Fodder Resources Development Plan for Chhattisgarh

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

Fodder Resources Development Plan for Chhattisgarh

...a policy paper

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Secretary (DARE) &
Director General (ICAR)

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MESSAGE

Chhattisgarh State is known as 'Rice Bowl' of central India. Agriculture is the main source of livelihood for the rural people. The State has a shortage of green and dry fodder to the extent of about 33.1 and 9.8 per cent, respectively. The cultivation of quality grass/fodder is also inadequate. Therefore, there is an urgent need of development of fodder security plan for round the year to provide fodder supply in different agro-climatic zones of the State.

I am happy to know that the State specific, "Fodder Resources Development Plan", has been developed by the ICAR-Indian Grassland and Fodder Research Institute (IGFRI), Jhansi for Chhattisgarh, in consultation with all the stakeholders from the State, under the program 'National Initiatives on Accelerating Fodder Technology Adoption (NIAFTA)'. This plan provides all the possible technological options for quality improvement, conservation and value addition of fodder. I am confident that the State will make use of this document in planning and implementation of developmental programs to enhance quality fodder production, conservation and use.

I appreciate the efforts made by ICAR-IGFRI, Jhansi in bringing out this document for the State of Chhattisgarh.

(Himanshu Pathak)

Dated the 23rd, July, 2024
New Delhi

भारतीय कृषि अनुसंधान परिषद
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Deputy Director General (Crop Science)

Message

I am happy to know that the ICAR-Indian Grassland and Fodder Research Institute, Jhansi, under their program, 'National Initiatives on Accelerating Fodder Technology Adoption (NIAFTA), in consultation with all the stakeholders from the state, has developed the state specific, "Fodder Resources Development Plan", for Chhatisgarh.

To formulate an implementable fodder resources development plan for each state/UT of the country, the Institute initiated a specific program, "National Initiative for Fodder Technologies Adoption (NIAFTA). '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. Fodder plan is an area-specific strategy providing technological options available for enhancing production, conservation, and value addition of fodder resources of the state. Chhattisgarh, the 'Rce Bowl' of central India, has the richest bio-diverse area in the country. More than 80% of the state's population is dependant on agriculture, including crops, livestock, fisheries, forestry. The cultivation of quality grass/fodder is rare and the state has a shortage of green/dry fodder. I hope the state fodder development plan for Chhattisgarh will be able to address all the issues in an effective manner.

I extend my congratulations to ICAR-IGFRI, Jhansi for bringing out this very useful document for the state of Odisha and I extend all my good wishes for their future endeavors.

(Tilak Raj Sharma)

Dated : 12 July, 2024
New Delhi

Fodder Resource Development Plan for Chhattisgarh developed as part of

National Initiative for Accelerating Fodder Technology Adoption (NIAFTA)

ICAR - Indian Grassland and Fodder Research Institute, Jhansi

Themes of NIAFTA

- Developing state fodder plan
- Disseminating fodder production technologies for enhanced productivity and improved management
- Promoting alternate land usage
- Focusing fodder based rationing
- Utilizing fodder processing technologies for value addition

NIAFTA Coordination Team

Dr. Pankaj Kaushal, Director	Chairman
Dr. Purushottam Sharma, PS & Head	Nodal Officer
Dr. V.K. Yadav, PC (FC)	Member
Dr. Mrs. Sadhna Pandey, Head, SS	Member
Dr. B.P. Kushwaha, PS	Member
Dr. B.B. Chaudhary, Scientist	Member
Sri A.K. Saxena, CTO	Member

Chhattisgarh State Fodder Resources Development Plan Committee

Dr. Shahid Ahmed, PS & Head	Coordinator
Dr. Nagaratna Birader, PS, RRS	Chairperson
Dr. S.R. Kantwa, PS,	Member
Dr. Vinod Kumar, PS, RRS	Member
Dr. Vinod Kumar Wasnik, Scientist	Member

Acknowledgement

Fodder plan is an area-specific strategy to be adopted to overcome the deficiency of green and dry fodder of the region and also to provide an 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 to fodder resources of the state.

Looking into the shortage of green and dry fodder in the country, the idea and vision of the development of state-wise fodder plans for different states of the country were visualized by Prof. Trilochan Mohapatra, Ex Secretary DARE, and Director General, ICAR. He advised to develop a state-wise fodder resource development plan which covers the broad areas as per the requirement of the state. We are highly grateful to him for his insight, guidance, encouragement, continuous support and suggestions in preparing this document. We extend our sincere thanks to Prof. Himanshu Pathak, Hon'ble Secretary DARE, and Director General, ICAR for motivating us to continue this important activity. We are also thankful to the Dr. T.R. Sharma, Deputy Director General (Crop Science), ADG (FFC) and other officers of the ICAR who extended their support during the development of the fodder plan of Chhattisgarh.

The institute is grateful to Mrs. Chandan Sanjay Tripathi, IAS, Director, Veterinary Services, Govt. of Chhattisgarh, Dr. Dakshinkar N. Purshottam, Vice Chancellor, Dau Shri Vasudev Chandrakar Kamdhenu Vishwavidyalaya, Anjora, Durg (C.G.), Dr. Girish Chandel, Honorable Vice Chancellor, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Dr. S.K. Jha, OIC, AICRP (FCU), IGKV Raipur, all ICAR Directors, Director (Research), Director (Extension), Deans of IGKV and Kamdhenu Vishwavidyalaya, all Heads, PCFC, AICRP (FCU), ICAR-IGFRI, IGKV and Kamdhenu Vishwavidyalaya scientists, for support in organizing interactive fodder resource development plan workshop and development of this plan.

The efforts made by our team from ICAR-IGFRI, Jhansi in preparation of fodder plan for the state of Chhattisgarh and organizing interactive workshop are praiseworthy. This fodder plan is prepared as a part of the activities of our program 'National Initiatives on Accelerating Fodder Technology Adoption (NIAFTA)', the whole team of the program and Nodal Officer, Dr. Purushottam Sharma, PS & Head deserves special appreciation.

(Pankaj Kaushal)
Director
ICAR-IGFRI, Jhansi

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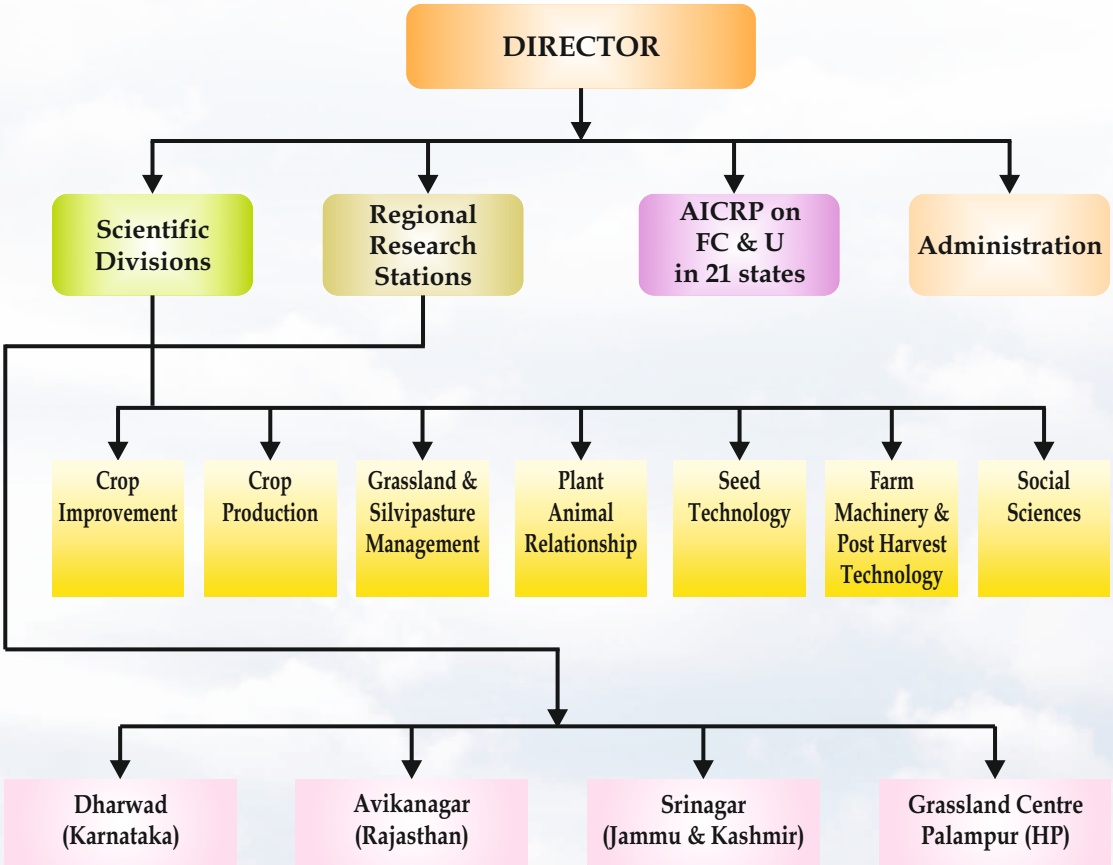
Organogram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IGFRI
Grassland

ICAR-IGFRI - A Profile

The ICAR-Indian Grassland and Fodder Research Institute (ICAR-IGFRI) Jhansi, was established in 1962 to conduct 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 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 22 coordinating centers and 27 volunteer centres at various State Agricultural Universities/CAU/NGO/ICAR institutes 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). Recently, ABIC has been established to develop and provide entrepreneurship skills in technologies generated by the institute as well as incubation centre to train and skill upliftment.

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 62 years achieving several milestones in generation of fodder technologies. Institute was conferred with "Sardar Patel Outstanding ICAR Institution Award 2015", for its outstanding 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 endeavouring 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

- Number 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
- 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

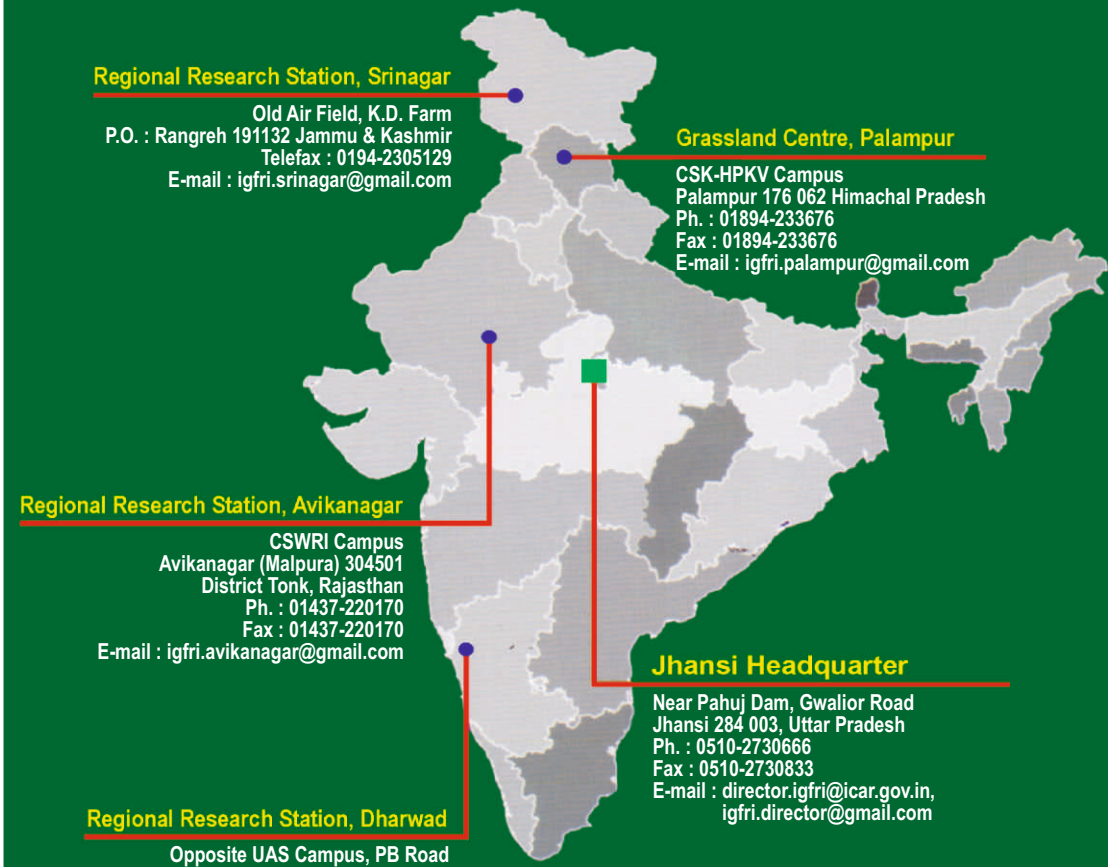
Transferring knowledge and skills are the essential component required for execution and implementation of resource conservation based projects in the country. The institute is organizing training and skill development programmes regularly of varying duration for farmers, students, state government officials, and field functionaries in the field of fodder resources, livestock management, soil and water conservation *etc.* The research institutes has signed MoUs with more than 20 Gaushalas for transfer of fodder production technologies. The MoUs with research institution are for collaboration on education, technology dissemination and providing consultancy on different proven 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.

NIAFTA: New Initiative

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. The plan is being designed for each agro-climatic zone of the state/UT suitable to specific niches so that the potential of available resources to achieve self-sufficiency in fodder production and utilization can be realized. 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.

ICAR-Indian Grassland and Fodder Research Institute

https://igfri.icar.gov.in



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Part-I : Agriculture, Livestock and Fodder Scenario

A. Introduction

Chhattisgarh is a state in central India which is carved out of Madhya Pradesh in the year 2000 as 26th state by partitioning 16 Chhattisgarhi-speaking south-eastern districts of Madhya Pradesh. Raipur was made its capital. It is the 10th largest state in India with a geographical area of 137, 90 thousand ha. Chhattisgarh stretches across the latitudinal expanse of 17°46' to 23°15' North on one hand to the longitudinal meridian of 80°30' to 84°23' East on the other. It covers an area of 1,35,192 sq km, which is 4.11% of the geographical area of the country. The state is bordered by the Madhya Pradesh in the northwest, Uttar Pradesh in the north, Jharkhand in the northeast, Maharashtra in the southwest, Telangana in the south and Odisha in the southeast. Chhattisgarh is the 16th most-populated state of the nation. It is a source of electricity and steel for India. Chhattisgarh accounts for 15% of the total steel produced in the country. The state is divided into 33 districts. Raipur, Bhilai, Durg, Bilaspur, Korba and Rajnandgaon are the major cities of Chhattisgarh. Surguja division has six districts, Bilaspur division has 8, Durg division has 7, Raipur division has 5 and Bastar division has 7 districts.

