Fodder Resources Development Plan for Jammu & Kashmir

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

भाकृअनुप
ICAR

Fodder Resources Development Plan for Jammu & Kashmir

भा.च.चा.अ.सं.
IGFRI

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

सत्यमेव जयते

भारत सरकार
कृषि अनुसंधान और शिक्षा विभाग एवं
भारतीय कृषि अनुसंधान परिषद
कृषि एवं किसान कल्याण मंत्रालय, कृषि भवन, नई दिल्ली 110 001

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MESSAGE

It gives me immense pleasure to learn that the State specific "Fodder Resources Development Plan" has been developed by the ICAR-Indian Grassland and Fodder Research Institute, Jhansi, for the Union Territory of Jammu and Kashmir in consultation with all the stakeholders. Livestock plays vital role in the economic development of the region and forms an integral part of agriculture. The region is facing shortage of green as well as dry fodder. The region has precious wealth of different types of livestock. The region is covered with three climatic regimes of Asia i.e., the monsoon zone of Punjab, plateau of Tibet and eastern limits of Mediterranean climatic region. Therefore, it is necessary to adopt suitable strategies to produce adequate fodder for better livestock productivity. The fodder plan provides the suitable technologies to increase the fodder production. I am confident that this document will serve as a guide to plan and fodder development activities in the State.

I appreciate the efforts made by ICAR-IGFRI in bringing out this important document.

(T. Mohapatra)

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

Fodder Resources Development Plan prepared as a part of

National Initiative for Accelerating Fodder Technology Adoption (NIAFTA)

ICAR - Indian Grassland and Fodder Research Institute, Jhansi

Themes of NIAFTA

- Developing State Fodder Resources Development 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.

Coordination Team

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

Members

- Dr. AK Roy, Project Coordinator, AICRP on FC&U
- Dr. AK Mishra, Head, Plant Animal Relationship Division
- Dr. Sunil Kumar, Head, Crop Production Division
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- Dr Tejveer Singh, Member
- Dr Maneet Rana, Member
- Dr Kamini, Member
- Dr Sheeraz Saleem Bhat
- Dr Sunil Kumar

Document Formatting and Cover Design

Mr. KP Rao, Chief Technical Officer

Acknowledgement

Present document 'Fodder Resource Development Plan for UT of J&K is prepared to provide an area specific strategy to be adopted to overcome deficiency of green and dry fodder in the state and also draw an executable plan for the state government and other agencies which are involved in livestock related policy and planning. The fodder resource development plan provides technological options available for enhancing production, conservation and value addition of fodder resources of the state.

Looking into shortage of green and dry fodder of the country, the idea and vision of the state wise fodder development plan for different states of the country was envisaged by Dr. Trilochan Mohapatra, Hon'ble Secretary DARE and Director General, ICAR. During his visit to ICAR-IGFRI-SRRS, Dharwad on 17th June 2019, advised to develop the state wise fodder resource development plan addressing fodder self-sufficiency of the state. We are highly grateful to him for his insight, guidance, encouragement, continuous support and suggestions made while preparation of this document. We are also thankful to Deputy Director General (Crop Science), ADG (FFC) and other officers of the ICAR who had extended all his support during the development of fodder plan for UT of J&K.

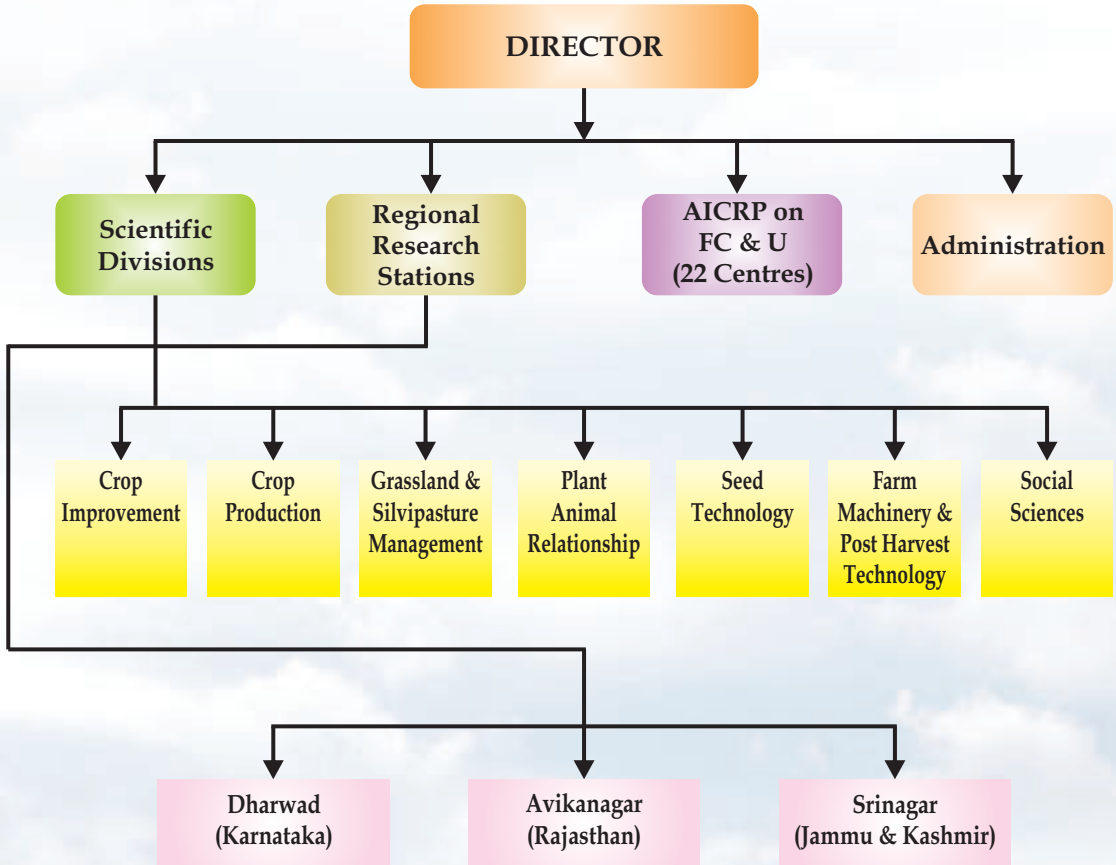
We are highly thankful to Government of J&K, especially to Dr. Nazeer Ahmad, Honourable VC, SKUAST-K, inaugurated and chaired the interactive workshop held online 20th June, 2020 and also gave his valuable suggestions for fodder resource development in the state. We are highly thankful to directors of line departments, like, agriculture, sheep and animal husbandry, livestock development board, forest department, scientists from SKUAST-K and SKUAST-J and ICAR-IGFRI for their support in organizing interactive workshop and showing keen interest in the developing plan for boosting forage and livestock sector in the state.

The efforts made by our team from ICAR-IGFRI, Jhansi specially Dr. Suheel Ahmad, OIC, IGFRI-RRS Srinagar in preparation of fodder plan for the UT of J&K and organizing interactive workshop are praise worthy. This fodder plan is prepared as a part of the activities of our programme 'National Initiatives on Accelerating Fodder Technology Adoption (NIAFTA)'. A note of special appreciation is being deserved by the entire team of the programme and Nodal Officer, Dr. Purshottam Sharma, Principal Scientist.

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

Contents

Organogram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ICAR-IGFRI - A Profile

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

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

Mandate

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

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

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

Proven Technologies of Institute

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

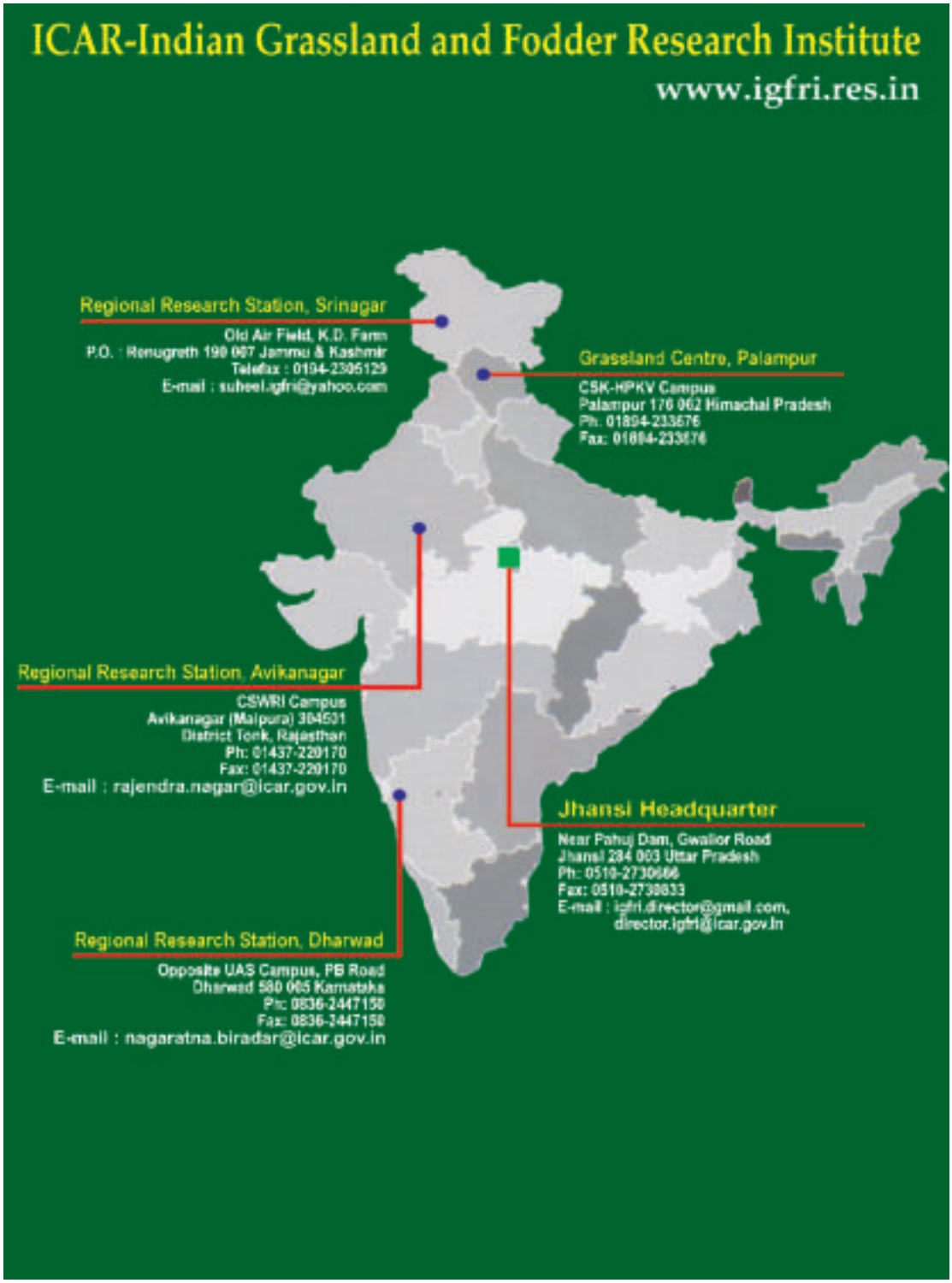
Accelerating Fodder Technology adoption

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

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

NIAFTA: New Initiatives

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

A. Introduction

Figure 1. Map of Jammu & Kashmir

The Union Territory of Jammu & Kashmir forms part of North western Himalayan region, and lies to the north of states of Himachal Pradesh and Punjab and to the west of UT of Ladakh with an area of 42,241 km^2. As per census 2011, the population of J & K is 10.22 million accounting to 1.03% of India's population. The rural and urban populations constitute 72.62% and 27.38% respectively. Tribal population is 10.91% of the UT's population. The average population density of J & K is 240 persons per sq km, which is lower than the national average (464 per sq km).

This region is located almost in the middle of three climatic regimes of Asia. In its south border, lies the weak monsoon zone of Punjab. On the northeast, it is bordered by the vast arid plateau of Tibet while the North-west border areas face the eastern limits of Mediterranean climatic region. This geographical position, coupled with the varied physiography, provides the region a wide climatic variation. It comprises of two main physical regions *viz.* provides the region a wide climatic variation. It comprises two main physical regions *viz.* outer-Himalaya (Shiwaliks) facing with sub-tropical and intermediate type of climate (Jammu region) and Kashmir Himalaya or temperate zone (Kashmir region).

The region has been divided into three broad macro-climatic zones (i) sub-tropical (ii) valley temperate (iii) intermediate/sub-temperate. The livestock production system is mainly extensive in Jammu and semi-intensive in Kashmir.

The UT has a precious wealth of livestock in the form of cattle, buffalo, sheep, goats, horses/mules etc. The cattle and sheep amongst all the livestock are considered the most important tool for the development of the rural economy. The agricultural sector (including livestock) contributes 16 percent to the Gross State Domestic Product (GSDP) of UT at constant prices. The livestock sector alone contributes 11 percent of the GSDP which is about 40 percent of the contribution of the agricultural and allied sector.

