medium, medium and large categories in the year 2010-11, when compared with 2005-06. There has been a steady decline in the average landholding size from 3.09 ha in 1970-71 to 2.22 ha in 1980-81, further to 1.75 ha in 1990-91 and to 1.37 ha in 2000-01. The decline in average land holding has been slowed down from 2000-01 onwards (Table 3).

General agriculture scenario

Agriculture is the most important occupation of the people in the state of Telangana. About 55% of the state's population is engaged in agriculture and allied activities (SEO, 2018). In the agricultural year 2016-17, about 47.74 lakh hectares was under net area sown and the gross cropped area was about 59.70 lakh hectares. The rainfall is erratic and uncertain and distribution of the rainfall is uneven in various places thus, making agriculture a proverbial gamble with the monsoons. Irrigation is one of the most important critical inputs for enhancing the

Table 3. Average land holding size in Telangana

Year	Land Holding (ha)
1970-71	3.09
1976-77	2.79
1980-81	2.22
1985-86	1.99
1990-91	1.75
1995-96	1.49
2000-01	1.37
2005-06	1.30
2010-11	1.12

(**Source**: SEO, 2018)

productivity of crops. One cannot imagine agriculture without irrigation. Two important rivers *viz*. the Godavari and Krishna are flowing through the State and providing irrigation opportunities by way of canals, tanks, tube wells, dug wells etc. Out of 30.0 lakh hectares gross irrigated area, 22.43 lakh ha is under tube wells and dug wells, while, 4.16 lakh ha through canals and 2.53 lakh ha through tank irrigation.

Cropping pattern

Cropping pattern refers to the proportionate area under different crops during agricultural year. Food crops account for major share in total cropped area in the state. The share of food and non-food crops in total cropped area was 66.4% and 33.6%, respectively in the year 2016-17. Trends in cropping pattern show that there has been a gradual decline in food crops, from 70.8% in 2001-02 to 53.5% in 2015-16, mainly on account of decline in coarse cereals. Average cropping intensity in Telangana was about 1.25 during 2016-17. However, there is a considerable variation in cropping intensity across 32 districts (excluding Hyderabad) in the state. It is observed that in 15 *districts* cropping intensity is less than the state average of 1.25. Low cropping intensity of 1.05 is observed in three districts *viz*. Adilabad, Vikarabad, and Sangareddy. The highest cropping intensity was reported in Nizamabad district at 1.84, followed by Karimnagar with 1.77. Temporal glimpses of the gross area sown reveals that rice, cotton, maize have been the important crops in the state. These three crops in the state alone constituted nearly 70% of the total cropped area in the state (Table 4).

Major forage sources

There are 3 categories of forage resources identified in the state of Telangana as in the undivided state of Andhra Pradesh:

- Community grazing lands also called as *gocharas* in plain areas
- Trees having fodder values *viz*. prosopis/*khejri,* subabul, sesbania, glyricidia, ficus etc.
- Cultivated fodder crops *viz*. fodder jowar, fodder maize, stylosanthes, napier grass, para grass, *pillipesaru* (*Phaseolus trilobus*), cowpea etc.

In recent years cultivated fodder crops *viz*. bajra napier hybrid, guinea grass, lucerne, perennial fodder sorghum etc. are becoming popular under assured irrigation areas.

Table 4. Distribution of land holdings in Telangana (2017-18)

S.No.	Crops	Area (in Lakh ha)	Yield (kg/ha)	Production (in lakh MTs.)	% Share in total cropped area
I	**Cereals and Millets**				
1	Rice	19.62	3516	62.63	34.04
2	Wheat	0.04	1596	0.06	0.07
3	Jowar	0.67	964	0.74	1.16
4	Bajra	0.09	1000	0.09	0.16
5	Ragi	0.01	887	0.01	0.02
6	Maize	6.30	3748	27.52	10.93
	Total Cereals	26.73	1673	91.05	46.37
II	**Pulses**				
1	Bengalgram	0.97	1324	1.48	1.68
2	Redgram	3.30	645	0.26	5.73
3	Greengram	0.99	638	0.63	1.72
4	Blackgram	0.38	844	0.09	0.66
5	Horsegram	0.01	0	0.00	0.02
6	Other pulses	0.06	0.06	0.07	0.10
	Total pulses	5.71	575	2.53	9.91
III	**Oil Seeds**				
1	Groundnut	1.67	1968	3.73	2.90
2	Sesamum	0.16	462	0.09	0.28
3	Sunflower	0.04	1498	0.08	0.07
4	Safflower	0.04	671	0.02	0.07
5	Soybean	1.52	1561	2.47	2.64
6	Castor	0.28	350	0.26	0.49
7	other oilseeds	0.03	1500	0.05	0.05
	Total oilseeds	3.74	1144	6.7	6.49
IV	**Other Crops**				
1	Cotton(kapas)	18.97	381	51.95	32.91
2	Chillies	0.63	3576	2.39	1.09
3	Sugarcane	0.35	70000	22.17	0.61
4	Turmeric	0.50	6011	2.49	0.87
5	Tobacco	0.04	2500	0.13	0.07
6	Onion	0.13	23833	1.99	0.23
V	**Total Cropped area**	**57.64**			

(**Source**: Agriculture Action Plan Inner, 2019-20)

Major sources of crop residues

The most common sources of fodder for livestock are crop residues, forages from common property resources (CPRs) like forests, pastures and grazing lands and cultivated fodders.

- Rice straw and maize stover (*kharif* and *rabi* seasons)
- Permanent pasture and other grazing lands
- Fodder tree species contribute to some extent

Rice alone accounted for 34.5% of the total food crop cultivated in *kharif* and 67.7% in *rabi* season, indicating its prominence for farmers in the State. Maize crop account for 24.7% and 11.9% of the total food crops area grown during *kharif* and *rabi* seasons, respectively. Jowar was another significant crop in the cereals and millets category accounting for about 2.4% in *kharif* and 2% of the total food cropped area in *rabi* season. Non-food crops were cultivated in 20.05 lakh hectares during the year 2016-17. Important non-food crops grown in the state include cotton, oil seeds, flowers and aromatic plants, tobacco and fodder. The fodder and green manure crops occupied 4585 ha, 23815 ha and 28,400 ha in *kharif, rabi* and total, respectively accounting for 1.4% share in total non-food cropped area in 2016-17.

The following crop residues are common in most of the areas:

Cereals: Rice straw

Millets: Jowar stover, bajra stover, maize stover, ragi straw etc.

Pulses: Greengram straw, bengal gram straw, red gram straw etc.

Commercial crop: Sugarcane top

Oilseeds: Groundnut straw, soybean straw etc.

Miscellaneous: Mulberry twigs

Horticulture scenario

The horticulture sector encompasses a wide range of crops namely fruit crops, vegetables crops, flower crops, spices and plantation crops. Over the years, horticulture has emerged as an indispensable component of agriculture, offering a wide range of choices to the farmers for crop diversification. Horticulture sector has been identified as one of the focus sectors for development of Telangana state. Horticulture sector contributes 40.5% to agriculture GSDP. Horticulture crops are grown in an area of 12.40 lakh acres with a production of 71.52 lakh MTs. Sector wise details are presented in Table 5.

Table 5. Area, production and productivity of horticultural crops

S.No.	Name of the crop	Area (Lakh Ac.)	Production (lakh Mts)	Productivity (MTs/Ac.)
1	Fruits	4.42	25.69	5.82
2	Vegetables	3.52	30.77	8.73
3	Spices	3.90	8.03	2.06
4	Plantation	0.45	6.49	14.33
5	Flowers	0.11	0.54	4.79
	Total	12.40	71.52	5.76

(**Source**: Govt. of Telangana, 2020)

B. Agro-climatic zones

Telangana state is divided into three agro-climatic zones *viz*. a. North Telangana Zone, b. Central Telangana Zone, and c. South Telangana Zone (Figure 3).

i. **North Telangana zone (NTZ):** It comprises the districts of Adilabad, Komaram Bheem Asifabad, Nirmal, Mancherial, Nizamabad, Jagtial, Peddapalli, Kamareddy, Rajanna Sircilla and Karimnagar. Annual rainfall ranges from 867 mm to 1189 mm, received mostly from the south-west monsoon rainfall. During this season maximum temperatures range between 31^0 and 39^0 C and minimum range between 14^0 and 25^0 C. There are 16 types of soils in NTZ. It has shallow black soils (18.4%), deep calcareous soils (16.6%) and red clayey soils (15.2% of area). However, as a whole, red soils of different textures are predominant in this zone to

Figure 3. Agro-climatic zones of Telangana

an extent of 45 per cent and are followed by black soils (24%) and calcareous soils (20%). Predominant crops in this zone include rice, maize, soybean, sesame, cotton, redgram, sugarcane and turmeric.

ii. **Central Telangana Zone (CTZ):** It consists of the districts of Sangareddy, Medak, Siddipet, Jangaon, Warangal Urban, Warangal Rural, Mahabubabad, Jayashankar Bhupalapally, Bhadradri Kothagudem and Khammam. The annual rainfall ranges from 779 to 1213 mm, received mostly from south-west monsoon. During rainy season maximum temperature ranges between 29 and 39^{0}C and minimum ranges between 16 and 25^{0}C. There are 19 types of soils in CTZ. It has red shallow gravelly soils (12.4%), red clayey soils (12.2%), deep calcareous soils (9%), red gravelly loam (8.5%) and colluvial soils (8% of the area). Red type of soils, as a whole in this zone occupies 54 per cent and is followed by calcareous soils (13%), colluvial soils (8%) and black soils (6%). Predominant crops in this zone include cotton, rice, maize, greengram, mango, sugarcane and chillies

iii. **South Telangana Zone (STZ):** It includes the districts of Vikarabad, Medchal, Malkajgiri, Hyderabad, Yadadri Bhuvanagiri, Rangareddy, Mahabubnagar, Nalgonda, Suryapet, Wanaparthy, Nagarkurnool and Jogulamba Gadwal districts. Annual rainfall ranges from 606 to 853 mm, received mostly from south west monsoon rainfall. During this season maximum temperature ranges between 28^0 and 38^{0}C and minimum ranges between 16 and 25^{0}C. There are 19 types of soils in this zone. It has red clayey soils (22.3%), red gravelly loam (16.5%) and alluvio-colluvial soils (14.4% of the area). As a whole, the zone is dominated by different textured red soils with varied depths to an extent of 54.8 per cent and is followed by alluvio-colluvial soils and calcareous soils (11.2%). Predominant crops in this zone include sorghum, cotton, rice, redgram, sesame maize, castor, safflower and groundnut.

C. Interactive Workshop-IGFRI and State Department

An interactive online workshop on "Fodder Resources Development Plan for Telangana" was organized on 4th July 2020. Dr. Lakshma Reddy, Director, Directorate of Animal Husbandry, Govt. of Telangana, Chaired the workshop.

Dr. V.K. Yadav, Director, ICAR-IGFRI, Jhansi briefly outlined the purpose of holding this online workshop. He highlighted the significant contributions of the IGFRI Jhansi catering to the fodder needs in the country and importance of this workshop.

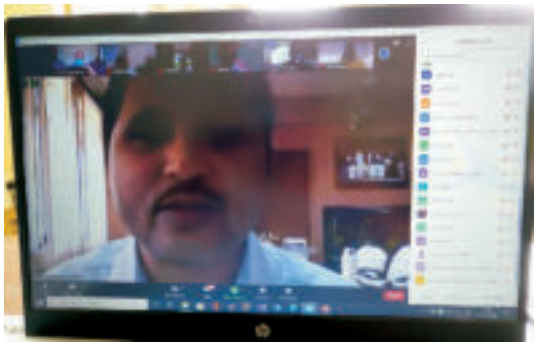

Figure 4. Director, IGFRI Jhansi giving inaugural remarks

Dr. V. Lakshma Reddy, Director of Animal Husbandry, Govt. of Telangana, Hyderabad, in his introductory remarks appreciated the

efforts of ICAR-IGFRI, Jhansi for initiative on Fodder Resources Development Plan and organizing this online meeting.

Dr. B.G. Shivakumar, Principal Scientist & Officer-in-Charge, ICAR-IGFRI, Southern Regional Research Station, Dharwad made a detailed presentation on "Fodder Resources Development Plan for Telangana state".

From ICAR-IGFRI, Jhansi, Dr. A.K. Roy, Project Coordinator (Forage Crops and Utilization), Dr. R.V. Kumar, Head, GSM Division, Dr. Sultan Singh, Principal Scientist, made their presentation. Dr. Sunil Kumar, Head Crop Production Division, Dr. A.K. Mishra, Head, Plant and Animal Relationship Division, Dr. Shahid Ahmed, Head Crop Improvement Division, Dr. P.K. Pathak, Head Farm Machinery and Post-Harvest Technology Division and Dr. Khem Chand, Head Social Sciences Division provided valuable inputs.

Dr. Jagadeeshwar, Director of Research, PJTSAU, Hyderabad, Dr. B. Singh, Director, RSFPD, Hyderabad, Dr. D.V.B. Ramana, Principal Scientist, ICAR-CRIDA, Hyderabad, Dr. Venkatesh Bhat, Principal Scientist, ICAR-IIMR, Hyderabad, Dr. Dasari Sreenivas, Professor & Head, Veterinary College, Korutla, Jagatial, Dr. Shashikala, Professor & In-charge, AICRP (FCU), PJTSAU, Hyderabad, Dr. Venkatanarayana, DV&AHO, Warangal and Dr. Madhusudan, DV&AHO, Mahbubnagar also presented their views.

Dr. V.K. Yadav, Director, ICAR-IGFRI, Jhansi in his concluding remarks urged all the stake holders to work in coordination and contribute for the finalization of the Fodder Plant and to implement this in Telangana state (Annexure-I).

D. Livestock scenario

Telangana is blessed with rich livestock resources especially sheep accounting for 25.67% of India's sheep population. Around 2.9 million families depend on livestock sector for their livelihood and livestock sector is emerging as one of the most potential and income generating sector for rural and semi urban areas. As per 2019 livestock census there were 4.22 million cattle (15^{th} rank in India), 4.93 million buffaloes (9^{th} rank in India), 19.06 million sheep (1^{st} rank in India), 4.65 million goats (12^{th} rank in India) and a total 32.63 million livestock (8^{th} rank in India) (Table 6-7). The district-wise distribution of live stock as per 20^{th} livestock census is presented below (Tables 8-12).

Cattle, buffaloes, sheep and goats account for 13.04, 13.02, 58.73 and 15.20% of the total state livestock population, respectively. Cattle in the state are mostly indigenous (85.57%) and crossbreds are only 14.43% of the total cattle population. Around 60% of total cross breed cattle population of the state is found in southern Telangana region, whereas northern Telangana and central Telangana have 25 and 15%, respectively (Raju *et al.*, 2018). Large number of buffaloes are female (92.57%) of which about 37.21% are milking while the male buffaloes constitute only 7.43% of the total buffaloes in the state. In sheep, only 2.55% is exotic while 97.45% is indigenous. The two districts of Mahbubnagar and Nalgonda account for nearly 18% of the states' sheep population.

The animal husbandry and dairying are important sectors within agriculture. They contributed Rs. 55,394 crores accounting for 7% of the Gross State Domestic Product (GSDP) at Current Prices in 2018-19 (DES, 2019). The sector has been playing a significant role in supplementing family incomes and generating employment opportunities in the rural sector, particularly among the land-less, small and marginal farmers and women besides providing nutritious food. The data on population of cattles, buffaloes, sheep and goat is presented in Table 8. There are several indigenous and exotic breeds of livestock observed in Telangana. The major breeds under cattle include Deoni, Ongole, crossbred Holstein Frisian (HF), Jersey, cross bred of Jersey and Sahiwal, non-descript breeds; buffaloes included grade Murrah, non-descript local breeds, sheep include Deccan, Nellore brown, Nellore Jodipe, non-descript and goat include Osmanabadi, Mahboobnagar and non-descript.

