Fodder Resources Development Plan for Madhya Pradesh

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

An ISO 9001:2015 Certified Institute

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

Fodder Resources Development Plan for Madhya Pradesh

...a policy paper

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सत्यमेव जयते

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Secretary (DARE) &
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भारतीय कृषि अनुसंधान परिषद
कृषि एवं किसान कल्याण मंत्रालय, कृषि भवन, नई दिल्ली–110 001

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Message

It gives me immense pleasure to learn that the State specific, "Fodder Resources Development Plan", has been developed by the ICAR-Indian Grassland and Fodder Research Institute, Jhansi for Madhya Pradesh, in consultation with all the stakeholders from the state, under their program 'National Initiatives on Accelerating Fodder Technology Adoption (NIAFTA)'.

Crop-livestock mix farming is the major source of livelihood and potential source of rural employment in Madhya Pradesh. The state is endowed with rich natural resources, salubrious climate and fertile agro-climatic conditions. It spreads over a large area, and has a terrain of plains in some areas and a hilly topography in other areas with a very high percentage of area under forest cover. The economy of Madhya Pradesh was ranked 10th among all the states of India during 2018-19. The majority of the state's population depends upon farming activities. Majority of farmers of the state depend on animal husbandry for their livelihood security. With the supply of milk, meat, eggs, wool, their castings (dung) *etc.,* animal husbandry plays an important role in the rural economy since time immemorial. Livestock production and agriculture are intrinsically linked to each other, and both are crucial for overall food security and economic viability of the farmers. The state has shown the true potential for growth in milk production and achieved a milestone in 2018-19 by achieving 10 million tonnes in milk production. The availability of quality fodder is the major challenge for enhancing the livestock productivity in the state.

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

7th June, 2023
New Delhi

(Himanshu Pathak)

Fodder Resources Development Plan for Madhya Pradesh prepared as a part of

National Initiative for Accelerating Fodder Technology Adoption (NIAFTA)

ICAR-Indian Grassland and Fodder Research Institute, Jhansi

Themes of NIAFTA

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

NIAFTA Coordination Team

Dr. Amaresh Chandra, Director	Chairman
Dr. Purushottam Sharma, PS & Head	Nodal Officer
Dr. V.K. Yadav, PS & Head	Member
Dr. Gaurendra Gupta, Scientist	Member
Dr. B.B. Choudhary, Scientist	Member
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Sri A.K. Saxena, CTO	Member

Madhya Pradesh Fodder Resources Development Plan Committee

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Dr. N. Biradar	Chairman
Dr. A.K. Roy	Member
Dr. S.R. Kantwa	Member
Dr. Vinod Kumar	Member
Dr. V.K. Wasnik	Member

Acknowledgement

The fodder resource development plan provides technological options available for enhancing production, conservation and value addition of fodder resources of the state. It is prepared with an objective to provide executable plan for the state government and other agencies involved in livestock and fodder related sector. It deals with area specific strategy which can be adopted to enhance the forage resource for better livestock output and increasing the livelihood options of the rural community.

Looking into the shortage of green and dry fodder in the country, the idea and vision of the development of state-wise fodder plans for different states of the country were visualized by Prof. Trilochan Mohapatra, Ex Secretary DARE, and Director General, ICAR. He advised to develop a state-wise fodder resource development plan which covers the broad areas as per the requirement of the state. We are highly grateful to him for his insight, guidance, encouragement, continuous support and suggestions in preparing this document. We extend our sincere thanks to Prof. Himanshu Pathak, Hon'ble Secretary DARE, and Director General, ICAR for motivating us for continuation of this important activity. We are also thankful to the Deputy Director General (Crop Science), ADG (FFC) and other officers of the ICAR who extended their support during the development of the fodder plan of Madhya Pradesh.

The institute is grateful to Sh. Lakhan Singh Yadav, Hon'ble Cabinet Minister, Animal Husbandry, Government of Madhya Pradesh, who inaugurated workshop, Hon'ble VC, JNKVV Jabalpur and their scientists, Dr. R.K. Rokde, Director, Directorate of Animal Husbandry and officers of Department of Animal Husbandry, Madhya Pradesh, for support in organizing interactive fodder resource development plan workshop and development of this plan.

The efforts made by our team from ICAR-IGFRI, Jhansi in preparation of fodder plan for the state of Madhya 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 Purushottam Sharma, Principal Scientist, deserves special appreciation.

(Amaresh Chandra)
Director
ICAR-IGFRI, Jhansi

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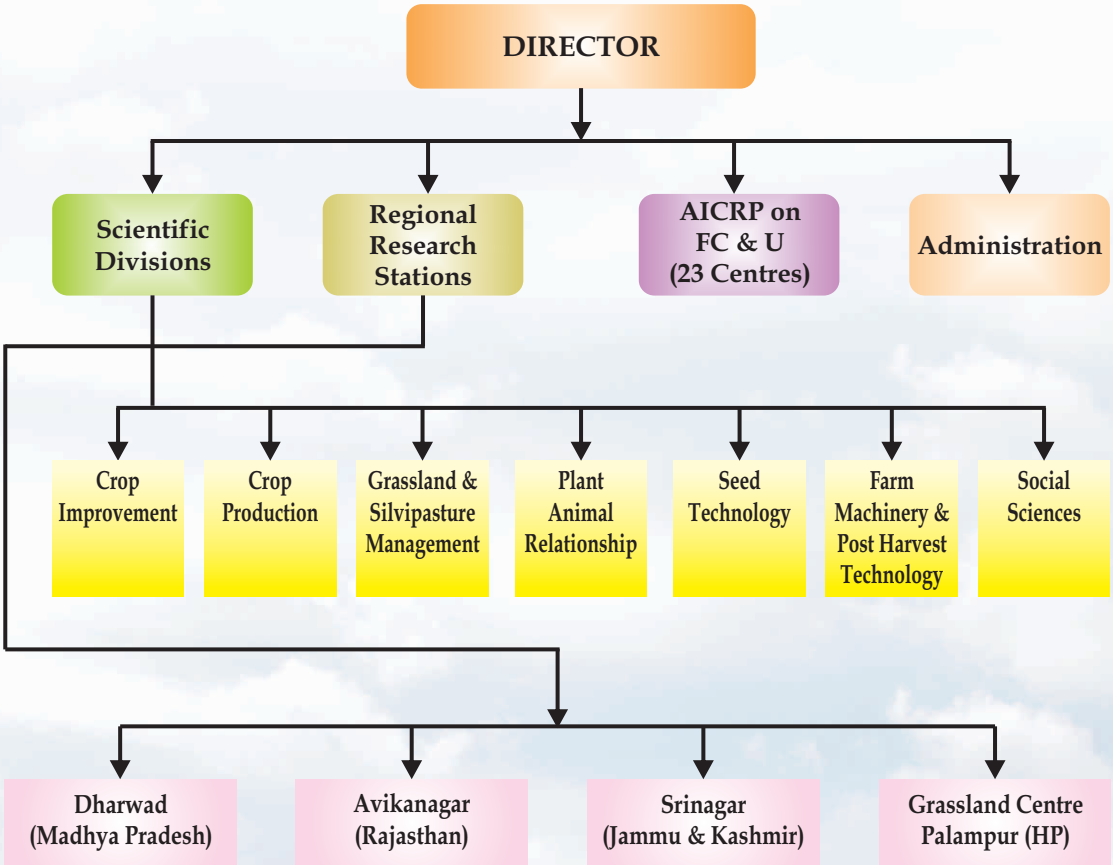
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IGFRI
Grassland

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 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 centers 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). Recently, ABIC has been established to develop and provide entrepreneurship skills in technologies generated by the institute as well as incubation center to train and skill upliftment.

Mandate

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

The institute has successfully served the country for 60 years achieving several milestones in generation of fodder technologies. Institute was conferred with "Sardar Patel Outstanding ICAR Institution Award in the year 2015" for its outstanding progress and contributions in the field of forage research, capacity building and infrastructure development. Institute is an ISO 9001: 2015 certified institute. The institute is 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 of fodder production technologies. The MoU of research institution are for collaboration on education, technology dissemination and providing consultancy on different proven technologies. Field demonstration on validated technologies for resource conservation and productivity enhancement in red soils of Bundelkhand region are operating at full fledge. Several outreach programmes such as Adarsh Chara Gram (a cluster of three villages), Mera Gaon Mera Gaurav (MGMG),

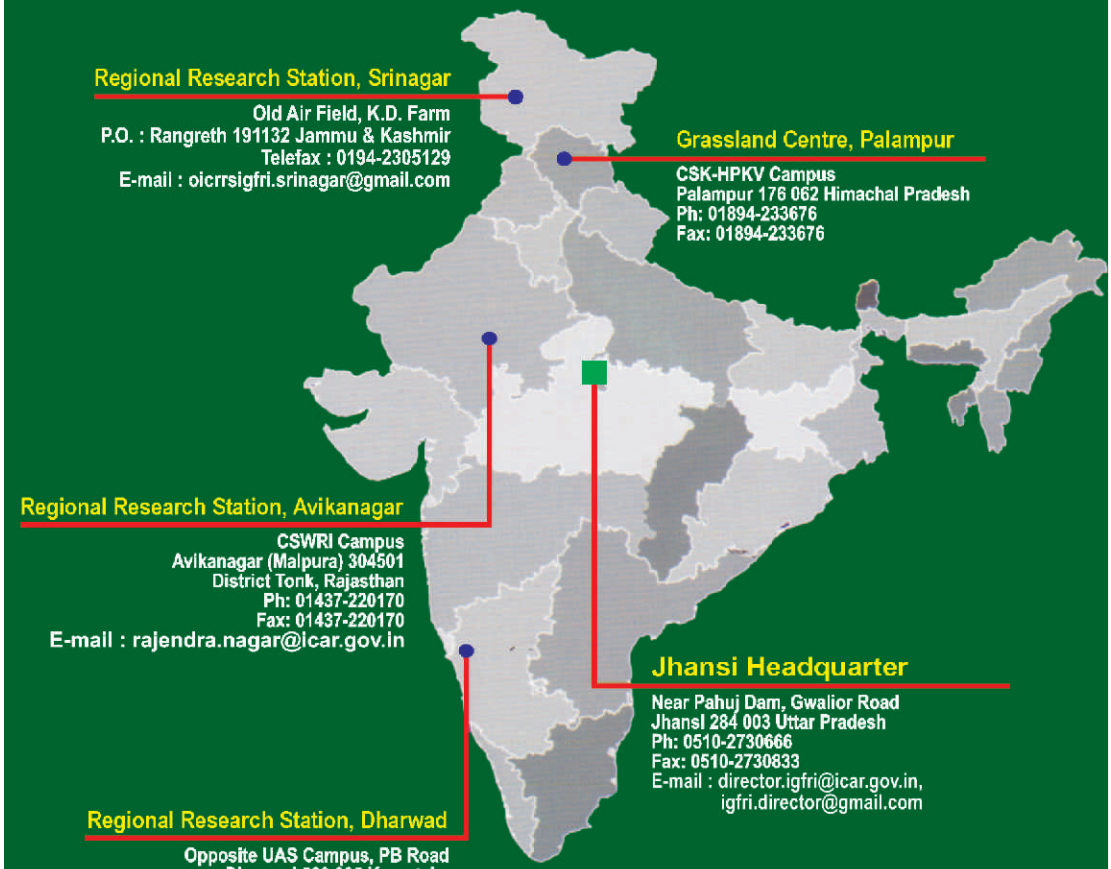
National Initiative on Fodder Technology Demonstration (NIFTD), Network Project on Bhadawari Buffaloes, Participatory Fodder Production in Mango Orchards, Farmers FIRST Programme, NICRA, TSP, SCSP, NEH, DFI-Kisan Mitra and NIAFTA have been initiated and implemented.