Fig. 1: Geographical map of Chhattisgarh

B. Agro-climatic zones

The state falls under east deccan physiographic zone and can be divided into three agro-climatic zones *viz.*, the Chhattisgarh plains, the northern hills of Chhattisgarh and the Bastar plateau (Table 1).

It has a tropical hot and humid climate. The average annual rainfall varies from about 1,100 mm to about 1,700 mm and the average annual temperature ranges between 11°C to 47°C. The state is drained by number of rivers which include Rihand, Hasdo (a tributary of Mahanadi) and Indravati.

Northern hills accounts 28.47 lakh ha geographical area which is about 21%. This includes Sarguja, Surajpur, Balrampur, Koria, Jashpur & Dharamjaigarh Tehsil of Raigarh districts. Chhattisgarh Plains has 69.49 lakh ha area which is 50% and most of the districts lie in this

Table 1: Agro-climatic zones and topographical features of Chhattisgarh

Zone	Climate	Rainfall	Soil type
Northern Hills	Eastern Tropical Humid & Cool	1400-1600 mm	Light to medium light (Red-Yellow) 55% Medium heavy to heavy (Brown - Black) 45%
CG Plains	Eastern Tropical Humid & Hot	Eastern & Southern Parts 1400-1600mm Northern & Western Parts 1200-1400 mm	Light to medium light (Red-Yellow) 65% Medium heavy to heavy (Brown - Black) 35%
Bastar Plateau	Southern Moderate Tropical	Northern & Southern Parts 1400-1600 mm Central Part 1600 mm	Light to medium light (Red-Yellow) 58% Medium heavy to heavy (Brown - Black) 42%

zone. They are Raipur, Gariyaband, Balodabazar, Mahasamund, Dhamtari, Durg, Balod, Bemetara, Rajnandgaon, Kabirdham, Bilaspur, Mungeli, Korba, Janjgeer, Raigarh & a part of Kanker districts (Narharpur & Kanker block). Bastar plateau has 39.94 lakh ha area which is 29%. It includes Jagdalpur, Narayanpur, Beejapur, Kondagaon, Dantewada, Sukma and the remaining part of Kanker districts.

Fig. 2: Agro-climatic zones of Chhattisgarh

As per the 2020 census, Chhattisgarh has a population of 29.46 million with 17th rank. The urban, rural and tribal population comprises of 23.24%, 76.76% and 30.62%, respectively. The average population density of the state is 189 per sq km, which is much lower than the national average of 382 persons per sq km. The 20th Livestock Census 2019 has reported a total livestock population of 15.87 million in the state.

C. Interactive workshop-IGFRI and state department

As a step towards augmenting fodder production and its proper utilization for ensuring the fodder availability to the livestock in the state of Chhattisgarh, a one day on 5th August, 2022 was organized for the development of, "Fodder Resource Development Plan for Chhattisgarh State", in collaboration with Indira Gandhi Krishi Vishwavidyalaya, (Raipur), Dau Shri Vasudev Chandrakar Kamdhenu

Vishwavidyalaya, Anjora (Durg) (C.G.) and Animal Husbandry and Veterinary Services Department, Chhattisgarh. The workshop was attended by 141 participants from various line departments *viz.*, department of animal husbandry and veterinary services, scientists from ICAR-IGFRI, AICRP (FCU) centers, SAUs and KVKs. The programme was coordinated by the Dr. Purushottam Sharma, Nodal Officer, NIAFTA. He welcomed all the participants and briefed about NIAFTA. Dr. Amaresh Chandra, Director, ICAR-IGFRI, Jhansi welcomed the chairman, special guest, experts and all the participants and shared the need of fodder plan development along with significant achievements of ICAR-IGFRI, Jhansi. Mrs. Chandan Sanjay Tripathi, IAS, Director, Veterinary Services, Govt. of Chhattisgarh presented the feed and fodder scenario and ongoing Charaghah Development programme carried out at Chhattisgarh by the various SHGs and government agencies. Dr. Dakshinkar N. Purshottam, Honorable Vice Chancellor, Dau Shri Vasudev Chandrakar Kamdhenu Vishwavidyalaya, Anjora, Durg, (C.G.) shared the information that state has surplus dry fodder in the form of paddy straw but deficit in green fodder production. Dr. Girish Chandel, Honorable Vice Chancellor, Indira Gandhi Krishi Vishwavidyalaya, Raipur briefed about the initiatives that has been taken by the university and KVKs towards fodder production and utilization.

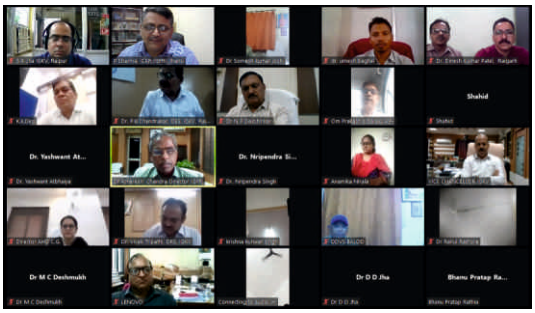


Fig. 3: Interactive workshop

Dr. Shahid Ahmed, Coordinator, Chhattisgarh fodder resource development plan committee, ICAR-IGFRI, Jhansi presented the draft of fodder plan prepared for Chhattisgarh state along with a contingency plan. Dr. S.K. Jha, OIC, AICRP (FCU), IGKV Raipur gave the presentation on improved fodder technologies suitable for Chhattisgarh State along with some success stories. General discussions among the participants were held and recommendations drawn are elaborated in Annexure I.

D. Livestock scenario

Livestock in the state is mainly livelihood oriented and generally owned by small and marginal farmers and landless agricultural laborers. However, Chhattisgarh is very rich in livestock wealth but milk availability is less than 200 g/day. Milk yield of cow as well as of buffalo is about half of the national average. Low yield is due to a lack of adoption of technology, feed scarcity and inadequate animal health services. Productivity

Fig. 4: Livestock of Chhattisgarh

of different livestock species in the state is low due to inadequate feed and fodder availability.

The livestock population in the state is large in numbers but its productivity is very low as compared to other parts of the country. To make the state self sufficient in animal food and fodder, state government has given priority to the development of livestock sector.

As per Livestock Census 2019, the livestock population of the state was 1,58,71,463 comprising of 97,16,929 indigenous cattle; 2,67,025 exotic and crossbred cattle; 11,74,722 buffaloes; 40,05,657 goats; 1,80,229 sheep; 5,26,901 pigs.(Table 2a, 2b and 2c).

Table 2a: Livestock population (Census 2019) of Chhattisgarh state

Livestock	Male	Female	Total population
Cattle	4632008	5351946	9983954 (Exotic-267025)
Buffalo	568436	606286	1174722
Goat	1254333	2751324	4005657
Sheep			180229 (Exotic-581)
Pig			526901 (Exotic-9119)
Total Livestock	**6454777**	**8709556**	**15871463**

Table 2b: District wise population of cattle and buffalo (Census 2019)

S.No.	Districts	Cattle (Male + Female)			Buffalo		
		Exotic	Indigenous	Total	Male	Female	Total
1	Balod	4775	331707	336482	12784	17441	30225
2	Baloda Bazar	6150	508361	514511	19177	37934	57111
3	Balrampur	6136	455227	461363	25826	30285	56111
4	Bastar	7005	278556	285561	42715	7668	50383
5	Bemetara	1441	416496	417937	17580	37133	54713
6	Bijapur	439	272003	272442	7150	7571	14721
7	Bilaspur	16081	590638	606719	48758	49535	98293
8	Dantewada	2418	185212	187630	10734	6836	17570
9	Dhamtari	8143	246652	254795	16500	22607	39107
10	Durg	10877	296816	307693	11521	39601	51122
11	Gariyaband	3447	250222	253669	10758	16273	27031
12	Janjgir-Champa	13634	500673	514307	19655	16147	35802
13	Jashpur	7299	425738	433037	15565	17851	33416
14	Kabirdham	990	357688	358678	18361	21729	40090

15	Kanker	17305	326024	343329	15245	6313	21558
16	Kondagaon	3833	335743	339576	21707	7897	29604
17	Korba	6586	347215	353801	27598	25066	52664
18	Korea	10629	370233	380862	32845	38719	71564
19	Mahasamund	27234	277918	305152	8606	14631	23237
20	Mungeli	2317	261053	263370	14254	22646	36900
21	Narayanpur	807	191339	192146	9578	7099	16677
22	Raigarh	47702	331326	379028	16240	8094	24334
23	Raipur	13928	329697	343625	12505	50074	62579
24	Rajnandgaon	5714	740486	746200	32438	28394	60832
25	Sukma	352	388715	389067	13150	12052	25202
26	Surajpur	15379	363289	378668	48839	24856	73695
27	Surguja	26404	337902	364306	38347	31834	70181
	Total	**267025**	**9716929**	**9983954**	**568436**	**606286**	**1174722**

Table 2c: District wise population of sheep, pig and goat (Census 2019)

S.No.	Districts	Goat	Sheep	Pig
			(Exotic + indigenous)	
1	Balod	54331	5610	2137
2	Baloda Bazar	100638	7637	3124
3	Balrampur	348178	5071	22180
4	Bastar	98170	28028	39001
5	Bemetara	102089	8945	1749
6	Bijapur	150220	391	64683
7	Bilaspur	206088	3513	4481
8	Dantewada	75745	94	42867
9	Dhamtari	58582	357	7260
10	Durg	61499	7472	1594
11	Gariyaband	81932	33889	2328
12	Janjgir-Champa	78461	7415	3116
13	Jashpur	445166	5387	39705
14	Kabirdham	77181	829	4812
15	Kanker	185263	2602	62735
16	Kondagaon	90235	4600	52891

17	Korba	187421	42	2308
18	Korea	209357	30	4213
19	Mahasamund	123996	15821	3494
20	Mungeli	74258	1207	1084
21	Narayanpur	78041	67	57157
22	Raigarh	217858	19331	10288
23	Raipur	70311	8227	1749
24	Rajnandgaon	140555	8645	11547
25	Sukma	149185	3978	63554
26	Surajpur	252362	579	4417
27	Surguja	288535	462	12427
	Total	**4005657**	**180229**	**526901**

The development departments working in state are entrusted with the responsibilities of all aspects of livestock and poultry development, augmentation of milk, meat & egg production, animal health care including prevention of animal diseases and creation of infrastructure and human resource. The department is also providing required scientific training, extension and expertise support to livestock and poultry farmers/producers to create sustainable livelihood opportunities and self employment avenues in the whole state, particularly in rural areas. The major issue with dairy farming is low productivity of livestock due to non-availability of feeds and fodders.

The major reasons for shortage of feed and fodder in the state is mainly related to more livestock population with low productivity. Beside this, the shortage of community grazing land and lack of proper fodder production and management, fragmented and less area for fodder in state, priority of commercial crop cultivation, lack of technical knowledge about fodder production are other contributing factors. Major constraints faced in dairy development particularly in Chhattisgarh state includes the cattle rearing focuses more on draught power than dairy, large number of animals with low productivity, non availability of feed and fodder (both in quality and quantity) and health services particularly in remote and hilly areas.

Over 90% farmers being marginal (69.4%) and small holders (21.75%) owning over 90-95% livestock, are not able to devote their small holdings for cultivation of fodder crops, as their priority is to produce food grains. Farmers are mainly dependent on paddy straw to feed the livestock which contributes 89% of dry fodder in the state.

Therefore, identification of suitable fodder crops and varieties and suitable cultivation practices are necessary to boost fodder production in the state.

E. Fodder scenario

Chhattisgarh has a total geographical area of approximately 138 lakh ha. Bastar plateau, Chhattisgarh plains and Northern hills are the prime geographical landmarks that have been marked as the productive areas of Chhattisgarh agriculture. Agriculture (including crops, livestocks, fisheries, forestry) is the main source of livelihood for the rural people in the state. The state has richest bio-diverse area in the country, having 12% of India's forests. The 44% of the state's land is under forests (63.4 lakh ha area under forest cover) and 80% of Chhattisgarh's population is dependent on agriculture for its livelihood. Out of 37.47 lakh farmer households; 80.4% fall under the small and marginal category, characterized by low income, low productivity and high dependence on rains and low investments. Horticulture and animal husbandry also provide a major share. The state is also known as "Rice Bowl of Central India", where rice is grown on about 77% of the net sown area.

The 73% of the Chhattisgarh plains, 97% of the Bastar plateau and 95% of the northern hills are rainfed. At present around 14.76 lakh ha area is net irrigated area of the state which is about 32% of the net sown area (mainly rice). Average rainfall in the state is around 1200-1400 mm. Irrigation is the prime need of the state for its overall development. Average annual temperature ranges between 11ºC to 47ºC. About 57% area has medium to light soil.

Paddy, maize, jowar, groundnut, gram, and wheat are major crops grown in Chhattisgarh. Chhattisgarh is known for rice cultivation and called "Rice Bowl" of India. Horticulture is a significant extension of agriculture industry in the state of Chhattisgarh. Medicinal herbs, flowers and aromatic plants form the key component of horticulture in the state. The government of Chhattisgarh offers co-operatives to the farmers of the state to enable them to buy best quality seeds and agricultural tools. Also, from time to time, the state and district level co-operatives provide loan facilities to the under-privileged peasants.

Chhattisgarh agriculture, with each passing day is gaining a new momentum, which will help it to forward its steps towards an economically viable phase. The strategic location, abundant power supply and rich storehouse of minerals augment the state's industrial and economic potential.

The productivity of livestock is mainly dependent on green and dry fodder, but the state has a deficit of green and dry fodder to the extent of about 53 and 16%, respectively. Major sources of dry fodder (t) are crop residue of food grains-696.9, pulse crops-198.7, others (groundnut + sugarcane)-39, pasture land-233.8 and forest-13886.8 with a total residue of 15052.2 ('000t). Top feed/ kitchen/ horticulture/ farm waste supplies were 1505.2 ('000t).

Requirement, availability and deficit of fodder in Chhattisgarh

Feed stuff	Requirement (Lakh tones)	Availability (Lakh tones)	Deficit (Lakh tones)	Deficit (%)
Green Fodder	448.93	210	238.93	53
Dry fodder	170.30	143	27.30	16
Grains and seeds	51	11.25	39.75	78

(Source : Estimation based on Economic survey of Chhattisgarh, 2013-14, Dr. S.P. Tiwari, Dean, College of Veterinary, Anjora, Durg, Chhattisgarh, CF: Indian Fodder Scenario: Redefining State Wise Status (2019). All India Coordinated Research Project on Forage Crops and Utilization, Edited by Drs. A.K. Roy, R.K. Agrawal and N.R. Bhardwaj, ICAR-IGFRI, Jhansi-284003, India. pp. 1-201.)