The state is performing well in the production of milk, meat and wool and produced 54.16 lakh tonnes of milk, 7.54 lakh tonnes of meat and 4.26 thousand tonnes of wool during 2016-17 and stood at 13th, 5th and 3rd position, respectively at the national level. The livestock keeping is considered to be one of the main sub-enterprises of agriculture. There were more than 29,75,306 livestock based households in Telangana, indicating the economic importance of livestock keeping particularly by the small and marginal land holder and land less labourers (Table 13). As per the latest government estimates, the three north Telangana districts of Nirmal, Adilabad and Kumaram Bheem Asifabad have the highest density of cattle population with 600-750 cattle for every 1000 population. The density of cattle and buffaloes population in Telangana is presented in Figure 4.

Table 6. Livestock population of Telangana

S.No.	Particulars	Number (million)	% population of India	Rank among states
1	Cattle	4.22	2.19	15
2	Buffaloe	4.23	3.85	9
3	Sheep	19.06	25.67	1
4	Goat	4.93	3.31	12
5	Total	32.63	6.09	8

(**Source**: BAHS, 2019)

Table 7. Milk, meat and wool production in Telangana

S.No.	Particulars	India	Telangana	% of India	Rank among states
1	Milk (million tonne)	187.75	5.42	2.88	13
2	Meat (Lakh tonnes)	81.14	7.54	9.29	5
3	Wool ('000 tonnes)	40.42	4.26	10.55	3

(**Source**: BAHS, 2019)

Table 8. District-wise livestock population in Telangana

District	Cattle	Buffaloe	Sheep	Goat	Total
Adilabad	311,163	48,649	153,202	186,322	699,336
Bhadradri Kothagudem	283,630	172,284	267,256	255,909	979,079
Hyderabad	15,635	23,327	13,231	33,876	86,069
Jangoan	106,628	129,656	679,929	126,668	1,042,881
Jayashankar Bhupalapall	168,849	123,890	420,601	156,331	869,671
Jogulamba Gadwal	75,463	58,240	576,693	67,568	777,964
Jagitial	47,405	124,248	610,985	97,033	879,671
Kamareddy	112,157	181,068	573,769	167,831	1,034,825
Kumuram Bheem Asifabad	264,451	49,445	160,958	259,539	734,393
Karimnagar	82,412	95,344	638,706	92,687	909,149
Khammam	141,117	375,097	667,318	190,013	1,373,545
Mahabubabad	181,554	129,628	677,881	178,035	1,167,098
Mancherial	179,757	105,798	520,731	183,526	989,812
Medchal Malkajgiri	27,068	59,895	149,401	40,020	276,384
Mahbubnagar	239,883	149,637	2,302,222	280,693	2,972,435
Medak	89,355	189,505	637,063	152,619	1,068,542
Nagarkurnool	223,475	111,755	967,926	206,403	1,509,559
Nalgonda	203,456	309,135	1,098,300	336,324	1,947,215
Nirmal	179,045	121,193	502,576	131,866	934,680
Nizamabad	101,252	206,898	735,549	156,619	1,200,318
Peddapalli	55,946	90,633	549,286	96,449	792,314
Rajanna Sircilla	43,818	73,422	388,227	87,723	593,190
Rangareddi	240,826	167,018	767,125	256,632	1,431,601
Sangareddy	153,829	165,273	438,757	229,029	986,888
Siddipet	126,615	177,912	801,259	183,442	1,289,228
Suryapet	95,148	289,759	779,090	140,439	1,304,436
Vikarabad	172,506	80,401	237,536	254,144	744,587
Wanaparthy	75,089	72,531	976,832	80,608	1,205,060
Warangal Urban	38,125	67,141	387,742	54,787	547,795
Warangal Rural	91,917	119,476	732,481	103,591	1,047,465
Yadadri Bhuvanagiri	104,965	158,048	650,426	147,947	1,061,386
Total	4,232,539	4,226,306	19,063,058	4,934,673	32,456,576

(**Source**: BAHS, 2019)

Table 9. District-wise indigenous, crossbred / exotic and total cattle population in Telangana

District	Exotic /crossbred	Indigenous	Total
Adilabad	5,764	305,399	311,163
Bhadradri Kothagudem	1,946	281,684	283,630
Hyderabad	6,266	9,369	15,635
Jangoan36,611	70,017	106,628	
Jayashankar Bhupalapalli	535	168,314	168,849
Jogulamba Gadwal	1,166	74,297	75,463
Jagitial 4,184	43,221	47,405	
Kamareddy	8,097	104,060	112,157
Kumuram Bheem Asifabad	882	263,569	264,451
Karimnagar	42,903	39,509	82,412
Khammam	4,043	137,074	141,117
Mahabubabad	1,358	180,196	181,554
Mancherial	3,235	176,522	179,757
Medchal Malkajgiri	19,290	7,778	27,068
Mahbubnagar	47,201	192,682	239,883
Medak 5,652	83,703	89,355	
Nagarkurnool	45,649	177,826	223,475
Nalgonda	7,383	196,073	203,456
Nirmal 2,480	176,565	179,045	
Nizamabad	9,289	91,963	101,252
Peddapalli	12,208	43,738	55,946
Rajanna Sircilla	12,485	31,333	43,818
Rangareddi	163,525	77,301	240,826
Sangareddy	12,290	141,539	153,829
Siddipet	48,268	78,347	126,615
Suryapet	2,234	92,914	95,148
Vikarabad	23,545	148,961	172,506
Wanaparthy	3,714	71,375	75,089
Warangal Urban	14,057	24,068	38,125
Warangal Rural	2,823	89,094	91,917
Yadadri Bhuvanagiri	61,730	43,235	104,965
Total 610,813	3,621,726	4,232,539	

(**Source**: BAHS, 2019)

Table 10. District-wise male, female, milking and total population of buffaloes in Telangana

District	Male	Female	Milking	Total
Adilabad	4,122	44,527	14,677	48,649
Bhadradri Kothagudem	19,633	152,651	53,732	172,284
Hyderabad	1,642	21,685	13,908	23,327
Jangoan	9,937	119,719	42,738	129,656
Jayashankar Bhupalapall	8,906	114,984	38,829	123,890
Jogulamba Gadwal	1,990	56,250	20,093	58,240
Jagitial	6,769	117,479	39,818	124,248
Kamareddy	7,603	173,465	58,710	181,068
Kumuram Bheem Asifabad	5,825	43,620	15,174	49,445
Karimnagar	6,942	88,402	34,068	95,344
Khammam	24,257	350,840	129,800	375,097
Mahabubabad	11,387	118,241	43,016	129,628
Mancherial	7,905	97,893	35,457	105,798
Medchal Malkajgiri	6,849	53,046	24,987	59,895
Mahbubnagar	10,552	139,085	53,709	149,637
Medak	16,013	173,492	65,191	189,505
Nagarkurnool	5,731	106,024	41,329	111,755
Nalgonda	22,336	286,799	99,022	309,135
Nirmal	8,996	112,197	38,926	121,193
Nizamabad	8,171	198,727	64,603	206,898
Peddapalli	3,961	86,672	33,755	90,633
Rajanna Sircilla	4,884	68,538	27,582	73,422
Rangareddi	16,659	150,359	72,104	167,018
Sangareddy	13,197	152,076	58,465	165,273
Siddipet	12,891	165,021	64,538	177,912
Suryapet	18,323	271,436	98,636	289,759
Vikarabad	7,749	72,652	28,356	80,401
Wanaparthy	6,902	65,629	26,829	72,531
Warangal Urban	5,428	61,713	25,987	67,141
Warangal Rural	7,362	112,114	42,692	119,476
Yadadri Bhuvanagiri	21,284	136,764	48,830	158,048
Total	314,206	3,912,100	1,455,561	4,226,306

(**Source**: BAHS, 2019)

Table 11. District-wise indigenous, crossbred / exotic and total sheep population in Telangana

District	Exotic/crossbred	Indigenous	Total
Adilabad	1,898	151,304	153,202
Bhadradri Kothagudem	1,960	265,296	267,256
Hyderabad	265	12,966	13,231
Jangoan	3,692	676,237	679,929
Jayashankar Bhupalapalli	39,481	381,120	420,601
Jogulamba Gadwal	521	576,172	576,693
Jagitial	5,994	604,991	610,985
Kamareddy	19,919	553,850	573,769
Kumuram Bheem Asifabad	507	160,451	160,958
Karimnagar	32,505	606,201	638,706
Khammam	2,817	664,501	667,318
Mahabubabad	4,550	673,331	677,881
Mancherial	984	519,747	520,731
Medchal Malkajgiri	2,506	146,895	149,401
Mahbubnagar	49,573	2,252,649	2,302,222
Medak	8,356	628,707	637,063
Nagarkurnool	5,770	962,156	967,926
Nalgonda	20,925	1,077,375	1,098,300
Nirmal	398	502,178	502,576
Nizamabad	24,915	710,634	735,549
Peddapalli	25,190	524,096	549,286
Rajanna Sircilla	23,344	364,883	388,227
Rangareddi	35,934	731,191	767,125
Sangareddy	21,527	417,230	438,757
Siddipet	65,593	735,666	801,259
Suryapet	11,677	767,413	779,090
Vikarabad	6,851	230,685	237,536
Wanaparthy	1,069	975,763	976,832
Warangal Urban	8,386	379,356	387,742
Warangal Rural	2,386	730,095	732,481
Yadadri Bhuvanagiri	57,458	592,968	650,426
Total	486,951	18,576,107	19,063,058

(**Source**: BAHS, 2019)

Table 12. District-wise male, female and total goat population in Telangana

District	Male	Female	Total
Adilabad	42,497	143,825	186,322
Bhadradri Kothagudem	70,361	185,548	255,909
Hyderabad	8,701	25,175	33,876
Jangoan	23,286	103,382	126,668
Jayashankar Bhupalapalli	27,969	128,362	156,331
Jogulamba Gadwal	13,855	53,713	67,568
Jagitial	14,767	82,266	97,033
Kamareddy	22,591	145,240	167,831
Kumuram Bheem Asifabad	67,621	191,918	259,539
Karimnagar	16,578	76,109	92,687
Khammam	37,148	152,865	190,013
Mahabubabad	41,675	136,360	178,035
Mancherial	33,543	149,983	183,526
Medchal Malkajgiri	6,751	33,269	40,020
Mahbubnagar	51,056	229,637	280,693
Medak	24,705	127,914	152,619
Nagarkurnool	35,106	171,297	206,403
Nalgonda	63,741	272,583	336,324
Nirmal	20,864	111,002	131,866
Nizamabad	19,008	137,611	156,619
Peddapalli	15,984	80,465	96,449
Rajanna Sircilla	20,664	67,059	87,723
Rangareddi	66,586	190,046	256,632
Sangareddy	39,529	189,500	229,029
Siddipet	32,300	151,142	183,442
Suryapet	39,952	100,487	140,439
Vikarabad	47,406	206,738	254,144
Wanaparthy	19,972	60,636	80,608
Warangal Urban	11,139	43,648	54,787
Warangal Rural	27,763	75,828	103,591
Yadadri Bhuvanagiri	40,661	107,286	147,947
Total	1,003,779	3,930,894	4,934,673

(**Source**: BAHS, 2019)

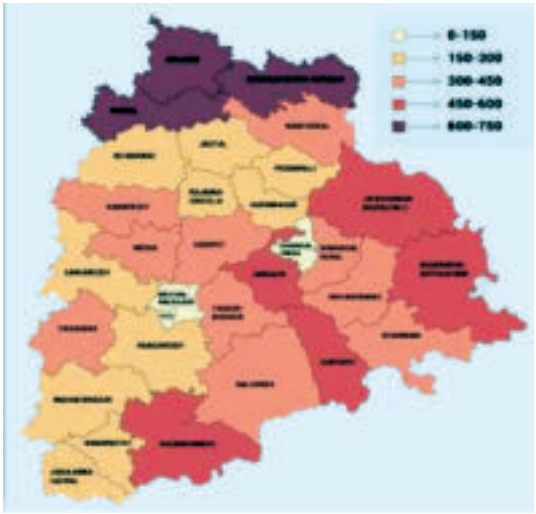

Figure 5. Cattle and buffaloes population per 1000 persons (Source: www.opendata@telangana.gov.in**)**

Table 13. Number of households and household enterprises owning animals in undivided districts of Telangana (Source: BAHS, 2012)

District	Cattle	Buffaloes	Goats	Sheep
Adilabad	204918	64639	51871	18133
Hyderabad	7623	14258	25876	7184
Karimnagar	121904	155247	33664	52537
Khammam	126641	130024	29426	10379
Mahabubnagar	205269	106944	71494	87930
Medak	105084	101426	49327	25041
Nalgonda	114331	190207	43962	46562
Nizamabad	51983	89055	13130	10311
Rangareddy	86850	67854	60919	23285
Warangal	170256	138161	26967	34634
Total	1194859	1057815	406636	315996

E. Fodder scenario

There is an acute shortage of feed and fodder resources, which is one of the major causes for low production levels of livestock. Fodder based cheaper feeding strategies are required to reduce the cost of quality livestock product as the feed alone constitutes 70% of the milk production cost. There is tremendous pressure of livestock on available total feed and fodder, as land available for fodder production has been decreasing. To meet the current level of livestock production and its annual growth in population, the deficit in all components of fodder, dry crop residues and feed has to be met either from

increasing productivity, utilizing untapped feed resources and increasing land area under fodder production. There is an immediate need to develop integrated planning for crop and animal production at village level (TFR, 2015).

Telangana state is located in semi-arid region with rainfall as major source of water. The rainfall is seasonal in character with short rainy season of 3 to 4 months and the state experiences dry conditions for 8 to 9 months in various parts and more so in southern parts of Telangana. Acute water scarcity conditions for longer periods will trigger drought. Prolonged water scarcity conditions prevailing over larger areas lead to severe droughts. During most of the years, some parts of the state or the other experience drought which do not have access to water resources other than rainfall (Figure 6).

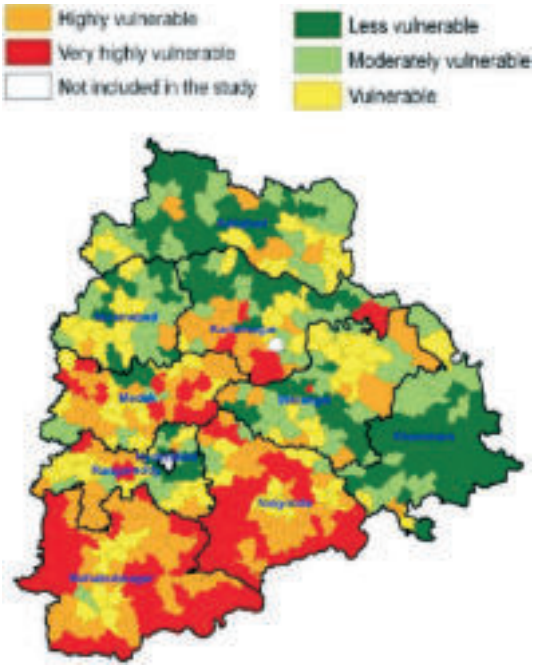

Figure 6. Agricultural drought vulne*rabi*lity in Telangana

Fodder shortage is a very important indicator to provide information on drought impact. Cattle wealth is the mainstay of the rural economy. As small and marginal farmers constitute majority among total community of farmers in the state, their only asset is cattle apart from their small landholdings. Cattle ownership diversifies production and resource management options, increases total farm production and income, provides year-round employment and spreads risk. In all the studies, related to vulne*rabi*lity of farmers, it has been found that the more cattle heads a farmer owns, the less vulnerable the farmer is to fluctuating finances. Only a small fraction of area under food crops is used for growing fodder crops in the state of Telangana leading acute scarcity of fodder for the livestock (Table 14). Telangana has an area of about 3.02 lakh hectares of permanent pastures and grazing lands was recorded in 2012-13 (DES 2015). Permanent pasture lands are very less in northern Telangana (25%), whereas central Telangana and southern Telangana occupy 37 and 38%, respectively. Area under miscellaneous tree crops is highest in central Telangana followed by southern Telangana and northern Telangana southern Telangana contains only 15% of the total forest area in the state whereas it is 40 & 45% in northern Telangana and central Telangana, respectively. Private primary grazing area is more in southern Telangana as it has more area under fallow lands.