NIAFTA: New Initiative

Institute has initiated "National Initiative for Fodder Technologies Adoption (NIAFTA)" to formulate an implementable fodder resource development plan for each state/UT of the country 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

https://igfri.icar.gov.in



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Part-I : Agriculture, Livestock and Fodder Scenario

A. Introduction

Madhya Pradesh was constituted on recommendation of the State Re-organization Commission on 1st November 1956. Situated between 21°60'N and 26°54'N latitudes and 74°0' and 82°47'E longitudes, this is the second largest state in the country in terms of area after Rajasthan, and the fifth in terms of population (Figure 1). State is endowed with rich natural resources, salubrious climate and fertile agro-climatic conditions. At present, Madhya Pradesh consists of 10 divisions and 52 districts. As per 2011 census, it has a population of 72.6 million with a population density of 236 person per sq km.

Figure 1 : Geographical location of Madhya Pradesh

It spreads over a large area, and has a terrain of plains in some areas and a hilly topography in other areas with a very high percentage of area under forest cover. MP has a sub-tropical type of climate with hot dry summer and cool dry winter thus it experiences the extreme climatic condition. Temperature rises to as high as 40°C or more particularly in the southern part in the districts of Khandwa, Khargone and Barwani *etc*.

The economy of Madhya Pradesh was ranked 10th position among all the states of India during 2018-19. Madhya Pradesh consists largely of a plateau streaked with the hill ranges of the Vindhyas and the Satpuras with the Chattisgarh plains to the east. For the sake of convenience, Madhya Pradesh is divided into 7 physiographic divisions which are Malwa plateau, plateau of Madhya Bharat, Bundelkhand plateau, Rewa Panna plateau, Narmada-Son valley, Satpura Maikal range and Baghelkhand Plateau. Madhya Pradesh with 32.8 million tonnes food grain production in 2018-19 was the second largest producer and accounted for about 14 per cent share in the country's total food grain output (285 million tonnes). Major food grains produced in the state include wheat, rice, maize, pearl millet, gram, pea, green gram, black gram and pigeon pea. Madhya Pradesh also recorded highest pulse production (7.81 million tonnes) in 2018-19 and state remains 3rd largest producer of vegetables with 18.15 million tonnes in 2018-

19, in India after UP and West Bengal. This is partly due to the fertile regions of Malwa plateau, Central Narmada Valley and Vindhyan range and Ganga, Narmada, Godavari, Tapi & Mahi basins and partly due to irrigation facilities created as great network of canals and tube-wells exists in the state. Soybean, groundnut and cotton are the major cash crops of the region. Central, eastern and northern part of MP is more advanced in terms of agriculture as compared to the other regions in the state. The majority of the state's population depends upon farming activities. Madhya Pradesh is one of the most important states in India as far as horticulture production (27.06 mt) is concerned after UP (39.7 mt) and West Bengal (32.95mt). Fruit crops occupy about 3.53 lakh hectare area in the state. The gross cropped area is 19.71 million hectare and the area sown more than once is 4.6 million hectare with the cropping intensity of 131% (2004-05). In Madhya Pradesh, the number of small and marginal farmers is about 62% of total land holders but their share in area is only 22%. Other 38% farmers are having 78% area. The total number of land holdings are 88.70 lakhs out of which 38.91 lakh (43.86%) are marginal farmers, 24.48 lakh (27.59%) small farmers and 25.31 lakh (28.53%) farmers hold land above 2 hectare.

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

B. Agro-climatic zones

On the basis of major climates suitable for a certain range of crops and cultivars, the Madhya Pradesh state is divided in 11 Agro-climatic zones. Relevant information of the zones is given in table 1.

Table 1: Description of Agro-climatic zones of Madhya Pradesh

S.No.	Agro-climatic zone	Districts covered	Districts partly covered	Total area (lakh ha)	Rain-fall (mm)	Soil type
1	Chhattisgarh plains	Balaghat	-	9.25	1200-1600 (3.00%)	Red & Yellow (Medium)
2	Northern Hill Region of Chhattisgarh	Shahdol, Mandla, Dindori, Anuppur, Sidhi (Partly), Umaria	Sidhi:- Singroli tehsil (Bedhan)	28.17 (9.16%)	1200-1600	Red & Yellow, Medium black skeletal (Medium/light)

3	Kymore Plateau & Satpura Hills	Rewa, Satna, Panna, Jabalpur, Seoni, Katni, Sidhi (except Singroli tehsil of Jabalpur)		49.97 (16.25%)	1000-1400	Mixed red and black soils (Medium)
4	Central Narmada Valley	Narsinghpur, Hoshangabad, Sehore (Partly), Raisen (Partly)	Sehore:- Budni Tehsil, Raisen:- Bareli Tehsil.	17.45 (5.67%)	1200-1600	Deep black (deep)
5	Vindhya Plateau	Bhopal, Sagar, Damoh, Vidisha, Raisen, (except Bareli Tehsil), Sehore (except Budni tehsil), Guna	-	42.59 (13.85%)	1200-1400	Medium black & deep black (Partly) (Medium/ Heavy)
6	Gird Region	Gwalior, Bhind, Morena, Sheopur-Kala, Shivpuri, (except Pichore, Karera, Narwar, Khaniadana Tehsil, Guna (except Aron, Raghogarh, Chachoda tehsil), Ashoknagar	-	31.85 (10.36%)	800-1000	Alluvial (Light)
7	Bundelkhand	Chhattarpur, Datia, Tikamgarh & Shivpuri (Partly)	Shivpuri :- Karera, Pichhore, Narwar & khaniadhana Tehsils.	22.82 (7.42%)	800-1400	Mixed red and black (Medium)
8	Satpura Plateau	Betul & Chhindwara	-	21.93 (7.13%)	1000-1200	Shallow black (Medium)
9	Malwa Plateau	Mandsaur, Neemuch, Ratlam, Ujjain, Dewas, Indore, Shajapur, Rajgarh & Dhar (Partly), Jhabua (Partly)	Dhar :- Dhar, Badnawar & Sardarpur, Tehsils. Jhabua:- Petlawad Tehsil	51.47 (16.74%)	800-1200	Medium black (Medium)

10	Nimar Plains	Khandwa, Burhanpur, Khargone, Barwani, Harda, Dhar (Partly)	-	25.17 (8.18%)	800-1000	Medium black (Medium)
11	Jhabua Hills	Jhabua (except Petlawad tehsil), Alirajpur & Dhar (Partly)	Dhar :- Only Kukshi Tehsil	6.88 (2.24%)	800-1000	Medium black skeletal (Light/ Medium)

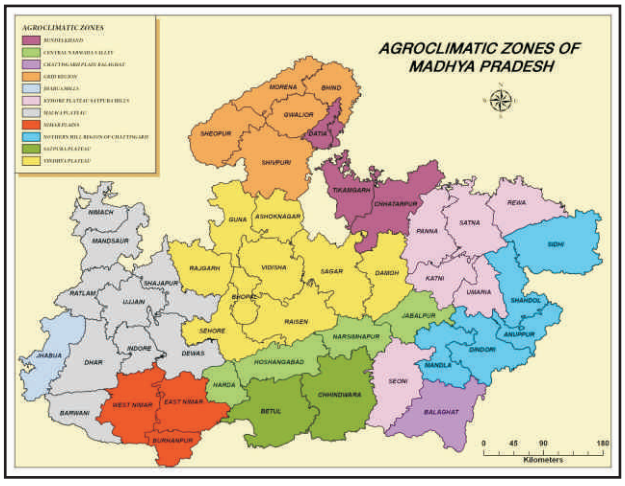

Figure 2 : Agroclimatic zones of MP

C. Interactive Workshop- ICAR-IGFRI and State Departments

As a step towards augmenting fodder production and its proper utilization for ensuring the qualitative and quantitative fodder availability to the livestock, ICAR-Indian Grassland and Fodder Research Institute, Jhansi in collaboration with the Animal Husbandry (AH), Govt. of MP organized one day Workshop on, "Fodder Production, Conservation and Utilization", at RCPV Noronha Academy of Administration and Management, Bhopal on 29th January, 2020. About 120 officers and other staff from different districts of MP participated in this meeting (Figure 3).

The major agenda items of the workshop were to highlight the fodder scenario in the state, activities of IGFRI Jhansi in mitigating the fodder scarcity, latest cultivation technologies, new high yielding varieties, modern methods of fodder conservation viz. silage and hay making, fodder based ration for livestock, suitable for the state.

The workshop was inaugurated by Sh. Lakhan Singh Yadav, Cabinet Minister, Animal Husbandry, Government of Madhya Pradesh. Dr. R.K. Rokde, Director, Directorate of Animal Husbandry in his welcome address highlighted the fodder related problems of MP and showed his pleasure with the presence of IGFRI for development of fodder plan for the state. Sh. Lakhan Singh Yadav 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 stressed upon need for technologies for grassland and pasture development on waste lands, model goshalas and also imparting training to state government officers and field level staff.

