Fodder Resources Development Plan for Nagaland

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

Fodder Resources Development Plan for Nagaland

...a policy paper

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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 a tradition with the Nagas and therefore, rearing of domestic animal such as Cattle, Mithun, Pig and Poultry birds play a significant role in the socio-economic development of Nagaland. With the diminishing and unmanaged grazing lands, the state is facing acute shortage of green fodder, the most important component in livestock development. There is shortage of green fodder in the state and hampers the productivity potential of the animals. Therefore, it is necessary to focus on enhancing forage resources in the state.

It is indeed a matter of great pleasure that the state specific, "Fodder Resources Development Plan", has been developed by the ICAR-Indian Grassland and Fodder Research Institute, Jhansi, for Nagaland in consultation with all the stakeholders. This plan provides the 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 Nagaland.

I complement the ICAR-IGFRI, Jhansi for their efforts in bringing out this comprehensive document for the state of Nagaland.

(T. MOHAPATRA)

Dated the 22nd April, 2022
New Delhi

Fodder Resources Development Plan prepared as a part of

National Initiative for Accelerating Fodder Technology Adoption (NIAFTA)

ICAR-Indian Grassland and Fodder Research Institute, Jhansi

Themes of NIAFTA

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

NIAFTA Coordination Team

Dr. Amaresh Chandra, Director	Chairman
Dr. Purushottam Sharma, PS & Head	Nodal Officer
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Dr. D.R. Palsaniya, PS	Member
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Dr. B.B. Choudhary, Scientist	Member
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Dr. Sunil Kumar, PS & Head	Coordinator
Dr. Sultan Singh, PS	Chairman
Dr. Deepak Upadhaya, Scientist	Member
Dr. Manjanagouda S. Sannagoudar, Scientist	Member
Dr. Mahesha, H.S., 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 Dr. Trilochan Mohapatra, Hon'ble Secretary DARE, and Director General, ICAR. He advised to develop a state-wise fodder resource development plan which covers the broad areas as per the requirement of the state. We are highly grateful to him for his insight, guidance, encouragement, continuous support and suggestions in preparing this document. We are also thankful to the Deputy Director General (Crop Science), ADG (FFC) and other officers of the ICAR who extended their support during the development of the fodder plan of Nagaland.

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 Nagaland 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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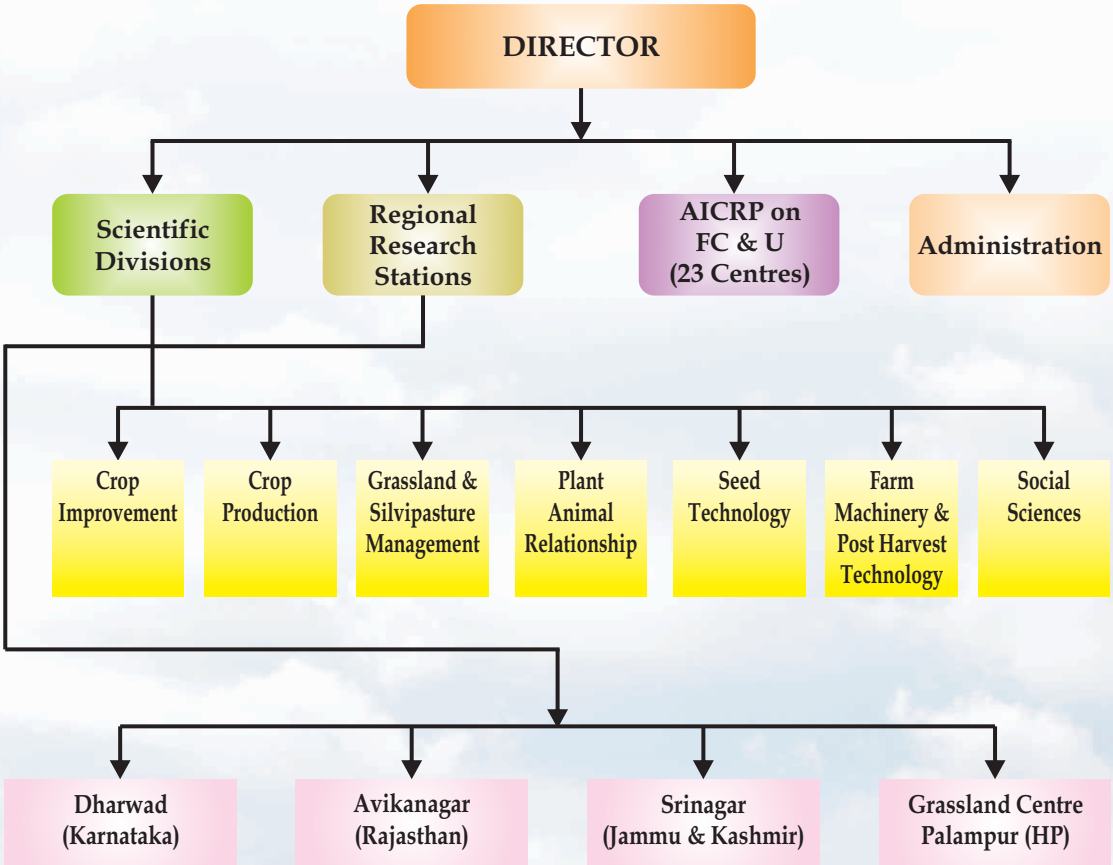
Organogram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IGFRI
Grassland