During a drought situation, every measure needs to be taken to save useful cattle. It is necessary to provide support to farmers for fodder so that they do not engage in distress selling of their cattle. It is also very important that they continue to sell milk and other products so that they have an alternative stream of income. Availability of green fodder for milch animals must be on the agenda during the drought years. Thus there is a great opportunity for fodder production in the state of Telangana as the drought probability is very high (Anon. 2016).

Availability of quality fodder, particularly during the months of November-May, is a major issue in Telangana. During summer period livestock has to rely on crop residues like rice straw, maize stover, sorghum stover, cotton stalk, red gram stalk etc. With this, animals get low nutritive value feed, undernourished leading to severe metabolic disorders and reproductive problems. The frequent droughts and preference to food crops in irrigated areas often lead to acute scarcity of fodder. There is a huge opportunity of fodder crops in many areas of the state.

Table 14. Area (ha) under food and fodder crops in Telangana

Season	Food crops	Fodder and green manure crops	% area under fodder and green manure crop
Kharif	2578283	4585	0.18
Rabi	1387088	23815	1.72
Total	3965371	28400	0.72

(**Source**: SEO, 2018)

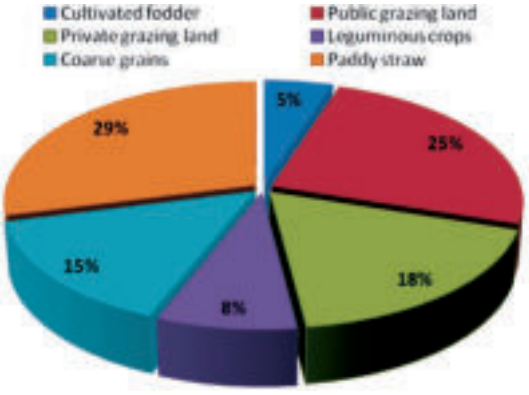

Figure 7. Major fodder resources in Telangana

Cattle and buffaloes are largely fed with crop residues and grazing to an extent with cultivated fodder. The most common sources of fodder for livestock are crop residues, forages from common property resources (CPRs) like forests, pastures and grazing lands and cultivated fodders (Figure 7) (Shashikala *et al.,* 2017). Sheep and goats are generally not given any feeding since they are reared only on grazing. Tree fodders often called multipurpose tree species (MPTs) also meet the fodder needs to some extent during lean periods. As per the estimates of Raju *et al.* (2018) there was 19.47 million tonnes of dry matter availability in the state (Tables 15-17). Of this about 12% was contributed by green fodder. The contribution of cultivated green fodder and fodder from farm bunds accounted for 11 and 6% of the total green fodder availability in the state. A large part of cultivated green fodder was in northern Telangana. Crop residues contributed to about

77% of the total dry matter available in Telangana. Apart from rice and maize crop residues (85%), sorghum, green gram, bengalgram and ground nut also contributed for the dry matter pool of the state. Legumes contributed nearly 11% of total crop residues.

Table 15. Potential feed availability from different sources in Telangana

Item	North Telangana	Central Telangana	South Telangana	Total
Green fodder ('000 tonnes)				
Cultivated fodder	183.0	22.3	62.6	267.9
Private primary grazing	96.1	109.0	272.7	477.8
Public primary grazing	112.9	170.6	165.7	449.2
Public secondary grazing	416.0	458.2	154.4	1028.6
Fodder from farm bunds	50.9	46.8	50.7	148.4
Sugarcane tops	1.1	3.4	0.5	5.0
Total greens	860	810	707	2377
Crop residues ('000 tonnes)				
Fine straw	2748	1940	1727	6415
Coarse straw	2512	2545	1531	6587
Legume straw	663	336	638	1638
Sugarcane crop residues	78	246	36	360
Total DM	6001	5075	3932	15008
Concentrates ('000 tonnes)				
Grains	429	427	253	1108
Brans and chunnies	173	123	110	406
Oil seed cakes	226	129	207	561
Total DM concentrates	828	686	569	2083
Availability for ruminants('000 tonnes)				
Total DM	7341	6284	4969	18593
Green fodder	860	810	707	2377
Dry fodder	6001	5075	3932	15008
Concentrates	480	398	330	1208
Concentrates for poultry	348	288	239	875
Availability (%)				
Total DM	113	83	61	84
Green fodder	44	38	31	37
Dry fodder	152	120	86	118
Concentrates	93	44	34	51

(**Source**: Raju *et al.,* 2018)

Table 16. Region-wise crop-residue availability ('000 tonnes) in Telangana

Crop residues	North Telangana	Central Telangana	South Telangana	Total
Paddy straw	2744	1156	2503	6403
Wheat straw	4	3	0	7
Sorghum straw	93	183	15	292
Bajra straw	15	6	2	24
Maize straw	2403	2516	1351	6271
Ragi straw	0	5	0	5
Small millet straw	0	1	0	1
Sugarcane top	0	1	1	2
Horsegram straw	30	49	63	142
Greengram straw	28	26	13	68
Blackgram straw	50	116	30	195
Redgram straw	110	106	4	220
Bengalgram straw	5	2	6	13
Cowpea straw	35	374	162	571
Groundnut straw	78	228	55	360
Soyabean straw	2	0	0	2
Other straws	403	21	0	425
Palm residue	6	5	4	15
Total	6001	4794	4212	15008

(**Source**: Raju *et al.*, 2018)

Table 17. Region-wise concentrate availability ('000 tonnes) in Telangana

Ingredient	North Telangana	Central Telangana	South Telangana	Total
Rice bran	169	119	106	394
Sorghum grain	2	1	3	6
Maize grain	385	395	223	1003
Cotton seed cake	26	31	23	80
Ground nut cake	12	41	147	200
Sesamum cake	3	1	0	4
Sunflower cake	5	8	2	16
Soya bean meal	184	9	0	194
Castor cake	0	1	25	26
Broken rice grain	42	30	26	99

Pulse chunnies	4	4	4	11
Palm by products	0	11	0	11
Pulse hulls	4	4	4	11
Miscellaneous				
Total	846	662	575	2083

(**Source**: Raju *et al.*, 2018)

SWOT Analysis

The state of Telangana has inbuilt strengths both in terms of fodder resources and animal husbandry and weakness in terms of lesser emphasis on fodder cultivation, lack of technical know-how about fodder cultivation and small land holdings. There is a great opportunity for developmental activities towards augmenting fodder resources as there is a very good demand for milk, meat and their by-products. Addressing the envisaged threats is also important for realizing the objective of augmenting fodder resources in the state (Table 18).

Table 18. SWOT analysis and factors regarding fodder development in Telangana

		Failure factor
Internal factor	**Strength**	**Weakness**
	• Most common sources of fodder for livestock are Crop residues 52% and crop residues are in abundance • Forages from common property resources (CPRs) like forests, pastures and grazing lands 43% • Fallow lands (including current fallow and other fallow land) was spread over 15.03% of the total geographical area in the State • Availability of high yielding varieties of different fodder crops • State is performing well in the production of milk, meat and eggs at the national levels there by more scope for end products of livestock • Large area under irrigation through canals, tube wells, dug wells etc. • Permanent pastures and other grazing lands of 2.99 lakh ha available for sheep and goats • Varied agro-climatic conditions persist in the state for growing fodder crops round the year • Increased demand for livestock products reflect the raising need of feed and fodder • Introduction of fodder trees *viz*. subabul, glyricidia, sesbania, prosopis etc. as sources of fodder during lean period • Introduction of potentially high yielding perennial fodder crops in irrigated areas	• Lack of technical manpower resource in fodder development • The operational landholding size of marginal and small farmers, who constitute about 80% of the total operational holdings in the state, remained the same. • Area under fodder crops is almost negligible and static in the state • Forage crops being low priority crops and hence unorganized small markets • Lack of promotional infrastructure facilities for forage seed production • Lack of organized marketing of fodder and transportation is difficult due to bulky in nature • Regional fodder imbalance and uneven fodder production and distribution • Uneven and unreliable seasons/drought/ calamities • Increasing cost of inputs *viz*., fertilizers, irrigation, transport costs • Changing land use pattern- shift towards non-agricultural purpose • Weed infestation and spread • Less funding for R&D in fodder priority areas • Water becoming scarce commodity due to climatic changes

External factor	• Optimum utilization of land resources can reduce the fodder deficit in the state • Production of azolla as source of fodder under in house fodder cultivation systems. • Establishment of dry fodder banks and silage units in drought prone villages. • Value addition of dry fodder *viz*. rice straw, millet straw and forest hays with urea spray • Growing of fodder crops in interspaces of orchards in dry land horticulture regions • Using non-conventional niches *viz*. bunds, farm pond embankments, non-cultivable waste lands, un-utilized land in the fields, kitchen backyards etc. for growing of fodder crops. • Utilization of CPR's for growing fodder trees, range grasses and legumes	• Uncertain climatic scenario like floods, droughts etc. • Migration of work force (farming) from rural to urban areas for employment and in search of better opportunities

Table 19. Region-wise concentrate availability ('000 tonnes) in Telangana

Ingredient	North Telangana	Central Telangana	South Telangana	Total
Rice bran	169	119	106	394
Sorghum grain	2	1	3	6
Maize grain	385	395	223	1003
Cotton seed cake	26	31	23	80
Ground nut cake	12	41	147	200
Sesamum cake	3	1	0	4
Sunflower cake	5	8	2	16
Soya bean meal	184	9	0	194
Castor cake	0	1	25	26
Broken rice grain	42	30	26	99

Part-II : Fodder Resource Development Plan

The annual requirement and availability of fodder and feed in Telangana for the year 2016 as per the assessment of National Institute for Animal Nutrition and Physiology (NIANP), Bengaluru is presented in Table 20. It is observed that there was acute scarcity of green fodder to a tune of 39,97,000 metric tonnes accounting for 62% of the total requirement, while there was surplus of dry fodder to a tune of 22,60,000 metric tonnes. However poor collection and conservation affected the dry fodder availability many a times during the lean period. It is therefore necessary to formulate a comprehensive fodder resources development plan for sustainable fodder production in the state.

Table 20. Requirement and availability of green and dry fodder in Telangana

S.No.	Particulars	Available (t)	Requirement (t)	Deficit (t)
1	Green fodder	23,77,000	63,74,000	-39,97,000(-62%)
2	Dry fodder	1,50,08,000	1,27,48,000	+22,60,000(+17%)

(**Source**: NIANP, 2017)

Cattle and buffaloes are largely fed with crop residues, grazing in fallows to some extent and feeding with cultivated fodder to limited extent. The most common sources of fodder for livestock are crop residues, forages from common property resources (CPRs) like forests, pastures and grazing lands and cultivated fodders. Sheep and goats are generally not given any feeding as they are reared generally on grazing. Tree fodders often multipurpose tree species (MPTS) also meet the fodder needs of goats and sheep to a great extent during lean periods.

Strategies for enhancing fodder resources

The food and horticulture crops occupy most of the cultivated land in the state. The fodder crops due to lesser preference do not find place as priority crops in most of the agricultural situation. Further a large number of small and fragmented land holdings do not provide a scope for introduction of fodder crops as the land holder prefer food and commercial crops to meet their food and monetary returns for their sustenance. Although animal husbandry and livestock keeping form a major component of these small land holders, they seldom think of forage crops and at times meet their fodder requirement through crop residues and natural grazing at the cost of lower productivity from the animal husbandry. There is a need for creating awareness among livestock keepers to go for forage cultivation in non-conventional niches and also earmark a small portion of their land for cultivation of fodder crops. This can be possible only when we are able to accommodate fodder crops without affecting the

presently followed agricultural practices by the farmers. In the process we have to identify the pockets of lands suitable for fodder cultivation in the present cropping and farming systems. Introduction of fodder crops through increased cropping intensity, use of community lands, non-cropped areas, field bunds, exploring the possibilities of horti-pasture systems, conservation of green fodder in the form of silage, value addition of dry fodder, crop residues in the form of bales and protecting the dry fodder from rains and fungal infection for increasing their self life will enhance the fodder availability during lean period. Multi-pronged strategies are needed for enhancing green fodder production, dry fodder conservation and proper utilization for mitigating the fodder shortage in the state.

Context specific fortification and densification of crop residues, cultivation of fodder trees on bunds, using superior dual purpose (food-feed) varieties and intercropping of cereal crops with fodder legumes, urea treatment of poor quality straws and establishing feed and fodder base at mandal level, utilizing available local feed resources in a particular agro climatic and soil condition to meet the requirements are some of the strategies to improve feed and fodder resources in Telangana (ILRI, 2015), so that the vibrant animal husbandry may be allowed unhindered growth and achieve its full potential. The details of various ways of enhancing fodder resources are presented below.

A. Cultivated fodder resources

Since fodder crops are cultivated in small area as of now, the present supply of cultivated fodder in the state is very less. There are several fodder crops suitable for cultivation in the state under diverse agro-climatic conditions. However only paragrass (*Bracharia* spp.), forage sorghum (mostly multicut), maize, napier bajra hybrid, guinea grass, anjan grass, stylosanthes, lucerne etc. are popular crops cultivated in the state of Telangana. Pillipesara (*Phaseolus trilobus*) and cowpea are grown in rice fallows with residual moisture to some extent. The area under fodder crops may be increased through development of fodder based cropping systems and round the year fodder production systems suitable for different situations. Efficient utilization of limited land resources and other agricultural inputs for obtaining the best from the harvest in the form of herbage per unit area and time is the primary objective of intensive forage production system. Intensive cropping is the only alternative to boost forage yield from irrigated lands.

Fodder-food based cropping systems

Hitherto there has been emphasis on integration of different food and commercial crops in the cropping systems and fodder and forage crops are kept out of such systems. However, selection of suitable fodder crops fit into many cropping systems and proves to be complementary to the productivity and profitability of the systems having

positive influence on the sustainability of such systems. Right combination of graminaceous and leguminous food and fodder crops improve the quality of the fodder besides maintaining the soil fertility and productivity of the soil. Some of the fodder based cropping systems suitable for the Telangana have been listed below.

Some of the promising food –fodder based cropping systems:

- Rice-Cowpea- Fodder Maize/Fodder Sorghum
- Rice-Fodder Rice bean-Maize+ Fodder Cowpea
- Rice-Lucerne (Annual)-Maize/Sorghum
- Sorghum+ Fodder Cowpea-Bengalgram/Fodder maize
- Maize+Fodder Cowpea-Bengalgram
- Redgram+Fodder Maize-Cowpea
- Redgram+Fodder Maize-Bengalgram
- Greengram+Fodder Maize-Sorghum
- Greengram+Fodder Sorghum-Bengalgram
- Soybean+Fodder Maize–Bengal gram/Fodder sorghum
- Groundnut+Fodder maize/Fodder sorghum-Bengalgram

Round the year fodder production systems

In many areas where animal husbandry is more remunerative than the mixed farming, farmers are now coming forward earmarking their entire land for fodder cultivation to ensure the availability of quality fodder to the livestock. This is more prevalent when the land holding is less remunerative for crop production. Even in mixed farming systems, farmers can earmark some area for fodder crops for continued green fodder availability round the year. Under such circumstances one can follow round the year fodder production systems to meet the green fodder requirement of the live stock. Some of the suitable fodder crops for round the year production systems are presented in Table 21.

Table 21. Fodder crops and cropping systems for round the year fodder production

Kharif (Rainy season)	*Rabi* (Winter season)	*Zaid* (Summer season)
Fodder sorghum	Cowpea	Fodder Maize
Fodder sorghum	Annual Lucerne	Fodder Maize
Fodder Maize+Cowpea	Oats	Cowpea
Fodder Maize+Cowpea	Oats	Cowpea
Fodder Sorghum+Cowpea	Oats	Fodder Maize
Fodder Cowpea	Fodder Sorghum	Fodder Maize

Under assured irrigation areas, cultivation of perennial fodder crops like bajra napier hybrid, guinea grass, lucerne etc. will provide assured green fodder supply. In rainfed areas a combination of grasses like signal grass, grazing guinea, stylosanthes, hedge lucerne etc. will also help realize green fodder during rainy season and also to make use of off-season rains (Table 22).