Figure 3 A: Inauguration of fodder plan workshop by Hon'ble minister Sh. Lakhan Singh Yadav ji

Figure 3 B. Discussion with Participants of fodder plan workshop

Figure 3 C. Participants of one day fodder plan workshop at Bhopal

Dr. Vijay Yadav, the Director IGFRI presented the brief overview of fodder technologies available and requested the state government officials to interact with IGFRI experts and give suggestions for incorporation in the fodder plan of state. Dr. Yadav also suggested to conduct a training cum exposure program of fodder technologies for the MP government officials at IGFRI, Jhansi. Dr. S.R. Kantwa, Principal Scientist, presented the State Fodder plan for all 11 ago-climatic zones and discussed about advance fodder production technologies for arable land. Dr. R.V. Kumar, Head GSM Division, explained in detail the technologies of silvi-pasture, horti-pasture and development of grassland on marginal lands. Dr. Sultan Singh, Principal Scientist, presented the post harvest technologies of fodder conservation especially for hay and silage preparation. Dr. B.P. Kushwaha, Principal Scientist, briefed about conservation and improvement of Bhadawari buffalo and identification of Bundelkhandi goat as recognized breed in coming days. Dr AK Mehta, OIC- AICRP- FCU, JNKVV Jabalpur gave presentation about fodder improvement, production and fodder seed production in the state. Dr. Dubey, from ICAR- CIAE Bhopal and Dr. Amit Kumar Patil from IGFRI presented brief about different machineries developed for sowing, intercultural operations and harvesting.

Dr. Purushottam Sharma, Principal Scientist, highlighted the social and economic benefits of forage production and feeding. He also informed about the 4 mobile apps and facilities available for the farmers in ATIC, IGFRI, Jhansi.

Dr. R.K. Rokde, Director, AH, briefed about 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 in the state. He also instructed all officers for plantation of BN hybrid on all farms.

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

D. Livestock Scenario

As per the 2019 livestock Census, there were about 40622 thousand livestock head of which 18735 thousand were cattle, 10307 thousand buffaloes, 11065 thousand goats, 325 thousand sheep and 165 thousand pigs (Table 2) in the state. As compared to previous livestock census of 2012, the present census 2019 showed an increase in exotic/crossbred population by 99.69 percent and decrease in indigenous cattle by 9.09 per cent whereas buffalo population increased by 25.88% and goat population increased by 38.07% (Table 3). The number of indigenous milch cows remained almost same as 5930.2 to 5969 thousand and exotic/crossbred milch cows increased 383.2 to 812.3 thousand, similarly the population of milch buffaloes increased from 3912 to 4939 thousand (Table 4). The milk production is mainly from cows (7751.11 thousand tonnes) followed by buffaloes (7363.4 thousand tonnes) and goat (796.65 thousand tonnes) (Table 5). A significant increase was observed in per capita milk availability which increased from 349 gm/day in 2013-14 to 538 g/day in 2018-19. This change in composition of dairy animals has also helped in sustaining growth in milk production which is about 16.3% of the total milk production of the country. In 2018-19, Madhya Pradesh produced 15911.13 thousand tonnes of milk but the productivity is very less (8.48 and 3.0 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 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 MP (census 2019)

Species	Population (Number in thousands)
Cattle	18735
Buffaloes	10307
Sheep	325
Goat	11065
Pig	165
Total	40662

Table 3: Comparative categorization of livestock population between 2012 and 2019 census

(Number in thousands)

Year	Cattle						Buffaloes			Goat
	Exotic			Indigenous			Male	Female	Total	
	Male	Female	Total	Male	Female	Total				
2012	159.9	681.1	840.9	8064.6	10696.8	18761.4	1283.6	6904.4	8187.9	8013.9
2019	156.9	1522.4	1679.2	5961.6	11094.3	17055.9	978.9	9328.2	1037.1	11604.5
% change	-1.82	+123.5	+99.7	-26.1	+3.72	-9.09	-23.7	+35.11	+28.88	+38.1

Table 4: Comparative categorization of in milch livestock population between 2012 and 2019 census

(Number in thousands)

Year	Milch cows (Indigenous)	Milch cows (Exotic/CB)	Milch bufflaoes
2012	5930.2	383.2	3911.6
2019	5969.0	812.3	4939.2
% change	+0.66	+111.98	+26.27

Table 5: Milk production during 2018-19 (in '000 tonnes)

	Buffaloes	Cattle	Goat	Total
Milk production	7363.4	7751.11	796.65	15911.13

E. Fodder Scenario

The productivity of livestock is mainly dependent on green and dry fodder, but the state has a shortage of green fodder, dry fodder and concentrates to the extent of about 35.04, 40.71 and 40.21%, respectively (Table 6) as per Roy *et al.,* 2019. Fodder crops are the cheapest source of feed for livestock but the area (year 2003-04) under fodder cultivation (approx. ten thousand hectares) and permanent pastures & grazing lands (13.21 lakh hectares), is not sufficient. The declining area and deteriorating quality of natural grassland has further compounded the fodder scarcity.

Current requirement of green fodder in state is 37.41 million tonnes, while the availability is only 24.30 million tonnes. Hence, availability of green fodder is hovering around at about 64.96% (Table 6). Further it is clear from the table 7 that much of the fodder in the state is contributed from crop residue *viz.,* coarse straw 25.11% and fine straw 11.42%, together accounts to 36.53%. If supply of green fodder is increased, the milk production in the state will also increase and the income of the farmers may be doubled in coming days. The establishments of pasture with suitable species, adoption of new technologies and demonstrations/capacity building programmes will guide the stakeholders to improve cost effective fodder availability and improve the income of farmers. The annual requirement of fodder in Madhya Pradesh state in terms of dry

fodder is estimated at 19.65 million tonnes of which, about 59.29% or only about 11.65 million tonnes is available. Occurrence of natural calamities like drought and flood has become a regular feature in many districts of the State further aggravates the deficit of feed and fodder resources. Despite this feed constraint, milk production in the state has been exhibiting an increasing trend because of high yielding cross bred animals and more dependence on concentrates which is much more costly than green fodder.

Therefore, 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, productivity and quality of green fodder. Therefore, there is an urgent need for developing fodder security plan for round the year feed and fodder supply in different agro-climatic zones of the state.

Table 6: Fodder requirement and availability in Madhya Pradesh

Type	Requirement (million tonnes)	Availability (million tonnes)	Availability (%)	Deficit (%)
Green	37.41	24.30	64.96	35.04
Dry	19.65	11.65	59.29	40.71

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

Table 7: Percentage contribution of different sources towards total estimated DM availability in Madhya Pradesh State

Type	Contribution (%)
Coarse straw	25.11
Fine straw	11.42
Leguminous straw	23.80
Sugarcane tops	2.25
Total crop residues	62.58
Gross cropped area	18.60
Fallows	0.32
Forests	5.37
Pasture	2.75
Others*	0.37
Total greens	27.40
Grains	0.97
Brans and chuni	1.22
Oil cakes	7.84
Total concentrate	10.03

Source: Estimation prepared for the purpose using data from 2015-2019

Part-II : Fodder Resource Development Plan

Strategies for enhancing fodder resources

Keeping in view the importance of fodder and constraints in fodder production, to overcome the gap between demand and supply, the emphasis need to be given on several steps for augmenting the fodder production in the state. Existing resource utilization pattern needs to be studied in system approach. Fodder production is a component of the farming system and efforts need to be made for increasing the forage production in a system mode. The holistic approach of integrated resource management for fodder production will be based on maintaining the fragile balance between productivity functions and conservation practices for ecological stability and 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 as forest department is allowing for planting of fodder trees and grasses in forest finches. It is suggested to grow forage grasses and fodder trees along with village roads and panchayat lands, and on terrace risers/bunds - a non-competitive land use system. Use of participatory techniques to identify the problems of fodder production and utilization 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 as per carrying capacity) are some other solutions to this problem. 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 are developed on the basis of their performance in different agro-climatic zones and 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 specific cropping systems prevailing in the zones. Details of different interventions are explained as under:

A. Cultivated fodder resources

Land allocation under fodder crops and grazing lands/permanent pastures is about ten thousand ha and 13.21 lakh ha, respectively. Fodder cultivation is taken on very less area and farmers are fulfilling their fodder requirement through seasonal weeds in existing crops and straw 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 per cent of the cultivated area under fodder crops. The net sown area of Madhya Pradesh is estimated at 153.02 lakh hectares with a cropping intensity of 149%. Thus 5 per cent area (7.65 lakh ha.) with 149% cropping intensity comes to about 11.34 lakh hectare which is required

to have a reasonable and sustainable fodder supply in the state. Of this, about 4.54 lakh hectare should be brought under perennial fodder crops and 6.80 lakh hectare under annual fodder crops. There is number of fodder crops suitable under different agro-climatic conditions of state. A large basket of perennial grasses, range legumes, cultivated forage cereals & legumes are identified as suitable for different agro-climatic zones of the state. The crops like bajra x napier hybrid, perennial sorghum, sorghum, maize, pearl millet, oat, cowpea, berseem, lucerne, guar *etc.,* are suitable for irrigated and arable land conditions whereas crops like Anjan grass, Dinanath grass, Marvel grass, Guinea grass, *Heteropogon*, *Chrysopogon*, *Stylosanthes etc.,* are suitable for rainfed and non-arable land conditions. Crops like BN hybrid, perennial sorghum, guinea grass, etc being perennial in nature, once planted will be able to provide fodder for 3-4 years. It thus saves investment on seed cost and land preparation. With the inclusion of leguminous fodder in inter row space of perennial grasses, round the year quality green fodder supply for livestock can be ensured. In case of perennial fodder crops propagated through stem cuttings or rooted slips, micro-nurseries may be developed in each block with 25000-40000 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 8.

