# Fodder Resources Development Plan for Assam


भा.च.चा.अ.सं.
IGFRI

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

An ISO 9001:2015 Certified Institute

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

भाकृअनुप
ICAR

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**TRILOCHAN MOHAPATRA, Ph.D.**
SECRETARY & DIRECTOR GENERAL


सत्यमेव जयते


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# MESSAGE

Assam is one of the biodiversity hotspots inhabiting vast genetic diversity of flora and fauna besides being reservoir of diverse domesticated livestock. Agriculture is considered as the mainstay of the economy of state contributing more than one fourth (26.19%) to the State's Net Domestic Product (NSDP) and supports about 70 per cent of its population. The net and gross cropped area of the total land holdings of state are small and marginal which is one of the major obstacles for agriculture development.

Livestock is the integral part of the mixed-farming system in Assam embodying highest number in the NE Region, however, production is still not matching with the requirements. The productivity of livestock is mainly dependant on green and dry fodder, but the state has a shortage of green as well as dry fodder to the extent of about 91.0 and 54.6 percent, respectively. Therefore, systematic action plan and strategies are required to narrow down the gap.

I am delighted to know that ICAR-Indian Grassland and Fodder Research Institute (IGFRI), Jhansi has prepared a detailed "Fodder Resource Development Plan" for the state of Assam. The plan analyses current scenario of fodder and livestock in the state; scope for fodder resource development and suggest suitable technologies as well strategies for fodder augmentation along with brief action plan, roadmap for planning pilot programme for fodder resource development. There is a need to focus on programmes, partnerships and projects to implement the action plan that would bring cheer to state dairy farmers. ICAR-IGFRI is committed for the greater synergies for formulating, implementing and upscaling strategies for fodder production in the state.

**Date the 22nd October 2020**
**New Delhi**

**(T. Mohapatra)**

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

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- Dr. Purushottam Sharma, PS — Nodal Officer

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## Assam State Fodder Resources Development Plan Committee

- Dr. JP Singh, Coordinator
- Dr. BP Kushwaha, Chairman
- Dr. Shahid Ahmad, Member
- Dr. N Dikshit, Member
- Dr. AK Dixit, Member

## Document Formatting and Cover Design

Mr. KP Rao, Chief Technical Officer

# Acknowledgement

Present document 'Fodder Resource Development Plan for Assam' 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 Assam.

We are highly thankful to Government of Assam, especially to Mr. Shyam Jagannathan, IAS Commissioner & Secretary, Government of Assam, who inaugurated the interactive workshop held at Guwahati on 25th November, 2019 and also gave his valuable suggestions for fodder resource development in the state. We are highly thankful to Dr P C Das, Director Animal Husbandry, Assam and Dr. A.K. Tripathi, Director, ICAR-ATARI, Dr. D.C. Deka, International Livestock Research Institute, Dr. C.K. Baruah and Dr. S.H. Rahman, Fodder Development Officer 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 in preparation of fodder plan for the state of Assam and organizing interactive workshop are praise worthy. The efforts done by Dr Prabhu G. in editing the document are duly appreciated. 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

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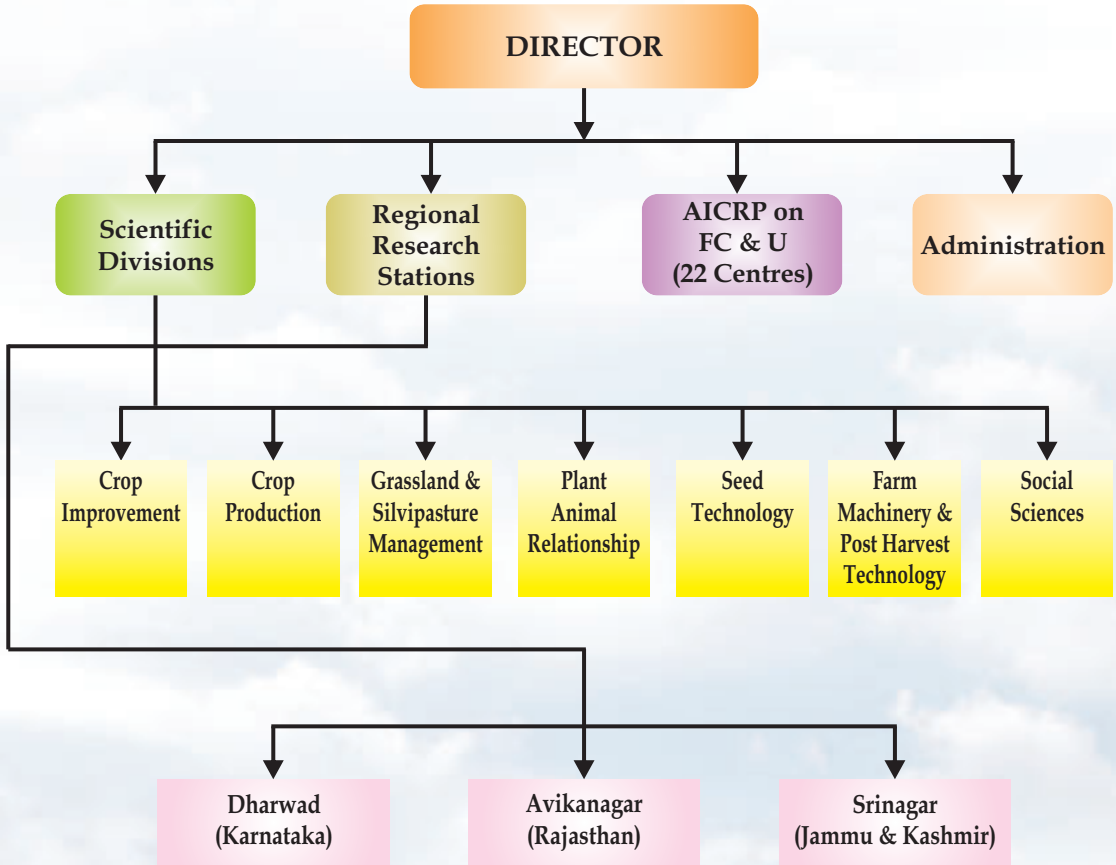
# Organogram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# ICAR-IGFRI - A Profile