Total geographical area of the erstwhile state of J & K was 2,22,240 km^2 out of which 78,114 km (35.15%) area lies under the illegal occupation of Pakistan, and 42,735 km^2 (19.23%) under the illegal occupation of China (including the area handed over illegally

by Pakistan to China). Recently, owing to reorganization, the region is left with an area of 42,241 km² only.

Climate

The climate of the region is determined by altitudinal gradient, the elevation ranges from 247 m in Jammu to about 7135 m in Kashmir Himalaya. With increase in the elevation, rainfall decreases from 1052 mm in Jammu to 662 mm in Srinagar with mean annual temperature of 24.5^0 C in Jammu and 13.3^{0}C in Srinagar, giving rise to sub-tropics and temperate climates.

The length of the crop growing season also decreases as we proceed from south to north. In Jammu, the crop can be grown round the year while in Kashmir valley double cropping is possible. Regular snowfall is witnessed at higher altitudes during winter, chilling subzero temperature is also recorded at higher peaks.

Like other hill ecosystems, climate is also determined not only by altitude but also by slope and aspects of hills.

Land use scenario

The Government of India vide notification dated 31.10.2019 has carved out two union territories of Jammu & Kashmir and Ladakh from the erstwhile State of Jammu & Kashmir. Situated in the northern most part of the country, Jammu & Kashmir (UT) covers an area of 42,241 sq km, which is 6.76% of the geographical area of the country.

The UT of Jammu & Kashmir is bordered by Pakistan in the west; UT of Ladakh is situated on the northern and eastern side and the States of Himachal Pradesh and Punjab lie South to the UT of Jammu & Kashmir.

The average annual rainfall varies from about 600 mm to about 800 mm and the average annual temperature from sub-zero to 40°C. The UT is drained by a number of rivers *viz* Jhelum, Chenab, Indus, Ravi, Tawi etc. All the 20 districts of UT of Jammu & Kashmir are hill districts. The land use scenario of the Union territory is presented in the table 1. Maximum area is under forest (49.5%) and net sown area is about 18.69% of the total area.

Table 1. Land use pattern of Jammu & Kashmir ('000 hectares)

Land Use Types	J & K	
	Area (in 000' ha)	Percentage
Geographical Area	42,241	
Reporting area for land utilization	4,058	100.00
Forests	2,019	49.5
Land not available for cultivation	571	14.08
Permanent pastures and other grazing lands	123	3.39
Land under misc. tree crops and groves	57	1.39

Cultivable wasteland	139	3.44
Fallow land other than current fallows	15	0.37
Current fallows	106	2.61
Net area sown	758	18.69

B. Agro-climatic zones

The region is blessed with varied agro-climatic zones, producing in a wide variety of agricultural and horticultural produce, some of them are unique to the region. Jammu region is home to high quality 'Basmati', 'Rajmash', Black Caraway ('zeera') etc. While, Kashmir region is known for high quality Saffron, 'Zeera', fresh and dry temperate fruits and commercial floriculture.

Enormous potential exists for bio-diversification due to varied agro-climatic and soil conditions. The region has three different agro-climatic zones depending on altitude, slope, aspect, precipitation and soil type. Details of agro-climatic zones and farming situations are presented in table 2.

Table 2. Important characteristics of agro-climatic zones of Jammu & Kashmir

S.No.	Particulars	Jammu		Kashmir
		JK-1 (sub-tropical)	JK-2 (Intermediate)	JK-3 (Temperate)
1.	Geographical distribution	Jammu district, lower parts of Udhampur, Samba, Rajouri, Kathua, Poonch districts	All outer hills of Jammu Division and parts of Poonch, Rajouri, Udhampur and Kathua	All ten districts of Kashmir valley *viz.*, Anantnag, Pulwama, Srinagar, Budgam, Baramulla and Kupwara, Doda, parts of Kahua
2.	Principal crops	Paddy, maize, wheat, oats	Maize, wheat, barley, paddy, oats, oilseeds	Paddy, maize, oilseeds, oats, temperate fruits almond, saffron
3.	Vegetables	Tomato, French bean, okra, ginger, brinjal, cucumber, onion, pea, knol-khol, cauliflower, garlic, exotic vegetables	Potato, tomato, peas, beans cabbage and cauliflower, capsicum, pea, garlic, cucumber	Cabbage and cauliflower, potatoes, beans and peas. Exotic: vegetables and herbs such as broccoli, lettuce, celery and parsley
4.	Fruits	Mango, litchi, guava, citrus, papaya,	Pomegranate, olive, stone fruits (peach, plum, apricot, walnut, almond)	Apple, pear, almond, walnut, cherry, apricot

5.	Major livestock	Cattle, buffalo, goat and sheep	Cattle, buffalo, goat and sheep, horses/mules	Cattle, sheep, buffalo
6.	Average land holdings (ha)	0.99	0.93	0.53
7.	Net irrigated area (%)	36	10	62
8.	Major rivers	Ravi, Tawi	Chenab	Jhelum
9.	Altitude (m amsl range)	300-1350	800-2000	1500-3500
10.	Average annual rainfall (mm)	1200	1059	750
			Temperature (^{o}C)	
11.	Maximum	32.1	31.4	24.5
12.	Minimum	13.6	11.5	1.2
13.	Thermal index	Mild	Mild	Very Cold
14.	Hydric index	Humid	Sub-Humid and Dry	Sub-Humid and Dry

Agriculture scenario

Agriculture is the main source of income in rural areas of J&K. Agriculture has dominance of female workforce as percentage of female cultivators to total workers is >50% which is otherwise 28.8% at country level. Main crops are rice, maize, wheat, potato, barley, pulses and lentil. Agriculture is mostly rainfed with only 42% irrigated area in Jammu & Kashmir. More than 80% farmers are small and marginal with an average land holding size of 0.5 ha in the Jammu & Kashmir which is below than country average (1.57 ha) (table 3).

Table 3. Agricultural scenario in UT of Jammu & Kashmir

Particular	Jammu	Kashmir	J&K	India
Net sown area (mha)	0.41	0.32	0.74	141.02
Gross sown area (mha)	0.75	0.41	1.154	195.22
Cropping intensity%	181	126.08	156.79	138.43
Avg. holding size (ha)	0.81 (16 kanals)	0.44 (9 kanals)	0.63 (12.5 kanals)	1.15
Irrigated area (%)	29.89	59.63	68.94	44.84
Rainfed area (%)	70.11	40.37	31.06	55.16

The food grain production is around 1768.9 (Metric tonnes); fruit production is 2125.59 (Thousand metric tonnes) and vegetable production is 1539.587 (thousand Metric tonne) (year 2018-19). The cropping intensity in Jammu division is reported to be 181%, whereas Kashmir closely follows with the levels of 126.08%. In Kashmir regions, high cropping intensity is typically constrained by the incidence of moisture stress at the sowing time in October-November, inundation of fields in low lying areas after winter, harsh winters and short growing season.

Horticulture scenario:

Horticulture is not only a means of employment but also forms integral part of food and nutritional security and important source of economic security. Horticulture is gaining momentum by its growing contribution to agriculture and GSDP. Fruit production in J & K is around 2125.58 (thousand metric tonnes) (year 2018-19). The horticulture sector occupies an important position in the farming system of the region. It has several agro-climatic conditions: sub-tropical, temperate and cold arid. Each agro-climatic region has its own potential to grow specific fruits (Table 4).

Table 4. Area under major horticulture crops (ha)

District	Apple	Pear	Apricot	Peach	Plum	Cherry	Citrus	Mango	Ber	Others	Total
Anantnag	16539	1057	337	239	375	199	0	0	0	242	18988
Kulgam	16766	894	124	125	206	72	0	0	0	218	18405
Pulwama	11425	687	87	43	59	45	0	0	0	12	12358
Shopian	21625	396	24	6	6	745	0	0	0	97	22899
Srinagar	3089	353	160	76	249	1254	0	0	0	450	5631
Ganderbal	5716	312	108	92	149	804	0	0	0	244	7425
Budgam	14649	1784	62	51	953	185	0	0	0	594	18278
Baramulla	24661	645	120	56	0	207	19	0	0	263	25971
Bandipora	5605	115	60	14	24	74	0	0	0	0	5892
Kupwara	18942	433	54	37	41	104	3	0	0	18	19632
Jammu	0	1	0	19	5	0	2166	4749	2783	2125	11848
Samba	0	10	0	9	5	0	1604	1482	3421	1166	7697
Udhampur	1063	720	250	280	113	0	1663	974	223	981	6268
Reasi	930	307	65	129	80	0	1712	840	118	733	4914
Doda	5314	1399	332	149	109	9	50	0	0	589	7951
Kishtwar	2309	200	650	158	207	10	9	0	0	39	3582
Ramban	3322	492	283	124	88	10	34	0	0	458	4811
Kathua	877	650	36	84	68	0	2795	3820	744	2657	11731
Rajouri	1227	1595	416	265	549	0	3464	633	615	1699	10463
Poonch	2082	1623	892	607	1322	0	363	0	0	1508	8397
Total J&K	156141	13673	4059	2563	4608	3718	13882	12498	7904	14093	233140

C. Interactive workshop: IGFRI and State Department

The institute organized one day online workshop on "Fodder Resource Development Plan : UT of J &K" with the officers of animal husbandry and agriculture department related to animal husbandry/fodder production of state and researchers of SKUAST, J&K on June 20, 2020. Dr. Nazeer Ahmad, Honourable VC, SKUAST-K, chaired the workshop. In his opening remarks, he congratulated ICAR-IGFRI for conducting the workshop and highlighted the importance of livestock sector in the region and various challenges and issues this sector is facing, particularly with respect to forage production. He stressed on the establishment of hortipastures and rehabilitation of grasslands for increased fodder production.

Dr. Vijay Kumar Yadav, Director, ICAR-IGFRI, Jhansi welcomed all the dignitaries and gave an eloborate perspective of the fodder plan. He also briefed about the research/extension activities carried out by ICAR-IGFRI vis-à-vis fodder production, utilization and conservation.

Figure 2 Glimpses of interactive workshop

Dr Suheel Ahmad, OIC, RRS Srinagar presented a detailed fodder plan of UT of Jammu and Kashmir, including road map, implementation, stakeholder responsibilities, budgetary requirements and modalities.Dr A K Roy, PC, AICRP-FC, presented various forage production/protection technologies suitable for UT of J & K.Dr R V Kumar gave a detailed account of technologies for grassland and silvopasture management for enhancing production.Dr Sheeraz Saleem Bhat, scientist, RRS Srinagar presented the technologies for hortipasture development for augmenting forage availability. The workshop was attended by various directors of line departments, like, agriculture, sheep and animal husbandry, livestock development board, forest department, scientists from SKUAST-K and SKUAST-J and ICAR-IGFRI. Dr. Purushottam Sharma, PS, IGFRI, presented vote of thanks (Annexure I).

D. Livestock scenario

The state has a precious wealth of livestock in form of cattle, buffalo, sheep, goats, poultry, etc. The cattle and poultry amongst all the livestock are considered the most important tool for the development of the rural economy. The production of Pashmina shawls and other animal products like carpets, shawls and blankets of Kashmir earn handsome foreign exchange for the nation. Therefore livestock industry in the state has vast scope for development rendering quick economic returns and has been identified as critical to the overall economic and social development.

As, per 20th livestock census (2019), total livestock population is 8318.70 thousand in Jammu & Kashmir including Ladakh. Total livestock population has declined in comparison to the 19th livestock census of 2012 (Table 5). Declining population of cattle could be due to decreasing fodder supply, degrading pasture lands and movement of rural people towards urban areas. The Jammu & Kashmir holds 6th position with regard to sheep population and 1st place in respect of the yak population in the country. The milk production in J &K is 2540.11 (000 tone) and per capita milk availability is 401 g/day in Jammu & Kashmir (20th livestock census of 2019) (Table 6). Livestock sector is constantly facing shortage of green as well dry fodder as there is gap in supply of green fodder and dry fodder as there is around 49.17% fodder shortage in Jammu & Kashmir.

