Fodder Resources Development Plan for Mizoram

आज़ादी का अमृत महोत्सव

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

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...a policy paper

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Jhansi-284 003 (UP) India

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

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MESSAGE

Animal husbandry is the major source of livelihood and economic security for the native population in the state of Mizoram. Due to diminishing and unmanaged grazing lands, the state is facing acute shortage of green as well as dry fodder. There is shortage of 38% of green fodder and 23 % of dry fodder in the state, that is affecting productivity of the animals. Therefore, strategies for improving livestock productivity and production must focus on enhancing forage resources in the state.

I am extremely happy to learn that the state specific,"Fodder Resources Development Plan", has been developed by the ICAR-Indian Grassland and Fodder Research Institute (IGFRI), Jhansi, for Mizoram in consultation with all the stakeholders. This plan highlights technological options to enhance production, conservation and value addition of fodder. I am confident that this document will guide fodder development and promotion activities in the state of Mizoram.

I complement ICAR-IGFRI, Jhansi for their meticulous efforts in bringing out this comprehensive fodder plan for the state of Mizoram.

(T. MOHAPATRA)

Dated the 04th July, 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
Shri A.K. Saxena, CTO	Member

Mizoram State Fodder Resources Development Plan Committee

Dr. Sunil Kumar, PS & Head	Coordinator
Dr. Sultan Singh, PS	Chairman
Dr. Deepak Upadhyay, Scientist	Member
Dr. Mahesha H.S., Scientist	Member
Dr. Manjanagouda S Sannagoudar, Scientist	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 Prof. 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 Mizoram.

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 Mizoram 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

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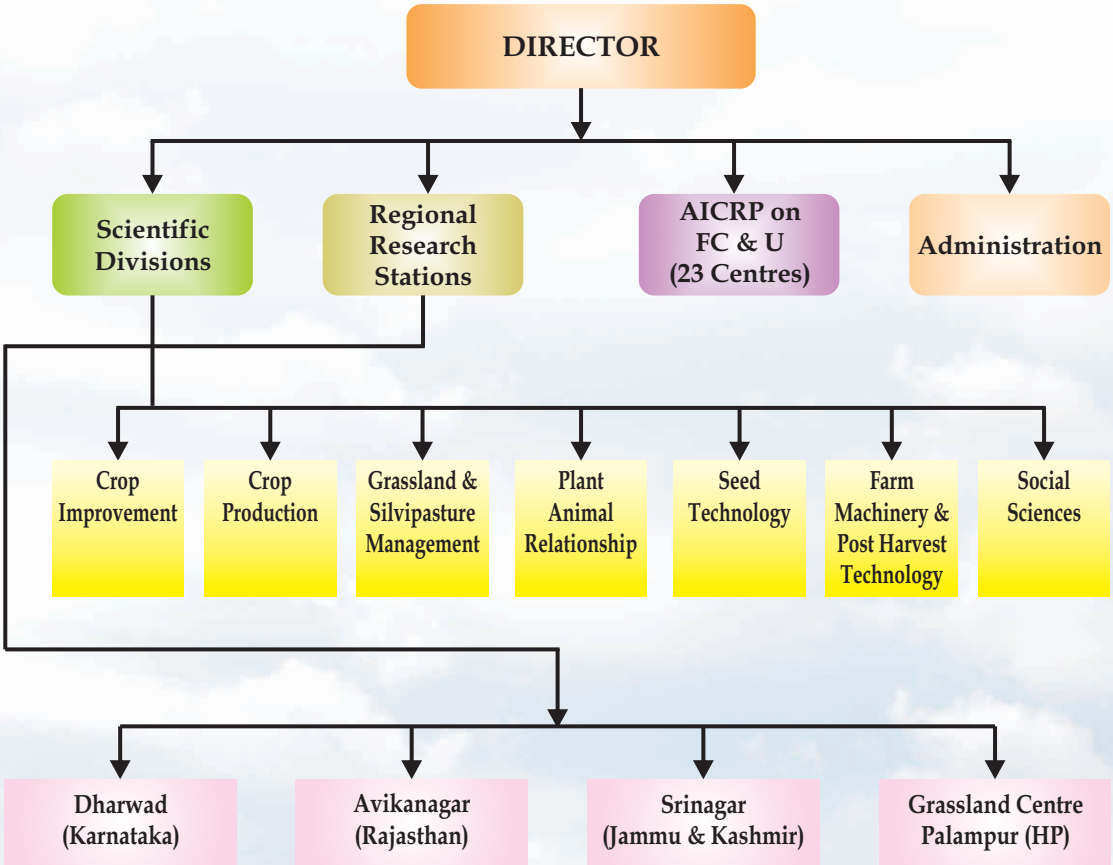
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IGFRI
Grassland

ICAR-IGFRI - A Profile

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

The ICAR-Indian Grassland and Fodder Research Institute (ICAR-IGFRI), Jhansi, was established in 1962 to conduct scientific research on grasslands and fodder production, conservation and their utilization. On 1 April, 1966, it became part of the Indian Council of Agricultural Research (ICAR). Subsequently All India Coordinated Research Project on Forage Crops and Utilization was started in 1972 with ICAR-IGFRI, Jhansi as head quarter for multi-location testing of forage varieties and technologies in different agro climatic zones of the country through 23 coordinating centers and 15 as volunteer 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),

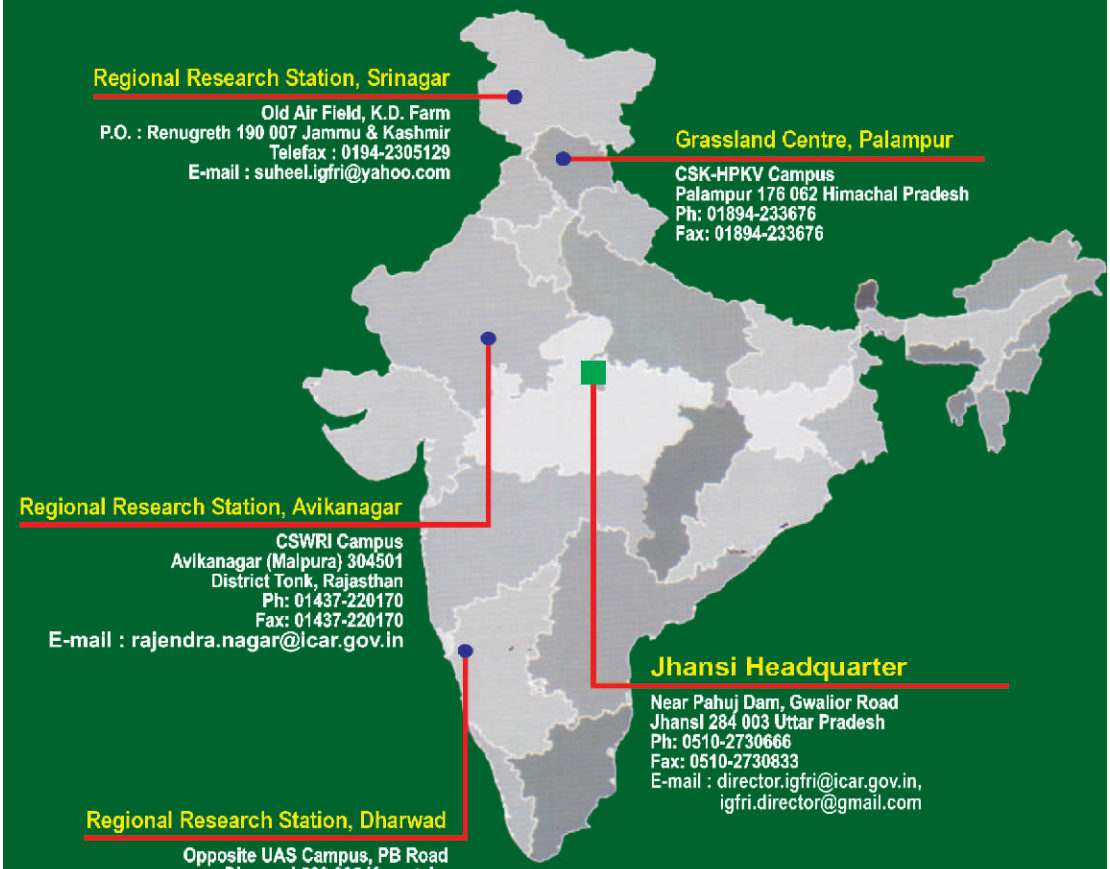
National Initiative on Fodder Technology Demonstration (NIFTD), Network Project on Bhadawari Buffaloes, Participatory Fodder Production in Mango Orchards, Farmers FIRST Programme, NICRA, TSP, SCSP, NEH, DFI-Kisan Mitra and NIAFTA have been initiated and implemented.