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

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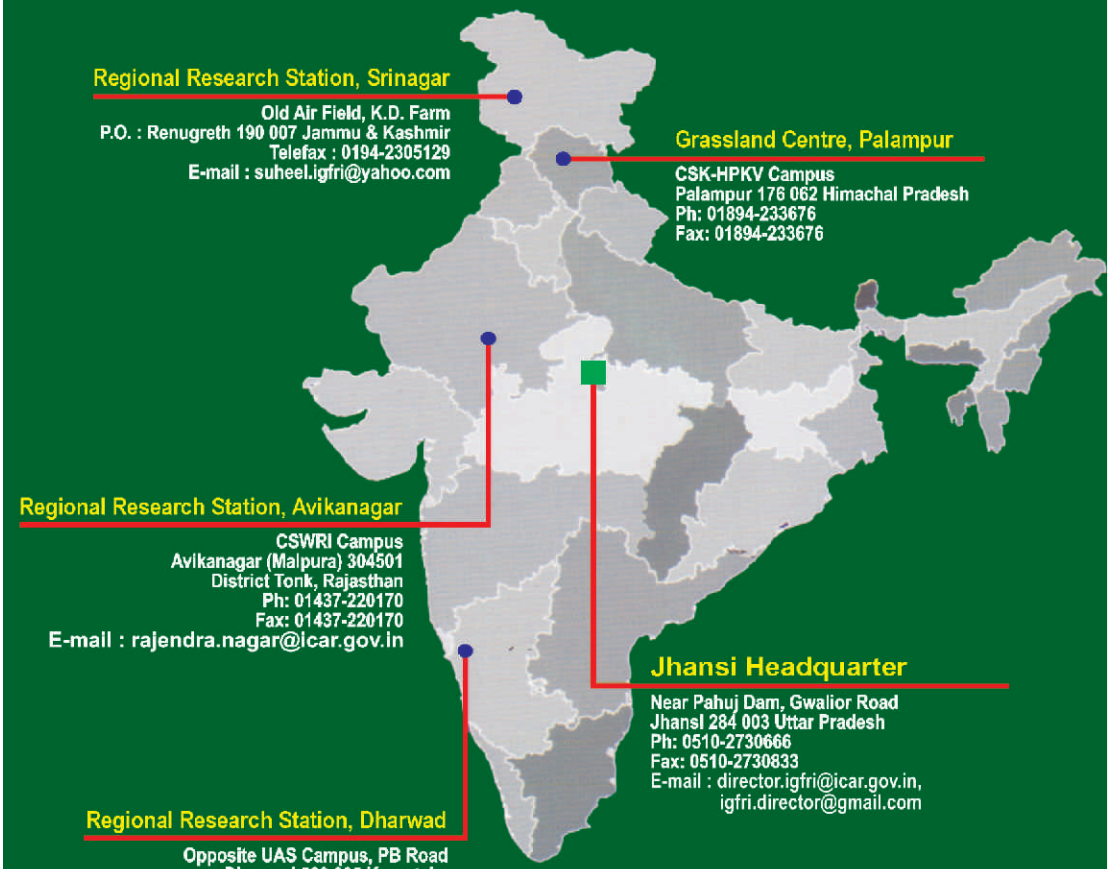

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Part-I : Agriculture, Livestock and Fodder Scenario

A. Introduction

Nagaland is one of the Northeastern states of India spread over an area of 16,579 km^2, lies between 25°60″ and 27°40″ North latitude and 93°20″ and 95°15″ East longitude. The inhabitants of Nagaland are almost entirely tribal with distinctive dialects and cultural features. The topography of Nagaland is full of hill ranges, which break into a wide chaos of spurs and ridges. The terrain is mountainous covered by rich and varied biodiversity of flora and fauna. It is one of the 25 hot spots of the world with respect to its biological diversity, and hence can be termed as the state of true Mega bio-diversity. The state is predominantly rural with 82.26% of population living in villages. It is an agrarian state with over 71% of its population dependent on agriculture and its allied sectors. Scope of agriculture production to a commercial level is of high potentiality but hilly terrain and topography of the state poses limitations.

Figure 1: Location of Nagaland

Agriculture Scenario: The climate of Nagaland to a large extent is controlled by its undulating topographical terrain features. The year is divided into four season's *viz.*, winter (December-February), pre-monsoon (March-April), monsoon (May-September) and retreating monsoon (October-November). The average annual temperature ranges from 18-20°C to 23-25°C, respectively in the higher and lower elevation. Monsoon season is the longest lasting for five months from May to September with May, June and July being the wettest months. Owing to varied topography and relief annual rainfall varies from 1000 mm to over 3000 mm at different places with an average of 2000 mm. The principal crops include rice, corn, millets, pulses, tobacco, oilseeds, sugarcane, potatoes, and fibres. The current practice of agriculture is largely unsustainable owing to the traditional Jhum (Shifting cultivation) cycle mode of operation. Ninety percent of cereals and commercial crops are produced in the *Kharif* season in Nagaland. *Rabi* is the main season for pulses and oil seed production.

Horticulture Scenario: The agro-climatic conditions in Nagaland are quite

conducive for cultivation of various fruits, vegetables, plantation crops, flowers, and spices. Horticultural crops are cultivated by almost all rural households in Nagaland; however, it has typically been considered as a backyard activity since farmers' main focus remains on agriculture in general. Farmer prefers field crops over orchards because gestation period of horticultural crop cycles are longer than the agriculture. In Nagaland, the total horticultural crop area has been estimated at 33,274 ha (2011). The main fruit crops are pear, plum, peach, orange, lemon, pomelo, pomegranate, papaya, banana, guava, jack fruit, pineapple, cardamom and passion fruit. Farmers produce vegetables mainly for self-consumption, and as supplemental income generating activity. Principal vegetable grown in the state are cabbage, potato, beans, sweet potato, cauliflower, brinjal, chillies, bean, tomato, ginger, garlic, radish, onion, Naga cucumber, and leafy vegetables. Nagaland produces high quality tea in the hills and foot hill areas adjoining Assam state. At present, about 750 ha land is under tea cultivation. At present tea is produced mostly in Mokokchung and Mon districts but Wokha also has potential areas for producing tea. The state also has the potential to produce medicinal plants, which have essential oil bearing properties. The department has identified Citronella, Patchouli, Lemon grass, Geranium, Agar, and

Table 1: Land utilization pattern of Nagaland

Land Use	Area (in 000' ha)	Percentage
Total geographical area	1658	NA
Forests	873	54.31
Barren and uncultivable land	2.5	0.15
Permanent pastures and grazing lands	NA	NA
Land put on non-agriculture use	92.9	5.59
Land under misc. tree crops and groves	94	5.64
Culturable wasteland	69	4.18
Fallow lands other than current fallows	99	5.99
Current fallows	50	3.01
Net area sown	380	22.90

Source: Statistical Handbook of Nagaland, 2020; NA= Not Available

B. Agro-climatic zones of Nagaland

The state is classified into four agro climatic zones, namely High-Hills, Mid-hills, Low-Hills and Foot-Hills. These zones have distinct characteristics with regard to soils, crops, rainfall, and biodiversity. Description of major agro climatic zones and their characteristics were provided in Table 2.