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

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

### Mandate

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

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

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

### Proven Technologies of Institute

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

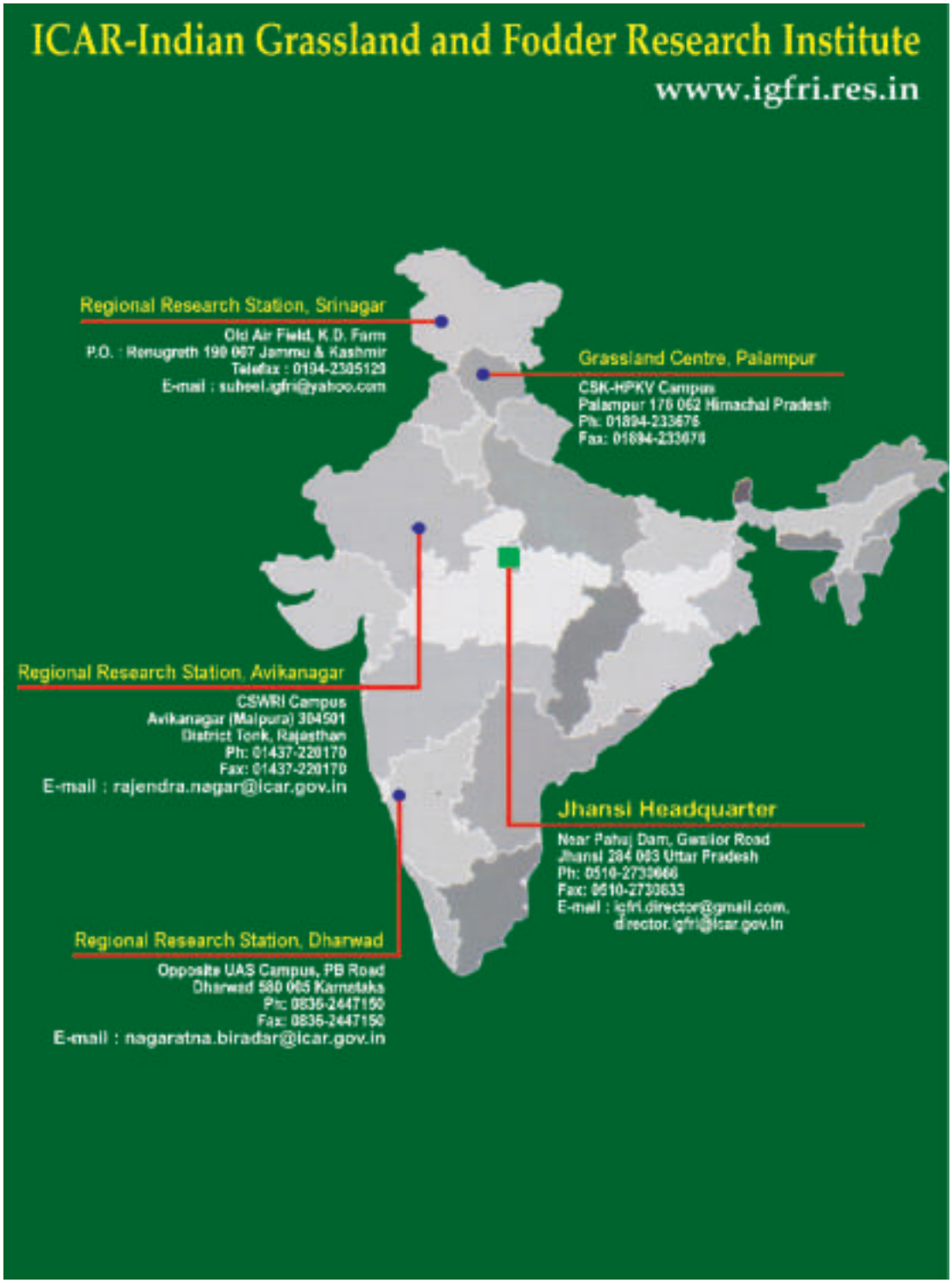
### Accelerating Fodder Technology adoption

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

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

### NIAFTA: New Initiatives

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

## A. Introduction

Assam, the North-Eastern state of India is considered to be a biological hot spot that gives shelter to wide varieties of flora and fauna besides being a reservoir of different domesticated livestock. The state is situated between 24° 8' -28° 2' N latitude and 89° 42'-96.0"E longitude (Figure 1). The climate of the state is comparatively cooler than the rest of the country, with a maximum temperature of 36 °C and minimum temperature of 7 °C. The Assam receive the highest rainfall of country as well as the world (1800 mm to 3000 mm). The state relief and drainage is covered by two major river valleys (north-Brahmaputra and south-Barak) and a hilly region (in west and east).

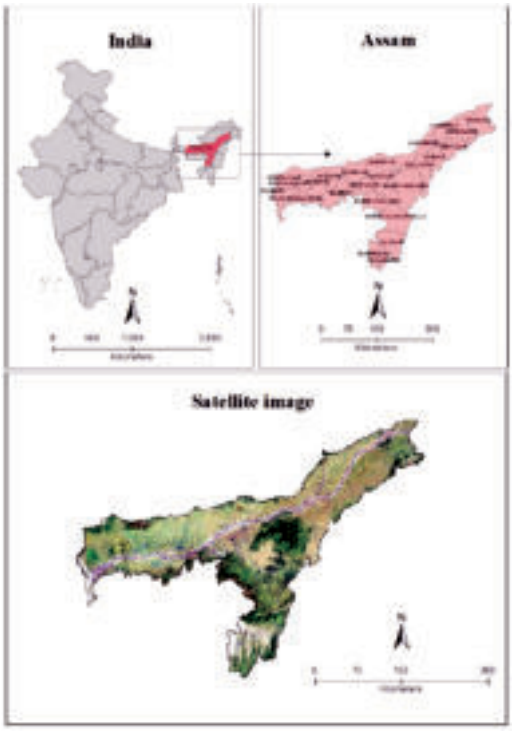


**Figure 1: Geographical location of Assam**

The total geographical area of the state is 78.44 lakh hectare, and provide shelters to 2.57% population of the country. More than 85% of the state's population lives in 77.67 lakh hectare of rural areas. Assam, the most prominent state in the North Eastern region, embodies the highest number of livestock in respect of almost all the animals in the region.