Table 22. Fodder production potential of the best fodder crop combinations at Hyderabad

S.No.	Fodder crop combinations	Green fodder yield (q/ha)
1	BN Hybrid + Cowpea - BN Hybrid + Cowpea - BN Hybrid +Berseem	1334
2	Maize + Cowpea - Bajra +Cowpea + Berseem	1267
3	Maize + Cowpea - Sorghum (Ratoon) + Cowpea - Berseem	1098

(**Source**: AICRP (FCU), Jhansi)

Identification of suitable crops for different agro-climatic conditions

There are large number fodder crops having varied characteristics *viz*. short growing period, wider adaptability, tolerance to biotic and abiotic stress *viz*. pests and diseases, sub-optimal temperatures and moisture and high regeneration capacity etc. The suitable crops and varieties to a given agro-climatic conditions should be identified and made available to needy farmers. This will ensure the cultivation of fodder crops by the needy farmers to meet the green fodder requirement (Table 23). Under irrigated systems, suitable annual fodder crops may be cultivated in any period of the year depending upon the photoperiod requirement of the crops. The thermo/photo insensitive crops like fodder maize, fodder cowpea may be grown all-round the year under irrigated conditions. Likewise there are suitable perennial crops for both rainfed and irrigated conditions. Although irrigated fodder crops can be grown under rainfed conditions, the fodder productivity will be lower than their full yield potential.

Table 23. Suitable fodder crops, varieties, seed/planting requirement and average yield

S.No.	Crop	Varieties	Seed or Root Slips or Stem Cuttings per ha	Average Green Fodder Yield (GFY) (t/ha/year or season)
i.	**Perennial fodder crops**			
a.	**Irrigated conditions**			
1	Bajra Napier hybrid	CO-5, CO-6, DHN 6, DHN-15, APBN 1	28,000 nos.	200-250
2	Guinea grass	Bundel Guinea - 2, Dharwad Guinea Grass 1	40,000 nos.	150-200
3	Lucerne	Anand 2, RL 88	10 kg/ha	60-80

b.	**Rainfed conditions**			
3	Perennial fodder sorghum	COFS 29, COFS 31	10 kg/ha	100-150
4	Signal grass	DBRS 1	40,000 nos.	40-50
5	Nandi grass	Locally available	40,000 nos.	20-40
6	Rhodes grass	-	40,000 nos.	20-30
7	*Stylosanthes* spp	-	10 kg/ha	20-30
ii.	**Annual fodder crops(Both for rainfed and irrigated conditions)**			
1	Fodder maize*	African Tall	40 kg/ha	35-40
2	Fodder bajra	Moti Bajra, APFB-2, APFB-09-1	20-25 kg/ha	25-30
3	Fodder sorghum**	SSV 74	15-20 kg/ha	25-30
4	Fodder cowpea*	MFC 09-1, Swetha, BL	120-25 kg/ha	15-20
5	Fodder oats**	Kent , RO-16, JHO-822	60-70 kg/ha	40-50
6	Berseem**	Warden	20-25 kg/ha	30-40
7	Annual lucerne**	Anand 1	10 kg/ha	20-30
iii.	**Fodder trees**			
1	*Caliandra* spp	Local specs	Depend on spacing	10-20
2	*Moringa oleifera*	PKM 1, Bhagya	Depend on spacing	15-20
3	Sesbanai sesban	-	Depend on spacing	15-20
4	*Glyricidia sepum*	-	Depend on spacing	10-20
5	*Acacia* spp	-	Depend on spacing	10-15

* Under irrigated conditions round the year
** Under irrigated conditions as winter crop

It is estimated that fodder and green manure crops occupy about 0.72% of the gross cropped area in the state. Hence it should be planned to bring at least 5% of the cultivated area under fodder crops. The total cultivated area of Telangana state is estimated at 47.74 lakh ha. Thus 5% area comes to 2.39 lakh ha. Assuming a cropping intensity of 1.25 it must come to about 3.0 lakh ha to have a reasonable and sustainable fodder supply in the state of Telangana. Of this, about 50% should be brought under perennial fodder crops (bajra napier hybrid, guinea grass, perennial fodder sorghum, other grasses), another 50% be brought under annual fodder crops (fodder maize, fodder sorghum, fodder cowpea etc.). In case of perennial fodder crops propagated through stem cuttings or roots, micro-nurseries may be developed in each block with 40000 rooted slips/ha and in 5 ha in each districts, in 2 years time there will be sufficient planting material for whole state. Likewise the seeds will be multiplied at each block to get sufficient seed for whole state in 2 years. In addition, pasture lands maybe developed wherever possible through the introduction of range grasses.

i. Fodder production in non-arable areas

The non arable areas are constrained by the limitation of lack of water, salinity, poor soil fertility, rugged soil surface etc. for cultivation of food crops. There is sizeable area under this category in the state of Telangana. These areas can be used for cultivation of fodder crops. The choice of crops and timely sowing determine the success of the production system. The suitable fodder crops for these areas are presented in Table 24. Besides the fodder crops, fodder trees *viz*. *Prosopis cineraria*, *Acacia* spp, subabul etc. under hot and dry conditions, *Sesbania* spp, *Erythrina* spp, *Calliandra* spp etc. under humid and moist conditions may be cultivated for enhancing the productivity and availability of fodder during lean periods.

Table 24. Fodder crops suitable for non-arable lands and their productivity

Fodder crop	Green fodder yield (t/ha)
Dinanth grass	25-30 t/ha
Perennial fodder sorghum	30-40 t/ha
Cenchrus spp	25-30 t/ha
Grazing guinea	15-20 t/ha
Stylosanthes spp	10-15 t/ha
Clitoria spp	10-12 t/ha
Hedge lucerne	15-20 t/ha
Sehima grass	2-4 t/ha

ii. Fodder production in arable areas

Indeed cultivation of fodder crops on arable areas is sure way of ensuring the availability of fodder in drought prone state likes Telangana. The arable areas may be used for cultivation of both annual and perennial fodder crops depending upon the requirement of the farmers. The annual crops although may be cultivated in diverse seasons, rainy season seems to be more appropriate and suitable for rainfall vagaries in rainfed areas. However, these crops may be grown in any season under irrigated conditions. The perennial fodder crops may be given prominence in areas where the animal husbandry and dairying are more common and constitute a major component of agricultural activities. The choice of perennial fodder crops also ensures year-round fodder availability in irrigated conditions or where life-saving irrigations are possible. The important fodder crops their varieties suitable for arable farming are presented in Table 25.

Table 25. Fodder crops suitable for arable lands

Fodder crop	Crop	Varieties
Annual		
Kharif (Rainfed)	Fodder maize	African Tall, APFM 8, J 1006, TSFM-15-5
	Fodder sorghum	SSG 59-3, Pusa Chari 6, HC 136, Pusa Chari 9, Pusa Chari 23, SV-74, SSV-84, TSFB15-4 and TSFB-15-8

	Fodder bajra	Gaint Bajra, Raj Bajra Chari 2, CO-8, TNSC 1, AVKB 19, KHB 202, Moti Bajra, APFB-2, APFB-09-1
	Fodder cowpea	UPC 5286, Bundel Lobia 1, Bundel Lobia 2, MFC 09-1, MFC-08-14, EC 4216, Vijaya
	Fodder horse gram	DFHG 1
	Fodder oats	RO 19
Rabi (Irrigated)	Fodder maize	African Tall, TSFM 15-5
	Fodder sorghum	SSG 59-3, Pusa Chari 6, HC 136, Pusa Chari 9, Pusa Chari 23, SV-74, SSV-84, TSFB15-4 and TSFB-15-8
	Fodder cowpea	UPC 5286, Bundel Lobia 1, Bundel Lobia 2, MFC 09-1, MFC-08-14, EC 4216,Vijaya
Summer (Irrigated)	Fodder maize	African Tall, APFM 8
	Fodder cowpea	UPC 5286, Bundel Lobia 1, Bundel Lobia 2, MFC 09-1, MFC-08-14, EC 4216,Vijaya
	Berseem	Wardan
Perennial		
Rainfed	Signal grass	Basilisk
	Congo signal/ruzi grass	DBRS 1
	Grazing guinea	-
	Perennial fodder sorghum	COFS 29, COFS 31
	Dinanath grass	Bundel 1, Bundel 2, IGFRI 42-1, IGFRI 43-1, CO 1, TNDN 1
	Rhodes grass	Callide
	Stylosanthes seabrana	Phule Kranti
	Clitoria spp.	-
	Hedge lucerne	CO-2,TSHL-1
	Setaria anceps	Nandi, Narok and Kazungula
	Anjan grass	CO-2, Bundel Anjan 3
Irrigated	Bajra napier hybrid	DHN-6, DHN-15, CO-6, APBN 1
	Guinea grass	DGG-1, Bundel Guinea-1, Bundel Guinea-2
	Lucerne	RL-88, Anand-2, T-9, CO-1, Anand-11

iii. Fodder production modules for different agro-climatic zones

The fodder production modules vary due to the agro-climatic conditions prevailing in each of the zones. The production modules taking into consideration the finer aspects of soil types, rainfall pattern, cropping systems, availability of natural grasses, livestock holding pattern and other available sources of fodder greatly impact the fodder production module.

a. *North Telangana Zone (NTZ)*

The North Telangana Zone (NTZ) comprises of 10 districts in the north having reasonably good rainfall of 867 mm to 1189 mm. There are variety of soils and crops ranging from rice to sesame and sugarcane to turmeric. The temperature is moderate with good moisture availability. The crop residues of food crops and sugarcane top can constitute a sizeable source of dry/green fodder.

1. Collection and conservation of crop residues of food crops and non-food crops having fodder value forms a basic strategy for augmenting fodder availability.
2. Value addition of dry fodder in the form of crop residue *viz*. rice straw, millet straw, sugarcane tops and forest hays with urea spray will help enhance the quality of the fodder.
3. Cultivation of short duration annual fodder crops like fodder sorghum, fodder bajra, fodder maize, fodder cowpea in smaller pockets and as catch crops in the event of failure of main crops will ensure the availability of fodder and tide over the fodder shortage during failure of rains.
4. Cultivation of leguminous fodders like stylosanthes on bunds, basins of horticultural crops etc.
5. Promotion of irrigated perennial fodder crops *viz*. bajra napier hybrid, guinea grass, lucerne etc. under irrigated conditions.
6. Production of azolla as source of fodder under in-house fodder cultivation systems.
7. Establishment of well protected dry fodder banks and silage units in drought prone villages.
8. Introduction of fodder tree like glyricidia, sesbania, calliandra, moringa as fence trees and hedges.
9. Production and supply of fodder seeds and planting material to needy farmers on community basis.
10. Creating awareness about fodder crops and motivation of farmers for earmarking some area for fodder cultivation on regular basis.

b. *Central Telangana Zone (CTZ)*

The Central Telangana zone (CTZ) is spread over 10 districts of central Telangana. The agro-climatic conditions are mild with annual rainfall ranges from 779 to 1213 mm, received mostly from south-west monsoon. The maximum temperature ranges between 29^0 and 39^0C and minimum ranges between 16^0 and 25^0C with variety of soil with red soil as predominant type. The food crops and horticultural crops are grown in many areas.

1. The collection and conservation of crops residues having fodder value forms the most important measure for ensuring the fodder security.

2. Cultivation of annual fodder crops *viz*. fodder sorghum, fodder bajra, fodder maize, fodder cowpea serves as major fodder buffer during drought like situations when the main crops fail and fodder scarcity come to fore.
3. The annual fodder crops also may be cultivated during the lean period under irrigated conditions to tide over fodder shortages during summer.
4. Cultivation of perennial crops like bajra napier hybrid, guinea grass, perennial fodder sorghum, lucerne in earmarked areas under irrigated conditions will ensure the continued supply of green fodder round the year.
5. Introduction of fodder trees *viz*. glyricidia, sesbania, calliandra, moringa etc. ensures the availability of green fodder during drier months of summer.
6. Collection and value addition of dry crop residues and forest hay will improve the dry fodder availability and enhance the quality of the fodder.
7. Introduction of azolla cultivation, hay making and silage insures against the fodder shortages due to unforeseen conditions of drought, crop failure and immediate fodder demand.
8. Creating awareness about importance fodder and programme for enhancing the production and distribution of fodder seeds and fodder planting material in newer niches for popularization of cultivation of fodder crops.

c. *South Telangana Zone (STZ)*

The South Telangana Zone (STZ) consisting of 10 districts in the southern Telangana constitute the driest region of the state with an annual rainfall of 606 to 853 mm, received mostly from south west monsoon. The temperature ranges of the zone are also relatively higher among the different zones. The shallow red soils are predominant with low water holding capacity. The low water requiring crops like sorghum, millets, redgram, sesame, rainfed maize, safflower, castor and ground nut are more commonly grown. The fodder scarcity is acute during the non-rainy season due to less rainfall and non-availability of irrigation water for the field crops.

1. Collection and conservation of crop residues having fodder value and forest hay will augment the dry fodder resources for use during lean periods.
2. Introduction of short duration annual fodder crops fodder sorghum, fodder bajra, fodder maize, fodder cowpea as catch crops during the failure of main crops or in small areas as source of green/dry fodder when fodder requirement is very high.
3. Use of non-cropped areas, field bunds, ravines and waste lands for cultivation of perennial fodder crops like grazing guinea, hedge lucerne, stylosanthes, cenchrus, butterfly pea etc. for continued fodder availability and land use pattern for waste lands.

4. Introduction of fodder trees *viz*. subabul, glyricidia, sesbania, prosopis etc. as source of fodder during lean period as boundary trees, in non-cropped and non-cultivable areas, will ensure the availability of green fodder during lean period and ensure better land use.
5. Introduction of perennial irrigated fodder crops like bajra napier hybrid, guinea grass, lucerne, perennial fodder sorghum etc. as part of cropping system in irrigated areas.
6. Popularization of azolla, hay making, silage making as a buffer to tide over fodder scarcity during dry months of summer and in-house fodder cultivation in urban livestock keeping and dairying.
7. Enriching of low nutritive material like rice straw, stover and forest hay through urea spray, mineral mixtures etc.
8. Growing of short duration fodder crops *viz*. fodder cowpea, fodder maize as sequence crops for harnessing the residual soil moisture.
9. Using non-conventional niches *viz*. bunds, farm pond embankments, shaded area, non-cultivable waste lands, un-utilized land in the fields, **kitchen backyard** etc. for growing of fodder crops.
10. Establishment of permanent feed and fodder banks in all drought prone villages
11. Cultivation of range grasses like *Dicanthium, Cenchrus, Sehima* etc. and range legumes like stylosanthes on drier areas, fallow community lands etc.
12. Educating farmers about scientific utilization of fodder through chaff cutter, value addition, which improve fodder use efficiency and quality of the fodder and reduce the fodder wastage.
13. Harvesting and collection of perennial local grasses, feed and fodder from community lands during monsoon and stall fed in order to reduce the energy requirements of the animals
14. Utilization of community lands for growing fodder trees, range grasses and legumes for common utilization.
15. Planting of perennial fodder crops like grazing guinea, signal grass, Rhodes grass etc. on canal bunds, natural water courses to prevent erosion and other non-cropped areas and waste lands.
16. Formation of regional fodder working groups consisting people from NGOs, village institutions, researchers and concerned government agencies and networking of these groups will ensure fodder availability during lean period.