Table 2: Description of major agro climatic zones and their characteristics

Agro climatic zones	Districts	Elevation (mMSL)	Temperature (°C)	Cropping systems crops grown	Important fruit/ plantation	Livestock
High-hills	Kiphire Kohima Longleng Mokokchung			Rice-Potato/ Vegetable;Rice/ Maize-Mustard Rice	Plum, Pear, Kiwi, Mango, Banana, Passion fruit,	Cattle, Buffalo, sheep, goat, pig, pony,
Mid-hills	Peren Phek Tuensang Tseminyu Wokha Zunheboto	800-1500	3-24 °C	Rice-Groundnut, Rice-Rice-Cowpea, Rice-Wheat-Rice, Rice-Pulses, Rice-Linseed	Apple, Cherry, Walnut, Chestnut, Pear, Plum, Kiwi, Peach Mango, Papaya, Banana, Citrus, Guava, Litchi	horse, mithun
Low-hills	Chumoukedima	<800	8 - 38 °C	Rice-Wheat + Mustard; Rice-Potato	Guava, Citrus, Banana, Litchi, Jack fruit, Coconut, Cashew nut	Cattle, Buffalo, sheep, goat, pig, pony, mithun
Foot-hills	Dimapur Mon Niuland			Rice-Potato; Rice-Vegetable	Pineapple, Mango Papaya, Guava, Citrus, Banana, Litchi, Jack fruit, Coconut, Cashew nut	

C. Interactive Workshop-IGFRI and State Department:

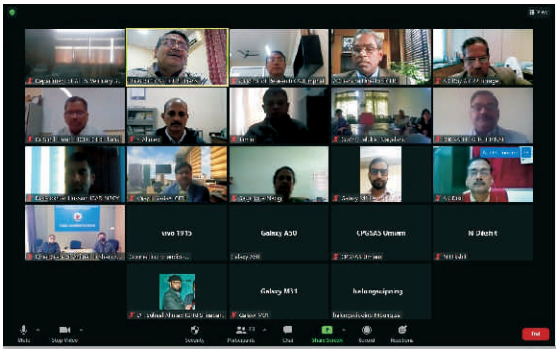


Figure 2: Interactive Workshop

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, Director of Research CAU, Deputy Directors of Veterinary & AH Department of Nagaland and other 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 Director mentioned the role of livestock in the rural economy and nutrition and the importance

of quality fodder. Director 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. Dr. A.K. Roy, Project Coordinator (FC&U), explained the status of fodder demand and supply in North Eastern 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, 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. Dr. Sunil Kumar, Head, Division of Crop Production presented the fodder plan of Nagaland. He mentioned the need for fodder plan, policies needed, topography, hill range, biological diversity, agro-climatic zones, livestock scenario, district-wise live stock population.

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

Livestock is considered as subsidiary income by most rural households in Nagaland. Along with agriculture, backyard pig and poultry rearing is integral to the livelihoods of farmers. Pig rearing in Nagaland is traditional and very common, provides additional income to households, and helps rural households to diversify their risks. The stocking rate of pigs in Nagaland ranges between 1-3 per household but some households from Dimapur district rear up to 15 pigs at a time. Pig rearing is easy since they are fed on by-products of paddy, maize, taro, vegetables and other gathered forages and is an excellent source of subsidiary income for the poor because of high local demand for pork. Dairying is not generally practiced by farmers except in some small pockets of Kohima and Dimapur districts, as in Nagaland, milk consumption is less. Rearing cows and mithun for meat is also a common traditional practice; however, they are allowed for free grazing and not stall-fed. The stocking rate of all forage species in a grazing area is, however, declining mainly because of increased management costs, lack of feed resources, increased risks due to disease and lack of market stimulus. The livestock sector growth rate of 6.63 percent in the state was, however, higher than NER (2.37) and India (3.51). The livestock population trends of Nagaland showed that the people are shifting mainly towards meat animals than for milk production. Very high growth rates were observed in ducks, followed by sheep, poultry, mithun, goat, cattle, pigs and buffalo.

Rearing of small ruminants, *viz.*, sheep and goat have good scope for the landless and marginal farmers as they are prolific and require low input. As per the 20th livestock Census (2019), there is about 552370 livestock population of which 76860 are cattle, 15650 buffaloes, 31600 goats, 360 sheep and 404690 are pigs (Table 3). As compared to previous livestock census of 2012, the present census 2019 showed a drastic decrease in livestock population by 39%. Total number of cattle declined from 234970 to 76860 and buffaloes declined from 32720 to 15650 as shown in the Table 3. The milk production is obtained mainly from cattle followed by buffaloes. Per capita milk availability is low in the state (81 g/day in 2018-19). Demand for animal source food in the region is increasing rapidly in the recent past. But at the same time production is not growing mainly because of constraints in feed and fodder production/availability. There is an acute deficiency of concentrates and green fodder in Nagaland, thus many farmers feed wild forages to their animals.

Table 3: Livestock scenario of Nagaland (Livestock population in thousands)

Species/Year	2012	2019	(+/-) %
Cattle - Crossbred	128.95	16.97	-86.84
Cattle - Indigenous	106.02	59.89	-43.51
Total Cattle	**234.97**	**76.86**	**-67.29**
Buffalo	32.72	15.65	-52.17
Total Cattle & Buffalo	**267.69**	**92.51**	**-65.44**
Sheep	3.83	0.36	-90.60
Goat	99.35	31.60	-68.19
Horse / Pony	0.47	70	14793.62
Pig	503.69	404.69	-19.65
Mithun	34.87	23.12	-33.70
Total Livestock	**911.16**	**552.37**	**-39.38**
Poultry	2178.47	2838.94	30.32

(Source: 20th Livestock census)

E. Fodder Scenario

The productivity of livestock is mainly dependent on green and dry fodder, but the state has a shortage of green fodder as shown in the Table 4. Though state is surplus in dry fodder (due to excess availability of crop residues), green fodder is lacking to the tune of about 60%, causing a serious deficit in animal production. The fodder crops are the cheapest source of nutrients for livestock. The land under grazing lands/permanent pastures is not well managed. Most of the grazing lands have either been degraded or encroached upon restricting its availability for grazing. Maize and some wild grasses are

source of green fodder. Good quality grass/fodder helps in increased production of milk and meat at a cheaper rate. The cultivation of quality grass/fodder is rare and the quantity fodder produced is also inadequate. Because, the smaller land holdings are devoted to cultivation of food crops on first priority and the cultivation of fodder gets lower priority. Looking at the vast gap between the demand and supply position of fodder, it becomes necessary to put adequate efforts to transfer the potential technologies developed by various research organizations of the state and country to farmer's field in order to increase the production and productivity of good quality fodder. Therefore, there is an urgent need of development of fodder security plan for round the year feed and fodder supply in different agro-climatic zones of the state.

Table 4: Estimated fodder demand-supply scenario (million tonnes) for the year 2018

Attributes	India	Nagaland
Fodder demand (MT)		
Green fodder	850.9	0.62
Dry fodder	530.2	0.39
Fodder supply (MT)		
Green fodder	577.3	0.25
Dry fodder	471.9	1.06
Deficit (%)		
Green fodder	32.15	59.67
Dry fodder	10.99	Surplus

(Note: 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)

Potential forage genetic resources

Major forage sources

- Pasture and grasslands are the major source of fodder in hilly region of the state.
- Fodder trees are second most important sources in the hills.
- Perennial grasses: BxN hybrid, Setaria, Guinea grass in lower hills
- Cultivated fodder: *Kharif* season: Maize, Millets, Cowpea as sole crop.
  Rabi season: Berseem, Forage Sarson, Oat, Buck wheat, as sole / mixed.
  Summer season: Maize, Cowpea as sole/mixed crop.