Table 8. Suitable fodder crops, varieties and seed/planting requirement in different agroclimatic zones:

Zone/Fodder crops	Varieties	Seed/ root slips/ stem cuttings/ha	Average yield (t/ha/ annum)
1. Chhattisgarh plains			
Maize	African tall, Pratap Makka Chari 6	40-50 kg/ha	35-40
Sorghum	CSH-13-R hybrid, CSV-15, Harasona, Haryana Chari-308, Jawahar Chari-6 & 69, MP chari, PC-6 & 9	20-30 kg/ha	25-35
Cowpea	BL-1, EC 4216, GFC-3, UPC-607, UPC 618, UPC -625	30-35 kg/ha	15-20
Oat	JHO-851, JHO-822, JHO- 2009-1, Jawahar oat 03-93, Jawahar Oat 03-91, JO-01, JO-2, OL-1769-1	80-100 kg/ha	35-40
Berseem	BB-2, JB-1, JB-5, BL-2, 10, 22; UPB-110, Wardan, JBSC-1, JHB 17-1, JHB 17-2	30-35 kg	60-70
Rice bean	Jawahar Rice Bean-1, JRBJ-05-1	30-35 kg/ha	25-30
Bajra Napier hybrid	IGFRI-3, BNH -10, CO (BN)-5, Co BN -6, BNH 11, BNH 14	28,000 nos.	80-120

Guinea grass	Bundel Guinea-1, Bundel Guinea-2, PGG-14, DGG-1	40,000 nos.	90-110
Setaria	PSS-1	40,000 nos.	70-80
Para grass (*Brachiaria mutica*)	Local improved selection	40,000 nos.	30-40
2. Northern Hill Region of Chhattisgarh			
Maize	African tall, Pratap Makka Chari 6	40-50 kg/ha	35-40
Sorghum	CSH-13-R hybrid, CSV-15, Harasona, Haryana Chari-308, Jawahar Chari-6 & 69, MP chari, PC-6 & 9	20-30 kg/ha	25-35
Cowpea	BL-1, EC 4216, GFC-3, UPC-607, UPC 618, UPC -625	30-35 kg/ha	15-20
Rice bean	Jawahar Rice Bean-1, JRBJ-05-1	30-35 kg/ha	25-30
Oat	JHO-851, JHO-822, JHO- 2009-1, Jawahar oat 03-93, Jawahar Oat 03-91, JO-01, JO-2, OL-1769-1	80-100 kg/ha	35-40
Berseem	BB-2, JB-1, JB-5, BL-2, 10, 22; UPB-110, Wardan, JBSC-1	30-35 kg	60-70
Bajra Napier hybrid	IGFRI-3, BNH -10, CO (BN)-5	28,000 nos.	80-120
Guinea grass	Bundel Guinea-1, Bundel Guinea-2, PGG-14, DGG-1	40,000 nos.	90-110
Dinanath grass	Bundel Dinanath- 1 & 2	40,000 nos.	50-60
Stylosanthes	*S. guanensis*	5-6 kg/ha	30-40
3. Kymore Plateau & Satpura Hills			
Maize	African tall, Pratap Makka Chari 6	40-50 kg/ha	35-40
Sorghum	CSH-13-R hybrid, CSV-15, Harasona, Haryana Chari-308, Jawahar Chari-6 & 69, MP chari, PC-6 & 9	20-30 kg/ha	25-35
Cowpea	BL-1, EC 4216, GFC-3, UPC-607, UPC 618, UPC -625	30-35 kg/ha	15-20
Oat	JHO-851, JHO-822, JHO- 2009-1, Jawahar oat 03-93, Jawahar Oat 03-91, JO-01, JO-2, OL-1769-1	80-100 kg/ha	35-40
Berseem	BB-2, JB-1, JB-5, BL-2, 10, 22; UPB-110, Wardan, JBSC-1	30-35 kg	60-70
Bajra Napier hybrid	IGFRI-3, BNH -10, CO (BN)-5	28,000 nos.	80-120
Guinea grass	Bundel Guinea-1, Bundel Guinea-2, PGG-14, DGG-1	40,000 nos.	90-110
Setaria	PSS-1	40,000 nos.	70-80
Dinanath grass	Bundel Dinanath- 1 & 2	40,000 nos.	20-30
Stylosanthes	*Stylosanthes hamata/scabra*	5-6 kg/ha	30-40

4. Central Narmada Valley			
Maize	African tall, Pratap Makka Chari 6	40-50 kg/ha	35-40
Sorghum	CSH-13-R hybrid, CSV-15, Harasona, Haryana Chari-308, Jawahar Chari-6 & 69, MP Chari, PC-6 & 9	20-30 kg/ha	25-35
Cowpea	BL-1, EC 4216, GFC-3, UPC-607, UPC 618, UPC -625	30-35 kg/ha	15-20
Oat	JHO-851, JHO-822, JHO- 2009-1, Jawahar oat 03-93, Jawahar Oat 03-91, JO-01, JO-2, OL-1769-1	80-100 kg/ha	35-40
Berseem	BB-2, JB-1, JB-5, BL-2, 10, 22; UPB-110, Wardan, JBSC-1	80-100 kg/ha	35-40
Bajra Napier hybrid	IGFRI-3, BNH -10, CO (BN)-5	28,000 nos.	80-120
Guinea grass	Bundel Guinea-1, Bundel Guinea-2, PGG-14 , DGG-1	40,000 nos.	90-110
Tri Specific hybrid	No specific variety	28,000 nos.	80-120
Stylosanthes	*Stylosanthes hamata/guanensis*	5-6 kg/ha	30-40
5. Vindhya Plateau			
Maize	African tall, Pratap Makka Chari 6	40-50 kg/ha	35-40
Sorghum	CSH-13-R hybrid, CSV-15, Harasona, Haryana Chari-308, Jawahar Chari-6 & 69, MP chari, PC-6 & 9	20-30 kg/ha	25-35
Pearl millet	BAIF BAJRA-1, MH-1610,	8-10 kg/ha	25-30
Cowpea	Raj Bajra Chari-2, BL-1, EC 4216, GFC-3, UPC-607, UPC 618, UPC -625	30-35 kg/ha	15-20
Guar	Bundel Guar- 3, Bundel Guar- 2	20-25 kg/ha	15-20
Oat	JHO-851, JHO-822, JHO- 2009-1, Jawahar oat 03-93, Jawahar Oat 03-91, JO-01, JO-2, OL-1769-1	80-100 kg/ha	35-40
Berseem	BB-2, JB-1, JB-5, BL-2, 10, 22; UPB-110, Wardan, JBSC-1	30-35 kg	60-70
Bajra Napier hybrid	IGFRI-3, BNH -10, CO (BN)-5	28,000 nos.	80-120
Guinea grass	Bundel Guinea-1, Bundel Guinea-2, PGG-14 ,DGG-1	40,000 nos.	90-110
Anjan grass	Bundel Anjan-3, Bundel Anjan-1	4 kg/ha	15-17
Marvel grass	JHD-13-2	4 kg/ha	15-17
6. Grid region			
Maize	African tall, Pratap Makka Chari 6	40-50 kg/ha	35-40
Sorghum	CSH-13-R hybrid, CSV-15, Harasona, Haryana Chari-308, Jawahar Chari-6 & 69, MP chari, PC-6 & 9	20-30 kg/ha	25-35

Pearl millet	BAIF Bajra-1, MH-1610, Raj bajra chari-2	8-10 kg/ha	25-30
Cowpea	BL-1, EC 4216, GFC-3, UPC-607, UPC 618, UPC -625	30-35 kg/ha	15-20
Guar	Bundel Guar- 3, Bundel Guar- 2	20-25 kg/ha	15-20
Oat	JHO-851, JHO-822, JHO- 2009-1, Jawahar oat 03-93, Jawahar Oat 03-91, JO-01, JO-2, OL-1769-1	80-100 kg/ha	35-40
Berseem	BB-2, JB-1, JB-5, BL-2, 10, 22; UPB-110, Wardan, JBSC-1	30-35 kg	60-70
Bajra Napier hybrid	IGFRI-3, BNH -10, CO (BN)-5	28,000 nos.	80-120
Guinea grass	Bundel Guinea-1, Bundel Guinea-2, PGG-14 ,DGG-1	40,000 nos.	90-110
Tri Specific hybrid	No specific variety	28,000 nos.	80-120
Anjan grass	Bundel Anjan-3, Bundel Anjan-1	4 kg/ha	15-17
Marvel grass	JHD-13-2	4 kg/ha	15-17
Black Spear Grass (*Heteropogon contortous*)	Bundel Lampa Ghas-1	4-5 kg/ha	20-25
7. Bundelkhand			
Pearl millet	BAIF BAJRA-1, MH-1610, Raj Bajra Chari-2	8-10 kg/ha	25-30
Cowpea	BL-1, EC 4216, GFC-3, UPC-607, UPC 618, UPC -625	30-35 kg/ha	15-20
Sorghum	CSH-13-R hybrid, CSV-15, Harasona, Haryana Chari-308, Jawahar Chari-6 & 69, MP chari, PC-6 & 9	20-30 kg/ha	25-35
Maize	African tall, Pratap Makka Chari 6	40-50 kg/ha	35-40
Guar	Bundel Guar- 3, Bundel Guar- 2	20-25 kg/ha	15-20
Oat	JHO-851, JHO-822, JHO- 2009-1, Jawahar oat 03-93, Jawahar Oat 03-91, JO-01, JO-2, OL-1769-1	80-100 kg/ha	35-40
Berseem	BB-2, JB-1, JB-5, BL-2, 10, 22; UPB-110, Wardan, JBSC-1	30-35 kg	60-70
Bajra Napier hybrid	IGFRI-3, BNH -10, CO (BN)-5	28,000 nos.	80-120
Guinea grass	Bundel Guinea-1, Bundel Guinea-2, PGG-14 ,DGG-1	40,000 nos.	90-110
Tri- specific hybrid (TSH)	No specific variety	28,000 nos.	80-120
Anjan grass	Bundel Anjan-3, Bundel Anjan-1	4 kg/ha	15-17
Marvel grass	JHD-13-2	4 kg/ha	15-17
Black Spear Grass (*Heteropogon contortous*)	Bundel Lampa Ghas-1	4-5 kg/ha	20-25

