भाकृअनुप
ICAR

Fodder Resources Development Plan for Jharkhand

Diamond Jubilee Year
1962-2021

आज़ादी का अमृत महोत्सव

भा.च.चा.अ.सं.
IGFRI

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

An ISO 9001:2015 Certified Institute
Sardar Patel Award for Outstanding ICAR Institute (Large) for 2015

Fodder Resources Development Plan for Jharkhand

...a policy paper

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

0510-2730666
0510-2730833
director.igfri@icar.gov.in
https://igfri.icar.gov.in
@ icarigfri Jhansi
igfri.jhansi.56
IGFRI Youtube Channel
Kisan Call Centre 0510-2730241

An ISO 9001:2015 Certified Institute
Sardar Patel Award for Outstanding ICAR Institute (Large) for 2015

Technical Bulletin: Fodder Resources Development Plan 16/2022

Citation:
ICAR-IGFRI (2022). Fodder Resources Development Plan for Jharkhand. ICAR-Indian Grassland and Fodder Research Institute, Jhansi.

Published:
2022

Published by:
Director
ICAR-Indian Grassland and Fodder Research Institute
Jhansi- 284003, Uttar Pradesh, India.

Printed at :
Classic Enterprises, Jhansi (U.P.)
7007122381

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

भारत सरकार
कृषि अनुसंधान और शिक्षा विभाग एवं
भारतीय कृषि अनुसंधान परिषद
कृषि एवं किसान कल्याण मंत्रालय, कृषि भवन, नई दिल्ली 110 001
GOVERNMENT OF INDIA
DEPARTMENT OF AGRICULTURAL RESEARCH & EDUCATION
AND
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
MINISTRY OF AGRICULTURE AND FARMERS WELFARE
KRISHI BHAVAN, NEW DELHI 110 001
Tel.: 23382629; 23386711 Fax: 91-11-23384773
E-mail: dg.icar@nic.in

MESSAGE

The rural economy of Jharkhand is dominated by smallholder mixed farming system with livestock as integral component for supporting livelihood. Seasonal scarcity and access to fodder has been one of the major hitches in optimizing performance of livestock sector in the state. It is required to focus on enhancing forage resources in the state.

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 Jharkhand in consultation with all the stakeholders. This document provides the technological options to enhance production, conservation and value addition of fodder. I am confident that it will guide fodder development and promotion activities in the state.

I appreciate the efforts made by ICAR-IGFRI, Jhansi in bringing out this comprehensive fodder plan for the state of Jharkhand.

(T. MOHAPATRA)

Dated the 22nd April, 2022
New Delhi

Fodder Resources Development Plan prepared as a part of

National Initiative for Accelerating Fodder Technology Adoption (NIAFTA)

ICAR-Indian Grassland and Fodder Research Institute, Jhansi

Themes of NIAFTA

- 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. D.R. Palsaniya, PS	Member
Dr. Gaurendra Gupta, Scientist	Member
Dr. B.B. Choudhary, Scientist	Member
Sri A.K. Saxena, CTO	Member

Jharkhand State Fodder Resources Development Plan Committee

Dr. A.K. Roy, PC, AICRP (FCU)	Coordinator
Dr. M.M. Das, PS	Chairman
Dr. N. Dixit, PS	Member
Dr. N. Bhardwaj, Scientist	Member

Acknowledgement

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

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

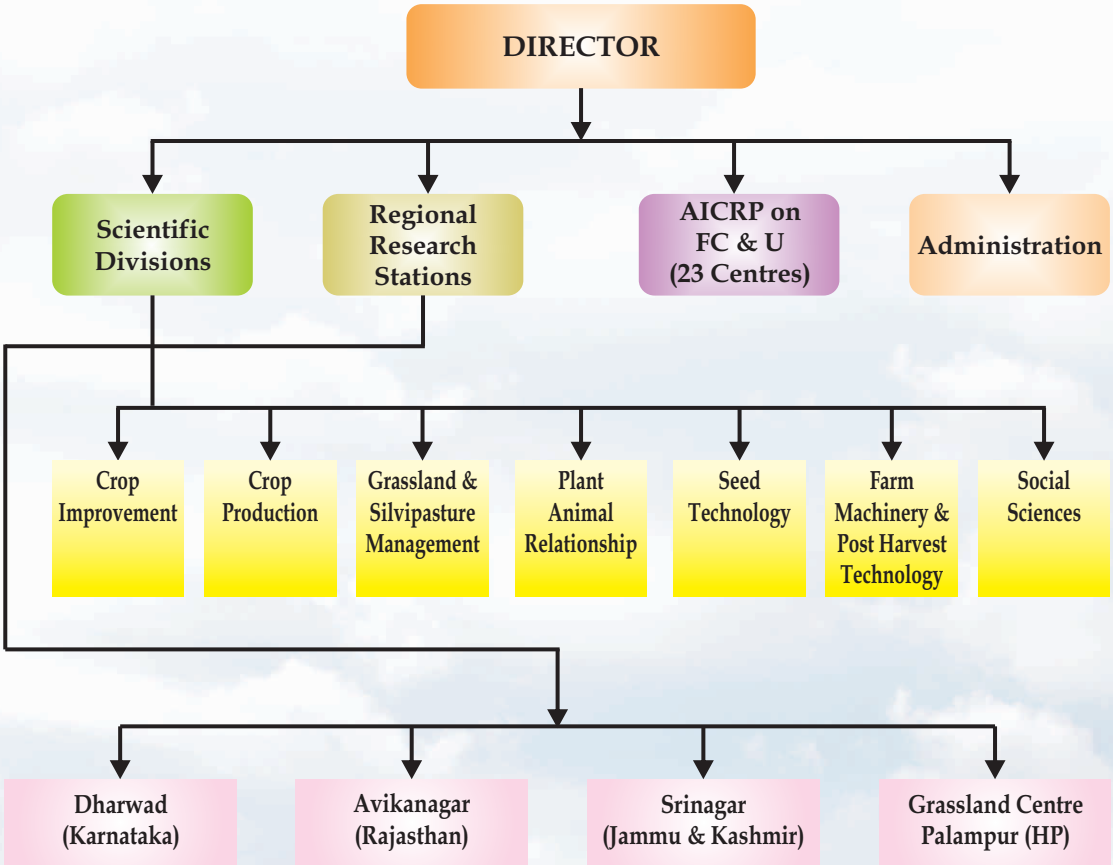
We express our sincere thanks to Department of Animal Husbandry, Government of Jharkhand and Directorate of Agriculture, Govt. of Jharkhand, especially to Shri Shashi Kant Jha, Director, Animal Husbandry, Jharkhand, and their staff and Hon'ble VC and Dr. Birender Kumar and Dr. Dr. Yogendra, of BAU, Ranchi and other officers for their support in organizing interactive online workshop on 26th July 2021 and showing keen interest in developing plan for augmenting forage and livestock sector in the state. We also thank to other participants including officials of state government, BAU, KVK personnel, veterinary officials, *etc.*, who actively participated in the workshop and provided their valuable suggestions for the improvement of plan.

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

(Amaresh Chandra)
Director
ICAR-IGFRI, Jhansi

Contents

Organogram


DIRECTOR
Scientific Divisions
Regional Research Stations
AICRP on FC & U (23 Centres)
Administration
Crop Improvement
Crop Production
Grassland & Silvipasture Management
Plant Animal Relationship
Seed Technology
Farm Machinery & Post Harvest Technology
Social Sciences
Dharwad (Karnataka)
Avikanagar (Rajasthan)
Srinagar (Jammu & Kashmir)
Grassland Centre Palampur (HP)


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 centre's at various State Agricultural Universities/NGO/ICAR under the National Agricultural Research System. The institute consists of seven multi-disciplinary division *viz.*, Crop Improvement, Crop Production, Farm Machinery and Post-Harvest Technology, Seed Technology, Social Science, Grassland and Silvipasture Management and Plant Animal Relationship. It also has five units *viz.*, PME, HRD, ATIC, ITMU and AKMU and facilities like Library, Central Research Farm, Dairy and Central Instrumentation Lab. The institute has three regional stations located in Avikanagar (Rajasthan), Dharwad (Karnataka) and Srinagar (Jammu & Kashmir) to conduct focused forage research on arid, semi-arid and temperate climatic conditions, respectively and a grassland center at Palampur (Himachal Pradesh). Recently, ABIC has been established to develop and provide entrepreneurship skills in technologies generated by the institute as well as incubation centre to train and skill upliftment.

Mandate

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

The institute has successfully served the country for 59 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 new frontier areas of forage research.