Major sources of crop residues

- Cereals: Rice, wheat, maize top and small millets (Finger millet, Barnyard millet and Proso millet).
- Pulses: Soybean, urd, moong, cowpea and rice bean

Other vegetation

Tree leaves, edible varieties of shrubs, herbaceous weed and epiphytic ferns are covered under this class of vegetation. Tree leaves mostly contains 8-28 % CP, 10-30 % CF and 3-17 % ash. Common genera of fodder trees and shrubs found in Nagaland are *Thumbergia, Phologacanthus, Leera, Senecie, Chloranthus, Phylanthus, Macaranga, Gleichemia (Fern), Listea and Lindera, Desmodium, Muccanum, Dalbergia, Milleta, Indigofera, Erythrina, Butea, Crotolaria and Derris, Ficus, Artocarpus, Wendlandia, Moringa, Peederia, Eurya, Camellia, Boehmeria, Hedichium*.

Constraints for availability of quality green fodder

Availability of adequate quantity of feed and fodder for livestock is essential for improving the livestock productivity. Use of traditional cultivation practice is one of the cause of low production and availability of green fodder. Secondly, quality seed and planting material is also not available timely. The number of livestock is growing rapidly, but 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 its availability for grazing. There are vast forest lands where animals are not 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 seeds is a major constraint. Fodder seed production is not remunerative in many of the fodder crops.

SWOT analysis of fodder development in Nagaland

Strengths:

- The farmers of the state are well known for rearing of different kinds of livestock like cattle, sheep, goat, pigs, mithun and poultry *etc.*, for livelihood security, draught, milk and meat purpose.
- Fertile soils and sufficient rainfall
- Diversification in cattle population
- Greater diversity of native grasses and fodder trees
- Pig farming is highly valued practice in terms of its demand and profitability.
- Surplus fodder during monsoon
- Organic agriculture practices are popular

Weakness:

- Very limited area under cultivation, so fodder area is very less.
- Milk consumption is not much in practice.
- 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.
- Dominance of marginal and small land holding farmers.
- Forest lands are not available for grazing

Opportunities:

- Conversion of surplus dry fodder into their value addition/quality improvement.
- 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/grazing 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.

Threats:

- Declining trend in livestock population due to uneconomic production systems
- Lean period of forage availability to enhance the performance of cross breeds.
- Soil erosion and natural calamities.
- 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, a 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 needs to be promoted and popularized. Likewise, the holistic approach of integrated resource management will have to be based on maintaining the fragile balance between productivity functions and conservation practices for ecological sustainability. Forage production must be taken up as a first management goal and at least 25% of the permanent pasture area should be put under fodder trees with improved grasses with regulated accessibility to the farmers. It is suggested to grow forage grasses and fodder trees along village roads and panchayat lands, and on terrace risers/bunds a non-competitive land use system. Use of participatory techniques to identify the problems and to carry out the improvement programs along with in-depth studies on migratory grazers, forage based agro-forestry systems and controlled grazing to maintain the productivity of pasture (grazing should be allowed as per carrying capacity) are some of the other solutions to this problem.

Details of different interventions are as under:

A. Cultivated fodder resources

Fodder cultivation is taken on very less area and due to this there is a vast gap between demand and supply of green fodder. Hence it should be planned to bring at least 5% of the cultivated area under fodder crops. The net sown area of Nagaland is reported 3.80 lakh hectare, thus 5% area comes to 0.19 lakh ha. There is number of fodder crops suitable under different agro-climatic conditions of the state. There is large basket of perennial grasses, range legumes, cultivated forage cereals and legumes, suitable to be grown and needs to be adopted by villagers, communities and individual livestock keeper.

The crops like Bajra Napier (BN) hybrid, guinea grass, sorghum, maize, oat, cowpea, guar, *etc.* are suitable for irrigated and arable land conditions whereas crops like anjan grass, *stylosanthes*, setaria, guinea grass *etc.,* are suitable for rainfed and non-arable land conditions. Crops like BN hybrid, guinea grass, *etc.*, being perennial in nature, once planted will be able to provide fodder for 3-4 years and won't need frequent sowing and investment on seed cost and land preparation and also with the inclusion of leguminous fodder in inter row space of perennial grasses, they can supply round the year green fodder. In view of stiff competition with food & other commercial crops,

forage varieties with tolerance in drought/water scarcity situations holds promise and can fit well in existing farming systems.

These varieties can be very well adopted and promoted in suitable agro-climatic zones of the state. Fodder production requires identification of suitable fodder crops, varieties and production technologies depending on the agro-climatic conditions and needs of livestock keepers. In case of perennial fodder crops propagated through stem cuttings or roots, micro-nurseries may be developed in each block with 40000 rooted slips/ha and in 5 ha in each districts, in 2 year time there will be sufficient planting material for whole state. Likewise, the seed should be multiplied at each block to get sufficient seed for whole state in 2 years. The important fodder crops and varieties have been presented in Table 5.

Table 5: Zone wise forage crop, their varieties and productivity for Nagaland

Sl.No.	Agro climatic zones	Crops	Variety	Green forage yield (q/ha)
1	High and Mid hills (Kiphire Kohima Longleng Mokokchung Peren Phek Tuensang Tseminyu Wokha Zunheboto)	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)
		White clover	PC-1	
		Dactylis grass	Local material	350-500 (3-4 cuts)
		Bromus	Local material	700-800 (3-4 cuts)
2	Foot and Low hills (Chumoukedima Dimapur Mon Niuland)	Guinea grass	Hamil, PGG-3,	800-900 (5-6 cuts)
			PGG -9, BG-2, BG-4	400-600 (2-3 cuts)
		Brachiaria brizantha	Local material	
		Seteria	Kazungula, Nandi, Narak, PSS-1	800-900 (3-4 cuts)
		BN hybrid	IGFRI-6, CO-2, CO-3, CO-4, CO-5, BN-21	900-1200 (4-5 cuts)
		Lathyrus	Nirmal, Madhuri	120-150
		Dinanath	Bundel Dinanath-1	500-600 (2 cuts)
		Oat	JHO-822, Sabzar, RO-19, Bundel Jai-2004	300-350
		Cowpea	UPC-4200, EC 4216, BL-1, BL-2	250-300
		Rice bean	Shyamalima, KRB-3	200-250
		Congo signal grass	Selection	500-600 (3-4 cuts)

(Adapted from: Sharma and Neog, 2015)

Round the year fodder production system: Intensive forage production systems are tailored with an objective of achieving high yield of green nutritious forage and maintaining soil fertility. Overlapping cropping system that comprises of raising legume, 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.

