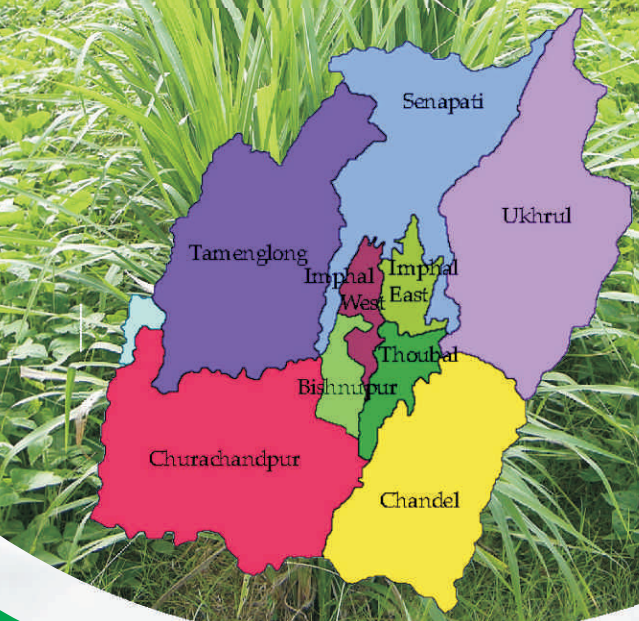
Fodder Resources Development Plan for Manipur



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 Manipur

...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 14/2022

Citation:
ICAR-IGFRI (2022). Fodder Resources Development Plan for Manipur. 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

Manipur depends on agriculture and allied sectors. And about 80 per cent of the population depends on agriculture for their livelihood. The state is rich in livestock population. The availability of year-round fodder is important for enhancing productivity and economizing livestock production. The State has a shortage of green fodder and the state to enhance forage resources in the state.

It is indeed a matter of great pleasure that the ICAR-Indian Grassland and Fodder Research Institute, Jhansi has developed the state specific, "Fodder Resources Development Plan", for Manipur in consultation with all the stakeholders. This document underlines the technological options to enhance production, conservation and value addition of fodder and 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 Manipur.

(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. Palsania, PS	Member
Dr. Gaurendra Gupta, Scientist	Member
Dr Bishwa Bhaskar Choudhary, Scientist	Member
Sri A.K. Saxena, CTO	Member

Manipur Fodder Resources Development Plan Committee

Dr. J.P. Singh, PS	Coordinator
Dr. B.P. Kushwah, PS	Chairman
Dr. Shahid Ahmad, PS & Head	Member
Dr. N. Dixit, PS	Member
Dr. A.K. Dixit, PS	Member

Acknowledgement

Fodder plan is an area-specific strategy to be adopted to overcome the deficiency of green and dry fodder of the region and also to provide an 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 the shortage of green and dry fodder in the country, the idea and vision of the development of state-wise fodder plans for different states of the country were visualized by Dr. Trilochan Mohapatra, Hon'ble Secretary DARE, and Director General, ICAR. He advised to develop a state-wise fodder resource development plan which covers the broad areas as per the requirement of the state. We are highly grateful to him for his insight, guidance, encouragement, continuous support and suggestions in preparing this document. We are also thankful to the Deputy Director General (Crop Science), ADG (FFC) and other officers of the ICAR who extended their support during the development of the fodder plan of Manipur.

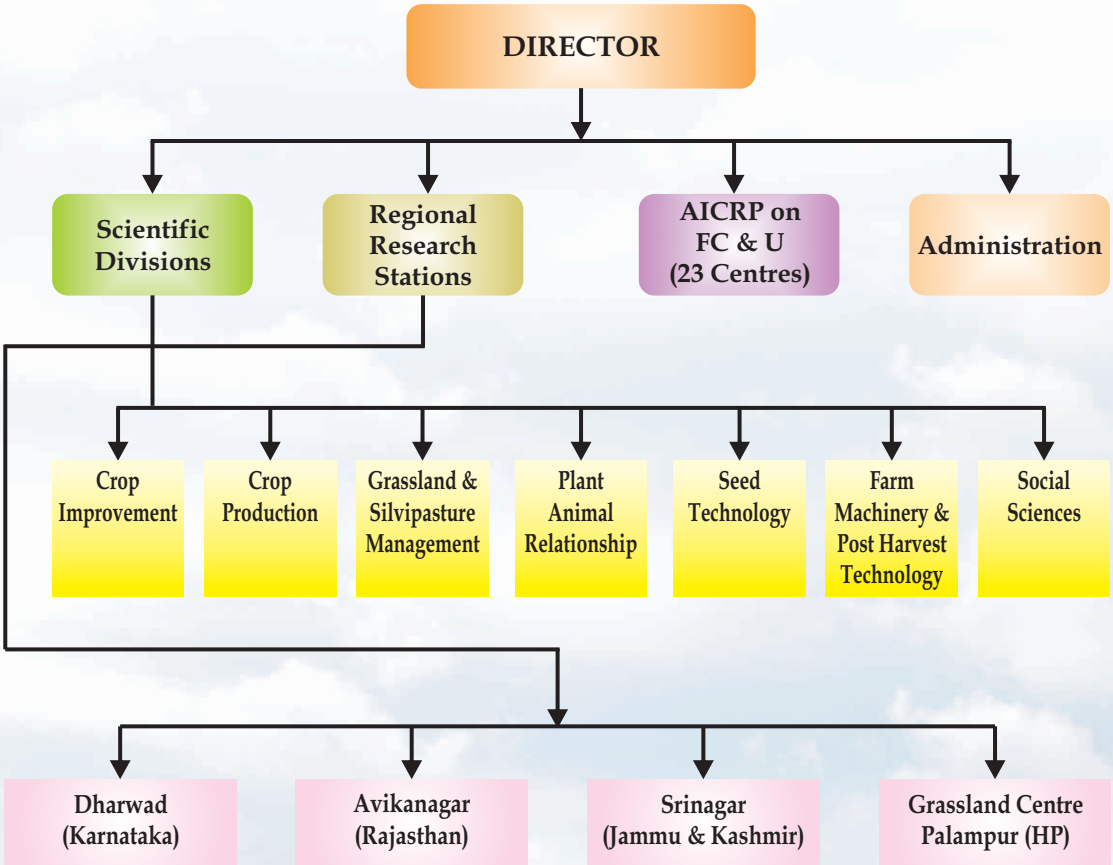
We extend thanks to Dr. Anupam Mishra, Hon'ble VC, Dr. S. Basanta Singh, Director (Instructions), all directors and faculties of CAU, Imphal for extending full participation of the scientists of CAU. We also thank to all the participants including officials of state government of north-east, KVK personnel, 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 Manipur and organizing interactive workshop are praiseworthy. This fodder plan is prepared as a part of the activities of our program 'National Initiatives on Accelerating Fodder Technology Adoption (NIAFTA)'; the whole team of the program and Nodal Officer, Dr. Purushottam Sharma, Principal Scientist, 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 forage research in new frontier areas.

Proven Technologies of Institute

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

Accelerating Fodder Technology adoption

Transferring knowledge and skills are the essential component required for execution and implementation of resource conservation based projects in the country. The institute is organizing training and skill development programmes regularly of varying duration for farmers, students, state government officials, field functionaries in the field of soil and water conservation. The research institutes has signed MoUs with more than 20 Gaushalas for transfer of fodder production technologies. The MoU of research institution are for collaboration on education, technology dissemination and providing consultancy on different proven technologies. Field demonstration on validated technologies for resource conservation and productivity enhancement in red soils of Bundelkhand region are operating at full fledge. Several outreach programmes such as Adarsh Chara Gram (a cluster of three villages), Mera Gaon Mera Gaurav (MGMG),