The livestock rearing is being, a key source of supplementary income and livelihood especially for small land holders and landless rural poor and plays an important role in the rural economy of the state. The desired growth of agriculture sector can be accomplished only through enhancing overall productivity of the livestock sector and this required a steady and adequate supply of quality fodder for supporting the livestock population. The agriculture sector of Assam supports more than 75% of its population. Agriculture is highly prone to flood risk in Assam, which is responsible for the reduction in cropping time availability and production risks. Agriculture is considered as the mainstay of the economy of Assam, plays a vital role in the state's economy and contributes more than one fourth (26.19%) of the Net State's Domestic Product (NSDP) and supports about 70 per cent of its population.

The net cropped area of the state is 27.53 lakh hectares against gross cropped area of 39.57 lakh hectares. About 83 percent of the total land holdings are small and marginal which is one of the major obstacles of Assam agriculture and the average operational holding is very small i.e.1.14 hectares only. The average cropping intensity of state is 146 per cent.

## B. Agro-climatic zones of Assam

Assam has been broadly divided into six agro-climatic zones on the basis of patterns of rainfall, terrain, soil type and climatic conditions (Figure 2). They are North Bank Plains Zone (NBPZ), Upper Brahmaputra Valley Zone (UBVZ), Central Brahmaputra Valley Zone (CBVZ), Lower Brahmaputra Valley Zone (LBVZ), Barak Valley Zone (BVZ) and Hills Zone (HZ). Relevant information of the zones is as under;

1. **North Bank Plain Zone (NBPZ):** (Darrang, Sonitpur, Lakhimpur, Dhemaji districts) is having 18.37% of total state area and 163% cropping intensity.
2. **Upper Brahmaputra Valley Zone (UBVZ):** (Golaghat, Jorhat, Sivasagar, Dibrugarh, Tinsukia districts) is having 20.40% of total state area and 131% cropping intensity.
3. **Central Brahmaputra Valley Zone (CBVZ):** (Nagaon, Marigaon districts) is having 7.08% of total area of state and 126% cropping intensity.
4. **Lower Brahpamutra Valley Zone (LBVZ):** (Goalpara, Dhubri, Kokrajhar, Bongaigaon, Kamrup, Nalbari, Barpeta districts) is having 25.75% of total area of state and 150% cropping intensity.
5. **Barak Valley Zone (BVZ):** (Cachar, Karimganj, Hailakandi districts) is having 8.9% of total area of state and 142% cropping intensity.
6. **Hill Zone (HZ):** (North Cachar Hills, Karbi Anglong districts) is having 19.4% of total area of state and 165% cropping intensity.

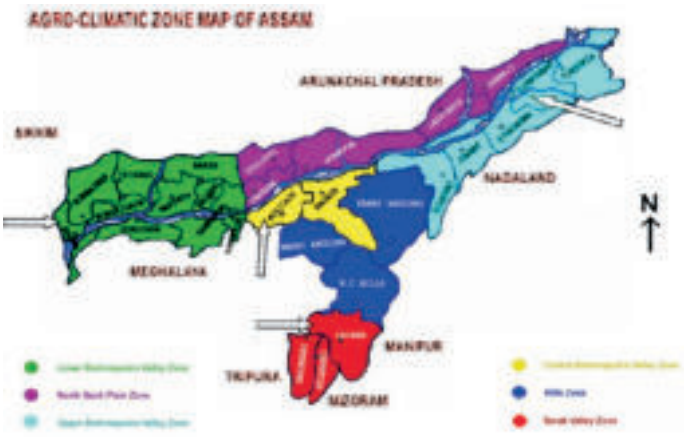


**Figure 2: Agro-climatic zones of Assam**

## 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 Assam, ICAR-Indian Grassland and Fodder Research Institute, Jhansi in collaboration with the Animal Husbandry and Veterinary Department (AHVD), Govt. of Assam has organized a Workshop on "Fodder Production, Conservation and Utilization" at Guwahati on 25th September 2019. The major agenda of the workshop were to highlight the fodder scenario in the state, activities of IGFRI, Jhansi in mitigating the fodder scarcity, modern methods of fodder conservation (silage and hay making), fodder based ration for livestock, modern high yielding varieties of fodder crops suitable for the state and advances in fodder crop production in Assam. Dr. Pulin Ch. Das, Director AHVD in his welcome address briefed the fodder related problems of Assam and showed his pleasure with the presence of IGFRI for the fodder development plan for the state of Assam. Mr. Shyam Jagannathan, IAS Commissioner & Secretary in his inaugural address, instructed the state government officials to collaborate with IGFRI for giving feedback in preparation of fodder plan and later its application in the state (Figure 3). About 35 officers from different districts of Assam participated in this meeting. Dr. Vijay K. Yadav, Director IGFRI presented the bouquet of fodder technology available for the state and requested the government officials to give suggestions for incorporation in the fodder plan of Assam. The Director also suggested to conduct a training program for the Assam government officials in IGFRI, Jhansi where exposure to fodder technologies will be made to them. Dr. A.K. Roy, Project Co-ordinator, fodder crops presented the details of varieties and technology available with IGFRI as well as centres of AICRP on Fodder Crops that may be useful for the state. Dr. B.P. Kushwaha, Principal Scientist, IGFRI, Jhansi presented the fodder plan for the Assam state, Dr. C.S. Sahay, Principal Scientist, IGFRI, Jhansi presented technologies related to feed fodder conservation and machinery related to fodder production. Dr. A. K. Tripathi, Director, ICAR, ATARI stresses the need of fodder bank development in the region and prepare the contingency plan for lean period in the region.