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



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Part-I : Agriculture, Livestock and Fodder Scenario

A. Introduction

Mizoram is a landlocked state in North East India whose southern part shares 722 kilometers long international borders with Myanmar and Bangladesh, and the northern part shares domestic borders with Manipur, Assam and Tripura. It is the fifth smallest state of India, with 21,081 km^2. It extends from 21°56' N to 24°31' N, and 92°16' E to 93°26' E. There are eight districts in Mizoram. Forests covers about 76% of the state, 8% is fallow land, 3% is barren and considered uncultivable area, while cultivable and sown area constitutes the rest.

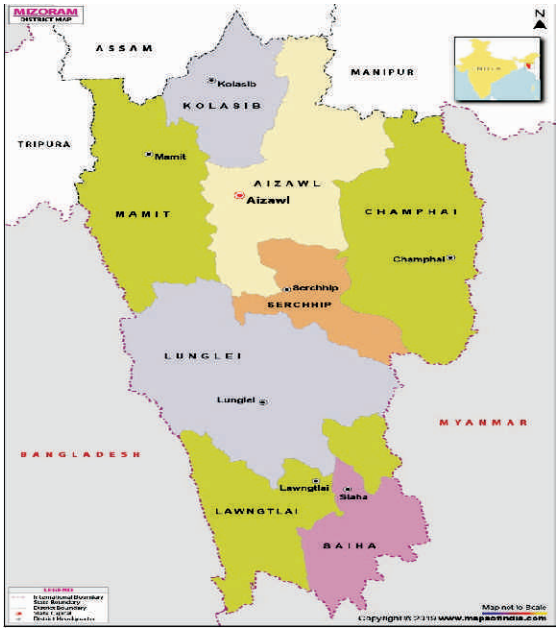


Figure 1: Location of Mizoram

Mizoram has a mild climate, being relatively cool in summer (20 to 29 °C) but progressing warmer, most probably due to climate change, with summer temperatures crossing 30 °C and winter temperatures ranging from 7 to 22 °C. The region is influenced by monsoons, heavy rains are received from May to September with little rain in the dry (cold) season. The climate pattern is moist tropical to moist sub-tropical, with average state rainfall of 2540 mm per annum. In the capital Aizawl, rainfall is about 2150 mm and in Lunglei, another major centre, about 3500 mm. The state is in a region where cyclones and landslides can cause weather-related emergencies.

Out of a total geographical area of 2.1 m ha, forest cover occupies 75.58%. Only about 6.2 percent of the geographical area is cultivable, which is mainly attributed to the state's topography. Because of its location and diverse climate, the state has certain unique advantages for developing horticulture crops, agro-processing industries, organic farming, off-season vegetable cultivation, and cultivation of medicinal and aromatic plants that can be gainfully exploited. Land under trees & groves is ~2.18%. Culturable wasteland is 0.24%, fallow land covers 8.11%, and permanent pastures and other grazing lands occupy 0.24% of the total area. The shares of cultivable wasteland and fallow provide a huge potential for fodder trees and other plantation crops, including fruits. The key land use indicators of the state are given in Table 1.

Table 1: Land use pattern of Mizoram

Land Use	Area (000 ha)	Percentage
Total geographical area	2108	NA
Reporting area for land utilization	2109	100.00
Forests	1594	75.58
Not available for cultivation	133	6.31
Permanent pastures and other grazing lands	5	0.24
Land under misc. tree crops and groves	46	2.18
Culturable wasteland	5	0.24
Fallow lands other than current fallows	171	8.11
Current fallows	60	2.84
Net area sown	95	4.50

Source: https://data.gov.in/resources/land-use-pattern-mizoram; Accessed on 30/05/2020

Between 55 to 60% of the state's working population is annually deployed on agriculture. The sector's contribution to the gross state domestic product was 30% in 1994, which declined to 14% in 2009 due to the economic growth of other sectors. Traditionally agriculture has been a subsistence profession in Mizoram and considered as a means for generating food for one's family, ignoring its potential for commerce, growth and prosperity. Rice remains the largest crop grown in Mizoram by gross value of output. Fruits have become the second-largest category, followed by condiments and spices.

Mizoram is a significant producer and global exporter of Anthurium (over 7 million a year) and roses in horticulture and floriculture. It is also a significant producer and domestic supplier of banana, ginger, turmeric, passion fruit, orange, papaya, pineapple and chowchow. Mizoram has accomplished this horticulture success and exports in 2009, with just 6% of its cultivated land dedicated to horticulture and floriculture, indicating a large potential for further growth and economic integration with other Indian states as well export driven economy. In 2013, the area dedicated to horticulture and floriculture increased to 9.4% of 1.2 million hectares potential.

Before 1947, agriculture in Mizoram predominantly used to be slash-and-burn driven Jhum cultivation. This was discouraged by the state government, and the practice has been slowly declining. A 2012 report estimates the proportion of shifting cultivation area in Mizoram to be about 30% - the predominant part of which was rice production (56% to 63% depending on the year). Despite dedicating most considerable amount of labor, the yield of rice is low. Mizoram average rice yield per acre is about 70% of India's average rice yield per acre and 32% of India's best yield. Mizoram produces about 26% of rice it consumes every year, and ~~it~~ buys the deficit from other Indian states. The crop

area used for jhum cultivation rotates in Mizoram; that is, the area slashed and burnt for a crop is abandoned for a few years and then jhumias return to slash and burn the same plot after a few years of non-use. The primary reasons for cyclical jhum cultivation include personal, economic, social and physical. Jhum cultivation practice offers low crop yields and is a threat to the biome of Mizoram. They have suggested that, increased government institutional support, shift to higher income horticultural crops, and assured supply of affordable food staples for survival as means to further reduce jhum cultivation.

Mizoram is one of the leading producers of bamboo in India, has 27 species of bamboo, and supplies 14% of India's commercial bamboo. Forest products contribute about 5% to the state's gross product. The state produces about 5,200 metric tonnes of fish a year, about 12% of potential that can be sustainably achieved. Sericulture is a vital handicraft industry engaging nearly 8,000 families in over 300 Mizo villages.

B. Agro-ecological zones of Mizoram

Mizoram state is classified in three zones. It possesses distinct charesterics of altitude, rainfall and temperatures. Based on which many crops, plant species and livestock make the agriculture of Mizoram, a diversified state. The details of agro-climatic zone and districts are given in Table 2.

Table 2: Description of major agro climatic situations (based on soil and topography)

Sl.No.	Agro climatic situation	Districts	Characteristics	Soil type	Major crop	Livestock and related activtities
1	Humid Mild Tropical Hill Zone	Mamit, Kolasib, Lunglei, Lawngtlai	Altitude: 200-800 mm Rainfall: 2000 - 2500 mm Temp.: 12-30 ^{o}C	Alluvial, Sandy, laterite	Rice, maize, tapioca, rice bean, cowpea, rapeseed	Cattle, buffaloes, goat, pig
2	Humid Mild Sub-Tropical Hill	Aizawl, Serchhip, Lunglei, Lawngtlai	Altitude: 1000 - 1500 m Rainfall: 2000 - 2700 mm Temp.: 12-30 ^{o}C	Alluvial, red sandy loam deep acidic soils	Rice, rapeseed, maize, cowpea, ginger, sugarcane	Cattle, buffalo, sheep, goat, pig
3	Humid Temperate Sub-Alpine	Champhai, Siaha, Lunglei, Lawngtlai	Altitude: 1500 m and above, Rainfall: 1800 - 2000 mm; Temp.: 11-20 ^{o}C	Alluvial, red loamy	Rice, rapeseed, cowpea, maize, soybean, potato	Cattle, buffalo, mithun, sheep, goat, pig

Source: Sahoo, U.K., Singh, S.L., Sahoo, S.S., Nundanga, L., Nuntluanga, L., Devi, A.S. and Zothansiama, J., 2018. Forest Dwellers' Perception on Climate Change and Their Adaptive Strategies to Withstand Impacts in Mizoram, North-East India. Journal of Environmental Protection, 9(13): 1372-1392.