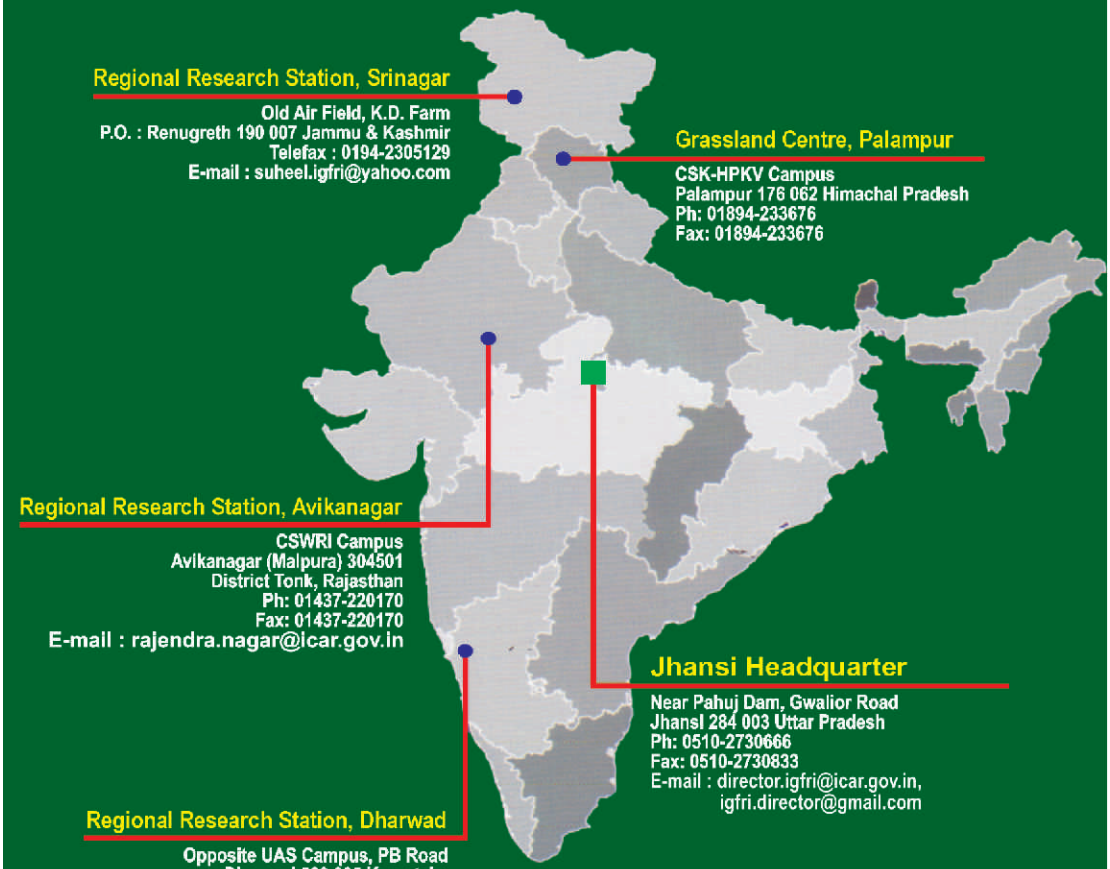
National Initiative on Fodder Technology Demonstration (NIFTD), Network Project on Bhadawari Buffaloes, Participatory Fodder Production in Mango Orchards, Farmers FIRST Programme, NICRA, TSP, SCSP, NEH, DFI-Kisan Mitra and NIAFTA have been initiated and implemented.

NIAFTA: New 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

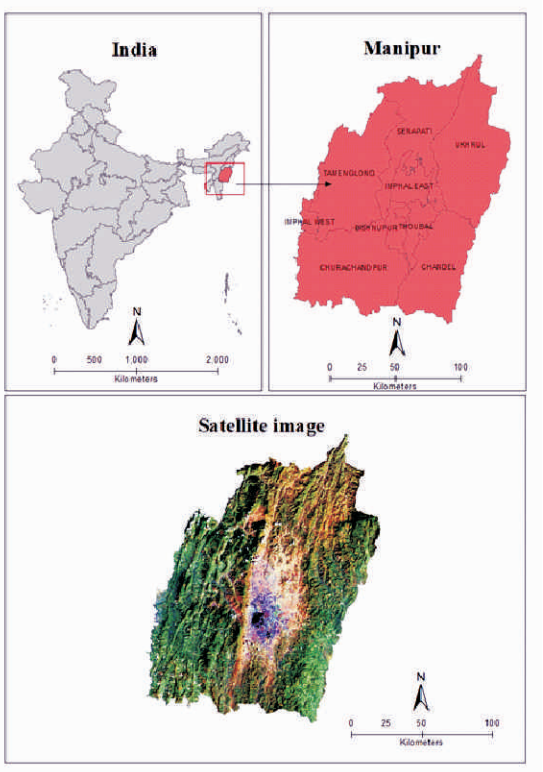


Figure 1: Geographical location of Manipur

Livestock production and agriculture are intrinsically linked to each other, and both are crucial for overall food security. Livestock not only provides food security through supply of milk, meat and self-employment of both men and women but also plays an important role for poverty alleviation of smallholder livestock farmers. The desired growth of agriculture sector can be accomplished only through enhancing overall productivity of the livestock sector. This would require a steady and adequate supply of quality fodder for supporting the livestock population. For development of livestock sector, the need of the hour is, therefore, to meet the current shortfall of fodder by adopting suitable measures for increasing the production of crop residues, green fodder and agricultural by-products. Ensuring an adequate supply of reasonable quality feed and fodder is one of the major challenges which Indian livestock sector is facing currently. The demand for livestock products, especially for milk and meat, in India has increased considerably in the recent past, and has strong potential for further growth. At the same time large number of farmer's of our country depend on animal husbandry for their livelihood. With the supply of milk, meat, eggs, wool, their castings (dung), etc, animal husbandry plays an important role in the rural economy since time immemorial.

Manipur, one of the eight sisters of the north eastern region of India, is a hill grit state situated at the lower tip of the sub Himalayan range. Resembling most of the northern states of India, the economy of state primarily depends on agriculture and allied activities. It has an area of 22,327 sq. km, and is bounded by Nagaland in the north, Assam in the west, Mizoram in the south-west and Myanmar in the east and south-east. Manipur is endowed with rich biodiversity and abundant natural resources. Despite inaccessibility, marginality and heterogeneity, the state has made good progress in

agriculture and allied sectors. About 80% of the state population depends on agriculture for livelihood.

B. Agro-climatic zones

There are four agro-climatic zones in the state, *viz.*

1) **Sub tropical plain zone:** Kangchup, Thoubal , Bishnupur
2) **Sub tropical hill zone:** Churachandpur, Chandel
3) **Temperate sub alpine zone:** Senapati, Lamlangate, Kamjong
4) **Mild Tropical Hill Zone:** Jiribam, Tamei, None

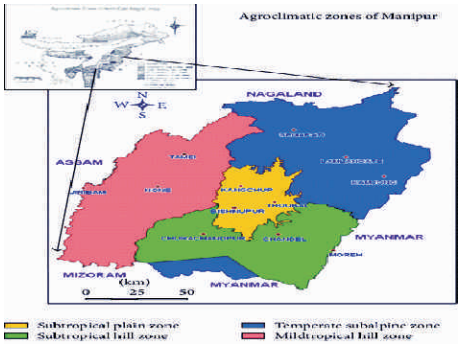


Figure 2: Agro-climatic zones of Manipur

Agriculture scenario

The major geographical area of the state is 22,327 sq. km of which 90% is hilly (5 districts) and the rest is central valley (4 districts). The size of cultivated area is about 17.15% of the total geographical area (Table 1). Agriculture is characterized by rugged terrain, wide variations in slopes and altitude, community land systems and conventional cultivation practices. Agriculture is the main occupation of the people of Manipur. Therefore, half of the total valley area, which accommodates 67% of the total population, is occupied for agriculture purposes.

Agricultural production system is mostly rainfed, monocropped and at subsistence level. Rice, being the staple food crop, accounts about 95% of the total food grains productions and covers about 72% of the total cropped area of the state. Besides rice, other cereals such as maize, wheat etc. and pulses along with various kinds of fruits and vegetables are also grown in both valley and hilly region. Of this total cultivated area, 52% is confined to the valley. The pressure on land in the valley is thus quite conspicuous.

Table 1: Land use scenario (×, 10^3 ha)

Attributes	India	Manipur
Land area	328726	2233
Cultivated land	155221	383
Land under fodder crops	8448	4
Land under permanent pastures and grazing landsPP-GL	10258	1

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

The pressure on land in the valley is thus quite conspicuous. Manipur's climate and soil conditions make it ideally suited for horticultural crops.

Horticulture plays an important role in subsistence farming which is practised by

majority of the small and marginal farmers, especially in hilly districts. The state is bestowed with several pre-requisites for successful cultivation of horticultural crops. The major fruit crops are pineapple (*Ananas comosus*), banana (*Musa* spp.), passion fruit (*Passiflora edulis*), khasi mandarin (*Citrus reticulate*) and kachai lemon (*Citrus jambhiri*). Recently temperate fruit crops like kiwifruit (*Actinidia deliciosa*) and plum (*Actinidia deliciosa*) have gained popularity.

An area of 1699.40 thousand hectares of Manipur is under forest cover with seven types of forest class, *viz.* tropical semi-evergreen forest, moist deciduous forests, east Himalayan wet temperate forests, sub-Alpine forests, grassy blanks, bamboo brakes and cane brakes.