Figure 3: Round the year forage production systems

Table 6: Crop diversification and promising intercropping system under irrigated condition in Nagaland

Sl.No.	Agro climatic situation	Cropping system	Green fodder yield (t/ha)
1.	Foothills	Rice - Maize- Maize + Cowpea	90-100
		Maize (Baby corn) -Oats - Maize (Baby corn)	90-110
2	Lower hills	Maize + Cowpea -Oat + Fodder Mustard - Sorghum + Cowpea	90-120
		B N Hybrid + (Cowpea- Oats) - Cowpea	120-140
3	Mid hills	Orchard grass+ Red clover/White clover	55-65
		Tall fescue+ Red clover/White clover	60-70

4	High hills	Horti-pasture system	
		• Plum/Litchi/Peach + Guinea/Setaria + *S. hamata*	
		• Peach/Plum/Apricot + Rye grass/ Tall fescue+ White clover	
		• Apple/Apricot/Peach+ Tall fescue/ Orchard grass + White/Red Clover	55-65
		• Silvi-pasture system	
		• Grewia/Bauhinia/Melia + Setaria/ Chrysopogon + *S. hamata*	
		• Ulmus/Robinia/Salix + Tall fescue/ Orchard grass + Cloves	60-70

B. Fodder production in fruit orchards through horti-pasture

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 fuel wood through utilizing moderately degraded land (Table 7). Citrus, guava, mango and apple *etc.*, based horti-pasture systems have been developed for higher forage productivity.

Figure 4: Intercropping of grasses/legumes in apple orchards

C. Fodder production from silvi-pasture/permanent pasture/grazing lands

The arable farming on degraded land in the state is difficult due to soil and moisture constraint. There are various Alternate Land Use (ALU) systems which provide fodder such as silvi-pasture (tree + pasture), horti-pasture (fruit trees + pasture) and agri-horti-silvipasture (crop + fruit trees + MPTS + pasture). Many multipurpose tree species (MPTS)/shrubs growing in ALU systems are useful as leaf fodder used for animal feed besides wood. These activities contribute significantly to domestic livestock production, which in turn influences milk and meat supply and contributes to household income. Grazing animals with MPTS trees provide not only nutritious fodder but shelter to the animals during bright and hot sunny days.

Table 7. Suitable grasses for fodder production under fruit orchard in Nagaland

Zones	Horticulture trees	Grasses
Foothills and Lower hills	Mango, Papaya, Guava, Citrus, Litchi, Jack fruit, Coconut, Cashew nut	**Grass:** Guinea grass, *Brachiaria brizantha*, Bajra x Napier Hybrid, Setaria anceps (var. S-18 Perennial), *Paspalum notatum*, *Dicanthium annulatum, Chrysopogon fulvus* **Legume:** *Stylosanthus hamata, Stylosanthus scabra,* Siratro (*Macroptilium atropurpureum*), *Macrotyloma axillare* (Dolichos), *Neonotonia wightii*
Mid and High hills	Plum, Pear, Kiwi, Mango, Banana, Passion fruit, Apple, Cherry, Walnut, Chestnut, Pear, Plum, Kiwi, Peach	**Grasses:** Perennial rye grass (*Lolium perenne*), tall fescue (*Festuca arundinacea*) Setaria grass (*Setaria anceps*), Anjan grass (*Cenchrus ciliaris*), Paspalum spp, *Dactylis glomerata* **Legumes:** White Clover (*Trifolium repens*), *Stylosanthus hamata, Neonotonia wightii*

Table 8. Fodder production potential under fruit orchard in Nagaland

Fruits	Area (ha)	Targeting 25 % orchards for fodder production Area (ha)	Enhanced green fodder availability tonne (range)	Enhanced dry fodder availability tonne (range)
Lemon	869	217	4340-6510	1085-2170
Apple	1821	455	9100-13650	2275-4550
Orange	5865	1466	29320-43980	7330-14660
Lemon	850	212	4240-6360	1060-2120
Plum	985	246	4920-7380	1230-2460
Gauva	553	138	2760-4140	690-1380
Mango	585	146	2920-4380	730-1460
Passion fruit	6783	1695	33900-50850	8475-16950

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

Source: Directorate of Horticulture 2016-2017

Horti-pasture systems developed at ICAR-IGFRI have good production potential of forage from 6.5-12t DM/ha on degraded land of rainfed areas. Horti-pasture systems can serve the purposes of forage, fruit and fuel wood and ecosystem conservation along with arresting the soil loss and conserve moisture. After a long rotation, it improves the soil fertility and microbial activities. This system supports 2-4 ACU / year.

Table 9: Suitable trees and grasses for silvipasture establishment under various climatic zones of Nagaland

Zone	Trees	Grasses
Lower hills and mid hills	*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	*Ulmus wallichiana, Salix alba, Morus serrata, Morus alba, Bauhinia variegata*	*Chrysopogon montanus, Lolium multiflorum, Festuca arundinacea, Dactylis glomerata, Phleum alpinum, Stipa* spp., *Chrysopogon gryllus*

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 Nagaland, 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 the 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.

E. Alternative fodder resources

There is a need for exploring the alternative or non-conventional fodder resources such as fodder beet, lathyrus, fodder sugarcane, moringa, azolla, hydroponics grown fodder. Azolla and hydroponics grown fodder could be an ideal source of fodder and required lesser land area but they are labour intensive activities and less remurative. These could a better option when the house-hold labourer is involving in production of fodder and animal feed. However, these can be supplementary in nature and cannot be substituted with the traditional fodder production methods.

(i) Moringa source of quality protein

Moringa is a good alternative for substituting commercial rations for livestock. The relative ease with which moringa can be propagated through both sexual and asexual means. The management of this crop can be grown even under poor soils. It can be grown as crop or tree fences in alley cropping systems, in agro-forestry systems and

even on marginal lands with high temperatures and low water availabilities where it is difficult to cultivate other agricultural crops. Its high nutritional quality and better biomass production, especially in dry periods, support its significance as livestock fodder. Moringa planted at ICAR-IGFRI, Jhansi with 50x50 cm spacing produced 80-130 tonnes of green forage/ha in 4 cuts at 45 days harvest intervals in 2nd year of planting. Moringa leaves contain 21.53 % crude protein (CP), 24.07 % acid detergent fiber (ADF) and 17.55 % neutral detergent fiber (NDF).

Figure 5: Moringa plantation for leaf meal production

(ii) Azolla as an alternate fodder

Azolla farming, in general, is inexpensive and it can be multiplied in natural water bodies for biomass production (Figure). Biomass productivity is dependent on time and relative growth rate and efficiency of the species. Azolla is a highly productive plant.

