भाकृअनुप
ICAR

Fodder Resource Development Plan for Uttar Pradesh

भा.च.चा.अ.सं.
IGFRI

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

An ISO 9001:2015 Certified Institute

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

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Website : http://www.igfri.res.in
Phone : 0510-2730666, Fax : 0510-2730833, E-mail : igfri.director@gmail.com
Follow us : @ icarigfri Jhansi igfri.jhansi.56 Kisan Call Centre 0510-2730241

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

सत्यमेव जयते

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GOVERNMENT OF INDIA
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AND
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
MINISTRY OF AGRICULTURE & FARMERS WELFARE
KRISHI BHAVAN, NEW DELHI-110 001
Tel.: 23382629, 23386711 Fax: 91-11-23384773
E-mail: dg.icar@nic.in

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 Uttar Pradesh in consultation with various stakeholders. The document presents suitable technologies to increase fodder production in the State. The State is having deficit of about 24% of green fodder and 30% of dry fodder requirements, respectively. The adoption of technologies will improve the productivity in the State. I am confident that this document will serve as a guide to plan and implement fodder development programs to make the State self-sufficient in fodder requirements.

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

(T. Mohapatra)

Dated the 24th March, 2021
New Delhi

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

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

Coordination Team

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

Members

- Dr. AK Roy, Project Coordinator, AICRP on FC&U
- Dr. AK Misra, Head, Plant Animal Relationship Division
- Dr. Sunil Kumar, Head, Crop Production Division
- Dr. RV Kumar, Head, Grassland & Silvipasture Management Division
- Dr. PK Pathak, Head, FMPHT Division
- Dr. Khem Chand, Head, Social Science Division
- Dr. Shahid Ahmad, Head, Crop Improvement Division

Uttar Pradesh State Fodder Resources Development Plan Committee

- Dr AK Misra, Coordinator
- Dr RK Agrawal, Chairman
- Dr Shahid Ahmad, Member
- Dr AK Dixit, Member
- Dr PN Dwivedi, Member

Document Formatting and Cover Design

Mr. KP Rao, Chief Technical Officer

Acknowledgement

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

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

We express our sincere thanks to Government of Uttar Pradesh, especially to Mr. B.L. Meena, Principal Secretary, Livestock and Dairy Development, Govt. of Uttar Pradesh who chaired the interactive workshop held at Directorate of Animal Husbandary, Lucknow on 13th December 2019, gave his valuable suggestions for fodder resource development in the state and stressed for adoption of recent technologies by the farmers and development of Model Fodder Production farms. We also extend our thanks to Dr. U.P. Singh, Director AH, Dr S.K. Srivastava, Director, Disease Control and Farms, and Dr A.K. Singh, Additional Director, AH for their support in organizing interactive workshop and showing keen interest in developing plan for augmenting forage and livestock sector in the state with special focus on pasture development on waste lands and impart training to state government officers. We also thank to other participants including officials of state government, KVK personnel, veterinary officials, etc., who actively participated in the workshop and provided their valuable suggestions for the improvement of plan.

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

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

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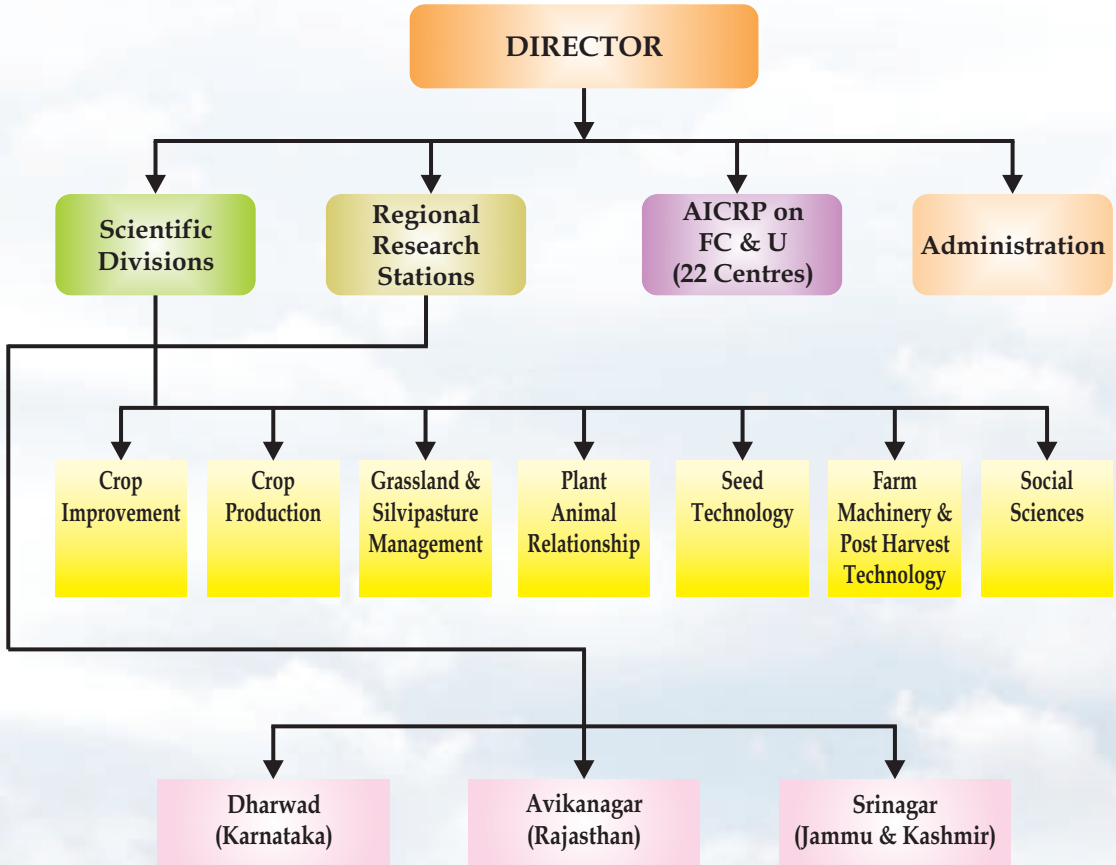
Organogram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ICAR-IGFRI - A Profile

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

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

Mandate

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

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

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

Proven Technologies of Institute

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

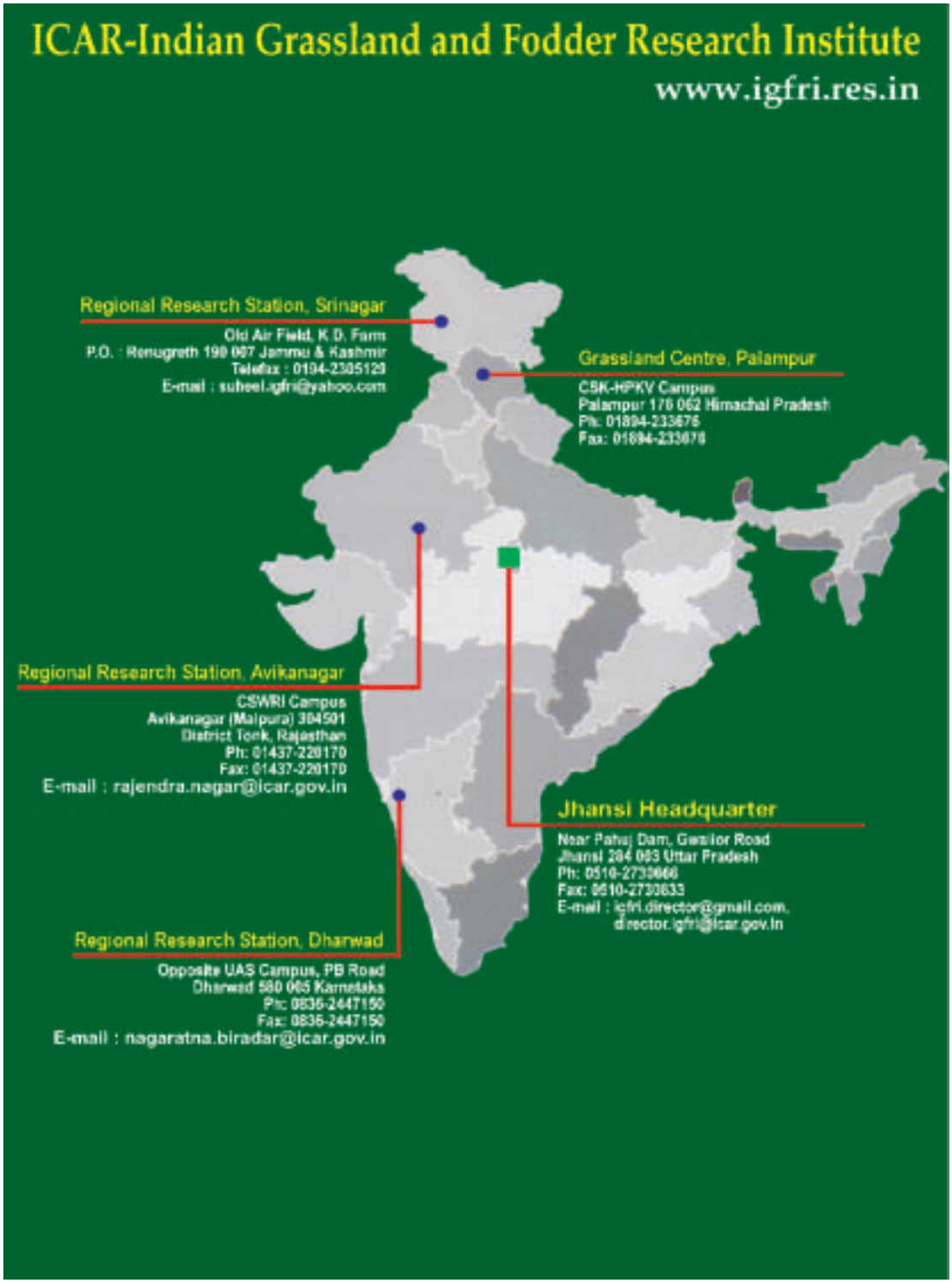
Accelerating Fodder Technology adoption

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

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

NIAFTA: New Initiatives

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


ICAR-Indian Grassland and Fodder Research Institute
www.igfri.res.in
Regional Research Station, Srinagar
Old Air Field, K.D. Farm
P.O. : Renugreth 190 007 Jammu & Kashmir
Telefax : 0194-2305123
E-mail : suheel.igfri@yahoo.com
Grassland Centre, Palampur
CSK-HPKV Campus
Palampur 176 062 Himachal Pradesh
Ph: 01894-233676
Fax: 01894-233476
Regional Research Station, Avikanagar
CSWRI Campus
Avikanagar (Malpura) 304501
District Tonk, Rajasthan
Ph: 01437-220170
Fax: 01437-220170
E-mail : rajendra.nagar@icar.gov.in
Jhansi Headquarter
Near Pahuj Dam, Gwalior Road
Jhansi 284 003 Uttar Pradesh
Ph: 0510-2730666
Fax: 0510-2730633
E-mail : igfri.director@gmail.com,
director.igfri@icar.gov.in
Regional Research Station, Dharwad
Opposite UAS Campus, PB Road
Dharwad 580 005 Karnataka
Ph: 0836-2447150
Fax: 0836-2447150
E-mail : nagaratna.biradar@icar.gov.in