Dr D.C. Deka from International Livestock Research Institute, in his presentation, stated that the productivity of livestock is less in north eastern region of the country, both in terms of milk and meat production. He stresses the need to increase the digestion capacity of rumen of livestock to address the problem of feed so that rice residue can be utilized for the purpose of feeding. Dr S.H. Rahman, Fodder Development Officer, Silchar discussed various problems in fodder production and emphasised on education and motivation to farmers on fodder cultivation. Dr. CK Baruah, Dy. V.O. Karimganj also stated the problem of availability of seed material and lack of motivation of the farmers to take fodder. In the workshop, fodder resources development plan for the state was presented and suggestions were invited. The salient

recommendations emerged from the workshop has been incorporated in the preparation of fodder plan for the state. (Annexure-I).

**Figure 3: Mr. Shyam Jagannathan, IAS, Commissioner & Secretary Animal Husbandry and Veterinary Department , Govt. of Assam, delivering the key note address.**

## D. Livestock Scenario

Livestock is the integral part of the mixed-farming system that characterizes agriculture in Assam. In addition to contribution to food and crop production; livestock and poultry are the daily source of earning to many poor households. Animal traction is still significant in the state due to increasing miniaturization of landholdings and high fuel cost that limits the use of machinery. Being a state with limited benefits of green revolution technologies and climatic uncertainties, the livestock sector has the potential contributor of farm diversification and intensification. Livestock products are integral parts of local diet, as more than 95 percent of the population is non-vegetarian.

Livestock production in Assam is characterized by indigenous cattle, buffalo, pigs, goats and chicken. There are pockets of nomadic systems of rearing, mostly in the fringes of the forests. In recent years, more specialized and commercially intensive production areas have been emerged in the state, particularly rearing of improved livestock and commercial poultry strains. Livestock in the state is largely fed on crop residues, food waste, whereas highly productive animals are supplemented with the concentrated grain-based feed. Unlike in other parts of India, cooperative farming (such as in Amul Dairy), and investment in cooperative farming in the state has remained largely unsuccessful.

As per the 2019 livestock census, there are about 18040280 livestock population in the state, comprising of 10853260 (cattle), 421720 (buffaloes), 4315170 (goats), 332100 (sheep) and 209900 (pigs) (Table 1). As compared to previous livestock census of 2012, an increase in exotic/crossbred population by 80.09 percent and indigenous cattle by 2.31 percent whereas buffalo and goat population decreased by 3.11 and 30.05 percent, respectively in the current census (Table 2). The number of indigenous milch cows increased from 2913.810 to 3063400 and exotic/crossbred milch cows from 158960 to 273390, whereas the population of milch buffaloes decreased from 136600 to 120550 (Table 3). The milk production is mainly from cattle (748180 tonnes) followed by buffaloes (117130 tonnes) and goat (16960 tonnes) (Table 4). A marginal increase was observed in per capita milk availability which increased from 69 gm/day in 2013-14 to 71 g/day in 2018-19.

**Table 1. Livestock population of Assam (census 2019)**

| Species | Number (thousands) |
|---|---|
| Cattle | 10853.26 |
| Buffaloes | 421.72 |
| Sheep | 332.10 |
| Goat | 4315.17 |
| Pig | 2099.0 |
| Total | 18040.28 |

**Table 2. Comparative categorization of livestock population between 2012 and 2019 census.**

*(Number in thousands)*

| Year | Cattle | | | | | | Buffaloes | | | Goat |
|---|---|---|---|---|---|---|---|---|---|---|
| | Exotic | | | Indigenous | | | Male | Female | Total | Total |
| | Male | Female | Total | Male | Female | Total | | | | |
| 2012 | 76.33 | 319.57 | 395.9 | 4216.4 | 5695.29 | 9911.7 | 171.42 | 263.85 | 435.27 | 6169.20 |
| 2019 | 105.67 | 607.31 | 712.98 | 3107.3 | 7033.0 | 10140.3 | 149.36 | 272.36 | 421.72 | 4315.17 |
| % change | 38.43 | 90.04 | 80.09 | -26.30 | 23.49 | 2.31 | -12.87 | 3.23 | -3.11 | -30.05 |

**Table 3. Comparative categorization of milch livestock population between 2012 and 2019 census.**

*(Number in thousands)*

| Year | Milch cows (Indigenous) | Milch cows (Exotic/CB) | Milch buffaloes |
|---|---|---|---|
| 2012 | 2913.81 | 158.96 | 136.60 |
| 2019 | 3063.40 | 273.39 | 120.55 |
| % change | 5.13 | 71.98 | -11.75 |

**Table 4. Milk production during 2018-19 (000 tonnes)**

| | Buffaloes | Cattle | Goat | Total |
|---|---|---|---|---|
| Milk production | 117.13 | 748.18 | 16.96 | 882.27 |

Although there is a large population of domesticated livestock in the state but the production is not at par with the requirements. Some of the constraints for the low production may be are i) absence of quality germplasm, as most of the animals are fed with non-descript varieties resulting in low productivity, ii) acute shortage of feeds and fodder, iii) high animal density, iv) small holding size, which is limiting fodder cultivation, v) recurrence of flood and (vi) poor perception of farmers towards livestock production as a viable alternative.

An important resource related challenge of the livestock sector in Assam is feed and fodder development. The same is affecting the milk productivity in the State. The demand and supply situation indicates the state's high dependency on the other parts of the country for the supply of inputs like animal feed. Programs aimed at popularization of commercial fodder cultivation are not successful in many places because of the high investment needed from the farmer in guarding their plots from free-roaming cattle.

## E. Fodder Scenario

The productivity of livestock is mainly dependent on the green and dry fodder, but the state has a shortage of green fodder and dry fodder to the extent of 91.0 and 54.6 per cent respectively. Fodder crops are the cheapest source of feed for livestock. The land under fodder crops and grazing lands/permanent pastures is about 29000 ha and 167000 ha respectively. Cowpea, maize, barley, oat, guinea grass, BN hybrid, white and red clover, grasspea, setaria grass, fescue grass and congo signal grass are the important fodder crops of the state. Good quality grass/fodder helps in increased production of milk and meat at a cheaper rate. The cultivation of quality grass/fodder is rare and the quantity is inadequate because, the smaller land holdings are devoted to cultivation of food crops on first priority and fodder gets the least priority. Looking at the vast gap between the demand and supply position, it becomes necessary to put adequate efforts to transfer the potential technologies developed by various research organizations of the state and country to farmer's field in order to increase the production and productivity of good quality fodder. Therefore, there is an urgent need of development of fodder security plan for round the year feed and fodder supply in different agro-climatic zones of the state.