C. Interactive Workshop-IGFRI and State Department

Interactive workshop of NEH states (Nagaland, Manipur, Mizoram, Meghalaya, Arunachal Pradesh and Sikkim) was organized on 8th December 2021 through virtual mode for discussing the status of fodder production, conservation and utilization in the six north eastern states of India. At the outset, Dr. Purushottam Sharma, Head, Division of Social Sciences & In-charge ATIC, ICAR-IGFRI Jhansi welcomed the dignitaries of six North Eastern States *viz.* Dr. Basant Singh, Director of Research, CAU, Imphal, Manipur; Director, Department of Animal Husbandry & Veterinary Sciences, Nagaland, Dr. A.K. Roy, PCFC, AICRP (FC & U), Dr. Amaresh Chandra, Director, ICAR-IGFRI, Head of Divisions and Officer-in-charges of Regional Stations, S. Acharya, Tripura; Mukhtar Hussain, ICAR- NRC Yak, Dr. Dinamani Medhi, Principal Scientist, Animal Nutrition, Dr. Subramanyam, Nagaland and other participants. Dr. Sharma highlighted the NIAFTA programme undertaken by the Institute and 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 six north eastern states deliberated threadbare. Important points emerged during the discussions are mentioned (Annexure-I).

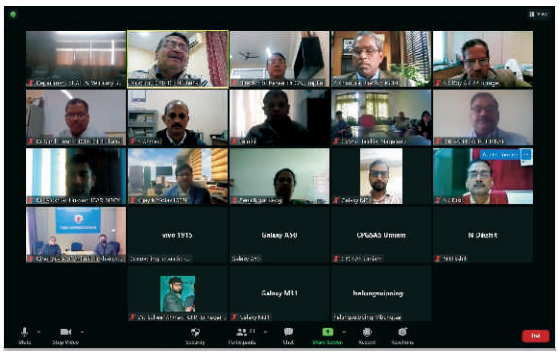


Figure 3: Interactive Workshop

Dr. Amaresh Chandra, Director, ICAR-IGFRI expressed hearty welcome to the participants and mentioned that India is having 536 million livestock and 198 million litres of milk but the productivity of milk is low. Outlined the non availability of quality fodder. Director expressed that the Institute has unique mandate to improve grassland productivity. As far as NE states are concerned, out of 8 states, fodder plan of two states are already developed. More valuable input is required from each state. As far as technology is concerned, ICAR- IGFRI & PCFC has developed more than 300 varieties, models for different production systems but improvement of forest areas and grassland productivity is required. Population of livestock is different in different states so also

implementing agency is different in different states. Availability of green fodder is 35%, 11% dry fodder and 40-45% feed. To meet the demand of livestock comprehensive plan is required and inputs from different states will be helpful for development of fodder plan. To improve the productivity, quality seed production is required and will be done. Director also 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.* It was also mentioned that IGFRI is having four Regional Stations at Srinagar, Dharwad, Avikanagar and Palampur.

The meeting ended with vote of thanks by Dr. S. Basant Singh. He expressed that the interactive workshop is very fruitful as far as NEH is concerned. We should have more and more nutritious fodder, more awareness programme, publicize importance of feed and fodder. Dr. Singh mentioned his support in collaborating and motivating the stake holders for participating in this endeavor to discuss about the enhance production and productivity of forage crops in the NE states. Dr. Singh thanked the organizer from the core of his heart and wished all success of this programme (Annexure-I).

D. Livestock scenario

Animal husbandry and poultry rearing are integral allied agricultural enterprises in addition to agri-horti production systems. The small and marginal farmers of the state, in general, earn their gainful employment from this sector with cattle, buffalo, sheep, goat, mithun, pig, *etc.* representing the main categories of the animals being reared. Rearing of pigs and poultry are important sources of income, especially in the hills. There was a decrease in livestock population from 2012 to 2019, *i.e.* decrease of 60.14, 5.91, 45.41 and 40.61% in exotic cattle, indigenous cattle, buffaloes and goats, respectively. At present the livestock population in the state is large in numbers but its productivity is very low compared to other parts of the country (Table 2-5).

Table 2: Livestock population of Manipur (census 2019)

Species	(Number in thousands)
Cattle	224.21
Buffaloes	36.23
Sheep	5.92
Goat	38.70
Pig	235.26
Horse	1.08
Mithun	9.06
Total	**550.46**

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

(Number in thousands)

Year	Cattle						Buffaloes			Goat
	Exotic			Indigenous			Male	Female	Total	Total
	Male	Female	Total	Male	Female	Total				
2012	11.39	32.92	44.31	85.73	133.80	219.54	28.0	38.37	66.37	65.16
2019	1.16	16.50	17.66	65.75	140.80	206.55	15.85	20.38	36.23	38.70
% change	-89.82	-49.88	-60.14	-23.31	5.23	-5.91	-43.39	-46.89	-45.41	-40.61

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

(Number in thousands)

Year	Milch cows (Indigenous)	Milch cows (Exotic/CB)	Milch buffaloes
2012	62.13	17.05	16.87
2019	50.36	7.0	6.84
% change	-18.94	-58.94	-59.45

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

	Buffaloes	Cattle	Goat	Total
Milk production	15.62	70.13	-	85.75

The state does not have any recognizable indigenous breed of cattle and buffaloes. The majority of the buffaloes in Manipur is swamp type and mostly reared by the poor farmers. Their production potentiality is low. Albinoid buffaloes are also found in Manipur. The farmers milk their buffaloes once in the morning and allow them to graze in the forest or nearby grazing lands throughout the day. In hill areas, buffaloes are reared under semi-domesticated system of management while in plain areas, buffaloes are reared under settled system of management. Under zero input system buffaloes thrive well and provide triple benefits of milk, meat and drought power to the farmers.

The local cattle of Manipur belong to the non-descript type, they are of medium size, stout and hardy. The local bullocks have fame in Assam and other neighboring states for their skill and draught power. If genetic improvement is done in terms of raising milk production and reproductive performance using an indigenous cattle breed, the local cattle can be transformed into a good economical dual purpose breed.

The Manipur is known for Manipuri horses. The Manipuri horses having qualities of both hill and plain breeds of horses have been bred over centuries in Manipur area of northeast. Manipuri horses are reputed for their intelligence, are used for polo and

racing. They are also known as Manipuri pony. Manipuri pony is one of the earliest breeds to be used as a polo pony which has been played throughout Asia since time immemorial.

E. Fodder Scenario

The productivity of livestock is mainly dependent on green and dry fodder, but the state has a shortage of green fodder to the extent of about 62.5 percent. Fodder crops are the cheapest source of feed for livestock. The land under fodder crops and grazing lands/permanent pastures is about 4000 ha and 1000 ha respectively (BAHS, 2014; Agriculture Statistical Year Book 2018). Maize, cowpea, berseem, oat, guinea grass, NB hybrid, setaria grass, fescue grass and congo signal grass are important fodder crops of the state. Good quality grass/fodder helps in increased production of milk and meat at a cheaper rate. The cultivation of quality grass/fodder is rare and the quantity is inadequate. Because of the smaller land holdings cultivation of food crops on first priority and the cultivation of fodder gets lower priority. Looking at the vast gap between the demand and supply position, it becomes necessary to put adequate efforts to transfer the potential technologies developed by various research organizations of the state and country to farmer's field in order to increase the production and productivity of good quality fodder. Therefore, there is an urgent need to develop fodder security plan for round the year feed and fodder supply in different agro-climatic zones of the state.

Constraints in fodder production

There is acute shortage of fodder especially green nutritious fodder, which is major cause of low productivity of livestock. Estimated annual green fodder yield of cultivated fodder is around 40 tons/hectare and it would be considered much below the potential of high yielding newly notified varieties/ hybrids of fodder crops.

1. **Meager area under fodder crops:** The total food grain production in Manipur during 2014–15 was 594.28 thousand tonnes from an area of 293 thousand hectare and out of this rice and maize occupied approximately 250.5 thousand hectare whereas area under fodder crops is only 4 thousand hectare. 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. At present, land holdings are small and farmers are always biased in choice of the crops. Due to these reasons agricultural land ratio does not permit diversion of land from food production to cultivated fodder. Thus, area under fodder crops is meager.