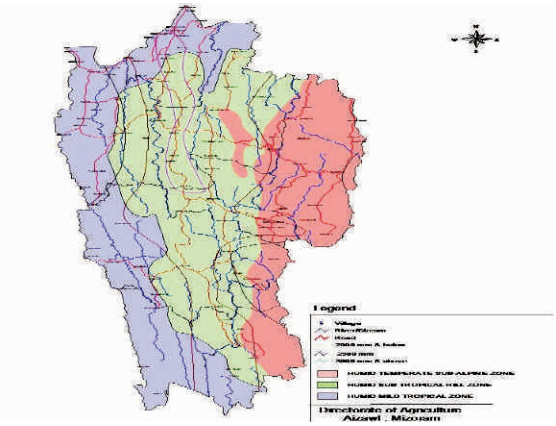


Figure 2: Agro-ecological zones of Mizoram

C. Interactive workshop- IGFRI and State Department

One day interactive workshop on "Fodder Resource Development Plan for Six North Eastern States" was organized through virtual mode on 8th December, 2021 by ICAR-IGFRI, Jhansi in collaboration with Central Agricultural University, Imphal, Manipur. Dr. Purushottam Sharma, Head, Division of Social Sciences & In-charge ATIC, ICAR-IGFRI, Jhansi, welcomed all dignitaries and participants. Later Dr. Sharma highlighted the work done by the institute under the NIAFTA program and mentioned the objectives of the interactive workshop.

The workshop was chaired by Dr. Amaresh Chandra, Director, ICAR-IGFRI, Jhansi. During the meeting, the Dr. Chandra mentioned the role of livestock in the rural economy and nutrition and the importance of quality fodder. He gave a brief introduction about the ICAR-IGFRI and its four regional research station located in different parts of the country, *viz.*, Srinagar, Dharwad, Avikanagar and Palampur, which are having a unique mandate to develop technologies that improve fodder production as well as conservation. ICAR-IGFRI and AICRP Forage Crops and Utilization have developed more than 300 varieties and forage production models for different agroclimatic zones of India. He also mentioned that different technologies are available at ICAR-IGFRI for sustainable fodder production *viz.* technology for round the year production, technology of crops/varieties, technology for arable land, non-arable lands, technology for new niches, development and rejuvenation of grassland *etc.* He also mentioned the availability of different fodder crops, suitable varieties, and superior quality seeds of improved varieties.

Dr. A.K. Roy, Project Coordinator (FC&U), explained the status of fodder demand and supply in northeastern states and highlighted the technologies available, especially the important forage crops and their varieties for NEH, production technologies available for oat, maize, rice bean, cowpea, and sorghum. Dr. Anil Kumar Tripathi, Director, ATARI, Guwahati mentioned the importance of fodder crops, especially Bajra- Napier, Congo-signal which are growing very well in the North Eastern regions, and there is a lot of scope for fodder production. He also mentioned about the shortage of fodder during the lean period of the winter season, and rice-fellow areas can be utilized for annual fodder crops.

Dr. Sunil Kumar, Head, Crop Production Division, presented the detailed fodder plan of Mizoram state, that covered the land use pattern, different agro-climatic zones, livestock

scenario, district-wise livestock population, estimated demand-supply scenario, important fodder crops, their varieties and productivity, zone-wise interventions or technologies, suitable trees and grasses for silvi-pasture establishment under various climatic zones of Mizoram, prospects of fodder production in terrace risers and zone-wise interventions for Mizoram. He also highlighted the brief action plan, modalities, road map, action point, agencies involved, and the implementation of the pilot programme.

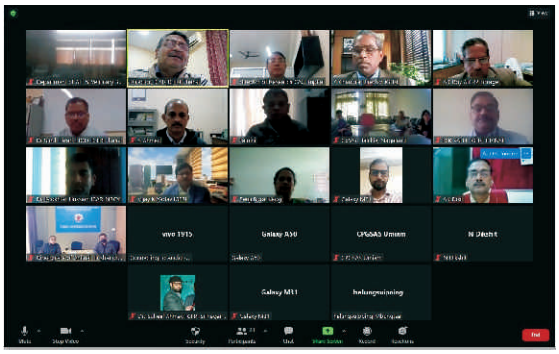


Figure 3: Interactive Workshop

At the end of the interaction meeting, Dr. S. Basanta Singh, Director of Research, CAU, Imphal, Manipur, proposed a vote of thanks to all the dignitaries and participants, and Dr. Singh expressed that the interactive workshop is very fruitful for fodder resource development in NEH states. Excellent topography, integrated farming, increasing role of feed and fodder in rearing livestock (Annexure-I).

D. Livestock Scenario

The state accounts for only 0.6% of the country's geographic area and 0.2% of the Indian population. The total livestock population of the state is 357.93 thousands, of which 80% population is contributed by pigs (292.46 thousands) (Table 3). This number of pig population indicates the value of this species in the Mizo economy. During 2012–2019, the state's livestock wealth composition further increased by 14.77%. Among the cattle population, there has been a distinct shift towards crossbred cattle with 74.16% increase in crossbred cattle stock and 4.17% increase in indigenous cattle stock. Three districts of Mizoram namely Aizawl, Champhai and Kolasib occupy 75% of exotic population of cattle (Table 4). There has been alarming decline in buffalo population by 59.19%. Similarly, goat, sheep and horse population declined by 33.27, 26.15 and 79.17%, respectively. The state has a small number of mithuns whose population has also shown an increasing trend during the two census periods.

The livestock sector contributes 30% of the output value from agriculture and its allied activities. The average absolute value of output from this sector has decreased from INR 1193 million (at 1999–2000 prices) in 2002–2003 to INR 1107.20 million in 2005–2006. The meat group accounted for 70% of the output value from livestock, followed by milk (22%) and eggs (7%). During 2002–2003 and 2005–2006, the actual value of the output from meat declined; egg increased; and milk remained stagnant. Meat production is the primary livestock activity and bovine meat is relished. The yield of pork is nearly three times the average productivity of the nation. Even the milk productivity of crossbred cattle, which

represents 45% of the cattle, is higher than the all-India average. Given the reasonably good yield levels of pork and milk from crossbred cattle, these two livestock species can serve as viable instruments for enhancing household's income.

Table 3: Summary of animal census of Mizoram from 1997 to 2019 (20th Livestock census, Thousands)

S.No.	Species/Year	1997	2003	(+/-) %	2007	(+/-) %	2012	(+/-) %	2019	(+/-) %
1.	Cattle - Crossbred	8.00	9.00	12.50	10.73	19.22	11.30	5.32	19.68	74.16
2.	Cattle - Indigenous	26.00	27.00	3.85	24.24	-10.22	23.28	-3.97	24.25	4.17
3.	Total Cattle	33.00	36.00	9.09	34.93	-2.97	34.57	-1.02	43.93	27.08
4.	Buffalo	5.00	6.00	20.00	5.83	-2.83	5.17	-11.28	2.11	-59.19
	Total Cattle & Buffalo	**38.00**	**42.00**	**10.53**	**40.76**	**-2.95**	**39.74**	**-2.56**	**46.04**	**15.85**
5.	Sheep	1.00	1.00	0.00	0.97	-3.00	0.65	-33.26	0.48	-26.15
6.	Goat	15.00	17.00	13.33	15.71	-7.59	22.21	41.35	14.82	-33.27
7.	Horse / Pony	2.00	2.00	0.00	1.39	-30.50	0.72	-48.06	0.15	-79.17
8.	Pig	163.00	218.00	33.74	267.36	22.64	245.24	-8.27	292.46	19.25
9.	Mithun	3.00	2.00	-33.33	1.94	-3.00	3.29	69.52	3.96	20.36
	Total	**222.00**	**280.00**	**26.13**	**328.14**	**17.19**	**311.86**	**-4.96**	**357.93**	**14.77**
	Livestock									
10	Poultry	1307	1125.00	-13.93	1239.00	10.13	1271.35	2.61	2047.81	61.07

Source: 20th Livestock census

Table 4: District wise livestock population of Mizoram (in thousands)

Sl.No.	District	Exotic cattle	Indigenous cattle	Buffalo	Sheep	Goat	Exotic Pig	Indigenous pig
1	Aizawl	9024	1411	58	--	517	80690	1355
2	Champhai	3046	5838	789	41	922	44139	2996
3	Kolasib	3889	2774	530	129	1603	31864	3526
4	Lawngtlai	1004	4781	126	110	2647	21177	9489
5	Lunglei	1551	4112	25	--	4709	29993	5885
6	Mamit	972	1841	11	10	1371	21855	4055
7	Serchhip	1255	1623	173	6	502	16039	1805
8	Siaha	714	1866	397	199	2549	17358	293

Source: 20th livestock census

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

E. Fodder Scenario

Feed and fodder alone constitute 60-70 percent of the cost of production of the various livestock species. Practice of growing fodder crops is not popular; rather livestock are left for grazing and roaming. A majority of the farmers prefer not to feed commercial concentrate feed and instead prepare cattle feed with wheat bran, boiled broken rice, and mustard oil cake. These ingredients and a handful of salt are mixed in a bucket to make a semi-solid composition with water and fed to the cattle thrice a day. Along with this mixture, paddy straw and grasses collected from the unprotected forest area, fallow lands *etc.* are also fed as dry fodder and green fodder, respectively. Calves and heifers are least cared by the farmers and are fed with poor quality paddy straw which has low nutritive value. The major fodder crops include fodder maize, cowpea, setaria, rice bean, congo signal grass, *Stylosanthes gracilis, S. guanansis, Phaseolus calcaratus*, berseem, oat and guinea grass *etc.* In the hilly regions of the state, pasture, grassland and fodder trees are the primary source of fodder. Crops residues include rice straw, maize straw, small millets and cowpea which serves as a major source of dry fodder.