Dhraf grass (*Chrysopogon fulvus*)	Bundel Dhawalu grass-1	5 kg/ha	15-20
8. Satpura Plateau			
Cowpea	BL-1, EC 4216, GFC-3, UPC-607, UPC 618, UPC -625	30-35 kg/ha	15-20
Sorghum	CSH-13-R hybrid, CSV-15, Harasona, Haryana Chari-308, Jawahar Chari-6 & 69, MP chari, PC-6 & 9	20-30 kg/ha	25-35
Maize	African tall, Pratap Makka Chari 6	40-50 kg/ha	35-40
Oat	JHO-851, JHO-822, JHO- 2009-1, Jawahar oat 03-93, Jawahar Oat 03-91, JO-01, JO-2, OL-1769-1	80-100 kg/ha	35-40
Lucerne	AL-3, RL-88, LL-Composite-3	20-25 kg/ha	80-120
Bajra Napier hybrid	IGFRI-3, BNH -10, CO (BN)-5	28,000 nos.	80-120
Guinea grass	Bundel Guinea-1, Bundel Guinea-2, PGG-14 ,DGG-1	40,000 nos.	90-110
Tri- specific hybrid (TSH)	No specific variety	28,000 nos.	80-120
Anjan grass	Bundel Anjan-3, Bundel Anjan-1	4 kg/ha	15-17
Marvel grass	JHD-13-2	4 kg/ha	15-17
Black Spear Grass (*Heteropogon contortous*)	Bundel Lampa Ghas-1	4-5 kg/ha	20-25
Dhraf grass (*Chrysopogon fulvus*)	Bundel Dhawalu grass-1	5 kg/ha	15-20
9. Malwa Plateau			
Pearl millet	BAIF BAJRA-1, MH-1610, Raj Bajra Chari-2	8-10 kg/ha	25-30
Cowpea	BL-1, EC 4216, GFC-3, UPC-607, UPC 618, UPC -625	30-35 kg/ha	15-20
Sorghum	CSH-13-R hybrid, CSV-15, Harasona, Haryana Chari-308, Jawahar Chari-6 & 69, MP chari, PC-6 & 9	20-30 kg/ha	25-35
Maize	African tall, Pratap Makka Chari 6	40-50 kg/ha	35-40
Oat	JHO-851, JHO-822, JHO- 2009-1, Jawahar oat 03-93, Jawahar Oat 03-91, JO-01, JO-2, OL-1769-1	80-100 kg/ha	35-40
Lucerne	AL-3, RL-88, LL-Composite-3	20-25 kg/ha	80-120
Berseem	BB-2, JB-1, JB-5, BL-2, 10, 22; UPB-110, Wardan, JBSC-1	30-35 kg	60-70
Bajra Napier hybrid	IGFRI-3, BNH -10, CO (BN)-5	28,000 nos.	80-120
Guinea grass	Bundel Guinea-1, Bundel Guinea-2, PGG-14 ,DGG-1	40,000 nos.	90-110
Tri- specific hybrid (TSH)	No specific variety	28,000 nos.	80-120

Anjan grass	Bundel Anjan-3, Bundel Anjan-1	4 kg/ha	15-17
Marvel grass Black Spear Grass (*Heteropogon contortous*)	JHD-13-2 Bundel Lampa Ghas-1	4 kg/ha 4-5 kg/ha	15-17 20-25
10. Nimar Plains			
Maize	African tall, Pratap Makka Chari 6	40-50 kg/ha	35-40
Cowpea	BL-1, EC 4216, GFC-3, UPC-607, UPC 618, UPC -625	30-35 kg/ha	15-20
Sorghum	CSH-13-R hybrid, CSV-15, Harasona, Haryana Chari-308, Jawahar Chari-6 & 69, MP chari, PC-6 & 9	20-30 kg/ha	25-35
Pearl millet	BAIF Bajra-1, MH-1610, Raj bajra Chari-2	8-10 kg/ha	25-30
Oat	JHO-851, JHO-822, JHO- 2009-1, Jawahar oat 03-93, Jawahar Oat 03-91, JO-01, JO-2, OL-1769-1	80-100 kg/ha	35-40
Lucerne	AL-3, RL-88, LL-Composite-3	20-25 kg/ha	80-120
Berseem	BB-2, JB-1, JB-5, BL-2, 10, 22; UPB-110, Wardan, JBSC-1	30-35 kg	60-70
Bajra Napier hybrid	IGFRI-3, BNH -10, CO (BN)-5	28,000 nos.	80-120
Guinea grass	Bundel Guinea-1, Bundel Guinea-2, PGG-14 ,DGG-1	40,000 nos.	90-110
Tri- specific hybrid (TSH)	No specific variety	28,000 nos.	80-120
Bajra Squamulatum hybrid (BSH)	No specific variety	40,000 nos.	50-60
Anjan grass	Bundel Anjan-3, Bundel Anjan-1	4 kg/ha	15-17
Marvel grass	JHD-13-2	4 kg/ha	15-17
Black Spear Grass (*Heteropogon contortous*)	Bundel Lampa Ghas-1	4-5 kg/ha	20-25
Dinanath (*P. pedicellatum*)	Bundel Dinanath- 1&2	4-5 kg/ha	20-30
11. Jhabua Hills			
Maize	African tall, Pratap Makka Chari 6	40-50 kg/ha	35-40
Cowpea	BL-1, EC 4216, GFC-3, UPC-607, UPC 618, UPC -625	30-35 kg/ha	15-20
Sorghum	CSH-13-R hybrid, CSV-15, Harasona, Haryana Chari-308, Jawahar Chari-6 & 69, MP chari, PC-6 & 9	20-30 kg/ha	25-35
Pearl millet	BAIF Bajra-1, MH-1610, Raj bajra Chari-2	8-10 kg/ha	25-30
Oat	JHO-851, JHO-822, JHO- 2009-1, Jawahar oat 03-93, Jawahar Oat 03-91, JO-01, JO-2, OL-1769-1	80-100 kg/ha	35-40

Lucerne	AL-3, RL-88, LL-Composite-3	20-25 kg/ha	80-120
Bajra Napier hybrid	IGFRI-3, BNH -10, CO (BN)-5	28,000 nos.	80-120
Guinea grass	Bundel Guinea-1, Bundel Guinea-2, PGG-14 ,DGG-1	40,000 nos.	90-110
Tri- specific hybrid (TSH)	No specific variety	28,000 nos.	80-120
Bajra squamulatum hybrid	No specific variety	40,000 nos.	50-60
Anjan grass	Bundel Anjan-3, Bundel Anjan-1	4 kg/ha	15-17
Marvel grass	JHD-13-2	4 kg/ha	15-17
Black Spear Grass (*Heteropogon contortus*)	Bundel Lampa Ghas-1	4-5 kg/ha	20-25

Round the year fodder production system: Intensive forage production systems are designed 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 BN hybrid/guinea grass with cowpea during summer after the final harvest of berseem/lucerne 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 than the sole cropping systems. The detailed list of fodder based crop sequences for different agro-climatic zones of MP is given in Table 9.

Table 9: Crop diversification and promising intercropping system

Zone/Condition	Cropping system	Green Fodder yield (t/ha)
1. Chhattisgarh plains zone		
Irrigated	Maize + cowpea - toria + oat	150-175
	BN hybrid/ guinea grass+ (cowpea/ricebean - berseem)	120-170
Rainfed	Sorghum - lathyrus	60-70
Water logged	Para grass	70-80
2. Northern Hill Region of Chhattisgarh zone		
Irrigated	Multicut sorghum + cowpea - berseem/oat	150-170
	BN hybrid + (Cowpea - berseem - cowpea)	170-210
	Sorghum + cowpea - berseem - maize +cowpea	160-180
3. Kymore Plateau & Satpura Hills zone		
Irrigated	Sorghum + cowpea - oat/berseem	130-140
	BN hybrid/ guinea grass + (Cowpea - berseem)	150-175

4. Central Narmada Valley zone		
Irrigated	Multicut sorghum + cowpea - berseem/oat	150-170
	BN hybrid + (Cowpea - berseem - cowpea)	170-210
	Sorghum + cowpea - berseem - maize +cowpea	160-180
Rainfed	*Pennisetum* Tri Specific hybrid + subabul (fodder sorghum + pigeon pea)	50-55
5. Vindhya Plateau zone		
Irrigated	Multicut sorghum + cowpea - berseem/oat/ barley	110-140
	BN hybrid/guinea grass+ (Cowpea - berseem)	110-140
Rainfed	*Pennisetum* Tri Specific hybrid + subabul (fodder sorghum + pigeon pea)	50-55
6. Grid region zone		
Irrigated	Multicut sorghum + cowpea - berseem	150-170
	BN hybrid/guinea grass + (cowpea - berseem)	110-160
Rainfed	*Pennisetum* Tri Specific hybrid + subabul (fodder sorghum + pigeon pea)	50-55
7. Bundelkhand zone		
Irrigated	Multicut sorghum + cowpea - berseem	150-170
	BN hybrid/guinea grass + (cowpea - berseem)	110-160
Rainfed	*Pennisetum* Tri Specific hybrid + subabul (fodder sorghum + pigeon pea)	50-55
8. Satpura Plateau zone		
Irrigated	Sorghum + cowpea - oat/lucerne/ barley	130-140
	BN hybrid/guinea grass + (Cowpea - lucerne)	110-160
Rainfed	*Pennisetum* Tri Specific hybrid + subabul (fodder sorghum + pigeon pea)	50-55
9. Malwa Plateau zone		
Irrigated	Multicut sorghum + cowpea - berseem	150-170
	BN hybrid/guinea grass + (cowpea - berseem/lucerne)	110-160
Rainfed	*Pennisetum* Tri Specific hybrid + subabul (fodder sorghum + pigeon pea)	50-55
10. Nimar Plains zone		
Irrigated	Multicut sorghum + cowpea - berseem	150-170
	BN hybrid/guinea grass + (cowpea - berseem/lucerne)	110-160
Rainfed	*Pennisetum* Tri Specific hybrid + subabul (fodder sorghum + pigeon pea)	50-55
11. Jhabua hills zone		
Irrigated	Sorghum/bajra + cowpea - lucerne	150-170
	BN hybrid/guinea grass + (Cowpea - lucerne)	110-170
Rainfed	Bajra/sorghum	40-50
	Pennisetum Tri Specific hybrid + subabul (fodder sorghum + pigeon pea)	50-55

Figure 4: BN hybrid + Berseem round the year fodder prodcution system

B. Fodder production in fruit orchards through horti-pasture

Lack of soil moisture under degraded land is the most limiting factor for arable farming in the state. There are various alternate land use (ALU) systems which provides fodder, food, fruits, fuel such as silvi-pasture (tree+pasture/+animals), horti-pasture (fruit trees+pasture/+animal) and agri-horti-silvipasture (crop+fruit trees+MPTS+pasture). Multipurpose tree species (MPTS)/shrubs growing in ALU systems are useful as leaf fodder available for animal feed besides wood and other products. 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 MP, 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 as fruit crops occupied about 4.53 lakh ha area in the state (2018-19). 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 10). Aonla and Guava based hortipasture systems/model has been developed for higher forage productivity. The range grasses tested in the system were *Cenchrus ciliaris*, *Stylosanthes seabrana* and *Stylosanthes hamata*. In MP, Mango is grown in 26707 ha area in different agro-climatic zones which if put under fodder crops (BN Hybrid, guinea, setaria or other fodder crops) can produce a huge quantity of green fodder which can fulfil the round the year requirement of green fodder of our livestock. The common mango planting distance followed is 10m x 10m which gives minimum 7-8 m inter row space for introducing fodder crops. These mango orchards can be utilized for additional fodder production of state (Figure 5).