Good quality grass/fodder helps in increased production of milk and meat at a cheaper rate. The cultivation of quality grass/fodder is less and the quantity fodder produced is also inadequate. Because, the smaller land holdings are devoted to cultivation of food crops as first priority and the cultivation of fodder gets lower priority. Looking at the vast gap between the demand and supply position of fodder, it becomes necessary to put adequate efforts to transfer the potential technologies developed by various research organizations of the state and country to farmer's field in order to increase the production and productivity of good quality fodder. Therefore, there is an urgent need of development of fodder security plan for round the year feed and fodder supply in different agro-climatic zones of the state.

Part-II : Fodder Resource Development Plan

The following strategies are proposed for enhancing production, conservation and proper utilization and mitigating the fodder shortage in the state.

Strategies for enhancing fodder resources

Keeping in view the constraints in fodder production and to overcome the gap between demand and supply, the emphasis need to be given on several steps for augmenting the fodder production. Existing resource utilization pattern needs to be studied in totality according to a system approach. Fodder production is a component of the farming system and efforts need to be made for increasing the forage production under farming system. The holistic approach of integrated resource management will be followed based on maintaining the fragile balance between productivity functions and conservation practices for ecological sustainability. Forage production must be taken up as a first management goal and 25% of the forest area should be put under trees with regulated accessibility to the farmers. It is suggested to grow forage grasses and fodder trees along village roads and panchayat lands, and on terrace risers/bunds – a non competitive land use system. Use of participatory techniques to identify the problems and to carry out the improvement programme along with in-depth studies on migratory graziers, forage based agroforestry systems and controlled grazing to maintain the productivity of pasture (grazing should be allowed as per carrying capacity) are some other solutions to this problem. Details of different interventions are as under:

A. Cultivated fodder resources

Since fodder cultivation is taken on very less area in the state there is a very vast gap between demand and supply of green fodder. Hence there is need to bring at least 10 per cent of the cultivated area under fodder crops to reduce the demand-supply gap. The total geographical area of the state is around 138 lakh ha with net sown area of 46.51 lakh ha, which is 34% of its total geographical area. The fodder should be grown on 10 per cent of net sown area *i.e.* 4.65 lakh ha. Out of 4.65 lakh ha area under fodder crops, 2.5 lakh ha should be brought under perennial fodder crops and 2.15 lakh ha under annual fodder crops.

Chhattisgarh is one of the richest bio-diverse area in the country with around 63.4 lakh ha area under forest cover, which is 44% of its total geographical area. The 25% of the forest area should be put under trees with accessibility to the farmers (15.85 lakh ha). Rural economy is dominated by small farmers (<2 ha) comprising of 75% of total farm

households. The average size of land holdings in the state is 1.4 ha, and is likely to decline with increasing population pressure, which is mostly rainfed. Crop production along with livestock could emerge as an important source of income and employment for the rural poor. Species like poultry, goat, sheep, and pigs have short-generation interval, have a high prolificacy rate and require less land, investment, and operational expenses and are better suited to the resource endowment of the poor. Cattle and buffalo are an important source of manure and draught power, which are vital to improving crop production and environment.

There are number of fodder crops suitable under different agro-climatic conditions of state. We have large basket of perennial grasses, range legumes, cultivated forage cereals & legumes. The crops like bajra napier hybrid, guinea grass, setaria grass, maize, oat, cowpea *etc.*, are suitable for irrigated and arable land conditions whereas crops like congo signal grass, fescue grass *etc.*, are suitable for rainfed and non-arable land conditions (Table 3, 3a & 4).

Table 3: Crops for Chhattisgarh

1.	**Major *kharif* crops:** Paddy, Soybean, Urd & Arhar
2.	**Major *rabi* crops:** Chickpea ,Lathyrus, Wheat, Maize, Rape-seed & mustard
3.	**Other good potential crops:** Sugarcane, Maize, Millets (kodo-kutki), Moong, Wheat, Groundnut
4.	**Oilseed crops:** Groundnut, Soybean, Niger, Sunflower
5.	**Horticulture:** Mango (whole state); Litchi (northern hilly area of Sarguja and Jashpur district); Cashew nut (plateau region of the Bastar & Raigarh district); Guava, Lime, Cheku, Sitafal, Bael, Ber, Anola
6.	**Vegetable:** Solaneious crops, Cucurbits, Beans, Cabbage, Cauliflower
7.	**Spices:** Chili, Ginger, Garlic, Turmeric, Coriander & Methi
8.	**Floriculture:** Marry-gold, Tuberose, Gladiolus, Roses, Gaillardia, Chrysanthemum, Orchids
9.	**Medicinal and aromatic crops:** Ashwagandha, Serpagandha, Satawar, Butch, Aonla, Tikhur, Lemongrass, Pamarosa, Jamarosa, Patchauli, *E.citridora*

Table 3a: Major fodder crops/species for Chhattisgarh state

Grasses	Legumes	Shrubs / Trees
Jowar, Bajra, Maize, Teosinte, Oats, Coix, BN hybrid, Para grass (*Brachiaria mutica*), Rhodes grass (*Chloris gayana*), Blue grass (*Bothriochloa intermedia*), Doob grass (*Cynodon dactylon*), Marvel grass (*Dichanthium annulatum*), Guinea grass (*Panicum maximum*), Dinanath grass (*Cenchrus pedicellatus*), Setaria sphacelata, Anjan grass (*C. ciliaris*)	Berseem, Lucerne, Cowpea, Sem/ Lablab bean, Rice/red bean, Guar, *Stylosanthes* (*S. hamata*)	*Bauhinia variegata*, *Dalbergia sissoo*, *Leucaena leucocephala*, *Moringa oleifera* Subabul

Table 4: Suitable fodder crops, varieties and seed/planting requirement

S.N.	Crop	Varieties	Rooted slips/ seed rate	Yield GFY t/ha/annum
1	Berseem	Wardan, BB-2, BB-3, JBSC-1, JHB-17-1, JHB-17-2, JHB-18-1, JHB-18-2	20kg/ha	70-80
2	Lucerne	Chetak, T-9, CO-1, Anand -2, LLC-3; LLC-5, RL-88	10-15 kg/ha	100-120
3	Oat	JHO-851, JHO-822 JHO-2004, JHO-99-2 JHO-2009-1, JHO-15-1	80 kg/ha	45-65
4	Sorghum	Single cut : HC-136, Pusa Chari-1, Haryana Chari-171, PC-6, HC-260, PC-23, HC-308, PC-9, PC-615 Dual purpose: SPV-669, R Hybrid CSH 13, JS 29/1, CSV-15 Multi cut: SSG-59-3 (Meethi sudan), Pant Chari-5 (UPFS- 32), COFS-29, CSH-20MF, UPMCH-1101, CO-27, Harasona (855-F), CO-31	35-40 kg/ha	40-70
5	Lathyrus	Nirmal, Ratan	70-80 kg/ha	35-30
6	Pearl millet	Multi cut : Giant bajra; CO-8, Proagro No. 1 (FMH-3) , Moti bajra, APFB-2 Dual purpose: Raj bajra chari-2, NDFB-2, 3, 5, 11; AVKB-19	10-12 kg/ha	40-70
7	Maize	African tall, J-1006, APFM-8, Pratap makka chari-6	30-40 kg/ha	35-60

8	Guar	HFG-119, BG-1, BG-2, BG-3	20-40 kg/ha	35-35
9	BN hybrid	IGFRI-3, NB 21, CO-1, CO-2, CO-3, CO-5, CO-CN-4, CO-6, PBN 83	30000 rooted slips	100-200
10	Guinea grass	Hamil, PGG-14, Bundel guinea-1, Bundel guinea-2, CO-1, CO-2	60000 slips / 2.5 kg/ha	100-150
11	Anjan grass	Marwar Anjan (CAZRI-75), Bundel Anjan-1; Bundel Anjan-3; Bundel Anjan-4	1-4 kg/ha	35-40

Crops like BN hybrid, guinea grass *etc.*, being perennial in nature, once planted will be able to provide fodder for 3-4 years and won't need frequent sowing and investment on seed cost and land preparation. Also inclusion of leguminous fodder in inter row space of perennial grasses, can supply round the year green fodder. In view of stiff competition with food & other commercial crops, forage varieties with tolerance to drought/water scarcity situations holds promise and can fit well in existing farming systems (Table 5). These varieties can be very well adopted and promoted in suitable agro-climatic zones of the state. Fodder production requires identification of suitable fodder crops, varieties and production technologies depending on the agro-climatic conditions and needs of livestock keepers. 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, and within 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 the entire state in 2 years. Rice and maize are the main agricultural crops whose residues being used as forage. The popular cropping pattern prevalent in different agro-climatic zones of the Chhattisgarh state are summarized below:

Table 5: The popular cropping pattern prevalent in Chhattisgarh

Agro-climatic zone	Total geographical net sown area	Irrigation (% of area)	Popular cropping pattern followed	
			Rainfed	Irrigated
Northern Hills	28.47 lakh ha. (21%)/8.35 lakh ha	11%	Rice - Fallow, Maize - Fallow, Fallow - Horse Gram/Niger (Horse gram and niger are mid season crop sown during Aug. to mid Sept.) Arhar - Fallow Rice - Wheat Maize - Mustard Sugarcane	Rice - Wheat, Maize - Wheat/ Mustard, Vegetable - Vegetable Sugarcane

C.G. Plains	68.49 lakh ha. (50%)/32.95 lakh ha	43%	Rice - Fallow, Rice - Lathyrus, Rice - Lathyrus, Rice - Gram/ Wheat Soybean - Gram/Wheat Soybean + Arhar Kodo/Urd/Moong/ Til + Arhar Maize – Mustard	Rice - Gram/ Wheat/ Sunflower, Rice - Rice/Maize, Maize - Urd, Vegetable - Vegetable, Soybean + Arhar, Sugarcane
Plateau	39.06 lakh ha. (29%)/6.40 lakh ha	5%	Rice - Fallow, Maize-Fallow, Millets/ Niger - Fallow, Arhar+Moong/ Urd – Fallow	Rice - Wheat/ Gram Maize - Gram/Mustard Rice - Maize Vegetable - Vegetable Sugarcane

Forest and fodder tree as resources

Chhattisgarh has a recorded forest area (RFA) of 59,772 sq km (25,786 sq km reserved forest, 24,034 sq km is protected forest and 9,952 sq km is un-classed forest). This also has 03 national parks; 11 wildlife sanctuaries (protected area network of the state covering 4.93% of its geographical area). About 50% of the villages located inside five kilometres radius of forests (tribal, economically backward, non-tribal, landless people). From a study it has been estimated that 948 hectare of land is converting to non-forestry every year.

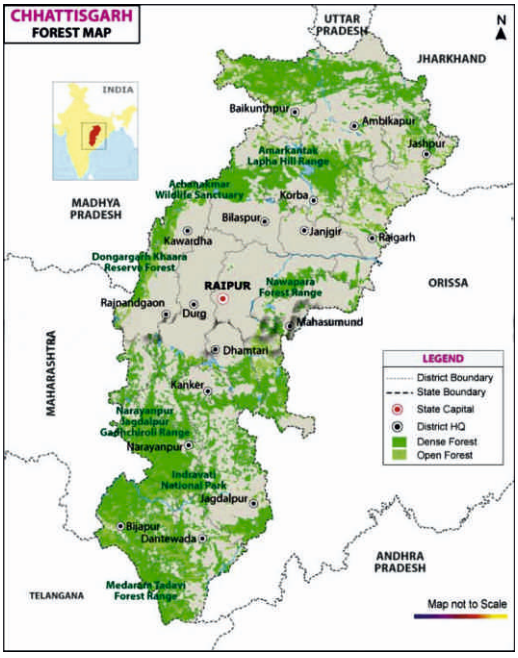


Fig. 5: Forest map

State has two type of forest namely Tropical Moist Deciduous Forests and Tropical Dry Deciduous Forests. Forest generally covers the two main tree species Sal (*Shorea robusta*) and Teak (*Tectona grandis*). Besides this other major species are Bija (*Pterocarpus marsupium*), Saja (*Terminalia tomentosa*), Dhavdha (*Anogeissus latifolia*), Mahua (*Madhuca indica*), Tendu (*Diospyros melanoxylon*) and Bamboo (*Dendrocalamus strictus*). Impact of feeding tree fodder during lean period as supplementary item is important.

Round the year fodder production system

Intensive forage production systems were developed and tested with an objective of accomplish the high yield of green nutritious forage and maintaining soil fertility. Overlapping cropping system that comprises of raising berseem, inter-planted with Bajra Napier hybrid/Guinea grass in spring and intercropping the inter-row spaces of the BN hybrid/Guinea grass with cowpea during summer after the final harvest of berseem can supply green fodder round the year. Under assured irrigated condition, multiple cropping sequences sorghum + cowpea - berseem + gobhi sarson - maize + cowpea and sorghum (multi-cut) + (cowpea-berseem + gobhi sarson) are promising for providing green fodder round the year. The fodder can also be knitted in existing food grain/ commercial production systems as these are equally or more remunerative and sustainable than the sole cropping systems. The detailed list of fodder based crop sequences for different agro-climatic zones of Chhattisgarh is given in Tables 6 and 7.

Table 6: Intensive fodder production models suitable for Chhattisgarh

IGFRI Model of intensive fodder production	
1	Maize + Cowpea/Ricebean – Oat - Maize + Cowpea
2	BN hybrid / Guinea grass+ Cowpea
3	BN hybrid + Oat
4	BN hybrid + (Cowpea – Oat)
5	Guinea grass + (Cowpea – Oat)
6	Guinea grass (sole)
7	Rice - Fodder Oat – Sesame
8	Rice -Fodder Lathyrus- Fodder Moong
9	Rice bean- Fodder Oat – Fodder Moong
10	BN hybrid and Guinea grass can be promoted either in open area or under

Fig. 6: BN hybrid + (Cowpea- Berseem)
(Under assured irrigation multiple cropping sequences)

Table 7: Fodder based crop rotation models according to climate and soil conditions of Chhattisgarh

IGFRI Model of intensive fodder production		
Crop rotation	**Climate & soil**	**GFY (t/ha/year)**
BN hybrid + Cowpea - Berseem	Sub-humid, Black soil	176
Sorghum + Cowpea - Berseem + Mustard - Sorghum + Cowpea	Sub-humid, Black soil	169
Pearl millet + Cowpea - Maize + Cowpea - Oats	Sub-humid, Red acidic soil	103
Maize + Cowpea - Sorghum + Cowpea - Berseem + Mustard	Sub-humid, Red acidic soil	96
Maize + Cowpea - Dinanath grass - Oats	Sub-humid, Alluvial soil	131
Maize + Rice bean - Berseem + Mustard	Sub-humid, Alluvial soil	112

Model- I: The BN hybrid + (cowpea-berseem+mustard) perennial grass based fodder production system is most productive and remunerative system ensures the round the year green fodder availability to the dairy animals throughout the country in peri-urban and milkshed areas. It provides 273 t/ha/year green fodder (44.3 t dry matter/ha/year), comprises of 67: 33 cereal: legume ratio and requires about 1090 ha-mm annual water and can sustain about 7-8 adult cattle unit/ha/year.