Table 5: Potential forage genetic resources

Foarge resources	Fodder production value
Axonopus compressus	Excellent fodder
Dichanthium setigera, Erinthus legisetesus, Panicum maximum, Pennisetum purpureum	Very good fodder
Arundinalla bengalansis, A. khasiana, Dendrocalamus spp, *Dichanthium annulatum, Pennisetum landestinum, Seteria pumila, S. palmifolia, S. palmifolia, S. sphacelata*	Good fodder
Bambusa spp., *Coix lacryma, Eragrostis eilianensis, E. vnioides, F. littoralis, F. dichotoma, F. bisumbellata, Imperata cylindrical, Thysanolena maxima, Urochloa mosambiensis*	Very common/ common fodder grass

Table 6: Estimated fodder demand-supply scenario (Million Tonnes)

Attributes	India	Mizoram
Fodder demand		
Green fodder	850.9	0.51
Dry fodder	530.2	0.32
Fodder supply		
Green fodder	577.3	0.37
Dry fodder	471.9	0.26
Deficit (%)		
Green fodder	32.15	38
Dry fodder	10.99	23

Source: 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).

Constraints for availability of quality green fodder

Availability of an adequate quantity of feed and fodder for livestock is essential for improving livestock productivity. The state has a maximum area under forest cover, but it is not available either for grazing or fodder collection. The use of traditional varieties and cultivation practice is also one prime cause of the low production and availability of green fodder. The number of livestock is multiplying, while the grazing lands are gradually diminishing due to pressure on land for agricultural and non-agricultural uses. Most of the grazing lands have either been degraded or encroached upon, restricting their availability for grazing. There is vast grassland/ degraded land where animals are allowed to graze. Owing to the importance of food crops and other cash crops, the area under fodder cultivation is limited, and it has remained static for the last four decades. Inadequate availability of quality fodder crop seeds is a significant constraint. Fodder seed production is not remunerative in many of the fodder crops.

Table 7: SWOT analysis of fodder development in Mizoram

Strengths	Weakness	Opportunities	Threats
• The farmers of the state are well known for rearing of different kinds of bovines like cattle, sheep, goat, pigs, mithun, poultry *etc.*, is done for livelihood security, draught, milk and meat purpose. • Fertile soils and sufficient rainfall • Diversification in cattle population • The state is having positive annual growth rate of cross breeds • Surplus fodder during monsoon	• Very limited area under cultivation, so fodder area is very less. • Lack of adoption of improved package technology of fodder production, conservation and utilization. • Poor quality fodder sources and deprived forage conservation facilities. • Lack of milk co-operative societies. • Lack of facility to harbour natural resources. • Jhum cultivation. • Dominance of marginal and small land holding farmers. • Pastoral form of animal husbandry in the state.	• Opportunities to exploit productive breeds are suitable to this zone. • Scope to establish milk co-operative societies and milk processing industries. • Opportunity to grow fodder crops in rice fallow/ residual moisture. • Scope for promotion of fodder in existing orchards, rejuvenation of wastelands/grazin g lands • Silvi-pasture can be source of round the year fodder supply having top feed and grasses in the system • Non-competitive land use for forages in terrace risers/ bunds	• Lean period of forage availability to wretched performance of cross breeds. • Soil erosion and natural calamities. • Social inhibition against milk consumption. • Priority to food and other commercial crops leads to less scope for proliferation of forage crops. • Lack of proper protection measures of sown pasture/improved pasture and issues of benefit sharing of grassland area/produce with local communities.

Part-II : Fodder Resource Development Plan

Strategies for enhancing fodder resources

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

Details of different interventions are as under:

A. Cultivated fodder resources

Suitable varieties of both conventional and non-conventional forage crop varieties along with their yield potentiality for Mizoram state are given in Table 8.

Table 8: Zone wise forage crop, their varieties and productivity for Mizoram

Sl.No.	Agro climatic situation	Major Fodder Crops	Varieties	Green forage yield (q/ha)
1	Humid Mild Tropical Hill Zone (Covering Mamit, Kolasib, Lunglei, Lawngtlai districts)	Fodder maize	Ganga- 5, African Tall, Vijay	300-350
		Ricebean	Shyamalima, KRB-3	200-250
		Cowpea	UPC-4200, EC 4216	250-300
		Oat	Kent, JHO-822, Sabzar, RO-19	300-350
		Bajra Napier hybrid	IGFRI-6, CO-2, CO-3, CO-4, CO-5, BN-21	900-1200 (4-5 cuts)
		Seteria	Kazungula, Nandi, Narak, PSS-1	900-1000 (4-5 cuts)
		Congo signal grass	Selection	500-600 (3-4 cuts)
		Guinea grass	Hamil, PGG-3, PGG -9, BG-2	800-900 (5-6 cuts)
		Dinanath	Bundal Dinanath	500-600 (2 cuts)
		Lathyrus	Nirmal, Madhuri	120-050

2	Humid Mild Sub-Tropical Hill (Covering Aizawl, Serchhip, Lunglei, Lawngtlai)	Fodder maize	Ganga- 5, African Tall, Vijay	300-350
		Ricebean	Shyamalima, KRB-3	200-250
		Oat	Kent, JHO-822, Sabzar, RO-19	300-350
		Bajra Napier hybrid	IGFRI-6, CO-2, CO-3, CO-4, CO-5, BN-21	900-1200 (4-5 cuts)
		Dinanath	Bundal Dinanath	500-600 (2 cuts)
		Congo signal grass	Selection	500-600 (3-4 cuts)
		Seteria	Kazungula, Nandi, Narak, PSS-1	800-900 (3-4 cuts)
3	Humid Temperate Sub-Alpine (Champhai, Siaha, Lunglei, Lawngtlai)	Tall fescue	HIM-1, HIMA-4	400-500
		Rye grass	Punjab Ryegrass-1	400-500
		Seteria	Kazungula, Nandi, Narak, PSS-1	800-900 (3-4 cuts)
		Red clover	PRC-3	400-600 (4-5 cuts)
		Dactylis grass	Local material	350-500 (3-4 cuts)
		Bromus	Local material	700-800 (3-4 cuts)
		Congo signal grass	Local material	600-700 (3-4 cuts)

Forage based crop intensification (Round the year forage production system)

Intensive forage production systems are tailored with the objective of achieving a high yield of nutritious green forage and maintaining soil fertility. The overlapping cropping system comprises raising legumes, inter-planted with perennial grasses in spring, and intercropping the inter-row spaces of the perennial grasses with appropriate legume during summer and winter to supply quality green fodder round-the-year. The cropping systems having rice, maize and one or two forage crops may be popularised for fulfilling regular fodder demand *viz.*, Rice – Maize– Maize + Cowpea, Maize (Baby corn) –Oats - Maize (Baby corn), Maize (Baby corn) –Mustard (fodder) + Oat -Maize (Baby corn), Maize + Cowpea –Oat + Fodder Mustard – Sorghum + Cowpea and BN Hybrid + (Cowpea- Oats)- Cowpea) are promising for providing green fodder round the year. Thus fodder can also be included in existing food grain/ commercial production systems as these are equally or more remunerative.