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 feed supplement 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),

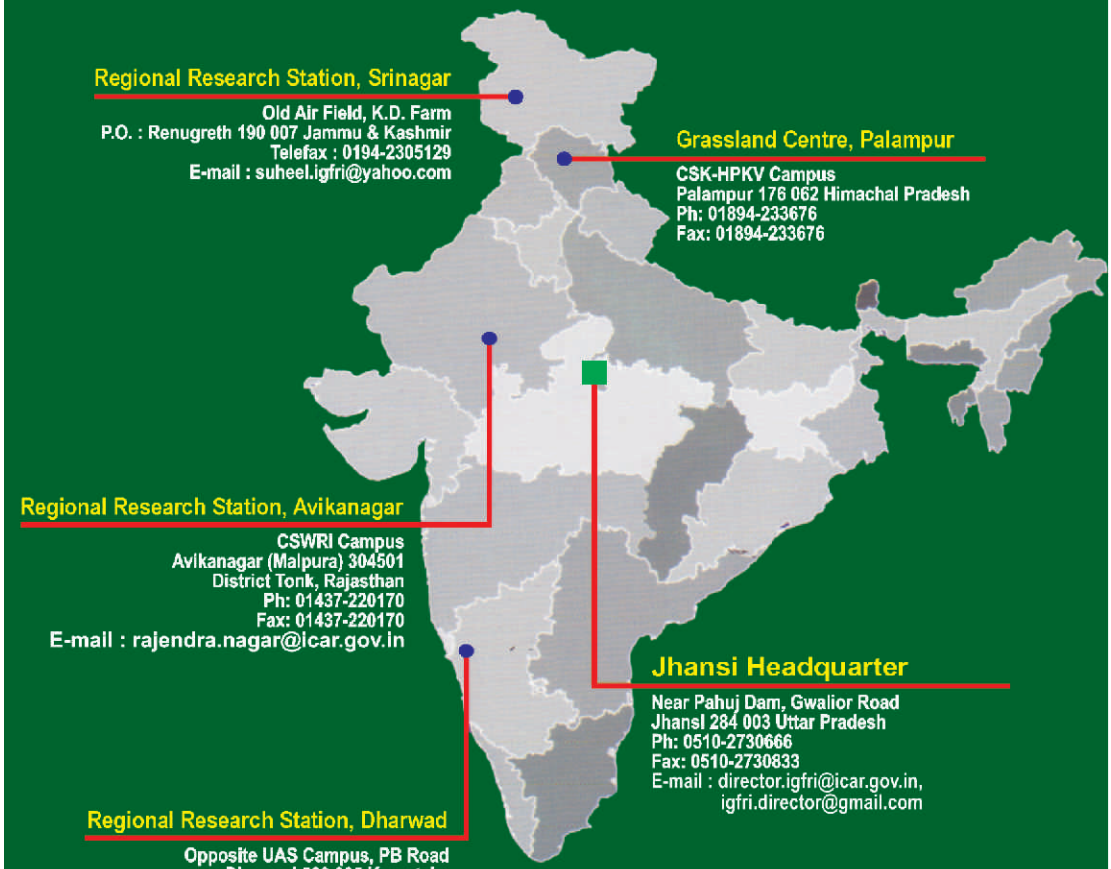
National Initiative on Fodder Technology Demonstration (NIFTD), Network Project on Bhadawari Buffaloes, Participatory Fodder Production in Mango Orchards, Farmers FIRST Programme, NICRA, TSP, SCSP, NEH, DFI-Kisan Mitra and NIAFTA have been initiated and implemented.

NIAFTA: New Initiatives

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

ICAR-Indian Grassland and Fodder Research Institute

https://igfri.icar.gov.in



Regional Research Station, Srinagar

Old Air Field, K.D. Farm
P.O. : Renugreth 190 007 Jammu & Kashmir
Telefax : 0194-2305129
E-mail : suheel.igfri@yahoo.com

Grassland Centre, Palampur

CSK-HPKV Campus
Palampur 176 062 Himachal Pradesh
Ph: 01894-233676
Fax: 01894-233676

Regional Research Station, Avikanagar

CSWRI Campus
Avikanagar (Malpura) 304501
District Tonk, Rajasthan
Ph: 01437-220170
Fax: 01437-220170
E-mail : rajendra.nagar@icar.gov.in

Jhansi Headquarter

Near Pahuj Dam, Gwalior Road
Jhansi 284 003 Uttar Pradesh
Ph: 0510-2730666
Fax: 0510-2730833
E-mail : director.igfri@icar.gov.in,
igfri.director@gmail.com

Regional Research Station, Dharwad

Opposite UAS Campus, PB Road
Dharwad 580 005 Karnataka
Ph: 0836-2447150
Fax: 0836-2447150
E-mail : nagaratna.biradar@icar.gov.in

Part-I : Agriculture, Livestock and Fodder Scenario

A. Introduction

Jharkhand became the 28th State of India on 15 November 2000, after carving out the southern parts of erstwhile Bihar. It largely comprises forest tracks of Chhotanagpur plateau and Santhal Pargana and has distinct tribal cultural traditions. Jharkhand is located between 83˚22' to 87˚57' Latitude and 21˚58' to 25˚18' Longitude and has average altitude of 1000 ft. The tropic of Cancer at 23½˚north passes through Ranchi district of the state. The geographical area of state is 79,714 sq km. The state is surrounded by West Bengal in the east, Chhattisgarh and Uttar Pradesh in the west, Bihar in the north and Odisha in the south. The waterfalls, lakes, hills, holy places *etc.*, add to its tourist values. The rivers Swarnrekha, Koyal, Shankh and Damodar flow through the state and are utilized for irrigation at many places. The state has five regions comprising of different districts (Fig. 1; Table 1).

Figure 1: Jharkhand state with different districts

Table 1. Different regions with districts in Jharkhand state

Regions	Districts*
Santhal Pargana	Deoghar, Jamtara, Dumka, Godda, Pakur, Sahibganj (**6**)
Palamuea	Palamu, Garhwa, Latehar (**3**)
North Chhotanagpur	Hazaribagh, Chatra, Koderma, Giridih, Dhanbad, Bokaro, Ramgarh (**7**)
South Chhotanagpur	Ranchi, Gumla, Lohardaga , Simdega, Khunti (**5**)
Kolhan division	Singhbhum (E), Singhbhum (W), Saraikela-Kharsawan (**3**)

Total numbers of districts are given in parenthesis

The total geographical area of Jharkhand state is 79.71 lakh ha of which the forest area is about 28.09% (22.39 lakh ha) (Table 2). The remaining area is being utilized for various purposes including crops cultivation. It is evident from the table 2 that only 16.71% of total available land is put to non-agriculture use and thus there is tremendous scope available for increasing the cultivable area. This land can be put to productive use after minor land work, tillage and agricultural technological operations. The total sown area is only about 19% of total area with cropping intensity of 125%. Better management of non-arable

land can increase the cultivable area. Resorting to modern agricultural, animal husbandry practices and non-traditional farming can further increase income of farmers.

Table 2. Land utilization pattern in Jharkhand

Land Use	Area (in thousands) (ha)	Percentage
Total geographical area	7972	100
Forests	2239	28.09
Not available for cultivation	1332	16.71
Permanent pasture and other grazing lands	110	1.38
Land under misc. tree crops and groves	93	1.17
Culturable wasteland	33	64.22
Fallow lands other than current fallows	962	12.07
Current fallows	1394	17.49
Net area sown	1504	18.87

Source: https://data.gov.in/

Agriculture is one of the largest means of earning livelihood for the people in the state. About 82% of people reside in the village area and solely depend on primary sector, *i.e.* agriculture. Rice is the leading crop in the state, other important crops being maize, millet, ragi (marua), wheat, barley *etc.* The agriculture is fully dependent on the vagaries of the monsoon. Merely 14% of total area sown is under irrigation. The hilly tract and pastures are difficult to bring under cultivation. The agriculture year in the state is divided into 3 seasons.

- *Bhadai* of Autumn (crops harvested in September-October): It generally consist of early ripening varieties of rice, millets, maize, jute, pulses and vegetables *etc.*
- *Aghani* (crops harvested in November-December): It consists mainly of winter rice, sugarcane *etc.*
- *Rabi* (crops harvested around the month of March): It consists of wheat, barley rape and mustard, gram and arhar etc.

Although, the entire state gives the impression of being located on hilly tracts, it also abounds plain area, which gives better crop. In fact it is a mix of high land (Tand) which is composed of brown-reddish soil and step-cut low land (Done). The low land (Done) having the ability to retain water and generally gives good yield of paddy. The high land (Tand) has less water retaining capacity and also prone to soil erosion resulting in low productivity. The state as a whole suffers from several critical gaps in agriculture and allied sectors though a number of opportunities exist to make the state self-sufficient in agricultural production.

With the low level of irrigation facility in the entire state, it is evident that there is an urgent need to resort to modern methods of soil conservation besides, launching multi programmes to provide irrigation facilities at least in the hilly tracts, if not in the entire state. Barring a few barren area full of pebbles more and more area out of waste land can be brought under cultivation of cash-crops such as tomato, ginger and chilies *etc.* those fetch greater return per quintal. This calls for a major effort by the agronomists, who can suggest the changes required for altering the soil composition so that cultivation of cash-crops could be undertaken at large scale to sustain some medium/ large/ small scale food processing units in the state. Moreover the existing practice of dispatching the cash crops to adjacent states/ districts by the middle men be got rid of. This uncalled for practice is undoubtedly draining this state of vital resources. An all out attempt, therefore, is called for raising the yield of cash crops per hectare which would ensures better and quick return for the benefit of the masses in general and farmers in particular.

Besides the land and soil constraint, the agriculture in Jharkhand State faces the problem of irrigation. Much to the dismay of farmers only 14% of total sown area is under direct irrigation. Rest of the area depends on the vagaries of the monsoon. Because of the hilly tract, the water level recedes much below than what is required for proper irrigation. So, the farmers generally resort to Diesel pump sets, tube well, ponds, rivers *etc.* but it is very difficult to cope up with this insurmountable problem of getting sufficient water for irrigation.

B. Agro-climatic zones of Jharkhand

Jharkhand state falls under the agro-climatic zone VII known as Eastern Plateau and Hilly region. Based on rainfall, temperature and soil characteristics, the state has been divided into three agro-climatic sub-zones *i.e.* IV, V and VI (Fig. 2). Details of physiographic zones and farming situations in the state are mentioned below (Table 3).