Part-I : Agriculture, Livestock and Fodder Scenario

A. Introduction

Figure 1. Geographical location of Uttar Pradesh

The real India lives in villages and smaller towns and therein lies the future of our country as well as Uttar Pradesh state. The Uttar Pradesh is situated between 23°52'N and 31°28'N latitudes and 77°3' and 84°39'E longitudes. The state is the fourth largest state in the country in terms of area, and the first in the population (Figure 1). The climate of the state also vary widely - primarily due to it being far from the moderating effect of the sea and the occasional cold air arising due to western disturbances - with temperatures reaching as high as 49°C in summer, and as low as -1°C in winter. The rainfall of the state is heaviest in the plains of east and decreases it volume towards the north-west. The economy of Uttar Pradesh is the fourth largest of all the states of India. Geographically Uttar Pradesh is situated in one of the most fertile tracts of the country i.e. Ganga and Yamuna basin. Uttar Pradesh is the largest producer of food grains in India and accounted for about 18 per cent share in the country's total food grain production. Food grain production in the state was 51,252.7 thousand tonnes in 2017-18. Major food grains produced in the state include rice, wheat, maize, millet (bajra), gram, pea and lentils. Pulse production in the state is at 2,208.0 thousand tonnes in 2017-18 and production of vegetables is 28.23 thousand tonnes in 2017-18, the state remains largest producer of vegetables in India. This is partly due to the fertile regions of the Indo-Gangetic plain and partly due to irrigation facilities such as canals and tube-wells. The majority of the state's population depends upon farming activities. Uttar Pradesh is one of the most important states in India as far as horticulture is concerned and it is also a major producer of mangoes. There are about 8,000 km² of water bodies, including lakes, tanks, rivers, canals, and streams. The cultivable area of state is 24.17 million hectares (82.1% of total geographical area) and the net area sown is 16.57 million hectares (68.5% of cultivable area). The gross cropped area is 25.41 million hectare and the area sown more than once is 8.84 million hectare with the cropping intensity of 153.54 %. The net irrigated area is 13.31 million

hectare (25.18 % canals, 66.94% tube wells and 7.88% other sources). The gross irrigated area is 19.21 million hectare and the percentage of net irrigated sown area is 80.3%. The total numbers of land holdings are 224.57 lakhs out of which 175.07 lakh (78.0%) are marginal farmers, 31.03 lakh (13.8%) small farmers and 18.47 lakh (8.22%) farmers hold land above 2 hectare.

A large number of farmers of Uttar Pradesh state depend on animal husbandry for their livelihood. Livestocks sector plays an important role in rural economy through supply of milk, meat, eggs, wool, their castings (dung), etc, since time immemorial. Livestock production and agriculture are intrinsically linked to each other, and both are crucial for overall food security. Marginal, small and semi-medium farmers with average operational holdings of area less than 4 ha own more than 80 percent livestock of the state.

B. Agro-climatic zones of Uttar Pradesh

On the basis of major climates suitable for a certain range of crops and cultivars, the Uttar Pradesh State is divided in 9 Agro-climatic zones (Figure 2). Relevant information of the zones is given in Table 1.

Table 1. Description of Agroclimatic zones of Uttar Pradesh

S.No.	Agroclimatic zone	Districts covered	Total area (000 ha)	Mean Rainfall (mm)	Soil type
1	Bhabhar and Tarai zone	Saharanpur (58%), Muzaffarnagar (10%), Bijnor (79%), Moradabad (21%), Rampur (40%), Bareilly (19%), Pilibhit (75%), Shahjahanpur (6%), Kheri (39%), Bahraich (47%), Shrawasti (71%)	1847.3	1400	Alluvial, low to medium in phosphorus, medium to high in potassium and highly carbonized soils
2	Western Plain zone	Saharanpur (42%), Muzaffarnagar (90%), Meerut, Baghpat, Ghaziabad, Gautam Buddha Nagar, Bulandshahr	1637.4	795	Alluvial, pH value normal to sodic and low to medium carbonic soils
3	Mid western Plain zone	Bareilly (81%), Budaun, Pilibhit (25%), Moradabad (79%), J.P. Nagar, Rampur (60%), Bijnor (21%)	1697.1	1032	Almost alluvial normal to slight sodic and contains medium carbonic

4	South western semi arid zone	Agra, Firozabad, Aligarh, Hathras, Mathura, Mainpuri, Etah	2234.2	662	Alluvial and arawali.
5	Central plain zone	Shahjahanpur (94%), Kanpur Nagar, Kanpur Dehat, Etawah, Auraiya, Farrukhabad, Kannauj, Lucknow, Unnao, Rae Bareli, Hardoi, Kheri (61%), Sitapur, Fatehpur, Allahabad (58%) & Kaushambi	5647.3	863	Alluvial, pH value normal to sodic and low to medium carbonic soils
6	Bundelkhand zone	Lalitpur, Jhansi, Jalaun, Hamirpur, Mahoba, Banda and Chitrakoot	2961.0	867	Rakar, Parwa, Kabar and Maar
7	North eastern plain zone	Gorakhpur, Mahrajganj, Deoria, Kushinagar, Basti, Sant Kabir Nagar, Siddharthnagar, Gonda, Bahraich (63%), Balrampur and Shrawasti (29%)	2955.5	1240	Alluvial, calcareous
8	Eastern plain zone	Azamgarh, Mau, Ballia, Pratapgarh, Faizabad, Ambedkar Nagar, Barabanki, Sultanpur, Varanasi, Chandauli, Jaunpur, Ghazipur and Sant Ravidas Nagar (86%)	3808.7	803	Alluvial, sodic and Diarasoil
9	Vindhyan zone	Allahabad (42%), Sant Ravidas Nagar (14%), Mirzapur and Sonbhadra	1381.8	1134	Kali, Bhari red granules and alluvial soil in plane area

Source: Department of Land Resources, Ministry of Rural Development, Govt. of India

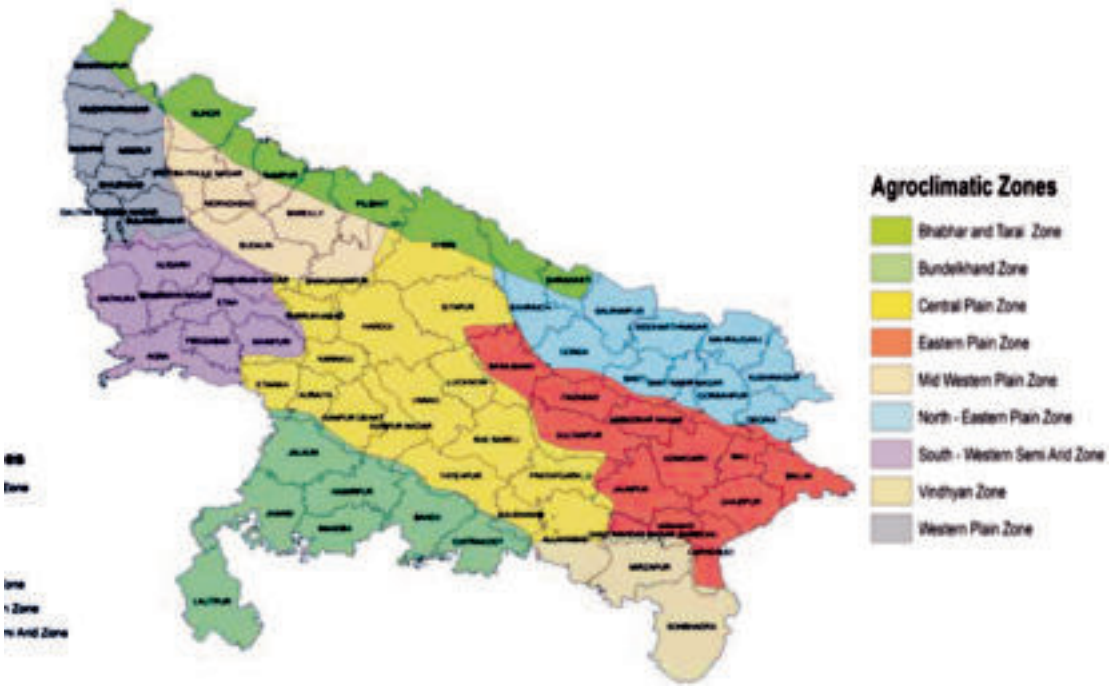


Figure 2. Agroclimatic zones of Uttar Pradesh

C. Interactive Workshop-IGFRI and State Department

As a step towards augmenting fodder production and its proper utilization for ensuring the fodder availability to the livestock in the state of Uttar Pradesh, ICAR-Indian Grassland and Fodder Research Institute, Jhansi in collaboration with the Animal Husbandry (AH), Govt. of Uttar Pradesh organized one day Workshop on "Fodder Production, Conservation and Utilization" at Directorate of Animal Husbandary, Lucknow on 13th December 2019. About 60 officers and other staff from different districts of Uttar Pradesh participated in this meeting (Figure 3).

The major agenda items of the workshop were on fodder plan for the state by looking in to the current fodder scenario in the state. A detailed and presentation were laso made on the modern methods of fodder conservation and fodder based ration for livestock. The Workshop was chaired by Mr. B.L. Meena, Principal Secretary, Livestock and Dairy Development, Govt. of Uttar Pradesh. Dr. Uttar Pradesh Singh, Director AH who highlighted the fodder related problems of Uttar Pradesh and showed his pleasure with the presence of IGFRI for development of fodder plan for the state. Mr. Meena expressed concern over fodder deficit scenario of the state. He stressed for adoption of recent technologies by the farmers and development of Model Fodder Production farms. He requested the Director IGFRI for grassland and pastures development on waste lands and imparts training to state government officers.

Dr. Vijay Kumar Yadav, Director, IGFRI, Jhansi presented the brief over view of fodder technologies available and stressed the state government officials to give suggestions for incorporation in the fodder plan of Uttar Pradesh. Dr. Yadav also suggested to conduct a training program for the Uttar Pradesh government officials in IGFRI, Jhansi where exposure to fodder technologies will be made to them. Dr. A K Dixit, Principal Scientist, presented the State Fodder plan for all 9 agro-climatic zones and discussed about advance fodder production technologies for arable land. Dr. RV Kumar, Head, GSM, explained in detail the technologies of silvi-pasture, horti-pasture and development of grassland on marginal lands. Dr. A K Misra, Head, PAR, stressed on fodder conservation and presented the technology for silage preparation. Dr. Purushottam Sharma, Principal Scientist, highlighted the social and economical benefits of forage production and feeding.

Dr. AK Singh, Additional Director, AH, presented the livestock and fodder status of the state. He envisaged that efficient land utilization, quality fodder seed and fodder production plan are key factors for improving fodder availability. Dr. SK Srivastava, Director, Disease Control and Farms, instructed all the farm managers of state fodder production farm to procure silo bags and ensiling machines with the help of IGFRI, Jhansi.

Figure 3. Interactive workshop at Lucknow

The salient recommendations emerged from the workshop has been incorporated in the preparation of fodder plan for the state. The detailed proceeding of the workshop is available in Annexure I.

D. Livestock Scenario

As per the 2019 livestock census, there are about 67784.8 thousand livestock population of which 18789.3 thousand were cattle, 33016.8 thousand buffaloes, 14480.0 thousand goats, 984.7 thousand sheep and 408.7 thousand pigs in Uttar Pradesh state (Table 2). As compared to previous livestock census of 2012, the latest census 2019 showed an increase in exotic/crossbred population by 64.6 percent and decrease in indigenous cattle by 19.3 percent whereas buffalo population increased by 7.8 per cent and goat population decreased by 7.1 (Table 3). The number of indigenous milch cows decreased by 6595.5 to 5589.2 thousand and exotic/crossbred milch cows increased 1659.8 to 2847.8 thousand, similarly the population of milch buffaloes increased from 13950 to 14621 thousand (Table 4). The milk production is mainly from buffaloes (19463 thousand tonnes) followed by cows (9691 thousand tonnes) and goat (1363.8 thousand tonnes) in Uttar Pradesh (Table 5). A marginal

increase was observed in per capita milk availability from 359 gm/day in 2017-18 to 371 g/day in 2018-19. The change in composition of dairy animals has also helped to sustain growth in milk production and the state is account about 16.3 percent of the total milk production of the country. Uttar Pradesh produced 30519 thousand tones of milk in 2018-19 but the productivity is a major concern (7.4 and 3.1 kg/day from cross breed/exotic and non-descriptive/indigenous breeds, respectively). The milk yield of an animal depends upon its breed and management practices. The poor quality of feed and fodder is also an important reason for the low yield of milk. In various agro-climatic zones of the state the feed available to the animals is of poor quality and lesser quantity. In order to get better yields of milk, the milch cattle must be supplied with right kind of feed and fodder. Fodder scarcity makes dairying uneconomical and unattractive as an income generation activity among the poor farmers of the country.