# Part-II : Fodder Resource Development Plan

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

**Green Fodder:** The total green fodder requirement will be in the range of 300–350 million tonnes in the state.

**Dry Fodder:** The total dry fodder requirement will be in the range of 35-40 million tonnes in the state.

**Strategies for enhancing fodder resources**

Keeping in view of the constraints in fodder production and reduce the gap between demand and supply, the emphasis is to be given on the stepwise augmentation of the fodder production in the state. The existing resource utilization pattern needs to be studied in a system approach. Fodder production is a component of the farming system and efforts need to be made for increasing the forage 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. 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 is about 0.29 lakh ha and 1.67 lakh ha respectively (BAHS, 2014; Agriculture Statistical Year Book 2018). 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 Assam is estimated at 27.53 lakh hectare. Thus 5% area comes to 1.38 lakh ha. With a cropping intensity of 146% it must come to about 2.01 lakh ha to have a reasonable and sustainable fodder supply in the state. Of this, about 1.01 lakh ha should be brought under perennial fodder crops and 1.00 lakh ha under annual fodder crops. There are number of fodder crops suitable under different agro-climatic conditions of state. We have large basket of perennial grasses, range legumes, cultivated forage cereals &

legumes. The crops like bajra napier hybrid, guinea grass, setaria, grasspea, maize, oat, cowpea, etc are suitable for irrigated and arable land conditions whereas crops like congo signal, fescue grass, coix 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 two years time there will be sufficient planting material for the whole state. Likewise the seeds will be multiplied at each block to get sufficient seed for whole state in two years. The important fodder crops, varieties and seed/planting material requirement have been presented in Table 5.

**Table 5. Suitable fodder crops, varieties and seed/planting requirement.**

| S.No. | Crop | Varieties | Seed/root slips/stem cuttings per ha | Average yield (t/ha/annum) |
|---|---|---|---|---|
| **i.** | **Perennial fodder crops** | | | |
| 1 | Bajra X Napier Hybrid | BNH-10, CO-5, Swetika-1, PBN-342, CO-6, IGFRI 6, PBN 342 | 28,000 nos. | 200-250 |
| 2 | Guinea grass | Bundel Guinea -2, Bundel Guinea -4, DGG-1 | 40,000 nos. | 150-200 |
| 3 | Signal/Para grass | DBRS 1, local material | 40,000 nos. | 40-50 |
| 4 | Nandi grass | Nandi, Golden timothy, Setaria-92 or Locally available | 40,000 nos. | 20-60 |
| 5 | Job's tear/ Coix | Bidhan Coix-1 | | 35-40 |
| 6 | Rye grass | PRG-1 | | 14-15 |
| **ii.** | **Annual fodder crops** | | | |
| 1 | Fodder maize | African Tall, J-1006 | 40 kg/ha | 35-40 |
| 2 | Fodder sorghum | SSV 74, PC-9, PC-23, Harasona, JS-29-/1, MSFH-3, | 15-20 kg/ha | 25-30 |

| | | | | |
|---|---|---|---|---|
| 3 | Fodder cowpea | UPC-8705, UPC-625, 622, 621, 618, 5287, 5286, 4200, Bundel lobia-1, Bundel lobia-2 | 20-25 kg/ha | 15-20 |
| 4 | Oat | JHO-99-2, JHO-15-1, Kent, JHO-822, JHO-2004, OS 403, RO 11-1 | 80 kg/ha | 40-50 |
| 5 | Rice bean | Shymalima, RBL-6, Bidhan-1, Bidhan-2, JRBJ-05-2, Bidhan Rice bean 3, KRB 19 | 30-35 kg/ha | 30-35 |
| 6 | Grass pea | Madhuri | 50-60 kg/ha | 5-6 |
| 7 | Dinanath grass | Pusa dinanath-1, Bundel dinanath-1, Bundel dinanath -2, Jawahar Pennisetum-12 | 2.5 kg/ha | 15-30 |
| 8 | Berseem | Bundel Berseem 3 | 20-25 kg/ha | 55-60 |
| **iii. Fodder trees** | | | | |
| 1 | *Caliandra* spp. | Local species | Depend on spacing | 10-20 |
| 2 | *Moringa oleifera* | PKM 1, Bhagya | Depend on spacing | 15-20 |

**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. It is an overlapping cropping system that comprises of raising oat inter-planted with Bajra Napier hybrid (BN)/Guinea grass in spring and intercropping the inter-row spaces of the B N Hybrid/Guinea grass with cowpea during summer after the final harvest of oat can supply green fodder round-the year. Under assured irrigation multiple cropping sequences maize + cowpea/rice bean – oat - maize + cowpea¸ maize + cowpea – oats/ – maize + cowpea; BN hybrid + oat ; BN hybrid + (cowpea – oat ); guinea grass + (cowpea – oat) (Figure 4) ; guinea grass (sole) 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. BN hybrid and guinea grass can be promoted either in open area or under orchards to meet the round the year green fodder requirement. BN Hybrid based cropping system intercropped with cowpea has green fodder production potential of 170-175 t/ha and dry fodder potential of 30-35 t/ha per year under assured water supply.

**Figure 4. BN hybrid + cowpea and Maize + cowpea for fodder production**

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

The arable farming on the degraded land in the state is difficult due to soil and moisture constraints. There are various alternate land use (ALU) systems which can provides fodder such as silvi-pasture (tree + pasture), horti-pasture (fruit trees + pasture) and agri-horti-silvipasture (crop + fruit trees + MPTS + pasture). Many multipurpose tree species (MPTS)/shrubs growing in ALU systems are useful as a 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 also shelter to the animals during bright and hot sunny days. In Assam, 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 an ample scope and many opportunities for introducing fodder crops in existing orchards. Horti-pasture system integrates pasture (grass and /or legumes) and fruit trees to fulfil the gap between demand and supply of fruit, fodder and fuel wood through utilizing moderately degraded land (Table 6).