2. **Uncontrolled grazing of dairy animals:** Uncontrolled grazing has led to a decline in biomass availability. The grazing pattern has created manifold problems in these pastures. Obnoxious weeds have invaded the pastures. Excessive and continuous grazing has severely damaged these lands.
3. **Poor Management Practices:** Management practices play an important role in determining productivity of grasslands. Presence of inferior and unproductive grass species, lack of fertilizer application, and absence of legume component, improper cutting and indiscriminate grazing are some of the important factors responsible for poor productivity of grasslands. There exists a wealth of indigenous knowledge for its proper utilization and management of natural resource base but farmers because of increasing population pressure and declining land productivity are not using it.
4. **Intense livestock population:** As per 20th livestock census, state have approximately 40.7% of cattle, 6.6% of buffaloes and 7.0% goats of the total livestock population of the state. It is a fact that considerable fodder resources are wasted on maintenance of an excessive number of poorly fed and low yielding animals, which contributed to process of pasture destruction.
5. **Shortages of quality fodder seeds**: Shortages of quality fodder seeds of high yielding improved varieties/hybrids is main reason of low green fodder yield. At present seed replacement rate in fodder crops is less than 20%. Higher seed replacement rate is directly co-related with higher yield. In view of above, there is huge opportunity to increase green fodder production through enhancing seed replacement rate of quality seed of high yielding varieties.

Part-II : Fodder Resource Development Plan

Strategies for enhancing fodder resources

Among four agro-climatic zones of the state, potential districts from each agro-climatic zone may be selected: coordinated efforts in collaboration with agencies located in selected districts of different Agro-climatic zones and various departments of state should be made. From each cluster, livestock keepers/fodder growers may be identified and different interventions can be implemented with the help of collaborating KVK and other field functionaries. Demonstrations of different fodder related technologies at farmer's field under cluster approach. ICAR-IGFRI, Jhansi can provide scientific and technological backstopping to farmers, extension staff and related stakeholders. For feed and fodder security in different agro-climatic zones of the state, ICAR-IGFRI, Jhansi can provide technical backstopping in implementation of following interventions:

A. Cultivated fodder resources

There are number of fodder crops suitable under different agro-climatic conditions of the state. We have large basket of perennial grasses, range legumes, cultivated forage cereals & legumes. Hence it should be planned to bring at least 5% of the cultivated area under fodder crops. The net sown area of Manipur is estimated at 3.83 lakh hectare. Thus 5% area comes to 0.19 lakh ha. With a cropping intensity of 108% it must come to about 0.21 lakh ha to have a reasonable and sustainable fodder supply in the state.

Crops like BN hybrid, guinea grass, etc being perennial in nature, once planted will be able to provide fodder for 3-4 years and won't need frequent sowing and investment on seed cost and land preparation and also with the inclusion of leguminous fodder in inter row space of perennial grasses, can supply round the year green fodder. In view of stiff competition with food & other commercial crops, forage varieties with tolerance in drought/water scarcity situations holds promise and can fit well in existing farming systems. These varieties can be very well adopted and promoted in suitable agro-climatic zones of the states. Fodder production requires identification of suitable fodder crops, varieties and production technologies depending on the agro-climatic conditions and needs of livestock keepers. In case of perennial fodder crops propagated through stem cuttings or roots, micro-nurseries may be developed in each block with 40000 rooted slips/ha and in 5 ha in each districts, in 2 years time there will be

sufficient planting material for whole state. Likewise the seeds will be multiplied at each block to get sufficient seed for whole state in 2 years. The important fodder crops, varieties and seed/planting material requirement have been presented in Table 6.

Table 6: Suitable fodder crops, varieties and seed/planting requirement for Manipur state

SN	Crop	Varieties	Seed/root slips/ stem cuttings per ha	Average yield (t/ha/annum/)
i. Perennial fodder crops				
1	Bajra X Napier Hybrid	BNH-10, CO-5, Swetika-1, PBN-342, CO-6	28,000 nos.	200-250
2	Guinea grass	Bundel Guinea -2, Bundel Guinea -4, DGG-1; Hamil	40,000 nos.	150-200
3	Signal grass	DBRS 1, local material	40,000 nos.	40-50
4	Nandi grass	Nandi, Golden Timothy, Setaria-92 or Locally available	40,000 nos.	20-60
5	Paragrass	Local material	3-5 kg/ha	-
6	Marvel grass	JHD-2013-2	3-5 kg/ha	40-50
7	Anjan grass	Bundel Anjan-1	3-5 kg/ha	40-45
8	Dhawalu grass	Bundel Dhawalu Ghas-1	3-5 kg/ha	20-25
ii. Annual fodder crops				
1	Fodder maize	African Tall, J-1006	40 kg/ha	35-40
2	Fodder sorghum	SSV 74, PC-9, PC-23, Harasona, JS-29-/1, MSFH-3,	15-20 kg/ha	25-30
3	Fodder cowpea	UPC-8705, UPC-625, 622, 621, 618, 5287, 5286, 4200, Bundel Lobia-1, Bundel Lobia-2	20-25 kg/ha	15-20
4	Oat	JHO-2015-1; JHO-99-2, Kent, JHO-822, JHO-2004,	80 kg/ha	40-50
5	Rice bean	Shymalima, RBL-6, Bidhan-1, Bidhan-2, JRBJ-05-2, Bidhan Ricebean 3	30-35 kg/ha 5-8 kg/ha	30-35 15-30
6	Dinanath grass	Pusa Dinanath-1, Bundel Dinanath -2		
iii. Fodder trees				
1	Caliandra spp	Local species	Depend on spacing	10-20
2	*Moringa oleifera*	PKM 1, Bhagya	Depend on spacing	15-20
3	*Acacia nilotica*	Local species	Depend on spacing	-

For feed and fodder security in different agro-climatic zones of the state, ICAR-IGFRI, Jhansi can provide technical backstopping in implementation of following interventions:

Round the year fodder production system: Intensive forage production systems are tailored with an objective of achieving high yield of green nutritious forage and maintaining soil fertility. Under assured irrigation, multiple cropping sequences *viz.*, maize + cowpea/ricebean – oats/ berseem – maize + cowpea; NB hybrid/guinea grass + (cowpea/ricebean –oats/berseem); BN hybrid/guinea grass (sole) are promising for providing green fodder throughout the year. The fodder can also be knitted in existing food grain/ commercial production systems as these are equally or more remunerative. Bajra napier hybrid (BN hybrid) and guinea grass can be promoted either in open area or under orchards to meet the round the year green fodder requirement. Under assured water supply, BN hybrid based cropping system intercropped with cowpea/ricebean during kharif season and berseem during rabi season has green fodder production potential of 170-175 t/ha and dry fodder potential of 30-35 t/ha per year.

Figure 4: BN hybrid + cowpea round the year fodder production system

B. Fodder production through horti-pasture/silvi-pasture

Due to soil and moisture constraint, the arable farming on degraded land is difficult. There are various alternate land use systems (ALUs) which provides fodder such as silvi-pasture (tree + pasture/+ animals), horti-pasture (fruit trees + pasture/+animal) and agri-horti-silvipasture (crop + fruit trees + MPTS + pasture). Many multipurpose tree species (MPTS)/shrubs growing in ALU systems are useful as leaf fodder used for animal feed besides wood. These activities contribute significantly to domestic livestock production, which in turn influences milk and meat supply and contributes to household income. Grazing animals with MPTS trees provide not only nutritious fodder but shelter to the animals during bright and hot sunny days. In Manipur, leaves of tress species grown in agroforestry are being used as leaf fodder mostly for small ruminant and for large ruminant during lean period or during fodder scarcity and under climatic abnormalities. Horti-pasture system integrates pasture (grass and /or legumes) and fruit trees to fulfill the gap between demand and supply of fruit, fodder and fuel wood (Table 7). Horti-pasture systems developed at ICAR-IGFRI have good production potential of forage from 6.5-12 t DM/ha on degraded land of rainfed areas. Horti-pasture systems can serve the purposes of forage, fruit and fuel wood and

ecosystem conservation along with arresting the soil loss and conserve moisture. After a long rotation it improves the soil fertility and microbial activities. This system supports 2-4 ACU /year.

Table 7: Fodder production from non-arable lands

Hortipasture (fruit trees + pasture/ +animal)	Jack fruit/pine apple/lime/lemon/orange/ passion fruit + para grass/broom grass/ gazing guinea grass
Silvipasture (tree + pasture+animals)/ grassland	Tree bean (Parkia roxborghii)/siris tree (*Albizzia lebbek*) + congo signal grass (*Brachiaria ruziziensis*) / broom grass (*Thysanolaena latifolia*)

In the Manipur, different fruits crops have about 0.44 lakh ha (2012-13) area. These crops area planted very sparsely. The intervening spaces among trees in fruit orchards largely left leaving that space unkempt and unattended due to shortage of labour and mechanization. Technology for cultivation of fodder in these inter tree spaces has been developed and can used for cultivation of annual/perennial forages. Suitable varieties of guinea grass, setaria grass and perennial legumes can be grown. Through proper planning if 50% of inter spaces of the fruit orchards/plantations crops can be used for fodder production it can produce about 1.43 to 2.64 lakh tone dry matter.