B. Fodder production through horti-pasture and silvi-pasture systems

Several orchard and plantation crops are grown in Telangana. They occupy a sizeable cropped area. Since the planting geometry of these crops is quite spacious and the time

to fruiting or harvesting stage is quite long, there is a reasonable possibility of accommodating fodder crops in the intervening spaces without seriously affecting the growth and productivity of these crops. As the sphere of activity of root and shoot systems of orchard and plantation crops vis-à-vis the fodder crops is quite different they will not be competing for the resources whether it is water and nutrients in the soil or solar radiation in the above ground portion. Further it is not the orchard or the plantation crops that are put to inconvenience rather it is fodder crops which are put to competition but due to their inherent tolerance they will be able to survive in competition with the tall statured orchard and plantation crops and yet produce reasonable yield. It is this characteristic of the fodder crops we have to explore and exploit through hortipasture systems. Several examples of successful production fodder in horti-pastoral systems have been reported from different agro-climatic conditions in mango, sapota, guava, aonla, bael etc. at Jhansi and Dharwad. Likewise there is a great potential for fodder production in orchards and plantation crops in Telangana. The introduction of fodder crops in these horticultural crops will be complementary to *in-situ* soil and water conservation, enhancing the soil organic carbon, improving soil microflora and increasing the overall productivity of the system. Some of the suitable fodder crops for growing in the orchards and plantation crops are listed in the Table 26.

Table 26. Suitable fodder crops in fruit orchards and plantations in Telangana

Sl. No.	Orchard/Plantation Crops	Suitable fodder crops
1	Mango	**Grasses:** Guinea grass, bajra napier hybrid, perennial fodder sorghum, signal grass etc. **Legumes:** *Stylosanthes hamata,* cowpea, horsegram, hedge lucerne etc.
2	Sweet oranges and acid limes	**Grasses:** Perennial fodder sorghum, Rhodes grasss, signal grass, guinea grass etc. **Legumes:** *Stylosanthes scabra,* hedge lucerne, fodder horse gram etc.
3	Guava	**Grasses:** Guinea grass, grazing guinea, bajra napier hybrid, perennial fodder sorghum, signal grass etc. **Legumes:** *Stylosanthes hamata,* cowpea, horsegram, hedge lucerne etc.
4	Pomegranate	**Grasses:** Perennial fodder sorghum, Rhodes grasss, signal grass, guinea grass etc.

		Legumes: Stylosanthes scabra, hedge lucerne, fodder horse gram etc.
5	Oil palm	**Grasses:** Guinea grass, bajra napier hybrid, signal grass, grazing guinea etc. **Legumes:** Stylosanthes hamata, cowpea, horsegram, hedge lucerne etc.
6	Cashew nut and cocoa	**Grasses:** Guinea grass, bajra napier hybrid, signal grass, grazing guinea, Setaria ancepts etc. **Legumes:** Stylosanthes hamata, cowpea, horsegram, hedge lucerne etc.
7	Coconut	**Grasses:** Guinea grass, bajra napier hybrid, Setaria anceps, signal grass, grazing guinea etc. **Legumes:** Stylosanthes hamata, cowpea, lucerne, horsegram, hedge lucerne etc.

If an attempt is made to grow fodder crops in orchards and plantation crops under horti-pastoral systems, there is a great possibility of increasing the green fodder availability in the state. Even with a fair assumption of only 50 or 25 % of the vacant area is used for fodder production and with 50 or 25% % yield potential of the intercropped fodder crops we can realize quit a good quantity of green fodder. The anticipated availability of green fodder yield (GFY) from horti-pastoral systems in Telangana is presented in Table 27.

Table 27. Fodder production potential (tonnes) in orchards and plantation crops

Name of Crop	Area# (acres)	50% area*	25% area*	GFY** in 50% Area	GFY** in 25% Area
Mango	307,537	53,769	76,884	3,075,370	1,537,685
Sweet oranges	62,904	31,452	15,726	629,040	314,520
Acid lime	31,993	15,997	7,998	319,930	159,965
Guava	8,868	4,434	2,217	88,680	44,340
Pomegranate	3,990	1,995	998	39,900	19,950
Oil palm	34,909	17,455	8,727	349,090	174,545
Cashew nut	8,715	4,358	2,179	87,150	43,575
Coconut, cocoa etc.	1,634	817	409	16,340	8,170
Total	4 60,550	30,275	115,138	4,605,500	2,302,750

Total area under orchards and plantation crops
*Assuming 50 or 25 % area is available for fodder cultivation
** GFY in 50 and 25% area at an average 50% yield of 40 t/acre/annum

The districts having larger area under orchards and plantations will have higher share of green fodder production through horti-pastoral systems as presented in the Table 28.

Table 28. District-wise availability of green fodder (tonnes) through horti-pastoral systems

S.No.	District	Area# (acres)	50% area*	25% area*	GFY** in 50% Area	GFY** in 25% Area
1	Adilabad	776	388	194	7,760	3,880
2	Bhadradri Kothagudem	51,273	25,637	12,818	512,730	256,365
3	Jagtial	33,391	16,696	8,348	333,910	166,955
4	Jangoan	11,451	5,726	2,863	114,510	57,255
5	Jayashankar Bhupalpalli	610	305	153	6,100	3,050
6	Jogulamba Gadwal	11,288	5,644	2,822	112,880	56,440
7	Kamareddy	1,734	867	434	17,340	8,670
8	Karimnagar	7,074	3,537	1,769	70,740	35,370
9	Khammam	42,901	21,451	10,725	429,010	214,505
10	Kumuram Bheem Asifabad	1,269	635	317	12,690	6,345
11	Mahabubabad	17,409	8,705	4,352	174,090	87,045
12	Mahabubnagar	12,445	6,223	3,111	124,450	62,225
13	Mancherial	17,998	8,999	4,500	179,980	89,990
14	Medak	3,444	1,722	861	34,440	17,220
15	Medchal-Malkajigiri	2,916	1,458	729	29,160	14,580
16	Mulug	2,040	1,020	510	20,400	10,200
17	Nagarkurnool	19,502	9,751	4,876	195,020	97,510
18	Nalgonda	64,919	32,460	16,230	649,190	324,595
19	Narayanpet	7,319	3,660	1,830	73,190	36,595
20	Nirmal	4,023	2,012	1,006	40,230	20,115
21	Nizamabad	4,701	2,351	1,175	47,010	23,505
22	Peddapalli	4,943	2,472	1,236	49,430	24,715
23	Rajanna Sircilla	2,956	1,478	739	29,560	14,780
24	Rangareddy	25,890	12,945	6,473	258,900	129,450
25	Sangareddy	13,308	6,654	3,327	133,080	66,540
26	Siddipet	15,058	7,529	3,765	150,580	75,290
27	Suryapet	23,122	11,561	5,781	231,220	115,610
28	Vikarabad	13,803	6,902	3,451	138,030	69,015
29	Wanaparthy	12,686	6,343	3,172	126,860	63,430
30	Warangal (Urban)	5,339	2,670	1,335	53,390	26,695
31	Warangal (Rural)	7,825	3,913	1,956	78,250	39,125
32	Yadadri Bhuvanagiri	7,137	8,569	4,284	171,370	85,685
	Total	460,550	230,275	115,138	4,605,500	2,302,750

Total area under orchards and plantation crops
*Assuming 50 or 25 % area is available for fodder cultivation
** GFY in 50 and 25% area at an average 50% yield of 40 t/acre/annum

Another area that can be brought under fodder cultivation is barren and non-cultivable areas. There is 6.07 lakh ha of barren and non-cultivable area accounting for 5.42% of the total geographical area of Telangana (SEO, 2018). This area can be put to alternate land use systems for fodder production such as silvi-pasture, horti-pasture and agri-horti-silvi-pasture systems. Several successful fodder production systems have been reported from different areas. Use of multipurpose trees (MPTs) suitable to different seasons could be base crops under silvi-pasture systems and different orchard and plantation depending on the edapho-climatic conditions of given location may form base for horti-pastoral systems. Under low rainfall areas less water requiring crops like custard apple, pomegranate etc. could be ideal base horticulture crops while under moderate to high rainfall areas plantation crops like oil-palm, coconut etc. could be base crops. Suitable forage grasses and legumes like guinea grass, stylosanthes, hedge lucerne could be ideal fodder crops under these orchard or plantation crops. For degraded and problematic lands, silvi-pastoral management system keeping livestock as main component is most appropriate. The forage trees, which are suitable for these lands include *Acacia eburnea, A. nilotica, A. leucophloea, Balanities roxburghii, Pongamia pinnata* (in river beds or bottom of ravines), *Dichrostachis cineria, Leucaena leucocephala* and *Prosopis juliflora*. On plateau, *Butea monosperma* thrives well. All these trees can contribute substantially towards fodder for livestock during drought period. It was found that grasses like *Andropogon gayanus, Bothriochloa intermedia*, *Dichanthium annulatum, D. caricosum, Bothriochloa pertusa* and *Cynodon dactylon* had very high soil conservation and aggregation values and these are quite palatable and sustain drought situations and can form part of silvi-pastoral systems with above-mentioned trees (Singh, 2015). Under low to medium and irregular rainfall areas range grasses like *Cenchrus* spp., *Sehima* spp., *Chrysopogon* spp., *Pennisetum* spp., *Dicanthium* spp. etc. and fodder legumes like *Atylosia scrabaeoides, Macrotyloma axillare, Macroptilium atropurpureum, Stylosanthes scabra* etc. could be ideal fodder crops in many non-arable areas. The productivity of the systems may depend on the production practices, grazing/harvesting regimes, regeneration capacity under a given condition etc. The degraded and eroded soils may be restored to a great extent through *in-situ* soil and water conservation structures and levelling, terracing, graded bunding etc. before introduction of horti/silvi components along with the fodder components. Encouraging local grass with high biomass having fodder value may also be encouraged though removal of obnoxious weeds and controlled grazing etc. Cut and carry method of fodder harvesting or grazing by small ruminant will help in quick regeneration and with less loss by trampling by the grazing animals. These alternative land use systems will help mitigate the fodder shortages in resource poor conditions and in dryland areas.

C. Fodder crop production in permanent pastures/grazing lands

About 2.99 lakh ha area accounting for 2.67 % of the geographical area of Telangana is under permanent pastures and other grazing lands (SEO, 2018). This area is spread across the state in small patches in each village and is being used as community grazing land for the animals of the villages. The extent of such area is more in drier parts of the state as compared to irrigated areas. This area is also subjected to encroachment by the neighboring land owners and also used for construction of community buildings in many places by the government in general. This along with 1.82 lakh ha of cultivable wasteland accounting for 1.62% of the geographical area of Telangana could be developed in to community pasture or grazing lands on scientific basis for higher productivity. The pastures/grazing lands may be developed through re-seeding with improved grass specie for the region *viz*. *Cenchrus* spp., *Sehima* spp., *Chrysopogon* spp. *Dicanthium* spp. *Heteropogon* spp. *Panicum* spp.etc. They may be allowed establish well through removal of obnoxious weed species and protecting from grazing in the early stages of growth. Then these grazing resources are maintained through rotational grazing, freeing from non-palatable weed species and shrugs, soil fertility buildup through nutrient management, maintenance of stable plant population through seed pelleting / sowing, control of soil erosion, in situ soil and moisture conservation and ensuring flowering and seed production of these improved and nutritious fodder species in these pasture lands for sustainable fodder supply. In addition, a suitable plan may be developed for appropriate silvi-pastoral systems development in these lands for ensuring fodder supply through lopping of the fodder shrubs and other multipurpose trees in the system. The planting of fodder crops in the intervening space in the trees will supplement as well as complement the fodder supplying capacity of the silvi-pastoral systems. Fodder production and accessibility can be improved by using

Figure 8. Silvi-pastoral system practiced by farmers in Telangana
(http://horticulture.tg.nic.in/AGRFORST/SMAFINDEX.html)

Figure 9. Bajra napier hybrid and desmanthes in 3:1 ratio under subabul
(Source: AICRP (FCU), PJTSAU, Hyderabad**)**

double rows of fodder tree/shrubs at wider spacing. Once the fodder tree/shrubs are well established, grass should be allowed to grow in the area between double rows. Competition between tree/shrub and grass should be monitored constantly so that fodder productivity does not decrease. The silvi-pastoral systems should be properly managed to increase the productivity of the systems through appropriate age of not less than 12-16 months at first harvest of fodder trees/shrubs to provide sufficient time for establishment of deep root system and truck diameter. Direct grazing by small ruminants for 1-2 weeks with 3-6 weeks of recuperation period depending on the climatic conditions; maintaining cutting height of about 50-150 cm depending upon fodder tree/shrubs; cutting frequency of 6-12 weeks and dry season management, increase the productivity of silvi-pastoral systems (Ramana, 2018). Silvi-pasture systems bajra napier hybrid and *Desmanthus*/ *Stylosanthes* in a ratio of 3:1 under subabul has been observed most promising with appreciable green fodder and crude protein yields besides improving soil fertility (Susheela *et al.*, 2016) (Figure 9).

D. Fodder on non-competative lands

Farm bunds, canal sides, farm boundaries and terraces remain unoccupied by the crops. Often they offer shelter to pests and pathogens and harbor several weeds cleaning of which adds to cost of cultivation of main crops. These areas can form a very good niche for introduction of fodder crops. Many a times these places enjoy the availability of inputs *viz*. water and nutrients applied to the main crops which facilitate good growth of fodder crops without any additional care. The extent of availability of farm bunds, canal sides and farm boundaries and terraces increase with the land fragmentation. Smaller the land holdings, the higher will be the proportion of farm bunds available. The majority of the land holdings being marginal, small and semi-medium, there is a plenty of area for introduction of fodder on the bunds. Area under farm bunds consists of 2.024% of gross cropped area with an annual yield of 5 t/ha (Ramachandra *et al.,* 2007). The extent of availability of fodder from bunds has been presented in Table 29. There are several fodder crops suitable for cultivation on bunds depending upon the agro-ecosystem and farmers' needs. Under irrigated agro-ecosystem bajra napier hybrid (Figure 10) and guinea grass are more suitable and quite productive. Under rainfed ecosystem signal grass, grazing guinea etc. are quite productive. Among the fodder legumes stylosanthes, hedge lucerne, butterfly pea could be grown both on bunds and in the basins of the orchard and plantation crops. Planting of fodder crops for arresting the soil erosion and for *in-situ* soil and water conservation is becoming very common in many places particularly in irregular and high intensity rainfall areas under rainfed conditions.

Table 29. Fodder production possibilities on farm bunds in different land holdings

Category	No. of holdings	Total area (ha)	Average holding (ha)	Bund length/ holding (m)	Total length of bunds (m)	Fodder production in 10% holdings (tonnes)
Marginal (0.5-1.0 ha)	3,441,087	1,566,779	0.46	271.67	934,840,105	654,388
Small (1.0-2.0 ha)	1,327,362	1,869,352	1.41	475.63	631,333,188	441,933
Semi Medium (2.0-4.0 ha)	602,925	1,585,135	2.63	649.60	391,660,080	274,162
Medium (4.0-10.0 ha)	166,833	926,760	5.56	947.89	158,139,332	110,698
Large (>10 ha)	15,775	248,799	15.77	1590.66	25,092,662	17,565
Total	5,553,982	6,196,825			2,141,065,367	1,498,746

Notes:
1. No. of holdings & total area as per Agriculture Action Plan Inner, (2019-20)
2. Average holding is computed by dividing total area by no. of holdings
3. Bund length/holding computed as minimum perimeter possible per holding in rectangle shape
4. Total length of bunds is computed by multiplying no. of holdings into bund length/holding
5. Fodder production @ 7 kg/m bund length in only 10% of the total land holdings

Figure 10. Production of bajra napier hybrid on bunds
(Source: ICAR-CCARI, Goa**)**

E. Crop residue quality enhancement

The state of Telangana is rich in dry fodder resources like crop residues. However due to lack of emphasis on clean harvesting and good conservation practices there observed to be a lot of wastage of crop residue which otherwise could be good source of dry fodder in many parts of the state. The major agricultural crops being rice and maize, there is good availability of crop residue for using as dry fodder. The legume crops also provide good quantity of residues rich in crude protein content. The crop residues constitute major source of fodder especially during the lean periods and at times of failure of crops due to lower rainfall and other natural calamities like famine and floods. The extent of availability of crop residues in Telangana has been presented in Table 30. However the potential may further be enhanced through adoption of good harvesting and conservation practices. These crop residues besides meeting the local demand may

be transported to other fodder scarcity areas easily to meet the fodder requirement. The concept of fodder banks now attempted to address the fodder problem during lean periods and other exigencies more or less is solely dependent on the crop residues in many areas.