Table 9: Agroclimatic zone wise cropping systems in Mizoram

Sl. No.	Agro climatic situation	Cropping system	Green fodder yield (t/ha)
1.	Humid Mild Tropical Hill Zone (Covering Mamit, Kolasib, Lunglei, Lawngtlai districts)	Rice - Maize- Maize + Cowpea	90-100
		Maize (Baby corn) -Oats - Maize (baby Corn)	90-110
2	Humid Mild Sub-Tropical Hill (Covering Aizawl, Serchhip, Lunglei, Lawngtlai)	Maize + Cowpea -Oat + Fodder Mustard - Sorghum + Cowpea	90-120
		B N Hybrid + (Cowpea- Oats) - Cowpea	120-140

3	Humid Temperate Sub-Alpine (Champhai, Siaha, Lunglei, Lawngtlai)	Orchard grass+ red clover Tall fescue+ red clover	55-65 60-70

Figure 4: Round the year fodder production system

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

Mizoram state has a large area under fruit trees which can be utilized for the production of a large amount of quality fodder by the introduction of either grasses or grass-legume mixtures. Studies conducted at ICAR-IGFRI and its regional stations (Karnataka, Kashmir) have successfully demonstrated that introduction of grasses under fruit trees *viz.,* in guava, aonla and bael based hortipastures, in apple and almond-based hortipastures and under mango and sapota hortipastures enhances fruit tree growth and increases economic yield (20-25%) and physicochemical properties of fruits due to synergistic effect as grass/ legume mixtures improve soil organic carbon percentage, carbon sequestration, conserve moisture and increases the population of beneficial microbes.

Figure 5: Hortipasture system

Table 10: Suitable grasses for fodder production under fruit orchard in Mizoram

Horticulture crops	Fodder crops
Mango, guava, citrus, passion fruit	**Grass:** Guinea grass, *Brachiaria brizantha,* Bajra Napier hybrid, Setaria anceps (var. S-18 Perennial), *Dicanthium annulatum, Chrysopogon fulvus* **Legume:** Cowpea, rice bean, Desmodium sp., *Stylosanthes guianensis,* Siratro (*Macroptilium atropurpureum*), *Macrotyloma axillare* (Dolichos)

Table 11: Additional green and dry fodder production on introduction of grasses under fruit orchard with 25 % area under each orchard (Based on data of 2018)

Fruits	Area (ha)	Targeting 25% orchards for fodder production area (ha)	Enhanced green fodder availability tonne (range)	Enhanced dry fodder availability tonne (range)
Lime	8100	2025	40500	10125
Mandarin	16370	4092	81840	20460
Orange	1590	397	7940	1985
Guava	420	105	2100	525
Mango	910	227	4540	1135
Papaya	1250	312	6240	1560

Base: Average forage production under hortipasture: Green 20-30 t/ha; Dry: 5-10 t/ha

Source: Horticultural Statisticsat a Glance 2018; Horticulture Statistics Division, Department of Agriculture, Cooperation & Farmers' Welfare, Ministry of Agriculture & Farmers' Welfare, Government of India.

Targeting non-arable lands for forage production

There are various Alternate Land Use (ALU) systems provides fodder for livestock 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 for animal feed besides various products. These activities contribute significantly to domestic livestock production, which influences milk and meat supply and contributes to household income. Grasslands/pastures are major resources of grazing of animals in the higher hills. Unlike other states where tree leaves are mainly fed to small ruminants, in Mizoram hills, it is a major

Figure 6: Silvipasture system

source of fodder for bovines too. There is ample scope and many opportunities for introducing fodder crops in existing orchards. Horti-pasture system integrates pasture (grass and /or legumes) and fruit trees to fulfill the gap between demand and supply of fruit, fodder and fuelwood through utilizing moderately degraded land.

Establishment of Silvipastures for round the year quality fodder supply:

Silvipasture can enhance average dry fodder biomass production from 1.25 – 4.50 tonnes per hectare (t/ha) per year on natural grassland to 4.50 – 8.70 t/ha per year. The average animal carrying capacity can be increased up to 50% compared to natural grazing land during the rainfed season by adopting silvipastural models. Trees in silvipastures supply fodder during this lean period, thereby it can reduce feeding cost, thus ensures round year fodder supply. The fodder trees can be integrated on-farm bunds, agricultural land border areas, and grasslands owned by local people. Studies carried out by ICAR-IGFRI on silvipatures established in degraded land have shown significant improvement in soil nutrients, organic carbon, soil micro-flora, and enzyme activities, and carbon sequestration potential. Therefore, silvipastures can be established on wastelands of Mizoram, which will be a win-win situation as on the one side, it will reclaim the wasteland and on the other side, it will provide round the year fodder for livestock. Moreover, tree leaf fodder quality does not get impacted significantly by seasons, as in the case of forage crops and grasses. The list for suitable fodder trees for Mizoram has been given in Table 12.

Table 12: Zone wise suitable fodder trees, their fodder quality traits and season of lopping

Suitable fodder trees		
Lower hills and mid hills	**Crude Protein (%)**	**Best season for lopping**
Grewia optiva	15.60-19.05	Winter
Celtis australis	14.47-15.33	Summer
Bauhinia variegata	10.73-15.91	Nov-Dec
Ficus roxburghii	12.28-13.35	October-May
Melia azedarach	12.8	Summer
Leucaena leucocephala	24.20	Summer/Winter
Albizzia chinensis	15.08	April-November
Albizzia lebbeck	16.81-26.50	April-November
Morus alba	15.00-27.64	Summer
Pittosporum floribunduma	14.70	Winter
Quercus leucotrichophora	10.20-11.42	Winter/summer

High hills	Crude Protein (%)	Best season for lopping
Ulmus wallichiana	16-18	Winter
Robinia pseudoacacia	14-25.5	Summer/Winter
Salix alba	12.00-17.00	Summer/Winter
Populus ciliata	10.00-12.00	Rainy season
Quercus dilatata	9.56	Winter/summer
Morus serrata	14.00-22.00	Summer
Morus alba	15.00-27.64	Summer
Bauhinia variegata	10.73-15.91	Nov-Dec

Table 13: Suitable trees and grasses for Silvipasture establishment under various climatic zones of Mizoram

Zone	Trees	Grasses
Lower hills and mid hills (Mamit, Kolasib, Lunglei, Lawngtlai and Aizawl, Serchhip, Lunglei, Lawngtlai districts)	*Grewia optiva, Celtis australis, Melia azedarach, Leucaena leucocephala, Albizzia chinensis, Albizzia lebbeck, Morus alba,*	*Dicanthium annulatum, Chrysopogon fulvus, Lolium perenne, Tall fescue, Setaria grass, Dactylis glomerata, Panicum maximum*
High hills (Champhai, Siaha, Lunglei, Lawngtlai)	*Ulmus wallichiana, Salix alba, Morus serrata, Morus alba, Bauhinia variegata*	*Chrysopogon montanus, Lolium multiflorum, Festuca arundinacea, Dactylis glomerata, Phleum alpinum, Stipa* spp., *Chrysopogon gryllus*

C. Fodder Production from permanent pasture/grazing lands:

Mizoram has round about 0.24% area of its total geographical under permanent pasture/grazing and wasteland that can be utilized for pasture improvement by planting of fodder trees and establishment of silvipasture system. Mizoram is known for beautiful alpine pastures, which are a major source of livelihood for many tribes. These are mainly used by migratory grazing animals such as sheep, goats, equines and buffaloes. Due to various problems *viz.*, continuous and overgrazing, overstocking, late grazing up to the onset of severe winters, growing of non-palatable weeds and shrubs and poor soil fertility of these alpine pastures has deteriorated as observed in the last few years. Thus proper management of these alpine pastures is urgently required. Some interventions are proposed to be taken in some selected pastures, includes:

i. Rotational grazing

ii. Removal of non-palatable weeds and shrubs
iii. Nutrient management based on soil nutrient profiling
iv. Maintenance of proper population through seed pallets sowing
v. Management of soil erosion
vi. Management to ensure flowering and seed production in nutritious species

D. Fodder on non-competitive lands

Introducing perennial cultivated grasses on farm bunds along irrigation channels involves growing two rows of Bajra Napier hybrid/guinea grass/setaria/ tall fescue/phalaris hybrid along with field boundary can supply 7-11 q green fodder per 100 m length of boundary per year. As terrace cultivation is most important in the hills of Mizoram, planting perennial grasses on bunds will also help to stabilize terraces that are more prone to soil erosion during the rainy season. Studies conducted at ICAR-VPKAS, Almora showed the great possibility of raising BxN hybrid with proper management under certain specific constraint areas *viz.* grasslands under chir pine and deodar forest, hillside slopes and top of the risers of the terraced fields. Planting of BN hybrid during onset of monsoon improves the plant establishment. During the first year of planting, BN hybrid gives 1-2 cut (70 to 80 days intervals) and 5-6 cut second year onwards (40 to 50 days intervals) and a number of cuts may vary as per the rainfall. Approximately 8-10 kg of green fodder is produced per running meter from field terrace risers.