Table 10 : Fodder production from Non-arable lands

Hortipasture	Mango/ Anola/Guava + Guinea
	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 + 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. 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 mango orchard

C. Fodder production from permanent pastures/ grazing lands

According to Land Capability Classes, class V-VII are unfit for arable farming and mostly are extensive areas which have 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 MP, there is about 13.21 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 grazing guinea, anjan grass, dhaman, *Heteropogon*, *Dichanthium*, *Chrysopogon*, *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 BN hybrid, TSH, 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 without allocation of addition land to the fodder crops. Introducing perennial cultivated grasses on farm bunds along with irrigation channels involves growing of 2 rows of bajra x napier hybrid/guinea grass along with field boundary can supply 7-11q green fodder per 100m running length of boundary per year which can support milch animal of livestock keepers without any additional expenditure and land diversion (Figures 7 & 8). Total number of land holdings in MP is 8.87 million which gives an opportunity to grow fodder on their bunds/ boundary. Table 11 indicates the fodder production potential of bunds in the MP state.

Table 11 : Fodder production potential under different size of land holdings in MP

Size of holding	Total holding Number ('000)*	Average Size of Holding (ha)*	Total bund length available for fodder ('000 km)#	Fodder production @ only 7 kg/ metre bund length if 10% bund length utilized ('000 tonnes)**
Marginal (<1 ha)	3891.02	0.49	545.99	382.19
Small (1-2 ha)	2448.65	1.42	582.66	407.86
Semi-medium(2-4 ha)	1654.83	2.63	546.39	382.48
Medium (4-10 ha)	789.14	5.76	378.75	265.13
Large (>10 ha)	88.73	15.77	70.48	49.34
All classes	8872.38		2124.28	1487.00

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 : BN hybrid planted on bunds

Figure 8 : Grazing guinea planted on bunds

E. Alternative fodder resources

There is a need for exploring the alternative or non-conventional fodder resources *viz.*, moringa, *Azolla*, hydroponics, crushed areca leaves, pineapple wastes etc. Although, Azolla and hydroponics could be 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, belong to family *Moraginaceae*, is a good alternative for substituting commercial rations for livestock. The relative ease with which drumstick 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 50 x 50cm spacing gave 80-130 tonnes 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 where it is difficult to cultivate other agricultural crops.

Figure 9 : Moringa plantation for leaf meal production

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 B_{12}, 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 37.8t fresh weight/ha (2.78t DM/ha dry weight).

Figure 10 : Azolla on commercial scale

Figure 11 : Azolla at individual farmer

c. Hydroponic fodder production

Hydroponics is a method of growing plants without soil (Figure 12). 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 cowpea. 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.

Figure 12 : Hydroponic fodder production

F. Crop residue quality enhancement

Figure 13 : Mechanized urea treatment during threshing operations

The wheat, paddy, sorghum, bajra, maize, chickpea, urd, sugarcane, potato *etc.,* are important crops of the MP 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 13). 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 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, bale, silage and 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.

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 UP. 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 x napier hybrid grass, guinea grass, setaria, pineapple stover *etc.*

Table 12 : Suitable stage of harvest of different crops for silage making:

Forage crops	Stage of harvest
Maize	50% flowering to dough stage
Sorghum	50% flowering to dough stage
Oat	Boot to dough stage
Grasses	Early flowering

Size of silo:

A silo can contain 350 kg silage properly compacted chaffed material per cubic meter. Therefore to feed one animal @ 10 kg silage/day needs 300 kg/month or a silo of (approx.) 1 cubic meter (1x1x1 m). However to feed @ 20 kg silage/day per animal needs 600 kg/month will require a silo size of 2 cubic meter (2x1x1m).

Characteristics of quality silage:

- Brown and greenish brown in colour.

- It should be fragile, not clumpy
- It should have pleasant aroma of lactic acid

Table 13 : Ideal characteristics of good quality silage

Attributes	Good	Intermediate	Poor
pH	4.2-4.8	4.8-5.2	> 5.2
Lactic acid (%)	3-14	Variable	Variable
Butyric acid (%)	< 0.2	0.2-0.5	> 0.5
Ammonia-N (% of total N)	< 10	10-16	> 16

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 14 : Chaffing of forage for ensiling

Figure 15 : Trench silo

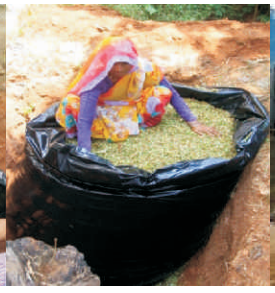

Figure 16 : Silage preparation in plastic bags

Figure 17 : Stack of the silage

H. Custom hiring centre

These need to be developed to provide equipment, 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 farmers and will help in reducing the cost of fodder production.

I. Contingency fodder planning and fodder conservation technologies

Establishing fodder banks

Drought/ floods cause misery both to humans and livestock due to the widespread crop failures leading to acute shortages of food and fodder and affecting human and livestock, nutrition and production. The excess crop residues produced can be processed as feed block, bales, leaf meal, and pellets and stored appropriately for utilization during natural calamities. This processed fodder can be stored in the form of a fodder bank at the block level or *tehsil* level in the drought/ flood prone areas.

There is a need of promoting the forage bank concept of preserving surplus production from rangelands during the rainy season in various forms to use during lean periods by transporting economically baled and nutritionally enriched dry fodder from surplus areas. Inter-state transport of crop residues especially paddy and wheat straw for fodder and feed security needs to be explored at the time of harvest of paddy and wheat. The facility may be strengthened to promote commodity forage banks at the *tehsil* level, where surplus fodder can be stored as hays/silage/ fodder blocks for use during scarcity. Establishing forage banks near forest covers and bringing crop residues from excess areas will meet the forage requirement during scarcity and natural calamities.

Live fodder banks: Live fodder banks in form of fodder trees and perennial grasses, legumes and shrubs should be planted along the road side, *panchayat* land, wastelands which can provide fodder during the lean period when ground grasses or annual grasses are not available.

Post harvest processing and conservation of excess fodder

a. Hay: Although it is common practice, necessary training is needed to ensure long keeping quality of the hay material. The basic principle of hay making is to reduce the moisture content in the green forages sufficiently as to permit their storage without spoilage or further nutrient losses. The moisture content 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. The thin stemmed forage crops such as oat, lucerne, berseem, cowpea, clovers and grasses are highly suitable for hay making.

***b. Silage*:** Silage-making is one of the technologies that empower farmers to provide quality roughage throughout the year using forages, crop residues, agro-industrial by-

products. Silage is a high-quality succulent feed resource resulting from the fermentation of green fodder stored and preserved anaerobically. Silage-making is practised to keep and preserve green fodder, when it is available in excess, for later use during the scarcity period. The surplus green fodder available during July-October and December-April can be used during scarcity period between mid-October to mid-December and mid-April to mid-July. 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 Gujarat. However, its success will depend on surplus forage production, the 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, oat, sorghum, Bajra Napier hybrid grass, guinea grass, Setaria, etc. Maize and sorghum may be harvested at 50% flowering stage, whereas oat may be harvested from boot to dough stage for silage making. Maize is the most suitable crop for silage making.

***c. Feed block/ Bales*:** The dry fodder being voluminous in nature often needs larger space and pose problems in transportation. Hence, pressing dry fodder into bales to reduce keeping space and ease transportation has been found to be more necessary in recent times. Bale making or feed block making could be good strategy for reducing the cost involved in transportation of fodder from one place to another and saving the space for storage. The mechanization aspect may also be thought of in terms of harvesting with weed cutters and chaffing of fodder with power operated chaff cutters, which reduce the reliance on manual labour and also help in saving time on these activities. It will also help in supplying fodder during the calamities as well as lean season.

Table 14. Contingent planning for fodder in Madhya Pradesh

Period	Contingent measures	
	Fodder based	**Feed & other sources**
Drought / lean period (Oct.- March)	• Encourage perennial fodder on bunds and waste land on community basis • Establishing fodder banks • Encouraging fodder crops in irrigated area • Silage- using excess fodder for silage	• Utilizing fodder from perennial trees • Fodder bank reserves • Utilizing fodder stored in silos • Transporting excess fodder from adjoining districts • Use of feed mixtures
Floods/Heavy rains	• Establishing fodder banks • Encouraging fodder crops in irrigated area • Silage- using excess fodder for silage	• Utilizing fodder from perennial trees • Fodder bank reserves

J. Seed requirement and availability for targeted area under forages

To reduce the gap in demand and supply of green fodder, some area (5-10%) needs to be devoted for growing fodder crops by the livestock keepers and farmers. Keeping 5 per cent area for fodder out of the net cultivated area, the requirement and source of fodder seed is given in table 15.

Net sown Area of the state is 15.3 million hectares with cropping intensity of 149%. Five per cent area (7.65 lakh ha.) with 149% cropping intensity come to about 11.34 lakh ha, which is required to have a reasonable and sustainable fodder supply in the state. Of this, about 4.54 lakh hectares should be brought under perennial fodder crops and 6.80 lakh hectares under annual fodder crops.

Table 15 : Fodder seed requirement, availability and sources of supply for Madhya Pradesh state

Total cultivated area (lakh ha) of state	Area to be sown under fodder crops (5% of total cultivated area, lakh ha)	Important forage crops	Area under individual fodder crop (lakh ha)	Seed rate (kg/ha or no/ha)	Forage seed requirement**	Forage seed source
153	7.65	Maize (5%)	0.38	40-50 kg/ha	1500 q	NSC,
Cropping	Cropping	Sorghum (10%)	0.75	20-30 kg/ha	1200 q	SSC,
intensity	intensity	Pearl millet (10 %)	0.75	8-10 kg/ha	750 q	SAUs,
149% =228	149% = 11.3	Cowpea (10%)	0.75	30-35 kg/ha	1300 q	SVUs,
lakh ha	lakh ha	Oat (10%)	0.75	80-100 kg/ha	7500 q	NDDB,
		Berseem (10%)	0.75	25-30 kg/ha	1200 q	Private
		Lucerne (10%)	0.75	15-20 kg/ha	1200 q	sector,
		Bajra Napier Hybrid (10%)	0.5	28,000 nos. rooted slips/ha	140 lakh rooted slips	IGFRI, Jhansi
		Guinea grass (5%)	0.25	3-4 kg seed or 40,000 nos. rooted slips/ha	0.75-1.00 or 10000	
		Other perennial grasses and legumes for pastures and wasteland Grass (10%)	0.75	4 kg/ha	30 q	

Note: For calculation of seed requirement, the seed rate mentioned in the standard package of practices for the respective crop was considered

**Considering 5 per cent in range grasses and legumes and 10 per cent in cultivated crops at initial stage which should be multiplied later

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 eleven 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 MP 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 MP.

v. Master trainers training at IGFRI/ SAUs

The staff of Dept. of Animal Husbandry, Veterinary, Agriculture, Horticulture, Forestry etc. from the Govt. of MP 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 MP.