Model-II: Annual based fodder production system sorghum (multi-cut) + cowpea – berseem + mustard– maize + cowpea provides about 197 t/ha/year green fodder in 67: 33 ratio of cereal: legume mixture, suitable for peri-urban and milk-shed areas. This cropping system requires about 1820 ha- mm water for successful growth and development of the fodder crops which can provide green fodder to 5-6 adult cattle unit /ha/year.

The growing of catch crops (short duration forages) can also prove remunerative in gap periods and residual soil moisture conditions. Maize/sorghum/pearl millet + cowpea fodder crops can be planted after harvest of *rabi* season crops in summer and before planting of rainy season crops. The inclusion of forages in crop sequences in irrigated conditions may help in maintaining of soil health and improves its productivity due to dense canopy and addition of large amounts of stubble biomass. Crop sequences like paddy – berseem and maize + cowpea (fodder) – wheat are important food-fodder based crop sequence in different agro-climatic zones.

The inter crops (early short statured forages like cowpea, and lathyrus) can be incorporated in widely spaced row crops like cotton, sugarcane and grain crops of

maize and sorghum for optimum utilization of natural resources. In sole pigeon pea intercropping of short duration forage sorghum or pearl millet could be done as an intercrop without affecting the yield of pigeon pea. The intercropping of sesbania with maize in maize – wheat system recorded maximum wheat equivalent yield and net return.

The experiment conducted at Kanker, Chhattisgarh revealed that these cropping systems were found most productive and remunerative.

- Maize + Cowpea - Oats - Bajra + Cowpea : GFY 1026 q/ha
- Jowar + Cowpea - Berseem + Mustard - Maize + Cowpea : GFY 960 q/ha
- Bajra + Cowpea - Berseem + Mustard - Maize + Cowpea : GFY 959 q/ha

Fig. 7: Cultivation of fodder oat and berseem at Baikunthpur, Bhaadi Village of the District on the field of farmers by Krishi Vigyan Kendra, Korea-Chhattisgarh.

Source: Gautam *et. al.* (2018)

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

Lack of soil moisture under degraded land is the most limiting factor for arable farming in the state. There are various alternate land use (ALU) systems which provides fodder, food, fruits, fuel such as silvi-pasture (tree + pasture/+ animals), horti-pasture (fruit trees + pasture/+ animal) and agri-horti-silvipasture (crop + fruit trees + MPTS + pasture). Multipurpose tree species (MPTS)/shrubs growing in ALU systems are useful as leaf fodder available for animal feed besides wood and other products (Table 8). These activities contribute significantly to domestic livestock production, which in turn influences milk and meat supply and contributes to household income. Grazing animals with MPTS trees provide not only nutritious fodder but shelter to the animals during bright and sunny hot days. In Chhattisgarh, leaves of tress species grown in agroforestry are being used as leaf fodder mostly for small ruminant and for large ruminant during lean period or during fodder scarcity and under climatic abnormalities.

Table 8: Multi-purpose tree species for Chhattisgarh state

Peepal (Ficus religiosa)	*Mahua (Bassia latifolia),*	*Cassava (Manihot esculenta)*
Bargad (Ficus benghalensis)	*Bhimal (Grewia latifolia)*	*G. sepium*
Neem (Azadirachta indica)	*Jamun (Engenia jambolans*	*Babul (Acacia nilotica)*
Kachnar (Bauhinia variegata)	*Gliricidia (Gliricidia maculata)*	

There is ample scope and many opportunities for introducing fodder crops in existing orchards as fruit crops occupied about 2.54 lakh ha area in the state (2020-21). Horti-pasture system integrates pasture (grass and/or legumes) and fruit trees to fulfil the gap between demand and supply of fruit, fodder and fuel wood through utilizing moderately degraded land (Table 9). Major fruits of the state are mango, cashew, litchi, papaya, lime and banana. Aonla and guava based hortipasture systems/model has been developed for higher forage productivity. In Chhattisgarh, mango is grown in 76320 ha area in different agro-climatic zones which if put under fodder crops (BN hybrid, guinea, setaria or other fodder crops) can produce a huge quantity of green fodder which can fulfil the round the year requirement of green fodder of our livestock. The common mango planting distance followed is 10m x 10m which gives minimum 7-8 m inter row space for introducing fodder crops. These mango orchards can be utilized for additional fodder production of state.

Table 9: Fodder production from non-arable lands

Hortipasture	Guava/Mango + Guinea grass
	Guava/Mango + BN hybrid
	Guava + Para grass
	Litchi + Setaria grass
Silvipasture/ Grassland	Sal/Bamboo + Para grass (low land)
	Sal/ Bamboo + Guinea grass

Horti-pasture systems developed at ICAR-IGFRI have good production potential of forage from (6.5-12 t DM/ha) degraded land of rainfed areas. Horti-pasture systems can serve the purposes of forage, fruit and fuel wood and ecosystem conservation along with arresting the soil loss and conserve moisture. After a long rotation it improves the soil fertility and microbial activities. This system supports 2-4 ACU/year. In the state, majority of horticultural crops area planted very sparsely. The intervening spaces among trees in fruit orchards/plantations crops are largely left leaving that space unattended due to shortage of labour and mechanization. Technology for cultivation of fodder in these inter-tree spaces has been developed and can be used for cultivation of annual/perennial forages. Suitable crops under trees *i.e.* bajra x napier hybrid, guinea

grass, setaria grass and perennial legumes can be grown. Through planning if 50% of inter spaces of the fruit orchards/plantations crops can be used for fodder production it can produce about 0.85 to 1.56 lakh tonne dry matter.

The range grasses and legumes tested in the system that can be planted with MPTS were *Cenchrus ciliaris*, *Stylosanthes seabrana, Dichanthium annulatum* and *Stylosanthes hamata* through seed pellets or by sowing can provide cheaper source of green fodder. Fodder shrubs and trees like Chhaya, *Sesbania* spp., Glyricidia, Subabul can be promoted.

C. Fodder production from permanent pasture/grazing lands

Rangelands are extensive areas which are unfit for arable farming and are mostly under natural vegetation where animals graze. The Himalayan rangelands involving the seasonal pattern of animal migration and other forest grazing areas depict the true nature of Indian rangelands. These vast areas could be developed as model grassland with increasing production potential with rich genetic diversity of forage plant species in different eco-climatic conditions and a variety of habitats and niches. The area under permanent pasture/grazing are presently in very poor and degraded conditions. Rejuvenation and replanting with suitable grass species like congo grass and signal grass through seed pellets or by sowing can provide cheaper source of green fodder (Table 10 & 10a) and will also help livestock keepers in reducing production cost substantially.

Table 10: Silvo-pasture model for highly degraded/ waste lands

Model	Forage yield	Adult cattle unit maintained
1. *Ficus infectoria* with grasses and legumes species	12.3 t DM/ha	3- 4/ha
2. *Morus alba* with grass and legume species	11-13 t DM/ha	3-4/ha
3. *Hardwickia binata* with grasses and legume species	7-9 t DM/ha	2- 2.5/ha
4. *Acacia nilotica* with grass and legume species	9-11 t DM/ha	2.5-3/ha

Fig. 8: Alternate land used systems depicting trees/ shrubs with grasses for fodder cultivation

High percentage of cultivable wasteland compared to the total net sown area, indicating the scope for expansion of crop cultivation in the state. There is need to develop model grassland with increasing production potential having rich genetic diversity.

Table 10a: Fodder from permanent pasture land/ grazing lands

Grasses	Rainfall (mm)	Soil type	Seed rate (kg/ha)	DFY (t/ha)
Sewan (*Lasiurus scindicus*)	250	Light	3-5	3.5
Anjan (*Cenchrus ciliaris*)	300	Versatile	5-6	4.0
Dhaman (*Cenchrus setigerus*)	350	Versatile	8-10	3.0
Blue panic (*Panicum antidotale*)	500	Versatile	2-4	3.0
Marvel grass (*Dichanthium annulatum*)	575	Medium to heavy	4-5	2.5
Guria grass (*Sehima nervosum*)	500	Mixed Red/black	7-8	2.5
Dinanath (*Pennisetum pedicellatum*)	400	Versatile	8-9	3.0
Rhodes (*Chloris gavana*)	600	Sodic	8-10	2.5
Bahia (*Paspalum notatum*)	550	Light	11-17	3.5
Sabi grass (*Urochloa mosmabicellatum*)	550	Versatile	2-4	3.0
Range legume species				
Stylo (*Stylosanthes scabra*)	450	Light to medium	5-7	3.5
Stylo (*Stylosanthes hamata*)	325	Light to medium	4-6	2.5
Siratro (*Macroptillium atropurpureum*)	500	Light to medium	7-8	1.8
Butter fly pea (*Clitoria ternatea*)	300	Light to medium	15-20	3.0

Community pastureland development

Grazing intensity in such type of natural grassland is as high as 12.6 ACU/ha compared with 0.8 ACU/ha in developed countries. The productivity can be increased by developing model grass land with minimum input and management.

Fig. 9: Community pastureland

Different combination of range grasses and legumes used are *Cenchrus ciliaris, Cenchrus setigerus, Chrysopogan fulvus, Sehima nervosum, Heteropogon contortus, Dichanthium annulatum, Bothriochloa intermedia, Stylosanthes seabrana, Stylosanthes hamata, Clitoria ternatea, Macroptilium atropurpureum.* The varieties recommended for such lands are given in table 11. The target areas are degraded land, community land and forest land available with different state governments in India. The establishment cost of the system will be about Rs. 25,000-30,000/ha. Forage production from the system will be 6-8 t dry matter/ha/year which can support 2-2.5 ACU/ha with availability period of fodder from July to December. Its B:C ratio over the period of 10 years is 1.5-2.

Table 11: Different fodder varieties for permanent pasture land/ grazing lands

Species	Strains/varieties
Cenchrus ciliaris (Anjan grass)	Bundel Anjan-1, Bundel Anjan-3, Bundel Anjan-4, Marwar anjan (CAZRI-75)
Chrysopogon fulvus (Guria grass)	IGFRI-1
Dichanthium annulatum (Marvel grass)	CAZRI-490, CAZRI-485, IGFRI-495-1, Marvel-8
Panicum antidotale (Blue panic grass)	CAZRI-331, CAZRI-379, CAZRI-347
Pennisetum pedicellatum (Dinanath grass)	Bundel dinanath-1, Bundel dinanath-2

D. Fodder production on non-competitive land use systems

Different grasses can also be promoted as rainfed grasses in other niches like farm pond embankments, bunds, uncultivated farm lands, in orchards, rain water outlets etc to meet the green fodder at farm level. Introducing perennial cultivated grasses on farm bunds along with irrigation channels involving growing of 2 rows of bajra x napier hybrid/guinea grass along with field boundary can supply 7-11 q green fodder per 100 m length of boundary per year which can support milch animal of livestock keepers without any additional expenditure. Besides additional farm productivity can also be achieved and it will also work as a guard crop for main crop, reducing runoff loss of water and controlling soil erosion. Table 12 indicates the fodder production potential of bunds in the Chhattisgarh state.

Fig. 10: Perennial cultivated grasses on farm bunds along with irrigation channels

Table 12: Fodder production potential under different size of land holdings

Size of holding	Total holding numbers ('000)*	Average size of holding (ha)*	Total bund length available for fodder ('000 km)#	Production of fodder (@ 7 kg fodder/metre bund length) if 10% bund length utilized for fodder ('000 tonnes)**
Marginal (<1 ha)	2183	0.436	288	202
Small (1-2 ha)	831	1.419	198	139
Semi-medium (2-4 ha)	503	2.679	165	115
Medium (4-10 ha)	202	5.712	96	68
Large (>10 ha)	27	16.295	22	15
All classes	3746	1.357	873	611

Source: *Agricultural Census Database, 2015-16, Ministry of Agriculture and Farmers Welfare, Govt. of India; #based on calculations

E. Alternative fodder resources

Where land is real constraint, then farmers can be encouraged to make use of non-conventional feed resources like azolla, hydroponic fodder, crushed areca sheath, banana stem *etc*. In the workshop there was a discussion on promotion of hydroponics and azolla. The dry matter yield of hydroponic fodder and azolla is very low and need more labour. So, while using these technologies careful considerations on various factors can be given. However, these can be supplementary in nature and cannot substitute natural fodder production.

Fodder beet (*Beta vulgaris*)- Energy supplement

1. Protein content: 4-6 per cent in root & 12-14% in fresh leaves; root size 2.5-4.5 kg
2. Yield potential: 600-800 q/ha (fresh weight)
3. Contain growth stimulant 'saponin' and leaves are rich in carotene (1.4–6.2 per cent), vitamin C, E
4. Easily raised on saline – alkaline lands
5. Ensiled along with other cereal fodder crops
6. Cleaned roots and leaves fed directly to the animals (leaf @ 10-15 kg/animal/day (3-4 kg dry matter) with other green and dry fodder materials
7. For sheep, goat, pigs: 4-7 kg/animal/day fresh beet

Fodder beet is grown in rotation with cowpea, clusterbean, pearlmillet in *kharif* and oat and berseem in *rabi*. About 20% of fodder is received as leaf foliage.

Fig. 11: Fodder beet cultivation

Cactus (Opuntia)

1. Cactus (*Ficus indica*) is also called as prickly pear-spineless contain a high percentage of water - up to 90 per cent when fresh fed to livestock, reduced the water requirement by 40 to 100%.
2. Farmers prefer to cut the cactus into smaller pieces and supplement with hay or straw.
3. Average biomass generation is 5 to 10 times greater than any other xerophytic plant growing under similar environment.
4. Yield is 8-11 t/ha under rainfed and under irrigated and fertilised conditions cactus pear yields 22 t/ha.

Fig. 12: Spineless cactus

Azolla (anquatic fern)

1. Inexpensive and multiplied in natural water bodies for production of biomass.
2. Rich in proteins, essential amino acids, vitamins (vit. A, vit. B12, Beta Carotene, lysine), and minerals including calcium, phosphorous, potassium, ferrous, copper, magnesium.
3. On a dry weight basis, azolla has protein 25-35%, fat 3.0%, carbohydrate 50%, mineral content 10-15%, and 7-10% comprising a combination of amino acids, bio-active substances and biopolymers.