Table 2. Livestock population of Uttar Pradesh (census 2019)

Species	(Number in thousands)
Cattle	18789.3
Buffaloes	33016.8
Sheep	984.7
Goat	14480.0
Pig	408.7
Total	67784.8

Table 3. Comparative categorization of livestock population of Uttar Pradesh between 2012 and 2019 census

Year	Cattle						Buffaloes			Goat
	Exotic			Indigenous			Male	Female	Total	
	Male	Female	Total	Male	Female	Total				
2012	631.6	2947.5	3579.0	4275.6	11702.4	15978.1	4914.7	25710.6	30625.3	15585.6
2019	380.2	5512.1	5892.3	1667.8	11229.2	12897.0	2481.6	30535.0	33016.8	14480.0
% change	-39.8	87.0	64.6	-61.0	-4.0	-19.3	-49.5	18.8	7.8	-7.1

Table 4. Comparative categorization of in milch livestock population of Uttar Pradesh between 2012 and 2019 census

Year	Milch cows (Indigenous)	Milch cows (Exotic/CB)	Milch bufflaoes
2012	6595.0	1659.8	13950
2019	5589.2	2847.8	14621
% change	-15.2	71.6	4.8

Table 5. Milk production of Uttar Pradesh during 2018-19 (000 tonnes)

	Buffaloes	Cattle	Goat	Total
Milk production	19463	9691	1363.8	30519

Inspite of the large population of livestock in the state productivity remains very low. Some of the constraints for low productivity may be enumerated as i) absence of quality germ-plasm, as most of the animals are of non-descript breeds resulting in low productivity, ii) acute shortage of feeds and fodder, iii) high animal density, iv) small holding size limiting fodder cultivation, v) recurrence of flood and (vi) poor perception of the farmers towards livestock production as a viable alternative etc.

E. Fodder Scenario

The productivity of livestock is mainly dependent on green and dry fodder, the state has a shortage of green fodder and compounded feed to the extent of about 38 percent and 47 percent respectively. Fodder crops are the cheapest source of feed for livestock but the area under fodder cultivation (~767 thousand hectares in 2014-15) and permanent pastures and graizing lands (65 thousand ha), is not sufficient. The declining area and deteriorating quality of natural grassland has further compounded the problem.

Current requirement of green fodder in state is 1499.6 lakh tones, while the availability is only 1145.0 lakh tones. Thus the availability of green fodder is hovering around 76.4 percent in this decade (Table 6). If this supply is increased, the milk production in the state will also increase and the income of the farmers will also increase. The annual dry fodder requirement of Uttar Pradesh state is estimated around 735.1 million tonnes of which, only about 511.4 million tonnes is available which is about 69.6 % of the actual requirement. Occurrence of drought and flood are regular feature in many districts of the state which is further aggravating the deficit of feed and fodder. Despite this feed constraint, milk production in the state has exihibited increasing trend because of more dependence on concentrates which is much more costly than green fodder.

Table 6. Fodder availability in Uttar Pradesh

Type	Requirement (lakh tonnes)	Availability (lakh tonnes)	Availability (%)
Green	1499.6	1145.0	76.4
Dry	735.1	511.4	69.6

Source – Roy *et al.* (2019), Indian Fodder Scenario: Redefining state wise status

Looking at the vast gap between the demand and supply, it becomes necessary to put adequate efforts to transfer the potential technologies developed by various research organizations of the state and country to farmer's field in order to increase the production and productivity of good quality fodder. Therefore, there is an urgent need of development fodder security plan for round the year fodder supply in different agro-climatic zones of the state.

Part-II : Fodder Resource Development Plan

Strategies for enhancing fodder resources

Keeping in view the constraints in fodder production and in order to overcome the gap between demand and supply, a coordinated efforts needs to made for augmenting the fodder production. The high yielding and better nutritional varieties of fodder crops and fodder production models involving annual and perennial forages needs to be promoted and popularized. Likewsie the holistic approach of integrated resource management will be based on maintaining the fragile balance between productivity functions and conservation practices for ecological sustainability. Forage production must be taken up as a first management goal and 25% of the forest area should be put under trees with regulated accessibility to the farmers. It is suggested to grow forage grasses and fodder trees along village roads and panchayat lands, and on terrace risers/bunds - a non competitive land use system. Use of participatory techniques to identify the problems and to carry out the improvement programme along with In-depth studies on migratory graziers, forage based agroforestry systems and controlled grazing to maintain the productivity of pasture (grazing should be allowed as per carrying capacity) are some other solutions to this problem.

Details of different interventions are as under:

A. Cultivated fodder resources

The land under fodder crops and grazing lands/permanent pastures was about 7.67 lakh ha and 0.65 lakh ha, respectively during the year 2014-15. Since fodder cultivation is taken on very less area and due to this there is a very vast gap between demand and supply of green fodder. Hence it should be planned to bring at least 5% of the cultivated area under fodder crops. The net sown area of Uttar Pradesh is estimated at 165.73 lakh hectare ha. Thus 5% area comes to 8.29 lakh ha. With a cropping intensity of 154 % it must come to about 12.77 lakh ha to have a reasonable and sustainable fodder supply in the state. Of this, about 5.77 lakh ha should be brought under perennial fodder crops and 7.00 lakh ha under annual fodder crops. There is number of fodder crops suitable under different agro-climatic conditions of state. We have large basket of perennial grasses, range legumes, cultivated forage cereals & legumes. The crops like Bajra Napier hybrid, guinea grass, setaria, sorghum, maize, oat, cowpea, berseem, guar, etc are suitable for irrigated and arable land conditions whereas crops like Anjan grass, stylosanthes etc. are suitable for rainfed and non-arable land conditions. Crops like BN hybrid, guinea grass, etc being perennial in nature, once planted will be able to provide fodder for 3-4 years and won't need frequent sowing and investment on seed cost and land preparation and also with the inclusion of leguminous fodder in inter row space of perennial grasses, they can supply round the year green fodder. In view of stiff

competition with food & other commercial crops, forage varieties with tolerance in drought/water scarcity situations holds promise and can fit well in existing farming systems. These varieties can be very well adopted and promoted in suitable agro-climatic zones of the states. Fodder production requires identification of suitable fodder crops, varieties and production technologies depending on the agro-climatic conditions and needs of livestock keepers. In case of perennial fodder crops propagated through stem cuttings or roots, micro-nurseries may be developed in each block with 40000 rooted slips/ha and in 5 ha in each districts, in 2 years time there will be sufficient planting material for whole state. Likewise the seeds will be multiplied at each block to get sufficient seed for whole state in 2 years. The important fodder crops, varieties and seed/planting material requirement have been presented in Table 7.

Table 7. Suitable fodder crops, varieties and seed/planting requirement.

Zone/Fodder crops	Varieties	Seed/root slips/stem cuttings per ha	Average yield (t/ha/annum/)
Bhabar & Tarai Zone			
Maize	African tall, Pratap Makka Chari 6	40-50 kg/ha	35-80
Sorghum	Single cut: Pusa Chari hybrid-106, Pant Chari- 4, Pusa Chari 6, Pusa Chari -9, Pusa Chari -23, MP Chari, Pant Chari-3		
	Multicut: Pant Chari-5, SSG-988	20-30 kg/ha	35-40
Pearl millet	Single cut: Giant Bajra, Multicut: FBC-16	8-10 kg/ha	30-40
Cowpea	Bundel Lobia 1, Bundel Lobia 4	30-35 kg/ha	30-35
Oat	Bundel Jai 822, Bundel Jai 851, Bundel Jai 2009-1	80-100 kg/ha	35-40
Berseem	Wardan, Bundel Berseem 2	25-30 kg/ha	60-70
Bajra Napier Hybrid	IGFRI-5, 7, 10	28,000 nos. rooted slips/ha	70-100
Guinea grass	Bundel guinea 2	3-4 kg seed or 40,000 nos. rooted slips/ha	60-90
Western Plain Zone			
Maize	African tall, J-1006	40-50 kg/ha	35-80
Sorghum	Single cut: HC-308, Pant Chari- 3, Pant Chari- 4, Raj Chari-1, Raj Chari- 2, UP Chari 1, UP Chari 2, Pusa Chari 6, Multi cut: SSG- 898	20-30 kg/ha	35-50
Pearl millet	Single cut: Giant Bajra, multi cut: FBC-16	8-10 kg/ha	30-40
Cowpea	Bundel Lobia 1, Bundel Lobia 2	30-35 kg/ha	30-35
Guar	Bundel Guar- 3, Bundel Guar- 2	30-35 kg/ha	25-30
Oat	Bundel Jai 851, Bundel Jai 99-2,	80-100 kg/ha	35-40
Berseem	Wardan, Bundel Berseem 2,	25-30 kg/ha	60-70
Bajra Napier Hybrid	IGFRI- 7, 10	28,000 nos. rooted slips/ha	70-100
Guinea grass	Bundel guinea 2	3-4 kg seed or 40,000 nos. rooted slips/ha	60-90

Anjan grass	Bundel Anjan-3, Bundel Anjan-1	4 kg/ha	15-17
Mid Western Plain Zone			
Maize	African tall, Pratap Makka Chari 6,	40-50 kg/ha	35-80
Sorghum	Single cut: HC-308, Pant Chari- 3, Pant Chari- 4, UP Chari 1, MP Chari,		
	Multicut: Pant Chari-5 SSG-988 & 898	20-30 kg/ha	35-50
Pearl millet	Single cut: Giant Bajra,	8-10 kg/ha	30-40
	Multicut: FBC-16		
Cowpea	Bundel Lobia 1, UPC- 625, UPC - 618	30-35 kg/ha	30-35
Guar	Bundel Guar- 3, Bundel Guar- 2	30-35 kg/ha	25-30
Oat	Bundel Jai 851, Bundel Jai 2009-1	80-100 kg/ha	35-40
Berseem	Wardan, Bundel Berseem 3,	25-30 kg/ha	60-70
Bajra Napier Hybrid	IGFRI- 7, 10	28,000 nos. rooted slips/ha	70-100
Guinea grass	Bundel guinea 2	3-4 kg seed or 40,000 nos. rooted slips/ha	60-90
Anjan grass	Bundel Anjan-3, Bundel Anjan-1	4 kg/ha	15-17
South Western Semi-Arid Zone			
Sorghum	Single cut: HC-308, Pant Chari- 3, Pant Chari- 4, UP Chari 1 & 2, MP Chari, Pusa Chari 6	20-30 kg/ha	35-50
	Multi cut: Pant Chari-5		
Pearl millet	Single cut: AVKB -19, Giant Bajra, Raj Bajra Chari-2,	8-10 kg/ha	30-40
	Multi cut: FBC-16		
Cowpea	Bundel Lobia 1, UPC- 625	30-35 kg/ha	30-35
Guar	Bundel Guar- 3 , Bundel Guar- 2	30-35 kg/ha	25-30
Oat	Bundel Jai 851, Bundel Jai 99-2,	80-100 kg/ha	35-40
Berseem	Wardan, Bundel Berseem 2	25-30 kg/ha	60-70
Bajra Napier Hybrid	IGFRI- 7, 10	28,000 nos. rooted slips/ha	70-100
Guinea grass	Bundel guinea 2, Bundel guinea 4, PGG 14	3-4 kg seed or 40,000 nos. rooted slips/ha	60-90
Anjan grass	Bundel Anjan-3, Bundel Anjan-1	4 kg/ha	15-17
Marvel grass	JHD-13-2		
Central Plain Zone			
Maize	African tall, Pratap Makka Chari 6	40-50 kg/ha	35-80
Sorghum	Single cut: HC-308, Pant Chari- 3, Pant Chari- 4, Pusa Chari 6, UP Chari 1 & 2, MP Chari,	20-30 kg/ha	35-50
	Multi cut: Pant Chari-5		
Pearl millet	Single cut: Giant Bajra,	8-10 kg/ha	30-40
	Multicut: FBC-16		
Cowpea	Bundel Lobia 1, UPC 5286, UPC 9202,	30-35 kg/ha	30-35
Guar	Bundel Guar- 3, Bundel Guar- 2	30-35 kg/ha	25-30
Oat	Bundel Jai 822, Bundel Jai 851,	80-100 kg/ha	35-40
Berseem	Wardan, Bundel Berseem 2	25-30 kg/ha	60-70
Bajra Napier Hybrid	IGFRI- 7, 10, Hybrid Napier-3	28,000 nos. rooted slips/ha	70-100

