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Glimpses of Forage Technology Demonstration Activities

आज़ादी का अमृत महोत्सव

All India Coordinated Research Project on Forage Crops & Utilization

(Indian Council of Agricultural Research)
ICAR-IGFRI, Jhansi-284 003 (U.P.)
website: http://www.aicrponforagecrops.res.in

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अखिल भारतीय समन्वयित अनुसंधान परियोजना
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Message

The Forage Technology Demonstrations (FTDs) provide an opportunity to researchers and extension personnel for understanding the farmer's resources and requirement to fine tune and/or modify the technologies for easy adaptability at farmers' fields. The FTDs acts as direct interface between researcher and farmers as the scientists are directly involved in planning, execution and monitoring of the demonstrations for the technologies developed by them and get direct feedback from the farmers' field about the crops in general and technology being demonstrated in particular.

I am happy to know that ICAR-All India Coordinated Research Project on Forage Crops and Utilization (AICRP on FC&U) on the occasion of its Golden Jubilee Year has come up with a compilation entitled "Glimpses of Forage Technology Demonstration activities". The document includes details of demonstrations, reason behind selection of farmers/ village/ area; ways to contact and convince farmers about forage technologies, inputs, technical guidance, benefit accrued to farmers, impact, response of farmers, feedback etc.

I am sure that this document will benefit scientists, policy planners, extension workers and all other involved in enhancing forage resources in the country.

I extend my heartiest congratulations to Dr. A.K. Roy, Project Coordinator, AICRP on FC&U and his team for preparing this important document.

(T.R. Sharma)

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ICAR-Indian Grassland and Fodder Research Institute

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निदेशक
Dr. Amaresh Chandra FNAAS
Director

Foreword

Forage Technology Demonstration (FTD) is a most appropriate approach to demonstrate the production potential of newly released varieties and technologies to the farmers. It also paves the way of interacting and solving the issues of stakeholders related to fodder production. The researchers can directly showcase their technology at the farmer's field. This helps in the adoption of new technologies by farmers thereby increase in farm income.

I am happy to know that ICAR-All India Coordinated Research Project on Forage crops and utilization on the occasion of its Golden Jubilee Year has come up with a compilation entitled "Glimpses of Forage Technology Demonstration Activities". The document includes details of FTDs conducted by different AICRP on Forage crops and utilization centers in their respective states.

I am sure that this compilation will benefit policy planners, extension workers and all other involved in conducting FTDs in forage crops in the country.

(Amaresh Chandra)

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PREFACE

The focus of On-farm demonstrations in last century has shifted from introducing farmers to innovation to share experiences to support knowledge co-creation between researcher and farmers. A field demonstration is usually established by researchers or extension workers preferably in collaboration with farmers to validate and demonstrate new technologies to make them aware of new possibilities. Thus, Forage Technology Demonstrations (FTDs) provide an opportunity to researchers and extension personnel for understanding the farmer's resources and requirement to fine tune and/or modify the technologies for easy adaptability at farmers' fields. Under the component, the field demonstrations on different forage crops are planned to conduct on farmers fields in different agro-climatic conditions by forage scientists. FTDs programme helps by providing quality seed material of elite cultivars of fodder crops, increase fodder availability in rural and dairy catchment area and increase milk production by supplementing fodder and thereby ensuring employment generation in rural areas. All India Coordinated Research Project on Forage Crops and Utilization had played vital role in providing all assistance with respect to fodder technology demonstration such as free distribution of seeds/planting materials, fodder awareness programmes to the farming community in different states of country. Impact of FTDs on the socio economic conditions of farmers was also assessed. We hope that this publication about different FTD activities will enrich the knowledge of different stakeholders about introduction of new forage varieties and forage technologies, improvement of forage productivity, introduction of various fodder conservation techniques, and ultimately improvement of farm productivity by active participation of farming community.

Editors

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An overview of Forage Technology Demonstration (FTD) activities of ICAR-AICRP on Forage Crops and Utilization

R.K. Agrawal, N.R. Bhardwaj, S.R. Kantwa, Subhash Chand and A.K. Roy

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Introduction

The concept of Fodder Technology Demonstration (FTD) was introduced with the purpose of improving the adoption behavior of farmers related to improved fodder crop varieties/ production technologies and to harvest the maximum yield potential in real farm conditions. It involved supply of essential farm inputs, popularizing the advantages of adopting improved technologies, extending the cultivation of improved fodder varieties and getting the feedback from farmers involved in FTDs to maximize the technology dissemination process among the poor farmers and livestock rearing communities. Unlike other crops, there has been a low increase in production of the fodder crop for fodder or seed yield mainly due to non-adoption of the improved technologies like improved variety, good quality seeds, time of sowing, seed rate, weed management and other plant production and protection measures. By popularizing the complete adoption of improved technologies, the yield barriers of forage crops can be surpassed and it will lead to meet the ever-increasing demand of the quality fodder. FTDs were designed to get feedback on performance of the improved fodder varieties and latest fodder production technologies from the farmer for evolving new strategies to increase the productivity and adaptability of the fodder varieties.