Table 5. Livestock population of Jammu & Kashmir including Ladakh (20th Livestock Census, 2019)

State	Jammu & Kashmir (thousands)
Cattle	2532.62
Buffaloes	690.83
Sheep	3247.50
Goats	1730.22
Pigs	1.22
Horses/Ponies	63.34
Mules	16.72
Donkeys	9.56
Camels	0.47
Yaks	26.22
Mithun	0.01
Total Livestock	8318.70
Total Livestock population 19th census (2012)	9200.842
Decrease in Total livestock population	-882.142

Table 6. Production of livestock products in Jammu & Kashmir (20th Livestock Census, 2019)

State	Jammu & Kashmir
Wool production (000 kg)	7629.28
Meat production (000 tonnes)	91.61
Milk production (000 tonnes)	2540.11
Per capita milk availability (g/day)	401

E. Fodder scenario

Livestock sector is constantly facing shortage of green as well dry fodder as there is gap in supply of green fodder and dry fodder as there is around 49.17% fodder shortage in Jammu & Kashmir. The region produces around 64 lakh MT of green fodder and 35 lakh MT of dry fodder. However the requirement of green fodder is 139.13 lakh MT and dry fodder is 58.53 lakh MT. Therefore, increased production of fodder is essential to meet the nutritional requirements of the livestock. Further, the agro-climatic conditions of the major portion of the region also warrants the need of cultivating even additional fodder that can be dried to hay or stored as silage for lean periods. Because of the predominant non-vegetarian food habits, the region is

acutely short in animal protein requirements with a total availability of 256 lakh kg of meat against a huge requirement of 1200 lakh kg as per the minimum requirements of MCI (Anon., 2015). Crop residues, tree leaves, sub-alpine & alpine pastures and forests are the mainstay of animal feeding requirements in Jammu & Kashmir. Fodder production is primarily a land-use activity and depends on multiple factors like climate, irrigation, livestock number and type besides cropping pattern. Fodder resources are derived from both cultivated as well as uncultivated lands. The uncultivated lands, as a source of fodder include common properties resources and private lands (table 7).

Table 7. Area under fodder crops and pastures/grazing lands in Jammu & Kashmir

Year	Fodder crops ('000 ha)	Permanent pastures and other grazing lands ('000 ha)
2005-06	53	128
2007-08	61	126
2008-09	54	128
2009-10	52	120
2010-11	53	119

Source: ENVIS Centre on Himalayan Ecology, GBPIHED, 2015

Available feed resources from cultivated lands can be classified into four important groups, *viz.* (i) cultivated fodder (most commonly jowar, oats, berseem and alfalfa) (ii) straw-I (residues from leguminous crops including pulses), (iii) straw-II (residues from coarse grain crops including maize and millets), and (iv) straw-III (residues from fine grain crops like paddy, wheat and barley). Severe scarcity months are April-June in Jammu sub-tropical zone and from December- April in temperate and sub-temperate zones. As per estimate, about 40.93% deficit exists for fodder in Jammu & Kashmir, where in deficit is more acute in Kashmir division (48.63%) than Jammu division (32.27%) (Table 8 & 9).

Table 8. Fodder balance sheet on dry matter basis ('000 tonnes)

Region	Availability	Requirement	Deficit
Jammu	5545.58	8188.00	2642.42 (32.27)
Kashmir	1866.49	3635.00	1768.51 (48.65)
Total	7411.49	111823	4410.93 (40.93)

Figures in parenthesis represent percentage (Source: Wani *et al.*, 2014)

The livestock sector represents around a third of agricultural GDP in most countries. Low productivity of livestock owing to fodder deficit (accounts for 50-60%), genetic improvement, health management. The limited land endowments make it difficult for the farmer to earmark adequate land for fodder cultivation.

Table 9. Availability of fodder on dry matter basis for J & K ('000 tonnes)

Group	Availability/production of fodder from land under resource*	Jammu division	Kashmir division	J & K
I	**Uncultivated fodder availability from common support lands**			
	Forests (village papers)	978.72	7.85	986.57
	Barren and un-cultivated land	229.12	29.13	258.25
	Non-Agricultural land	227.22	56.45	284.75
	Cultivated wasteland	163.60	50.25	213.85
	Permanent pastures	248.82	133.20	382.27
	Land under tree group	28.18	4.73	32.91
	Total	1875.66	281.61	2157.27
II	**Uncultivated fodder availability from private support lands**			
	Fallow land	74.72	100.54	175.26
	Orchard	2.84	83.78	86.62
	Fodder from bunds in paddy fields	29.20	35.20	64.40
	(5% of total paddy land)			
	Total	106.76	219.52	326.28
III	**Cultivated fodder/crop-residues- straws, stovers**			
	Fodder crops	186.16	71.36	257.52
	Rice	701	845	1546
	Maize	1014	403	1417
	Pulses	76	40	116
	Millet	82	2	84
	Wheat	1363	4	1371
	Barley	41	-	41
	Total	3463.16	1365.36	4828.52
	Grand total	5445.58	1866.49	7312.07
IV	**Forests**	1809.90	1219.20	3029.1

Source: Wani *et al*, 2014

SWOT analysis of fodder cultivation in Jammu & Kashmir:

The UT of Jammu & Kashmir is unique in terms of its diverse agro-climatic situation with majority of population dependent on agriculture, which provides immense opportunities and challenges to utilize this demographic dividend for sustainable agricultural development of the region. Jammu & Kashmir is ideally suited for livestock rearing owing to rich forage resources, varied agro-climatic conditions and a very strong institutional mechanism in the form of line departments and other R & D institutions. The SWOT analysis of various aspects of fodder cultivation in Jammu & Kashmir has been presented in Table 10. This in-depth analysis shall be very useful in the formulation of a comprehensive fodder resource development plan for the UT of Jammu & Kashmir.

Table 10. SWOT analysis

	Success factor	Failure factor
Internal factor	**Strength** • The region has lush green low altitude, mid-hill, sub-alpine and alpine pastures. • Availability of high yielding varieties of cultivated fodder crops (Oat, berseem, alfalfa, shaftal). • Increased demand of livestock products in the region.	**Weakness** • Lack of technical human resource in fodder development. • Land under fodder crops is static & little scope of expansion in area, as per capita land is declining. • Largely non-commercial status of fodder crop and un-organized small market.

	Success factor	Failure factor
Internal factor	**Strength** • Diverse agro-climatic regions persist (sub-tropical, sub-temperate, temperate and cold arid) • Livestock production is main source of livelihood of rural people. • Vast area of more than 355 thousand hectares fruit orchards provides opportunity for Horti-pasture system. • Forest fringe areas for development of silvipastures. • Rich fodder crop genetic resources	**Weakness** • Lack of proper seed chain and poor availability of quality fodder seeds. • Poor marketing chains and difficulty in transportation. • Long lean period • Regional fodder imbalances and uneven fodder production and distribution.
External factor	**Opportunity** • Increased demand for livestock products *viz.* milk & meat highlight raising need of feed and fodder. • Growing demand of organic livestock products have increased the importance of organic fodder. • Climate variability and many fodder crops. • Peri-urban dairy creating organized fodder market and need for post-harvest processing of fodder and crop residues and formulation of complete feed block (C.F.B). • Introduction of potential high yielding varieties can increase production by 2-3 fold. • By optimum utilization of land resources can nullify the deficit of fodder. • Increased trained human can help in dissemination and transfer of technology at faster rate. • Importance to fodder industry is increasing as prices of livestock product are increasing. • Introduction of innovative methods of fodder production can increase availability of fodder at rainfed areas or for venerable groups of animal rearers.	**Threats** • Rising input costs including fertiliser, irrigation water and transport costs. • Changing land use –housing, industries, tourism and commercial crops • Weed contamination and weed spread • Less funding in for R&D with failure to secure future requirement of fodder. • Most of the forests and grasslands are in degraded state • Climate change, water scarcity due to recurrent drought, and rise in weather uncertainty • Increase in global competition for markets under WTO regimes is real challenge to promote livestock production as per there standards. • Above all factors intensify the rate of migration of rural people towards city for employment and uplift living standards. • Difficulty in access to fodder crop germplasm available in other countries

Part-II : Fodder Resource Development Plan

The following strategies are proposed for enhancing fodder production, conservation and proper utilization for mitigating the fodder shortage in the UT of Jammu & Kashmir.

Strategies for enhancing fodder resources

Keeping in view the constraints in fodder production and in order to overcome the gap between demand and supply, the emphasis needs 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 fodder production in a farming system approach. The holistic approach of integrated resource management will be based on maintaining the fragile balance between productivity functions and conservation practices for ecological sustainability. Fodder production must be taken up as a first management goal and 25% of the forest area should be put under trees having fodder value 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. In-depth studies on migratory graziers, forage based agroforestry systems and participatory pasture management and controlled grazing to maintain the productivity of pasture (grazing should be allowed as per carrying capacity) are some other solutions to this problem. Coupled with production, proper conservation and utilization of fodder methods also need to be adopted and livestock keepers need to be sensitized and trained accordingly. In the hill region livestock are generally fed with whole plant without chaffing which causes wastage upto 50% and that can be saved by simply introducing chaff cutters. Details of different interventions are as under;

A. Cultivated fodder resources

There are number of fodder crops like perennial grasses, range legumes, cultivated forage cereals & legumes suitable under different agro-climatic conditions of the state. Thus crop needs to be selected as per agro-climatic zones, and appropriate production technologies need to be practiced realising full potential. The list of crops and their recommended varieties are given table 11. The crops like Bajra × Napier hybrids, guinea grass, rye grass, setaria, maize, sorghum, oat, cowpea, berseem etc. are suitable for irrigated and arable land conditions whereas perennial grasses like tall fescue, orchard grass, *Bromus* spp., *Phalaris* spp., timothy, perennial and annual rye grasses, *Brachiaria* spp., *Paspalam* spp., *Chrysopogon* spp., *Bothriocloa* spp., *Setaria* spp., guinea grass, etc. and perennial legumes like red clover, white clover, sainfoin and *Stylosanthes* are suitable for rain-fed and non-arable land conditions.

While up-scaling plan for ensuring round the year quality green fodder availability, appropriate combination of annual and perennial fodder crops needs to be adopted for ensuring round the year quality fodder supply. The annual crops *viz.* maize, oats, shaftal, sorghum, berseem and perennial fodders, like orchard grass, tall fescue, *Setaria*, sainfoin, red and white clover etc. can be conserved for utilisation during lean period (December to March in Kashmir and April to June in Jammu). Potential remunerative forage based crop sequences that can be followed in Jammu & Kashmir have been presented in table.12.

Table 11. Suitable forage crops for various agro climatic zones of Jammu & Kashmir

Zone	Crop	Varieties	Potential green fodder yield
Temperate zone (1500-3500 m)	Oat	JHO 2015-1, OS-424, SKO-225, SKO-90, SKO-96, SKO-20, Sabzar, JHO-99-1, JHO-99-2	35-45 t/ha
	Maize	African tall, KDFM-1	60-70 t/ha
	Wheat	VL-829 (Dual purpose)	35-40 t/ha
	Sorghum	CSH-13-R Hybrid (Single cut dual purpose type), CSH-20 MF (Multi cut variety), Pant Chari 7 (dual purpose variety), Pant Chari 6 (gives 2-3 cuts)	30 t/ha
	Lolium	PBRG-2, Palam Rye Grass-1, Grasslands Manawa, Punjab Ryegrass-1	25-30 t/ha
	Red Clover	Montgomery, PRC-3	25-35 t/ha
	White clover	PLP composite-1	25-35 t/ha
	Tall fescue	Hima-1, Hima-14, Demeter, Elite entries at RRS IGFRI, Srinagar	30-35 t/ha
	Phalaris aquatica L.	IGFRI-Phalaris-2	60-70 t/ha
	Cowpea	GFC-2, GFC-3, UPC-287, UPC-622,	35-40 t/ha
Intermediate zone (800-1500 m)	Oat	JHO 2015-1, OS-424, SKO-225, SKO-90, SKO-96, Sabzar, SKO-20, Kent, Palampur-1, JHO-99-1, JHO-99-2	30-40 t/ha
	Maize	African tall, Pratap Makka, J-1006	60-70 t/ha

	Setaria	S-25, Nandi, Setaria-92, S-25, S-18, PSS-1	30-40 t/ha
	Siratro	-	30-40 t/ha
	Tall fescue	Hima-14, EC-178182, Hima-1, Hima-4	40-45 t/ha
	Shaftal	SH-48	30-35 t/ha
	Sainfoin	IGFRI-S-17	50-60 t/ha
	White clover	PLP composite-1	25-35 t/ha
	Phalaris aquatic L.	IGFRI-Phalaris-2	60-70 t/ha
Sub-tropical zone	Berseem	BL-180, Wardan, BL-1, BL-2, UPB-110	65 t/ha
(<500-800 m)	Oat	JHO 2015-1, OS-424, SKO-225, SKO-96, Bundel Jai-991 (JHO-99-1), Bundel Jai-992 (JHO-99-2), UPO-94, RO-11-1, Pant Forage Oat-3 (UPO-06-1), Pant Forage Oat-4 (UPO-06-2), Palampur-1, Kent	35-45 t/ha
	Chrysopogon	Bundel Dhawalu Ghas-1	25-30 t/ha
	Heteropogon	Bundel Lampa Ghas -1	25-30 t/ha
	Guinea grass	RSDGG-1, CO (GG) 3, Bundel guinea 2	45-50 t/ha
	B N hybrid	TNCN 1280, BNH-11, PBN 342, IGFRI-5, 7, 10, NB37, CO-5, CO-6	60-70 t/ha
	Pennisetum hybrid (*P. glaucum* x *P. squamulatum*)	BBSH-1	30-40 t/ha
	Sorghum	CSH-13-R Hybrid (Single cut dual purpose type), CSH-20 MF (Multi cut variety), Pant Chari 7 (dual purpose variety), Pant Chari 6 (gives 2-3 cuts) Pant Chari 8 (Suitable for both *Zaid* and *Kharif*)	40-45 t/ha
	Pearl millet	Giant Bajra, CO-8, Gujarat Forage Bajra-1, NDFB-3	40-45 t/ha
	Cowpea	GFC-2, GFC-3, UPC-287, UPC-622	35-40 t/ha