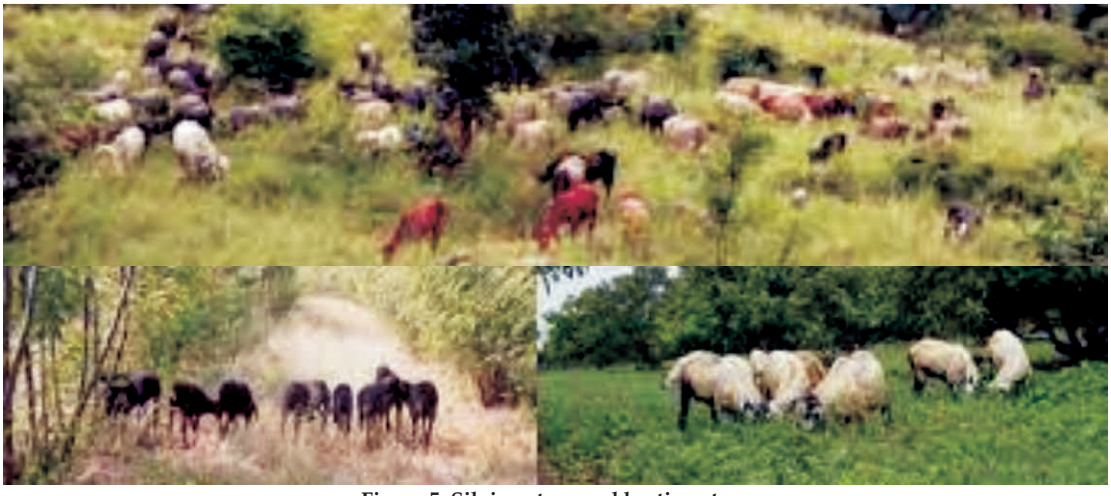


Figure 5: Silvi-pasture and horti-pasture

C. Fodder production from permanent pasture/grazing lands

In the Manipur state there is about 1000 ha area is under permanent pasture/grazing which are presently in very poor and degraded conditions. Rejuvenation and replanting with suitable grass species like congo signal grass, grazing guinea through seed pellets or by sowing can provide cheaper source of green fodder and will also to livestock keepers in reducing production cost substantially.

Figure 6: Permanent pasture/grazing lands

D. Fodder on non-competitive lands

Total number of land holdings in Manipur is 150620 and out of that about 75% under marginal and small category which gives an opportunity to grow fodder on their bunds/ boundary. Grasses like congo signal and grazing guinea can also be promoted as rainfed grasses in other niches like farm pond embankments, bunds, uncultivated farm lands, in orchards, rain water outlets *etc.* to meet the green fodder requirements at farm level. Introducing perennial cultivated grasses on farm bunds along with irrigation channels involves growing of 2 rows of bajra napier hybrid/guinea grass along with field boundary can supply 7-11 q green fodder per 100 m length of boundary per year which can support milch animal of livestock keepers without any additional expenditure. Table 8 indicates the fodder production potential of bunds in the Manipur.

Table 8: Fodder production potential under different size of land holdings

Size of holding	Total holding Number ('000)*	Average size of Holding (ha)*	Total bund length available for fodder (km)#	Fodder production @ only 7 kg/ metre bund length if 10% bund length utilized (tonnes)**
Marginal (<1 ha)	76.73	0.52	11108.1	7775.67
Small (1-2 ha)	48.85	1.28	11073.5	7751.47
Semi-medium (2-4 ha)	22.23	2.48	7009.9	4906.96
Medium (4-10 ha)	2.76	4.86	1217.0	851.9
Large (>10 ha)	0.04	11.00	26.5	18.57
All classes	150.62		30435.1	21304.6

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

Figure 7: BN hybrid planted on bunds

Figure 8: Grazing guinea planted on bunds

E. Alternative fodder resources

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

a. Moringa as alternate protein source

Moringa is a good alternative for substituting commercial rations for livestock. The relative ease with which Moringa can be propagated through both sexual and asexual means and its low demand of soil nutrients and water after being planted, make its production and management comparatively easy. Its high nutritional quality and better biomass production, especially in dry periods, support its significance as livestock fodder. Moringa planted at ICAR-IGFRI, Jhansi at 50x50 cm spacing gave 80-130 tonnes green forage/ha in 4 cuts at 45 days harvest intervals in 2nd year of planting. Moringa leaves contains 21.53% crude protein, 24.07% acid detergent fiber (ADF) and 17.55% neutral detergent fiber (ADF). One of its main attribute is its versatility, because it can be grown as crop or tree fences in alley cropping systems, in agroforestry systems and even on marginal lands with high temperatures and low water availabilities where it is difficult to cultivate other agricultural crops.

Figure 9: Moringa - A nutritious fodder tree

b. Azolla as alternate fodder

Azolla farming, in general, is inexpensive and it can be multiplied in natural water bodies for production of biomass. Biomass productivity is dependent on time and relative growth rate and efficiency of the species. Azolla is very rich in proteins, essential amino acids, vitamins (vitamin A, vitamin B12, Beta Carotene), and minerals including calcium, phosphorous, potassium, ferrous, copper, magnesium. On a dry weight basis, Azolla has 25-35% protein, 10-15% mineral content, and 7-10% comprising a

Figure 10: Azolla- a non-conventional forage resource

combination of amino acids, bio-active substances and biopolymers. During lean/ drought period it provides sufficient quantity of nutrients and acts as a feed resource. Azolla is a highly productive plant. It doubles its biomass in 3–10 days, depending on conditions and it can yield upto 37.8 t fresh weight/ha (2.78 t DM/ha dry weight).

c. Hydroponic fodder production

Hydroponics is a method of growing plants without soil. Only moisture and nutrients are provided to the growing plants. Hydroponic growing systems produce a greater yield over a shorter period of time in a smaller area than traditionally-grown crops. Hydroponic fodder systems are usually used to sprout cereal grains, such as barley, oats, wheat, sorghum, and corn, or legumes, such as alfalfa, clover, or cowpea. It may fit for those producers who do not have local sources for forage. HPF may offer a ready source of palatable feed for small animal producers (poultry, piggery, goat. rabbits). It consists of a framework of shelves on which metal or plastic trays are stacked. After soaking overnight, a layer of seeds is spread over the base of the trays. During the growing period, the seeds are kept moist, but not saturated. They are supplied with moisture and nutrients, usually via drip or spray irrigation. Seeds will usually sprout within 24 hours and in 5 to 8 days have produced a 6 to 8 inch high grass mat. Peri-urban small farms, landless animal farms and steep hill farms having noagricultural land but possess small pig, poultry and/or cow units can benefit from either of the two or combining the hydroponic fodder-cum-sprouted grain technologies. Hydroponic fodder cannot substitute green fodder and hay completely, as it lacks in fibre content. But it is definitely a better substitute for packaged feeds.

Figure 11: Hydroponic fodder production from maize

F. Crop residue quality enhancement

Dry crop residue is the important ingredient of animal diet. The paddy straw is a major source of dry fodder in the state. The paddy straw is low in protein content, low in palatability, digestibility and incapable to support even maintenance requirement of the adult ruminants, if fed as such. Urea treatment offers an opportunity to transform crop residues of poor quality into a valuable feed resource by refining it for rapid adoption at farmers level for greater economic reward. Urea treatment of straw increases its N content resulting into enhanced

microbial activity and ruminal digestion of the straw. In addition, urea treatment also exerts its effect on lingo-cellulose complex, wherein the lignin forms the complex with cellulose, thus preventing its microbial digestion. Urea also acts as preservative and application of urea solution on the straw and subsequent storage of treated straw would ensure the unspoiled storage. The use of a cheap source of nitrogen such as urea to improve the nitrogen content of such roughages makes a promising alternative to improve the nutritive value of straw. Further spray of salt and mineral mixtures will also enhance the palatability and nutritive value of dry fodders.