Table 30. Potential availability of crop residues in Telangana

S.No.	Crops	Area# (in Lakh ha)	Total Yield# (in lakh MTs.)	HI*	Crop Residue (in Lakh MTs)
I	**Cereals and Millets**				
1	Rice	19.62	62.63	0.5	62.63
2	Wheat	0.04	0.06	0.4	0.09
3	Jowar	0.67	0.74	0.4	1.11
4	Bajra	0.09	0.09	0.4	0.14
5	Ragi	0.01	0.01	0.4	0.02
6	Maize	6.30	27.52	0.4	41.28
	Total Cereals	26.73	91.05		105.26
II	**Pulses**				
1	Bengalgram	0.97	1.48	0.3	3.45
2	Redgram	3.30	0.26	0.3	0.61
3	Greengram	0.99	658	0.3	1.47
4	Blackgram	0.38	0.09	0.3	0.21
5	Horsegram	0.01	0.00	0.3	0.00
6	Other pulses	0.06	0.07	0.3	0.16
	Total pulses	5.71	659.9	0.3	5.91
III	**Oil Seeds**				
1	Groundnut	1.67	3.73	0.3	8.70
2	Sesamum	0.16	0.09	0.3	0.21
3	Sunflower	0.04	0.08	0.3	0.19
4	Safflower	0.04	0.02	0.3	0.05
5	Soybean	1.52	2.47	0.3	5.76
6	Other oilseeds	0.03	0.05	0.3	0.12
	Total oilseeds	3.74	6.7		15.03
IV	**Other Crops**				
1	Sugarcane	0.35	22.17	0.9	2.46
V	**Total**				128.66

Agriculture Action Plan Inner, 2019-20
* HI= Harvest Index i.e. Economic yield/Biological yield (Maheswarapp *et al.*, 2011)

The crop residues are poor in crude protein content. It may be improved by urea spray. Urea spray may be done by dissolving 4 kg urea in 40 liter water and mixing this solution with 100 kg stover or crop residue or dry fodder. Further spray of salt and mineral mixtures will enhance the palatability and nutritive value of dry fodders. The conjunctive use of crop residues with green fodder is said to be ideal method of meeting the fodder requirement of livestock in many traditional areas. In the event of imminent failure of crops due to lack of rains under rainfed conditions, the crops may be harvested and used as source of green fodder and in case of excess availability it may be dried and conserved as dry fodder.

F. Alternative fodder resources

Fodder both green and dry may be derived from either cultivation of fodder crops for green fodder and storing it after drying for dry fodder purpose. The crop residues could be major source of dry fodder. However in case of exigencies we should have alternative fodder sources for meeting fodder requirement. These could be through cultivation of fodder shrubs, azolla, hydroponics etc. These methods could be viable sources when they are cost effective and sustainable. These methods often need ideal conditions and trained human resources to undertake them. In intensive livestock production for milk and meat production, these could be reliable alternatives sources fodder to tide over fodder scarcity. The large house-hold labour force may reduce the cost of production and make quality fodder availability at cheaper prices. These alternative sources of fodder may be attempted in isolation in case of emergency or in conjunction with other methods of fodder production.

a. Cultivation of fodder shrubs/trees

Fodder trees and shrubs constitute a vital component in livestock productivity in the arid and semi-arid zones. A tree or shrub is classified as fodder if it is browsed by animals. Palatability depends upon a number of interacting factors linked to animals as well as environment. Trees and shrubs recognized as fodder vary from region to region and an exhaustive inventory of them is difficult to make. Fodder shrubs like *Sesbania grandiflora, Moringa oleifera, Leucaena leucocephala* etc. can be suitably incorporated in the cropping systems in many cropped areas. These shrubs and trees may also be allocated to non-cropped areas, on undulated terrain and wastelands to harness them for fodder production. The shrubs like moringa (Figure 11), sesbania etc. having multiple utilities could be more attractive as they have several economic uses besides having fodder value. In recent time moringa is becoming very popular fodder crop already having proved a quite successful vegetable shrub. The fodder shrubs having ease of establishment, good competitive ability,

Figure 11. Moringa grown as hedge crop for fodder

high productivity and persistence under repeated cutting/grazing, ability to adapt to wide climatic and edaphic conditions, free from pests and diseases, lesser demand for inputs like fertilizers can be used as alternative source of fodder during lean periods and sudden fodder shortages owing to conditions beyond farmers' control. They may be incorporated in the farming systems as living fence around the household, vegetation on non-cropped lands, hedgerows in alley cropping, component species intercropping (Chen *et al.*,1991).

b. Azolla cultivation

Azolla is a free floating water fern consisting of a short branched floating stem bearing roots which hang down in water. It can be termed green fodder grown on water surface. It is rich in many nutrients *viz*. protein, amino acids, vitamins, magnesium, calcium, phosphorus and potassium and it can fix atmospheric nitrogen. It may be grown on ponds, ditches and rice fields in arid and semi-arid regions. Even it can be grown on poly bags. It is an excellent feed supplement for livestock. Feeding azolla reduces the feed cost and increases the milk yield. It is highly regenerative and doubles its biomass yield in 4-10 days and yield may be as high as 8-12 t/ha. It may be cultivated during all seasons of the year on demand. In rice field it helps reduce weed problems also. It can be used as supplemental feed along with green and dry fodders. This could be an ideal alternative during non-availability of land for cultivation of fodder crops. Feeding of azolla is found to increase the fat content of milk in dairy animals (Figure 12, Table 31).

Figure 12. Azolla production in poly-sheet based pit

Table 31. Effect of azolla feeding on milk yield and net income in dairy animals at Khammam district in Telangana (Source: Prasad *et al.*, 2016**)**

Treatment	Azolla yield (kg/month)	Fat % before azolla feeding	Fat % after azolla feeding	Net income (Rs/month)
Azolla feeding	20 (For 5 months)	6.5	8.5	Rs. 200/ month (Rs. 1000/ 5 months

c. Hydroponic fodder production

Hydroponics is a soil less culture of crops. Fodder crops may be raised under this method to meet the green fodder requirement in areas where there is no scope for cultivation of fodder crops in conventional methods. Here fodder plants are grown in nutrient solution for up to 8-10 days using high seed rate and fed to animals when the seedlings are very young. The hydroponic fodder production system is very quick

growing of green fodder in 8-10 days. This can be undertaken where there is non-availability of land for cultivation of fodder crop like urban and peri-urban areas or areas having sub-optimal conditions like high/low temperatures, poor soil conditions like deserts or undulated rocky terrain with no good soil conditions. It involves low to medium investment in erecting a hydroponic structure consisting of trays with regulated chamber for temperature and moisture supply. Crops like fodder maize, sorghum, oats etc. may be grown under this system. The cost of production of fodder will be higher here. Hence this could be a method in emergency and cannot be an alternative to green fodder or dry fodder in normal circumstances (Figure 13).

Figure 13. Sh.A.V.Rao displaying hydroponic green fodder at Allipuram village in Khammam district (Source: The Hindu, Telangana, 15th August 2015**)** (https://www.thehindu.com/news/national/telangana/technology-comes-in-handy-for-this-farmer/article7543425.ece)

G. Fodder conservation technologies : Hay, bales, silage and fodder block

The green fodder and dry fodder availability may be affected due to some unforeseen circumstances like lack of rainfall, cyclones and subsequent floods, insect pests and diseases affecting the normal growth and availability. It is therefore necessary to conserve both green fodder and dry fodder at times of excess availability to tide over the possible fodder shortages in future. There are methods to conserve both green and dry fodders for a reasonable period of time and meet the shortages without many hiccups. The dry fodder is mostly conserved in terms of fodder stacks and bales while the green fodder is conserved in the form of silage. Further the bulky nature of dry fodders may be reduced through bale making to facilitate transfer from area of fodder sufficiency to area of fodder deficiency. Further the grain mixtures and non-conventional sources are also conserved in the form of feed blocks. These conserved sources of fodder may be stored for long without impairing their quality or palatability.

a. Dry fodder heaps and bale making

Once the food and commercial crops having fodder value for the crop residues are harvested the straw in case of cereal crops and stover in case of leguminous crops are collected after sun drying either in the field or in the threshing yard and stacked for using as dry fodder. The stackig process is often less scientific as it does not involve proper drying of the crop residues and also the place of stacking may be low lying with high soil moisture and subject to water logging. This leads to wetting of crop residue and becomes prone to fungal infection reducing its nutritive value and palatability. The stacks called in colloquial language as "

i. Tractor mounted in situ baler

ii. Transportation of bales

Figure 14. Tractor mounted baler and transportation of bales
(Source: https://telanganatoday.com/use-of-straw-balers-increase-manifolds-in-telangana**)**

b. Silage

At times there will be excess availability of green fodder having moisture content of >70-80%. This cannot be stored for long time. This will result in rotting and spoilage of the green fodder. This green fodder may be converted into silage and stored for long without affecting the palatability or nutritive value. Silage is the material produced by controlled fermentation, under anaerobic conditions, of chopped green crop residues or forages with high moisture contents. Silage is produced by the activities of naturally-occurring bacteria that convert some of the plant sugars into organic acids that preserve nutritional qualities under anaerobic conditions. Silage may be made from practically any green fodder having >6% glucose to facilitate good anaerobic fermentation. The fodder crops such as maize, sorghum, oats, bajra, are more suitable. Quality of silage may be improved by using suitable additives such as molasses, urea, salt, formic acid etc. The important steps in silage making involve construction of silage storage structure of appropriate size. One cubic meter silo can store 500-600 kg green fodder. Harvesting of fodder crops at 30-35% dry matter stage and chopping it into 2-3 cm size. Filling the chopped fodder in to silo and thoroughly pressing it remove all air pockets and spreading additives layer by layer. Once the filling is over the silo should be sealed air tight to facilitate anaerobic fermentation. The silage will be ready in 45 days time. Once the silo is opened, it should be used as early as possible. Initially silage may be fed @ 5 kg/animal. This can be used just like green fodder. This will serve as a good green fodder substitute during lean period and in summer when no green fodder is available. The stages of silage making have been presented in Figure 15.

Chaffing of forage for ensiling Trench silage Stack of the silage

Figure 15. Silage preparation

c. Feed block making

Feed blocks are a feed supplement which can enhance efficient utilization of native and improved pastures. Their main effect on animals is to increase appetite and intake of poor-quality forages and pastures which boosts animal performance and consequently improves productivity. The major ingredients of complete feed include 25% cereals, 37% wheat or rice bran, 35% oil cake, 2% mineral mixture and 1% common salt (NIANP, 2012). The feed block making technique is simple, and easily accessible to small farmers. The equipment required is very simple and relatively cheap. Mixing may be done by hand, in a concrete mixer or in a horizontal barrel mixer. Whatever the applied formula, the steps for making the blocks remain the same. These steps consist of: weighing, mixing, moulding and drying (Figure 16). Small (10 to 20 kg) or large (50 to 100 kg) quantities can be prepared in each batch. Once dried, the blocks can be stored in a dry place for several months up to year. Blocks should be used as a supplement and not as the basic ration.

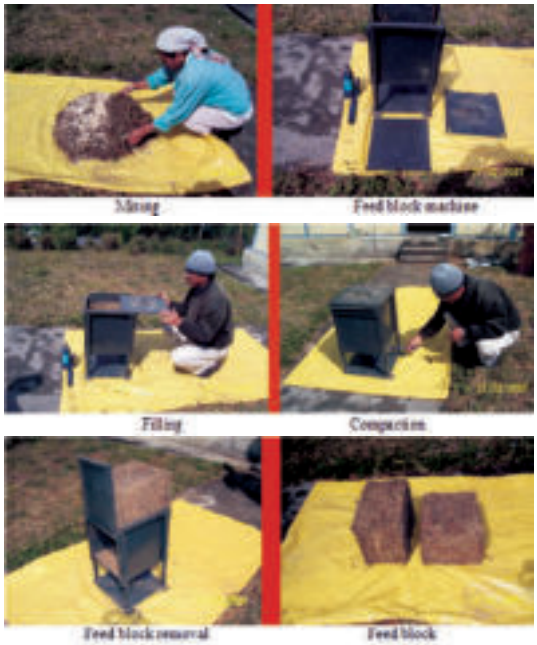

Figure 16. Stages in feed block making
(Source: http://www.kiran.nic.in/feedblock.html**)**

H. Development of fodder resource bases

Most of the fodder growing areas are bereft of minimum facilities like fertile soils, leveled lands, life saving irrigation facilities etc. Often the marginal and sub-marginal lands which are not found suitable for growing preferred food and commercial crops are allocated to growing fodder crops. The fodder crops tolerate and grow under such poor soil conditions and input situations but their productivity will be low. If land improvement activities like leveling, application of manures, removal of stones and pebbles and reclamation of problematic soils through amendments, *in-situ* soil and water conservation measures are taken up, the productivity of such areas may substantially improved. Since these areas rarely get irrigation facilities, development of watersheds, micro-irrigation facilities will also help the fodder crops grow to their full potential and record higher yields. These soil and water resources developmental activities may be undertaken at community level under government programmes like waste land development programmes, Mahatma Gandhi National Rural Employment Guarantee Programmes (MGNREGA) etc.

I. Rejuvenation of Common Property Resources (CPRs) and Common Property Land Resources (CPLRs)

Rural Common Proper Resources (CPRs) are broadly defined as resources to which all members of an identifiable community have inalienable use rights. CPRs include community pastures, community forests, waste lands, common dumping and threshing grounds, watershed drainages, village ponds and rivers and rivulets as well as their banks and beds. The first three resources are particularly important because of their contribution to animal husbandry and sustenance in dry regions. Common property land resources (CPLRs) include the categories of land like community pasture and grazing grounds, village forests and woodlots, and village sites, on which the villagers have legal usufructuary rights. These also include all other land formally held by the panchayat or a community of the village. The CPLRs seem to have provided significant support to the poor, landless households, small and marginal farmers. Apart from providing livelihood support to the poor the CPLRs also perform several useful ecological functions. Lack of organized institutional care of CPLRs has also led to severe environmental degradation. The regeneration of degraded CPLRs would not only improve the performance of ecological environmental variables, it would also provide opportunity to enhance fodder availability from these lands.

J. Exploring new niches

The food and commercial crops are the first priority crops in the cultivated areas in the

state of Telangana. The fodder crops seldom receive attention as preferential crops. They are relegated to less resourceful lands. It is really difficult to change this pattern in the present agricultural scenario in the state. We have to explore the possibility of growing fodder crops without altering the present cropping systems, so that it is easily adoptable by the farming community. In this direction, identification new niches attract greater attention. Rice, maize, pulses, horticultural crops occupy larger area of land and if we are able to identify scope for introduction of fodder crops as intercrops, alternate crops or catch crops between seasons, it will greatly enhance the availability of fodder in the state. The rice fallows provide scope for cultivation of fodder crops like cowpea, rice bean etc. on residual moisture after harvest of rice. The fodder crops harness the residual moisture and put up good growth and fodder yield. Likewise diversification of maize crop through replacement of grain crop with baby corn or sweet corn varieties which have good demand in the present urban markets will provide green maize crop after harvest of baby corn or sweet corn cobs for fodder. Harvesting of green pods in cowpea, vegetable peas, field bean etc. provide remaining portion as green fodder. This does not alter the present crop pattern but provide scope for enhancing the availability of green fodder. Growing of stay green type of maize varieties help using the crop after harvesting of cobs for silage making. Cultivation of fodder crops on farm bunds, embankments of water tanks, tank beds during drought time, river course during lean period provide ample scope for green fodder production. There is a need for systematic survey and estimation of such area available for fodder cultivation.