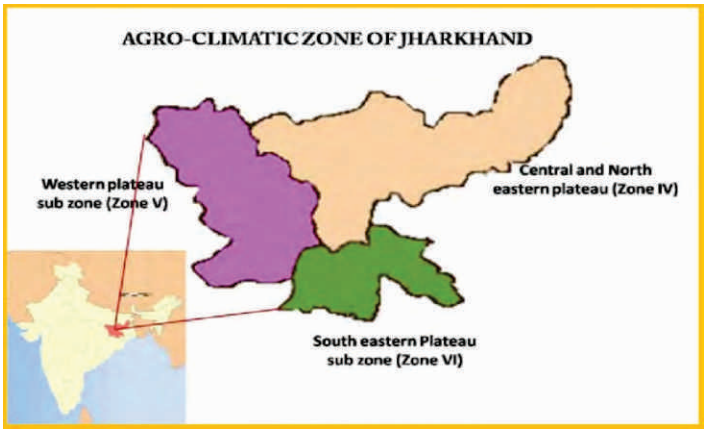


Figure 2: Agro-climatic zones of Jharkhand

Table 3. Characteristics of agro-climatic zones

Zone	Districts	Characteristics/farming situations
Central and North Eastern Plateau Zone (IV)	Bokaro, Chatra, Deoghar, Dhanbad, Dumka, Giridih, Godda, Jamtara, Hazaribagh, Koderma, Pakur, Ranchi, Sahibganj (13)	• Total area: 4.1 mha • Forest area: 13% • Annual rainfall: 1320 mm • Low water retentive capacity of the soil particularly that of uplands. • Late arrival and early cessation of monsoon and erratic and uneven distribution of rainfall. • Lack of safe disposal of runoff water during monsoon and water storage and moisture conservation practices for raising Rabi crops. • Drying of tanks and wells by February results in no Rabi crop production. • Important crops: rice, wheat, maize, ragi, potato, arhar, rapeseeds, mustards, gram and pulses. • Rainfall pattern: The region is highly dependent on the monsoonal rainfall. The distribution of rainfall in not even also.
Western plateau zone (V)	Garhwa, Gumla, Khunti, Latehar, Lohardaga, Palamu, Ramgarh, Simdega (8)	• Total area: 2.5 mha • Forest area: 33% • Annual rainfall: 1246 mm • Late arrival and early cessation of monsoon. • Erratic / uneven distribution of rainfall. • Low water retentive capacity of soils. • Lack of soil and water conservation practices • Important crops: rice, maize, barley, lentil, sesamum, groundnut, potato, arhar and gram • Rainfall pattern: High rainfall enables rice cultivation but it is totally dependent on monsoon.

Zone	Districts	Characteristics/farming situations
South eastern plateau zone (VI)	Singhbhum (E), Singhbhum (W), Saraikela-Kharsawan (3)	• Total area: 1.3 mha • Forest area: 24% • Annual rainfall: 1400 mm • Uneven distribution of rainfall. • Low water holding capacity. • Eroded soils. • Poor soil fertility. • Important crops: rice, wheat, marwa, arhar, linseed • Rainfall pattern: Uneven rainfall distribution, have some rivers as well whose water is used in irrigation.

Across the different zones in totality, the potential cultivable land in the state compares well at 52% of the total geographical area, while it is 55% in the country. But 76% of the total potential cultivable area is under net sown area in the country, while it is only 43% in Jharkhand. Majority of the population live in rural areas, and is largely dependent on agriculture and allied activities. Paddy, coarse grains, maize, wheat and pulses and oilseeds are the major crops. Mango, banana, guava, papaya, tomato, chili & other spices are major horticultural crops; state is also rich in minor forest produce. Agriculture in Jharkhand is characterized by high dependence on nature, low productivity, less diversified cropping, inadequate irrigation, and dominance of small and marginal farmers. The periodic agricultural drought directly impacts the livelihood of majority of the farmers due to poor access to resources, inputs and lack of capacity to use modern farm production technologies and practices. Climate change and over-dependence on rain-fed agriculture has led to a vicious cycle of low productivity, low income and poor finances in last two decades. Jharkhand agriculture is largely rain-fed, with only 11 percent of the cultivated area under assured irrigation. Due to insufficient irrigation, many farmers can only cultivate one crop in a year. This mono-cropping also affects the soil quality, and eventually the crop quality.

Main crop: Paddy

Major Crops: Paddy, Wheat, Maize, Pulses, Oilseeds & Horticultural Crops

Minor Crops: Maize, *Arhar, Urad*, Moong, Wheat, Gram, Mustard

Major Cropping sequences: Paddy + Maize, Paddy + Wheat + Maize, Paddy + Pulse

The Jharkhand state has an average annual rainfall of 1400 mm and the climate ranges from dry semi humid to humid semi-arid types. About 82% of annual rainfall occurs within the monsoon season, which lasts from mid-June to September. The temperature usually varies between 18 ˚C to 29 ˚C, however, it can go as high as 45 ˚C during summer and as low as 2 ˚C during winter. The soil is generally red and yellow with some amount of sand. Most of the terrains are rocky covered with pebbles. In general, the soils of Jharkhand are low to very low in available phosphorus and sulphur, medium in available nitrogen and potassium and deficient in available boron. About 1.6 million ha (19% of total geographical area) is acidic. About 70% of soils are deficit in organic carbon and micronutrients. Majority of soils of the state have medium status of available nitrogen (280-560 kg/ha) and 19.6% area have low available N content. The water holding capacity is very low due to porous nature of soil and undulating topography. Depending upon topography, soils are broadly classified into upland, medium and lowland.

- **Upland:** Upland soils are generally red, acidic (pH 5.5-5.9) and poor water holding capacity. Moisture is easily saturated during rains but release of moisture is very fast under upland. It is suitable for *Kharif* pulses.
- **Medium land:** Soils are yellowish, slightly acidic (pH6-6.5) and suitable for *rabi* pulses and sequential cropping system, rice-gram/lentil, maize-gram/lentil and intercropping of mustard + chickpea can be taken under irrigated condition
- **Low land:** Soils are greyish, slightly alkaline (pH 7-7.3) and high water holding capacity. Low land may be utilized for spring/summer and farmers can be taken transplanted rice-spring/summer moong. Land is generally vacated after harvesting of transplanted paddy in 2nd week of Dec to 2nd week of Jan.

C. Interactive Workshop-IGFRI and State Department

As a part of "National Initiative for Accelerating Fodder Technology Adoption (NIAFTA)", the workshop was organized on 26th July, 2021 through virtual mode for discussing the status of fodder production, conservation and utilization for the state of Jharkhand. At the outset, Dr. Purushottam Sharma, Head, Division of Social Sciences & In-charge ATIC, ICAR-IGFRI Jhansi welcomed Shri Shashi Prakash Jha, Director, Animal Husbandry, Government of Jharkhand; Dr. Amaresh Chandra, Director, ICAR-IGFRI, Dr. A.K. Roy, PCFC, members & dignitaries. He mentioned the objectives of the workshop and informed that so far 16 meetings were organized and 11 fodder plans were published. During the workshop, fodder plan of Jharkhand deliberated. Important points emerged during the discussions are mentioned.

Dr. Amaresh Chandra, Director, ICAR-IGFRI in his inaugural speech expressed hearty welcome to all the participants including Director, Agriculture & Animal husbandry, Government of Jharkhand, Dr. A.K. Roy, PCFC, members, Officer-In-charges of Regional Stations, AICRP centres located in Jharkhand and staffs of line departments.

Figure 3: Interactive Workshop

Dr. Amaresh Chandra informed that in the recommendation of the Regional Committee meeting a suggestion came for preparation of a Joint comprehensive fodder plan for the state of Jharkhand. Director mentioned that we have number of technologies available *viz.* technology for round the year green fodder production, technology of crops/varieties, technology for arable land, non-arable lands, technology for new niches *etc.* He highlighted the utilization of fallow lands to help increase fodder production and conservation for the state.

Dr. A.K. Roy, PCFC, presented draft fodder plan including agricultural scenario, details of varieties, technologies, land utilization pattern and highlighted the ways to increase livelihood through livestock, crop residue management, rejuvenation of grazing lands, introducing innovative models and suggested brief action plan involving identification of areas for fodder production, road map for implementation, budget and modalities *etc.*

Shri Shashi Kant Jha, Director, Animal Husbandry, Jharkhand mentioned that there is immense scope of fodder cultivation in Jharkhand. Land availability is there but there is no system of storing rain water besides low productive animals and lack of awareness of fodder cultivation, access to availability of seeds are the major constraints. Livestock are maintained by landless farmers or by small/marginal farmers. Shri Manoj Tiwari highlighted that there is deficit of 79% green fodder and 21% dry fodder for the state. Dry fodder is a problem during summer season but during rainy season this can be exported to adjoining Bihar state.

Dr. Birender Kumar and Dr. Yogendra, BAU, Ranchi made presentation about suitable fodder technologies for Jhakhand.

Dr A.K. Dixit, Dr. R.V. Kumar, Dr. Sunil Seth, Dr. M.M. Das, Dr. P.K. Pathak IGFRI Jhansi also made presentations (Annexure-I).

D. Livestock scenario

Animals are the main drought power of agriculture in the state as most of the poor farmers can't afford modern machines such as harvester combine, thrasher, tractors *etc.* So from agriculture point of view animals are important assets. Livestock populations in a state also influence the human activity in all spheres. In fact the livestock constitute an important source of income for the farmers, as these are independent of vagaries of monsoon. So, it being more resilient, is capable of eliminating the dependence of farmers on agriculture produce to a great extent. Moreover, livestock population of the area meets the increasing need of human being for meat, milk and milk products. A chronic tragedy

in the Indian agriculture scenario, which holds true for Jharkhand state as well as that farmers are under employed and in many cases their marginal productivity tend either to zero or negative. In these cases livestock population and animal husbandry provide subsidiary occupation to the farmers. In regions like Ranchi, Dumka, Gumla *etc.* which faces the problem of arid and semi arid land, difficult hilly tract, acute shortage of irrigation facilities, livestock and animal husbandry occupy a dominant role.