Figure 7: BN hybrid on bunds

E. Alternative fodder resources

Alternative fodder resources supplement the efforts for the supply of quality fodder at an affordable cost. They also sometimes provide a viable medium for nutritious fodder, particularly in times of scarcity and natural calamity. There is a need for exploring the alternative or non-conventional fodder resources *viz.*, moringa, azolla, hydroponics, fodder beet, food processing industry wastes. Although azolla and hydroponics could be ideal sources of fodder in plain areas and occupy the lesser land area, they are labor-intensive activities. These could be better options when household labor is involved in augmenting the fodder resources and those livestock keepers, who have a lesser number of animals. However, these can be supplementary and cannot substitute natural fodder production.

(i) Moringa as alternate protein source

Moringa oleifera is an excellent alternative source for substituting commercial rations for livestock of Mizoram state. The relative ease with which moringa can be propagated through sexual and asexual means and its low demand for 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 in low and mid hill situation of Mizoram. 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 contain 21.53% crude protein, 24.07% acid detergent fiber (ADF), and 17.55% neutral detergent fiber (ADF). Thus, the moringa-based silvi-pasture model can be developed by involving suitable grass species, where moringa leaves can be utilized for leaf meal production for substituting as the source of protein in rations and grasses will provide cheaper and nutritious fodder.

Figure 8: Moringa - A nutritious fodder tree

(ii) Azolla as alternate fodder

Azolla farming can be taken to supply protein supplements and reduce the cost of concentrate. Azolla farming is inexpensive and can be multiplied in natural water bodies for the production of biomass. Azolla doubles its biomass in 3–10 days, depending on conditions and it can yield up to 37.8 t fresh weight/ha (2.78 t DM/ha dry weight) and its 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 and 10-15% minerals. During the lean/drought period, it provides a sufficient quantity of nutrients and acts as a feed resource.

Figure 9: Azolla ponds

(iii) Sugar beet/Fodder beet

Fodder beet is an important energy supplements for small and large both category of ruminant animals including pig. Fodder beets contain about 16-22% dry matter and

provide about 4000 kcal/ kg (dry matter) gross energy N digestibility in ruminants is about 85%. The crude prude content ranges between 7-8% on a dry matter basis. Fodder beet can be cultivated in most of the parts of the state except high hills in duration of 140-150 days. It can be very good energy supplement to large pig population of Mizoram.

Figure 10: Sugar beet fodder field

(iv) Hydroponic fodder production

Hydroponics is a method for rapid quality fodder production. Hydroponic growing systems produce a greater yield over a shorter period in a smaller area than traditionally-grown crops. Hydroponic fodder systems are usually used for sprouting cereal grains such as barley, oats, wheat, sorghum and corn. The hydroponic structure consists of a framework of shelves on which metal or plastic trays are stacked. After soaking overnight, a layer of seeds is spread over the base of the trays. During the growing period, the seeds are kept moist but not saturated. They are supplied with moisture and nutrients, usually via drip or spray irrigation. Seeds will usually sprout within 24 hours and, in 5 to 8 days, have produced a 6 to 8-inch high grass mat. Peri-urban small farms, landless animal farms and steep hill farms having no agricultural land but possess small pig, poultry and/or cow units can benefit from either of the two or combining the hydroponic fodder-cum-sprouted grain technologies.

Figure 11: Hydroponic fodder production

F. Crop residue quality enhancement

Quality enhancement of rice and other crop residues is required as value-added fodder. There are various methods of treating the crop residues before feeding to improve their nutritional value. It has been reported that even chaffing of stalk before feeding can reduce the emission of methane by 10% while saving the wastage by 25-30%. Further, treatment of crop residues by soaking in water and treating

Figure 12: Complete feed block

with steam under pressure can also improve the nutritive value and palatability. There are other methods like urea treatment in addition to molasses. The establishment of a complete feed production unit can also enhance the availability of balanced fodder and will also increase the supply of complete feed at an affordable price can motivate a large number of small farmers to expand their livestock development activities as a reliable source of livelihood. To operationalize such decentralized feed production units on an economically viable scale, the units can be operated by local livestock keeper groups who have a significant stake in procurement, distribution and its viability.

G. Fodder conservation technologies – Hay, Bales, Silage and Feed block

In recent time's 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 dry fodder in the form of haymaking and heaping. However, the lack of scientific haymaking has often limited keeping quality of haymaking and heaping. Recently there has been greater emphasis on conserving green fodder, popularly known as "Silage."

Hay/ Bales: Although it is common practice, necessary training is needed to ensure long keeping quality of the hay material. Further, dry fodder being voluminous in nature often needs larger space and poses problems in transportation. Hence, pressing dry fodder into bales to reduce keeping space and ease transportation is more necessary in recent times. The moisture content in hay must be less than 15% at storage time. Hence, crops with thin stems and many leaves are better suited for haymaking as they dry faster than those having thick and pithy stems and small leaves.

Figure 13: Storage of bales

Silage: The basic principle of silage making is to convert the sugars in the ensiled fodder into lactic acid. This reduces the pH of the silage to about 4.0 or lower, depending on the type of process. Silage making may be recommended in Assam. However, its success will depend on surplus forage production, erratic rainfall pattern, availability of labor (cutting, raking, collecting, chopping, pit

Figure 14: Silage in bags

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, guinea grass, setaria, pineapple waste *etc.*

Feed Block: Bale making or feed block making could be a good strategy for reducing the cost involved in the 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 labor and also help in saving time on these activities. It will also help in supplying fodder during the calamities as well as the lean season.

H. Contingency fodder planning

Mizoram is prone to natural disasters like earthquakes, cyclones, hailstorms, landslides, floods, fire *etc.* There is always abundant rainfall during the monsoon season. High wind/cyclonic storms always strike the state at the beginning and after the monsoon season, which creates havoc in the state by damaging dwelling houses and crops. Due to excess rainfall, landslides are a severe hazard for the state. So, suitable contingent plans for fodder production and livestock management are mentioned in Table 14.

Table 14: Contingent planning for fodder production 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 Hydroponics	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)	Urea molasses block Easy access to feed & fodder through government agencies
Cyclone	Store fodder at safe place Supplementary feeding	House/farm waste based feeding

I. Seed requirement & availability for targeted area under forages

Quality fodder production depends on the availability of quality seeds/planting materials of improved varieties. To increase fodder production in the state, there is a need to increase the area under fodder crops atleast by 5% (4,750 ha) of the net cultivated area (95,000 ha). The seed requirement of different fodder crops for this 5%

area is presented in Table 15. Similarly, 25% area of existing orchard and 25% of cultivable wastelands if brought under grassland it will change the fodder availability scenario in the state.

Table 15: Seed requirement for the 5% (4,750 ha) of the net cultivated area (95,000 ha) of Mizoram

Sl. No.	Crop	Area under each crop (ha)	Seed rate (kg/ha)	Seed requirement (Quintal)	Source of seed supply
Kharif					
1	Fodder maize	712 (15%)	50-60	356-427.2	IGFRI, Jhansi CAU, Imphal AAU, Jorhat RSFPD, Kalyani
2	Rice bean	570 (12%)	25-30	142.5-171.0	BCKV, Kalyani RSFPD, Kalyani
3	Cowpea	712 (15%)	40-45	248.8-320.4	IGFRI Jhansi RSFPD, Kalyani
4	Deenanath grass	522 (11%)	3-4	15.66-20.88	IGFRI, Jhansi
Rabi					
5	Berseem	1187 (25%)	25	296.75	IGFRI, Jhansi
6	Oat	1330 (28%)	100	1330	IGFRI, Jhansi
Perenial					
7	*Stylo santhes* spp.	237 (5%)	5-6	11.85-14.22	IGFRI, Jhansi
8	BN hybrid	570 (12%)	40,000 root slips	2.28 crore root slips	IGFRI, Jhansi CAU, Imphal KVK, Aizawl
9	Guinea grass	237 (5%)	4-5	9.48-11.85	IGFRI, Jhansi
10	Setaria	475 (10%)	5	23.75	CAU, Imphal AAU, Jorhat KVK, Aizawl ICAR-RC NEH, Kolasib
11	Congo signal grass	712 (15%)	2-4	14.24-28.48	CAU, Imphal AAU, Jorhat KVK, Aizawl ICAR-RC NEH, Kolasib

Table 16: Seed requirement for development of hortipasture systems in 25 % area under each orchard (Based on data of 2018)