Guinea grass	Bundel guinea 2, Bundel guinea 4 , PGG 14	3-4 kg seed or 40,000 nos. rooted slips/ha	60-90
Anjan grass	Bundel Anjan-3, Bundel Anjan-1	4 kg/ha	15-17
Marvel grass	JHD-13-2	4 kg/ha	15-17
Bundelkhand Zone			
Maize	African tall, Pratap Makka Chari 6	40-50 kg/ha	35-80
Sorghum	Single cut: HC-308, Pant Chari- 3, Pant Chari- 4,P usa Chari 6, UP Chari 1 & 2, MP Chari Multi cut: SSG 988	20-30 kg/ha	35-50
Pearl millet	Single cut: Giant Bajra, Multicut: FBC-16	8-10 kg/ha	30-40
Cowpea	Bundel Lobia 1, UPC 9202	30-35 kg/ha	30-35
Guar	Bundel Guar- 3, Bundel Guar- 2	30-35 kg/ha	25-30
Oat	Bundel Jai 822, Bundel Jai 851,	80-100 kg/ha	35-40
Berseem	Wardan, Bundel Berseem 2,	25-30 kg/ha	60-70
Bajra Napier Hybrid	IGFRI- 7, 10, Hybrid Napier-3	28,000 nos. rooted slips/ha	70-100
Guinea grass	Bundel guinea 2, Bundel guinea 4 , PGG 14	3-4 kg seed or 40,000 nos. rooted slips/ha	60-90
Anjan grass	Bundel Anjan-3, Bundel Anjan-1	4 kg/ha	15-17
Marvel grass	JHD-13-2	4 kg/ha	15-17
North Eastern Plain Zone			
Maize	African tall, Pratap Makka Chari 6	40-50 kg/ha	35-80
Sorghum	Single cut: HC-308, Pant Chari- 4, Pant Chari- 3, UP Chari 1 & 2, MP Chari Multi cut: SSG-988 & 898	20-30 kg/ha	35-50
Pearl millet	Single cut: Giant Bajra, Raj Bajra Chari-2, Multi cut: FBC-16	8-10 kg/ha	30-40
Cowpea	Bundel Lobia 1, UPC- 625	30-35 kg/ha	30-35
Guar	Bundel Guar- 3, Bundel Guar- 2	30-35 kg/ha	25-30
Oat	Bundel Jai 851, Bundel Jai 2009-1	80-100 kg/ha	35-40
Berseem	Wardan, Bundel Berseem 3	25-30 kg/ha	60-70
Bajra Napier Hybrid	IGFRI-5, 7, 10	28,000 nos. rooted slips/ha	70-100
Guinea grass	Bundel guinea 4, PGG 14	3-4 kg seed or 40,000 nos. rooted slips/ha	60-90
Anjan grass	Bundel Anjan-3, Bundel Anjan-1	4 kg/ha	15-17
Eastern Plain Zone			
Maize	African tall, Pratap Makka Chari 6	40-50 kg/ha	35-80
Sorghum	Single cut: HC-308, Pant Chari- 3, Pant Chari- 4, UP Chari 1 & 2, MP Chari Multi cut: Pant chari-5, SSG-988	20-30 kg/ha	35-50
Pearl millet	Single cut: AVKB -19, Giant Bajra, Raj Bajra Chari-2, Multi cut: FBC-16	8-10 kg/ha	30-40
Cowpea	Bundel Lobia 1, UPC- 625, UPC - 618	30-35 kg/ha	30-35
Guar	Bundel Guar- 3, Bundel Guar- 2	30-35 kg/ha	25-30
Oat	Bundel Jai 851, Bundel Jai 99-2,	80-100 kg/ha	35-40

Berseem	Wardan, Bundel Berseem 3	25-30 kg/ha	60-70
Bajra Napier Hybrid	IGFRI- 7, 10, Hybrid Napier-3	28,000 nos. rooted slips/ha	70-100
Guinea grass	Bundel guinea 4, PGG 14	3-4 kg seed or 40,000 nos. rooted slips/ha	60-90
Marvel grass	JHD-13-2	4 kg/ha	15-17
Vindhyan Zone			
Sorghum	Single cut: Pusa chari-6, 9 &23, Pusa Chari 6, UP Chari 1 & 2, MP Chari Multi cut: SSG-988 & 898	20-30 kg/ha	35-50
Pearl millet	Single cut: Giant Bajra, Multi cut: FBC-16	8-10 kg/ha	30-40
Guar	Bundel Guar- 3, Bundel Guar- 2	30-35 kg/ha	25-30
Oat	Bundel Jai 851, Bundel Jai 2009-1	80-100 kg/ha	35-40
Berseem	Wardan, Bundel Berseem 2	25-30 kg/ha	60-70
Bajra Napier Hybrid	IGFRI-5, 7, 10	28,000 nos. rooted slips/ha	70-100
Tri-Specific Hybrid	IGFRI TSH Selection	28,000 nos. rooted slips/ha	80-90
Guinea grass	Bundel guinea 1, Bundel guinea 2, PGG 14	3-4 kg seed or 40,000 nos. rooted slips/ha	60-90

Round the year fodder production system:

Intensive forage production systems are tailored with an objective of achieving high yield of green nutritious forage and maintaining soil fertility. Overlapping cropping system that comprises of raising berseem, inter-planted with Bajra Napier Hybrid/Guinea grass in spring and intercropping the inter-row spaces of the B-N Hybrid/Guinea grass with cowpea (Figure 4) during summer after the final harvest of berseem can supply green fodder round the year. Under assured irrigation multiple cropping sequences sorghum + cowpea - berseem + gobhi sarson - maize + cowpea and sorghum (multi-cut) + cowpea-berseem + gobhi sarson are promising for providing green fodder round the year. The fodder can also be knitted in existing food grain/ commercial production systems as these are equally or more remunerative. The detailed list of fodder based crop sequences for different agro-climatic zones of Uttar Pradesh is given in Table 8.

Figure 4. BN hybrid + cowpea round the year fodder prodcution system.

Table 8. Crop diversification and promising intercropping system.

Zone/Condition	Cropping system	Green Fodder yield (t/ha)
Bhabar & Tarai Zone		
Irrigated	Maize + cowpea - toria - oat	150-175
	NB Hybrid + (cowpea - berseem)	120-170

Western Plain Zone		
Irrigated	Multicut sorghum + cowpea - berseem/oat	150-170
	NB Hybrid + (cowpea - berseem - cowpea)	170-210
	Sorghum + cowpea - berseem - maize - cowpea	160-180
Mid Western Plain Zone		
Irrigated	Sorghum + cowpea - oat/berseem	130-140
	NB Hybrid + (cowpea - berseem)	150-175
South Western Semi-Arid Zone		
Irrigated	Sorghum/bajra + cowpea - berseem	150-170
	NB Hybrid/guinea grass + (cowpea - berseem)	110-160
Rainfed	Bajra/sorghum	40-50
	Pennisetum Tri Specific Hybrid + subabul (fodder sorghum + pigeon pea)	50-55
Central Plain Zone		
Irrigated	Sorghum + cowpea - oat/berseem/ barley	130-140
	NB Hybrid/guinea grass + (Cowpea - berseem)	110-160
Rainfed	Pennisetum Tri Specific Hybrid + subabul (fodder sorghum + pigeon pea)	50-55
Bundelkhand Zone		
Irrigated	Multicut sorghum + cowpea - berseem	150-170
	NB Hybrid/guinea grass + (cowpea - berseem)	110-160
Rainfed	Pennisetum Tri Specific Hybrid + subabul (fodder sorghum + pigeon pea)	50-55
North Eastern Plain Zone		
Irrigated	Multicut sorghum + cowpea - berseem	150-170
	NB Hybrid + (cowpea - berseem)	130-160
Rainfed	Sorghum - lathyrus	60-70
Waterlogged	Para grass	70-80
Eastern Plain Zone		
Irrigated	Sorghum + cowpea - oat/berseem	130-140
	NB Hybrid + (cowpea - berseem)	110-160
Rainfed	Rice- lathyrus/berseem	35-50
Vindhyan Zone		
Irrigated	Multicut sorghum + cowpea - berseem/oat/ barley	110-140
	NB Hybrid/guinea grass+ (cowpea - berseem)	110-140
Rainfed	Pennisetum Tri Specific Hybrid + subabul (fodder sorghum + pigeon pea)	50-55

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

The arable farming on degraded land in the state is difficult due to soil and moisture constraint. There are various alternate land use (ALU) systems which provide fodder such as silvi-pasture (tree + pasture), horti-pasture (fruit trees + pasture, figure 5) and agri-horti-silvipasture (crop + fruit trees + MPTS + pasture). Many multipurpose tree species (MPTS)/shrubs growing in ALU systems are useful as leaf fodder used for animal feed besides wood. These activities contribute significantly to domestic livestock production, which in turn influences milk and meat supply and contributes to household income. Grazing animals with MPTS trees provide not only nutritious fodder but shelter to the animals during bright and hot sunny days. In Uttar Pradesh, leaves of tress species grown in agroforestry are being used as leaf fodder mostly for small ruminant and for large ruminant during lean period or during fodder scarcity and under climatic abnormalities. There is ample scope and many opportunities for introducing fodder crops in existing orchards. Hortipasture system integrates pasture (grass and /or legumes) and fruit trees to fulfill the gap between demand and supply of fruit, fodder and fuel wood through utilizing moderately degraded land (Table 9). Aonla and guava based hortipasture systems have been developed for higher forage productivity. The range grasses tried in the system were *Cenchrus ciliaris*, *Stylosanthes seabrana* and *Stylosanthes hamata*. In Uttar Pradesh, mango is grown in 0.25 mha area in different agro-climatic zones which if put under fodder crops (Bajra Napier Hybrid, guinea grass, perennial sorghum and stylosanthus) can produce a huge quantity of green fodder which can fulfill the round the year requirement of green fodder of our live stock. The common mango planting distance followed is 10 m x 10 m which gives minimum 7-8 m inter row space for introducing fodder crops. These mango orchards can be utilized for additional fodder production of state.