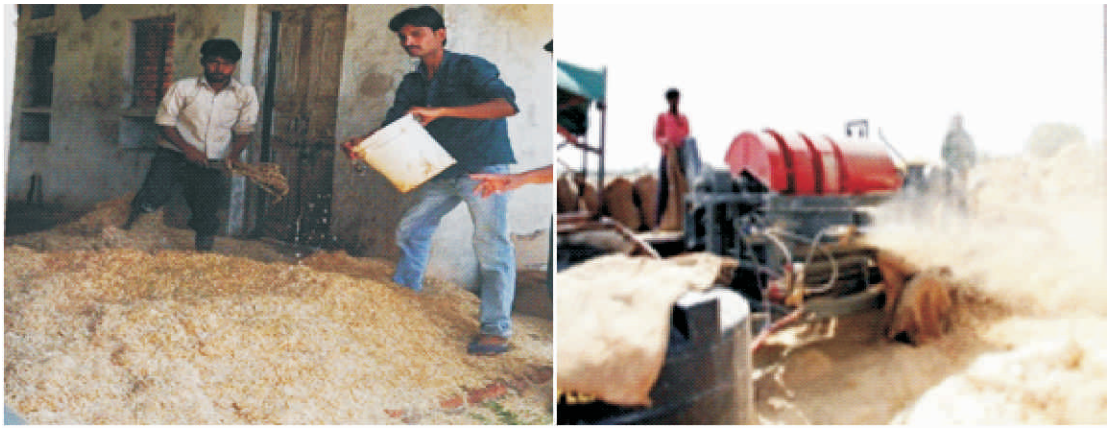


Figure 12: Urea treatment in crop residue

G. Fodder seed production

The availability of quality seed and planting material is major challenge for successful cultivation of fodder crops. The farmers in general are not inclined to go for seed production of these crops in view of oscillating demand. Hence, there is a need for concerted effort for enhanced seed and planting material production in different agro-climatic conditions. At present seed replacement rate in fodder crops is less than 20 percent. Higher seed replacement rate is directly co-related with higher yield. In view of above, there is huge opportunity to increase green fodder production through enhancing seed replacement rate of quality seed of high yielding varieties. The type of crop and quantum of demand varies with the agro-climatic conditions. Therefore there is need to tailor the programme according to anticipated needs in consultation and participation of clientele departments/stakeholders. The projected demand of fodder seed of Manipur is give in Table 9. Participatory fodder seed production may be probable answer to reply the problem of seed shortage. Cluster based seed buy back policy may be implemented in different agro-climatic zones.

Table 9: Projected fodder seed requirement, availability and sources of Manipur

Important forage crops	Per cent of gross cultivated area to be sown under fodder crop	Area under individual fodder crop (ha)	Seed rate (kg or no. per ha)	Forage certified seed requirement (tonne or thousand number)	Seed multiplication ratio	Foundation seed requirement (kg)	Breeder seed requirement (kg)	Availability source
Fodder maize	30	5400	50	270	75	3600	48.0	IGFRI, Jhansi, CAU, Imphal, AAU, Jorhat
Fodder sorghum	5	900	30	27	100	270	2.7	IGFRI, Jhansi, CAU, Imphal, AAU, Jorhat
Rice bean	15	2700	30	81	40	2025	50.6	CAU, Imphal, ICAR RC NEH, Umiam, Meghalaya, BCKV, Kalyani
Fodder cowpea	10	1800	30	54	40	1350	33.8	IGFRI, Jhansi, CAU, Imphal
Dinanath grass	5	900	6	5.4	70	77.1	1.1	IGFRI, Jhansi
Fodder oat	30	5400	100	540	20	27000	1350	IGFRI, Jhansi, CAU, Imphal, AAU, Jorhat
Bajra X Napier Hybrid	4	720	28000	20160	-	-	-	CAU, Imphal, ICAR RC NEH, Umiam, Meghalaya, BCKV, Kalyani
Guinea grass	4	720	40000	28800	-	-	-	CAU, Imphal, ICAR RC NEH, Umiam, Meghalaya BCKV, Kalyani
Signal grass	4	720	40000	28800	-	-	-	IGFRI, Jhansi, CAU, Imphal
Nandi grass	4	720	40000	28800	-	-	-	IGFRI, Jhansi, CAU, Imphal
Paragrass	2	360	4	1.44	75	19.2	0.3	IGFRI, Jhansi, CAU, Imphal
Marvel grass	2	360	4	1.44	75	19.2	0.3	IGFRI, Jhansi, CAU, Imphal
Anjan grass	2	360	4	1.44	75	19.2	0.3	IGFRI, Jhansi, CAU, Imphal
Dhawalu grass	2	360	4	1.44	75	19.2	0.3	IGFRI, Jhansi, CAU, Imphal

Note: Net cultivated area of Manipur state is 3.83 lakh hectares with cropping intensity of 108%.

It is assumed that for reasonable and sustainable fodder supply in the state at least 5 per cent area of net cultivated land to be come under fodder. Therefore area to be sown under fodder crops will be 0.19 lakh hectare (0.21 lakh hectare gross cultivated areas)

H. Fodder conservation technologies – Hay, Bales, Silage, Feed block

In recent times due to frequent droughts, failure of crops and non-availability of fodder has forced everybody into thinking of fodder conservation. Traditionally fodder conservation has been only with the dry fodder in the form of hay making and heaping. However, the lack of scientific hay making has often limited keeping quality of hay making and heaping. Recently there is greater emphasis on conserving green fodder popularly known as "Silage". While the hay making is possible with the dry fodders, green fodders are required for silage making.

a. **Hay/ Bales:** Although it is a common practice, necessary training is needed to ensure long keeping quality of the hay material. Further the dry fodder being voluminous in nature often needs larger space and pose problems in transportation. Hence pressing dry fodder in to bales to reduce keeping space and ease transportation has been found to be more necessary in recent times. The basic principle of hay making is to reduce the moisture concentration in the green forages sufficiently as to permit their storage without spoilage or further nutrient losses. The moisture concentration in hay must be less than 15% at storage time. Hence, crops with thin stems and many leaves are better suited for hay making as they dry faster than those having thick and pithy stems and small leaves.

b. **Silage:** The basic principle of silage making is to convert the sugars in the ensiled fodder into lactic acid, this reduces the pH of the silage to about 4.0 or lower, depending on the type of process. However, its success will depend on surplus forage production, Unreliable rainfall pattern, Requirement for labour (cutting, raking, collecting, chopping, pit construction and cleaning, ensiling) and materials (polythene, molasses). Several green crops and grasses may be used for silage making *viz.* maize, sorghum, bajra napier hybrid grass, guinea grass, setaria, pineapple stover, *etc.*

c. **Feed Block:** Bale making or feed block making could be good strategies for reducing the cost involved in transportation of fodder from one place to another and saving the space for keeping the fodder. The mechanization aspect may also be thought of in terms of harvesting with weed cutters and chaffing of fodder with power operated chaff cutters, which reduce the reliance on manual labour and also help in saving time on these activities. It will also help in supplying fodder during the calamities as well as lean season.

Chaffing of forage for ensiling

Trench silo

Silage preparation in plastic bags

Stack of the silage

Figure 13: Silage making methods

I. Custom hiring centre

These need to provide equipments, machinery *etc.* to the farmers at affordable cost. The use of new machineries and technologies will enhance production, reduce drudgery and cost. The custom hiring centre should have all important implements/machinery require for fodder production and which are difficult to have for most of farmers and will help in reducing the cost of fodder production. The following machineries/ equipment's *viz.*, power tiller, Bund former, Seed cum fertilizer drill, Multi crop planter, Grass Weed Slasher, Power Weeder, knap sack sprayers, etc can be put under custom hiring in Manipur. Nowadays, Power tiller with multi attachments is available in market, it is immensely relevant for a custom hiring centre established in areas of marginal and small farmers (Table 10).

Table 10: Major machineries for custom hiring centre

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

J. Contingency fodder planning

In Manipur, agriculture sector is facing the consequences of climate change. Climate change is a reality and an increasing trend in temperature, precipitation and emission of greenhouse gases has been observed in Manipur. The state is also projected to experience more of extreme rainfall and reduction in crop yields. Due to climate change especially extreme events, as subsistence level farming is coupled with prevalent shifting cultivation, the small and marginal farmers in general and livestock keeoers in particular are more affected. Hence, there is an urgent need for devising climate proof plan and climate ready policy for climate compatible agricultural development in Manipur. Location-specific climate smart technology baskets need to be devised or introduced and should be demonstrated through participatory approach, for ensuring

a climate resilient livestock and fodder production system, and a climate resilient ecosystem. Therefore proper contingent planning (Table11) can help to mitigate some adversity of these events.