Fruit crop	Targeting 25% orchards for fodder production area (ha)	Cultivatd area available for fodder production	Grass	Seed requirement (ha) (Quintal)	Source of seed
Lime	2025	607	Setaria, Congo signal	30.35	IGFRI, Jhansi
Mandarin	4092	1227	Guinea, Congo signal	61.35	ICAR-RC NEH,
Orange	397	119	Setaria, Congo signal	5.95	Kolasib
Guava	105	31	Guinea, Setaria	1.55	CAU, Imphal
Mango	227	68	Setaria, Congo signal	3.40	AAU, Jorhat KVK, Aizawl

Table 17: Grass seed requirement for development of silvipasture system

Agroclimatic zone	Tree species	Grass	Cultivable wasteland area (25%) (ha)	Grass seed requirement (Quintal)	Source of seed
Humid Mild Tropical Hill Zone (Covering Mamit, Kolasib, Lunglei, Lawngtlai districts)	*Grewia optiva, Celtis australis, Melia azedarach, Albizzia lebbeck maximum*	Setaria, Congo signal, Deenanath, *Panicum*	500	20	ICAR-RC NEH, Kolasib CAU, Imphal AAU, Jorhat KVK, Aizawl
Humid Mild Sub-Tropical (Covering Aizawl, Serchhip, Lunglei, Lawngtlai) Hill	*Leucaena leucocephala, Albizzia chinensis, Morus alba*	Guinea, Congo signal, Setaria	500	20	
Humid Temperate Sub-Alpine (Champhai, Siaha, Lunglei, Lawngtlai)	*Ulmus wallichiana, Salix alba, Morus serrata, Morus alba, Bauhinia variegata*	*Lolium multiflorum, Festuca arundinacea, Dactylis glomerata, Phleum alpinum*	500	20	

J. Zone-wise summarised fodder intervention

Summary of different fodder intervention for sustainable livestock production in three agroclimatic zones of Mizoram is given below (Table-18 & 19):

Table 18: Specific feed and fodder interventions suggested for Mizoram

Sl. No.	Agro Climatic Zone	Fodder interventions
1	Humid Mild Tropical Hill Zone (Covering Mamit, Kolasib, Lunglei, Lawngtlai districts)	Cereals - fodder maize, oat, BN hybrid, Legumes - cowpea, dolichos, rice bean, *Stylosanthes guianensis*, Grass - Deenanath, *Brachiaria brizantha, Dicanthium annulatum, Chrysopogon fulvus,* Grasses and trees/shrubs to develop silvipasture
2	Humid Mild Sub-Tropical Hill (Covering Aizawl, Serchhip, Lunglei, Lawngtlai)	Cereals-Fodder maize, oat, BN Hybrid, Pulses- cowpea, rice bean, *Stylosanthes guianensis* Grass- Deenanath, setaria, congo signal Non conventional fodder-Azolla, moringa leaves, silkworm pupae meal, vegetable and fruit waste in pig feed, pine apple waste, jackfruit waste and cashew apple for pig Rejuvenation of grazing lands/pasture
3	Humid Temperate Sub-Alpine (Covering Champhai, Siaha, Lunglei, Lawngtlai)	Temperate fodder crop-Tall fescue, Dactylis, *Lolium perenne*, bromus, white clover, red clover Rice straw based complete feed blocks (CFB) for mithun Grasses and trees/shrubs to develop silvipasture and rejuvenation of grazing lands/pasture

Table 19: Strategic feed and fodder interventions suggested for Mizoram

Intervention	Aim
For green fodder production	
Establishment of fodder nursery	Establishment of perennial fodder nurseries in selected milk shed areas will facilitate easy availability of suitable varieties of perennial fodder.
Introducing improved fodder crops in existing cropping systems or food fodder systems	Growing new high yielding fodder crops and their varieties to increase green fodder availability
Introducing improved fodder crops in fruit orchards and plantations	Use of non-competitive land to increase green fodder availability
Re-vegetation of pasture grasses on common grazing land	Increase herbage production
Forages on bunds and along irrigation channels	Increase fodder availability and stabilize bund
Fodder shrubs and trees	Increase green fodder availability in summer and leaf meal preparation

For dry fodder use	
Improved chaff cutters (smaller, women friendly model)	Overcome problems faced by women in operating the mechanized wheeled model
Use of feed troughs	Reduce feed wastage during feeding
Fodder conservation/ Others	
Fodder baling and establishing fodder banks in dry matter surplus districts	To address fodder shortage in drought years
Awareness and training on use of area specific mineral mixture	Encourage feeding area specific mineral mixture to improve efficiency of feed utilization

Table 20: 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	

Part-III : Brief Action Plan

i. Identification of areas for propagating fodder production

A benchmark 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 the three agro-climatic zones of the state, one district from each agro-climatic zone can be selected. A benchmark survey may be initiated in 2 blocks in each of the selected districts, which will fairly give an idea about the possible conditions for the 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 Mizoram state as to which fodder crops and their varieties would be more suitable for different agro-climatic conditions prevailing in the state, and it has been outlined in the recommendations. The same may be used as a guideline for the identification of suitable fodder crops and varieties.

iv. Providing package of practices for fodder crops

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

v. Master trainers training at IGFRI/CAUs

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

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

There are 4 Krishi Vigyan Kendras (KVKs) operating in the state of Mizoram. They will be roped in to identify the needy farmers for training on fodder crops.

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

vii. Conduction of frontline demonstration and training

After benchmark survey and identification of suitable places for propagating awareness about the fodder crops, a 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 to benefit 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 from the discussion during the workshop, the non-availability of quality seeds and planting material of suitable fodder crops is one of the major hindrances for the cultivation of fodder crops. Therefore efforts will be made to estimate the quantum of various fodder crops' seeds and planting material well in advance and an institutional mechanism will be put in place to ensure the availability of different categories 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

There is fodder scarcity in almost all places in Mizoram. 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 after that. 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 holders 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 Mizoram. 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 problematic soils.
- Enhancing production through grassland, rangeland and grazing land management.

- 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 of foresight and or lack of machinery *etc.* Hence conservation of fodder resources wherever possible for future use during lean periods and at times of natural calamities like famine, high rainfall *etc.* will be highlighted. Further, as fodder is bulky, 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 holders are faced with fodder scarcity owing to natural calamities unforeseen failure of crops, and it poses a significant threat to sustainable animal husbandry and dairying. To tide over such a situation of fodder scarcity, efforts will be made to educate the policymakers, heads of line departments to establish fodder banks at village clusters or sub-division for ensuring the supply of a minimum quantity of fodder to livestock keepers so that the animals are forces to go hungry. In addition, the establishment of fodder warehouses with enriched, dry fodder or silage bins will also be popularized.

xiii. Networking through ICAR-DAHD- Milk Federations

Any isolated efforts to augment fodder resources may not be sustainable in the long run owing to some unforeseen situations in the 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, ICAR-Research Complex for NEH Regions and its centres, CAU, Imphal, 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 forthcoming issues in the 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, policymaking, *etc.* the ultimate end user will be common farmers. Further, there are several private players, *viz.* dairy owners, animal pharma industries, feed manufacturers, NGOs involved in livestock production and dairying *etc.* They will all be brought together under Public-

Private Partnership (PPP) mode in a more transparent, efficient, and economical way for all the partners.

xv. Impact analysis of technology adoption

The objectives of the programme also aim at seeing the perceptible changes that are going to occur through the implementation of the proposed project. Hence, baseline data on various parameters will be collected before the start of the project and after the project implementation at regular intervals. The findings will be used to analyze 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 a multi-task, multi-partner, and multi-year activity. Hence an accurate road map is necessary for making it a 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 21).

Table 21. 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. It has been presented in Table 22.

Part-V : Implementation of Pilot Programme

A 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. A pilot project is proposed to be implemented in selected villages of identified districts. The detailed plan for implementing the pilot project is presented in Table 22.

District identified for implementation of pilot project:

Based on the population growth of livestock, three districts were identified for implementation of the pilot project *viz.*, Kolasib, Aizawl, and Champhai.

Table 22. Implementation level plan for pilot project

S.No.	Activity	Action points
1	Target area selection	• Selection of 2 cluster of 3 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; 900 farmers in first year (6 training program for farmers of each cluster) • Exposure visit of progressive farmers and master trainers at IGFRI, Jhansi and other ICAR institutes located in Mizoram 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

4	Suitable silvi-pasture/ horti-pasture system demonstrations	• In existing orchard- 1 ha (Guinea, setaria, orchard grass) • In new orchard - 1 ha (Guinea, setaria, orchard grass) • Popular and potential fodder trees • Moringa can be a potential source of legume fodder in upland areas and may be explored
5	Need based Watershed/ micro irrigation facility development	• Suitable fodder species *viz.* Dichanthium, Chrysopogan, 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, lathyrus, 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, urea enriching machinery of straw, 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 Mizoram, Govt. of India through various state and central schemes like RKVY , NLM *etc.* can meet the fund requirement. ICAR-IGFRI will provide technical support for formulation of such fodder development proposals for funding. The cost requirement for the implementation of pilot project is presented in Table 22.