K. Custom hiring centers

Cultivation of fodder crops requires special machineries to reduce the drudgery and ease of operation. The kind of machinery and frequency of use depends on the fodder crops selected and crop production adopted. In general, land preparation, preparation of fodder seeds and planting material for sowing/planting needs specific farm implements or machinery. In addition harvesting of fodder crops at regular interval at desired height from ground level also is cumbersome. The harvesting of seeds and processing of seeds and seed treatment will be more precise with machineries. However as fodder growing farmers are small land holders and may not be economically stronger to purchase these machineries individually. Thus purchasing these common machineries collectively at community level and establishing custom hiring centers would facilitate use of these machineries by all categories of fodder growers in the locality. Some of the common machineries needed for fodder production related activities have been listed in Table 32.

Table 32. Fodder production related machineries for custom hiring centers

Prime movers or general machines	Land preparation/ Tillage machine	Sowing/ Transplanting machine/ Intercultural machines	Harvesting machines
I. Tractors i. Tractors 2WD (20-40 HP) ii. Tractors 2WD (40-70 HP) iii. Tractors 4WD (20-40 HP) iv. Tractors 4WD (40-70 HP) **II. Power tillers** i. Power tillers (< 8 HP) ii. Power tillers (> 8 HP)	i. Disc plough ii. Cultivator iii. Disc harrow iv. Leveler blade v. Furrow opener vi. Ridge maker vii. Bund former viii. Rotovator	i. Seed cum fertilizer drill ii. Post hole digger iii. Raised bed planter iv. Ridge furrow planter v. Pneumatic planter vi. Poly-mulch laying machine vii. Weed slasher viii. Power weeder ix. Power sprayer	i. Tractor drawn reaper ii. Tractor drawn reaper cum binder iii. Tractor operated chopper iv. Automated seed separator v. Seed palleting machines

Part-III : Brief Action Plan

i. Identification of areas for propagating fodder production

Bench mark survey on the micro-climatic conditions, cropping systems and introduction of fodder crops may be initiated for identifying the suitable fodder crops and their varieties and production potential vis-à-vis the farmers' acceptance and their satisfaction.

ii. Selection of villages in different agro-climatic zones based on livestock resources

Three districts from each agro-climatic zone with identical agro-climatic conditions, 2 mandals/talukas from each district and 5 villages from each mandal/taluka will be selected. Bench mark survey will be initiated at mandal level which will fairly give an idea about the possible conditions for propagation of fodder crops under varied situations.

iii. Identification of fodder species/varieties suitable for different agro-climatic zones

An exercise was made during the workshop to elicit the opinion of the staff of the Dept. of Animal Husbandry and Veterinary Services, Govt. of Telangana as to which fodder crops and their varieties would be more suitable for different agro-climatic conditions prevailing in the state and it has be outlined in the recommendations. The same may be used as guideline for identification of suitable fodder crops and varieties.

iv. Finalization of suitable package of practices for fodder crops

There are already well established package of practices for different fodder crops under various agro-climatic conditions. The same will be adopted as package of practices *mutatis mutandis* for successful cultivation of fodder crops in the state of Telangana.

v. Master trainers training at IGFRI/NIANP/NDRI/SAUs/SVUs

The staff of Dept. of Animal Husbandry and Veterinary Services, Agriculture, Horticulture, Forestry etc. from the Govt. of Telangana having aptitude to work for augmenting fodder resources will be identified through their superiors in the first stage as master trainers. And they will be offered intensive need based training programme at IGFRI, Jhansi or IGFRI SRRS, Dharwad depending upon the need and convenience of the selected master trainers so identified. The number of participants, the duration of the training programme and the topics of training programme will be finalized after discussion with the Head of the line departments, Govt. of Telangana.

vi. Creating awareness among farmers and other stakeholders and promoting production of forage crops

The Krishi Vigyan Kendras (KVKs) operating in the state of Telangana as per the agro-climatic zones will be roped-in to identify the needy farmers for training on fodder crops at the corresponding KVKs. In the process other stake holders like milk co-operatives, non-governmental agencies (NGOs), progressive farmers will also be made partners in creating awareness about fodder production.

vii. Conduct of frontline demonstration and training

After bench mark survey and identification of suitable places for propagating awareness about the fodder crops, sufficient number of front line demonstrations in each of the selected tehsil will be conducted in the farmers' field to make them aware of the fodder production potential and motivate them to go for cultivation of fodder as per their needs. In addition tailor made training programmes will be organized through KVKs for the benefit of the interested farmers on the topics of their interest in fodder crop production, livestock production and dairying.

viii. Strengthening of forage seed production chain

As emerged out of the discussion during the workshop, the non-availability of quality seeds and planting material of suitable fodder crops is one of the major hindrances for the cultivation of fodder crops. Therefore efforts will be made to estimate the quantum of seeds of various fodder crops and planting material well in advance and an institutional mechanism will be put in place to ensure the availability of different category of fodder seeds and planting material so that the non-availability does not become an issue for fodder cultivation.

ix. Adoption of holistic approach for fodder production, conservation and utilization

In fact there is a fodder scarcity in almost all places in Telangana. The would-be fodder cultivating farmers may be doing so out of their dire requirement of fodder for their livestock. And hence the fodder production will be need based and there is no way of facing any problem thereafter. However, all efforts will be made to interlink the activities of fodder production, its conservation either in the form of silage (for green fodder) or hay (for dry fodder), and its scientific utilization will be ensured through creating awareness on all these aspects and ensuring the compliance by the master trainers, trained farmers and other stake holder in the process.

x. Promote R&D technologies for fodder and seed production, processing, storage and utilization

The appropriate R&D technologies for fodder production, fodder seed production, fodder processing, fodder conservation and fodder utilization will be promoted through training to the master trainers, staff of line departments,

KVKs, NGOs on regular interval basis. The newer problems faced in the field will be transferred back to research institutes *viz*. IGFRI, NIANP, NDR etc. for solutions and they will be addressed though suitable inter-phase mechanisms between researchers and farmers.

xi. Enhance acreage and productivity in non-conventional areas

Indeed there is a shortage of land for production of fodder crops in the state. Therefore efforts will be made to bring non-conventional areas for production of fodder crops. In the process all efforts will be made for:

a. Production of fodder in non-arable lands, wastelands etc.

b. Production of fodder in problem soils *viz*. saline, sodic, alkaline, acidic, marginal soil having poor nutrient quality soil etc.

c. Enhancing production through grassland, rangeland and grazing land management.

xii. Conservation of forage resources to mitigate calamities and ease of transport

In many areas in spite of having a large chuck of crop wastes having fodder value, it cannot be used due to faulty agricultural practices or lack of foresight and or lack of machinery etc. For example a large area of rice cultivated in Telangana do not necessarily result in good quality rice straw as dry fodder owing to lack of proper farm machinery, lack of awareness among farmers to conserve rice straw etc. Hence conservation of fodder resources wherever possible for future use during lean periods and at time of natural calamities like famine, high rainfall etc. will be highlighted. Further as fodder is bulky in nature accounting for huge expenditure in transportation, bale making of dry fodders, silage in polybags of convenient sizes will be attempted.

xiii. Establishment of fodder banks

At times livestock holder are faced with fodder scarcity owing to natural calamities, unforeseen failure of crops and it poses a great threat to sustainable animal husbandry and dairying. To tide over such situation of fodder scarcity, efforts will be made to educate the policy makers, heads of line departments to establish fodder banks at village clusters or tehsils for ensuring the supply of minimum quantity of fodder to livestock keeper so that the animals are not forced to go hungry. In addition, establishment of fodder ware-houses with enriched dry fodder or silage bins will also be attempted.

xiv. Networking through ICAR-DHAD-SAUs-SVUs-Milk Federations

Any isolated efforts to augment fodder resources may not be sustainable in long run owing to unforeseen situations in future. And hence, networking of fodder producers, fodder entrepreneurs, heads of line departments will be made for foreseeing at the grass root level. Likewise, networking of ICAR Institutions *viz*.

IGFRI, NIANP, NDRI, PJTSAU etc., Department of Animal Husbandry and Veterinary Services of the state and central govt., Milk Federations and Dairy owners etc., will be established to supervise and evolve a mechanism to attend to such exigencies.

xv. Public-Private-Partnership (PPP) mode of operation

Although the initial stage of programme is hovering around the government agencies involved in various aspects of fodder production, processing, conservation, utilization, rationing, policy making etc. the ultimate end user will be common farmers. Further there are several private players *viz*. dairy owners, animal pharma industries, feed manufactures, NGOs involved in livestock production and dairying etc. They will all be brought together under Public-Private Partnership (PPP) mode of operation.

xvi. Impact analysis of technology adoption

The objectives of the programme also aim at seeing the perceptible changes that are going to occur though the implementation of the proposed project. Hence, base line data on various parameters will be collected before the start of the project and after the project implementation at regular interval. The findings will be used for impact analysis of the technology demonstrated through this project. Midterm corrections needed, if any, will be identified through this impact analysis study.

Part-IV : Road Map

This project is conceived to be multi-objective, multi-partner and multi-year activity. Hence a proper road map is necessary for making it more practical and result oriented one. The following road map has been proposed under this project. There are several actions points to be carried out in the process of implementation by several agencies as shown below (Table 33).

Table 33. Road map for the implementation of the proposed activities

Sl. No.	Action Point	Agencies involved
1	Breeder seed production of the identified varieties	IGFRI, Jhansi/ SAUs
2	Foundation seed production	RFS/ DAHD /SAHD
3	Production of TFL/certified seeds	SAUs/Milk unions/ NSC / SSC
4	Demonstration, Training of farmers, Field trials at farmers field, package of practices	District KVK /milk unions/SAHD
5	Extension activities and development of fodder warehouse	Milk Unions / State Animal Husbandry Department
6	Dry fodder processing, value addition and fodder management (chaff cutter, Fodder block, Baling, grinding)	District level milk union/Animal Husbandry Dept.
7	R & D activity (Evaluation of fodder quality, food-feed crops, Hydroponics etc.,)	ICAR Institutes / SAUs / SVUs
8	Capacity building of stake holders	ICAR-IGFRI/SAUs

The programme implementation is a time bound multi-stage oriented plan and aims to complete the activities in time frame in a logical way. It has been presented in Table 34.

Part-V : Implementation of Pilot Programme

This Pilot Programme will be implemented in the selected representative districts of Telangana to test the feasibility of technological advancements in fodder technologies and showcase them for the needy farmers for fodder production. The programme will be implemented in a time bound manner encompassing the various components under different agro-climatic zones (Table 34). The various activities proposed and action points identified have been presented in Table 35.

Table 34. Agro-climatic zone wise farming situation and identified district

Sl. No.	Zone	Farming situation	Identified District
1.	Northern Telangana	Rainfed/Irrigated	Adilabad, Nirmal, Nizamabad
2.	Central Telangana	Irrigated/Rainfed	Medak, Siddipet, Jangaon
3.	Southern Telangana	Irrigated/Rainfed	Mahbubnagar, Rangareddy, Nalgond

Table 35. Pilot Programme Implementation Plan

S.No.	Activity	Action points
1	Target area selection	• Selection of 3 districts (1 from each agroclimaic zone) • Selection of 2 cluster of 5 villages in each district total 6 clusters for 3 districts • Selection of 1 to 2 ha in each cluster for technology demonstrations • Bench mark survey
2	Training	• Training of master trainers- 25 master trainers per batch and 1 batch from each district at IGFRI, Jhansi • Training of farmers; 10 from each village; 300 farmers in first year (6 training program for farmers of each cluster) • Exposure visit of progressive farmers and master trainers at IGFRI, Jhansi/ICAR-Research Complex for North East, Design Agartala/NDDB, Anand.
3	Technology Demonstrations	• Selection of crop and varieties will be done after identifying suitable districts and village clusters both under annual and perennial crops for different seasons *viz. kharif*, *rabi* and *zaid*

		• Silage should be encouraged • Since crop residue being a precious commodity, fodder banks using densification technologies can be developed • Annual fodder crops Fodder sorghum: SSV 74, PC-9, PC-23, Harasona, JS-29-/1, MSFH-3, CO-FS-05 Maize: African Tall, J-1006 Cowpea: UPC-8705, UPC-625, 622, 621, 618, 5287, 5286, 4200, Bundel lobia-1, Bundel lobia-2, Kashi kanchan (for pod and fodder) Oats: JHO-99-2, JHO-15-1, Kent, JHO-822, JHO-2004 Rice bean: Shymalima, RBL-6, Bidhan-1, Bidhan-2, JRBJ-05-2, Bidhan Ricebean 3 Dinanath grass: Pusa dinanath-1, Bundel dinanath -1, Bundel dinanath -2 • Perennial fodder crops Hybrid Napier: BNH-10, CO-4, CO-5, Swetika-1, PBN-342, CO-6 Guinea grass: Bundel Guinea-2, Bundel Guinea -4, DGG-1, CO-3 Congo signal grass: DBRS 1, local material
4	Suitable silvi-pasture/ horti-pasture system demonstrations	• In existing Orchard- 1 ha (Guinea, Grazing Guinea) • In new Orchard - 1 ha (Guinea, Grazing Guinea) Popular and potential fodder trees: Calliandra, Erythrina, Gliricidia, Sesbania, Leuceaenea. Moringa can be a potential source of legume fodder in upland areas and may be explored
5	Need based Watershed/ micro irrigation facility development	• Suitable fodder species *viz.* grazing guinea, signal grass, etc to check soil & water erosion and enhancing water retention will be highlighted.
6	Rejuvenation of grasslands/ pasturelands/CPRs	• The related activities will be taken up during post rainy season / with first *rabi* rains

7	Tapping rice fallow and other fallow areas for fodder production	• Suitable annual fodder crops *viz.* fodder cowpea, oats etc. will be grown on residual moisture to ensure fodder supply during the period
8	Input supply	• Inputs *viz.* seeds/rooted slips/fertilizers, insecticides etc, small machinery and tools - improved sickles etc. will be supplied to farmers
9	Custom hiring centre in each village cluster	• Exploring and facilitating the farmers with chaff cutter, Bhusa urea enriching machinery, baling of paddy straw, dry fodder etc, complete feed block making machine, regular farm implements including tractors, harrow, seed drill etc.

Funding arrangements

Projects will be submitted to Govt. of Telangana, Govt. of India through various state and central schemes like RKVY etc. to meet the fund requirement. ICAR- IGFRI will provide technical support for formulation of such fodder development proposals for funding. The fund requirement for the implementation of the pilot project is presented in Table 36.

Table 36. Approximate budget requirement for the implementation of pilot programme

Sl. No.	Activity	Amount (Rs. In Lakhs)					
		Ist yr	IInd yr	IIIrd yr	IVth yr	Vth yr	Total
1	Training of master trainers, farmers and exposure visit	15	15	15	5	5	55
2	Annual cultivated fodder crops	18	18	18	6	6	66
3	Perennials Fodder crops	27	27	27	9	9	99
4	Suitable silvi-pasture/ Horti-pasture system demonstrations	5.4	5.4	5.4	1.8	1.8	19.8
5	Need based Watershed/ micro-irrigation facility development to check soil and water erosion, enhancing water retention	27	27	27	9	9	99
6	Rejuvenation of grassland/ pasturelands/CPRs	22.5	22.5	22.5	7.5	7.5	82.5

7	Tapping rice fallow and other fallow areas for fodder production	9	9	9	3	3	33
8	Multi-utility center in each village cluster	144	9	9	9	9	180
9	Human resource (Trained)	9	9	9	9	9	45
	Total	276.90	141.90	141.90	59.30	59.30	679.30
	Contingency 5%	13.85	7.10	7.10	2.97	2.97	33.97
	Grand Total	290.75	149.00	149.00	62.27	62.27	713.27

(Rupees Seven Hundred Thirteen Lakhs Twenty Seven Thousand only)

Part-VI : Modalities

This programme is undertaken to enhance the fodder production, conservation and utilization on more sustainable basis in different districts of Telangana. The ICAR-IGFRI will take a lead in Technological support in collaborating with other public and private sector agencies in this regard. The modalities of executing this programme are as follows:

- ICAR-IGFRI will be knowledge partner and will help in providing all technical backup, technological support, seed procurement, sources etc.
- ICAR-IGFRI will provide all the technological and technical support in implementation of fodder action plan
- ICAR-IGFRI will also supply the seeds/planting material or will facilitate for the same from reliable sources in case of non-availability locally.
- ICAR- IGFRI would help in seed procurement on buy back arrangement in cases where seed production activities are involved in the programme

Line Departments *viz*. Dept. of Agriculture, Dept. of AH&VS, Dept. of Horticulture, Dept. of Forestry etc., Govt. of Telangana along with KVKs, NGOs, Milk Federation etc. will implement the programme at field and farmers level.