Jharkhand, an important state from eastern region of India, possess a good number of livestock, representing over 4.39% of the national population (Table 4). But their contribution to national milk production was only 1.16%, indicating lower yields from livestock when compared to the yields and contributions from other states like Punjab, Haryana and Uttar Pradesh. Even the per capita availability of milk was also low (177 g/day) in comparison to national average of 394 g/day (Table 5). Among four important species of livestock, cattle and buffaloes are maintained for milk and animal power, while sheep and goats are maintained mainly for meat, with milk and wool as secondary sources of income. Cattle and buffaloes, which are considered as milch animals, are partly stall fed and require substantial quantity of feed and fodder for economic management. However, in case of sheep and goats, most of the population is maintained exclusively on free grazing, although supplementary feeding can significantly improve their productive and reproductive performances. Recently sustained efforts of the Government of Jharkhand has yielded encouraging results in milk production, but per animal productivity is still low when compared to even national average (Table 6).

Table 4. District-wise population of livestock in Jharkhand

District	Cattle	Buffalo	Sheep	Goats	Pigs
Bokaro	400941	28525	16375	345816	16696
Chatra	510637	102000	457	300965	73570
Deoghar	692702	54383	25022	472849	30129
Dhanbad	349900	32673	18496	271044	36002
Dumka	747624	48090	28645	407126	128562
East Singhbum	412587	58544	91686	388863	22146
Garhwa	701752	73950	24978	414456	31478
Giridih	973869	112335	11982	730195	53106
Godda	672763	96016	4717	288944	104736
Gumla	558248	90480	7974	608665	107915
Hazaribagh	548412	70492	2628	476081	45160
Jamtara	431636	20420	38364	256925	37077
Khunti	279817	32918	34597	266678	40844
Koderma	183641	20496	430	120382	3198

District	Cattle	Buffalo	Sheep	Goats	Pigs
Latehar	347936	38088	91	274418	53042
Lohardaga	145722	16765	2282	175745	8202
Pakur	387417	70215	46812	309543	97940
Palamu	666463	94442	35157	352021	41819
Ramgarh	119968	29161	4147	209934	18325
Ranchi	636402	125153	39719	784961	68396
Sahebganj	263183	46545	3706	354589	68045
Saraikela Kharsawan	305172	30753	75651	364976	42111
Simdega	403412	26600	14476	418100	110301
West Singhbhum	471002	31269	112791	527897	38176
Total	**11211206**	**1350313**	**641183**	**9121173**	**1276976**

Source: BAHS (2019)

Table 5. Livestock and milk production scenario in India *vis-à-vis* Jharkhand state

Attributes	India	Jharkhand
***Population* (×, 10^6)**		
Cattle	193.46	11.21
Buffalo	109.85	1.35
Sheep	74.26	0.64
Goats	148.22	9.12
Pigs	9.06	1.27
Others	1.25	0.01
Total	536.76	23.61
Milk production		
Total (×, 10^6 tons)	187.7	2.18
Per capita availability (g/d)	394	177

Source: BAHS (2019)

Table 6. Average milk yield (kg/day) of bovines in India *vis-à-vis* Jharkhand state

Attributes	India	Jharkhand
Cattle		
Exotic	11.67	9.54
Crossbred	7.85	7.07
Indigenous	3.85	3.05
Non-descript	2.50	1.29

Buffalo		
Indigenous	6.34	5.22
Non-descript	4.21	2.40

Source: BAHS (2019)

E. Fodder scenario

The milk production is heavily dependent on the quantity of nutritious fodder fed to milch animals. Animals yielding up to 10 kg milk per day can be maintained exclusively on good quality fodder. As there are no opportunities to sell surplus fodder in local markets, farmers are reluctant to cultivate fodder exclusively on fertile agricultural lands, without owning high yielding animals. Hence, it is said that, although the promotion of fodder production is a critical factor, which has a direct influence on the livestock sector, fodder cultivation is closely linked to the productivity of livestock and the available critical veterinary support services including genetic improvement of indigenous non-descript animals.

The fodder supply situation in Jharkhand is extremely precarious and the gap was very wide (Table 7). During the year 2018-19, against the demand for 26.1 million tons of green fodder, only 2.46 million tons was available, while the dry fodder supply was adequate to meet only 46.02% of the demand in Jharkhand. Thus the shortage of fodder resources indicated that most of the livestock remained underfed. Such shortage of fodder resources could be attributed to the growing livestock population, low productivity and less emphasis on forage cultivation by the livestock farmers/owners. Because of low productivity, the farmers are not keen to feed quality green fodder to their low productive animals. As a result, there is no real demand for green fodder, although the present supply was able to meet only 9.4% of the actual demand in Jharkhand.

Table 7. Estimated fodder demand-supply scenario (× 10^6, tons) for the year 2018-19

Attributes	India	Jharkhand
Fodder demand		
Green fodder	850.9	26.1
Dry fodder	530.2	16.3
Fodder supply		
Green fodder	577.3	2.46
Dry fodder	471.9	7.5
Deficit (%)		
Green fodder	32.15	90.57
Dry fodder	10.99	53.98

For calculation of demand of dry and green forages, data were adopted from article *'India's livestock feed demand: Estimates and projections. Dikshit, AK, and PS Birthal. 2010. Agricultural Economics Research Review, 23(1): 15-28'.*

The present scenario of severe shortage of green fodder on one side and neglect of available resources in the absence of better quality livestock on the other side is really a matter of concern. However, now the time has come to take a close look at the micro level, where farmers are making investments in maintaining better quality animals to pursue dairy husbandry as an income generation activity. For these farmers, procuring good quality fodder is a major challenge. While majority of them are small holders, who are unable to use their holdings for fodder cultivation, for others, cultivation is a loss of opportunity to earn higher income by cultivating other high value cash crops. Over 90% farmers being resource poor and owning over 90-95% livestock, are not able to devote their small holdings for cultivation of fodder crops, as their priority is to produce food grains. Non-availability of critical inputs such as good quality seeds required for cultivating suitable fodder crops is another problem. Thus, the area under fodder cultivation has remained very low (Table 8). At national level, it is estimated that only 5.4% of the total cultivated land is devoted to fodder production. This area has remained almost static for the last few decades and there is very little scope for increasing the area under fodder production due to the pressure on land holding to divert the area for other uses. The situation in Jharkhand is even more precarious, since only 1.15% of total cultivated lands are used for fodder production. In the advanced States like Haryana, Punjab, Gujarat and some parts of Rajasthan, land use for green fodder production is around 10% of total cultivated land or more. Thus there is a need for restructuring the land use strategy to elevate the over-all percentage of cultivable lands for fodder production to not less than 10%. Permanent pastures and other grazing resources also constitute around 1.39% of total geographical area in Jharkhand. But their productivity and carrying capacity are declining, though these lands support grazing ruminants such as cattle, sheep and goats in large numbers. The common property and community lands which are under the public domain have also been drastically reduced for livestock grazing. In brief, the constraints related to fodder production are as given below-

- Most of the arable land is highly fertile, hence, there is little scope for availability of land for forage cultivation
- Low productivity of fodder as grown in marginal lands, fallow lands, low lying areas, red and laterite areas, saline and coastal areas
- Limited availability of quality seed of improved varieties of fodder crops
- Almost no priority for fodder seed production by the farmers/seed producing agencies
- Lack of post harvest management for surplus fodder, particularly available during *kharif* season
- Over-grazing and continuous degradation of pastures and other grazing resources
- The farmers are not fetching the minimum selling price for his livelihood through selling of milk

Table 8. Land use scenario (× 10^3 ha)

Attributes	India	Jharkhand
Land area	328726	7912
Cultivated land	155221	2770
Land under fodder crops	8448	32
Land under PP-GL	10258	110

Source: BAHS (2014); Agriculture Statistical Year Book (2018); PP-GL: Permanent pastures and grazing lands

SWOT analysis

A comprehensive fodder plan for the state needs a complete SWOT Analysis (Table 9) so that the right interventions can be taken up to sustain its economy, rural livelihood and to meet out the rising demands for livestock based products.

Table 9. SWOT analysis and factors regarding fodder development in Jharkhand

Internal factor Strength	**Success factor** • Around 23% of the total land is under forest cover, which can contribute a substantial quantity of fodder for livestock • Availability of high yielding varieties of fodder crops • Waste land constitutes more than 18.70% of total land, which needs to exploited for fodder • Presence of good number of livestock (23.61 million heads), providing milk, meat and other animal products • Livestock sector is still main occupation of livelihood of rural people in the state. • Grasslands/ grazing lands of 6377 sq km (8.09% of total land area) is available for grazing animals like sheep, goats and cattle (venerable group)	**Weakness** • Land under fodder crops is static & little scope of expansion in area, as per capita land is low • Lack of technical human resource in fodder development • Largely non-commercial status of fodder crop and un-organized small market. • Lack of promotional infrastructure facilities of production and marketing of quality seeds. • Marketing of fodder crops is not being organized and transportation of bulky fodder is difficult • Fodder industry does not have access to sustainable R&D funding • Uneven and unreliable seasons/drought

External factor	Opportunity	Threats
	• Increased demand for livestock products *viz.* milk & meat indicates the raising need of feed and fodder. • Climate variability- resulting in more fodder production in same season • Peri-urban dairy creating organized fodder market and need for post-harvest processing of fodder and crop residues and formulation of complete feed block • Introduction of genetically potential high yielding varieties, those can increase production by 2-3 fold • By optimum utilization of land resources, the deficit of fodder can be reduced to a substantial extent in the state • Increase in number of expert human resource can help in dissemination and transfer of technology at faster rate. • Introduction of innovative methods of fodder production can increase availability of fodder at rainfed areas or for venerable groups of animal keepers	• Rising input costs including fertiliser, irrigation water and transport costs • Changing land use - competition between agricultural (e.g. grain production) and non-agricultural uses (*e.g.* infrastructure, housing etc) • Weed contamination and weed spread • Less funding in for R&D with failure to secure future requirement of fodder • Degradation of natural resources • Climate change, water scarcity due to recurrent drought, and rise in weather uncertainty affecting crop failure and productivity of forage crops • Increase in global competition for markets under WTO regimes is real challenge to promote livestock production as per there standards and requirements • Migration of rural people towards city for employment and uplift living standards

Part-II : Fodder Resource Development Plan

Strategies for enhancing fodder resources

Following strategies can be adopted for increasing area and production of fodder/forage in Jharkhand:

- The area of permanent pasture and other grazing land can be increased by utilizing cultivable waste land as well as barren and uncultivated land.
- Low land having excessive soil moisture after rice may be utilized for berseem/ lathyrus production (November 1st fortnight) with suitable drainage system.
- Inclusion of forage crop in cropping system under integrated farming system approach.
- Establishment of silvipasture, agroforestry and hortipasture units in the land available with farmers or with village panchayats.
- Undulating problematic land can be utilized with suitable crop
- Border / Bund plantation of forage trees.