Table 12. Potential remunerative forage based crop sequences in Jammu & Kashmir

Zone	Crop sequence	Green fodder equivalent yield (t/ha/year)
Temperate zone	Rice - Oat	30-40
(1500-3000 m)	Rice - Mustard + Oat	30-40
	Rice - Berseem	60-80
	Rice + (Phalaris spp.+ Tall fescue + Orchard grass on field bunds) - Oat + Berseem	50-60
	Fodder Maize - Oat	90
	Maize (F) + Cowpea (F) - Oat + Berseem	110-130
Intermediate zone	Maize + Cowpea - Wheat	50-60
(800-1500 m)	Maize (F)+ Cowpea (F) - Wheat	55-65
	Maize -Oat	70-75
Sub-tropical zone	Rice - Berseem	80-100
(<500-800 m)	Cow pea/Maize - Oat + Berseem + (Chrysopogon + Heteropogon on field bunds)	100-110
	Sorghum + cow pea - Oat + berseem	100-110
	Bajra × Napier hybrid (perennial) + cowpea (annual)+ Fodder Maize-Berseem + Oat	110-120

B. Fodder production in fruit orchards through Horti-pasture:

The region has the largest potential for production of quality sub tropical & temperate horticultural crops. It has created a niche in production of apple, pears, and dry fruits i.e., almond and walnut. Among temperate fruits, apple, walnut and almond rank first, second and third, respectively in area and production, covering 64.05 per cent, 27.31 per cent and 8.65 per cent of area. The region has a variety of agro-climatic conditions

Figure 2. *Lolium* and red clover in an apple orchard (GFY: 35-45 t/ha)

Figure 3. Harvesting of fodder from hortipastoral system at ICAR-CITH

ranging from sub-tropical, sub temperate, temperate and cold arid. Each agro-climatic region has its own potential to grow specific fruit, providing an opportunity to grow a variety of fruits during the major part of the year. Use of forage crops (temperate perennial grass/legume mixtures) in the interspaces of fruit orchards offers a huge potential as a sustainable orchard floor management approach, combined with grazing by sheep for the improvement of physical, chemical and biological properties of orchard soils and augmenting forage resource availability. Suitable grass and legume crops for introduction under fruit orchard in Jammu and & Kashmir have been presented in table 13.

Table 13. Suitable grass and legume crops for introduction under fruit orchard in Jammu & Kashmir

Zone	Districts	Fruit crop	Grass	Legumes
Temperate zone	Anantnag, Pulwama, Shopian, Budgam, Baramulla, Srinagar, Ganderbal, Kulgam, Kupwara and Budgam	Apple, Almond, Pear, Cherry, Walnut and Apricot	Tall fescue (*Festuca arundinacea*) variety-Hima-3), Orchard Grass (*Dactylis glomerata*), *Phalaris hybrid*	Lucerne (*Medicago sativa*), White Clover (*Trifolium repens*), red clover (*Trifolium pretense*), Sainfoin (*Onobrychis viciifolia*)
Intermediate zone	Doda, Rajouri, Poonch and parts of Udhampur	Peach, Plum, Apricot, Olive and Pomegranate	Perennial rye grass (*Lolium perenne*), tall fescue (*Festuca arundinacea*) Setaria grass (*Setaria anceps*), Anjan grass (*Cenchrus ciliaris*), *Paspalum* spp, *Dactylis glomerata*	White Clover (*Trifolium repens*), *Stylosanthus hamata, Macrotyloma axillare* (*Dolichos*), *Neonotonia wightii*
Sub-tropical zone	Jammu, Kathua, Samba and parts of Udhampur	Mango, Citrus, Ber, Aonla	Guinea grass, *Brachiaria brizantha*, Bajra Napier Hybrid, *Setaria anceps Paspalum notatum, Dicanthium annulatum,*	*Trifolium alexandrinum, Stylosanthus hamata, Stylosanthus scabra,* Siratro (*Macroptilium atropurpureum*), *Chrysopogon fulvus Macrotyloma axillare* (*Dolichos*), *Neonotonia wightii*

Figure 4. *Phalaris* **hybrid + almond (GFY: 40-45) t/ha)**

Figure 5. *Dactylis glomerata* **+ almond (GFY: 30-35 t/ha)**

The table 14 presents the estimates of the potential of utilization of fruit orchards fir fodder production in different districts of Jammu & Kashmir**.** It is pertinent that even if 25% area of 50% orchards is used for fodder production then about 728.56 (thousand tone) green fodder and 204.0 (thousand tone) dry fodder can be produced.

In a study carried as part of an inter-institutional project between ICAR-IGFRI and ICAR-CITH, it was observed that intercropping of grasses with either red or white clover produced significantly higher total green and dry forage yields. Maximum yield was obtained by the treatment combination of orchard grass + red clover (36.03 t/ha) followed by tall fescue + red clover + apple cv. Red Gold (33.47 t/ha). Maximum crude protein yields were also observed these treatments. The study revealed that intercropping of apple trees with legume crops like red and white clover and their association with grasses (tall fescue and orchard grass) is beneficial for the twin benefits of sustainable fruit and forage production. Production and nutritive value of forage in hortipastoral systems can be improved by introducing shade-tolerant grass and legume species in appropriate mixtures. Grass-legume mixtures are preferred over pure-grass forage stands throughout the world because they often increase the total yields of herbage and protein and offer balanced nutrition to livestock. Mixtures offer several potential advantages over pure grasses or pure legumes. These advantages include the control of erosion, weed control and prolonged stand longevity. Establishment and upscaling of hortipastoral models should be replicated at farmers' fields. There is a need for development of recommendations/advisories for managing animal, forage crops, and fruit trees. This will require greater knowledge regarding three-way interactions between livestock, pasture and fruit trees. To encourage more farmers/orchardists and educated youth in the animal husbandry and horticulture sector, hortipastoral models need to be developed along with introduction of fodder conservation techniques. This approach would enhance the supply of nutritious fodder thereby ensuring sustainable livestock production in the region. The list of suitable grass and legume species which can be cultivated in different fruit orchards are given in table 13.

Grass/legume mixtures in a ratio of 50:50 are recommended for intercropping in fruit orchards for forage augmentation and orchard floor management, besides providing several ecosystem services, like carbon sequestration and improvement of soil fertility. It was also observed that these grass/legume mixtures did not affect growth and yield attributes of apple trees.

Package and Practices of apple based hortipastoral system:

Orchard grass/tall fescue/*Lolium* + red clover/white clover in 50:50 proportions

Seed rate: 6-8 kg per hectare orchard grass or tall fescue or *Lolium*, 3-4 kg per hectare red and white clover.

Fertilizer N: P: K: 60:40:30 kg/ha as basal dose every year during March-April and 25-30 kg N per hectare after every cut, FYM @ 5-8 t/ha during first year.

Cutting Management: First cut in the 2nd week of May and subsequent cuts at 45 days interval

Note: An area of 0.65 (high density) to 7.0 m^2 (conventional) around each fruit tree should be kept weed free or without any intercrop using reduced tilling or by using herbicides.

C. Fodder production from permanent pasture/grazing lands

Major threats to forage crop genetic resources includes conversion of natural grasslands and pastures to agricultural lands, pasture degradation and deforestation, diversion of grasslands and pastures to developmental projects, improper grazing management and rural/urban encroachment need to be checked in the UT. Appropriate strategies are needed for effective utilization of grasslands based on their carrying capacity and nutritive status. Involvement of the locals and end-users for grasslands and natural pastures through participatory management needs to be emphasized on the lines of the Joint Forest Management. Suitable grasses and legume mixtures need to be introduced in grasslands to increase their production potential and carrying capacity. List of suitable grasses and legumes for introduction under grasslands and pastures in various agro-climatic zones of Jammu & Kashmir has been presented in table 15.

Figure 6. Glimpses of fodder production and conservation activities in Kashmir

Figure 7. Harvesting of oat in outskirts of Srinagar

Figure 8. Oat crop being rolled into ropes for storage and further use during winter

Table 14. Additional green and dry fodder productions on introduction of grasses under fruit orchard via targeting 50% of total existing orchards and 25% area under each orchard

District	Area under fruit crops (ha)	Targeting 50% orchards for fodder intervention area (ha)	Targeting 25% area of 50% orchards for fodder production area (ha)	Enhanced green fodder availability (tonnes)	Enhanced dry fodder availability (tonnes)
Anantnag	18988	9494	2373.5	59337.5	16614.5
Kulgam	18405	9202.5	2300.625	57515.63	16104.38
Pulwama	12358	6179	1544.75	38618.75	10813.25
Shopian	22899	11449.5	2862.375	71559.38	20036.63
Srinagar	5631	2815.5	703.875	17596.88	4927.125
Ganderbal	7425	3712.5	928.125	23203.13	6496.875
Budgam	18278	9139	2284.75	57118.75	15993.25
Baramulla	25971	12985.5	3246.375	81159.38	22724.63
Bandipora	5892	2946	736.5	18412.5	5155.5
Kupwara	19632	9816	2454	61350	17178
Jammu	11848	5924	1481	37025	10367
Samba	7697	3848.5	962.125	24053.13	6734.875
Udhampur	6268	3134	783.5	19587.5	5484.5
Reasi	4914	2457	614.25	15356.25	4299.75
Doda	7951	3975.5	993.875	24846.88	6957.125
Kishtwar	3582	1791	447.75	11193.75	3134.25
Ramban	4811	2405.5	601.375	15034.38	4209.625
Kathua	11731	5865.5	1466.375	36659.38	10264.63
Rajouri	10463	5231.5	1307.875	32696.88	9155.125
Poonch	8397	4198.5	1049.625	26240.63	7347.375
Total J&K	233140	116570	29142.505	728562.525	203997.475

Base: Average forage production under hortipasture: Green 25 t/ha; Dry: 7 t/ha

Table 15. Suitable grasses and legumes for introduction under grasslands and pastures in various agro-climatic zones

Zone	Grasses	Potential green fodder yield	Legumes	Potential green fodder yield
Temperate zone (1500-3500 m)	*Dactylis glomerata, Festuca arundinacea, Lolium perenne, Phleum pratense, Bromus unioloides, Phalaris spp., Poa pratensis, Lolium multiflorum,. Avena sativa*	25-45 t/ha	*Trifolium pratense, T. repens, Onobrychis viciifolia, Medicago sativa, Trifolium resupinatum*	20-30 t/ha
Intermediate zone (800-1500 m)	*Dactylis glomerata, Festuca arundinacea, Lolium perenne, Dicanthium annulatum, Chrysopogon fulvus, Heteropogon contortus, Setaria* spp., *Avena sativa*	25-40 t/ha	*Trifolium alexandrinum, Stylosanthus hamata, Trifolium resupinatum*	20-35 t/ha
Sub-tropical zone (<500-800 m)	*Dicanthium annulatum, Chloris gayana, Chrysopogon fulvus, Heteropogon contortus, Cenchrus ciliaris, Paspalum notatum, Avena sativa*	20-30 t/ha	*Trifolium alexandrinum, Stylosanthus hamata, Stylosanthus scabra, Trifolium resupinatum*	30-40 t/ha
Cold arid zone (> 4000 m)	*Festuca arundinacea, Avena sativa, Phalaris* spp., *Dactylis glomerata*	15-30 t/ha	*Medicago sativa, Medicago falcata, Lotus corniculatus, Astragalus* spp., *Caragana* spp., *Melilotus officinalis, Cicer microphyllum*	15-40 t/ha

Grazing management and fodder collection needs to be regulated so that there is proper regeneration of the different grasses and legumes, besides other medicinal herbs in the grasslands and pastures. Improvement of the conditions of rangelands and grasslands is essential, which can be done through re-seeding of different productive and good quality forage grasses and legumes and nutritional management. Besides that adoption of suitable silvipasture models and utilization of forest fringes areas can bring self sufficiency for green fodder and grazing resources in the state.

i. Rejuvenation of pastures/ grazing lands (Margs/Bahaks)

Grasslands of Jammu & Kashmir are a storehouse of numerous plant species besides serving as summer pastures for the flocks of various ethnic communities, like, Gaddis,

Gujjars, Bakarwals, Chopans, Changpas. These are locally known as Margs/Bahaks and are mainly used by migratory grazing animals such as sheep, goat, equines, buffaloes and yak etc.