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

There are 53 Krishi Vigyan Kendras (KVKs) operating in the state of MP. 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 MP. There 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 MP. 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 problematic 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 MP 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 present times livestock holder are faced with fodder scarcity owing to natural calamities, unforeseen failure of crops and it poses a great threat to sustainable animal husbandry and dairying. To tide over such situation of fodder scarcity, efforts will be made to educate the policy makers, heads of line departments to establish fodder banks at village clusters or tehsils for ensuring the supply of minimum quantity of fodder to livestock keeper so that the animals are not 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, CIAE 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 programme. 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 16).

Table 16 : 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 KVKs /milk unions/SAHD/LDB
5	Extension activities and development of fodder warehouse	Milk Unions/State Animal Husbandry Department
6	Dry fodder processing, value addition and fodder management (chaff cutter, fodder block, baling, grinding)	District level milk union/Animal Husbandry Dept.
7	R & D activity (evaluation of fodder quality, food-feed crops, hydroponics etc.,)	ICAR Institutes/ SAUs / SVUs
8	Capacity building of stake holders	ICAR-IGFRI/SAUs

The programme implementation plan is a time bound multi-stage oriented and aims to complete the activities in time frame in a logical way. It has been presented in table 16.

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 (eleven). The detailed plan for implementation of pilot project is presented in the table 17.

Table 17 : Implementation level plan for pilot project

Sl. No.	Activity	Action points
1	Target area selection	• Selection of 11 districts (1 from each agro-climatic zone) of MP Selection of 2 cluster of 5 villages in each district total 22 clusters for 11 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; 1100 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 MP and nearby states/NDDB, Anand, KNKVV, Jabalpur, RVSKVV, Gwalior.
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, berseem 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 MP, 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 18.

Table 18 : 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)	22.0	22.0	22.0	14.67	14.67	95.34
Exposure visit of farmers/stakeholders	16.5	16.5	16.5	5.5	5.5	60.5
Seed/ Planting material	22.0	22.0	5.5	5.5	5.5	60.5
Micro Irrigation facilities	22.0	22.0	16.5	16.5	5.5	82.5
Other farm inputs small equipment etc	22.0	14.67	14.67	5.5	5.5	62.34
Custom hiring centre equipment TA/DA/ staff (SRF/YP/RA) /	128.33 36.67	5.5 36.66	5.5 25.67	5.5 25.67	5.5 25.67	150.33 150.34
Consultancy/ Miscellaneous etc.						
Total	269.5	188.83	106.37	78.84	67.84	711.38

(Rupees seven Crore eleven Lakhs thirty eight thousand only)

Part-VI : Modalities

This programme is undertaken to enhance the fodder production, conservation and utilization on a more sustainable basis in different fodder deficit districts of MP. 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 UP along with KVKs, NGOs, Milk Federation *etc.*, will implement the programme at field and farmers level.

Annexure-I

Proceedings and recommendations of interactive fodder workshop

दिनाँक 29 जनवरी 2020 को आयोजित एक दिवसीय कार्यशाला, "चारा उत्पादन, संरक्षण एवं उपयोग", का कार्यवाही विवरण।

आर.सी.व्ही.पी. नरोन्हा प्रशासनिक एवं प्रबंधन अकादमी, भोपाल में दिनाँक 29 जनवरी 2020 को पशुपालन विभाग मध्य प्रदेश और भारतीय चरागाह एवं चारा अनुसंधान संस्थान झाँसी के तत्वावधान में चारा उत्पादन, संरक्षण एवं उपयोग विषय पर एक दिवसीय कार्यशाला आयोजित की गई। कार्यशाला का उद्घाटन मुख्य अतिथि श्री लाखन सिंह यादव जी, माननीय मंत्री, मध्य प्रदेश शासन, पशुपालन विभाग द्वारा दीप प्रज्वलित करके किया गया।

कार्यशाला में भारतीय चरागाह एवं चारा अनुसंधान संस्थान झाँसी के निदेशक डॉ. वी. के. यादव एवं उनके संस्थान के 9 विषय विशेषज्ञ, जे.एन.के.वी.वी., जबलपुर के विषय विशेषज्ञ, केंद्रीय कृषि अभियांत्रिकी संस्थान, भोपाल के विषय विशेषज्ञ तथा मध्य प्रदेश पशुपालन विभाग के 7 संयुक्त संचालक एवं जिले के 51 उप संचालक एवं समस्त जिलों से 92 विभागीय पशु चिकित्सक उपस्थित हुए।

माननीय मंत्री जी, पशुपालन विभाग द्वारा उद्बोधन में हरा चारा उत्पादन में वृद्धि, हरे चारे की उन्नत प्रजाति के बीज का उपयोग एवं हरे चारे के संरक्षण हेतु सायलो तकनीक बाबत् बताया गया तथा प्रदेश में निराश्रित गौवंश के व्यवस्थापन हेतु 1000 नवीन गौशालाओं की स्थापना एवं पशुओं को हरे चारे हेतु लगभग 5000 एकड़ भूमि में बहुवर्षीय चरागाह विकसित किए जाने बावत् जानकारी दी गई।

डॉ. आर. के. रोकड़े, संचालक, पशुपालन, मध्य प्रदेश द्वारा वर्ष 2011 से 2015 के मध्य संचालित भारत सरकार की आर.के.वी.वाई. योजना की सब–स्कीम, 'त्वरित चारा विकास कार्यक्रम', के अंतर्गत पशुपालकों को चारा बीज किट प्रदान करने के फलस्वरूप उन वर्षों में प्रदेश में हरे चारे उत्पादन तथा दुग्ध उत्पादन में वृद्धि दर्ज होने के बावत् बताया गया। विभाग द्वारा हरे चारे उत्पादन को प्रोत्साहित किए जाने हेतु बहुवर्षीय चारा उत्पादन जैसे हाइब्रिड नेपियर चारा उत्पादन हेतु किये गए प्रयासो के बारे में जानकारी दी गई।

डॉ. वी.के. यादव, निदेशक, भारतीय चरागाह एवं चारा अनुसंधान संस्थान, झाँसी द्वारा मध्य प्रदेश में चारे की कमी दूर करने हेतु अपनाई जा सकने वाली विभिन्न चारा फसलों एवं नवीन तकनीकों की जानकारी प्रदान की गई।

कार्यशाला में वैज्ञानिकों द्वारा मध्य प्रदेश में चारा विकास हेतु व्याख्यानों में निम्नानुसार उपयोगी जानकारी दी गई।

1. डॉ एस.आर. कांटवा, आई.जी.एफ.आर.आई, झाँसी द्वारा फॉडर प्रोडक्शन को प्रोत्साहन प्रदान करने व रोजगार के साधन के रूप में बढ़ावा देने एवं चारा उत्पादन से भूमि संरक्षण तथा खरपतवार में कमी के बारे में जानकारी से अवगत कराया गया।

2. डॉ. आर.वी. कुमार, आई.जी.एफ.आर.आई., झाँसी द्वारा ग्रासलैंड एवं पाश्चर डेवलपमेंट के लाभ बावत जानकारी प्रदान की गई।
3. डॉ. सुल्तान सिंह, आई.जी.एफ.आर.आई., झाँसी द्वारा पशुओं को फॉडर खिलाने से होने वाले लाभ, पशुओं के उत्पादन एवं स्वास्थ्य के बारे में जानकारी दी तथा साइलो मेकिंग, हे मेकिंग एवं साइलो के बारे में बताया गया।
4. डॉ. ए.के. मेहता, जे.एन.के.वी.वी., जबलपुर द्वारा फॉडर क्राप की विकसित किस्मों एवं उपयोग की जानकारी दी गई।
5. डॉ. यू.सी. दुबे, सी.आई.ए.ई., भोपाल द्वारा फार्म मशीनरी, फॉडर कल्टिवेशन एवं हार्वेस्टिंग पर उपयोगी जानकारी प्रदान की गई।
6. डॉ. पुरूषोत्तम शर्मा, आई.जी.एफ.आर.आई., झाँसी द्वारा मध्य प्रदेश में फॉडर प्रोडक्शन बढ़ाने पर ज़ोर देते हुए सीड रिप्लेसमेंट रेट तथा अन्य वैज्ञानिक तकनीकों के बारे में जानकारी प्रदान की गई। डॉ. शर्मा द्वारा फोरेज इंडिया एप, फारेज सीड एप तथा एम. किसान पोर्टल के बारे में अवगत कराया गया।

कार्यशाला में आई.जी.एफ.आर.आई., झाँसी में चारा विकास से संबंधित प्रशिक्षण सत्रों में विभागीय अधिकारियों को समय–समय पर सहभागिता की सहमति व्यक्त की गई तथा मध्य प्रदेश में चारा विकास हेतु आई.जी.एफ. आर.आई., झाँसी द्वारा आवश्यक तकनीकी सहयोग प्रदान किए जाने बाबत अनुरोध किया गया। अंत में सभी अतिथियों एवं सम्मिलित विभागीय अधिकारियों का आभार प्रदर्शन कर कार्यशाला का समापन किया गया।

Annexure-II

List of participants in ICAR-IGFRI collaborative workshop held on 29 January 2020, at Bhopal