While improving the fodder resources, it is necessary to address the opportunities related to production and efficient use of crop residues, increasing the biomass yield of cultivated fodder crops on agricultural lands as well as on wastelands and community pastures. The strategy should cover selection and adoption of high yielding and stress tolerant fodder crops and varieties, improving the yield through sustainable production practices, efficient conservation and strengthening the value chain of dairy and meat producers to provide various critical services required to optimize the productivity as well as income.

Crop residues are major source of dry fodder for animals. The residues of cereals like paddy, wheat, maize, sorghum and legumes/pulses are collected and conserved and utilized as source of dry fodder. The green grasses/foliages available on the bunds, fallow lands and on the non-cropped areas like community land are used as source of green fodder. Farmers are cultivating high yielding varieties, which have lower fodder yield as these are dwarf in plant height, less in leafy biomass and stalk yield. However, these varieties are very well accepted as the food grains and fetched higher price, while the crop residues had no significant value, due to low productivity of livestock. But with the development of dairy husbandry particularly in peri-urban areas, crop residues are now in good demand. With such demand, farmers have started shifting back to the varieties with higher grain as well as stalk yield. Similar demand for high stalk yielding varieties has now set a new direction for breeding and selection of new crop varieties, which have higher fodder quality and yield, without any reduction in grain yield.

There are varieties of fodder crops suitable different agro-climatic conditions. The crops like Bajra x Napier hybrid, guinea grass, lucerne etc are suitable for irrigated conditions. The crops like perennial fodder sorghum, signal grass, Brizantha grass, Stylosanthes are suitable for rain fed conditions. Since they are perennial in nature, once planted, they are be able to provide fodder for 2-3 years and do not require frequent sowing and investment in terms of seed/planting materials and land preparation. On the other hand fodder maize, fodder sorghum, fodder bajra, fodder oat and fodder cowpea/ricebean are annual in nature and grown when there is availability cultivated lands. Unfortunately livestock farmers who have undertaken forage production are not able to optimize the yields and maximize the returns due to several reasons. These include cultivation on poor quality soils, inadequate fertilizer application, low moisture availability, improper timing of sowing and inadequate facilities to transport and storage of forage. Selection of suitable forage crops to suit the local agro-climatic conditions, non-availability of good quality certified seeds, lack of knowledge about cultivation practices and lack of marketing opportunities to sell the surplus forage at remunerative prices are also important problems, contributing to the poor response to forage production. Except for a few crops like sorghum, maize, bajra, berseem and lucerne, which are cultivated in a few isolated pockets in different parts, most of the farmers are not aware of other forage crops, which have special advantages under adverse agro-climatic conditions. Hence, to improve the availability of forage resources the following strategies can be adopted-

A. Cultivated fodder resources

There is great diversity in forage crops and varieties in varied regions and different growing seasons. We have large basket of perennial grasses, range legumes, cultivated forage cereals & legumes. In view of stiff competition with food & other commercial crops, forage varieties with tolerance in drought/water scarcity situations holds promise and can fit well in existing farming systems. These varieties can be very well adopted and promoted in suitable agro-climatic zones of the states (Table 10).

Table 10. Promising varieties of cultivated fodder and grasses/legumes

Crop	Varieties	GFY potential (t/ha)	Suitable for existing production systems
Sorghum (annual)	Pusa Chari-1, SSG 59-3 (Meethi Sudan), CSH-20MF (UPMCH- 1101), PAC 981, CSV-15 , HC-136, HC-171	35-45	Food-forage cropping system/ sole forage
Sorghum (perennial)	CO FS-27, CO FS-29	80 -100	Sole forage, intercropping with leguminous fodder
Bajra	Avika Bajra Chari (AVKB-19), Raj Bajra Chari-2, CO-8, APFB-2, PCB-164, APFB-09-1, Giant Bajra	30-40	Food-forage cropping system/ sole forage

Crop	Varieties	GFY potential (t/ha)	Suitable for existing production systems
Maize	Pratap Makka Chari 6, African Tall, J-1006	40-50	Sole forage/ silage (Milk shed areas)
Sudan grass	Meethi Sudan, Sweet Sudan Grass, Punjab Sudex Chari-1 (LY-250)	45-65	Sole forage/silage (Milk shed areas)
Cowpea	Bundel Lobia-1, 2 , 4, S 450, EC -4216, UPC-4200, UPC, 618, TNFC 0926	25-35	Food-forage cropping system/sole forage
Oat	OL-1804, RO-11-1, OS-403, JHO -851, JHO 822, JHO 99-2	40-55	Food-forage cropping system/ sole forage
Berseem	Wardan, Bundel Berseem -3, JHB 17-1, JHB 17-2	75-100	Sole forage
Lathyrus	Prateek, Nirmal	25-35	Rice fallow areas
NB hybrid	BNH -10, Co (BN)-5, CO (BN)-4, BNH -11, BNH -14	150-180	Round the year forage system, on farm boundaries, horti-pasture
Guinea grass	Bundel Guinea-1, Bundel Guinea-2, Hamil, Makunei, DGG-1, PGG-518	120-150	Round the year forage system, on farm boundaries, horti-pasture
Anjan grass	Bundel Anjan-1, CO-1 , Bundel Anjan-3	25-35	Silvipasture/Horti-pasture, forest fringes, degraded lands/ watersheds, community lands
Stylosanthes sp.	*S. hamata, S. seabrana, S. scabra*	25-30	Silvipasture/horti-pasture , forest fringes, degraded lands/ watersheds, community lands

Round the year forage productions from arable lands

The strategy needs to be focused on increasing forage production per unit area and encouraging forage production in mixed crop-livestock framing systems. For round the year fodder supply, fodder production systems have been developed and available for both irrigated and rainfed situations which needs to be promoted (Fig. 4-6). Under irrigated situations, Bajra x Napier hybrid based cropping system (Bajra x Napier hybrid + (berseem - oat + mustard) with green fodder production potential of more than 200 t/ha may be tried. But under rainfed situations, the system comprising of subabul + trispecific hybrid - fodder sorghum + pigeon pea may be adopted. Among

different perennial cultivated grasses, Bajra x Napier hybrid is most suitable for bunds of irrigated areas and tri-specific hybrid (TSH), guinea grass, Anjan grass and Nandi grass are suitable under rainfed conditions. Hence, they can also be adopted under non-competitive land use system.

Figure 4: Perennial based: N-B hybrid + cowpea under irrigated system

Figure 5: Perenial based: Subabul + trispecific hybrid - sorghum (fodder) + pigeon pea

Figure 6: NB hybrid on field boundary under non-competitive land use system

B. Fodder production in fruit orchards through horti-pasture

Hortipasture system integrates pasture (grass and /or legumes) and fruit trees to fulfill the gap between demand and supply of fruit, fodder and fuel wood through utilizing moderately degraded land. Aonla and Guava based hortipasture systems/ model has been developed for higher forage productivity (Fig. 7). The range grasses tried in the system were *Cenchrus ciliaris*, *Stylosanthes seabrana* and *Stylosanthes hamata*.

Figure 7: Aonla based hortipasture system

C. Fodder from pasture and other non-arable land

In rainfed agro-climatic zones of eastern states like Jharkhand, a large number of livestock is dependent on forage produced in rangelands**.** The design having different tree and grass combination was developed that creates space for forage, which depending on the design of the system, can grow at rates comparable to open pasture. Silvi-pasture models are suitable for highly degraded/waste lands under rain-fed situation (Fig. 8-9). Under poor soil, deficient water and nutrient situations where crop cultivation is not possible, silvi-pasture systems can serve the purposes of forage and firewood production and ecosystem conservation.

Figure 8: Ficus infectoria based silvipasture

Figure 9: Morus alba based silvipasture

Rejuvenation of grazing lands/common property resources

The areas under natural grasslands/pastures/common property resources are on decline, but still in a state like Jharkhand, theses resources are important. Excessive stocking pressure and degeneration of the original pasture grasses has led in to decline in biomass productivity from these resources. A comprehensive strategy for rejuvenation of these important resources is required like encouraging establishment of cooperatives for forages and pasture management (Fig. 10). Such cooperatives could be formed on the lines of highly successful milk-cooperatives. The suitable technologies are available at the research institutes which can be implemented by state authorities.