Limited agricultural land, severe climatic conditions and seasonal availability of forage resources have been the main reasons for migration of pastoral communities from one place to another. Due to various unpalatable species especially weeds infestation has increased in Himalayan grasslands leading to the decrease in herbage quantity production by 20–50% and quality by 10–15%. Restoration, protection, conservation and development and sustainable utilization of these rangelands grasslands are very important for sustaining livestock but no focus has been given on conservation and improvement of these grasslands and rangelands in J & K. Spatial and vertical distribution of the grasslands and details regarding their area in Jammu & Kashmir has been presented in the table 16, 17 & 18.

Thus proper management of these grasslands are urgently required and expected fodder production from pastures of Jammu & Kashmir on their improvement is presented in table 18. Some interventions are proposed to be taken in selected pastures includes:

i. Grazing management and pasture rehabilitation
ii. Removal of non-palatable weeds
iii. Studying the floristics and carrying capacity
iv. Introduction of high yielding grasses/legumes using suitable interventions
v. Management of soil erosion

Multiplication and re-sowing of endemic grasses and legumes.

Table 16. Spatial distribution of grasslands in Jammu & Kashmir

Region (J&K)	Geographical area (sq. km)	Grasslands (sq. km)	Grasslands (%)
Jammu	25636.16	906.09	3.53
Kashmir	15936.43	2106.59	13.22
(JK India)	41572.59	3012.68	7.24
Pakistan occupied Kashmir	77338.76	1673.92	2.16
Aksai Chin	38366.89	1164.58	3.04
Total	221214.24	5851.18	2.64

Table 17. Expected forage production from pasturelands in Jammu & Kashmir

Region	Geographical area (sq. km)	Area under grasslands (ha)	Green fodder availability (tonnes)	Dry fodder availability (tonnes)
Jammu	25636.16	90609	1359135	317131.5
Kashmir	15936.43	210659	3159885	737306.5
Total	54307.41	301268	4519020	1054438

Base: Average forage production under grasslands: Green 15 t/ha; Dry: 3.5 t/ha for Jammu & Kashmir

There is need to study grassland management strategies practiced by pastorals to have better understanding of traditional practices of grassland management in Jammu & Kashmir. Then scientific interventions involving these pastoralist should be designed for sustainable management of the these pasturelands. Further scientific investigations using GIS and remote sensing should be carried out to evaluate and characterize the grasslands according to their forage yield and quality attributes.

Figure 9. Degraded pasture (infested with *Anthemis cotula* weed) in Budgam

Figure 10. Improved pasture at Yusmarg, Budgam

Issues of pastureland and pastoralists in Jammu & Kashmir:

1. Deterioration of natural pastures due to no protection and their easy access owing to no ban on grazing is leading to continuous misuse, indiscriminate cutting and grazing, overstocking, proliferation of noxious and poisonous weeds.
2. Shrinkage of village pastures previously ear-marked for grazing of livestock locally known as "Gass charai" due to population pressure, illegal encroachments etc.
3. Failure to produce fodder crop seeds by private/public agencies is leading to the dependency on natural pasture. Lack of large-scale dissemination of improved fodder production technologies is also contributing to dependence on natural pastures and their overexploitation leading to their degradation.
4. During summer when pastoralists move to alpine pastures, conflicts arise as they move through protected/reserved forests and National Parks/wildlife sanctuaries, prohibited for grazing.

Table 18. Important pastures of Jammu & Kashmir

Winter grazing areas (Outer hills/ Siwaliks)	Intervening pastures			Summer grazing areas		Pahalgam	Wardwan	Baramulla	Doda and Kishtiwar
	Middle mountain pastures	Pir Panjal pastures	Tulail	Gurez	Sonmarg				
Mendhore, Garsahi, Dharamsal, Tatapani, Kalakot, Mansar, Dombari, Arnas, Billawar etc.	Sarthal, Sanasar, Rupari, Zajinar, Darhal, Poshiana, Chimber, Khari Marg, Chandras etc.	Tosamaidan, Gorewan, Yusmarg, Khilan Marg, Pir ki Marg, Dubjan, Zaji Marg etc.	Gangabal, Tulail, Churnar, Rambal, Lal Marg, Hanjan Marg, Purana Ganga, Naya Ganga etc.	Tiragabal, Machal, Kurkbal, Guraz, Jugnei, Gadsar, Visan Sar, Kisan Sar, Kaobal, Sukhnai etc.	Sonamarg, Mina Marg, Gangbal, Naranag, Batimarg, Gumri, Zojilla, Dras etc.	Chandanwari, Astan marg, Aru, Seshnag, Zajibal, Amarnath etc.	Saein Nalla, Guru Nalla, Duksum, Simthan, Fambar etc.	Gulmarg, Khillan Marg, Tangmarg etc.	Simthan, Padar, Bhadarwah, Doda, Neelam valley, Paristan, Yubistan, Nuristan etc.

The productivity of these pastures has been estimated to range from 1.5 to 2.5 t DM per ha but owing to imporoved grassland management practices, there is a potential to improve this productivity from 10-15 t DM ha^{-1}

5. Lack of organization between pastoral communities on account of transhumance which limits their ability to bargain or negotiate with other institutions and their involvement in the policy process.
6. Pastoralists have received much less attention in comparison with other social groups from the governments and other institutions. There is a lack of any specific national or state policy for the sustainable development of pastoral communities.
7. Pastoralists still rely on age old traditional medical means for treatment of livestock. There are no satisfactory facilities available in the far off villages let alone high altitude pastures.

Strategies for grassland/Pasture restoration/improvement:

Following strategies should be followed for the grassland/pasture land restoration. Reseeding pastures with nutritive legumes and grasses followed by their protection and grazing management are key steps that will ensure rejuvenation of the grasslands and pasture land of Jammu & Kashmir.

Removal of unwanted species/weeds: Clearing and cleaning of the site should be carried out before sowing the improved grasses and legumes.

Protection of grassland: Live fencing like *Agave* spp., *Carrisa carandus, Prinsepia utilis, Xanthoxylum armatum, Dodonea viscosa* can be planted around

selected sites. Besides this, cattle proof trenches and physical barriers (stone wall; iron posts; barbed wire) can also be deployed for protection of the sites.

Introduction of improved range legumes and grasses: Legumes ensure quality and quantity biomass production under natural rangelands and pastures. In J & K grasslands and pastures have low or negligible legume component, thus range legumes introduction is important. Legumes are introduced with improved grasses in 2: 1 ratio (grass: legume). Legumes on pastures can enhance green fodder availability from 3-4 to 7-8 months. Grasses and legumes that can be introduced in J & K for are given in table 15.

Grazing management: Over grazing and higher grazing pressure owing to free access results in the detrimental changes to the botanical composition of the pasture lands. Due to continuous and over grazing, the most relished and palatable species are continuously grazed leaving behind non-palatable species like *Anthemis cotula, Xanthium spinosum, Cirsium arvense, Conium maculatum, carduus nutans* etc. Four types of grazing can be practiced namely continuous grazing, deferred grazing, rotational grazing and deferred rotational grazing. In the continuous, pasture area is grazed continuously and animals wander through whole area. Long continuous grazing ultimately leads to the depletion and disappearance of highly palatable species. In the deferred system, the grasslands are divided into different compartments and one or more compartments are left without grazing until seed setting. In the rotational type, no compartmentalization is made; instead the rangelands are grazed in rotation for 7-15 days. The deferred rotational system is a mix of both types and is superior one owing to increased grazing periods available, maintenance of proper grass species through self seeding and seed formation and these un-grazed paddocks are changed every year to allow good seed bank in the soil in the entire area. There is yet another system of cut and carry, where livestock are not allowed to graze, instead the grass is harvested and stall fed to the animals. These grazing management systems can be followed for sustain productivity of pastures.

Stakeholder participation and institutional support: The involvement and participation of pastoral community is a pre-requisite while initiating any programmes to revitalize the grasslands. Adequate institutional and individual support is needed and must be provided for the protection and rejuvenation of the grazing areas. There must be consolidation of a sustainable social peace through the joint management of pasture resources based on local agreements known and respected by all.

Establishing fodder banks along pastoral communities' migration routes: A secure movement of herds during their seasonal migration through a participatory approach

of management of pastures and establishment of fodder banks along their migration route should be focused. A major pastoralist of Jammu & Kashmir and details regarding their livestock and pastoralism type has been provided in the table 19. Fodder tree species *Ficus* spp., *Celtis australis, Morus alba, Bauhinia variegata*, *Leuceana leucocephala*, *Ulmus* species, *Robinia pseudoacacia*, *Salix* species etc. are suitable species for establishment of fodder banks in J & K. Grass species like Guinea grass, *Brachiaria brizantha*, Bajra Napier Hybrid, *Setaria anceps* (var. S-18 Perennial), *Paspalum notatum*, *Dicanthium annulatum*, *Chrysopogon fulvus* Perennial rye grass (*Lolium perenne*), tall fescue (*Festuca arundinacea*), Setaria grass (*Setaria anceps*), Anjan grass (*Cenchrus ciliaris*), *Paspalum* spp, *Dactylis glomerata* can be easily raised and legume species like *Trifolium alexandrinum, Stylosanthus hamata, Stylosanthus scabra, Siratro (Macroptilium atropurpureum), Macrotyloma axillare (Dolichos), Neonotonia wightii* White Clover *(Trifolium repens)*, *Stylosanthus hamata, Macrotyloma axillare (Dolichos), Neonotonia wightii* are suitable for raising fodder banks in migratory routes of pastoralists.

Table 19. Major pastoralists of Jammu & Kashmir

Name of the community	Composition of Livestock/ Animals	Type of Pastoralism
Bakarwals	Mainly Goats, Sheep, horses and dogs	Transhumance
Gujjars	Cattle, buffaloes, sheep, horses	Semi-sedentary and sedentary
Chopans	Mainly sheep	Semi-sedentary
Gaddies	Goats and Sheep	Semi-sedentary

Figure 11. Glimpses of pastoral migration

Figure 12. A Bakarwal family enroute Mughal road (Peer k Gali) during halt at Hirpora village

ii. Establishment of silvipastures:

Silvipasture can enhance average dry fodder biomass production from 1.25 – 4.50 t/ha per year on natural grassland to 4.50 – 8.70 t/ha per year. The average animal carrying capacity can be increased up to 50% in comparison to natural grazing land during rainfed season by adopting silvipastural models. Trees in silvipastures supply fodder during lean period thereby it can reduce feeding cost thus ensures round the year fodder supply. Zone wise list of important fodder trees of J & K and grass suitable for integration under fodder trees has been enlisted in table 21. These fodder trees can be integrated on farm bunds, agricultural border land area, and on grasslands owned by local people. In a study conducted in Himachal Pradesh by ICAR-IGFRI's regional research centre situated at Palampur, Himachal Pradesh (hilly region), it has been found that leaf dry biomass production of fodder trees established under silvipasture on grasslands in Mandi and Kangra district of Himachal Pradesh i.e. *Albizia lebbeck*, *Artocarpus chaplasha*, *Bauhinia variegata*, *Grewia optiva*, *Morus alba* ranged between 0.23-0.60 DM t ha^{-1} and grass biomass production ranged from 8.23 to 9.17 DM t ha^{-1} biomass. In addition to producing round the year fodder silvipastures also supply fuel wood, timber, non timber forest products; sequester atmospheric carbon dioxide; conserve soil and water; improves soil fertility too. Therefore, silvipastures can be established in the degraded forest lands or other wastelands which will be a win-win situation as on the one side it will reclaim the wasteland and on the other side it will provide nutritious fodder for livestock. Moreover, tree leaf fodder quality does not get impacted significantly by seasons as in case of forage crops and grasses.