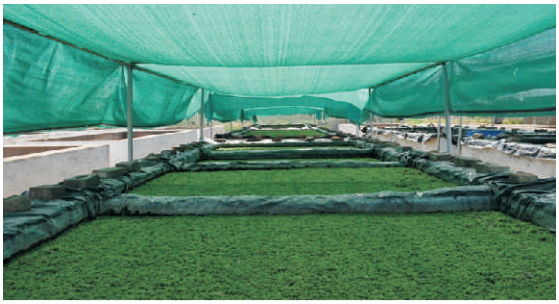


Figure 6: Azolla production unit at ICAR-IGFRI, Jhansi

It doubles its biomass in 3–10 days, depending on conditions and it can yield up to 37.8 tonnes fresh weight/ha (2.78 t DM/ha dry weight). Azolla is very rich in proteins, essential amino acids, vitamins (vitamin A, vitamin B12, Beta Carotene), and minerals including calcium, phosphorous, potassium, ferrous, copper, magnesium. On a dry weight basis, Azolla has 25-35% protein, 10-15% mineral content, and 7-10% comprising a combination of amino acids, bio-active substances and biopolymers. During lean/ drought period it provides sufficient quantity of nutrients and acts as a feed resource.

(iii) Hydroponic rapid fodder production

Hydroponics is science of soil-less growing of plants in nutrient rich solutions at regulated temperature and humidity. Hydroponic growing systems produce a greater yield over a shorter period of time in a smaller area than traditionally grown crops. Hydroponic fodder systems are usually used to sprout cereal grains, such as barley, oats, wheat, sorghum, and corn, or legumes, such as

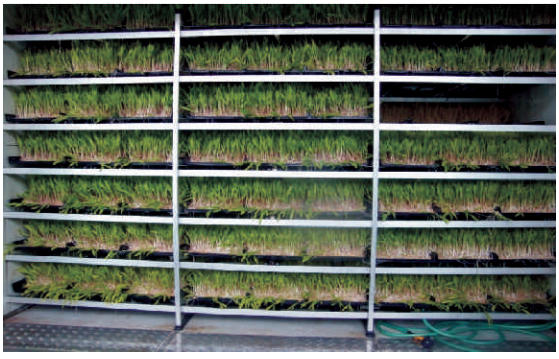


Figure 7: Hydroponics fodder production unit

alfalfa, clover, or cowpea. It may fit for those producers who do not have local sources for forage. HPF may offer a ready source of palatable feed for small animal producers (poultry, piggery, goat. rabbits). Hydroponic system consists of a framework of shelves on which metal or plastic trays are stacked as shown in Figure.

After soaking overnight, a layer of seeds is spread over the base of the trays. During the growing period, the seeds are kept moist, but not saturated. They are supplied with moisture and nutrients, usually via drip or spray irrigation. Seeds will usually sprout within 24 hours and in 5 to 8 days have produced a 6 to 8 inch high grass mat. Peri-urban small farms, landless animal farms and steep hill farms having no agricultural land but possess small pig, poultry and/or cow units can benefit from either of the two or combining the hydroponic fodder-cum-sprouted grain technologies. Hydroponic fodder cannot substitute green fodder and hay completely, as it lacks in fibre content. But it is definitely a better substitute for packaged feeds.

(iv) Sugar beet/Fodder beet

Fodder beet is an important energy supplement for both small and large categories of animals. 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 and duration 140-150 days. It can be very good energy supplement to large pig population of Nagaland.

Figure 8: Sugarbeet as fodder

F. Crop residue quality enhancement

The paddy, sorghum, maize, chickpea, urd, sugarcane, potato, *etc.*, are important crops of the Nagaland state in paddy straw and other cereal crops are major source of dry fodder in the state. The paddy straw is low in protein content, low in palatability, digestibility and incapable to support even maintenance requirement of the adult ruminants, if fed as such. Urea treatment offers an opportunity to transform crop residues of poor quality into a valuable feed resource by refining it for rapid adoption at farmer's level for greater economic reward. Urea treatment of straw increases its N content resulting into enhanced microbial activity and ruminal digestion of the straw. In addition, urea treatment also exerts its effect on lingo-cellulose complex, wherein the lignin forms the complex with cellulose, thus preventing its microbial digestion. Urea also acts as preservative and application of urea solution on the straw and subsequent storage of treated straw would

ensure the proper unspoiled storage. The use of a cheap source of nitrogen such as urea to improve the nitrogen content of such roughages makes a promising alternative to improve the nutritive value of straw. Further spray of salt and mineral mixtures will also enhance the palatability and nutritive value of dry fodders.

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

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

Figure 9: Urea treatment baler

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

Figure 10: Cover and plinth storage of dry fodder

(ii) 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 Nagaland. However, its success will depend on surplus forage production, unreliable rainfall pattern, labourers (for cutting, raking, collecting, chopping, pit construction and cleaning, ensiling) and materials (polythene, molasses). Several green crops and grasses may be used for silage

making *viz.*, maize, sorghum, BN hybrid grass, guinea grass, setaria, pineapple stover, sugar cane top *etc.*

Chaffing of forage for ensiling

Trench silo

Silage preparation in plastic bags

Stack of the silage

Figure 11: Different methods of silage making

Figure 12: Silage from different range grasses developed by IGFRI, Jhansi

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

(iv) Leaf meal production and utilization: Crop residues, straw and dry grasses form the basal roughage for feeding to livestock which are poor in quality being deficient in protein, available energy and minerals. Green fodder is not available throughout the year. Leaf meal made from leaves of legume crops/trees/shrubs are rich in protein, essential amino acids, beta carotene, minerals and could act as a replacer of feed concentrate for livestock to save the valuable feed grain and for providing nutritious diet to the livestock throughout the year. Important legume trees/shrubs which grows naturally and can be used for leaf meal production includes *Leucaena leucocephala, Glyricedia sepium, Sesbania grandiflora and Moriga oleifera* which are rich in crude protein (12-26%). Leguminous crops other than fodder tree leaves, which are also equally important for making leaf meal are *Stylosanthes* (14-16% CP), Lucerne (18-20% CP) and have commercial potentials for making leaf meal. Technology for leaf meal preparation has been developed in the IGFRI, Jhansi. Farmers can learn the technique of leaf meal preparation, storage and utilization through training programmes and demonstrations.

Figure 13: Technology for leaf meal preparation developed at IGFRI, Jhansi

H. Contingency fodder planning

The State of Nagaland is very vulnerable to natural calamities considering that it falls under the Seismic Zone and records one of the highest annual rainfalls in the country. Every year a noticeable number of people are affected by natural disasters among which landslides, floods and river bank erosion are most frequent. A strategic framework of management of fodder is given in Table 10.

Table 10: Contingent planning for fodder in Nagaland

Period	Contingent measures	
	Fodder based	Feed & other sources
Drought / lean period (October-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	• Molasses, rice bran, oil cake • Tapioca waste, pineapple waste, maize bran & kitchen waste *etc.*
Floods/Heavy rains	• Top feed (fodder trees/bushes) • Silage • Support from fodder bank (community based)	• 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 and availability for cultivation of fodder crops

Quality fodder production depends on the availability of superior 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 at least by 5% (19000 ha) of the net cultivated area (380,000 ha). The seed requirement of different fodder crops for this 5% area is presented in Table 11.