Table 9. Fodder production from Non arable lands

Hortipasture	Mango/Anola/Guava/Bel + Guinea grass/perennial sorghum
	Mango/Anola/Guava + *Cenchrus ciliaris, Stylosanthes seabrana* and *Stylosanthes hamata*
Silvipasture/Grassland	*Leucaena leucocephala/Melia azadirach,* + *Cenchrus ciliaris, Stylosanthes seabrana* and *Stylosanthes hamata*
	Leucaena leucocephala + NB hybrid
	Leucaena leucocephala + Guinea grass

Horti-pasture systems developed at ICAR-IGFRI have good production potential of forage from 6.5-12 t DM/ha on degraded land of rainfed areas. Horti-pasture systems can serve the purposes of forage, fruit and fuel wood and ecosystem conservation along with arresting the soil loss and conserve moisture. After a long rotation it improves the soil fertility and microbial activities. This system supports 2-4 ACU /year.

Figure 5. Fodder production from guava orchard

C. Fodder Production from permanent pasture/grazing lands

Rangelands are extensive areas which are unfit for arable farming and are mostly under natural vegetation where animals graze. These vast areas could be developed as model grassland with increasing production potential with rich genetic diversity of forage plant species in different eco-climatic conditions and a variety of habitats and niches. In the state of Uttar Pradesh there is about 0.65 lakh ha area is under permanent pasture/grazing which are presently in very poor and degraded conditions. Rejuvenation and replanting with suitable grass species like graizing guinea, anjan grass, stylosanthes, etc. through seed pellets or by sowing can provide cheaper source of green fodder and will also to livestock keepers in reducing production cost substantially (Figure 6).

Figure 6. Silvipasture on CPRs

D. Fodder on non-competitive lands

Perennial grasses like anjan grass, guinea grass etc can also be promoted in other niches like farm pond embankments, bunds, uncultivated farm lands, in orchards, rain water outlets etc to meet the green fodder at farm level (Figure 7). Introducing perennial cultivated grasses on farm bunds along with irrigation channels involves growing of 2 rows of Bajra napier hybrid / guinea grass along with field boundary can supply 7-11 q green fodder per 100 m length of boundary per year which can support milch animal of livestock keepers without any additional expenditure Total number of land holdings in Uttar Pradesh is 23.33 million with an average size of 0.76 ha which gives an opportunity to grow fodder on their bunds/ boundary. Table 10 indicates the fodder production potential of bunds in the Uttar Pradesh state.

Table 10. Fodder production potential under different size of land holdings in Uttar Pradesh

Size of holding	Total holding number ('000)*	Average size of holding (ha)*	Total bund length per holding (m)#	Per holding available bunds length for use (m)#	Potential of green fodder production per holding (q)#		Green fodder production (,000 t)**	
					@7kg GF/m	@11kg GF/m	@7kg GF/m	@11kg GF/m
Marginal (<1 ha)	18532.3	0.39	248	124	8.7	13.6	1612.3	2520.4
Small (1-2 ha)	3035.3	1.40	472	236	16.5	26.0	500.8	789.2
Semi-medium (2-4 ha)	1334.3	2.72	660	330	23.1	36.3	308.2	484.4
Medium (4-10 ha)	398.3	5.52	940	470	32.9	51.7	131.0	205.9
Large (>10 ha)	25.3	15.01	1548	774	54.2	85.1	13.7	21.5
All classes	23325.5	0.76	348	174	12.2	19.1	2845.7	4455.2

Source: *Agricultural Census Database, 2010-11, Ministry of Agriculture and Farmers Welfare, Govt. of India #based on calculations ** If only 10 % holdings kept under fodder under bund technology

Figure 7 : Guinea grass planted on bunds

E. Alternative fodder resources

There is a need for exploring the alternative or non-conventional fodder resources such as cactus, fodder beet, lathyrus, fodder sugarcane, moringa, azolla, hydroponics grown fodder. Azolla and hydroponics grown fodder could be an ideal source of fodder and required lesser land area but they are labour intensive activities and less remurative. These could a better option when the house-hold labourer is involving in production of fodder and animal feed. However, these can be supplementary in nature and cannot be substituted with the traditional fodder production methods.

a. Moringa source of quality protein

Moringa is a good alternative for substituting commercial rations for livestock. The

relative ease with which moringa can be propagated through both sexual and asexual means, it demands lesser soil nutrients and water, and easy to produce. Its high nutritional quality and better biomass production, especially in dry periods, support its significance as livestock fodder. Moringa (Figure 8) planted at ICAR-IGFRI, Jhansi at 50x50 cm spacing gave 80-130 t green forage/ha in 4 cuts at 45 days harvest intervals in 2nd year of planting. Moringa leaves contain 21.53% crude protein, 24.07% acid detergent fiber (ADF) and 17.55% neutral detergent fiber (ADF). One of its main attribute is its versatility, because it can be grown as crop or tree fences in alley cropping systems, in agroforestry systems and even on marginal lands with high temperatures and low water availabilities.

Figure 8: Moringa plantation for leaf meal production

b. Azolla as an alternate fodder

Azolla farming (Figure 9), in general, is inexpensive and it can be multiplied in natural water bodies for production of biomass. Biomass productivity is dependent on time and relative growth rate and efficiency of the species. 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 upto 37.8 t fresh weight/ha (2.78 t DM/ha dry weight).

Figure 9: Azolla production unit

c. Hydroponic rapid 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 cow peas. It may fit for those producers who do not have local sources for forage. HPF may offer a ready source of palatable feed for small animal producers (poultry, piggery, goat. rabbits). It 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 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.

Figure 10: Cactus and cowpea intercropping at IGFRI, Jhansi

d. Cactus as an alternate fodder

Cactus commonly known prickly pear, could be an alternate fodder crop under moisture stress environment and resource poor farmers of Uttar Pradesh. The cactus can be grown as an intercrop under wider row crops. This crop can grow under severly degraded soils, which are not suitable for other crops. The crude protein content is about 5 to 10%, cattle and goat can feed 50 to 70 kg and 6 to 8 kg of fresh cladoes per day (Figure 10).

F. Crop residue quality enhancement

The wheat, paddy, sorghum, bajra, maize, chickpea, urd, sugarcane, potato, etc are important crops of the Uttar Pradesh state in which wheat and paddy straw and stover of millets are major source of dry fodder in the state. The paddy straw is low in protein content, low in palatability, digestibility and incapable to support even maintenance requirement of the adult ruminants, if fed as such. Urea treatment offers an opportunity to transform crop residues of poor quality into a valuable feed resource by refining it for rapid adoption at farmer's level for greater economic reward (Figure 11). Urea treatment of straw increases its N content resulting into enhanced microbial activity and ruminal digestion of the straw. In addition, urea treatment also exerts its effect on lingo-cellulose complex, wherein the lignin forms the complex with cellulose, thus preventing

Figure 11: Enrichment of crop residues with Urea: Mechanized urea treatment during threshing operations

its microbial digestion. Urea also acts as preservative and application of urea solution on the straw and subsequent storage of treated straw would ensure the proper unspoiled storage. The use of a cheap source of nitrogen such as urea to improve the nitrogen content of such roughages makes a promising alternative to improve the nutritive value of straw. Further spray of salt and mineral mixtures will also enhance the palatability and nutritive value of dry fodders.

G. Fodder conservation technologies – Hay, bales, silage, feed block

In recent times due to frequent droughts, failure of crops and non-availability of fodder has forced everybody into thinking of fodder conservation. 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. **Hay/ Bales:** Although it is common practice, necessary training is needed to ensure long keeping quality of the hay material. Further the dry fodder being voluminous in nature often needs larger space and pose problems in transportation. Hence pressing dry fodder in to bales to reduce keeping space and ease transportation has been found to be more necessary 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.

b. **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. Different methods of sillage making are given in the Figure 13. Silage making may be recommended in Uttar Pradesh. 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, oat, BN hybrid grass, guinea grass, setaria, pineapple stover, sugarcane tops and potato halm. Sucargane and potato are the major crops of Uttar Pradesh, and their tops and hulm respectively can be useful for making silages in different parts of the state (Figure

Trench silo

Stack of the silage

Silage preparation in plastic bags

Figure 12: Different methods of sillage making

c. **Feed Block:** Bale making or feed block making could be good strategies 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.

Figure 13: Silage from different range grasses developed by IGFRI, Jhansi

H. Custom hiring centre

List of equipments can be brought under custom hiring in Uttar Pradesh (Table 11)

Table 11. List of List of equipments can be brought under custom hiring in Uttar Pradesh

Prime Movers or General Machines	Land preparation/ Tillage machine	Sowing/Transplanting machine/ Intercultural machines	Harvesting Machines
Prime movers (i) Tractor 2WD (above 20-40 PTO HP) (ii) Tractor 4WD (above 20-40 PTO HP) (iii) Tractor 2WD (above 40-70 PTO HP) (iv) Tractor 4WD (above40-70 PTO HP) **General machines** (i) Post hole digger (ii) Tractor operated laser guided land leveler	(i) Disc Plow (ii) Cultivator (iii) Disc harrow (iv) leveler blade (v) Cage wheel (vi) Furrow opener (vii) Ridger (viii) Weed Slasher (ix) Bund former (x) Crust breaker (xi) Roto-puddler (xii) Roto-cultivator	(i) Zero till seed cum fertilizer drill (ii) Potato Planter (iii) Multi crop planter (5tines) (iv) Ridge furrow planter (v) Pneumatic planter (vi) Self-propelled rice transplanter (8-12 rows) (vii) Pneumatic vegetable transplanter (viii) Plastic Mulch Laying Machine (ix) Raised Bed Planter with inclined plate planter and shaper attachment. (5-7tines) (x) Grass Weed Slasher (xi) Power Weeder	(i) Potato Digger (ii) Tractor drawn crop reaper/ reaper cum binder (iii) Rice straw chopper (iv) Crop Reaper cum Binder (3 wheel) (v) Crop Reaper cum Binder (4 wheel) (vi) Power Weeder (engine operated below 2 bhp) (vii) Power Weeder (engine operated above 2 bhp) viii) Power Weeder (engine operated above 5bhp) (ix) Power operated horticulture tools for pruning budding, grating, shearing etc. (x) Groundnut digger shaker (xi) Groundnut thresher (xii) Sugarcane trash cutter (xiii) Multi crop thresher (for wheat and paddy) (xiv) Combined harvester (xv) Straw combine xvi) Flail harvester

Part-III : Brief Action Plan

i. Identification of areas for propagating fodder production

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

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

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

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

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

iv. Providing package of practices for fodder crops

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

v. Master trainers training at IGFRI/SAUs

The staff of Dept. of Animal Husbandry, Vetenary, Agriculture, Horticulture, Forestry etc. from the Govt. of Uttar Pradesh having aptitude to work for augmenting fodder resources will be identified through their superiors in the first stage as master trainers. And they will be offered intensive need based training programme at IGFRI, Jhansi. The number of participants, the duration of the training programme and the topics of training programme will be finalized after discussion with the Head of the line department, Govt. of Uttar Pradesh.

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

There are 84 Krishi Vigyan Kendras (KVKs) operating in the state of Uttar Pradesh. They will be roped in to identify the needy farmers for training on fodder

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

vii. Conduction of frontline demonstration and training

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

viii. Strengthening of forage seed production chain

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

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

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

x. Enhance acreage and productivity in non-conventional areas

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

a. Production of fodder in non-arable land, wasteland.

b. Production of fodder in problem soils.

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

d. Enhancing production through alternate land use management such as horti-pasture- silvi-pasture etc.

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

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

xii. Establishment of fodder banks

At times livestock holder are faced with fodder scarcity owing to natural calamities, unforeseen failure of crops and it poses a great threat to sustainable animal husbandry and dairying. To tide over such situation of fodder scarcity, efforts will be made to educate the policy makers, heads of line departments to establish fodder banks at village clusters or tehsils for ensuring the supply of minimum quantity of fodder to livestock keeper so that the animals are forces to go hungry. In addition, establishment of fodder ware houses with enriched dry fodder or silage bins will also be popularized.