Table 11: Contingent planning for fodder production and utilization during adverse climatic conditions

Period	Contingent measures	Fodder based Feed & other sources
Drought/lean period (Oct-March)	➢ Utilizing fodder from perennial fodders (top feed, grasses), silage & hay ➢ Use of rice fallow for fodder (lathyrus/cowpea) with protection from open grazing ➢ Azolla cultivation ➢ Hydroponic fodder production	➢ Molasses, rice bran, oil cake ➢ Tapioca waste, pineapple waste, maize bran & kitchen waste etc.
Floods/Heavy rains	➢ Top feed (fodder trees/ bushes) ➢ Silage ➢ Support from fodder bank (community based) ➢ Store fodder at safe place ➢ Supplementary feeding	➢ Urea molasses block ➢ Easy access to feed & fodder through government agencies ➢ House /farm waste based feeding

Part-III : Brief Action Plan

i. Identification of areas for propagating fodder production

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

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

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

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

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

iv. Providing package of practices for fodder crops

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

v. Master trainers training at IGFRI/SAUs/CAUs

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

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

There are 11 Krishi Vigyan Kendras (KVKs) are operating in the state of Manipur which 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 block will be conducted in the farmers' field to make them aware of the fodder production potential and motivate them to go for cultivation of fodder as per the needs. In addition tailor made training programmes will be organized through KVKs for the benefit of the interested farmers on the topics of their interest in fodder crop production, livestock production and dairying.

viii. Strengthening of forage seed production chain

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

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

In fact there is a fodder scarcity in almost all places in Manipur. The would-be fodder cultivating farmers will be doing so out of their dire requirement of fodder for their livestock. 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. Therefore, efforts will be made to bring non-conventional areas for production of fodder crops. In the process all efforts will be made for:

- Production of fodder in non-arable land, wasteland.
- Production of fodder in problem soils.
- Enhancing production through alternate land use management such as horti-pasture- silvi-pasture *etc.*

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

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

xii. Establishment of fodder banks

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

xiii. Networking through ICAR-DAH-SAUs-CAUs-Milk Federations

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

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

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

xv. Impact analysis of technology adoption

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

Part-IV : Road Map

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

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

S.No.	Action point	Agencies involved
1	Breeder seed production of the identified varieties	IGFRI, Jhansi/CAU
2	Foundation seed production	RFS/DAHD/SAHD
3	Production of TFL/certified seeds	CAU/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/CAU
8	Capacity building of stake holders	ICAR-IGFRI/CAU

The programme implementation plan is a time bound multi-stage oriented and aims to complete the activities in time frame in a logical way.

Part-V : Implementation of Pilot Programme

Pilot project is proposed to be implemented in the selected areas to assess the acceptability and impact of technology and also refinement in technology and methodologies, if required. Pilot project is proposed to be implemented in selected villages of indentified districts of each agro-climatic zone (four). The detailed plan for implementation of pilot project is presented in the Table 13.

Table 13: Implementation level plan for pilot project

S.No.	Activity	Action points
1	Target area selection	• Selection of 4 districts (1 from each agroclimaic zone) of Manipur • Selection of 2 cluster of 5 villages in each district total 8 clusters for 4 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; 400 farmers in first year (6 training program for farmers of each cluster) • Exposure visit of progressive farmers and master trainers at IGFRI, Jhansi and other ICAR institutes located in Manipur and nearby states.
3	Technology Demonstrations	• Selection of crop and varieties will be done after identifying suitable districts and village clusters both under annual and perennial crops for different seasons *viz. kharif*, *rabi* and *zaid* • Silage should be encouraged • Since crop residue being a precious commodity, fodder banks using densification technologies can be developed • Annual fodder crops Fodder maize: African Tall, J-1006 Fodder sorghum: SSV 74, PC-9, PC-23, Harasona, JS-29-/1, MSFH-3,

		Fodder cowpea: UPC-8705, UPC-625, 622, 621, 618, 5287, 5286, 4200, Bundel lobia-1, Bundel lobia-2 Oat: JHO-2015-1; JHO-99-2, Kent, JHO-822, JHO-2004, Rice bean: Shymalima, RBL-6, Bidhan-1, Bidhan-2, JRBJ-05-2, Bidhan Ricebean 3 Dinanath grass: Pusa dinanath-1, Bundel dinanath -2 • Perennial fodder crops Bajra X Napier Hybrid: BNH-10, CO-5, Swetika-1, PBN-342, CO-6 Guinea grass: Bundel Guinea -2, Bundel Guinea -4, DGG-1; Hamil Signal grass: DBRS 1, local material Nandi grass: Nandi, Golden timothy, Setaria-92 or Locally available Marvel grass: JHD-2013-2 Anjan grass: Bundel anjan-1 Dhawalu grass: Bundel Dhawalu Ghas-1
4	Suitable silvi-pasture/ horti-pasture system demonstrations	• In existing Orchard- 1 ha (Guinea, Grazing Guinea) • In new Orchard - 1 ha (Guinea, Grazing Guinea) Popular and potential fodder trees: Calliandra, Accacia nilotica. Moringa can be a potential source of legume fodder in upland areas and may be explored
5	Need based Watershed/ micro irrigation facility development	• Suitable fodder species *viz.* grazing guinea, signal grass, etc to check soil and water erosion and enhancing water retention will be highlighted.
6	Rejuvenation of grasslands/ pasturelands/ CPRs	• The related activities will be taken up during post rainy season /with first *rabi* rains
7	Tapping rice fallow and other fallow areas for fodder production	• Suitable annual fodder crops *viz.* fodder cowpea, oats *etc.* will be grown on residual moisture to ensure fodder supply during the period

8	Input supply	• Inputs *viz.* seeds/ rooted slips/, Fertilizers, insecticides etc, small machinery and tools - improved sickles *etc.* will be supplied to farmers
9	Custom hiring centre in each village cluster	• Exploring and facilitating the farmers with chaff cutter, Bhusa urea enriching machinery, baling of paddy straw, dry fodder etc, complete feed block making machine, regular farm implements including tractors, harrow, seed drill *etc.*

Funding arrangements

Govt. of Manipur, 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 14.

Table 14: 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)	8	8	8	6	6	36
Exposure visit of farmers / stakeholders	6	6	6	2	2	22
Seed/ Planting material	8	8	2	2	2	22
Micro Irrigation facilities	8	8	6	6	2	30
Other farm inputs small equipments etc	8	6	6	2	2	24
Custom hiring center equipments	50	20	2	2	2	76
TA/DA/staff (SRF/YP/RA)/ Consultancy/Miscellaneous *etc.*	14	14	10	10	10	58
Total	102	70	40	30	26	268

(Rupees Two Crore Sixty Eight lakh only)

Part-VI : Modalities

This programme is undertaken to enhance the fodder production, conservation and utilization on more sustainable basis in different fodder deficit districts of Manipur. The ICAR- IGFRI has taken a lead in Technological support in collaborating with other public and private sector agencies in this regard. However the modalities of executing this programme are as follows:

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

Annexure-I

Proceedings and recommendations of the Interactive workshop

The one day workshop was organized on 8th December 2021 through virtual mode for discussing the status of fodder production, conservation and utilization for the six north eastern states of India. At the outset, Dr. Purushottam Sharma, Head, Division of Social Sciences & In-charge ATIC, ICAR-IGFRI Jhansi welcomed the dignitaries of six North Eastern States viz. Dr. Basant Singh, Director of Research, CAU, Imphal, Manipur; Director, Department of Animal Husbandry & Veterinary Sciences, Nagaland, Dr. A.K. Roy, PCFC, AICRP (FC & U), Dr. Amaresh Chandra, Director, ICAR-IGFRI, Head of Divisions and Officer-in-charges of Regional Stations, S. Acharya, Tripura; Mukhtar Hussain, ICAR- NRC Yak, Dr. Dinamani Medhi, Principal Scientist, Animal Nutrition, Dr. Subramanyam, Nagaland and other participants. Dr. Sharma highlighted the NIAFTA programme undertaken by the Institute and 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 six north eastern states deliberated threadbare. Important points emerged during the discussions are mentioned.

Dr. Amaresh Chandra, Director, ICAR-IGFRI expressed hearty welcome to the participants and mentioned that India is having 536 million livestock and 198 million litres of milk but the productivity of milk is low. Outlined the non availability of quality fodder. Director expressed that the Institute has unique mandate to improve grassland productivity. As far as NE states are concerned, out of 8 states, fodder plan of two states are already developed. More valuable input is required from each state. As far as technology is concerned, ICAR- IGFRI & PCFC has developed more than 300 varieties, models for different production systems but improvement of forest areas and grassland productivity is required. Population of livestock is different in different states so also implementing agency also is different in different states. Availability of green fodder is 35%, 11% dry fodder and 40-45% feed. To meet the demand of livestock comprehensive plan is required and inputs from different states will be helpful for development of fodder plan. To improve the productivity, quality seed production is required and will be done. Director also 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. Mentioned that IGFRI is having four Regional Stations at Srinagar, Dharwad, Avikanagar and Palampur.