Table 20. Suitable trees and grasses for silvipasture establishment under various climatic zones of Jammu & Kashmir

S.No.	Agroclimatic zone	Functional components
1.	Sub-tropical /low hills zone	**Trees:** *Acacia catechu, Albizia lebbeck, Grewia optiva, Celtis australis, Morus* spp, *Bauhinia variegata,, Dalberigia sissoo, Melia azedrach, Leucaena leucocephala, Salix tetrasperma, Azadirachta indica, Syzygium cumini, Toona ciliata, Terminalia tomentosa, T. bellerica, T. chebula, Populus deltoides, Vitex negundo, Woodfordia floribunda* etc. **Bamboos:** *Dendocalamus strictus* **Grasses:** Chrysopogaon fulvus, Heteropogon contortus, Setaria spp., Dinanath grass, Bajra-Napier hybrid, Guinea grass **Legumes:** Stylosanthus spp. Trifolium alexandrinum, Trifolium repens Stylosanthus hamata, Stylosanthus scabra, Macroptilium atropurpureum, Macrotyloma axillare, Neonotonia wightii, Stylosanthus hamata
2.	Intermediate/subtemperate mid hills zone	**Trees:** *Quercus leucotrichophora, Robinia pseudoacacia, Pistacia integerrima, Toon aciliata, Grewia optiva, Alnus nitida, Celtis australis, Morus* spp, *Albizia chinensis, Bauhinia variegata, Salix tetrasperma, Melia azedrach, Olea cusptidata, Vitex negundo, Woodfordia floribunda* **Grasses:** *Apluda mutica, Chrysopogaon fulvus, Heteropogon contortus, Panicum maximum, Setaria sphacelata,* Bajra-Napier hybrid, Guinea grass etc. **Legumes:** *Trifolium alexandrinum, Trifolium repens Stylosanthus hamata, Stylosanthus scabra, Macroptilium atropurpureum, Macrotyloma axillare, Neonotonia wightii, Stylosanthus hamata*
3.	Temperate Zone	**Tree:** *Celtis australis, Robinia pseudoacacia, Salix alba, Aesculus indica, Ulmus wallichiana, Morus* spp., *Populus ciliata, Populus deltoides* **Grasses:** *Bromis inermis, Festuca arundinacea, Dactylis glomerata, Chrosopogon gryllus, Setaria* spp., *Phleum pretense*, Red and white clovers, *sainfoin, Phalaris* spp., *Festuca rubra, Lotus corniculatus, Coronilla varia, Lolium perenne, Lolium multiflorum* **Legumes:** *Medicago sativa, Trifolium repens, Trifolium pretense, Onobrychis viciifolia*

Figure 13. Mulberry based silvopastoral system at RRS Srinagar

Fodder production from Forest fringe areas

The region is rich in forest resources which are spread over an area of 20,130 square kilometers. The plantations or trees outside forests in Jammu & Kashmir is more than 1000 km^2, which have great potential to be developed as silvopastoral systems. Plantation at spacing of 4 m x 4 m should be carried out so that forage crops could be cultivated between the interspaces. Forests and these plantations provide great scope for augmentation of forage resources in the region table 21. Moreover, in hilly areas construction of roads leads to denudation of hills and they are prone to soil erosion thus, grasses can be planted on denuded lands along the highway which will serve the purpose of soil and water conservation and will provide nutritious fodder for livestock as well. In a silvopasture system at RRS Srinagar, the pasture combination s*ainfoin* + *Phalaris aquatica* + *mulberry* recorded maximum green as well as dry fodder yield (26.8 t/ha and 6.5 t/ha, respectively) followed by sainfoin + *orchard grass* + *mulberry d*uring second year of experimentation.

Table 21. Expected forage availability from the forests and plantations

Land use	Area	Expected green forage availability (tonnes)	Expected dry forage availability (tonnes)
Forest area	20130 km^2 (considering 25% area to be used for forage crop cultivation)	10065000	2516220
Plantations/ TOFs	1000 km^2 (considering 40% area to be used of silvopasture establishment)	800000	200000

Base: Average forage production under hortipasture: Green 20 t/ha; Dry: 5 t/ha

Figure 14. Transplanting of grasses at Sonamarg on Srinagar/Ladakh highway for soil conservation

***Dactylis glomerata* L. (**Green fodder yield: 10-12 t DM /ha; Crude Protein : 28.3% to 12.5% (late bloom stages)

***Bromus unioloides* (**Green fodder yield: 7.0 t DM/ha: Crude Protein:14%)

Sainfoin (Green fodder yield: 14-16 t/ ha; Crude Protein: 20%)

Red clover (Green fodder yield 40-60 t/ha; Crude Protein: 22%)

Tall fescue. (Green fodder yield 10-12 t DM/ha**;** Crude Protein: 13%)

***Phalaris* aquatica** (Green fodder yield: 65-70 t/ha; Crude Protein: 14%)

Figure 15. Important temperate fodder and grasses and legumes

D. Fodder on non-competitive lands

Introducing perennial cultivated grasses on farm bunds along irrigation channels/farm boundaries/terraces

Introducing perennial cultivated grasses on farm bunds along irrigation channels involves by growing of 2 rows of Bajra × Napier hybrids, guinea grass, setaria, tall fascue and phalaris hybrid along with field boundary can supply 7-11 q green fodder per 100 m length of boundary per year. As terrace cultivation is most important in the hills of Jammu & Kashmir planting of perennial grasses on bunds will also help to stabilise terraces which are more prone for soil erosion during rainy season. Total number of land holdings is 1442.89 thousand in Jammu & KAshmir which gives an opportunity to grow fodder on their bunds/ boundary.

Bajra × Napier production terraced field's risers grasslands and Deodar Forest

Studies conducted at ICAR-VPKAS, Almora has shown that raising B x N hybrid can be integrated on grasslands, under deodar forest and on hill side slopes. Following strategy should be adopted for harnessing area under deodar forest for fodder production and hills slopes in Jammu & Kashmir.

Planting time: Onset of monsoon

Seed rate: 10-15q/ha rooted slips. Every 5^{th} or 6^{th} year we have to replant the root slips to avoid rat damage

Harvesting of green fodder: During first year of planting 1-2 cut (70 to 80days interval) and 5-6 cut from second year onwards (40 to 50 days intervals). Further, number of cuts may very as per the rain fall.

Production: 400 to 800 q/ha fodder production can be obtained from wastelands, and 8-10 kg per running meter from field terrace risers

Utilizing rice fallow for fodder production in Jammu Division:

The sub tropical zone of Jammu division is famous for basmati rice cultivation as around 1 lakh metric tonnes of basmati rice are produced in Jammu, Samba and kathua districts. Basmati of R S Pura belt in Jammu region is world famous owing to high quality of aroma. Basmati rice is grown on about 60,000 hectares area in Jammu, Kathua and Samba districts. This land remains fallow during winter season after the harvest of the rice crop. These rice fallows can be utilized for growing forage legume crops like berseem and lathyrus in residual soil moisture. Moreover bunds of rice field can be utilized for growing high yielding fodder shrubs like *Sesbania sesban*, *Leuceaena* and perennial fodder grasses like B-N hybrid and Guinea grass may be planted on field bunds without hampering rice productivity.

E. Alternative fodder resources:

Alternative source of fodder species like beetroot, turnip, rapeseed, vetc.h, peas, raddish, azolla etc. can be grown easily in J & K. Less commonly used fodder species

which are having good fodder value can be utilized in J & K. Rapeseed (*Brassica napus*); Kale (*Brassica oleracea* cv acomphala), Swedes (*Brassica napobrrasica*), Turnip (*Brassica rapa*), Raddish (*Raphanus sativus*), Beet (*Beta vulgaris*), Vetc.h (*Vicia sativus*), Peas (*Pisum sativum*) and *Azolla* spp. leaves can provide 2.5 to 5 t DM/ha. Aquatic plants like water hyacinth, aquatic spinach and leaves of lotus plant, lemna, water chestnut, hydrilla, pistia, aquatic weeds can be utilized as unconventional fodder.

i. Azolla as alternate fodder crop in Jammu Division

Figure 16. *Azolla* production unit

In, subtropical area of Jammu division *Azolla* farming can be taken up to reduce the cost on concentrate as *Azolla* provide good nutritious protein rich biomass for livestock. *Azolla* cultivation is an inexpensive as it can be multiplied in natural water bodies for production of biomass. *Azolla* is very rich in proteins, essential amino acids, vitamins (vitamin A, vitamin B12, β Carotene), and minerals including calcium, phosphorous, potassium, ferrous, copper, magnesium. On a dry weight basis, Azolla has 25-35% protein, 10-15% mineral content, and 7-10% comprising a combination of amino acids, bio-active substances and biopolymers. During lean/ drought period it provides sufficient quantity of nutrients and acts as a feed resource. Azolla is a highly productive plant. It doubles its biomass in 3–10 days, depending on conditions and it can yield up to 37.8 t fresh weight/ha (2.78 t DM/ha dry weight).

ii. Hydroponic fodder production

Hydroponics is a way of rapid quality fodder production. 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 cowpeas. But now less expensive and sustainable technologies are available which can be used for hydroponic fodder production.

Hydroponic structure consists of a framework of shelves on which metal or plastic trays are stacked. After soaking overnight, a layer of seeds is spread over the base of the trays. During the growing period, the seeds are kept moist, but not saturated. They are supplied with moisture and nutrients, usually via drip or spray irrigation. Seeds will usually sprout within 24 hours and in 5 to 8 days have produced a 6 to 8 inch high grass mat. Peri–urban small farms, landless animal farms and steep hill farms having no agricultural land but possess small pig, poultry and/or cow units

can benefit from either of the two or combining the hydroponic fodder–cum–sprouted grain technologies. Hydroponic fodder cannot substitute green fodder and hay completely, as it lacks in fibre content. But it is definitely a better substitute for packaged feeds.

iii. *Moringa* as an alternate fodder source in Jammu Division:

Figure 17. *Moringa* –A nutritious fodder

Moringa oleifera is an important alternative source for substituting commercial rations for livestock. It is a fast growing indigenous tree of India that can be propagated easily with both sexual and asexual means. It can thrive in low soil nutrients & water and produce sufficient amount of biomass in dry periods. *Moringa* leaves are highly palatable, digestible and nutritious as they posses 21.53% crude protein, 24.07% acid detergent fiber (ADF) and 17.55% neutral detergent fiber (ADF). The sub tropical zone of the UT i.e. Jammu division is well suited for the cultivation of *Moringa*. Planting of *Moringa* at ICAR-IGFRI at 50x50 cm spacing has been found to yield 80-130 tonnes green forage/ha in 4 cuts at 45 days harvest intervals in 2nd year of planting. This indicated that moringa has huge potential that can be exploited for sustaining livestock production in the UT.

iv. Sugar beet/Fodder beet:

Fodder beet is an important energy supplements for small and large both category of animal. Fodder beets contain about 16-22% dry matter and provide about 4000 kcal/ kg (dry matter) gross energy N digestibility in ruminants is about 85%. The crude protein content ranges between 7-8% on dry matter basis. Fodder beet can be cultivated in most of the parts of the state except high hills and its duration is 140-150 days .

Figure 18. Sugar beet / Fodder beet

F. Crop residue quality enhancement

Crop residue is one of the important source of dry fodder in Jammu & Kashmir. The cereals crops generates 58% of residue, while sugarcane generated 17%, oil seeds 5% and fibres 20%. Crop residue production in Jammu & Kashmir is around 4828.52 thousand tonnes.Crops wheat, rice, cereals and pulses are produced at large quantity (table 23) and residue of which can be utilized for value added fodder production. The surplus crop residues can be used for various alternative purposes, these include use of crop stubble as fodder for animals, for the generation of electricity and for use as input in the paper/ pulp industry etc.Quality enhancement of crop straw is required to use them as value added fodder. There are various methods of treating the crop residues before feeding, to improve its nutritional value. It has been reported that even chaffing of stalk before feeding, can reduce the emission of methane by 10% while saving the wastage by 25-30%. Further treatment of crop residues by way of soaking in water and treating with steam under pressure, can also improve the nutritive value and palatability. There are other methods like urea treatment in addition to molasses. Establishment of a complete feed production unit can also enhance availability of balanced fodder and will also increase the supply of complete feed at an affordable price can motivate a large number of small farmers to expand their livestock development activities as a reliable source of livelihood. To operationalize such decentralized feed production units on an economically viable scale, the units can be operated by local livestock keeper groups who have a major stake in procurement, distribution and its viability.

Paddy residue management in Jammu division

Jammu division of the UT is well known for Basmati rice cultivation which leads to the production of huge amount of rice strove and straw. In Jammu & Kashmir 0.5 metric tonne of rice residue was produced during 2014-2015. This rice straw on value addition can be converted into high quality fodder for meeting out rising fodder demand of livestock in UT. These paddy residues are low in nitrogen, soluble carbohydrates and minerals and but have more of lignin which makes it less digestible. Thus, paddy residue needs value addition for quality enrichment by processing them into more nutritious and palatable form. Steam treatment of paddy residues and converting it into

Table 22. Production of major crops of J & K, value added residue of which can be utilized as fodder

S.No.	Crop	Jammu & Kashmir MT (2016-17)
1.	Rice	572500
2.	Wheat	548500
3.	Maize	541100
4.	Other cereals	21100
5.	Pulses	10100

small pieces can enhance their palatability. Further, treatment of paddy residue with urea and molasses enhances its palatability, fibre digestibility and supply protein in the form of nitrogen. Therefore value addition of paddy residue can be for utilized as a quality fodder source in Jammu division.