**Table 6. Fodder production from Non arable lands.**

| | |
|---|---|
| Horti-pasture | Lemon/ Banana + Guinea grass |
| | Lemon/Banana + Para grass (Low land) |
| | Banana/ Lemon/Jackfruit/ + BN-hybrid |
| | Arecanut + Guinea grass |
| | Jackfruit/Guava + Guinea grass |
| Silvi-pasture/Grassland | *Leucaena leucocephala /Melia azadirach*, + Para grass (low land) |
| | *Leucaena leucocephala* + BN hybrid |
| | *Leucaena leucocephala* + Guinea grass |

Horti-pasture systems developed at ICAR-IGFRI have good production potential of forage from 6.5-12t DM/ha on degraded land of rainfed areas (Figure 5). Horti-pasture systems can serve the purposes of forage, fruit, 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 in banana plantation**

In the Assam state, different fruits crops have about 1.44 lakh ha (2015-16) area. These crops area planted very sparsely. The intervening spaces among trees in fruit orchards largely left leaving that space unkempt and unattended due to shortage of labour and mechanization. Technology for cultivation of fodder in these inter tree spaces has been developed and can be used for cultivation of annual/perennial forages. Suitable varieties of BN hybrid, guinea grass, setaria grass and perennial legumes can be grown. Through planning if 50% of inter spaces of the fruit orchards/plantations crops can be used for fodder production it can produce about 126.0 lakh tonne.

### C. Fodder Production from permanent pasture/grazing lands

Rangelands are extensive areas which are unfit for arable farming and are mostly under natural vegetation where animals graze. The Himalayan rangelands involving the seasonal pattern of animal migration and other forest grazing areas depict the true nature of Indian rangelands. These vast areas could be developed as model grassland with increasing production potential with rich genetic diversity of forage plant species in different eco-climatic conditions and a variety of habitats and niches. In the state of Assam there is about 1.67 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 congo signal grass, grazing guinea through seed pellets or by sowing can provide cheaper source of green fodder and will also to livestock keepers in reducing production cost substantially.

### D. Fodder on non-competitive lands

Congo signal grass, grazing guinea and setaria grass can also be promoted as rainfed grasses in other niches like farm pond embankments, bunds, uncultivated farm lands, in orchards, rain water outlets etc to meet the green fodder at farm level. Introducing perennial cultivated grasses on farm bunds along with irrigation channels 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. Besides additional farm productivity, it also works as a guard crop for main crop, reduces runoff loss of water and controls soil erosion. Total number of land holdings in Assam is 2.72 million which gives an opportunity to grow fodder on their bunds/boundary. Table 7 indicates the fodder production potential of bunds in the Assam state.

**Table 7: Fodder production potential under different size of land holdings**

| Size of holding | Total holding number ('000)* | Average size of holding (ha)* | Total bund length available for fodder (km)# | Fodder production @ only 7 kg/metre bund length if 10% bund length utilized ('000 tonnes)** |
|---|---|---|---|---|
| Marginal (<1 ha) | 1831.11 | 0.42 | 238221.8 | 166.75 |
| Small (1-2 ha) | 496.57 | 1.38 | 116828.7 | 81.78 |
| Semi-medium (2-4 ha) | 303.53 | 2.69 | 99655.5 | 69.76 |
| Medium (4-10 ha) | 84.87 | 5.15 | 38532.7 | 26.97 |
| Large (>10 ha) | 4.14 | 68.11 | 6828.3 | 4.78 |
| All classes | 2720.2 | | 500067.1 | 350.04 |

**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 6: Guinea grass plantation on field boundary**

## E. Alternative fodder resources

There is a need for exploring the alternative or non-conventional fodder resources *viz.*, moringa, azolla, hydroponics, crushed areca leaves, fodder beet, cactus, fodder sugarcane etc. Although, azolla and hydroponics could be the ideal sources of fodder and occupy lesser land area, they are labour intensive activities. These could be better options when house-hold labour is involved in augmenting the fodder resources and those livestock keepers, who have lesser number of animals. However, these can be supplementary in nature and cannot substitute natural fodder production.

### a. Moringa as alternate protein source

Moringa is a good alternative for substituting commercial rations for livestock (Figure 7). The relative ease with which Moringa can be propagated through both sexual and asexual means and its low demand of soil nutrients and water after being planted, make its production and management comparatively easy. Its high nutritional quality and better biomass production, especially in dry periods, support its significance as livestock fodder. Moringa planted at ICAR-IGFRI, Jhansi at 50x50 cm spacing gave 80-130 tonnes green forage/ha in 4 cuts at 45 days harvest intervals in 2nd year of planting. Moringa leaves contains 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 where it is difficult to cultivate other agricultural crops.

**Figure 7: Moringa plantation**

### b. Azolla as alternate fodder

Azolla farming, 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, Beta 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).

### c. Hydroponic fodder production

Hydroponics is a method of growing plants without soil. Only moisture and nutrients are provided to the growing plants. Hydroponic growing systems produce a greater yield over a shorter period of time in a smaller area than traditionally-grown crops. Hydroponic fodder systems are usually used to sprout cereal grains, such as barley, oats, wheat, sorghum, and corn, or legumes, such as alfalfa, clover, or cow peas. It may fit for those producers who do not have local sources for forage. 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 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.

### d. Fodder beet

Fodder beet is a high yield potential root crop. This can be an alternative to dormant winter grasses, double utility crop (grazed or lifted), high quality feed and good fodder for lactating cows. Fodder beet would be highly useful for the hilly and cold regions of Assam.

## F. Crop residue quality enhancement

The paddy straw is a 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. 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 ligno-cellulose complex, wherein the lignin forms the complex with cellulose, thus preventing 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 into bales to reduce keeping space and ease transportation has

Chaffing of forage for ensiling

Trench silo

Silage preparation in plastic bags

Stack of the silage

**Figure 8: Procedure of silage production and methods**

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. Silage making may be recommended in Assam (Figure 8). 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.