Figure 10: Rejuvenated grasslands with reseeding of grasses and legumes

D. Forages from new niches

There exists scope for improving the basket of feed resources through use of non-conventional/underutilized feed resources like spineless cactus, lathyrus, fodder beet, Moringa, Azolla *etc.* (Fig. 11). These can be incorporated in unutilized lands/marginal soils/degraded areas along with other existing options of forages/grasses.

Figure 11: Forages from new niches like spineless cactus and grass pea (Lathyrus)

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. 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 supplement (Fig. 12). It can successfully be grown during monsoon and summer months in Jharkhand state.

Figure 12: Azolla as feed supplement for livestock

E. Fodder conservation technologies

There is need of promoting the forage bank concept of preserving surplus production from rangelands during rainy season in various forms for use during lean periods by transporting economically baled and nutritionally enriched dry fodder from surplus areas. Interstate transport of crop residues for fodder and feed security needs to be explored at harvest of paddy and wheat straw. The facility may be strengthened to promote commodity forage banks at Tehsil level where surplus fodder can be stored as hays/silage/ fodder blocks for use during scarcity (Fig. 13). Establishment of forage banks near forest covers and bringing crop residues from surplus areas will meet out the forage requirement during scarcity and natural calamities. own during monsoon and summer months in Jharkhand state.

Figure 13: Ensiling of forages with polythene bags

Table 11. Summary of suitable technologies for different agro-climatic zones

Zone	Districts	Recommended forage activities
Central and North Eastern Plateau Zone (IV)	Bokaro, Chatra, Deoghar, Dhanbad, Dumka, Giridih, Godda, Jamtara, Hazaribagh, Koderma, Pakur, Ranchi, Sahibganj (13)	**Perennial fodder crops –** • BxN hybrid, Perennial Sorghum, Guinea grass, Anjan Grass, Setaria, Stylosanthes **Annual fodder crops** • Kharif – Fodder maize, fodder bajra, Deenanath grass, cowpea, ricebean, sudan hybrid, • Rabi- Oat, Berseem, Lathyrus, fodder beet • Zaid – Multicut sorghum, multicut bajra **Alternate land use** • Hortipasture, silvipasture, forage on bunds **Conservation techniques-** • Hay, silage, bales **Custom hiring center** • Farm implements
Western plateau zone (V)	Garhwa, Gumla, Khunti, Latehar, Lohardaga, Palamu, Ramgarh, Simdega (8)	**Perennial fodder crops –** • BxN hybrid, Perennial Sorghum, Guinea grass, Anjan Grass, Setaria, Stylosanthes **Annual fodder crops** • Kharif – Sorghum, Fodder maize, fodder bajra, Deenanath grass, cowpea • Rabi- Oat, Berseem, Lathyrus • Zaid – Multicut sorghum, multicut bajra **Alternate land use** • Hortipasture, silvipasture, forage on bunds **Conservation techniques-** • Hay, silage, bales **Custom hiring center** • Farm implements
South eastern plateau zone (VI)	Singhbhum (E), Singhbhum (W), Saraikela-Kharsawan (3)	**Perennial fodder crops** • BxN hybrid, Perennial Sorghum, Guinea grass, Anjan Grass, Stylosanthes **Annual fodder crops** • Kharif – Fodder Sorghum, Fodder maize, fodder bajra, Deenanath grass, cowpea, • Rabi- Oat, Berseem, Lathyrus • Zaid – Multicut sorghum, multicut bajra **Alternate land use** • Hortipasture, silvipasture, forage on bunds **Conservation techniques-** • Hay, silage, bales **Custom hiring center** • Farm implements

F. Other fodder interventions

Managing animal genetic resources

Indigenous breeds of livestock have been evolved and established under the existing conditions of diversified climatic and management systems with a certain level of efficiency in performance. Selective breeding of defined indigenous breeds of cattle having high milk yield, and those with excellent draught abilities, should be promoted to improve their production and reproduction potential. This will help in their proliferation, conservation and genetic up-gradation. Cross-breeding of non-descript and low producing cattle with high yielding breeds suitable for respective agro-climatic conditions, will also be encouraged in selected areas. It will lead to creation of milk shed areas thereby give impetus to fodder cultivation and marketing facilities.

Keeping animals healthy

Mismanagement and poor welfare make animals particularly susceptible to parasites and disease. Many young animals die of disease before they can lactate, reach slaughter weight or reproduce. This results in low yields and farm income and decreases farmers' ability to towards better practices. With proper training and financial aid, farmers could reduce the untimely mortality and increase productivity. Efforts for prevention and control of various other bacterial, viral and parasitic diseases of livestock should be strengthened. Availability of necessary vaccines and their quality control should be streamlined. If needed, health care services should be provided through Farmers' Federations. State Animal Husbandry Departments should monitor disease surveillance and promotion of clean milk and meat production.

Introducing innovative models

Low scale of production, rising cost of feed, fodder and labour, inadequate logistics infrastructure such as roads, power and cold chain, and inconsistent as well as low quality of raw milk are some of the major challenges faced by resource poor farmers in dairy farming. Inclusive dairy farming models need to be introduced in order to curb these challenges. Models like *large scale dairy farms* with ownership of cattle remaining with the farmers, model where large scale dairy farm is the hub & satellite farms are spokes, *medium scale dairy farms* with anchor processors, *community dairy farms* with 'cow hostel' models are some innovations which may give dairy farming system the required scale and at the same time integrate the small and medium dairy farmers.

Management of crop residues

Animal production systems in rural areas mainly are sustained on crop residues

feeding. Hence, it is important to focus on augmenting for adequate quantitative and qualitative availability of nutritious fodder. The crop residues burning or wastage affects the availability of fodder for the animals. Similarly, diversion of edible crop residues towards packaging industry and bio-fuel production needs to be regulated.

Addressing the issues of shortage of fodder seeds

At national level, comparatively less importance is being given to fodder seed production by National Seed Corporation and other private certified seed companies. A comprehensive seed production chain/ plan with the involvement of ICAR institutions, SAUs, State agencies, Private sector along with farmers' participation in a holistic manner is required to address this issue in proper perspective. Indeed, fodder seed production have unique problem as the economic part is not the seed and the fodder crop is usually harvested before the seed set. Seed demand of cultivated forages, range grasses and legumes is increasing day by day, present resources are fulfilling only 15-20% of the total demand.

Insurance and minimum support price for fodder crops

Since the demand is growing and considering the vital role forages have to play in dairying and ruminant animal based industries, this commodity (fodder crop) should get a central place within the various agro-ecosystems and be treated at par with the facilities provided to agricultural crops like crop insurance, minimum support price (with the concept of fodder bank) and similar other benefits. Even it should be considered as a small scale industry in order to earn direct benefits derived from different central/state government development schemes.

Adopting agribusiness models/ small entrepreneurship development

Adopting agribusiness models or development of small entrepreneurship is also proposed on preparation of area specific mineral mixtures, manufacturing feed block/ pellet units, concentrate feeds, small implements, silage preparation, by-pass protein etc at village/ district level for benefit of the livestock farmers in general and during natural calamity in particular.

Custom hiring centres

Arrangement should be made to provide equipments, machinery etc to the farmers at affordable cost through customs hiring centres (CHCs). The use of new machineries and technologies will enhance production, reduce drudgery and cost. The custom hiring centre should have all important implements/ machineries (Table 12) require for fodder production and which are difficult to have for majority of the farmers and will help in reducing the cost of fodder production.

Table 12. Major machineries for custom hiring centre

Prime movers or General machines	Land preparation/ Tillage machines	Sowing/ Transplanting machines/ Intercultural machines	Harvesting machines
Tractors • Tractor 2WD (above 20-40 PTO HP) • Tractor 4WD (above 20-40 PTO HP) • Tractor 2WD (above 40-70 PTO HP) • Tractor 4WD (above 40-70 PTO HP) **Power tillers** • Power tiller (below 8 BHP) • Power tiller (8 BHP & above)	• Disc plow • Cultivator • Disc harrow • Leveler blade • Cage wheel • Furrow opener • Ridger • Weed slasher • Bund former • Crust breaker • Roto-puddler • Roto-cultivator	• Seed cum fertilizer drill • Self-propelled rice transplanter (4 rows) • Self-propelled rice transplanter (4-8 rows) • Post hole digger • Potato planter • Raised bed planter • Multi crop planter (5 tines) • Ridge furrow planter • Pneumatic planter • Pneumatic vegetable transplanter • Plastic mulch laying machine • Raised bed planter with inclined plate planter and shaper attachment (5-7 tines) • Grass weed slasher • Power weeder	• Potato digger • Tractor drawn crop reaper/ reaper cum binder • Rice straw chopper • Crop reaper cum binder (3 wheel) • Crop reaper cum binder (4 wheel) • Power weeder (engine operated below 2 bhp) • Power weeder (engine operated above 2 bhp) • Power weeder (engine operated above 5 bhp) • Power operated horticulture tools for pruning budding, grating, shearing *etc.*

G. Contingent fodder planning

1. Establishment of Fodder banks

There is need of establishment of fodder banks in the state as the state is prone to various natural calamities like frequent flood, drought, long dry spells *etc.* Floods cause misery to livestock due to the widespread crop failures leading to acute shortages of feed and fodder and affecting livestock, nutrition and production. Fodder bank can be established near forest areas with storage of surplus grasses in the form of hay. Crop residues from surplus areas can be preserved as compressed

bales or hay. Preparation and storage of straw and dried grass/ grass hay/ fallen leaves can be taken up at household level. Inter-state transport of crop residues for fodder and feed security needs to be explored at harvest of wheat/paddy. Excess fodder in flush season/ surplus production from rangelands during rainy season can be preserved as hay / silage. The excess crop residues produced can be processed as feed block, bales, leaf meal, pallets and can be properly stored for utilization during natural calamities.