Table 23: Details about identified interventions, their unit cost and number

Agro-climatic zone	Name of intervention	Unit size/ number	Cost per unit (Rs)	No. of farm families selected	Total quantity/ number	Total cost (Rs)
Humid Mild Tropical Hill Zone	Seasonal forage based crop diversification and intensification	0.2 ha	8,000	50	10 ha	4,00,000
	Perennial forage based crop diversification and intensification	0.2 ha	16,000	10	2 ha	1,60,000
	Forage production from non-arable lands: Silvi/ horti-pasture system	0.2 ha	5,000	10	2 ha	50,000
	Conservation of Fodder (fodder bank): silage and hay making	1 no.	4,000	50	50 no.	2,00,000
	Re-vegetation of pasture grasses on common grazing land	1 ha	1,00,000	Whole village	2 ha	2,00,000
	Animal nutrition through balanced diet/mineral mixture	1 no.	1,800	50	50 no.	90,000
	Popularization of farm machinery/implements		10,00,000	Whole village		10,00,000
	Capacity building of livestock keepers and fodder growers: On farm training cum field day (1 day for 200 persons)	1 no.	50,000	Whole village	2 no.	1,00,000
	Capacity building of progressive farmers/rural youth: On station training cum exposure (3 days for 50 persons)	1 no.	2,50,000	Whole village	1 no.	2,50,000
	Capacity building of Extension workers/ officers: On station training (7 days for 25 persons)	1 no.	4,00,000	Whole district	1 no.	4,00,000
Humid Mild Sub-Tropical Hill	Seasonal forage based crop diversification and intensification	0.2 ha	8,000	50	10 ha	4,00,000
	Perennial forage based crop diversification and intensification	0.2 ha	16,000	10	2 ha	1,60,000
	Forage production from non-arable lands: Silvi/ horti-pasture system	0.2 ha	5,000	10	2 ha	50,000
	Conservation of Fodder (Fodder bank): silage and hay making	1 no.	4,000	50	50 no.	2,00,000
	Re-vegetation of pasture grasses on common grazing land	1 ha	1,00,000	Whole village	2 ha	2,00,000

	Animal nutrition through balanced diet/mineral mixture	1 no.	1,800	50	50 no.	90,000
	Popularization of farm machinery/implements		10,00,000	Whole village		10,00,000
	Capacity building of livestock keepers and fodder growers: On farm training cum field day (1 day for 200 persons)	1 no.	50,000	Whole village	2 no.	1,00,000
	Capacity building of progressive farmers/ rural youth: On station training cum exposure (3 days for 50 persons)	1 no.	2,50,000	Whole village	1 no.	2,50,000
	Capacity building of extension workers/ officers: On station training (7 days for 25 persons)	1 no.	4,00,000	Whole district	1 no.	4,00,000
Humid Temperate Sub-Alpine	Seasonal forage based crop diversification and intensification	0.2 ha	8,000	50	10 ha	4,00,000
	Perennial forage based crop diversification and intensification	0.2 ha	16,000	10	2 ha	1,60,000
	Forage production from non-arable lands: Silvi/horti-pasture system	0.2 ha	5,000	10	2 ha	50,000
	Conservation of fodder (fodder bank): Silage and hay making	1 no.	4,000	50	50 no.	2,00,000
	Re-vegetation of pasture grasses on common grazing land	1 ha	1,00,000	Whole village	2 ha	2,00,000
	Animal nutrition through balanced diet/mineral mixture	1 no.	1800	50	50 no.	90,000
	Popularization of farm machinery/implements		10,00,000	Whole village		10,00,000
	Capacity building of livestock keepers and fodder growers: On farm training cum field day (1 day for 200 persons)	1 no.	50,000	Whole village	2 no.	1,00,000
	Capacity building of progressive farmers/ rural youth: On station training cum exposure (3 days for 50 persons)	1 no.	2,50,000	Whole village	1 no.	2,50,000

	Capacity building of extension workers/ officers: On station training (7 days for 25 persons)	1 no.	4,00,000	Whole district	1 no.	4,00,000
Plan for State AH/Ag farms	Perennial forage based crop intensification	1 ha	50,000	3 farms	3 ha	1,50,000
	Fodder seed production	1 ha	50,000	3 farms	6 ha	3,00,000
		Gross total				**90,00,000**

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 Mizoram. 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 Mizoram 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, Guwahati 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 Mizoram. Mentioned agro-climatic zones, livestock scenario, district-wise live stock population, estimated demand-supply scenario, important fodder crops, their varieties and productivity, zone-wise interventions or interventions or technologies , suitable trees and grasses for silvi-pature establishment under various climatic zones of Mizoram, prospects of fodder production in risers, introducing permanent cultivated grasses on terrace riser, quality enhancement of residues, zone-wise interventions for Mizoram, potential forage production systems for problem soils after soil amelioration, non competitive land-use for forage production, prospects of fodder production on riser. Highlighted brief action plan, modalities, road map, action point,

agencies involved, implementation of pilot programme and informed that models are available for different technologies. Implementation in aspirational districts (Kolasib, Aizawl, Champhai *etc.*) were mentioned.

- Dr. Lalnuntluangi Hmar, Dean Veterinary College, Mizoram, Aizawl mentioned that mainly Congo Signal is being cultivated in the Veterinary College. Fodder can be grown during the monsoon season but not during the winter season due to scarcity of water but during the lean season. Dr. Sunil replied that Guinea grass, BN hybrid (Co-5), Broom grass can be grown.
- Dr. C.S. sahay mentioned that fodder can be grown in bund because of sloppy nature.
- Dr. A.K. Roy mentioned that Setaria, Guinea grass and BN hybrid can be grown on the bund and Oat can be a very good option with some irrigation source.
- CPGS, CAU, Umiam enquired about amino acid and micronutrient studies in grasses. For piggery, tuber crops (fortified tuber tapioca) can be cultivated in large scale.
- Dy Director, Mizoram suggested multi-purpose fodder crop suitable for both pig and cattle feed.
- Dr. A. Chandra enquired about seed quantity required for NEH. Grass seeds can be sent as it is of low weight. *Stylosanthes guanensis* can be procured from Chennai. Dr. Joseph can help him in *Setaria* species and guinea grass.

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 Interactive workshop (8th December, 2021)

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 Kumar Yadav, ICAR-IGFRI, Jhansi
11. Dr. Suheel Ahmad, IGFRI Srinagar Station
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 Seth, ICAR-IGFRI, Jhansi
29. Dr. Jamini
30. Dr. Mokhtar Hussain, ICAR-NRCY, Derang

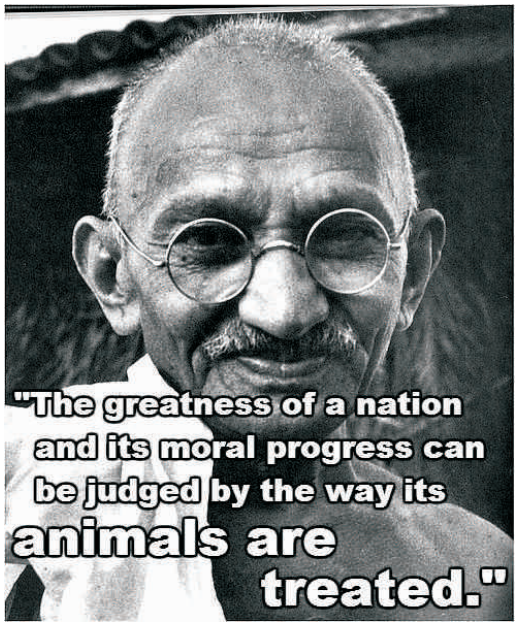
31. Director of Research, CAU, Imphal
32. Joint Director, ICAR, Mizoram
33. Dr. Joseph
34. CPGSAS, Umiam
35. CoVSc, Jalukie, Nagaland
36. Dr. Mahak Singh
37. Dr. Lalnuntluangi Hmar
38. Dr A.K. Samanta
39. Dr. R.P. Nagar, PS & OIC, IGFRI- WRRS, Avikanagar
40. Dr. Girin Kalita
41. Dr. Ch Nandakishore Singh
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. 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



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