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

Any isolated efforts to augment fodder resources may not be sustainable in long run owing to some unforeseen situations in future. And hence, networking of fodder producers, fodder entrepreneurs, heads of line departments will be made for foreseeing at the grass root level. Likewise, networking of ICAR Institutions viz. IGFRI, NIANP, NDRI, IVRI, IIVR, IIPR, IISR, etc., Department of Animal Husbandry and Veterinary Services of the state and central govt., Milk Federations and Dairy owners etc., will be established to supervise and evolve a mechanism to attend to problems associated with technologies and forth coming issues in future.

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

Although the initial stage of programme is hovering around the government agencies involved in various aspects of fodder production, processing, conservation, utilization, rationing, policy making, etc. the ultimate end user will

be common farmers. Further there are several private players viz. dairy owners, animal pharma industries, feed manufactures, NGOs involved in livestock production and dairying etc. They will all be brought together under Public-Private Partnership (PPP) mode in more transparent, efficient and economical way for all the partners.

xv. Impact analysis of technology adoption

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

Part-IV : Road Map

This project is conceived to be multi-task, multi-partner and multi-year activity. Hence a proper road map is necessary for making it more practical and result oriented one. The following road map has been proposed under this project. There are several actions points to be carried out in the process of implementation by several agencies (Table 12).

Table 12: Road map for the implementation of the proposed activities

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

The programme implementation 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 14.

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 (9). **The list of selected/identified Aspirational** districts on the basis of dry matter requirement and availability in different agro-climatic zones of Uttar Pradesh is given in the Table 13.

Table 13. Agro-climatic zone wise selected/identified district

S.No.	Agro-climatic zone	Identified district
1	Bhabhar and Tarai zone	Bijnour
2	Western Plain zone	Bulandshahar
3	Mid western Plain zone	Budaun
4	South western semi arid zone	Aligarh
5	Central plain zone	Kheri
6	Bundelkhand zone	Jalaun
7	North eastern plain zone	Gonda
8	Eastern plain zone	Barabanki
9	Vindhyan zone	Mirzapur

The detailed plan for implementation of pilot project is presented in the Table 14.

Table 14. Implementation level plan for pilot project

Sl.No.	Activity	Action points
1	Target area selection	• Selection of 9 districts (1 from each agroclimaic zone) of Uttar Pradesh • Selection of 2 cluster of 5 villages in each district total 18 clusters for 9 districts • Selection of 1 to 2 ha in each cluster for technology demonstrations • Bench mark survey
2	Training	• Training of master trainers- 25 master trainers per batch and 1 batch from each district at IGFRI, Jhansi • Training of farmers; 10 from each village; 900 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 located in Uttar Pradesh 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 should be encouraged • Since crop residue being a precious commodity, fodder banks using densification technologies can be developed
4	Suitable silvi-pasture/ horti-pasture system demonstrations	• In existing Orchard- 1 ha (Guinea, Grazing Guinea) • In new Orchard - 1 ha (Guinea, Grazing Guinea) Popular and potential fodder trees Moringa can be a potential source of legume fodder in upland areas and may be explored
5	Need based Watershed/ micro irrigation facility development	• Suitable fodder species viz. grazing guinea, signal grass, etc to check soil and water erosion and enhancing water retention will be highlighted.
6	Rejuvenation of grasslands/ pasturelands/ CPRs	• The related activities will be taken up during post rainy season /with first rabi rains
7	Tapping rice fallow and other fallow areas for fodder production	• Suitable annual fodder crops viz. fodder cowpea, oats etc. will be grown on residual moisture to ensure fodder supply during the period
8	Input supply	• Inputs viz. seeds/ rooted slips/, Fertilizers, insecticides etc, small machinery and tools - improved sickles etc. will be supplied to farmers
9	Custom hiring centre in each village cluster	• Exploring and facilitating the farmers with chaff cutter, Bhusa urea enriching machinery, baling of paddy straw, dry fodder etc, complete feed block making machine, regular farm implements including tractors, harrow, seed drill etc.

Funding arrangements

Govt. of Uttar Pradesh, 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 15.

Table 15. Approximate budget requirement for the implementation of pilot progamme.

(Rs in Lakhs)

Item	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Training (Master trainer/ farmers/ stakeholders)	18.0	18.0	18.0	12.0	12.0	78.0
Exposure visit of farmers / stakeholders	13.5	13.5	13.5	4.5	4.5	49.5
Seed/ Planting material	18.0	18.0	4.5	4.5	4.5	49.5
Micro Irrigation facilities	18.0	18.0	13.5	13.5	4.5	67.5
Other farm inputs small equipments etc	18.0	12.0	12.0	4.5	4.5	51.0
Custom hiring center equipments	105.0	45.0	4.5	4.5	4.5	163.5
TA/DA/ staff (SRF/YP/RA) / Consultancy/ Miscellaneous etc.	30.0	30.0	21.0	21.0	21.0	123.0
Total	220.5	154.5	87.0	64.5	55.5	582.0

(Rupees five Crore Eighty two Lakhs only)

Part-VI : Modalities

This programme is undertaken to enhance the fodder production, conservation and utilization on more sustainable basis in different fodder deficit districts of Uttar Pradesh. 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 & VS, Dept. of Horticulture, Dept. of Forestry etc, Govt. of Uttar Pradesh along with KVKs, NGOs, Milk Federation etc. Will implement the programme at field and farmers level.

Annexure-I

दिनाँक 13 दिसम्बर, 2019 को पशुपालन निदेशालय, उ.प्र., लखनऊ के प्रशासनिक भवन स्थित सभाकक्ष में प्रमुख सचिव, पशुधन की अध्यक्षता में सम्पन्न चारा उत्पादन, उपयोग एवं संरक्षण विषय पर आयोजित एक दिवसीय कार्यशाला का कार्यवृत्त।

सर्वप्रथम कार्यशाला की अध्यक्षता कर रहे प्रमुख सचिव, पशुधन, उ.प्र. शासन महोदय द्वारा उपस्थित भारतीय चरागाह एवं चारा अनुसंधान संस्थान, झाँसी के निदेशक एवं संस्थान के वैज्ञानिकों का पुष्पगुच्छ भेंट कर स्वागत किया गया। तत्पश्चात् कार्यशाला में प्रतिभाग कर रहे राजकीय पशुधन एवं कृषि प्रक्षेत्रों एवं चारा संवर्ग के अधिकारियों/कर्मचारियों का परिचय प्राप्त कर कार्यशाला का शुभारम्भ किया गया।

प्रमुख सचिव, पशुधन द्वारा प्रदेश में चारे की स्थिति को लेकर चिन्ता व्यक्त की गयी। चारा उत्पादन हेतु चारा क्षेत्र में नवीन अनुसंधानों, प्रसार कार्यक्रमों को कृषकों/पशुपालकों के बीच विस्तार करने एव अपनाने पर जोर दिया गया। विभागीय पशुधन प्रक्षत्रों पर नवीन चारा उत्पादन तकनीकी को अपनाते हुए उसे माडल प्रक्षेत्र बनाने के निर्देश दिये गये। गौशालाओं के तकनीकी विस्तार के सम्बन्ध में प्रमुख सचिव महोदय द्वारा चर्चा की गयी जिसके अन्तर्गत गौशालाओं का फॉडर प्लॉन, फॉडर कलेण्डर एवं प्रदेश में स्थित गौशालाओं की बेकार भूमि के सुधार हेतु निदेशक, भारतीय चरागाह एवं चारा अनुसंधान संस्थान, झाँसी से अनुरोध किया गया। उप निदेशक (प्रक्षेत्र), पशुपालन विभाग, उत्तर प्रदेश, लखनऊ को प्रक्षेत्रों की परती/ऊसरीली/पथरीली भूमि पर चारागाह विकसित करने के सम्बन्ध में संस्थान के वैज्ञानिकों की सहायता ली जायें एवं सभी प्रक्षेत्रों से कृषि संवर्ग के अधिकारियों/कर्मचारियों को संस्थान से प्रशिक्षण दिलाया जायें जिससे कि प्रक्षेत्रों पर पूरे वर्ष भर हरे चारे की उपलब्धता बनी रहें, साथ ही राजकीय पशुधन एवं कृषि प्रक्षेत्र, सैदपुर–ललितपुर पर आँवला के बाग में चारा घास एवं हस्तिनापुर प्रक्षेत्र पर ढ़लान वाले क्षेत्र में पैरा घास लगायी जाय, प्रमुख सचिव महोदय द्वारा निर्देश दिये गये।

निदेशक, भारतीय चरागाह एवं चारा अनुसंधान संस्थान, झाँसी, द्वारा संस्थान की स्थापना सन् 1962 में चारा उत्पादन सम्बन्धी नवीन प्रौद्योगिकी को कृषकों तक पहुँचाने के उददेश्य से किया गया है, से अवगत कराया गया। प्रदेश में पायी जाने वाली बुंदेलखण्डी बकरी को एक प्रजाति के रूप में पंजीकृत करवाये जाने, संस्थान द्वारा चारे की विकसित 226 उन्नति प्रजातियों के बारे में भी अवगत कराया गया। नई विकसित जई की किस्म बुन्देल जई–2015–1 एवं बाजरा तथा जगली बाजरा के संकरण से तैयार नई किस्म को जो उस दशा में भी सफलतापूर्वक उगायी जा सकती है जहाँ पर पानी की कमी है, पर चर्चा की गयी। अन्य चारे की तुलना में इस नई चारे की किस्म में अत्यधिक मात्रा में प्रोटीन एवं शुष्क पदार्थ पाया जाता है भी बताया गया। डॉ. यादव द्वारा अवगत कराया गया कि संस्थान पर सभी परिस्थितियों में चारा उत्पादन हेतु एकवर्षीय एवं बहुवर्षीय चारा फसलों के साथ अन्य फसलों की अर्न्तवर्ती खेती के माडल विकसित किये गये है। वन चरागाह पद्धति, आदर्श चरागाह, मेड़ों पर चारा उत्पादन, फलों के बगीचों में चारा उत्पादन, जंगली क्षेत्रों में, गौ–आश्रय केन्द्रों एवं पथरीली भूमि पर चारा घास लगाकर चारा उत्पादन किया जा सकता है। जनपद–ललितपुर के परिंदा गाँव में 65.00 हेक्टैयर क्षेत्रफल में संस्थान के वैज्ञानिकों द्वारा चारा विकास कार्यक्रम चलाया जा रहा है, जिसे देखकर अन्य कृषक/पशुपालक भी लाभ उठा सकते है, के बारे में जानकारी दी गयी। प्रमुख सचिव के द्वारा फाडर

प्लान तैयार किये जाने के सम्बन्ध में अवगत कराया गया कि संस्थान अपनी चारा उत्पादन सम्बन्धी तकनीकी जानकारी उपलब्ध करा सकता है जिसके लिये बजट आदि की व्यवस्था पशुपालन विभाग को स्वयं करनी होगी।

अन्य राज्यों की तुलना में उत्तर प्रदेश में ब्रीडर सीड की माँग बहुत कम रहती है जिसके सम्बन्ध में सलाह दी गयी कि आगामी 05 वर्षों का सीड प्लॉन तैयार करने के उपरान्त ब्रीडर सीड की माँग प्रेषित करें। प्रदेश एवं गौशालाओं हेतु एक माह में चारा उत्पादन योजना तैयार कर मुख्य सचिव, उ.प्र. शासन को उपलब्ध कराने हेतु निदेशक, भारतीय चरागाह एवं चारा अनुसंधान संस्थान, झाँसी, द्वारा प्रतिबद्धता व्यक्त की गयी।