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

Traditionally fodder conservation has been only with the dry fodder in the form of hay making and heaping. However, the lack of scientific hay making has often limited keeping quality of hay making and heaping. Recently there is greater emphasis on conserving green fodder popularly known as "Silage". While the hay making is possible with the dry fodders, green fodders are required for silage making.

a. **Silage:** 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. Silage making may be recommended in Jammu & Kashmir. However, its success will depend on surplus forage production, unreliable rainfall pattern, requirement for labour (cutting, raking, collecting, chopping, pit construction and cleaning, ensiling) and materials (polythene, molasses). Several green crops and grasses may be used for silage making *viz.* maize, sorghum, bajra napier hybrid grass, guinea grass, setaria, pineapple stover, etc.

b. **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 into bales to reduce keeping space and ease transportation has been found to be more necessary in recent times. 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.

c. **Feed Block:** Bale making or feed block making could be good strategy for reducing the cost involved in transportation of fodder from one place to another and saving the space for keeping the fodder. 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.

d. **Tree leaves conservation:** Willow, mulberry, *Grewia* tree leaves can made into silage and dry hay.

e. **Reduction of wastages by chaffing:** Minimize the wastage is important as it is

reported that 15-20% of the straw offered to livestock is usually refused by them when it was fed unchaffed. Therefore, chaffing is essential to minimize the wastage.

Expected enhanced fodder production from above mentioned interventions have been summarized in table 25.

H. Custom hiring centres

These need to be developed to provide various equipments, machinery etc. (table 23) to the farmers at affordable cost. The use of new machineries and technologies will enhance production, reduce drudgery and cost. The custom hiring centre should have all important implements/machinery require for fodder production and which are difficult to have for most of the farmers and will help in reducing the cost of fodder production.

Table 23. Major machineries for custom hiring centre

Prime Movers or General Machines	Land preparation/ Tillage machine	Sowing/ Transplanting machine/ Intercultural machines	Harvesting Machines
Tractors	(i) Disc Plow	(i) Seed cum fertilizer drill	(i) Potato Digger
(i) Tractor 2WD (above 20-40 PTO HP)	(ii) Cultivator	(ii) Self-Propelled Rice Transplanter (4-8 rows)	(ii) Tractor drawn crop reaper/reaper binder
(ii) Tractor 2WD (above 40-70 PTO HP)	(iii) Disc harrow	(iii) Self-Propelled Rice Transplanter	(iii) Rice straw Chopper
(iii) Tractor 4WD (above40-70 PTO HP)	(iv) Leveler Blade	(iv) Post hole digger	(iv) Crop Reaper cum Binder (3 wheel)
Power Tillers	(v) Cage wheel	(v) Potato Planter	(v) Crop Reaper cum Binder (4 wheel)
(i) Power Tiller (below 8 BHP)	(vi) Furrow opener	(vi) Multi crop planter (5 tines)	(vi) Power Weeder (engine operated below 2 bhp)
(ii) Power Tiller (8 BHP & above)	(vii) Ridger	(vii) Multi crop planter (5 tines) transplanter	(vii) Power Weeder (engine operated above 2 bhp)
	(viii) Weed Slasher	(viii) Ridge furrow planter machine	(viii) Power Weeder (engine operated above 5 bhp)
	(ix) Bund former	(ix) Pneumatic Planter	(ix) Power operated horticulture tools for pruning budding, grating, shearing etc.
	(x) Crust breaker	(x) Pneumatic vegetable planter	
	(xi) Roto-puddler	(xi) Plastic Mulch Laying Machine	
	(xii) Roto-cultivator	(xii) Raised Bed Planter with inclined plate planter and shaper attachment. (5-7 tines)	
		(xiii) Grass Weed Slasher	
		(xiv) Power Weeder	

Table 24. Estimated Enhanced fodder availability by various interventions

Intervention	Enhanced fodder availability	Remarks
Silvipastures	3100155 t DM	Targeting 25% of forest area and trees outside forests
Hortipastures	203997.475 t DM	If we target 50% orchards and 25% area under each targeted orchards
Grassland improvement	1054438 t DM	Rejuvenation and rehabilitation of permanent pastures and other grazing lands
Fodder conservation	Sustainable utilization of forages during scarcity periods	Hay and silage making, feed blocks, fodder banks along migratory routes, densification, urea treatment
Fodder cultivation	Productivity enhancement from 30-35 t/ha to 65 -75 t/ha	Through use of improved cultivars and forage intensification (with recommended POPs)
Crop residue management (paddy straw, maize stover, pea and potato haulms etc.)	Improvement of forage quality and sustainable use	Urea treatment, addition of molasses, silage making

Part-III : Brief Action Plan

i. Creation of a nodal agency like Fodder Development Board

There are a number of agencies involved in fodder related activities, but there seems lack of convergence. Hence, to bring all stakeholders on one platform, creation of a nodal agency is urgently required.

ii. Identifying forage crops/varieties suitable for different agro-climatic zones

Suitable forage crops/varieties have already been identified and as such should be procured and made available to the farmers of various agroclimatic zones through KVKs and other organizations.

iii. Zonation with respect to demand/supply of fodder

Bench mark survey on the micro-climatic conditions, cropping systems, livestock numbers fodder crops may be initiated for identifying fodder zones (sufficient, deficit, moderately deficit and highly deficit areas) together with the farmers' acceptance and their satisfaction.

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

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

v. 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 UT of J & K.

vi. Master trainers training at IGFRI/SAUs

The staff of line departments of Animal Husbandry, Sheep husbandry, Agriculture, Horticulture, Forestry, Revenue etc. having aptitude to work for augmenting fodder resources will be identified through their superiors in the first stage as master trainers. They will be offered intensive need-based training programme/exposure visit at IGFRI, Jhansi and its regional station at Srinagar. The number of participants, the duration of the training programme and the topics of training programme will be finalized after discussion with the competent authorities of the line departments.

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

The Krishi Vigyan Kendras (KVKs) operating in the region will be roped in to identify farmers for training on fodder crops. Other stake holders like milk co-operatives, non-governmental organizations (NGOs) and progressive farmers will also be made partners in the process of creating awareness about fodder production, utilization and conservation.

viii. Conduction of fodder technology/frontline demonstrations and training

After bench mark survey and identification of suitable places for propagating awareness about the fodder crops, sufficient number of fodder technology/front line demonstrations in each of the selected villages 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. In addition to this, tailor made training programmes will be organized through KVKs for the benefit of the interested farmers on the topics of their interest in fodder production, livestock production and dairying.

ix. Strengthening of forage seed production chain

Lack 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.

x. Adoption of holistic approach- fodder production, conservation and utilization

There is fodder scarcity in almost all agro-climatic zones. The would-be fodder cultivating farmers will be doing so out of their dire requirement of fodder for their livestock. 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 holders in the process.

xi. Enhance acreage and productivity in non-conventional areas

Indeed there is a shortage of land for allocation to fodder crops. Farmers are not willing to spare adequate land for fodder production. Therefore, efforts will be made to bring non-conventional areas for production of fodder crops. In the process all efforts will be made for:

a. Augmenting fodder production through alternate land use management such as horti-pasture, silvi-pasture etc.

b. Production of fodder in non-arable land, wastelands, sloppy areas etc.

c. Production of fodder in problem soils (saline, alkaline, water-logged).

d. Enhancing production from grasslands through pasture development/grazing management

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

In many areas in spite of having a large chunk of crop wastes having fodder value, it cannot be used due to faulty agricultural practices or lack of foresight and or lack of machinery etc. Hence conservation of fodder resources wherever possible for future use during lean periods and at time of natural calamities like heavy snowfall, high rainfall etc. will be highlighted. Further as fodder is bulky in nature accounting for huge expenditure in transportation, bale making of dry fodders, silage in polybags of convenient sizes for transportation and urea treatment of hay/straw will be promoted and popularized among the livestock holders.

xiii. Establishment of fodder banks

Many a times, livestock holders, especially in Changthang and Gurez region, are faced fodder scarcity owing to inaccessibility, heavy snowfall, 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 keepers. In addition, establishment of fodder ware houses with enriched dry fodder or silage bins will also be popularized.

xiv. 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, IVRI, IIVR, IIPR, IISR, etc., Department of Animal Husbandry, Sheep husbandry, Agriculture, Forestry etc. 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.

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

Although the initial stage of programme is hovering around the government

agencies involved in various aspects of fodder production, processing, conservation, utilization, rationing, policy making, etc. the ultimate end user will be common farmers. Further there are several private players *viz.* dairy owners, animal pharma industries, feed manufactures, NGOs involved in livestock production and dairying etc. They will all be brought together under Public-Private Partnership (PPP) mode in more transparent, efficient and economical way for all the partners.

xvi. Popularizing the use of area specific mineral mixtures

Because of long lean period and non-availability of green fodder, livestock productivity gets further reduced. In view of this, there is a need for popularization of mineral mixtures. Farmers will be acquainted regarding cost-effective and easy methods for the preparation of area-specific mineral mixtures.

xvii. Impact analysis of technology adoption

The objectives of the programme also aim at seeing the perceptible changes that are going to occur 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 action points to be carried out in the process of implementation by several agencies (Table 26).

Table 25. 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 KVK/milk unions/SAHD
5	Extension activities and development of fodder warehouse	Milk Unions/State Animal Husbandry Department
6	Dry fodder processing, value addition and fodder management (chaff cutter, Fodder block, Baling, grinding)	District level milk union/Animal Husbandry Dept.
7	R & D activity (Evaluation of fodder quality, food-feed crops, Hydroponics etc.,)	ICAR Institutes/ SAUs/SVUs
8	Capacity building of stake holders	ICAR-IGFRI/SAUs

The programme implementation plan is a time bound multi-stage oriented and aims to complete the activities in time frame in a logical way. It has been presented in Table 26.

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 of each agro-climatic zone. The list of selected/identified districts on the basis of dry matter requirement and availability in different agro-climatic zones of UTs of J & K is given in the Table 27

Table 26. Agro-climatic zone wise selected/identified district

S.No.	Zone	Farming situation	Identified districts
1.	Zone A (Sub-tropical/ Shiwaliks)	Irrigated Rainfed	Jammu, Kathua Samba
2.	Zone B (Sub-temperate/ mid-hill zone)	Irrigated plain zone Rainfed High hill zone Rainfed high hill zone	Rajouri Udhampur Doda
3.	Zone C (Temperate zone)	Low lying irrigated areas Karewa uplands Irrigated Karewas	Ganderbal, Bandipora, Kulgam Budgam, Pulwama Budgam, Shopian

The detailed plan for implementation of pilot project is presented in the Table 28.

Table 27. Implementation level plan for pilot project

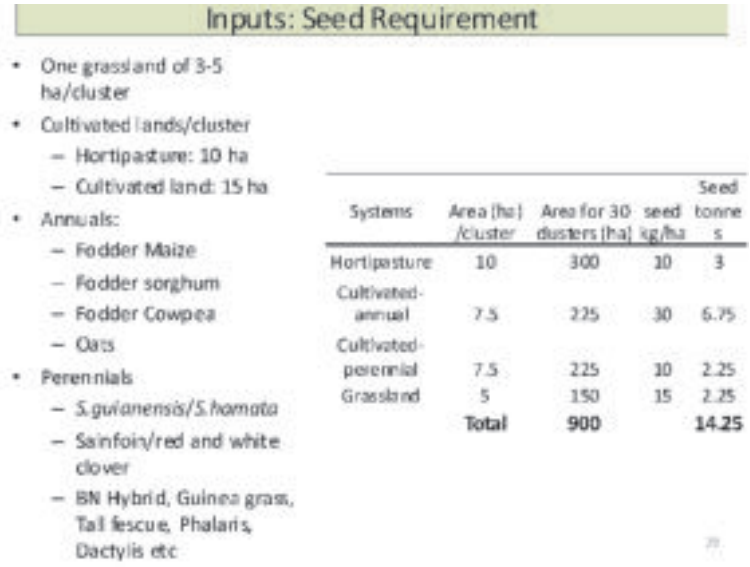
S.No.	Activity	Action points
1	Target area selection	• Selection of 10 districts (5 each from Jammu & Kashmir divisions) • Selection of 2 clusters of 5 villages in each district: total 20 clusters for 10 districts • Selection of 1 to 2 ha in each cluster for technology demonstrations • Bench mark survey
2	Training	• Training of master trainers - 25 master trainers per batch and 1 batch from each agroclimatic zone at IGFRI, Jhansi • Training of farmers; 10 from each village; 600 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, GBPUAT, VPKAS Almora and nearby states/NDDB, Anand.
3	Technology Demonstrations	• Selection of crop and varieties will be done after identifying suitable districts and village clusters both under annual and perennial crops for different seasons *viz. kharif, rabi* and *zaid* • Silage making 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- 5 ha • Popular and potential fodder trees Moringa can be a potential source of fodder in sub-tropical/mid-hill areas and may be explored
5	Development of fodder tree blocks	• In particularly hilly districts of the region, compact plantation of 1 ha on forest / community lands with grasses
6	Need based Watershed/ micro irrigation facility development	• Suitable fodder species to check soil and water erosion and enhancing water retention will be highlighted.
7	Rejuvenation of grasslands/ pasturelands/CPRs	• The related activities will be taken up during post rainy season (after monsoon rains in Jammu, after spring rains or during Autumn in Kashmir)
8	Tapping rice fallow and other fallow areas for fodder production	• Suitable annual fodder crops *viz.* fodder cowpea, oats, berseem etc. will be grown on residual moisture to ensure fodder supply during the period
9	Input supply	• Inputs *viz.* seeds/rooted slips/, fertilizers, insecticides etc., chaff cutters, small threshers and tools - improved sickles etc. will be supplied to farmers

10	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, brush cutters, regular farm implements including tractors, harrow, seed drill etc.