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Annexure-I

Proceedings of the online workshop on "Telangana State Fodder Resources Development Plan" held on 4th July, 2020 at 11.00 AM.

At the outset Dr. V.K. Yadav, Director, ICAR-IGFRI, Jhansi welcomed all the participants to the meeting and briefly outlined the purpose of holding this online workshop. He highlighted the significant contributions of the IGFRI Jhansi catering to the fodder needs in the country. He informed that under National Initiative for Accelerating Fodder Technology Adoption (NIAFTA), an effort is being made to have interactive workshop with the stake holders of different states towards finalizing "Fodder Resources Development Plan" for all the states in the country. He mentioned that National Fodder Mission will be initiated in due course of time and the plan so developed will be implemented to address the fodder shortages to ensure sustainable fodder supply and vibrant animal husbandry. Further he called for effective coordination across the stake holders to implement this program smoothly.

Dr. V. Lakshma Reddy, Director of Animal Husbandry, Govt. of Telangana, Hyderabad, in his introductory remarks appreciated the efforts of ICAR-IGFRI, Jhansi for initiative on Fodder Resources Development Plan and organizing this online meeting. He highlighted the emerging importance of animal husbandry in urban and peri-urban areas as there is a great demand for milk and milk products. He said the city of Hyderabad alone requires 25 lakh liters of milk every day. He observed that there is a wide gap between demand and availability of fodder and it needs immediate attention. He opined that this online workshop was timely and the officers of Animal Husbandry and other line departments would be benefited by the deliberations. He also urged to hold a meet in near future on "Fodder Crops and Machinery" at Hyderabad for the benefit of the stake holders.

Dr. Jagadeeshwar, Director of Research, PJTSAU, Hyderabad conveyed the greetings of the Hon'ble Vice-Chancellor, PJTSAU, Hyderabad and thanked ICAR-IGFRI for organizing this meeting. He appreciated the technologies for increasing the green as well as dry fodder needs in the country. Hydroponics, bale making, silage making and fodder demonstrations need to be done in the state of Telangana. He also mentioned the importance of broadening the genetic base of forage crops for increasing their productivity.

Dr. B.G. Shivakumar, Principal Scientist & Officer-in-Charge, ICAR-IGFRI, Southern Regional Research Station, Dharwad made a detailed presentation on "Fodder Resources Development Plan for Telangana state". He highlighted the present fodder scenario vis-à-vis the livestock status in the State. He briefly outlined the action plan, linkages proposed and modalities in implementing the proposed action plan.

Dr. A.K. Roy, Project Coordinator (Forage Crops and Utilization), ICAR-IGFRI, Jhansi delivered a presentation on "Fodder Technologies Research for Telangana" state highlighting the improved forage varieties, crop production and protection technologies required for the state.

Dr. R.V. Kumar, Head, GSM Division, ICAR-IGFRI, Jhansi made a presentation on "Grassland and Pastures Development" suitable for the state of Telangana.

Dr. Sultan Singh, Principal Scientist, ICAR-IGFRI, Jhansi made a presentation on "Fodder Conservation and Fodder Based Ration" suitable for the state of Telangana.

Dr. B. Singh, Director, RSFPD, Hyderabad informed that his station is catering to the forage seeds and planting material requirement of four states viz., Telangana, Andhra Pradesh, Odisha and Chhattisgarh. Presently certified seeds of fodder sorghum, fodder maize, fodder bajra etc. are available.

Dr. D.V.B. Ramana, Principal Scientist, ICAR-CRIDA, Hyderabad informed that there are large number of irrigation projects coming up in the state of Telangana and growing of fodder crops in these areas needs to be ascertained by the state government. In watershed and farm pond areas cultivation of azolla and growing fodder crops on bunds needs to be considered. Chopping of fodder is not practiced in the state and hence state government departments ensure the availability of chaff cutters through subsidy. As combined harvesters are used in the paddy fields leave 6-8 inches stubbles and farmers are burning it causing wastage of fodder as well as environmental hazards. Efforts should be made to ensure harvest at ground level.

Dr. Venkatesh Bhat, Principal Scientist, ICAR-IIMR, Hyderabad mentioned that fodder sorghum varieties are available for the state of Telangana.

Dr. Dasari Sreenivas, Professor & Head, Veterinary College, Korutla, Jagatial, felt that supply of quality forage seeds for the rainfed areas, fodder conservation through silage and better coordination between University and the State Government Departments needs to be emphasized.

Dr. Shashikala, Professor & In-charge, AICRP (FCU), PJTSAU, Hyderabad mentioned that they have submitted a project to National Livestock Mission and PJTSAU prepared five year plan for the production of forage seeds.

Dr. Sunil Kumar, Head Crop Production Division, ICAR-IGFRI, Jhansi mentioned the need for networking and coordination among different stake holders. He stressed popularization of fodder technologies, seed and plant material availability, introduction of intensive fodder production practices, popularization of fodder crops in newer niches, popularization of non-conventional fodder crops, growing of fodder crops in silvi and horti-pasture systems.

Dr. A.K. Mishra, Head, Plant and Animal Relationship Division, ICAR-IGFRI, Jhansi mentioned that more focus is needed on fodder conservation viz., silage, hay making etc.

Dr. Shahid Ahmed, Head Crop Improvement Division, ICAR-IGFRI, Jhansi mentioned that the seeds of newly released varieties of fodder crops are available for Telangana.

Dr. P.K. Pathak, Head Farm Machinery and Post-Harvest Technology Division, ICAR-IGFRI, Jhansi urged that mechanization in fodder production and post-harvest processing needs to be strengthened.

Dr. Khem Chand, Head Social Sciences Division, ICAR-IGFRI, Jhansi opined that program on fodder development can be taken up through MNREGA.

Dr. Venkatanarayana, DV&AHO, Warangal queried about the availability of cuscuta free lucerne, Chinese cabbage and fodder *Arachis*. He was informed to approach RSFPD, Hyderabad and PAU/HAU/HPKV for Chinese cabbage seeds. Further he opined that Public Private Partnerships (PPP) may be developed for creation of fodder grids, fodder banks at each district level, prevention of wastage of paddy, jowar straw and burning of crop residues. He suggested creation of a committee consisting of SAUs, ICAR Institutions, RSFPD etc. on fodder crops at Hyderabad and periodical meetings may be arranged to exchange the knowledge and material for the fodder development program in the state.

Dr. Madhusudan, DV&AHO, Mahbubnagar informed that *Stylosanthes hamata* can be grown in forest land and provision for the seeds may be made.

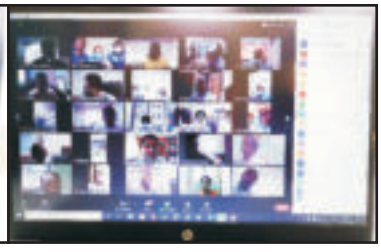
Dr. V.K. Yadav, Director, ICAR-IGFRI, Jhansi in his concluding remarks urged the entire stake holder to work in coordination and contribute for the finalization of the Fodder Plant and to implement this in Telangana state.

Dr. Purushottam Sharma Principal Scientist, Nodal Officer, NIAFTA, ICAR-IGFRI, Jhansi and Dr. B.G. Shivakumar, Principal Scientist & OIC, ICAR-IGFRI, SRRS, Dharwad thanked all the participants for attending the meeting and their valuable inputs.

Glimpses of Interactive workshop

Dr. Lakshma Reddy, Director - Animal Husbandry giving his remarks

Dr. R. Jagdeeshwar, Director of Research, PJTSAU giving his remarks



An overview of participants

Annexure-II

List of participants in the online Workshop on "Telangana State Fodder Resources Development" held on July 4, 2020

1. Dr. Vijay Kumar Yadav, Director, ICAR-IGFRI, Jhansi, Uttar Pradesh
2. Dr. V. Lakshma Reddy, Director of Animal Husbandry, Govt. of Telangana, Hyderabad, Telangana
3. Dr. R. Jagadeeshwar, Director of Research, PJTSAU, Hyderabad, Telangana
4. Dr. S. Ramachander, Additional Director of Animal Husbandry, Govt. of Telangana, Hyderabad, Telangana
5. Dr. A.K. Roy, Project Coordinator, AICRP (FCU), IGFRI, Jhansi, Uttar Pradesh
6. Dr. Venugopal Rao, ADAH, Directorate of Animal Husbandry, Govt. of Telangana, Hyderabad, Telangana
7. Dr. B. Singh, Director, RSFPD, Hyderabad, Telangana
8. Dr. Dasari Sreenivas, Prof. & Head, College of Veterinary Sciences, Korutla, Telangana
9. Dr. Madhusudan, DV&AHO, Mahbubnagar, Telangana
10. Dr. Vijaya Sekhar Reddy, ADAH, Medak, Telangana
11. Dr. P. Sekhar, DVAHO, Medchal, Telangana
12. Dr. P.K. Pankaj, ICAR-CRIDA, Hyderabad, Telangana
13. Dr. Y. Venugopal Rao, DVAHO, B. Kothagudem, Telangana
14. Dr. Md. Baleegh Ahmad, DVAHO, Nizambad, Telangana
15. Dr. K. Venkateswar Reddy, DVAHO, Wanaparthy, Telangana
16. Dr. T. Sudhakar, DVAHO, Mahabubabad, Telangana
17. Dr. V. Srinivas, DVAHO, Nalgonda, Telangana
18. Dr. Venkatanarayana,DVAHO, Warangal Urban, Telangana
19. Dr. B. Purandhar, DVAHO Khammam, Telangana
20. Dr. Adithya Keshava Sai, DVAHO, Jogulamba, Telangana
21. Dr. B. Murali, Scientist, PJTSAU, Hyderabad, Telangana
22. Dr. D. Suresh, DVAHO, Adilabad, Telangana
23. Dr. T. Shashikala, Principal Scientist, PJTSAU, Hyderabad, Telangana
24. Dr. D.V.B. Ramana, Principal Scientist, ICAR-CRIDA, Hyderabad, Telangana

25. Dr. A.V. Umakanth, Principal Scientist, ICAR-IIMR, Hyderabad, Telangana
26. Dr. Venkatesh Bhat, Principal Scientist, ICAR-IIMR, Hyderabad, Telangana
27. Dr. R.V. Kumar, Head, Division of Grassland and Silvi-pasture Management (GSM), ICAR-IGFRI, Jhansi, Uttar Pradesh
28. Dr. Sultan Sing, Principal Scientist, Division of Plant Animal Relationship (PAR), ICAR-IGFRI, Jhansi, Uttar Pradesh
29. Dr. P. Sharma, Principal Scientist and Nodal Officer, NIAFTA, ICAR- IGFRI, Jhansi, Uttar Pradesh
30. Dr. Sunil Kumar, Principal Scientist, ICAR-IGFRI, Jhansi, Uttar Pradesh
31. Dr. Sunil Kumar, Head, Division of Crop Production, ICAR-IGFRI, Jhansi, Uttar Pradesh
32. Dr. A.K. Misra, Head, Division of PAR, ICAR-IGFRI, Jhansi, Uttar Pradesh
33. Dr. Shahid Ahmed, Head, Division of Crop Improvement, ICAR-IGFRI, Jhansi, Uttar Pradesh
34. Dr. P.K. Pathak, Head, Division of Farm Machinery and Post Harvest Technology, ICAR-IGFRI, Jhansi, Uttar Pradesh
35. Dr. Khem Chand, Head, Division of Social Sciences, ICAR-IGFRI, Jhansi, Uttar Pradesh
36. Dr. Vinod Kumar, Principal Scientist, IGFRI SRRS, Dharwad, Karnataka
37. Dr. Edna Antony, Senior Scientist, IGFRI SRRS, Dharwad, Karnataka
38. Dr. Anju Basera, RSFPD, GOI, Hyderabad, Telangana
39. Dr. N.S. Kulkarni, Principal Scientist, ICAR-IGFRI, SRRS, Dharwad, Karnatak
40. Dr. K. Sridhar, Principal Scientist, ICAR-IGFRI, SRRS, Dharwad, Karnataka
41. Dr. B.G. Shivakumar, Principal Scientist & Officer-in–Charge, ICAR-IGFRI, SRRS, Dharwad, Karnataka
42. Dr. Harika
43. Dr. Katta Indu
44. Dr. Soumya, B.

Developed Fodder Crop Varieties from ICAR-IGFRI, Jhansi

Crop	Varieties	GFY (t/ha)	Recommendation for cultivation	Year of release
Berseem	Wardan	65-70	Whole country	1981
	Bundel Berseem 2	65-80	Central, NW zone	1997
	Bundel Berseem 3	68-83	NE Zone	2000
	JBSC-1	38-40	North west zone	2017
Lucerne	Chetak	140-150	North west central	1975
Oat	Bundel Jai 822	44-50	Central zone	1989
	Bundel Jai 851	40-50	Whole country	1997
	Bundel Jai 99-2	40-50	North West Zone	2004
	Bundle Jai 2004	50	North east and north west zone	2002
	Bundel Jai 2009-1	53-62	Central zone	2016
	Bundel Jai 99-1	35-40	Hill Zone	2007
	Bundel Jai 2010-1	27-34	South Zone	2015
	Bundel Jai 2012-2	33-37	South Zone	2017
	Bundel Jai 2015-1	25-30	Hill Zone	2018
Cowpea	Bundel Lobia 1	25-30	Whole country	1992
	Bundel Lobia 2	25-30	North Zone	1992
	Bundel Lobia 4	23-26	North-eastern Zone	2012
Guar	Bundel Guar 1	25-35	Whole country	1993
	Bundel Guar 2	30-40	Whole country	1994
	Bundel Guar 3	30-40	Whole country	1999
Field bean	Bundel Sem 1	25-35	Whole country	1993
Anjan grass	Bundel Anjan 1	30-35	Whole country	1989
Cenchrus	Bundel Anjan 3	30-35	Whole country	2006
ciliaris	Bundel Anjan-4	35-37	Whole Zone	2019
Dhaman grass *Cenchrus setigerus*	Bundel dhaman -1	13-15	Western part of country	2019
Dinanath grass	Bundel Dinanath 1	55-60	Whole country	1987
	Bundel Dinanath 2	60-65	Whole country	1990

BN hybrid	Swetika	100-120	Central, northern and north eastern areas	1983
Bajra-squamulatum hybrid	BBSH-1	30-33	Western and northern part of country	2019
Butterfly pea	Bundel clitoria-1 (JGCT-2013-3)	25	All India	2017
Bajra	AVKB-19 JHPM-05-2	50-60 70-80	Whole country Whole country except south zone	2007 2008
Guinea grass	Bundel guinea 1	40-50	Punjab, HP, Central UP, Maharastra, Tamilnadu	2004
	Bundel guinea 2	50-55	Rainfed conditions in semi-arid, tropical, sub-tropical and humid tropics	2008
	Bundel guinea 4	75-81	All guinea grass growing areas	2012
Sehima	Bundel Sen Ghas -1	18-20	Semi-arid, tropical and sub-tropical areas across the country	2007
Chrysopogon	Bundel Dhawalu Ghas-1	26-30	Rangelands under rainfed condition across the country	2007
Heteropogon	Bundel Lampa Ghas-1, IGHC-03-4	25-30	Rangelands under rainfed condition across the country	2007
Dichanthium	Bundel Marvel Grass-2013-2 (JHD- 2013-2)	35-45	NWZ particularly for Punjab and Rajasthan	2017

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