Table 11: Seed requirement for the 5% (19000 ha) of the net cultivated area (380,000 ha) of Nagaland

Sl. No.	Crop	Area under each crop (ha)	Seed rate (kg/ha)	Seed requirement (Quintal)	Source of seed
Kharif					
1	Fodder maize	2850 (15%)	50-60	1425-1710	IGFRI, Jhansi CAU, Imphal AAU, Jorhat RSFPD, Kalyani
2	Rice bean	2280 (12%)	25-30	570-684	RSFPD, Kalyani
3	Cowpea	2850 (15%)	40-45	1140-1282.5	RSFPD, Kalyani
4	Deenanath grass	2090 (11%)	3-4	62.7-83.60	IGFRI, Jhansi

Rabi					
5	Berseem	4750 (25%)	25	1187.5	IGFRI, Jhansi
6	Oat	5320 (28%)	100	5320	IGFRI, Jhansi
Perennial					
7	*Stylosanthes* spp.	950 (5%)	5-6	47.5-57.0	IGFRI, Jhansi
8	BN hybrid	2280 (12%)	40,000 root slips	9.12 crore root slips	IGFRI, Jhansi CAU, Imphal
9	Guinea grass	950 (5%)	4-5	38 - 47.5	IGFRI, Jhansi
10	Setaria	1900 (10%)	5	95.0	CAU, Imphal AAU, Jorhat ICAR-RC NEH, Kolasib
11	Congo signal grass	2850 (15%)	2-4	57 - 114	CAU, Imphal AAU, Jorhat ICAR-RC NEH, Kolasib

J. Zone wise summarized fodder intervention

The zone-wise details are summarized in below table.

Table 12: Summary of different fodder intervention for sustainable livestock production in four agro-climatic zones of Nagaland

Agro climatic zones	Fodder interventions
High hills	• Tall fescue, Dactylis, *Lolium perenne, Bromus*, white clover, red clover • Azolla, moringa leaves, silkworm pupae meal • Grasses and trees/shrubs -silvipasture and rejuvenation of grazing lands/pasture • Fodder seed village/community seed or planting material bank
Mid hills	• Bromus, white clover, red clover • Rice straw based complete feed blocks (CFB) • Grasses and trees/shrubs - silvipasture and rejuvenation of grazing lands/pasture • Fodder seed village/community seed or planting material bank •
Low hills	• Fodder maize, oat, cowpea, BN Hybrid • Rice straw based complete feed blocks (CFB) • Grasses and trees/shrubs - silvipasture and rejuvenation of grazing lands/pasture • Fodder seed village/community seed or planting material bank

Foot hills	• Fodder maize, oat, cowpea, BN Hybrid, Deenanath, *Brachiaria brizantha, Dicanthium annulatum, Chrysopogon fulvus* • *Stylosanthes hamata, Stylosanthes scabra, Macrotyloma axillare* (Dolichos), rice bean • Grasses and trees/shrubs-silvipasture and rejuvenation of grazing lands/pasture • Fodder seed village/community seed or planting material bank

Table 13: 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

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

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

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

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

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

iv. Providing package of practices for fodder crops

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

v. Master trainers training at IGFRI/SAUs/CAUs

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

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

There are 11 Krishi Vigyan Kendras (KVKs) are operating in the state of Nagaland will be roped in to identify the needy farmers for training on fodder crops. Other stake holders like Milk Co-operatives, Non-Governmental Agencies (NGOs) and progressive farmers will also be made partners in the process of creating awareness about fodder production.

vii. Conduction of frontline demonstration and training

After bench mark survey and identification of suitable places for propagating awareness about the fodder crops, sufficient number of front line demonstrations in each of the selected block will be conducted in the farmers' field to make them aware of the fodder production potential and motivate them to go for cultivation of fodder as per the needs. In addition, tailor made training programmes will be organized through KVKs for the benefit of the interested farmers on the topics of their interest in fodder crop production, livestock production and dairying.

viii. Strengthening of forage seed production chain

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

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

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

x. Enhance acreage and productivity in non-conventional areas

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

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

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

In many areas in spite of having a large chuck of crop wastes having fodder value, it cannot be used due to faulty agricultural practices or lack foresight and or lack of machinery *etc.* For example a large area of paddy cultivated in Nagaland do not necessarily result in good quality paddy straw as dry fodder owing to incessant rains during harvest, lack of proper farm machinery, lack of awareness among

farmers to conserve paddy straw *etc.* Hence, conservation of fodder resources wherever possible for future use during lean periods and at time of natural calamities like famine, high rainfall *etc.* will be highlighted. Further, as fodder is bulky in nature accounting for huge expenditure in transportation, bale making of dry fodders, silage in polybags of convenient sizes for transportation will be promoted and popularized among the livestock holders.

xii. Establishment of fodder banks

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

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

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

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

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

xv. Impact analysis of technology adoption

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

Part-IV : Road Map

This project is conceived to be multi-task, multi-partner and multi-year activity. Hence a proper road map is necessary for making it more practical and result oriented one. The following road map has been proposed under this project. There are several actions points to be carried out in the process of implementation by several agencies (Table 14).

Table 14. 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 /CAUs
2	Foundation seed production	RFS /SAHD
3	Production of TFL/certified seeds	SAUs/CAUs/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/ CAUs
8	Capacity building of stake holders	ICAR-IGFRI/CAUs

Part-V : Implementation of Pilot Programme

Pilot project is proposed to be implemented in the selected areas to assess the acceptability and impact of technology and also refinement in technology and methodologies, if required. Pilot project is proposed to be implemented in selected villages of identified districts of each agro-climatic zone (4). The districts were to be selected/identified on the basis of dry matter requirement and availability in different agro-climatic zones of Nagaland *viz.*, Dimapur, Kohima, Mon and Wokha.

The detailed plan for implementation of pilot project is presented in the Table 15.