4. Yield upto 37.8 t fresh weight/ha (2.78 t DM/ha)
5. Given directly or mixed with concentrates to cattle, poultry, sheep, goats, pigs and rabbits

Fig. 13: Azolla

Hydroponic fodder production

Hydroponics is a method of growing plants without soil. Only moisture and nutrients are provided to the growing plants. Hydroponic growing systems produce a greater yield over a shorter period of time in a smaller area than traditionally-grown crops. Hydroponic fodder systems are usually used to sprout cereal grains, such as barley, oats, wheat, sorghum, and corn, or legumes, such as alfalfa, clover, or cow peas. It may fit for those producers who do not have local sources for forage. It may offer a ready source of palatable feed for small animal producers (poultry, piggery, goat, rabbits). Crops suitable for hydroponics are maize, bajra, jowar, cowpea, horse gram, sun hemp, foxtail millet, moth bean, barley, oats, wheat, alfalfa, clover.

Benefits

- ✓ Nutritious-rich in vitamins, minerals, proteins, moisture, enzymes
- ✓ Ready source of palatable feed and easy for digestion for small animal producers (poultry, piggery, goat, rabbits).
- ✓ Reduces the feed cost spent on the concentrate to half
- ✓ Cannot substitute green fodder and hay completely, as it lacks in fiber content
- ✓ Milk yield improves by 12-18% after feeding hydroponic fodder to the animals.

Fig. 14: Hydroponic fodder production

F. Fodder conservation technologies – Hay, bales, silage and feed block

Though, in general, there is scarcity of green fodder in the state, but still in most places surplus green fodder is available during the monsoon. A major part of this surplus green fodder goes waste or is improperly stored, reducing its nutritional value. The farmers may be trained in the techniques like making silage and provided with assistance from the central or state schemes to facilitate silage making at household level.

Hay/Bales: Although it is common practice, necessary training is needed to ensure long keeping quality of the hay material. Further, the dry fodder being voluminous in nature often needs larger space and pose problems in transportation. Hence pressing dry fodder in to bales to reduce keeping space and ease transportation has been found to be more necessary. The basic principle of hay making is to reduce the moisture concentration in the green forages sufficiently as to permit their storage without spoilage or further nutrient losses. The moisture concentration in hay must be less than 15% at storage time. Hence, crops with thin stems and many leaves are better suited for hay making as they dry faster than those having thick and pithy stems and small leaves.

***Leaf meal preparation*:** Chhattisgarh is blessed with variety flora and fauna, utilization the available fodder tree species for leaf meal preparation is one of grey area. Leaf meal can also be produced from other cultivated crops like lucerne, hedge lucerne *etc.* It involves harvesting the crop, chaffing and drying on clean floor for one and half to two days (based on sunlight intensity) and packing. This forms an excellent source of protein and acts as an alternative to expensive concentrate feed. Leaf meal based ration improves intake, nitrogen retention and utilization by animals.

Fig. 15: Lucerne leaf meal production

Silage making: The basic principle of silage making is to convert the sugars in the ensiled fodder into lactic acid; this reduces the pH of the silage to about 4.0 or lower, depending on the type of process. In this way, the biological activities responsible for spoilage are inhibited. To attain this, the early establishment and maintenance of oxygen free, *i.e.*, anaerobic, micro-environment is essential. The term 'silage' refers to any wet and/or green fodder, preserved by organic acids, chiefly lactic acid, that is

produced naturally by bacterial fermentation of sugars in the plants under anaerobic conditions. Stored material is highly acidic and has a lower feeding value compared to the original green fodder in the field. Silage making may be recommended. However, its success depends on availability of surplus green fodder production and labour. Several fodder crops are suitable for silage making *viz.,* maize, sorghum, bajra napier hybrid grass, guinea grass, setaria, pineapple stover, sugarcane tops *etc.*

Feed block: Bale or feed block making could be good strategies to reduce the cost involved in fodder transportation and saving the space for fodder storage. The mechanization aspect may also be thought of in terms of harvesting with weed cutters and chaffing of fodder with power operated chaff cutters, which reduce the reliance on manual labour and also help in saving time on these activities. It will also help in supplying fodder during the calamities as well as lean season.

Technology for sugarcane top silage making*:** Sugarcane **(Saccharum officinarum)* is a plant which is actually a giant grass. The top of a plant includes growing point, a few of the upper nodes and accompanying leaves. Usually the tops and dry leaves are burned off before the cane is processed for disposal, but in some cases the small farmers cut the tops for livestock feeding. Although, the feeding value of fresh cane tops is not very promising. It contains only 3-4 per cent CP and 40-45% TDN, besides containing oxalates as a deleterious factor. But theses sugarcane tops can be enriched and preserved as silage for feeding of livestock during lean periods. For enrichment, sugarcane tops are collected/ harvested and wilted for 4-5 hours in the harvesting field itself to obtain dry matter content of 30-35%. The tops are then chopped to a length of 3-5 cm using a chaff-cutter and ensiled in silo pits/other silos with 1.0 per cent urea, 0.5 per cent common salt and 2-5 per cent molasses on air-dry basis.

The material needs to be properly compressed in order to remove most of the air and obtain as much as possible sugarcane tops in each silo. After filling up and compacting the fodder, the silos were properly sealed to prevent air contact, and then, stored in a covered place at room temperature, free from moisture and solar radiation. Thus, sugarcane top silage gets ready for livestock feeding by 40 days.

G. Contingency plan for unforeseen situations

1. **For unusual rains or continuous high rainfall in a short span leading to water logging or heavy rainfall with high speed winds in a short span** : A farmer with crops like rice, maize, cowpea, sorghum, bajra, gram, berseem, oat in field can minimise the loss by adopting the suggested contingency measure
   a. **If crop is in vegetative stage :** Drain out excess water, 2% urea spray if leaves seems to pale yellow colour
   b. **If in flowering stage:** Drain out excess water
   c. **Crop maturity stage:** Drain out excess water, harvesting at physiological maturity immediately and drying of plants

d. Post harvest: To cover produce with plastic sheet or shift produces to farm shed and protection against pest/disease damage in storage *etc.*

2. Contingency plan for drought: Farmers should follow these guidelines

1. Short duration high yielding variety should be grown to obtain higher yield.
2. Dual purpose varieties of forage maize will provide GFY and grain also.
3. Farmers are advised for sowing drought tolerant varieties in water scarcity condition.
4. During dry spells protective irrigation can be provided to sorghum, pear millet and maize.
5. Give a top dressing of nitrogen spray immediately after stress period following rains showers.
6. Field should kept in weed free condition.

Crop	Varieties (normal or delayed monsoon; short and long dry spell)
Forage Maize	African Tall, J-1006, JM216(Dual purpose)
Forage *Bajra*	*Giant Bajra, Rajka Bajra chari 2*, JBV2,JVB3
Forage Sorghum	CSH 18,JJ1022,JJ741,JJ938, M.P. Chari, SSG-59-3,
Forage Cowpea	Bundel lobia 1, UPC-5286
Rice bean	Bidhan 1, JRBJ05-2

3. Contingency plans for livestocks

Livestocks in drought situation			
Factor	**Suggested contingency measures**		
	Before the event	**During the event**	**After the event**
Feed and fodder availability	Preservation of surplus fodder, encourage fodder cultivation and tree plantation and also encourage supply of molasses to cattle feed plants.	Arrangement of feeds and fodder from adjoining areas, exploitation of non conventional feed resources, use of area treated straw and feed blocks.	Promotion of fodder seed production, cultivation and storage establishment of fodder block making machines in fodder surplus areas; fodder bank
Drinking water	Repairs of tube wells, clear of the sludge in the canals and local water catchments and clean the water tanks, large ponds and lakes	Harvesting water through the existing reservoirs and exploitation of groundwater.	To strengthen reservoirs by promoting recharging of water and rain water harvesting during rainy season.

Health and disease management	Mass vaccination and deworming	Provide shades to animals and water as much as possible. treatment of diseased animals and proper disposal of carcasses.	Treatment of diseased animals and provide vitamin and mineral supplement to regain strength and vigour.

Livestock's during floods	**Before the event**	**During the event**	**After the event**
Feed and fodder availability	Conservation of the fodder in the form of hay and silage.	Feeding of feed blocks and silages	Provide treated feed and fodder to animals against moulds and fungi.
Drinking water	Regular inspection of ponds and canals for any obstruction.	Provide drinking water in small through and plastic bucket.	Disinfection of contaminated water especially for drinking purpose.
Health and disease management	Storage of medicines	Treatment of injured animals	Disposal of dead animals.
Health and disease management	-	Grazing should be allowed during night and early hours of the day, vaccination and veterinary checkup time to time.	-

Livestocks in cyclone /heat wave and cold wave situation		
Factor	**Before the event**	**During the event**
Shelter/ environment management	Construction of wind breaks, shed should have sufficient over hangs, fixing of sprinklers, provide thatch on the roof. Construction of wind breaks, keep curtains ready, arrange for heating devices.	Construct wind breaks keep animals under shade during hot hours of the day, provide cooling fans in shades and also sprinkle water at regular intervals. Construction wind breaks, put gunny bags on all openings of shed.

Suggested contingency measures for poultry			
Factor	**Before the event**	**During the event**	**After the event**
Drought			
Shortage of feed ingredients	Storage of feed	Provide non conventional feed, supplement anti oxidant and anti stress	
Drinking water	Storage of water in tanks	Add Vit-C and other anti stress ingredient with water	
Health and disease management	Regular vaccination	Vaccination and treatment of diseased one	Disposal of dead birds
Floods			
Shortage of feed ingredients	Storage of feed in safe storage bins to avoid mould and fungi	Use pellet feeding	
Drinking water	Safe storage of water in tanks	Provide treated water	
Health and disease management	Regular vaccination	Vaccination and treatment of diseased one, proper litter management and addition of lime as per need	Disposal of dead birds
Cyclone			
Shortage of feed ingredients	Storage of feed	Use stored feed carefully avoiding dampness	
Drinking water	Safe storage of water in tanks	Provide treated water	
Health and disease management	Vaccination and treatment of diseased one, proper litter management	Disposal of dead birds	
Heat wave and cold wave			
Shelter/ environment management	Construction of wind breaks, poultry shed should have sufficient over hangs fixing of sprinklers on the roofs, provide thatch on the roof, decrease stocking density, decrease litter depth.	Provide cooling fans in shades and also sprinkle water on the roof at regular intervals. Use of wind breaks, put gunny bags on all openings of shed, use heating devices	

	Construction of wind breaks, keep curtains ready, arrange for heating devices, increase stocking density, decrease litter depth.	
Health and disease management	Routine health care	Reduce energy content and increase protein content in feed, add anti stress factors, provide cool drinking water. Increase energy content

H. Custom hiring center

These need to be developed to provide equipment's, machinery *etc.* to the farmers at affordable cost. Use of new machineries and technologies will enhance production, reduce drudgery and cost. The custom hiring center should have all important implements/machinery required for fodder production (Table 13).

Target beneficiary:

Livestock keepers, farmers including farm women, farmers of social and economical weaker section, state seed production farms, seed producing farmers groups, NGOs, startups, farmers cooperatives *etc.*

Basket of Technologies

1. Forage crop varieties, annual and perennials
2. Forage on bund, embankments
3. Forage in tree basin
4. Intensive forage production
5. Round the year fodder production
6. Forage in horti and silvi-pasture systems
7. Forage conservation/leaf meal technology

I. Strengthening fodder seed production farms and fodder seed production

The Chhattisgarh State Livestock Department carries out various activities to support the sector including

(1) Veterinary health care service delivery;
(2) Improvement in breeding procedure in animals and birds;
(3) Extension and human resource development;
(4) Rural development through promotion of livestock rearing.

Government farms which can be a source for disseminating the fodder production technologies in the state are as follows in tables 14, 15 & 16.

Table 13: List of equipment's, machinery for custom hiring centre

Prime movers or general machines	Land preparation/ tillage machine	Sowing/ transplanting machine/ intercultural machines	Harvesting/ threshing machines
Tractors (I) Tractor 2WD (above 20-40 PTO HP) (ii) Tractor 2WD (above 40-70 PTO HP) (iii) Tractor 4WD (above40-70 PTO HP) **Power Tillers** (I) Power Tiller (below 8 BHP) (ii) Power Tiller (8 BHP & above)	(i) Disc harrow (ii) Cultivator (iii) leveler blade (iv) Cage wheel (v) Furrow opener (vi) Drainage/ Mole plough (vii) Weed slasher (viii) Bund former (ix) Crust breaker (x) Roto-puddler (xi) Roto-cultivator (xii) Rotavator	(i) Seed cum fertilizer drill (ii) Self-propelled rice transplanter (4-8 rows, manual and power operated) (iii) Post hole digger (iv) Raised bed planter (v) Multi crop planter (5 tines) (vi) Ridge furrow planter (vii) Pneumatic vegetable transplanter (viii) Plastic mulch laying machine (ix) Raised bed planter with inclined plate planter and shaper attachment. (5-7 tines) (x) Grass weed slasher (xi) Power weeder	(i) Tractor drawn crop reaper/ reaper cum binder (ii) Engine operated reaper/ reaper-binder (iii) Power weeder (engine operated above 2 bhp) (iv) Power weeder (engine operated above 5 bhp) (v) Power operated horticulture tools for pruning budding, grating, shearing *etc.* (vi) Manual/ Engine operated tree climber for coconut harvesting (vii) Paddy thresher (viii) Fruit harvester-picker for cashew (ix) Flail harvester/ shrub master

Table 14: Government cattle breeding farm

Government cattle breeding farm	Year of the establish-ment	No. of animal sanctioned	Breed of the animal	Area of the farm (acres)	Land for fodder production (acres)
Pakriya - Bilaspur	1928-29	110	Sahiwal	2415	60
Sarkanda, Bilaspur	1948	260	Sahiwal	701.4	125
Chandrakhuri Raipur	1981	180	Crossbred/Jersey	719.6	414.4
Anjora Durg	1956-57	250	Sahiwal	140	100

Table 15: Government poultry farm

Government poultry farm	Year of establish-ment	No. of animals	Breed of animal	Area (acres)
Dist. Durg	1956-57	6000	Grampriya, Vanraja, Black Rock, Turkey, Duck, Japanese Quail	46.7
Baikunthpur Dist. Koria	183-84	4200	Grampriya, Vanraja, Chebro, Delam Red, Japanese quail	9.0
Koni Dist. Bilaspur	1956-57	4600	Grampriya, Vanraja, Chebro, Delam red, Duck	13.0
Dist. Raigarh	1959-60	4000	RIR, Kalinga Brown, Giriraja	6.66
Sakalo Ambikapur	1986-87	1600	Multicolor	8.0
Jagdalpur	1964	1600	RIR, Kalinga,Brown Multicolor, Japanese quail, Giriraja	5.0

Table 16: Government goat and pig farms

Government goat farms	Year of establish-ment	No. of animals	Breed	Area (acre)
Pakaria Bilaspur	1982	500	Jamunapari, Sirohi	
Srora Raipur	2008-09	500	Jamunapari, Sirohi	
Government pig farm				
Parchanpal Bastar	1980	125	Largewhite, Yorkshire, Russian, Charmukha	104
Sakalo Ambikapur	1987	125	Largewhite Yorkshire, Hemp, Russian Charmukha	10

Seed production responsibilities

Feed shortages and the poor quality of available feed are the major constraints to increase livestock productivity. Sowing a new pasture or improving an existing natural pasture requires a reliable source of seed or vegetative material of species recommended and adapted for the area. The objective of a forage seed production is to make available quality seed or vegetative material that is suited to farmers' needs for livestock production. Farmers' needs are variable depending on the environment, type and class of grazing animal and the animal product required. These needs may also include forage use for conservation (hay or silage), site stabilization (erosion) and amenity uses (turf). It is therefore necessary to ensure positive consumer reaction to new materials and accompanying production techniques to help farmer adoption of these materials.