Calendar of activities for implementation

S.No.	Activities	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Selection: Tehsils, villages, farmers												
2	Benchmark survey and fodder budgeting												
3	Development of technology module												
4	Training at various levels												
5	Seed indenting and procurement												
6	Implementation of technology modules												
7	Input supply												
8	Fodder custom hiring Centres												
9	Warehouse structure and machinery installation												
10	Baling, procurement and storage												
11	Feed back on technology performance												



Seed Production responsibility

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

Foundation seed production : SC/SAUs/NGOs/ Participatory seed production

Production of certified/TFL seeds : RRS Srinagar/SAUs/RFS, Jammu/Line departments

Table 28. Enhancement of fodder availability by various interventions

Intervention	Enhanced fodder availability	Remarks
Silvipastures	3100155 t DM	Targeting 25% of forest area and trees outside forests
Hortipastures	203997.475 t DM	If we target 50% orchards and 25% area under each targeted orchards
Grassland improvement	1054438 t DM	Rejuvenation and rehabilitation of permanent pastures and other grazing lands
Fodder conservation	Sustainable utilization of forages during scarcity periods	Hay and silage making, feed blocks, fodder banks along migratory routes, densification, urea treatment
Fodder cultivation	Productivity enhancement from 30-35 t/ha to 65 -75 t/ha	Through use of improved cultivars and forage intensification (with recommended POPs)
Crop residue management (paddy straw, maize stover, pea and potato haulms etc.)	Improvement of forage quality and sustainable use	Urea treatment, addition of molasses, silage making

Funding arrangements

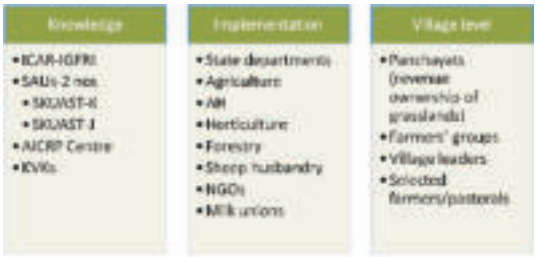
Governments of UT of J & K, Govt. of India through various state and central schemes like RKVY etc. can meet the fund requirement. ICAR- IGFRI will provide technical support for formulation of such fodder development proposals for funding. The fund requirement for the implementation of pilot project is presented in Table 29.

Table 29. Approximate budget requirement for the implementation of pilot programme

(Rs in Lakhs)

Item	Ist Year	IInd Year	IIIrd Year	IVth Year	Vth Year	Total
Training of master trainers, farmers and exposure visit	15	15	15	7	7	59
Annual cultivated fodder crops	10	8	8	6	6	38
Perennials Fodder crops	12	12	10	6	4	44
Suitable Silvipasture/ Hortipasture system demonstrations	7	7	2	2	2	20
Need based Watershed/ micro-irrigation facility development to check soil and water erosion, enhancing water retention	20	20	15	10	10	75
Rejuvenation of grassland/ pasturelands/CPRs	25	25	15	10	10	85
Tapping Rice fallow and other fallow areas for fodder production	7	7	7	4	4	29
Multi-Utility centre in each village cluster	140	2	2	2	2	148
Total	236	96	74	47	45	498
Contingency 5%	11.8	4.8	3.7	2.35	2.25	24.9
Grand Total	247.8	100.8	77.7	49.35	47.25	523

Part-VI : Modalities



This programme is undertaken to enhance fodder production, conservation and utilization on more sustainable basis in different fodder deficit districts of Jammu & Kashmir divisions. 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:

- ICAR- IGFRI will be knowledge partner and will help in providing all technical backup, technological support, seed procurement, sources etc.
- ICAR-IGFRI will provide all the technological and technical support in implementation of fodder action plan.
- ICAR-IGFRI will also supply the seeds/planting material or else will facilitate for the same from reliable sources in case of non-availability locally.
- ICAR-IGFRI would help in seed procurement on buy back arrangement in cases where seed production activities are involved in the programme.
- Line Departments *viz.* Dept. of Agriculture, Dept. of AH & Sheep Husbandry, Dept. of Horticulture, Dept. of Forestry etc., Governments of UTs of J & K along with SAUs, KVKs, NGOs, Milk Federations etc., will implement the programme at field and farmers level.

(Courtesy: Sahran Malik)

Annexure-I

Proceedings and Recommendations of Interactive Workshop

Online Workshop Report (NIAFTA) on Fodder Resources Development Plan : UT of J&K

June 20, 2020

Organizers

Department of AH&VS, Govt. of J & K

ICAR- Indian Grassland and Fodder Research Institute, Jhansi

The institute organized one day online workshop (Zoom) on "Fodder Resource Development Plan : UT of J &K" with the officers of Animal Husbandry and agriculture Department related to animal husbandry / fodder production of state and researchers of SKUAST, J&K on June 20, 2020 (10.15 am-1.15 pm).

Dr. Nazeer Ahmad, Hon'ble VC, SKUAST-K, chaired the workshop. In his opening remarks, he congratulated ICAR-IGFRI for conducting the workshop and highlighted the importance of livestock sector in the region and various challenges and issues this sector is facing, particularly with respect to forage production. He stressed on the use of tree forages, establishment of hortipastures and rehabilitation of grasslands for increased fodder production. He also called for suitable interventions in existing cropping system to popularize fodder.

Dr. Vijay Kumar Yadav, Director, ICAR-IGFRI welcomed all the dignitaries and gave an elaborate perspective of the fodder plan. He also briefed about the research/extension activities carried out by ICAR-IGFRI vis-à-vis fodder production, utilization and conservation.

Dr Suheel Ahmad, OIC, RRS Srinagar presented a detailed fodder plan of UT of Jammu and Kashmir, including road map, implementation, stakeholder responsibilities, budgetary requirements and modalities.

Dr A K Roy, PC, AICRP-FC, presented various forage production/protection technologies suitable for UT of J & K.

Dr R V Kumar gave a detailed account of technologies for grassland and silvopasture management for enhancing production.

Dr Sheeraz Saleem Bhat, scientist, RRS Srinagar presented the technologies for hortipasture development for augmenting forage availability.

The workshop was attended by various directors of line departments, like, agriculture, sheep and animal husbandry, livestock development board, forest department, scientists from SKUAST-K and J and ICAR-IGFRI.

Dr. Purushottam Sharma, PS, IGFRI, presented vote of thanks.

Major recommendations

- Focus should be more on tree forages, pastures and grassland rehabilitation which can be important source of fodder supply.
- The fallow period in existing crop rotations can be used for cultivation of short duration fodder crops/ varieties.
- The strategy for fulfilling winter fodder shortage should be developed.
- Azolla can be promoted as feed supplement.
- Fallow land can be used for grassland and pasture development through convergence with central / state govt schemes.
- There is shortage of improved fodder varieties seed. Efforts should be made by IGFRI and SKUAST to fulfill the same.
- The awareness about scientific pasture management and grazing system should be increased.
- Agro-climatic region specific strategy should be developed to fulfill fodder demand.
- The indent for fodder seed should be given in time and accordingly seed should be lifted.
- Crop residue enrichment technologies should be promoted.

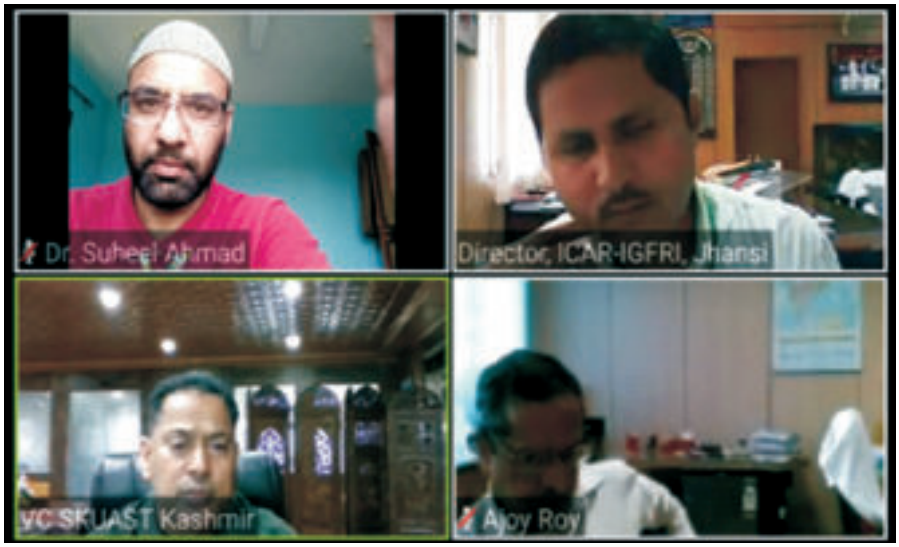
Annexure-II

List of dignitaries/guests participating in the Fodder Plan Workshop J&K on June 20, 2020

S.No.	Name	Designation	Organization
1.	Dr. Nazeer Ahmad	VC	SKUAST-K
2.	Dr. VK Yadav	Director	IGFRI, Jhansi
3.	Dr. AK Roy	PC	IGFRI, Jhansi
4.	Shri Altaf Aijaz Andrabi	Director	Agriculture Deptt.
5	Director		Agriculture Deptt., Jammu
6	Dr. Hamidullah Dar	Deputy Director (Feed and Fodder)	AH Deptt. Kashmir
7	Shri Yadvendra Singh Sason	Agrostologist	Agriculture Deptt. Jammu
8	Director	Sheep Husbandry Department	Jammu
9	Director	Sheep Husbandry Department	Kashmir
10	Director	Sheep Husbandry Department	Kashmir
11	Director	AH Deptt.	Kashmir
12	Director	AH Deptt.	Jammu
13	Dr. Razdan	CEO	Livestock Development Board, Kashmir
14	Dr. T H Masoodi	Dean, Forestry	SKUAST-K
15	Dr. B C Sharma	Head, Agronomy Div.	SKUAST-J
16	Shri Riyaz Gul	Agrostologist	Forest Deptt.
17	Dr. Noor Saleem	Sr. Scientist	AICRP-FC, SKUAST_K
18	Dr. Zahida	Asstt. Prof.	AICRP-FC, SKUAST_K
19	Dr. Zahoor Ahmad Dar	Professor	AICRP-Maize, SKUAST-K
20	Dr. Ansar-ul-Haq	Assoc. Prof.	SKUAST-K
21	Dr. Manpreet Kaur	Asstt. Prof.	SKUAST-J
22	Shri Nazim Hamid Mir	Scientist	RRS, Srinagar
23	Shri Lateef Jawahiri	Agrostologist	Agriculture Deptt., Kashmir

24	Shri Khurshid Ahmad Gilkar	Research Asstt.	High Altitude Seed Multiplication Farm, Aru, Pahalgam
25	Dr. RV Kumar,	Head, GSM	IGFRI, Jhansi
26	Dr. Khem Chand	Head, SS	IGFRI, Jhansi
27	Dr. PK Pathak	Head, FMPHT	IGFRI, Jhansi
28	Dr. AK Mishra	Head, PAR	IGFRI, Jhansi
29	Dr. Shahid Ahmad	Head, CI	IGFRI, Jhansi
30	Dr. Sunil Kumar	Head, CP	IGFRI, Jhansi
31	Dr. OH Chaturvedi	Head	RRS, CSWRI, Garsa
32	Dr. Suheel Ahmad,	OIC	RRS, IGFRI Srinagar
33	Dr. AK Dixit,	PS	IGFRI, Jhansi
34	Dr. S Radotra,	PS	RRS, IVRI, Palampur
35	Dr. Shiraj Bhatt,	Scientist	RRS, Srinagar
36	Dr. P Sharma,	PS	IGFRI, Jhansi
37	Dr. SR Kantwa,	PS	IGFRI, Jhansi
38	Dr. Tejvir Singh,	Scientist	IGFRI, Jhansi
39	Dr. Maneet Rana,	Scientist	IGFRI, Jhansi
40	Dr. Kamini,	Scientist	IGFRI, Jhansi
41	Dr. G Meer	Scientist	RRS, IGFRI, Srinagar Kashmir

Glimpses of interactive workshop



Developed Fodder Crop Varieties from ICAR-IGFRI, Jhansi

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

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

Contact Us :

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