1. Shri Lakhan Singh Yadav, Hon'ble Minister of Animal Husbandry, Govt. of MP
2. Shri Manoj Shrivastava, Additional Chief Secretary, Govt. of MP
3. Dr. R.K. Rokade, Director, Animal Husbandry, Govt. of MP
4. Dr. V.K. Yadav, Director, ICAR-IGFRI, Jhansi
5. Dr. Purushottam Sharma, PS & Nodal Officer, NIAFTA, ICAR-IGFRI, Jhansi
6. Dr. S.R. Kantwa, PS, ICAR-IGFRI, Jhansi
7. Dr. R.V. Kumar, PS & Head, GSM, ICAR-IGFRI Jhansi
8. Dr. Sultan Singh, PS & I/c PME, ICAR-IGFRI, Jhansi
9. Dr. Khem Chand, PS & Head, SS, ICAR-IGFRI Jhansi
10. Dr. Amit Kumar Patil, Scientist, ICAR-IGFRI, Jhansi
11. Dr. U.C. Dubey, PS, CIAE, Bhopal
12. Dr. A.K. Mehta, Prof., JNKVV, Jabalpur
13. Dr. Neha Waskel, VAS, Shajapur
14. Dr. Anjali Baghel, VAS, Khargone
15. Dr. Devinder Kaur Madan, DDS, State DI Lab, Bhopal
16. Dr. M.K. Bhardwaj, O/o JDVS, Bhopal
17. Dr. Samar Singh Rathod, O/o DDVS, Shivpuri
18. Dr. A.R. Dhakad, SVS, Dy. Director, VS, Neemach
19. Dr. Pranay Tiwari, SVS, Dy. Director, VS, Burhanpur
20. Dr. B.P. Singh, O/o Dy. Director, VS, Anuppur
21. Dr. Y.C. Dixit, Dy. Director, VS, Anuppur
22. Dr. J.P. Shiv, Dy. Director, VS, Seoni
23. Dr. P.K. Sharma, ABPO, Narsinghpur
24. Dr. R.K. Bamnele, VAS, Narsinghpur
25. Dr. P.K. Atulyas, Dy. Director, VS, Balaghat
26. Dr. R. D.P. Dinesh, VEO, Pali
27. Dr. R.M. Bhurmude, VEO
28. Dr. Shalini Gajbhiye, VAS, Sehore
29. Dr. Shekhar Singh Chauhan, VAS, Bhind
30. Dr. Param Singh Kushwh, SVS, Ratlam

31. Dr. Vimal Tiwari, Dy. Director, VS, Chhatarpur
32. Dr. S.S. Chaudhary, Dy. Director, VS, Dindori
33. Dr. M.L. Mehra, Dy. Director, VS, Mandla
34. Dr. Durgendra Singh, VEO, Rindori
35. Dr. RaviKumar Soni, VEO, Dhinarkheda
36. Dr. K.K. Sharma, VAS, O/o Dy. Director, VS, Katni, Shehdol
37. Dr. Sanjay Singh Kaurav, VAS, Ashoknagar
38. Dr. Darshan Singh Tomar, VAS, Ashoknagar
39. Dr. Umesh Sharma, Addl. Dy. Director
40. Dr. B.S. Sharma, Registrar
41. Dr. Mahesh Singh Sisodiya, VAS, Sheopur
42. Dr. P.S. Patel, Joint Director, SVH
43. Dr. Neetu Rawat, VAS, Bhopal
44. Dr. Pankaj Bhargava, Addl. Dy. Director, VS
45. Dr. Ghanshyam Parte, VAS, Balaghat
46. Dr. Ajay Ramteke, Dy. Director, AH
47. Dr. Prakhar Bhargava, Asstt. Director, AH
48. Dr. H.P. Trivedi, Dy. Director, VS, Ujjain
49. Dr. Umesh Jain, Addl. Dy. Director, Agar
50. Dr. M.K. Shende, VAS, O/o Dy. Director, VS, Seoni
51. Dr. L.M. Aya, DDVS, Sheopur
52. Dr. Shobhna Kaushal, VAS, Bhopal
53. Dr. Nasheema Siddiqui, VEO, Vidisha
54. Dr. Dushyat Pandey, VAS, Damoh
55. Dr. S.C.L. Verma, Dy. Director, VS, Vidisha
56. Dr. R.K. Shrivastav, Dy. Director, VS (FMD), Bhopal
57. Dr. A.K.S. Bhadiria, Addl. Dy. Director, VS, Sahti
58. Dr. S.K. Tiwari, Dy. Director Sahti, Bhopal
59. Dr. D.K. Vishwakarma, Dy. Director, Damoh
60. Dr. Sanjay Pandey, SVS
61. Dr. A.K. Verma
62. Dr. N.K. Bamniya, JDVS, Ujjain
63. Dr. Wilson Dawer, Dy. Director, VS, Jhabua

64. Dr. Manish Chouhan, VEO Rama, Jhabua
65. Dr. T.R. Yadav, SVS, Barwani
66. Dr. S.K. Modi, SVS, Dhar
67. Dr. D.K. Jain, Addl. Dy. Director, Mandsaur
68. Dr. Raju Rawat, Dy. Director, VS, Khargone
69. Dr. G.D. Verma, Dy. Director, VS, Dhar
70. Dr. K.G. Dwivedi, Dy. Director, VS, Khandwa/Burhanpur
71. Dr. C.B. Nagar, VS, Dy. Director, VS, Dewas
72. Dr. B.D. Mukati, VAS, ADM Office, Harda
73. Dr. Shweta Makar, VAS (Roshni), Khandwa
74. Dr. Narendra Singh Tomar, VAS, Jabalpur
75. Dr. Sujeet Singh Patel, VAS, Chhatarpur
76. Dr. Deepti Gupta, VAS, Chhatarpur
77. Dr. B.K. Patel, Dy. Director
78. Dr. B.P. Ahirwar, VAS, Tikamgarh
79. Dr. A.K. Gupta, Addl. Dy. Director
80. Dr. R.P. Gautam, Addl. Dy. Director, VS
81. Dr. Abhijit Shukla, Addl. Dy. Director, Govt. Poultry Farm, Hathikheda
82. Dr. Pooja Gour, VAS, Joint Director
83. Dr. A.S. Tomar, JDVS, Gwalior/Chambal
84. Dr. R.K. Mehiya, JDVS, Directorate MP, Bhopal
85. Dr. AKhilesh Bhardwaj, Addl. Dy. Director
86. Dr. Priyakant Pathak, Addl. Dy. Director
87. Dr. Seema Rao, Addl. Dy. Director
88. Dr. Neelesh Shah, Addl. Dy. Director

Annexure-III

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

Crop	Varieties	GFY (t/ha)	Recommendation for cultivation	Year of release
Berseem	Wardan	65-70	Whole country	1981
	Bundel Berseem 2	65-80	Centra1,NWzone	1997
	BundelBerseem 3	68-83	NE zone	2000
	JBSC-1	38-40	North west zone	2017
	JHB 17-1	40-45	North west and NE zone	2020
	JHB 17-2	40-85	North west and NE zone	2020
	JHB 18-1	30-80	North west and Central India	2021
	JHB 18-2	30-80	North west and Central India	2021
Lucerne	Chetak	140-150	North west central zone	1975
Oat	Bundel Jai 822	44-50	Central zone	1989
	Bundel Jai 851	40-50	Whole country	1997
	Bundel Jai 99-2	40-50	North West zone	2004
	Bundel Jai 2004	50	Northeast and northwest zone	2002
	Bundel Jai 2009-1	53-62	Central zone	2016
	Bundel Jai 99-1	35-40	Hill zone	2007
	Bundel Jai 2010-1	27-34	South zone	2015
	Bundel Jai 2012-2	33-37	South zone	2017
	Bundel Jai 2015-1	25-30	Hill zone	2018
Cowpea	Bundel Lobia 1	25-30	Whole country	1992
	Bundel Lobia 2	25-30	North zone	1992
	Bundel Lobia 4	23-26	North-eastern zone	2012
Guar	Bundel Guar 1	25-35	Whole country	1993
	Bundel Guar 2	30-40	Whole country	1994
	Bundel Guar 3	30-40	Whole country	1999
Field bean	Bundel Sem 1	25-35	Whole country	1993
Anjan grass	Bundel Anjan 1	30-35	Whole country	1989
Cenchrus	Bundel Anjan 3	30-35	Whole country	2006
ciliaris	Bundel Anjan 4	35-37	Whole zone	2019

Dhaman grass *Cenchrus setigerus*	Bundel Dhaman 1	13-15	Western part of country	2019
Dinanath grass	Bundel Dinanath 1	55-60	Whole country	1987
	Bundel Dinanath 2	60-65	Whole country	1990
BN hybrid	Swetika	100-120	Central, northern and north eastern areas	1983
	DHN-6 (Sammpoorna)	120-150	Irrigated areas of Madhya Pradesh state	2008
	DHN-15	200-250	Irrigated areas of Madhya Pradesh state	2020
Bajra-squamulatum hybrid	BBSH-I	30-33	Western and northern part of country	2019
Butterfly pea	Bundel Clitoria 1 (JGCT-2013-3)	25	All India	2017
Bajra	AVKB-19	50-60	Whole country	2007
	JHPM-05-2	70-80	Whole country except south zone	2008
	DRSB-1	35-40	North Transitional zone-8 (Madhya Pradesh)	2005-06
Guinea grass	Bundel Guinea 1	40-50	Punjab, HP, Central UP, Maharastra, Tamilnadu	2004
	Bundel Guinea 2	50-55	Fainted conditions in semi- arid, tropical, sub-tropical and humid tropics	2008
	Bundel Guinea 4	75-81	All guinea grass growing areas	2012
	DGG-1	85-125	Humid/arid tropical and sub-tropical regions	2016
Bracharia	DBRS-1	25-30	Whole country	2016
Sehima	Bundel Sen Ghas 1	18-20	Semi-arid, tropical and sub- tropical areas across the country	2007
Chrysopogon	Bundel Dhawalu Ghas-1	26-30	Rangelands under fainted condition across the country	2007
Heteropogon	Bundel Lampa Ghas-1, IGHC-03-4	25-30	Rangelands under rainfed condition across the country	2007
Dichanthium	Bundel Marvel Grass-2013-2 (JHD-2013-2)	35-45	NWZ particularly for Punjab and Rajasthan	2017
Congo Signal grass	DBRS-1	35-40	Rainfed conditions in Madhya Pradesh	2016
Lablab bean	Bundel Sem-1 (JLP-4)	22-25	Through out India	1993
Butter fly pea	JGCT-2013-3	20-25	Through out India	2017

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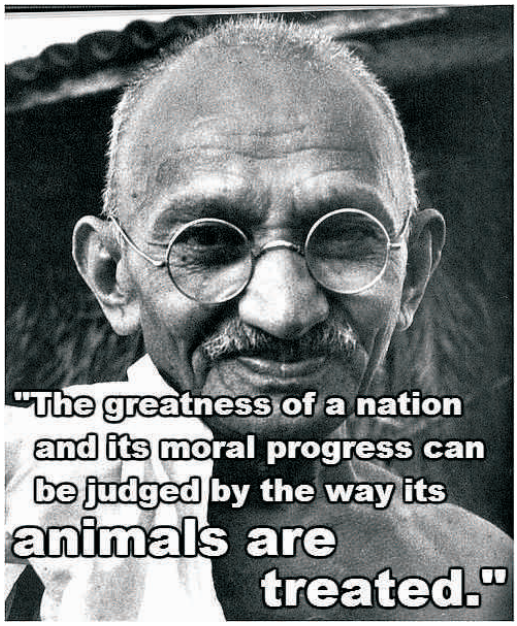

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