प्रधान वैज्ञानिक डॉ. ए.के. दीक्षित द्वारा प्रदेश के सभी 09 एग्रोक्लाइमेटिक जोन के लिए फाडर एक्सन प्लान पर विस्तारपूर्वक चर्चा की गयी। पूरे वर्ष भर हरे चारे की उपलब्धता बनाये रखने के लिए फाडर प्लान में बहुवर्षीय चारा फसलों को फसल चक्र में सम्मिलित कर चारा उत्पादन पर जोर दिया गया। डॉ. दीक्षित द्वारा गेहूँ की नयी प्रजाति वी.एल.–829 हरे चारे एवं दाने के लिए अपनाये जाने पर बताया गया, जिसकी बुवाई के 60 दिन बाद प्रथम कटाई चारे के रूप में कर दाने के लिए उपयोग में लाया जा सकता है। बरसीम की फसल में तराई क्षेत्र में कम उत्पादन के लिए जड सडन रोग के लिए जिम्मेदार बताया गया। बरसीम में इस समस्या से निजात पाने के लिए रोगरोधी किस्मों को अपनाने एवं बरसीम बीज का रासायनिक उपचार करने के साथ इसकी अन्तिम कटाई 25 फरवरी से 7 मार्च के मध्य करने पर जोर दिया गया।

वरिष्ठ वैज्ञानिक डॉ. आर.वी. कुमार द्वारा ग्रासलैण्ड एवं पाश्चर डेवलेपमेन्ट विषय पर विस्तार से चर्चा की गयी। इनके द्वारा बेकार पडी भूमियो पर चारा वृक्षों/झाड़ियों के साथ–2 चारा घास (नैपियर/गिनी/अंजन घास) को सम्मिलित कर एक साथ उगाने की तकनीकी पर प्रकाश डाला गया। इनके द्वारा जलमग्न भूमियो के लिए पैरा घास के उत्पादन पर जोर दिया गया। कार्यशाला में वन चारागाह पद्यति, आदर्श चरागाह, मेड़ों पर चारा उत्पादन, फलों के बगीचों में चारा उत्पादन, जंगली क्षेत्रों में, गौ–आश्रय केन्द्रों एवं पथरीली भूमि पर चारा घास लगाकर चारा उत्पादन की जानकारी दी गयी।

डॉ. ए.के. मिश्रा, वरिष्ठ वैज्ञानिक द्वारा चारे के संरक्षण एवं चारा आधारित राशनिंग पर प्रकाश डाला गया। चारे के संरक्षण हेतु मक्का, ज्वार, जई आदि से साइलेज तैयार करने की विधि पर विस्तारपूर्वक चर्चा की गयी। साइलेज बनाने के लिए मक्के/ज्वार की फसल को 50 प्रतिशत पुष्पावस्था में कटाई कर जब उसमें शुष्क पदार्थ की मात्रा 30 प्रतिशत या अधिक हो तथा शर्करा की मात्रा 7 प्रतिशत से अधिक हो, कटाई के लिए उत्तम होती है। औद्यानिक वृक्षों के मध्य चारा फसलों के उत्पादन से चारा प्राप्ति के साथ–2 उद्यान फसलों की पैदावार में 20–25 प्रतिशत वृद्धि होने के सम्बन्ध में बताया गया। साईलेज बनाने एवं उसकी उपयोगिता के सम्बन्ध में विस्तार से अवगत कराया गया। लीन पीरियड में जब हरे चारे की कमी होती है तब साईलेज की महत्ता बढ़ जाती है। साईलेज में हरे चारे के तत्वों को मूलरूप में सुरक्षित रख कर उपयोग में लाया जा सकता हैं। साईलेज बनाते समय दो प्रकार की किण्वन क्रिया (Fermentation) होती हैः– (1) Lactic Acid Type Fermentation (2) Butyric Acid Type Fermentation. साईलेज बनाते समय चारा फसल में शर्करा, प्रोटीन एवं शुष्क पदार्थ की मात्रा बहुत ही महत्वपूर्ण कारक है। साईलेज बनाते समय वायु, नमी (75 प्रतिशत से

अधिक) एवं प्रोटीन की अधिकता में शर्करा के किण्वन के समय Butyric Acid Type Fermentation जिसे Clostridial Fermentation भी कहा जाता हैं, होने के फलस्वरूप ब्यूटाईरिक एसिड उत्पन्न होता है जिसके कारण साईलेज में दुर्गन्ध आने लगती है। अतः साईलेज बनाने के लिये उपयोग में लायी जा रही चारा फसल में शुष्क पदार्थ (30 प्रतिशत से अधिक), शर्करा की मात्रा (7.0 प्रतिशत से अधिक), प्रोटीन की मात्रा (8.0 प्रतिशत से कम), नमी (55–75 प्रतिशत) तथा वायुरहित होना अति–आवश्यक हैं। मक्का एवं जई की फसलें भी साईलेज बनाने के लिये उपयुक्त होती है। यह भी अवगत कराया गया कि साईलेज बनाने हेतु साईलो–बैग बाजार में उपलब्ध है, जिनमें साईलेज बनाकर सुरक्षित रखा जा सकता हैं। इसके अतिरिक्त साईलो–बेल बनाने की मशीनें भी उपलब्ध हैं। साईलो–बैग में साईलेज बनाते समय इस बात का विशेष ध्यान रखा जाये कि चारा भरने के उपरान्त बैग वायुरहित कर दिया जायें। डॉ. मिश्रा द्वारा गन्ने के अगोले से साईलेज बनाने के सम्बन्ध में चर्चा की गयी तथा अवगत कराया गया कि गन्ने के अगोले से भी साईलेज बनाया जा सकता हैं।

प्रधान वैज्ञानिक डॉ. पुरूषोत्तम शर्मा द्वारा चारा उत्पादन हेतु सामाजिक–आर्थिक पहलुओं पर प्रकाश डाला गया। यह भी अवगत कराया गया कि संस्थान द्वारा 04 मोबाइल एप्पस लांच किये गये है जिनसे चारा उत्पादन सम्बन्धी जानकारी प्राप्त की जा सकती है। चारा एप, फोरज इंडिया, फॉडर एवं रेंज ग्रासेस तथा फोरज सीड एप उपलब्ध है जिन्हें अपने मोबाईल फोन पर प्ले स्टोर से डाउनलोड कर एवं किसान कॉल सेंटर के नंबर 0510–2730241 पर फोन करके जानकारी प्राप्त कर सकते है, से अवगत कराया गया। इसके अतिरिक्त एम–किसान पोर्टल से कृषकों/पशुपालकों को जोडकर चारा उत्पादन सम्बन्धी जानकारी उपलब्ध करायी जाती है।

डॉ. अरविन्द कुमार सिंह, अपर निदेशक(गो.वि.) द्वारा पशुपालन विभाग की ओर से प्रदेश में पशुधन एवं चारे की स्थिति पर विस्तार से चर्चा की गयी। यह अवगत कराया गया कि प्रदेश में उपलब्ध पशुधन को पर्याप्त मात्रा में चारा उपलब्ध कराने हेतु बेहतर भूमि उपयोग, गुणवत्तायुक्त चारा बीज की उपलब्धता, उचित फसल योजना अपनाये जाने की आवश्यकता बतायी गयी।

उप निदेशक (प्रक्षेत्र), पशुपालन विभाग, उ.प्र., लखनऊ द्वारा ब्रीडर बीज की मांग आगामी 05 वर्षों के लिए प्रेषित किये जाने के क्रम में अवगत कराया गया कि प्रक्षेत्रों के अतिरिक्त किसी और संस्था द्वारा चारा बीज उत्पादन कार्यक्रम संचालित नही किया जाता है एवं जनपदों में पशुपालक केवल अपने पशुओं हेतु चारा उत्पादन के लिये ही बीज प्राप्त करता है। ब्रीडर बीज से आधारीय बीज उत्पादन एवं आधारीय बीज से प्रमाणित बीज उत्पादन का कार्य किया जाता है। जो कृषकों में चारा उत्पादन हेतु वितरित किया जाता है। ऐसी स्थिति में प्रक्षेत्र अपनी आवश्यकतानुसार ही ब्रीडर बीज की माँग संस्थाओं को प्रेषित करता है। ऐसी स्थिति में ब्रीडर बीज की माँग में बढ़ोत्तरी किया जाना सम्भव नहीं हैं।

निदेशक, रोग नियंत्रण एवं प्रक्षेत्र द्वारा निर्देश दिये गये कि सभी प्रक्षेत्रों पर साईलो–बैग का क्रय कर साईलेज बनाया जायें, बेल मेकिंग व साईलेज मेकिंग मशीनों का भी क्रय कर स्थापित किया जायें। निदेशक रोग नियंत्रण एवं प्रक्षेत्र महोदय द्वारा यह भी निर्देश दिये गये कि प्रक्षत्रों पर चारा बीज उत्पादन बढ़ाने के सम्बन्ध में भारतीय चारागाह एवं चारा अनुसंधान संस्थान, झाँसी से सहयोग प्राप्त किया जायें तथा सभी प्रक्षेत्रों पर

अनिवार्य रूप से हाईब्रिड नैपियर की रोपाई कराई जाये। कार्यशाला में यह भी निर्देश दिये गये कि एक तकनीकी कमेटी बनाकर भारतीय चारागाह एवं चारा अनुसंधान संस्थान, झाँसी से सलाह ली जाये कि प्रक्षेत्रों पर कौन–कौन सी चारा एवं चारा बीज फसलें उगायी जा सकती है जिससे चारे की कमी को पूरा किया जा सकें। कार्यशाला में प्रक्षेत्रों को भारतीय चरागाह एवं चारा अनुसंधान संस्थान, झाँसी से टाई–अप कराने के सम्बन्ध में निदेशक, भारतीय चरागाह एवं चारा अनुसंधान संस्थान, झाँसी से अनुरोध किया गया, जिस पर निदेशक, भारतीय चरागाह एवं चारा अनुसंधान संस्थान, झाँसी द्वारा अवगत कराया गया कि वे संस्थान के वैज्ञानिकों को प्रक्षेत्र पर भेजकर वैज्ञानिक सलाह/तकनीकी सुझाव ही उपलब्ध करा सकते है किन्तु प्रक्षेत्रों को संस्थान से टाई–अप नहीं कर सकते हैं।

कार्यशाला के अन्त में निदेशक प्रशासन एवं विकास महोदय द्वारा उपलब्ध करायी गयी चारा उत्पदन सम्बन्धी जानकारी को शत–प्रतिशत प्रक्षेत्रों पर लागू करने के निर्देश दिये गये। प्रदेश के विभिन्न जनपदों से आये चारा विकास से जुड़े अधिकारियों/कर्मचारियों को निर्देश दिये कि जनपदों में उनकी तैनाती चारा विकास कार्यक्रमों को गति देने के लिए की गयी है जबकि जनपदस्तरीय अधिकारियों स्थापना/कैश/बिल सम्बन्धी कार्य कराये जा रहे है, जो उचित नही है। जनपदों में यदि चारा सम्बन्धी किसी प्रकार की विषम स्थिति उत्पन्न होती है तो इसके लिए सम्बन्धित अधिकारी/कर्मचारियों की जिम्मेदारी तय की जायेगी। अतः चारा क्षेत्र से जुडे प्रतिभागी अधिकारी/कर्मचारियों से यह अपेक्षा की गयी कि कार्यशाला में उपलब्ध करायी गयी चारा उत्पादन की विभिन्न तकनीकियों को कृषकों/पशुपालकों तक पहुँचाकर चारे की कमी को पूरा करने में अपना महत्वपूर्ण योगदान दें। इसके साथ ही भारतीय चरागाह एवं चारा अनुसंधान संस्थान, झाँसी से प्रतिभागी वैज्ञानिको का आभार प्रकट करते हुए एवं प्रतिभागी सभी अधिकारी/कर्मचारियों को धन्यवाद देकर कार्यशाला का समापन किया गया।