The need for seed production

With the development of improved and high-yielding varieties in forage crops, it has been realized that truthful labeled (TFL) and certified seed should be supplied to the farmers. Shortage of improved technologies in the field of seed production of forage crops will have to be overcome by launching a participatory seed production programme. Apart from the seed production techniques, seed processing and handling techniques need to be developed for maintaining the quality of forage seeds. The demand of quality seed of forage crops is increasing day by day. This can be achieved only through identification of high seed-producing forage crop varieties and through sufficient production of quality seeds with the participatory programme of researchers, farmers, NGOs, and seed growers/farmers.

Quality forage seed production is a specialized activity and is a relatively recent phenomenon in India. Because of limited experience and expertise, organized forage seed production and delivery systems are almost non-existent at the required niches. Consequently, the supply of quality forage seed has been insufficient to meet the demand of even better known species and cultivars that have originated through crop breeding efforts.

The nature of forage seed production is more complex and a number of environmental and physiological factors have a significant impact on seed production potential of a particular crop. By and large, forage crops are shy seed yielders. In majority of forage crops, seed production depends on photo period, thermo period, humidity, soil type and condition and the soil moisture. These crops can give better seed yield if grown under ideal agro-climatic situations/sites. Each forage crop is, therefore, suited to only specific area for forage and/or seed production such as berseem in the northern plains and lucerne in the north-west India. Concerted efforts are, therefore, required in this direction so that available technology could be passed on to the forage and seed producing agencies and also to farmers for their eventual use in augmenting forage resources.

Breeder seed production of the identified varieties : IGFRI, Jhansi / SAUs/NSC

Foundation seed production : SSC/RFSPD/ SAUs/NGO

Production of certified/TFL seeds : Milk unions/Contract farming/ Seed producing organization

Seed/planting material requirement

The seed/planting material requirement of the state was calculated by taking into consideration 10% (13.79 lakh ha) of total cultivated land (137.9 lakh ha). Out of 11 crops, from Sl no. 1 to 9, the percentage of contribution is 10 % (1.379 lakh ha) and for serial no 10 and 11, 5 % (0.6895 lakh ha), respectively.

Table 17: Seed/planting material required

S.No.	Crop	Varieties	Seed rate (kg or no./ha)	Seed requirement (t)
1	Berseem	Wardan, BB-2, BB-3, JBSC-1, JHB-17-1, JHB-17-2, JHB-18-1, JHB-18-2	20 kg/ha	27,580
2	Lucerne	Chetak, T-9, CO-1, Anand-2, LLC-3, LLC-5, RL-88	12.5 kg/ha	17,238
3	Oat	JHO-851, JHO-822, JHO-2004, JHO-99-2, JHO-2009-1, JHO-15-1	80 kg/ha	1,10,320
4	Sorghum	*Single cut:* HC-136, Pusa Chari-1, Haryana Chari-171, PC-6, HC-260, PC-23, HC-308, PC-9, PC-615 *Dual purpose:* SPV-669, R Hybrid CSH 13, JS 29/1, CSV-15 *Multi cut:* SSG-59-3 (Meethi sudan), Pant Chari-5 (UPFS-32), CoFS-29, CSH-20MF, UPMCH-1101, CO-27, Harasona (855-F), CO-31	35-40 kg/ha	51,413
5	Pearl Millet	Multi cut: Giant bajra, CO-8, Proagro No. 1 (FMH-3), Moti bajra, APFB-2	10-12 kg/ha	15,169
6	Maize	Dual purpose: Raj bajra chari-2, NDFB-2, 3, 5, 11; AVKB-19, African tall, J-1006, APFM-8, Pratap makka chari-6	30-40 kg/ha	48,265 kg

7	Guar	HFG-119, BG-1, BG-2, BG-3	20-40 kg/ha	41,370
8	BN Hybrid	IGFRI-3, NB 21, CO-1, CO-2, CO-3, Co-5, Co-CN-4, CO-6, PBN 83	30000 rooted slips/ha	41,370,00 slips
9	Guinea Grass	Hamil, PGG-14, Bundel guinea-1, Bundel guinea-2, CO-1, CO-2	60000 slips & 2.5 kg/ha	82,740,00 slips & 3448
10	Lathyrus	Nirmal, Ratan	70-80 kg/ha	5171
11	Anjan Grass	Marwar Anjan (CAZRI-75), Bundel Anjan-1, Bundel Anjan-3, Bundel Anjan-4	1-4 kg/ha	1724

J. Package of practices of important fodder crops

Guinea grass (*Panicum maximum* L.)

Climatic requirements

Irrigated crop cultivated throughout the year whereas rainfed crop is cultivated only during monsoon season. Guinea grass thrives well in warm moist climate. It can grow from sea level to 1800 m altitude. It is frost sensitive. It thrives between a temperature range of 15 to 38 °C. The physiological development and productivity is much influenced by photoperiod, thermo period, humidity, soil texture, structure and moisture.

Soil conditions

All types of soils with good drainage are preferred. It usually grows on well-drained light textured soil, preferably sandy loams or loams, but is better suited to medium to highly fertile loams. It cannot tolerate heavy clays or prolonged water logging. The crop grown on ideal site can give better yield.

Field preparation

The grass requires thorough cultivation to prepare a weed-free seedbed for establishment. For this, two or three ploughings and one levelling are sufficient. Form ridges of 15 cm height for planting slips. In acid soils, application of lime @ 500 kg ha^{-1} in alternate years is desirable.

Seed and Sowing

The best season of planting is with the onset of southwest monsoon during May-June. As an irrigated crop planting can be done at any time of the year. Seeds and slips can be used as planting material. Seed germination is poor, since seed of some genotypes may not reach maximum germination until up to 18 months after harvest, while others may take only a few months. Dormancy can be overcome by removal of glumes from fresh seed. Seed can be drilled or broadcast at 2-3 kg/ha, and being a small seed, should be planted at no more than 1 cm deep. For line sowing/planting, seeds should be sown in nursery (1-2 kg ha^{-1}) and the seedlings transplanted in the main field. 30-35 days old

nursery plants are transplanted into the main fields for better establishment of the crop. It can also be established from rooted tillers (or cuttings with thick stemmed varieties) also. Establishment of crop through vegetative propagation is preferred. To obtain slips for planting, old clumps are uprooted and slips with roots are separated. For planting one hectare area at a spacing of 60 cm x 60 cm, 27,777 slips are required.

Spacing

45 cm x 45 cm or 60 cm x 60 cm

Nutrient management

Apply NPK fertilizers as per soil test values along with recommended FYM/compost. In absence of soil test results, 20-25 t FYM should be well mixed in soil at the time of land preparation. At sowing time a basal dose of 60 kg N, 50 kg P_2O_5 and 40 kg K_2O/ha should be applied in bands prior to planting. Subsequently 20 kg and 10 kg N respectively, should be top dressed just after and 20 days after the cut. Alternatively, the crop may be fertilized with 40 kg N just after the cut. The fertilizer may be applied on either side of the plants, along the row and earthed up.

Water management

Water is essential input to ensure good yield. The grass should be planted in well moist soil condition. The crop needs regular irrigation at an interval of 15-18 days in March to May, at 10-12 days interval in summer months. During monsoon seasons the irrigation is rarely needed in event of long monsoon failure. Irrigation with cowshed washing or sewage water within 3-4 days after cutting gives better growth.

Weed management

The delicate seedlings or newly emerged shoots from slips or cuttings require protection from weeds in the first two months. Two inter-cultivations should be given during this period. Later, inter-cultivation may be necessary after three or four cuttings. The gap filling may be done after 20 days of planting. Regular hand weeding/hoeing is required to ensure good aeration and crop growth.

Production potential

First cut at 60-65 days after planting and subsequent cuts are obtained at 40-50 days interval. About six to seven harvests can be made in a year. Cutting at 15 to 20 cm above the ground level is advised. Approximately 80-100 t ha^{-1} of green fodder is obtained per year.

Nutritive value

Guinea grass is well eaten by all classes of grazing livestock, with particularly high intakes of young leafy growth. IVDMD from 64% (2 week re-growth) to 50% (8 week re-growth). Crude protein from 6-25% depending on age and N supply. Seasonally, CP values in 12 week old regrowth commonly range from 5-10%, P levels from 0.15-0.18%, Ca from 0.6-0.8% and Na from 0.07-0.12%.

Seed production

Guinea grass is partially apomictic but cross-fertilizes about 5%. Seed ripens unevenly and is shed as it matures. High levels of nitrogen have been reported to encourage seed production in guinea. It has wider maturity periods and is therefore difficult to harvest. Hand harvesting to remove ripe panicles is often followed. Highest seed yield will be obtained when the panicle has sheds 40-60 percent of its spikelets, which occurs about 12-14 days from panicle emergence. Direct heading is less efficient in terms of seed recovery than mowing, windrowing and sweating. Yields of 50-100 kg/ha pure seed yield can be obtained from hand harvest of panicles and around 150-200 kg/ha from ground sweeping.

Dhaman/Anjan Grass (Buffel Grass) *Cenchrus ciliaris* L.

Important features:

- A perennial grass highly drought tolerant and well adapted to arid and semi-arid areas.
- It thrives well in light textured soils and grows easily on all types of well drained and even low pH soils.
- It is highly suitable for pastures under rainfed conditions.
- Both annual and perennial plants have solid culms and fibrous roots.

Varieties: Bundel Anjan 1, Bundel Anjan 3, Co-1, Marwar Anjan.

When and how to plant: Planting is preferred in the monsoon season at the rate of 6-8 kg seed/ha.

Seedlings of 6-7 weeks can be transplanted when it is drizzling, at 45-60 × 45-60 cm spacing. About 30,000-40,000 seedlings are required per hectare.

Chemical fertilizer (kg/ha): Appy an initial dose of 40 kg N and 20 kg P mixed in soil as a basal dose. Apply 20 kg N to the one-month old crop. In subsequent years, a top dressing of 40 kg N and 20 kg P is required at the start of rains.

Farm Yard Manure (t/ha): Apply 5 t mixed in soil before planting.

Irrigation: Mostly grown as a rainfed crop, irrigation is required every 12-15 days if necessary.

When to harvest: First harvest at 70-75 days after planting and subsequently after 40-45-days.

Green fodder yield (t/ha): 30-40 t in 3-4 cuttings per year depending on growth under rainfed conditions

Berseem (*Trifolium alexandrinum* L.)

Berseem is popularly known as the king of fodder crops for irrigated condition of northern India, because it is available for 6-7 month from November to May. The crop gives 4 to 6 cuts during winter, spring and early summer seasons and provides

nutritious, succulent and palatable forage. The green forage of berseem, on dry matter basis contains 17-22% crude protein, 42-49% neutral detergent fibre, 35-38% acid detergent fibre, 24-25% cellulose and 7-10% hemi cellulose.

Land requirements

Well drained clay to clay loam soil rich in humus, calcium and phosphorus are suitable for good crop of berseem. Comparatively heavy textured soils are considered better due to greater water retaining capacity and congenial edaphic environments for crop persistency. The land should be free from volunteer plants. The field should be perfectly leveled to obtain even distribution of irrigation water and to avoid water stagnation. Berseem can be grown in saline-sodic soils. Fine seed bed is required especially when berseem is to be grown as seed crop in rows without pudling to facilitate weed removal and rouging for quality seed production.

Isolation requirements

The extent of natural cross-pollination depends upon insect activity. A minimum isolation as per the requirement for foundation and certified seed should be maintained from the fields of other varieties and the fields of the same variety not confirming to varietal purity requirements for certification.

Sowing time

Sowing time is an important factor governing germination, seedling survival, number of cuts and herbage production. Berseem should be sown when the temperature is in the range of 25-27^{O}C. Thus, the optimum sowing time of berseem in Punjab, Haryana and Uttar Pradesh is mid of October. In West Bengal and Gujarat, sowing is done in the month of November.

Seed rate and sowing method

Under normal conditions the optimum seed rate of berseem is 25 kg/ha. The seed bed for berseem sowing is prepared by filling the water to a depth of 4-5 cm, raking the soil and creating the muddy condition by light puddling (mechanical manipulation of soil at high moisture content). Then the overnight soaked seeds are broadcasted in standing muddy water in crosswise directions to obtain uniform seed distribution. The sowing should be done towards the evening or during non windy periods of the day.

Nutrient management

Since, berseem is a leguminous crop, it needs less nitrogen from external sources, because, its root nodules contain *Rhizobium trifolii* bacteria which fix atmospheric nitrogen for plant use. Therefore, fertilizer nitrogen is required only for establishment prior to the formation of root nodules. A dose of 20 kg N/ha at sowing is the optimum for growth of the crop. In general, the crop responds significantly upto 80-90 kg P_2O_5/ha as basal application. The potassium requirement of berseem has been found to be 30 to 40 kg K_2O/ha in low potassium soils.

Weed management

The weed management is one of the vital components of berseem cultivation. The major associated weed of berseem crop is kasani/chicory (*Chicorium intybus*). Usually chicory is found admixed with berseem seed. Since the size of chicory seed resembles with berseem seed; it becomes difficult to separate them by ordinary methods. However, the seed of berseem is oval while the seed of chicory is conical. To remove chicory seeds from berseem seed, 10% common salt solution is used. The chicory seeds being lighter in density than berseem, seed float on the surface while berseem seeds settle down at the bottom of container. In this way chicory seeds may be drained off and berseem seed is collected.

Disease and insect-pest management

During the month of December and January, when the crop attains luxuriant vegetative growth and cloudy days persist for longer period, the heavy infestation of fungal diseases such as root rot and stem rot occur. It has been observed that the problem is more acute under the situations of cloudy condition prevailing for longer period, creation of damp conditions due to water stagnation, light penetration at the ground is curtailed due to delayed cutting and field is heavily manured with un-decomposed FYM and/or irrigated with sewage water. The agronomic approaches to manage diseases are; using well rotten manure in proper quantities, fertilizing the crop with heavy dose of potassium, leveling field properly to avoid water stagnation, avoiding frequent irrigations during cloudy days, cutting the crop frequently to expose the ground for adequate light penetration and avoiding the growing of berseem crop in the same field year after year and deep ploughing during summer.