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.

## H. Custom hiring centre

These need to be developed to provide equipments, machinery etc 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. The following list of machineries/equipment's can be put under custom hiring in Assam

**Table 8. List of machineries and equipment's.**

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

# 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 six agro-climatic zones of the state, one districts 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 provoked the opinion of the staff of the Animal Husbandry Department (AHD) of Assam on which fodder crops and their varieties would be more suitable for different agro-climatic conditions prevailing in the state of Assam and it is outlined in the recommendations. The same may be used as a 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 the package of practices *mutatis mutandis* for successful cultivation of fodder crops in the state of Assam.

### v. Master trainers training at IGFRI/SAUs

The staff of Dept. of Animal Husbandry and Veterinary Services, Agriculture, Horticulture, Forestry etc. from the Govt. of Assam having aptitude to work for augmenting fodder resources will be identified through their superiors in the first stage as master trainers. Further, 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 a discussion with the head of the line department, Govt. of Assam.

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

There are 22 Krishi Vigyan Kendras (KVKs) operating in the state of Assam. They

will be linked 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 as partners in the process of creating awareness about fodder production.

### vii. Conduction of frontline demonstration and training

After the 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 of 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 Assam. 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 form of silage (for green fodder) or hay (for dry fodder), and its scientific utilization will be ensured through creating awareness on all these aspects and ensuring the compliance by the master trainers, trained farmers and other stake holder in the process.

### x. Enhance acreage and productivity in non-conventional areas

Indeed there is a shortage of land for allocation to production of fodder crops in the state of Assam. 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 of foresight and or lack of machinery etc. For example a large area of paddy cultivated in Assam 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, NRC on Pig, CIFRI, CPCRI, 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 to occur though the implementation of the proposed project. Hence, base line data on various parameters will be collected before the start of the project and after the project implementation at regular interval. The findings will be used for impact analysis of the technology demonstrated through this project. Midterm corrections needed if any will be identified through this impact analysis study.

# Part-IV : Road Map

This project is conceived to be multi-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 9).

**Table 9. Road map for the implementation of the proposed activities**

| S.No. | Action Point | Agencies involved |
|---|---|---|
| 1 | Breeder seed production of the identified varieties | ICAR-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 10.

# 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 (six). The detailed plan for implementation of pilot project is presented in the Table 10.

**Table 10. Implementation level plan for pilot project.**

| Sl. No. | Activity | Action points |
|---|---|---|
| 1 | Target area selection | • Selection of 6 districts (1 from each agro-climatic zone) of Assam<br>• Selection of 2 cluster of 5 villages in each district (total 6 clusters for 3 districts)<br>• Selection of 1 to 2 ha in each cluster for technology demonstrations<br>• Bench mark survey |
| 2 | Training | • Training of master trainers - 25 master trainers per batch and 1 batch from each district at ICAR-IGFRI, Jhansi<br>• Training of farmers; 10 from each village; 600 farmers in first year (6 training program for farmers of each cluster)<br>• Exposure visit of progressive farmers and master trainers at ICAR-IGFRI, Jhansi and other ICAR institutes located in Assam 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*<br>• Silage should be encouraged<br>• Since crop residue being a precious commodity, fodder banks using densification technologies can be developed<br>• Annual fodder crops<br>Fodder sorghum: SSV 74, PC-9, PC-23, Harasona, JS-29-1, MSFH-3 |

| | | |
|---|---|---|
| | | Maize: African Tall, J-1006<br>Cowpea: UPC-8705, UPC-625, 622, 621, 618, 5287, 5286, 4200, Bundel lobia-1, Bundel lobia-2<br>Oats: JHO-99-2, JHO-15-1, Kent, JHO-822, JHO-2004,<br>Rice bean: Shymalima, RBL-6, Bidhan-1, Bidhan-2, JRBJ-05-2, Bidhan Ricebean 3<br>Dinanath grass: Pusa dinanath-1, Bundel dinanath -1, Bundel dinanath -2<br>• Perennial fodder crops<br>Hybrid Napier: BNH-10, CO-5, Swetika-1, PBN-342, CO-6<br>Guinea grass: Bundel Guinea -2, Bundel Guinea -4, DGG-1<br>Congo signal grass: DBRS 1, local material<br>Setaria: Nandi, Golden timothy, Setaria-92 |
| 4 | Suitable silvi-pasture/ horti-pasture system demonstrations | • In existing Orchard - 1 ha (Guinea grass, Grazing Guinea)<br>• In new Orchard - 1 ha (Guinea grass, Grazing Guinea)<br>Popular and potential fodder trees: Calliandra, Erythrina, Gliricidia, Sesbania, Leucaena.<br>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/ pasture lands/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/, fertilisers, 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 Assam, 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 11.

**Table 11: 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) | 12 | 12 | 12 | 8 | 8 | 52 |
| Exposure visit of farmers/ stakeholders | 9 | 9 | 9 | 3 | 3 | 33 |
| Seed/Planting material | 12 | 12 | 3 | 3 | 3 | 33 |
| Micro Irrigation facilities | 12 | 12 | 9 | 9 | 3 | 45 |
| Other farm inputs, small equipments etc. | 12 | 8 | 8 | 3 | 3 | 34 |
| Custom hiring center equipments | 70 | 30 | 3 | 3 | 3 | 109 |
| TA/DA/staff (SRF/YP/RA)/ Consultancy/Miscellaneous etc. | 20 | 20 | 14 | 14 | 14 | 82 |
| Total | 147 | 103 | 58 | 43 | 37 | 388 |

**(Rupees Three Crore Eighty Eight 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 Assam. 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 Assam along with KVKs, NGOs, Milk Federation etc. will implement the programme at field and farmers level.

# Annexure-I

## Proceedings and Recommendations of Interactive Workshop

### Workshop on Fodder Production, Conservation and Utilization

**November 25, 2019**

**Organizers**

**Department of AH&VD, Govt. of Assam**

**ICAR- Indian Grassland and Fodder Research Institute, Jhansi**

Interactive Workshop started with welcome address by Dr. Pulin Ch. Das, Director AHVD in which he stated the fodder related problems of Assam and showed his pleasure with the presence of IGFRI for development of fodder plan for the state of Assam.