Annexure-II

दिनाँक 13 दिसम्बर, 2019 को लखनऊ, उत्तर प्रदेश में आयोजित 'चारा उत्पादन संरक्षण एवं उपयोगिता' पर आधारित कार्यशाला के प्रतिभागियों की सूची

क्र.सं.	नाम	पद एवं पता
1	श्री बी.एल. मीणा	प्रमुख सचिव, पशुधन एवं दुग्ध विकास, उत्तर प्रदेश शासन
2	डॉ. विजय कुमार यादव	निदेशक, भारतीय चरागाह एवं चारा अनुसंधान संस्थान, झाँसी
3	डॉ. एस. के. श्रीवास्तव	निदेशक, रोग नियंत्रण एवं प्रक्षेत्र, पशुपालन विभाग, उ.प्र., लखनऊ।
4	डॉ. यू.पी. सिंह	निदेशक, प्रशासन एवं विकास, पशुपालन विभाग, उ.प्र., लखनऊ।
5	डॉ. ए.के. मिश्रा	विभागाध्यक्ष, भारतीय चरागाह एवं चारा अनुसंधान संस्थान, झाँसी
7	डॉ. आर.वी. कुमार	विभागाध्यक्ष, भारतीय चरागाह एवं चारा अनुसंधान संस्थान, झाँसी
8	डॉ. पुरूषोत्तम शर्मा	प्रधान वैज्ञानिक, भारतीय चरागाह एवं चारा अनुसंधान संस्थान, झाँसी
9	डॉ. ए.के. दीक्षित	प्रधान वैज्ञानिक, भारतीय चरागाह एवं चारा अनुसंधान संस्थान, झाँसी
10	डॉ. अरविन्द कुमार सिंह	अपर निदेशक (गो.वि.), पशुपालन निदेशालय, उ.प्र., लखनऊ।
11	डॉ. बी.बी. सिंह	संयुक्त निदेशक (प्रशिक्षण), पशुपालन निदेशालय, उ.प्र., लखनऊ।
12	डॉ. ए.के. प्रसाद	संयुक्त निदेशक (प्रक्षेत्र), पशुपालन निदेशालय, उ.प्र., लखनऊ।
13	डॉ. ए.के. सिंह	संयुक्त निदेशक, बी.पी. संस्थान, पशुपालन निदेशालय, उ.प्र., लखनऊ।
14	डॉ. अनिल कुमार शर्मा	संयुक्त निदेशक (पशु पोषण), पशुपालन निदेशालय, उ.प्र., लखनऊ।
15	डॉ. पी.के. सिंह	उप निदेशक, पशुपालन निदेशालय, उ.प्र., लखनऊ।
16	डॉ. राकेश कुमार	पशु चिकित्साधिकारी, बी.पी. संस्थान, पशुपालन निदेशालय, उ.प्र., लखनऊ।
17	डॉ. सरस्वती शुक्ला	पशु चिकित्साधिकारी, बी.पी. संस्थान, पशुपालन निदेशालय, उ.प्र., लखनऊ।
18	डॉ. मृनालिनी	पशु चिकित्साधिकारी, बी.पी. संस्थान, पशुपालन निदेशालय, उ.प्र., लखनऊ।
19	डॉ. मनीष सचान	पशु चिकित्साधिकारी, आई.वी.पी., लखनऊ।
20	डॉ. प्रकाश चन्द्र सिंह	उप निदेशक (प्रक्षेत्र), पशुपालन विभाग, उ.प्र., लखनऊ।
21	श्री अर्जुन	चारा विकास अधिकारी, पशुपालन निदेशालय, उ.प्र., लखनऊ।
22	डॉ. रमेश कुमार सिंह	सहायक निदेशक (प्रक्षेत्र), पशुपालन विभाग, उ.प्र., लखनऊ।
23	डॉ. एम.पी. सिंह	अधीक्षक, राजकीय पशुधन प्रक्षेत्र, चकगंजरिया स्थान निबलेट–बाराबंकी।
24	श्री शिवनाथ सिंह	प्रक्षेत्र प्रबंधक, राजकीय पशुधन एवं कृषि प्रक्षेत्र, मंझरा, लखीमपुर–खीरी।
25	श्री उदय प्रताप सिंह	कृषि प्रभारी, राजकीय पशुधन एवं कृषि प्रक्षेत्र, मंझरा, लखीमपुर–खीरी
26	श्री राम अवतार	डेरी प्रभारी, सहायक, राजकीय पशुधन एवं कृषि प्रक्षेत्र, मंझरा, लखीमपुर–खीरी।

27	श्री सुभाष चन्द्र शर्मा	डेयरी प्रभारी, सहायक, राजकीय पशुधन एवं कृषि प्रक्षेत्र, हस्तिनापुर–मेरठ।
28	श्री अमरदीप सिंह	कृषि प्रभारी, राजकीय पशुधन एवं कृषि प्रक्षेत्र, हस्तिनापुर–मेरठ
29	श्री अशोक कुमार श्रीवास्तव	प्रक्षेत्र प्रबंधक, राजकीय पशुधन एवं कृषि प्रक्षेत्र, भरारी–झाँसी।
30	श्री दिलबाग सिंह	कृषि प्रभारी, राजकीय पशुधन एवं कृषि प्रक्षेत्र, भरारी–झाँसी।
31	श्री चरन सिंह	ग्रुप–3 कृषि सहायक, राजकीय पशुधन एवं कृषि प्रक्षेत्र, भरारी–झाँसी।
32	श्री उपेन्द्र नाथ सिंह	प्रक्षेत्र प्रबंधक, राजकीय पशुधन एवं कृषि प्रक्षेत्र, सैदपुर–ललितपुर।
33	श्री अखिलेश कुमार निगम	ग्रुप–3 कृषि सहायक, राजकीय पशुधन एवं कृषि प्रक्षेत्र, सैदपुर–ललितपुर।
34	श्री कोमल सिंह	प्रक्षेत्र प्रबंधक, राजकीय पशुधन एवं कृषि प्रक्षेत्र, बाबूगढ़–हापुड़।
35	श्री दुर्गेश कुमार	ग्रुप–1 कृषि सहायक, राजकीय पशुधन एवं कृषि प्रक्षेत्र, बाबूगढ़–हापुड़।
36	श्री सुशील कुमार	ग्रुप–3 कृषि सहायक, राजकीय पशुधन एवं कृषि प्रक्षेत्र, बाबूगढ़–हापुड़।
37	श्री श्याम प्रताप सिंह	ग्रुप–1 कृषि सहायक, राजकीय पशुधन एवं कृषि प्रक्षेत्र, आराजी लाइन्स–वाराणसी।
38	श्री चन्द्रशेखर सिंह	ग्रुप–3 कृषि सहायक, राजकीय पशुधन एवं कृषि प्रक्षेत्र, आराजी लाइन्स–वाराणसी।
49	श्री अनिल कुमार तिवारी	ग्रुप–3 कृषि सहायक, राजकीय पशुधन एवं कृषि प्रक्षेत्र, आटा–जालौन।
40	श्री प्रदीप कुमार	ग्रुप–3 कृषि सहायक, राजकीय पशुधन एवं कृषि प्रक्षेत्र, आटा–जालौन।
41	श्री सुनील कुमार	प्रक्षेत्र प्रबंधक, राजकीय पशुधन एवं कृषि प्रक्षेत्र, नीलगांव–सीतापुर।
42	श्री संदीप यादव	ग्रुप–3 कृषि सहायक, राजकीय पशुधन एवं कृषि प्रक्षेत्र, नीलगांव–सीतापुर।
43	श्री राजेन्द्र कुमार	ग्रुप–3 कृषि सहायक, राजकीय पशुधन एवं कृषि प्रक्षेत्र, नीलगांव–सीतापुर।
44	श्री राजेन्द्र प्रसाद वर्मा	ग्रुप–1 कृषि सहायक, राजकीय पशुधन प्रक्षेत्र, चक गंजरिया स्थित निबलेट–बाराबंकी।
45	श्री अजय कुमार शाही	ग्रुप–2 कृषि सहायक, राजकीय पशुधन प्रक्षेत्र, चक गंजरिया स्थित निबलेट–बाराबंकी।
46	श्री राजेन्द्र प्रसाद	ग्रुप–1 कृषि सहायक, पशुपालन विभाग, आजमगढ़ मण्डल, आजमगढ़।
47	श्री जय सागर त्रिपाठी	ग्रुप–1 कृषि सहायक, पशुपालन विभाग, वाराणसी मण्डल, वाराणसी।
48	श्री हरेन्द्र सिंह यादव	ग्रुप–2 कृषि सहायक, भदावरी भैंस एवं जमुनापारी बकरी प्रजनन प्रक्षेत्र, इटावा।
49	श्री नगीना सिंह	ग्रुप–1 कृषि सहायक, उप निदेशक (प्रक्षेत्र), पशुपालन विभाग, उ.प्र., लखनऊ।
50	श्री रवीन्द्र नाथ लाल	ग्रुप–2 कृषि सहायक, पशुपालन विभाग, लखनऊ मण्डल, लखनऊ।
51	डॉ. कमल कुमार वर्मा	ग्रुप–2 कृषि सहायक, पशुपालन विभाग, बस्ती मण्डल, बस्ती।
52	श्री जितेन्द्र कुमार	ग्रुप–2 कृषि सहायक, मुख्य पशु चिकित्साधिकारी, सुल्तानपुर।
53	श्री जनार्दन यादव	ग्रुप–2 कृषि सहायक, मुख्य पशु चिकित्साधिकारी, मऊ।
54	श्री अर्जुन पाठक	ग्रुप–2 कृषि सहायक, मुख्य पशु चिकित्साधिकारी, उन्नाव।
55	श्री बसन्त सिंह	ग्रुप–3 कृषि सहायक, मुख्य पशु चिकित्साधिकारी, जौनपुर।

56	श्री अशोक कुमार सिंह	ग्रुप–3 कृषि सहायक, मुख्य पशु चिकित्साधिकारी, जौनपुर।
57	श्री सुशील कुमार त्यागी	ग्रुप–3 कृषि सहायक, मुख्य पशु चिकित्साधिकारी, सहारनपुर।
58	श्री हरेन्द्र पाल	ग्रुप–3 कृषि सहायक, मुख्य पशु चिकित्साधिकारी, अलीगढ़।
59	श्री दयानन्द	ग्रुप–3 कृषि सहायक, मुख्य पशु चिकित्साधिकारी, फतेहपुर।
60	श्री योगेन्द्र सिंह राजपूत	ग्रुप–3 कृषि सहायक, मुख्य पशु चिकित्साधिकारी, अमरोहा।
61	श्री दीपक कुमार निर्मल	ग्रुप–3 कृषि सहायक, मुख्य पशु चिकित्साधिकारी, महराजगंज।
62	श्री नृपेन्द्र सिंह	ग्रुप–3 कृषि सहायक, मुख्य पशु चिकित्साधिकारी, अयोध्या।
63	श्री अशोक कुमार यादव	ग्रुप–3 कृषि सहायक, मुख्य पशु चिकित्साधिकारी, देवरियां।

Glimpses of interactive workshop at Uttar Pradesh

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 DHN-6	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 Uttar Pradesh, 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 :

Director

ICAR-Indian Grassland and Fodder Research Institute

Gwalior Road, Near Pahuj Dam, Jhansi-284 003 (UP)

Website : http://www.igfri.res.in

Phone : 0510-2730666, Fax : 0510-2730833, E-mail : igfri.director@gmail.com

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किसान कॉल केन्द्र : 0510-2730241

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