Roguing

The seed crop must be rogued at pre-flowering, flowering and seed maturity stage to remove offtypes, other crop plants and chicory plants. However, the rouging must be complete before harvest.

Harvesting and seed yield

When two thirds of the pods have turned yellowish to brown, the crop is ready to harvest. It is advised to harvest the crop in the early morning to avoid the seed shattering. On an average 5-7 q/ha seed yield can be obtained.

Rizka/Alfalfa/Lucerne (*Medicago sativa* L.)

Lucerne is known as 'Queen of forage crops'. In India, lucerne is mostly grown in irrigated areas of Punjab, Haryana, Uttar Pradesh, Rajasthan, Gujarat, Maharashtra, Tamil Nadu and in Leh area of Ladakh. It is generally grown during *rabi* season as an important fodder crop in areas where water supply is inadequate for berseem and winter period is short. Its deeper root system makes it very well adaptable to dry areas with irrigation facility. It grows well as rainfed or unirrigated crop in high water table

areas. It is perennial (3-4 years), persistent, productive and drought tolerant forage legume which contains 15% crude protein with 72% dry matter digestibility.

Land and isolation requirements

Land and isolation requirements of lucerne are similar to those of berseem described earlier.

Sowing time

Middle of October is the best time for sowing lucerne. However, it can be sown from the end of September to early December.

Seed rate and sowing method

A seed rate of 10-12 kg/ha is required. It can also be sown through seed drill or desi plough with row to row spacing of 30-45 cm. The seed should not be planted deeper than 1.5 cm.

Nutrient management

A basal dose of 20 kg N, 60-75 kg P_2O_5 and 40 kg K_2O/ha is also required. Boron deficiency is generally noticed in leached and coarse textured soils. Spray of 0.2 per cent borax, contends boron deficiency.

Water management

To obtain good germination, pre-sowing irrigation (*palewa*) is essential in lucerne. Since, lucerne takes a long time to establish at early stage, very frequent irrigations may be required at the interval of 7-10 days. One irrigation at full bloom and another at pod filling stage is required. Proper drainage should be ensured to avoid waterlogging in rainy season.

Weed management

For seed production, the weeding of crop is a must. In seed crop Amer bel or dodder (*Cuscuta*) is most important weed. It may reduce seed yield by 60%. For certified seed production of Lucerne, its population should be <0.05 per cent (20 *Cuscuta* seeds/kg Lucerne seed). Pendimethalin 1-2 kg /ha (pre-emergence) or Diquat @ 6-10 kg/ha 5-10 days after sowing effectively controls *Cuscuta*. 'T 9' cultivar is found highly susceptible to this weed, while 'LLC 6' and 'LLC 7' are moderately tolerant to *Cuscuta* infestation

Disease and insect-pest management

Lucerne weevil and aphid are two important insects of this crop. These insects can be managed through the application of neem oil @ 30 ml per litre of water. The most important diseases of lucerne are rust, leaf spot, downey mildew and phytopthora rot. Application of Dithane M-45 (0.25 per cent) as spray is effective for rust and leaf spot control.

Forage and seed yield

In a year, 8- 10 cuts can be taken between October-April with 80-120 t/ha green fodder and 18-20 t/ha dry fodder. The seed yields usually vary from 0.2-0.3 t/ha.

Cowpea (Lobia) *Vigna unguiculata* L.

Cowpea is a quick growing leguminous forage crop. It is usually grown mixed with cereal fodders and grasses to improve the nutritive value of the herbage. It contains 20-24% crude protein, 43-49% neutral detergent fibre, 34-37% acid detergent fibre, 23-25% cellulose and 5-6 per cent hemicelluloses on dry matter basis. The digestibility of cowpea fodder is above 70%. It is an excellent cover crop, which suppresses weeds and enriches the soil. Cowpea requires warm climate with good atmospheric humidity.

Land requirements

Cowpea can be grown on variety of soils. The plants prefer light soils. Loam and sandy loam soils with good drainage are most suitable for good crop growth. The land should be free from volunteer plants.

Isolation requirements

Cowpea is largely self-pollinated crop but some cross pollination by insects has been recorded. The seed crop should be isolated at least 10m for foundation seed and 5m for certified seed.

Varieties

EC-4216, UPC-5286, IFC-8503, EC-4216, FC-8, Bundel lobia-1, Bundel lobia-2 *etc.*

Sowing time

In irrigated areas, sowing can be done during summer while in rainfed areas, it can be done after commencement of rains. Its sowing time extends from March to middle of July.

Seed rate and sowing method

A seed rate of 20-25 kg/ha is sufficient for its proper plant population. The sowing should be done in lines at an inter row spacing of 45-60 cm and intra row spacing of 10-15 cm. The seed should be sown with seed drill or behind the plough at a depth of 2-3 cm.

Nutrient management

Cowpea is a leguminous crop and has capacity to fix atmospheric nitrogen. However, for good growth 20 kg N and 60 kg P_2O_5/ha should be applied at the time of sowing for good crop growth. In sulphur deficient soils (below 10 ppm), 20-40 kg sulphur per hectare is recommended for quality fodder biomass production.

Water management

Normally the *kharif* season crop does not require irrigation except in case of long dry spells in which the crop should be irrigated at an interval of 10-12 days. But, summer crop requires 6-7 irrigations at 8-10 days interval.

Weed management

In general *kharif* crops are densely infested with weeds due to conducive situation for growth. Weeds have to be controlled by using a blade harrow in between rows till the crop gets established.

Roguing

Off type and diseased plants should be removed from the field time to time as required.

Harvesting and seed yield

The seed crop can be harvested when the pods matures or turned to yellow colour. Threshing can be done by beating sticks when pods are dry. Average seed yield varies from 8-10 q/ha. The seed should be dried to 9 per cent moisture content before storage.

K. Fodder cultivation and preservation practices for Chattisgarh state

1. Sowing of fodder crops like maize, jowar, oat *etc*., and leguminous fodder crops like barseem, lucerne and cowpea *etc*., should be initiated with the onset of *rabi* season. Procurement of seed, land preparation and inputs required for cultivation of fodder crops should be started as early as possible.
2. During the late part of *rabi* season, when harvesting of crops are done, it is highly advised to preserve fodder for summer season when there is imminent scarcity of fodder for livestock. For central and southern parts of Chhattisgarh, making 'hay' is advised while in northern cooler parts of the state, making 'silage', along with 'hay' is advised.
3. For making hay, crops like oat, BN hybrid napier, lucerne, berseem, peas, cowpea, chick pea, field bean, are suitable and for silage making crops like maize, jowar, para grass and BN hybrid are most suitable for the state.
4. Paddy straw needs to be stored as dry fodder in quantities sufficient to cover entire winter and summer till monsoon. Enrichment of paddy straw by urea treatment should be undertaken. Neem coated urea can also be used for this purpose.
5. Feed requirement for animals and human being is generally more during winter. Increase the animal ration by 5-10 per cent during winter season to maintain production of animals.
6. Take special care so that agricultural pesticides and disinfectants do not get mixed with animal feed and fodder even in little quantities.

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 production potential *vis-à-vis* the farmers' acceptance and their satisfaction.

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

Among different agro-climatic zones of the state, one district from each agro-climatic zone can be selected. Bench mark survey may be initiated in 2 taluks in each of the selected districts which will fairly give an idea about the possible conditions for propagation of fodder crops under varied situations.

iii. Identifying 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 agriculture and animal husbandry department of Chhattisgarh to finalize which fodder crops and their varieties would be more suitable for different agro-climatic conditions prevailing in the state of Chhattisgarh and it has been outlined in the recommendations. The same may be used as guideline for identification of suitable fodder crops and varieties.

iv. Providing 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 Chhattisgarh.

v. Master trainers training at IGFRI/SAUs

The staff of Dept. of Animal Husbandry and Veterinary Services, Agriculture, Horticulture, Forestry *etc.* from the Govt. of Chhattisgarh 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. 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 department, Govt. of Chhattisgarh.

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

The Krishi Vigyan Kendras (KVKs) operating in the state of Chhattisgarh will be

roped in to identify the needy farmers for training on fodder crops. Other stake holders like milk co-operatives, non-governmental agencies (NGOs) and progressive farmers will also be made partners in the process of creating awareness about fodder production.

vii. Conduction 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 the 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 various fodder crops' seeds 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- fodder production, conservation and utilization

In fact there is a fodder scarcity in most of the places in Chhattisgarh. The would-be fodder cultivating farmers will be doing so out of their dire requirement of fodder for their livestock. 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. Enhance acreage and productivity in non-conventional areas

Indeed there is a shortage of land for allocation to fodder crops production 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:

i. Production of fodder in non-arable land, and wasteland.

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

iii. Enhancing fodder production through grassland, rangeland and grazing land management.

iv. Enhancing production through alternate land use management such as hortipasture-and silvi-pasture *etc.*

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

In many areas in spite of having a large chunk of crop wastes with fodder value, it cannot be utilized due to faulty agricultural practices or lack of foresight and or lack of machinery *etc.* For example a large scale paddy cultivated do not necessarily result in good quality paddy straw as dry fodder owing to incessant rains during harvest, lack of proper farm machinery, lack of awareness among farmers to conserve paddy straw *etc.* Hence, conservation of fodder resources wherever possible for future for use during lean periods and at the time of natural calamities like famine, high rainfall *etc.* will be highlighted. Fodder being bulky in nature this accounting for huge expenditure in transportation, bale making of dry fodders, silage in polybags of convenient sizes for transportation will be promoted and popularized among the livestock holders.

xii. Establishment of fodder banks

At times livestock holder face 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 forces to go hungry. In addition, establishment of fodder ware houses with enriched dry fodder or silage bins will also be popularized.

xiii. Networking through ICAR-DAHD-SAUs-Milk Federations

Any isolated efforts to augment fodder resources may not be sustainable in long run owing to some 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, KVKs *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 problems associated with technologies and forth coming issues in future.

xiv. 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 in more transparent, efficient and economical way for all the partners.

xv. Impact analysis of technology adoption

The objectives of the programme also aim at seeing the perceptible changes that are to happen through 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-task, multi-partner and multi-year activity. Hence, a proper road map is necessary for making it more practical and result oriented. 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 (Table 18).

Table 18: Road map for the implementation of the proposed activities

S.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 KVKs/milk unions/SAHD/LDB
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 plan is a time bound multi-stage oriented and aims to complete the activities in time frame in a logical way.

Part-V : Implementation of Pilot Programme

Pilot project is proposed to be implemented in the selected areas to assess the acceptability and impact of technology and also refinement in technology and methodologies, if required. Pilot project is proposed to be implemented in selected villages of identified districts (3) of each agro-climatic zone. The detailed plan for implementation of pilot project is presented in the Table 19.

Table 19: Implementation level plan for pilot project

S.No.	Activity	Action points
1	Target area selection	Selection of 3 districts (1 from each agro-climatic 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 and other ICAR institutes/ SAUs located in state.
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
4	Suitable silvi-pasture/ horti-pasture system demonstrations	In existing orchard- 1 ha (Guinea); In new orchard - 1 ha (Guinea); 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 and 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.*

Aspirational areas

For successful initial implementation of plan in state of Chhattisgarh, following districts should be targeted. Districts like Baloda Bazar, Balrampur, Bastar, Bemetara, Bilaspur, Bijapur, Dantewada, Durg, Gariyaband, Janjgir-Champa, Kanker, Jashpur, Korba, Korea, Kondagaon, Mahasamund, Narayanpur, Raigarh, Raipur, Rajnandgaon, Sukuma, Surajpur and Surguja as they have higher number of livestock's as compare to others.

Funding arrangements

Govt. of Chhattisgarh, Govt. of India through various state and central schemes like RKVY *etc.*, for proceeding the project. ICAR- IGFRI will provide technical support for formulation of such fodder development proposals for funding. The fund requirement for the implementation of pilot project is presented in Table 20.

Table 20: Approximate budget requirement for the implementation of pilot programme

(Rs in Lakhs)

Item	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Training (Master trainer/ farmers/ stakeholders)	6.0	6.0	6.0	4	4	26.0
Exposure visit of farmers/ stakeholders	4.5	4.5	4.5	1.5	1.5	16.5
Seed/planting material	6	6	1.5	1.5	1.5	16.5
Micro irrigation facilities	6	6	4.5	4.5	1.5	22.5
Other farm inputs small equipments *etc.*	6	4	4	1.5	1.5	17.0
Custom hiring center equipments	35	15	1.5	1.5	1.5	54.5
TA/DA/Staff (SRF/YP/RA)/ Consultancy/Miscellaneous *etc.*	10	10	7	7	7	41.0
Total	73.5	51.5	29	21.5	18.5	194.0

(Rupees One Crore Ninety Four Lakhs only)

Part-VI : Modalities

1. Programme is undertaken to enhance the fodder production, conservation and utilization on more sustainable basis in different fodder deficit districts.
2. The ICAR- IGFRI has taken a lead in Technological support in collaborating with other public and private sector agencies in this regard. However, the modalities of executing this programme are as follows:
3. ICAR- IGFRI will be knowledge partner and will help in providing all technical backup, technological support, seed procurement, sources *etc.*
4. ICAR-IGFRI will provide all the technological and technical support in implementation of fodder action plan.
5. ICAR-IGFRI will also supply the seeds/planting material or else will facilitate for the same from reliable sources in case of non-availability locally.
6. ICAR-IGFRI would help in seed procurement on buy back arrangement in cases where seed production activities are involved in the programme.
7. Line Departments *viz*., Dept. of Agriculture, Dept. of AH & VS, Dept. of Horticulture, Dept. of Forestry *etc*., Govt. of Chhattisgarh along with KVKs, NGOs, Milk Federation *etc.,* will implement the programme at field and farmers level.

Part-VII: Responsibility of different partners

Stakeholder	Responsibility
ICAR-IGFRI, Jhansi	i. Coordination and overall monitoring of action plan, ii. Technical plan evaluation and technical back stopping, iii. Technological options and need based assistance in related to input procurement, iv. Capacity building of progressive farmers and extension workers, v. Compilation of data and submission to concern quarter.
Krishi Vigyan Kendras (KVK)	Respective KVK of zone with scientific/technical assistance from ICAR-IGFRI: I. Forage based crop diversification and intensification at farmers field, II. Forage production from non-arable lands, III. Fodder under non-competitive land use system, IV. Conservation of fodder (fodder bank), V. Re-vegetation of pasture grasses on common grazing land, VI. Animal nutrition through balanced diet/ mineral mixture, VII. Popularization of fodder machinery, VIII. Procurement of machinery related to crop residue enrichment, baling and feed block, IX. Capacity building of livestock keepers and fodder growers, X. Collection of data, its compilation and submission to implementing agency.
Deptt. of AH and Agril.	i. Fodder seed production at its farms ii. Convergence of animal husbandry schemes to selected villages, iii. Veterinary services and to provide logistic support.
State Govt. Deptt. of Agri., Horti. and Livestock	Convergence of agriculture schemes to selected villages and to provide logistic support.