2. Fodder conservation

a. Hay: Although it is common practice, necessary training is needed to ensure long keeping quality with preservation of nutrient quality of the hay material. 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. The thin stemmed forage crops such as oat, lucerne, berseem, cowpea, clovers and grasses are highly suitable for hay making.

b. Silage: Silage is a high quality succulent feed resources resulting from the fermentation of green fodder stored and preserved anaerobically. Silage-making is practiced to store and preserve green fodder, when it is available in excess, for later use during scarcity period. The surplus green fodder is available during July–October and December–April followed by a scarcity period between mid-October to mid-December and mid-April to mid-July. Large farmers may prepare silage from maize, oat and sorghum *etc.* However, its success will depend on surplus forage production, requirement for labour (cutting, raking, collecting, chopping, pit construction and cleaning, ensiling) and materials (polythene, molasses). Several green crops (maize, oat, sorghum, Bajra x Napier hybrid grass, guinea grass, Setaria, etc) and grasses may be used 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 keeping the fodder. It will also help in supplying fodder during the calamities. Bales of hay and other dry fodder should be stored and covered with asbestos sheet or polythene sheet.

3. **Top feed:**

Fodder trees may be planted around the house, wasteland *etc.* in drought prone regions. Perennial fodder production on river beds, tank bed on community basis should be encouraged. Village gauchar (grazing) lands should be developed for fodder production. On boundaries of agricultural field trees or shrubs like Sesbania, Subabul, Neem etc should be planted.

4. **Unconventional fodder:**

The possibilities of availability of unconventional / alternative feed resources such as sugar cane top, sugar cane bagasse, banana plant, babul pods and mahua seed cake *etc.* may be explored during drought. The top fodder (Neem, Subabul, Acacia, Pipal, Gular, Sesame, Sal, Jamun, Mango, Jackfruit, Bamboo etc and fallen leaves from forest may also be used as fodder for livestock. During drought, sorghum may accumulate HCN, which is toxic to livestock. Care may be taken in feeding of stunted grown Sorghum fodder.

5. Short duration fodder crops of Sorghum / Bajra / Maize (UP Chari, Pusa Chari, HC-136, HD-2/ Rajko, Giant Bajra, L-74, K-6677, / African tall, Kisan composite, Moti, Manjari, BI-7) and cowpea should be sown in unsown and crop failed areas.

6. Permanent fodder seed banks should be established in all drought prone areas.

H. Seed supply

Since 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 required quantum of various fodder 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.

A seed chain for quality fodder seed production needs to be established and managed.

ICAR-IGFRI/SAUs can provide the breeder seed which should be multiplied as foundation seed by NSC/SSC/DAFD/Regional fodder stations/milk cooperatives. Foundation seed should be multiplied into certified seed by agencies like progressive farmers, milk federations, seed cooperatives, and self-help groups etc under the technical guidance of SAUs/NDDB/state officials. Private companies should also be roped in for production and marketing of quality seeds. The seed source for the state include ICAR-IGFRI, Jhansi; BAU, Ranchi; RPCAU, Pusa; BAU, Sabour; NSC, Regional fodder station, Kalyani *etc.*

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

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

An exercise will be conducted to elicit the opinion of the staff of the Animal Husbandry Department of Jharkhand state as to which fodder crops and their varieties will be more suitable for different agro-climatic conditions prevailing in the state. The same will 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 Jharkhand.

v. Master trainers training at IGFRI/SAUs

The staff of Departments of Animal Husbandry, Veterinary, Agriculture, Horticulture, Forestry *etc.* from the Govt. of Jharkhand having aptitude to work for augmenting fodder resources will be identified through their higher authorities 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 departments, Govt. of Jharkhand.

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

The Krishi Vigyan Kendras (KVKs) operating in the state of Jharkhand, 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

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

x. Enhance acreage and productivity in non-conventional areas

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

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

b. Production of fodder in problem soils

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

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

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.* Hence conservation of fodder resources wherever possible for future use during lean periods and at time of natural calamities like famine, flood *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

Many times livestock holders are faced with fodder scarcity owing to natural calamities, unforeseen failure of crops etc and it poses a great threat to sustainable management of 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 to force for going hungry. In addition, establishment of fodder-ware houses with enriched dry fodder or silage bins will also be popularized.

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

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

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

Although the initial stage of programme is hovering around the government agencies involved in various aspects of fodder production, processing, conservation, utilization, rationing, policy making, *etc.* the ultimate end user will be common farmers. Further there are several private players *viz.* dairy

owners, animal pharma industries, feed manufactures, NGOs involved in livestock production and dairying *etc.* They will all be brought together under Public-Private Partnership (PPP) mode for working in more transparent, efficient and economical way for all the partners.

xv. Impact analysis of technology adoption

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

Part-IV: Road Map

This project is conceived to be multi-task, multi-partner and multi-year activity. Hence a proper road map is necessary for making it more practical and result oriented one. The following road map has been proposed under this project. There are several actions points to be carried out in the process of implementation by several agencies (Table 13). Indeed, the programme implementation plan is a time bound multi-stage oriented and aimed to complete the activities in time frame in a logical way.

Table 13. Road map for the implementation of the proposed activities

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

Part-V: Implementation of Pilot Programme

Pilot project is proposed to be implemented in the selected areas (selected villages of identified districts of each agro-climatic zone) to assess the acceptability and impact of technology and also refinement in technology and methodologies, if required. The detailed plan for implementation of pilot project is presented in Table 14.

Table 14: Implementation level plan for pilot project

S.No.	Activity	Action points
1	Target area selection	• Selection of 3 districts (1 from each agroclimaic zone) • Selection of 2 cluster of 5 villages in each district total 6 clusters for 3 districts • Selection of 1 to 2 ha in each cluster for technology demonstrations • Bench mark survey
2	Training	• Training of master trainers- 25 master trainers per batch and 1 batch from each district at IGFRI, Jhansi • Training of farmers; 10 from each village; 300 farmers in first year (6 training program for farmers of each cluster) • Exposure visit of progressive farmers and master trainers at IGFRI, Jhansi/other ICAR Institutes/ BAU, Ranchi/NDDB, Anand
3	Technology demonstrations	• Selection of crop and varieties will be done after identifying suitable districts and village clusters both under annual and perennial crops for different seasons *viz. kharif*, *rabi* and zaid • Silage preparation should be encouraged • Since crop residue being a precious commodity, fodder banks using densification technologies can be developed
4	Suitable silvi-pasture/ horti-pasture systems 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	Development of fodder trees blocks	• Particularly in hilly and dry districts of state compact plantation of 1 ha on forest/ community lands with grasses
6	Need based watershed/ micro irrigation facility development	• Suitable fodder species to check soil and water erosion and enhancing water retention will be highlighted
7	Rejuvenation of grasslands/ pasturelands/ CPRs	• The related activities will be taken up during post rainy season /with first *rabi* rains
8	Tapping rice fallow and other fallow areas for fodder production	• Suitable annual fodder crops *viz.* fodder cowpea, oats *etc.* will be grown on residual moisture to ensure fodder supply during the period
9	Input supply	• Inputs *viz.* seeds/ rooted slips/, fertilizers, insecticides etc, chaff cutters, small millets thrasher and tools - improved sickles *etc.* will be supplied to farmers
10	Custom hiring centre in each village cluster	• Exploring and facilitating the farmers with chaff cutter, straw 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 Jharkhand, Govt. of India through various State and Central schemes like RKVY *etc.* can meet the fund requirement. ICAR- IGFRI will provide technical support for formulation of such fodder development proposals for funding. The fund requirement for the implementation of pilot project is presented in Table 15.

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

(Rs in Lakhs)

Item	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Training (Master trainer/ farmers/ stakeholders)	6.0	6.0	6.0	4	4	26.0
Exposure visit of farmers/ stakeholders	4.5	4.5	4.5	1.5	1.5	16.5
Seed/Planting material	6.0	6.0	1.5	1.5	1.5	16.5

Micro Irrigation facilities	6.0	6.0	4.5	4.5	1.5	22.5
Other farm inputs small equipments *etc.*	6.0	4.0	4.0	1.5	1.5	17.0
Custom hiring center equipments	35.0	15.0	1.5	1.5	1.5	54.5
TA/DA/ staff (SRF/YP/RA)/ Consultancy/ Miscellaneous *etc.*	10.0	10.0	7.0	7.0	7.0	41.0
Total	73.5	51.5	29	21.5	18.5	194.00

Part-VI: Modalities

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

Annexure-I

Proceedings and recommendations of the Interactive workshop held on 26th July 2021

As a part of "National Initiative for Accelerating Fodder Technology Adoption (NIAFTA)", the workshop was organized on 26th July 2021 through virtual mode for discussing the status of fodder production, conservation and utilization for the state of Jharkhand. At the outset, Dr. Purushottam Sharma, Head, Division of Social Sciences & In-charge ATIC, ICAR-IGFRI Jhansi welcomed Shri Shashi Prakash Jha, Director, Animal Husbandry, Government of Jharkhand; Dr. Amaresh Chandra, Director, ICAR-IGFRI, Dr. A .K. Roy, PCFC , members & dignitaries. Mentioned the objectives of the workshop and informed that so far 16 meetings were organized and 11 fodder plans were published. During the workshop, fodder plan of Jharkhand deliberated threadbare. Important points emerged during the discussions are mentioned.

Dr. Amaresh Chandra, Director, ICAR-IGFRI in his inaugural speech expressed hearty welcome to all the participants including Director, Agriculture & Animal husbandry, Government of Jharkhand, Dr. A. K. Roy, PCFC , members, Officer-In-charges of Regional Stations, AICRP centres located in Jharkhand and staffs of line departments. Dr. Amaresh Chandra informed that in the recommendation of the Regional Committee meeting a suggestion came for preparation of a Joint comprehensive fodder plan for the state of Jharkhand. Director mentioned that we have number of technologies available *viz.* technology for round the year production, technology of crops/varieties, technology for arable land, non-arable lands, technology for new niches *etc.* Highlighted the utilization of fallow lands to help increase fodder production and conservation for the state.