Dr. Vijay Kumar Yadav, Director, IGFRI presented the bouquet of fodder technology available in the country and stresses the state government officials to give suggestions for incorporation in the fodder plan of Assam. Director also suggested to conduct a training program for the Assam government officials in IGFRI, Jhansi where exposure to technology will be made to them.

Dr. A.K. Roy presented the details of varieties and technology available with IGFRI as well as centers of AICRP on Fodder Crops that may be useful for the state. Dr. B.P. Kushwaha and Dr. C.S. Sahay also presented technologies related to animal and feed conservation and machinery related to fodder production.

Mr. Shyam Jagannathan, IAS, Commissioner & Secretary gave his key note address during this meeting in which he instructed the state government officials to collaborate with IGFRI for giving feedback in preparation of fodder plan and later its application in the state. About 30 officers from different districts of Assam participated in this meeting.

Dr. A.K. Tripathi, Director, ICAR, ATARI stresses the need of fodder bank development in the region and prepare the contingency plan for lean period in the region. He also stated that a fodder cafeteria has been developed at ATARI, Guwahati and stated that officials may come there to see the developed fodder field.

Dr. D.C. Deka from International Livestock Research Institute, in his presentation, stated that the productivity of livestock is less in north eastern region of the country, both in terms of milk and meat production. He stresses the need to increase the digestion capacity of rumen of livestock to address the problem of feed so that rice residue can be adopted well for the purpose of feeding.

Dr. S.H. Rahman Fodder Development Officer, Silchar stated following problems for fodder cultivation in the state.

1. Lack of seed material
2. Farmers are more interested in *Kharif* and *Rabi* crop rather than growing fodder.
3. Open grazing is also a problem.
4. No irrigation and fencing is available in the cultivated area.
5. Most of the areas are affected by flood called as Kachhar and short duration fodder is requirement of that area.
6. Farmers need to be educated and motivated for fodder production.

Dr. C.K. Baruah, D.V.O. Karimganj also stated the problem of availability of seed material and lack of motivation of the farmers to take fodder. He suggested that

1) *Penisetum pedicellatum* is well grown in Assam and this may be promoted in the state.
2) Along with seed, the cost of manuring and fencing should also be provided to farmers. Locally available lilly weeds may be used as fodder.
3) Another D.V.O. asked for the fund availability for promoting fodder in the state.

**Recommendations of fodder workshop**

The workshop dwelled in detail about the various aspects of addressing the problems of fodder shortage in the state of Assam. After threadbare discussion and deliberations, the following action points emerged:

- Moringa can be a potential source of legume fodder in upland areas.
- Cowpea, maize, multicut sorghum, oat were identified as popular fodder crops for the entire state.
- Hybrid Napier/guinea grass intercropped with rice bean can be promoted for round the year fodder production system.
- Congo signal grass, dinanath grass can also be a important fodder crops of the state.

- In rice fallow land oat, cow pea and maize before paddy:
  - High rainfall/water stagnated area: rice bean as annual fodder and para grass as perennial fodder.
  - Marshy land: Dal grass
  - Tiger grass/broom grass can be used as fodder
  - The potential fodder trees recommended are: Bauhinia, Jack fruit, Subabul etc.
  - Silage making could be and for overcoming green fodder shortage during lean period.
  - Ration balancing using fodder resources should be followed.
  - Crop residue could be conserved as fodder banks using densification technologies like bale making etc.

* Further enrichment of dry fodder with urea spray, mineral mixture could improve the nutritive value of the fodder.
* There is need for assessing the potential of locally available fodder sources and due emphasis should be given for tapping those resources.
* Collection and conservation of paddy straw and areca nut leaves after harvest must be encouraged.
* Popularization of azolla as a feed supplement
* Creating awareness providing fodder related information, knowledge among the farming community through self-help groups (SHGs) must be undertaken.
* Besides training the farmers about fodder technologies, field demonstrations on fodder crops should be taken up on farmers' field.

# Annexure-II

## List of participants in Workshop on Fodder Production Conservation and Utilization at Guwahati, Assam on November 25, 2019

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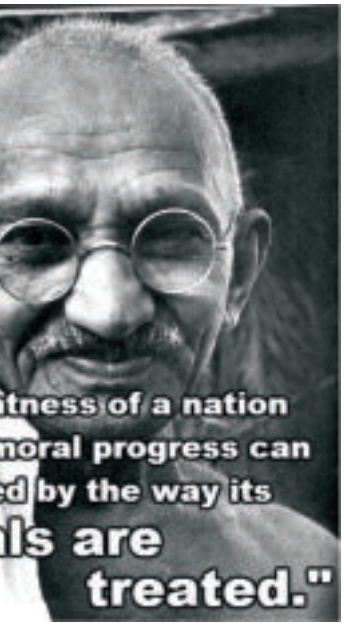
# Annexure-III

## 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<br>JHPM-05-2 | 50-60<br>70-80 | Whole country<br>Whole country except south zone | 2007<br>2008 |
| Guinea grass | Bundel guinea 1 | 40-50 | Punjab, HP, Central UP, Maharastra, Tamilnadu | 2004 |
| | Bundel guinea 2 | 50-55 | Rainfed conditions in semi-arid, tropical, sub-tropical and humid tropics | 2008 |
| | Bundel guinea 4 | 75-81 | All guinea grass growing areas | 2012 |
| Sehima | Bundel Sen Ghas -1 | 18-20 | Semi-arid, tropical and sub-tropical areas across the country | 2007 |
| Chrysopogon | Bundel Dhawalu Ghas-1 | 26-30 | Rangelands under rainfed condition across the country | 2007 |
| Heteropogon | Bundel Lampa Ghas-1, IGHC-03-4 | 25-30 | Rangelands under rainfed condition across the country | 2007 |
| Dichanthium | Bundel Marvel Grass-2013-2 (JHD- 2013-2) | 35-45 | NWZ particularly for Punjab and Rajasthan | 2017 |

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