Annexure-I

Proceedings of Interactive Workshop on "Fodder Resources Development Plan for Chhattisgarh" organized on 5th August, 2022

As a step towards augmenting fodder production and its proper utilization for ensuring the fodder availability to the livestock in the state of Chhattisgarh, a one day workshop on 5th August, 2022 was organized for the development of, "Fodder Resource Development Plan for Chhattisgarh State", in collaboration with Indira Gandhi Krishi Vishwavidyalaya, (Raipur), Dau Shri Vasudev Chandrakar Kamdhenu Vishwavidyalaya, Anjora (Durg) (C.G.) and Animal Husbandry and Veterinary Services Department, Chhattisgarh. The workshop was attended by 141 participants from various line departments *viz*., department of animal husbandry and veterinary services, scientists from ICAR-IGFRI, AICRP (FCU) centers, SAUs and KVKs. The programme was coordinated by the Dr. Purushottam Sharma, Nodal Officer, NIAFTA. To begin with he welcomed all and briefed about NIAFTA. Dr. Amaresh Chandra, Director, ICAR-IGFRI, Jhansi welcomed the chairman, special guest, experts and all the participants and shared the need of fodder plan development along with significant achievements of ICAR-IGFRI, Jhansi.

Inaugural session

Mrs. Chandan Sanjay Tripathi, IAS, Director, Veterinary Services, Govt. of Chhattisgarh presented the feed and fodder scenario and ongoing Charaghah development programme carried out at Chhattisgarh by the various SHGs and government agencies. Under RKVY scheme seeds of berseem, sorghum, rooted slips of Bajra Napier hybrids has been distributed to Gauthan through SHGs. To increase the fodder production and conservation training has been also given to SHGs. She shared the success story of a farmer who has produced the fodder and benefited with power driven chaff-cutter for their own dairy animals. One SHGs group Maa Durga has developed CPR Land from non forest wasteland scheme. Dr. Dakshinkar N. Purshottam, Honorable Vice Chancellor, Dau Shri Vasudev Chandrakar Kamdhenu Vishwavidyalaya, Anjora, Durg, (C.G.) shared the information that state has surplus dry fodder in the form of paddy straw but deficit in green fodder production. As the available paddy straw is poor in nutrition. To address this problem we have treated to paddy straw by urea. Now university has successfully developed the paddy straw pellets. Even so still state is facing shortage of green fodder due to the pre grazing system adopted in the state. University has initiated the programme on perennial grasses (Bajra Napier Hybrid and Marvel grass) and developed horti-silvi-pastrure system, intercropping using leguminous component (Stylo). The university is facing issue of non availability of marvel grass seeds round the year, suggested for assured availability of marvel grass seeds. He told that the land use planning is important for

fodder production. The hay making production technology should be disseminated to farmers and for that training should be organized. Dr. Girish Chandel, Honorable Vice Chancellor, Indira Gandhi Krishi Vishwavidyalaya, Raipur briefed about the initiative has been taken by the university and KVKs towards fodder production and utilization. University has also developed *makka chari* and *chara barbatti*-1fodder crops varieties. All KVKs are providing quality seeds to Gauthan for fodder production. Several agro technologies and varieties available with ICAR-IGFRI should be defused to Chhattisgarh state farmers through the fodder plan for the continuous supply of green fodder. Agri-business models should be formed which helps to reach to smaller as well as larger farmer communities.

Technical session

Dr. Shahid Ahmed, Coordinator, Chhattisgarh fodder plan development committee, ICAR-IGFRI, Jhansi presented the draft of fodder plan prepared for Chhattisgarh state along with a contingency plan. Dr. S.K. Jha, OIC, AICRP (FCU), IGKV Raipur gave the presentation on improved fodder technologies suitable for Chhattisgarh State along with some success stories.

General discussion and comments

Dr. P.K. Chandrakar, Directorate of Extension, IGKV Raipur suggested for availability of nutritional enriched fodder seeds. General discussion between ICAR Directors, Director (Research), Director (Extension), Deans of IGKV and Kamdhenu Vishwavidyalaya, all heads, PCFC, AICRP (FCU), ICAR-IGFRI, IGKV and Kamdhenu Vishwavidyalaya scientists and NIAFTA coordination team were taken place. At the end of programme Dr. Vinod Kumar Wasnik, Senior Scientist, ICAR-IGFRI presented the vote of thanks.

Recommendations

To meet out the state fodder demand, due to the higher fodder production potential and perennial nature of bajra napier hybrid it should be promoted in the state. As the state is having surplus amount of paddy straw dry fodder to enhance its nutrition it should be treated with urea. Tree resources should be utilized for fodder purpose to feed the cattle as state is having largest forest cover. Wasteland whose topography and slope is not good for cultivated fodder crops cultivation should be brought under marvel grass production Several varieties and technologies are available with ICAR-IGFRI, Jhansi for the continuous supply of fodder it should be disseminated within the state through fodder plan. To acquaint the farmers about fodder production, conservation and utilization training should be organized. To extend the reach among smaller as well as larger farmer communities agribusiness models should be formed.

Annexure-II

List of participants in online workshop on "Fodder Resources Development Plan for Chhattisgarh" held on 5th August, 2022

ICAR-IGFRI Jhansi (U.P.) organized in collaboration with Indira Gandhi Krishi Vishwavidyalaya, (Raipur), Dau Shri Vasudev Chandrakar Kamdhenu Vishwavidyalaya, Anjora (Durg) (C.G.) and Animal Husbandry and Veterinary Services Department, Chhattisgarh, on 5th August, 2022.

1. Mrs. Chandan Sanjay Tripathi, IAS, Director, Veterinary Services, Govt. of Chhattisgarh
2. Dr. Dakshinkar N. Purshottam, Honorable Vice Chancellor, Dau Shri Vasudev Chandrakar Kamdhenu Vishwavidyalaya, Anjora ,Durg, (C.G.)
3. Dr. Girish Chandel, Honorable Vice Chancellor, Indira Gandhi Krishi Vishwavidyalaya, Raipur
4. Dr. Amaresh Chandra, Director, ICAR-IGFRI, Jhansi
5. Dr. S.K. Jha, OIC, AICRP (FCU), IGKV, Raipur
6. Dr. P.K. Chandrakar, Directorate of Extension, IGKV, Raipur
7. Dr. Purushottam Sharma, PS & Head and Nodal Officer, NIAFTA, ICAR-IGFRI, Jhansi
8. Dr. Shahid Ahmed, Coordinator, Chhattisgarh Fodder Plan Development Committee, ICAR-IGFRI, Jhansi
9. Dr. A.K. Roy, PC (FCU), ICAR-IGFRI, Jhansi
10. Dr. Sunil Tiwari, Head, CP Division, ICAR-IGFRI, Jhansi
11. Dr. R.V. Kumar, Head, GSM Division, ICAR-IGFRI, Jhansi
12. Dr. Vijay Kumar Yadav, Head, ST Division, ICAR-IGFRI, Jhansi
13. Dr. K.K. Singh, Head, PAR Division, ICAR-IGFRI, Jhansi
14. Dr. R.P. Nagar, PS and OIC, RRS, ICAR-IGFRI, Avikanagar
15. Dr. (Ms.) Nagaratna Biradar, PS and OIC, RRS, ICAR-IGFRI, Dharwad
16. Dr. Sudesh Radotra, PS and OIC, RRS, ICAR-IGFRI, Palampur
17. Dr. Sheeraz S. Bhat, Scientist, RRS, ICAR-IGFRI, Srinagar Station
18. Dr. Suheel Ahmad, Scientist, RRS, ICAR-IGFRI, Srinagar Station
19. Dr. Nazim Hamid Mir, Scientist, RRS, ICAR-IGFRI, Srinagar Station
20. Dr. Vinod Kumar Wasnik, Scientist, ICAR-IGFRI, Jhansi
21. Sh. A.K. Saxena, CTO, ICAR-IGFRI, Jhansi
22. Dr. G.C. Kujur, DDVS, Animal Husbandry

23. Dr. Hitesh Mishra, KVK, Kondagaon
24. Dr. Dinesh Kumar Patel, Raigarh
25. Dr. Vivek Tripathi, DRS, IGKV
26. Dr. Diproshan Banjara, SMS, Agronomy
27. Deans of IGKV and Kamdhenu Vishwavidyalaya
28. DDVS, BALOD
29. DVS, Animal Husbandry, C.G.
30. DDVS, Narayanpur
31. Incharge KVK, Jhabua
32. KVK, Raisen
33. KVK, Mandla
34. KVK, Janjgir-Champa
35. KVK, Balod
36. DDVS, Dhamtari
37. Ms. Anamika Nirala
38. Dr. Sadhana Kurrey
39. Dr. Upasana Sahu
40. Dr. Nripendra Singh
41. Dr. Dinanath Choudhary
42. Dr. K.K. Deo
43. Dr. Dinesh Kumar Patel
44. Dr. (Ms.) Abha Vaishnava
45. Dr. Somesh Kumar Joshi
46. Dr. Umesh Baghel
47. Sh. Om Prakash
48. Dr. Rupal Pathak
49. Dr. S.L. Ogrey
50. Dr. Kumud Swarnkar
51. Dr. Yashwant Atbhaiya
52. Dr. Sachin Kumar
53. Dr. S.S. Sengar
54. Dr. L.N. Jaiswal
55. Dr. M.C. Deshmukh

56. Dr. B.P. Rathia
57. Dr. Deepak Sharma
58. Dr. Surinder Paul
59. Dr. Lalit Bishwal
60. Dr. Vikas Khune
61. Dr. Indu
62. Dr. Rupesh Singh
63. Dr. D.D. Jha
64. Dr. Nripendra Singh
65. Dr. Vivek Tripathi
66. Dr. Jitendra Pal Kanwar
67. Dr. B.D. Sahu
68. Director, AHD, C.G.
69. Ms. Manisha Khaparde
70. Dr. P.N. Shukla
71. Dr. Kalpana Dubey
72. Dr. Rahul Rathore
73. Dr. Neeta Mishra, Kondagaon
74. Dr. Surendra Kumar
75. Dr. Shatrughan Singh
76. Dr. (Ms.) Megha Dubey
77. Dr. G.P. Suryavanshi
78. Dr. S.K. Chandan
79. Dr. Uma Singh Sengar
80. Dr. Rajesh Sudhakar Wakchaure
81. Dr. Deepesh Rawte
82. Dr. Amit Jain
83. Dr. Mahesh Chandra
84. Dr. Dinesh
85. Dr. Shishirkant Pandey
86. Dr. Anish
87. Dr. Makhan Patra
88. Dr. Govina Dewangan

89. Dr. (Ms.) Amita Sharma
90. Dr. Prem Prakash Thakur
91. Dr. Surendra Kumar Nag
92. Dr. Nitin Gade
93. Dr. Chandu Lal Thakur
94. Sh. Prem Sahu
95. Sh. Rupesh Kumar Singh
96. Sh. Ajit Nair
97. Sh. Keshav Sahu
98. Sh. Lakhan Singh Gurjar
99. Dr. Deepika Sidar
100. Dr. Deepak Thakur
101. Dr. C.P.S. Solanki
102. Dr. S.B. Sahu
103. Sh. Devendra
104. Dr. D. Suryam Dora
105. Dr. Raghabendra Sharma
106. Dr. Bindeshwary Sirmour
107. Dr. B.P. Soni
108. Dr. (Ms.) Rashmi Gupta
109. Dr. Kumar Soni
110. Dr. M.P. Khare
111. Dr. K.P.S. Saini
112. Dr. Mamta Meshram

Annexure-III

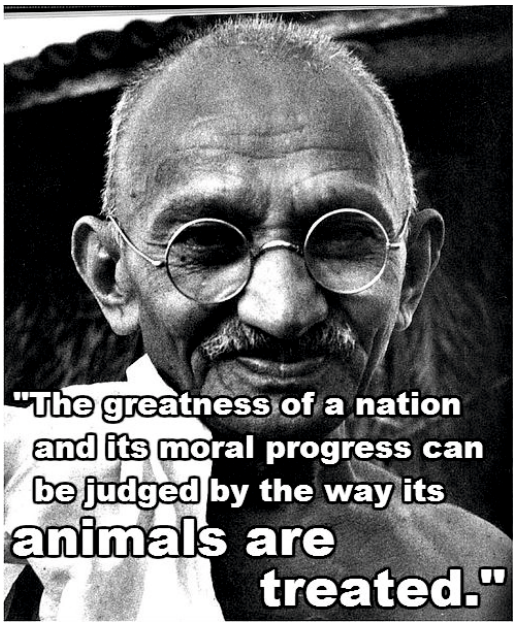
Fodder crop varieties developed by ICAR-IGFRI, Jhansi, in seed chain

Crop	Varieties	GFY (t/ha)	Recommendation for cultivation	Year of release
Berseem	Wardan	65-70	Whole country	1981
	Bundel Berseem 2	65-80	Centra1,North-west zone	1997
	BundelBerseem 3	68-83	North-east zone	2000
	JBSC-1	38-40	North-west zone	2017
	JHB 17-1	40-45	North-west and North-east zone	2020
	JHB 17-2	40-85	North-west and North-east zone	2020
	JHB 18-1	30-80	North-west and Central India	2021
	JHB 18-2	30-80	North-west and Central India	2021
Lucerne	Chetak	140-150	North-west central zone	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
	Bundel 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
	DHN-6 (Sammpoorna)	120-150	Irrigated areas of Chhattisgarh state	2008
	DHN-15	200-250	Irrigated areas of Chhattisgarh state	2020
Bajra-squamulatum hybrid	BBSH-I	30-33	Western and northern part of country	2019
Butterfly pea	Bundel Clitoria 1 (JGCT-2013-3)	25	All India	2017
Bajra	AVKB-19	50-60	Whole country	2007
	JHPM-05-2	70-80	Whole country except south zone	2008
	DRSB-1	35-40	North transitional zone-8 (Chhattisgarh)	2005-06
Guinea grass	Bundel Guinea 1	40-50	Punjab, HP, Central UP, Maharastra, Chhattisgarh	2004
	Bundel Guinea 2	50-55	Fainted conditions in semi- arid, tropical, sub-tropical and humid tropics	2008
	Bundel Guinea 4	75-81	All guinea grass growing areas	2012
	DGG-1	85-125	Humid/arid tropical and sub-tropical regions	2016
Bracharia	DBRS-1	25-30	Whole country	2016
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 fainted 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
Congo Signal grass	DBRS-1	35-40	Rainfed conditions in Chhattisgarh	2016
Lablab bean	Bundel Sem-1 (JLP-4)	22-25	Through out India	1993
Butter fly pea	JGCT-2013-3	20-25	Through out India	2017

Notes

Notes



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