Table 15. Implementation level plan for pilot project

S.No.	Activity	Action points
1	Target area selection	• Selection of 2 districts • Selection of 2 cluster of 5 villages in each district total 4 clusters for 2 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 in 2 batches at IGFRI, Jhansi • Training of farmers; 10 from each village; 200 farmers in first year (4 training program for farmers of each cluster) • Exposure visit of progressive farmers and master trainers at IGFRI, Jhansi
3	Technology Demonstrations	• Selection of crop and varieties will be done after identifying suitable districts and village clusters both under annual and perennial crops for different seasons *viz.*, *kharif*, *rabi* and *zaid* • Silage should be encouraged • Since crop residue being a precious commodity, fodder banks using densification technologies can be developed • Annual fodder crops • Perennial fodder crops

4	Suitable silvi-pasture/ horti-pasture system demonstrations	• In existing Orchard- 1 ha (Guinea, Setaria, Congo Signal grass) • In new Orchard - 1 ha (Guinea, Setaria, Congo Signal grass) **Popular and potential fodder trees:** Calliandra, Erythrina, Gliricidia, Sesbania Moringa can be a potential source of legume fodder in upland areas and may be explored
5	Need based Watershed/ micro irrigation facility development	• Suitable fodder species *viz.*, grazing guinea, signal grass, etc to check soil and water erosion and enhancing water retention will be highlighted.
6	Rejuvenation of grasslands/ pasturelands/ CPRs	• The related activities will be taken up during post rainy season /with first *rabi* rains
7	Tapping rice fallow and other fallow areas for fodder production	• Suitable annual fodder crops *viz.*, fodder cowpea, oats *etc.* will be grown on residual moisture to ensure fodder supply during the period
8	Input supply	• Inputs *viz.*, seeds/ rooted slips/, fertilizers, insecticides etc, small machinery and tools - improved sickles *etc.* will be supplied to farmers
9	Custom hiring centre in each village cluster	• Exploring and facilitating the farmers with chaff cutter, Bhusa urea enriching machinery, baling of paddy straw, dry fodder etc, complete feed block making machine, regular farm implements including tractors, harrow, seed drill *etc.*

Funding arrangements

Govt. of Nagaland, Govt. of India through various state and central schemes like RKVY, NLM, NDDB *etc.* can meet the fund requirement. ICAR- IGFRI will provide technical support for formulation of such fodder development proposals for funding. The budget requirement for the implementation of pilot project is presented in Table 16.

Table 16. Approximate budget requirement for the implementation of pilot programme.

Agro-climatic zone	Name of intervention	Unit size/ number	Cost per unit (Rs)	No. of farm families selected	Total quantity/ number	Total cost (Rs)
High 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
Low hills	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
Foot hills	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
Mid hills	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					**1,18,50,000**

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 Nagaland. 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 Nagaland along with KVKs, NGOs, Milk Federation *etc.* will implement the programme at field and farmers level.

Annexure-I

Proceedings and recommendations of the Interactive workshop

The one day workshop was organized on 8th December 2021 through virtual mode for discussing the status of fodder production, conservation and utilization for the six north eastern states of India. At the outset, Dr. Purushottam Sharma, Head, Division of Social Sciences & In-charge ATIC, ICAR-IGFRI Jhansi welcomed the dignitaries of six North Eastern States viz. Dr. Basant Singh, Director of Research, CAU, Imphal, Manipur; Director, Department of Animal Husbandry & Veterinary Sciences, Nagaland, Dr. A.K. Roy, PCFC, AICRP (FC & U), Dr. Amaresh Chandra, Director, ICAR-IGFRI, Head of Divisions and Officer-in-charges of Regional Stations, S. Acharya, Tripura; Mukhtar Hussain, ICAR- NRC Yak, Dr. Dinamani Medhi, Principal Scientist, Animal Nutrition, Dr. Subramanyam, Nagaland and other participants. Dr. Sharma highlighted the NIAFTA programme undertaken by the Institute and mentioned the objectives of the workshop and informed that so far 16 meetings were organized and 11 fodder plans were published. During the workshop, fodder plan of six north eastern states deliberated threadbare. Important points emerged during the discussions are mentioned.

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

Dr. A.K. Roy, PCFC (FC &U) mentioned fodder scenario of North eastern states and emphasized the need of regional planning as <1.0% land is available for fodder cultivation. Farming community has crop livestock interactions, subsistent livelihood

economy and not commercially oriented. Highlighted that technology is available especially the important forage crops suitable for NEH, production technologies available for oat, maize, rice bean, cowpea and sorghum. Dr. Roy mentioned about food-fodder intercropping system, integrated nutrient management, irrigation management, cutting and nutrient management, sequence cropping, crop varieties, non conventional forage, improving digestibility and nutrition of crop residues. Key steps for establishment of good pasture, rejuvenation of degraded pasture lands, extension technologies, on-line resources and need of quality and quantity of fodder especially in lean period were highlighted. Dr. P. Sharma, thanked Dr. Roy for overview of the fodder plan.

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

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

Dr Sunil Tiwari, Head, Division of Crop production presented the fodder plan of Nagaland. Welcome the Director of Research, CAU, Deputy Directors Veterinary and AH and departments. Mentioned need for fodder plan, policies needed, topography, hill range, biological diversity, agro-climatic zones, livestock scenario, district-wise live stock population. Show case models selected, estimated fodder demand and supply, scenario for the year 2018, constraints for availability of green fodder, strategies for enhancing fodder resources. Highlighted that models are available for different technologies, training for masters, trainers, training for farmers and stake holder. Crop varieties, suitable grasses for fodder production under fruit orchard in Nagaland, alternate fodder resources, feed for pig and Mithun were highlighted. Mentioned need

of tapioca and sugar beet, contingent planning zone-wise fodder intervention for low hills, high hills, foot hills and plain areas. Mentioned the crisis of seed every year and suggested that fodder seed village, community seed or planting material bank be created to help solve the crisis. Road map for the implementation of the proposed activities through the pilot project, aspirational districts i.e in Dimapur, Kohima, Mon and Wokha etc.

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

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

Annexure-II

List of participants in Interactive workshop (8th December, 2021)

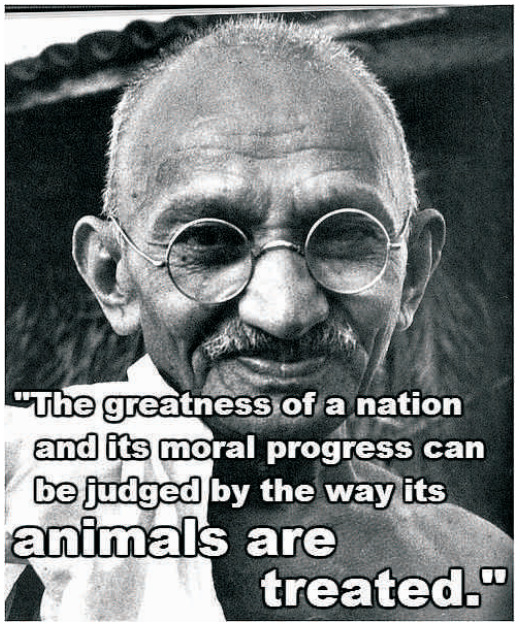
1. Dr. Amaresh Chandra, Director, ICAR-IGFRI, Jhansi
2. Dr. S. Basanta Singh, Director-Instructions, CAU, Imphal
3. Dr. Anil Kumar Tripathi, Director, ICAR-ATARI, Guwahati
4. Directorate of AH & Veterinary Services, Nagaland
5. Directorate of AH & Veterinary Services, Sikkim
6. Directorate of AH & Veterinary 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. Mahesh 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

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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