Dr. A.K. Roy, PCFC (FC &U) mentioned fodder scenario of North eastern states and emphasized the need of regional planning as <1.0% land is available for fodder cultivation. Farming community has crop livestock interactions, subsistent livelihood economy and not commercially oriented. Highlighted that technology is available

especially the important forage crops suitable for NEH, production technologies available for oat, maize, rice bean, cowpea and sorghum. Dr. Roy mentioned about food-fodder intercropping system, integrated nutrient management, irrigation management, cutting and nutrient management, sequence cropping, crop varieties, non conventional forage, improving digestibility and nutrition of crop residues. Key steps for establishment of good pasture, rejuvenation of degraded pasture lands, extension technologies, on-line resources and need of quality and quantity of fodder especially in lean period were highlighted. Dr. P. Sharma, thanked Dr. Roy for overview of the fodder plan.

Dr. Anil Kumar Tripathi, Director, ATARI mentioned that there are about 20 KVK's and has lot of linkage for technology demonstration. Some fodder banks are also available. Bajra- Napier, Congo-signal are coming up very well and there is lot of scope for fodder production. He also mentioned the shortage of fodder during lean period of winter season and rice fellow area can be utilized for annual fodder crops. Director, ICAR-IGFRI appreciated the efforts made by Director, ATARI, Guwahati.

Deputy Director, Department of Animal Husbandry & Veterinary Sciences, Nagaland mentioned that seeds of maize, cowpea, sorghum, pearl millet and dinanath grass are procured from Kalyani, West Bengal or from private firm. Seeds of maize, jowar and bajra procured from Madhya Pradesh. The department also introducing dual purpose indigenous fodder trees, introducing silvi-pasture system and introducing horti-pasture system. Also expressed concern of people for showing very less interest in fodder cultivation but, dairy farmers are taking the interest. Dr. P. Sharma enquired about assessment of demand supply estimate of the state of Nagaland in terms of deficit and type of deficit. Director, AH & VS mentioned that seed is an important issue and there is a deficit of 60, 000 tonnes of dry fodder. Dr. Mahak Singh, ICAR (RC) Nagaland centre mentioned that there is huge demand of dairy development in Nagaland. Mentioned that Sorghum seeds are procured from IARI but root slips / sapling of plants are required.

Dr Sunil Tiwari, Head, Division of Crop production presented the fodder plan of Nagaland. Welcome the Director of Research, CAU, Deputy Directors Veterinary and AH and departments. Mentioned need for fodder plan, policies needed, topography, hill range, biological diversity, agro-climatic zones, livestock scenario, district-wise live stock population. Show case models selected, estimated fodder demand and supply, scenario for the year 2018, constraints for availability of green fodder, strategies for enhancing fodder resources. Highlighted that models are available for different technologies, training for masters, trainers, training for farmers and stake holder. Crop varieties, suitable grasses for fodder production under fruit orchard in Nagaland, alternate fodder resources, feed for pig and Mithun were highlighted. Mentioned need of tapioca and sugar beet, contingent planning zone-wise fodder intervention for low hills, high hills, foot hills and plain areas. Mentioned the crisis of seed every year and suggested that fodder seed village, community seed or planting material bank be created to help solve the

crisis. Road map for the implementation of the proposed activities through the pilot project, aspirational districts i.e in Dimapur, Kohima, Mon and Wokha etc.

- Prof. Arun Sangwar, College of Veterinary Sciences, Jalukie, Nagaland mentioned that the centre is having 266 acres and they need 50 acres for fodder cultivation. They need technical help i) live fencing, ii) planting material/seed. Dr. P. Sharma replied that training can be organized online/off line mode. Participants from Nagaland already attended two trainings at ICAR-IGFRI.
- Dr. Ch. Nandakishore Singh, Dir. Vety A & H reiterated the shortage of green and dry fodder. He also informed that Lohtak lake area of Manipur is not facing the shortage of green fodder and people of the area are growing Napier and Dinanath grass. Manipur state is procuring the fodder seed from NSC.

The meeting ended with vote of thanks by Dr. S. Basant Singh. Dr. Singh expressed that the interactive workshop is very fruitful as far as NEH is concerned. Excellent topography, integrated farming, increasing role of feed and fodder in rearing livestock. We should have more and more nutritious fodder, more awareness programme, publicize importance of feed and fodder. Dr. Singh mentioned his support in collaborating and motivating the stake holders for participating in this endeavor to discuss about the enhance production and productivity of forage crops in the NE states. Dr. Singh thanked the organizer from the core of his heart and thanked all success of this programme.

Annexure-II

List of participants in virtual workshop

1. Dr. Amaresh Chandra, Director, ICAR-IGFRI, Jhansi
2. Dr. S. Basanta Singh, Director-Instructions, CAU, Imphal
3. Dr. Anil Kumar Tripathi, Director, ICAR-ATARI, Guwahati
4. Directorate of AH & Veterinary Services, Nagaland
5. Directorate of AH & Veterinary Services, Sikkim
6. Directorate of AH & Veterinary Services, Arunachal Pradesh
7. Directorate of AH & Veterinary Services, Mizorum
8. Directorate of AH & Veterinary Services, Meghalaya
9. Directorate of Animal Husbandry & Veterinary, Manipur
10. Dr. Vijay K Yadav, ICAR-IGFRI, Jhansi
11. Dr. Suheel Ahmad, ICAR-IGFRI RRS, Srinagar
12. PC, KVK, Aizawal
13. Dr. Sengkan Koknal
14. Dr. Kalyan De, NRC on Pig, Guwahati
15. Dr. Dinamani Medhi
16. Dr. N. Dikshit, ICAR-IGFRI, Jhansi
17. Dr. Mokhtar Hussain
18. Mr. Seuji Bora Neog
19. Dr. S. Ahmed, ICAR-IGFRI, Jhansi
20. Dr. R.K. Patel, ICAR-IGFRI, Jhansi
21. Dr. Ririty Kharbuli
22. Dr. Sunil Tiwari, ICAR-IGFRI, Jhansi
23. Dr. A.K. Roy, AICRP FCU, ICAR-IGFRI, Jhansi
24. Dr. Robert Rualthankhuma
25. Dr. Ketholelie Mere
26. Dr. Helungsuipoing Mbungtsa
27. Dr. A.K. Dixit, ICAR-IGFRI, Jhansi
28. Dr. Sunil Kumar, ICAR-IGFRI, Jhansi
29. Dr. Jamini
30. Dr. Mokhtar Hussain, ICAR-NRCY, Derang

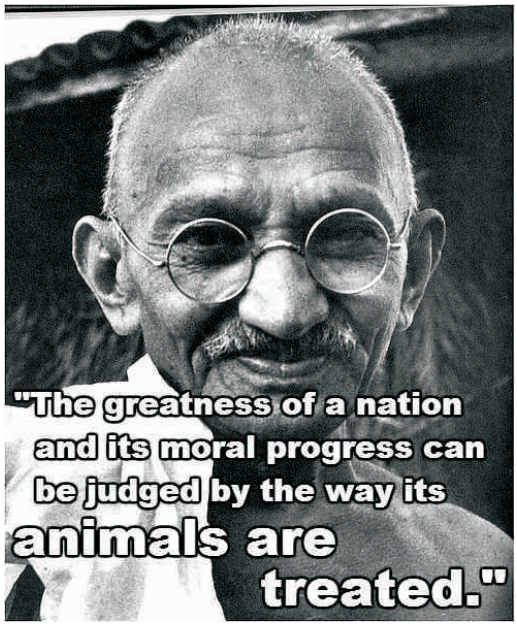
31. Director of Research, CAU, Imphal
32. Joint Director, ICAR, Mizoram
33. Dr. Joseph
34. CPGSAS, Umiam
35. CoVSc, Jalukie, Nagaland
36. Dr. Mahak Singh
37. Dr. Lalnuntluangi Hmar
38. Dr. A.K. Samanta
39. Dr. R.P. Nagar, PS & OIC, IGFRI- WRRS, Avikanagar
40. Dr. Girin Kalita
41. Dr. Ch Nandakishore Singh
42. Dr. Arup
43. Dr. B.M. Chettri
44. Dr. Chandra Shekhar Sahay, ICAR-IGFRI, Jhansi
45. Dr. Sujan Acharya, ARDD, Tripura
46. Coordinator, Indo Danish Project
47. Dr. R.V. Kumar, ICAR-IGFRI, Jhansi
48. Dr. Mahesha, H.S., ICAR-IGFRI, Jhansi
49. Dr. Sultan Singh, ICAR-IGFRI, Jhansi
50. Dr. J.K. Bisht, ICAR-VPKS, Almora
51. Dr. Sengo Dini, Arunachal Pradesh
52. Dr. B.N. Hazarika
53. Dr. Bishwa Bhaskar, ICAR-IGFRI, Jhansi
54. Dr. Purushottam Sharma, ICAR-IGFRI, Jhansi

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