Dr. A.K. Roy, PC (FCU), presented draft fodder plan including agricultural scenario, details of varieties, technologies, land utilization pattern and highlighted the ways to increase livelihood through livestock, crop residue management, rejuvenation of grazing lands, introducing innovative models and suggested brief action plan involving identification of areas for fodder production, road map for implementation, budget and modalities *etc.*

Shri Shashi Kant Jha, Director, Animal Husbandry, Jharkhand mentioned that there is immense scope of fodder cultivation in Jharkhand. Land availability is there but there is no system of storing rain water besides low productive animals and lack of awareness of fodder cultivation, access to availability of seeds are the major constraints. Livestock are maintained by landless farmers or by small/marginal farmers. Shri Manoj Tiwari highlighted that there is deficit of 79% green fodder and 21% dry fodder for the state. Dry fodder is a problem during summer season but during rainy season this can be exported to adjoining Bihar state.

Dr A.K. Dixit presented the advances on packages of practices of fodder suitable to the state of Jharkhand. Mentioned that Jharkhand receives good rain fall but due to low productivity and unavailability of quality fodder dominated by poor genetic constitution and poor disease and pest management fodder cultivation has not been popular. There is need of introduction of new technologies and allocation of more areas under forage especially rice fallow areas, soil and planting management, integrated nutrient management, prospects of fodder on field bunds and fallow land, non-conventional forage resources, azolla cultivation, fodder beet and Moringa cultivation and suggested that if complete package is followed than the fodder demand can be solved.

Dr. Birender Kumar and Dr. Yogendra, BAU, Ranchi made presentation about suitable fodder technolies for Jhakhand.

Dr. R.V. Kumar presented the grassland and pasture development suitable to the state. Focused on non arable land, Silvi-pasture comprising grasses, legumes and trees. Highlighted grassland productivity, cost of pasture land establishment, time and energy requirement for one hectare. Also mentioned *Hardwickia* based, *Acacia* based, *Ficus* based silvipasture, agro forestry and fodder availability from three tier system.

Dr. Sunil Seth presented horti-pastoral system and mentioned Uttamchara- Swasth Pashu. Emphasised integration of fruit trees with pasture (grasses and legumes) in the same unit of land. Guinea grass can be grown with fruit trees like Aonla, ber, guava, jackfruit.

Dr. M.M. Das, presented the fodder conservation and fodder based economic ration for Jharkhand state. Fodder can be conserved as either hay or silage. Maize, Sorghum Oat and grasses at 50% flowering stage can be used for silage making where as *Stylosanthes*, grasses and leaf meals can be preserved as hay. Dr Das Emphasized the need of mixed ration for high producing milch animals and mentioned that if green fodder can be fed we can save the need of dry fodder , feed and concentrates.

Dr. P.K. Pathak presented the necessity of densification, storage and fodder bank. Mentioned that machines are available for harvesting, chopping, hay making, feed pellets and complete feed block technology. Area required for storage, cover, plinth, type of crop residue to be stored, baling packing *etc.* are discussed.

Major recommendations

- There is need of mass awareness regarding fodder cultivation with improved technologies and capacity building programme *etc.* for line department staff, BAU staff and farmers
- The focus should be on silvi-pasture system, soil water conservation, productive animals and community farming and area of fodder cultivation will be increased.

- Good planting material and creation of a reservoir of planting material specially BN hybrid and guinea grass should be done.
- *In kharif* BN hybrid and Dinanath grass cultivation and in *rabi*, oat, berseem can be popularized. But berseem seed production is not being taken up. Grass pea can be grown and rice bean is performing better. During *kharif*, farmers grow less fodder as they get natural fodder outside.
- Many farmers want to cultivate forage crops but not cultivating due to inability of selling their produce.
- Director, ICAR-IGFRI expressed concern of keeping fallow land for 8-9 months and informed to the IGFRI technologies.
- Shri Jha, Director, Agriculture & Animal husbandry, Government of Jharkhand informed that if a plan be developed for one acre, five acre, 10 acre, 50 acre and 100 acre land then it will help to include the same in the government programme.
- At block level demonstration, training and fodder seed centre can be developed.
- Gochar, wasteland/ fallow land can be developed as pasture.
- Self help groups can be promoted for fodder cultivation.
- In orchards, guinea grass can be promoted.

Dr. Amaresh Chandra, Director, ICAR-IGFRI expressed gratitude for all for success of the workshop and thanked Shri Jha (Director- AH), BAU officials, members, and farmers for the input provided that are worth mentioning. Director reiterated that we have technology available for all the three zones and welcome information on area of fallow land, pasture land from state government and line departments so that it will be included in the development of fodder plan. The meeting ended with vote of thanks by Dr. Purushottam Sharma, Head, Division of Social Sciences, ICAR-IGFRI Jhansi to all the participants for the successful organization of the workshop.

Annexure-II

Interactive workshop "Fodder production, conservation and utilization" for the state of Jharkhand held at Jhansi on 26th July 2021

1. Dr. Amaresh Chandra, Director, ICAR-IGFRI, Jhansi
2. Shri Shashi Kant Jha, Director, Animal Husbandry, Jharkhand
3. Dr. Sunil Kumar, ICAR- IGFRI, Jhansi
4. Dr. Purushottam Sharma, ICAR-IGFRI, Jhansi
5. Dr. Prabha Kant Pathak, ICAR- IGFRI, Jhansi
6. Dr. R.V. Kumar, ICAR-IGFRI, Jhansi
7. Dr. S. Ahmed , ICAR-IGFRI, Jhansi
8. Dr. A.K. Roy, ICAR-IGFRI, Jhansi
9. Dr. Manoj Kr. Tiwary, Nodal Officer (Plan & Budget), Jharkhand
10. Dr. Minu Sharan
11. Directorate of AH Jkhand (Anushka Tiwary)
12. Dr. K.K. Singh, ICAR-IGFRI, Jhansi
13. Dr. Bipin Mahtha
14. Dr. Rajesh Chauhan
15. Sri Jai Prakash
16. Dr. Sunil Seth, ICAR- IGFRI, Jhansi
17. Sri Rahul Verma
18. Dr. Gaurendra Gupta, ICAR- IGFRI, Jhansi
19. Dr. Vijay K. Yadav, ICAR- IGFRI, Jhansi
20. Dr. Mithilesh Prasad Singh
21. Dr. T.C. Gupta
22. Dr. Mukesh Choudhary, ICAR- IGFRI, Jhansi
23. Dr. A.K. Dixit, ICAR- IGFRI, Jhansi
24. Dr. Pankaj K. Gupta
25. Dr. Arvind Kumar Sinha
26. Dr. Krishna Kant Tiwary
27. Dr. Palmei Gaibimei
28. Dr. Yogendra Prasad
29. Dr. N. Dikshit, ICAR- IGFRI, Jhansi
30. Dr. Balmiki Prasad
31. Dr. Tajwar Izhar

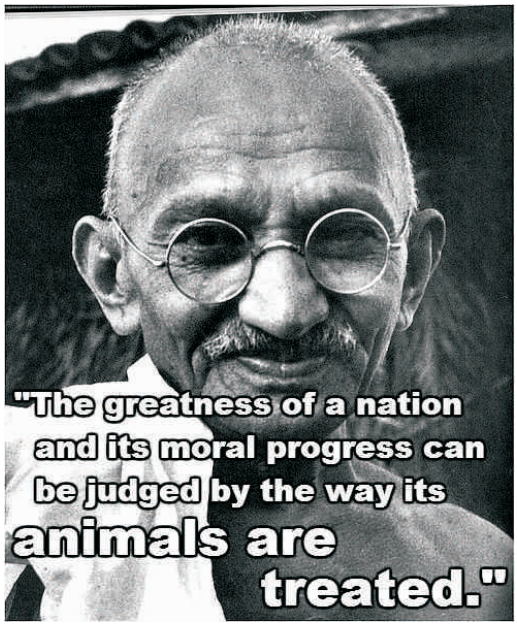
32. Dr. Surendra Chakrapani
33. Dr. Niraj Kumar verma
34. Dr. Shashi
35. Dr. Kaushalendra kumar Singh
36. Dr. Radhe Shyam Kunwar
37. Sri Birju Linda
38. Dr. Prabhu Govindasamy, ICAR- IGFRI, Jhansi
39. Dr. Brajesh Kumar, ICAR- IGFRI, Jhansi
40. Dr. Bishwa Bhaskar, ICAR- IGFRI, Jhansi
41. DAHO PALAMU
42. DAHO LATEHAR
43. Dr. Prabhat
44. Dr. Sukhlal Gagrai
45. D.A.H.O.
46. Dairy, Deoghar
47. DAHO GIRIDIH
48. Dr. Deepika Hemrom
49. Dr. Birendra Kumar, BAU Ranchi
50. Dr. Yogendra, BAU, Ranchi
51. Dr. Vidya Sagar

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 Karnataka state	2008
	DHN-15	200-250	Irrigated areas of Karnataka 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 (Karnataka)	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 Karnataka	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



Contact Us :

Director

ICAR-Indian Grassland and Fodder Research Institute

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

0510-2730666

0510-2730833

director.igfri@icar.gov.in

https://igfri.icar.gov.in

@ icarigfri Jhansi

igfri.jhansi.56

IGFRI Youtube Channel

Kisan Call Centre 0510-2730241

Classic Enterprises, Jhansi. 7007122381