Steps adopted in planning for the demonstrations

- A local survey was conducted with a view to ascertain the socio economic conditions of the farmers, farming situation under which the forage crop is to be grown, and the existing level of adoption of forage technologies and the productivity. It served as a broad benchmark for future planning, demonstration, and evaluation.
- Identifying the critical input on the basis of constraint analysis for adoption of the technologies and for providing full support for such inputs only.
- Advanced planning for the demonstration so that all the critical inputs specially variety seed/ planting material are arranged in time. Orientation training was organized for half a day or so for all the participating persons about aspects of technologies and methodologies including aims and objectives of the demonstration, so that there must be uniform clarity for better working.

Implementation of the Demonstration

- Prior to launching the demonstrations, all participating persons were informed well in advance about the date and venue including the demonstrating farmers. On this occasion, the neighbouring farmers may also be invited and educated about the details of the technologies.
- All the important farm operations were carried out by the demonstrating farmers under broad supervision and guidance of the scientist(s) in-charge of the demonstration.
- When demonstration plots are in the harvesting stage, the “field day” may be organized where neighbouring farmers including farmwomen and extension workers are invited. A question-answer hour (between the scientist, extension workers and farmers) should be organized.
- The concerned scientist is expected to maintain records of various expenses incurred on various inputs used for the demonstration plot(s), and check plots to derive cost benefit-ratio. After

harvesting the yield (fodder/grain) may be recorded for each demonstration plot(s) and check. Sale price of the fodder will be calculated at local rate / nearest market.

Selection of Varieties/ technologies: For FTDs, new varieties/ technologies developed by SAU/ ICAR institute were selected depending on its suitability for the particular zone. Preference to be given for the technologies developed by implementing institutions.

Selection of site: Extension department/ KVK personnel were involved in selecting the site for demonstration. The plot should be easily approachable by road and within the reach of other farmers in the village. It is preferred to have only one or two sites in the same village. Organize farmer's fair/field day before the harvest. Invite farmers from the same/ neighboring village, staff of Agriculture, Gram panchayat and university staff.

FTD activities of AICRP on Forage Crops and Utilization:

ICAR-AICRP on Forage Crops and Utilization conducts FTD activities through 22 AICRP centers located in various SAUs/ CAU/ NGO on the aspect of forage crops and livestock development.

Focus: Transfer of forage technology demonstration (FTD) is a form of applied research through AICRP on Forage Crops and Utilization centers involved in improvement of fodder production. FTD utilized latest notified/recommended hybrids/varieties along with full package of practices/forage production and protection technologies on selected farm with a view to demonstrate the potentiality of the technologies to the participating farmers, neighboring farmers and the extension workers and allied agencies to analyze the production constraints if any, and to assess the performance of the technologies for scientific feedback.

Objectives

- To show the production potential of the recommended forage varieties/hybrids, production and protection practices to the farmers and to the extension agencies for rapid transfer of technology for productivity and production.
- Assessing the popularization and production constraints.
- Assessing the performance of demonstration technologies in the socio-economic conditions of the farmers.

FTD activities conducted by TNAU, Coimbatore, Tamil Nadu: The Department of Forage Crops had released 29 high fodder yielding forage varieties including eight national varieties for general cultivation. Among the varieties released, Bajra Napier hybrids CO (CN) 4 and CO (BN) 5, Perennial fodder sorghum varieties CO (FS) 29 and CO 31, Lucerne CO 2 and *Desmanthus* CO 1 are very popular among the farmers and have revolutionized milk production in Tamil Nadu as well as in different states of India. Beside varieties, this Department has developed suitable package of practices for the improved varieties to maximize forage productivity with minimum inputs. These varieties and technologies have heralded a new era in fodder research and development at national level. The fodder varieties and technologies released by Department of Forage Crops, TNAU, Coimbatore are proverbial to the dairy farmers across Tamil Nadu and its neighboring states of Kerala, Andhra Pradesh, Karnataka and Maharashtra through forage technology demonstrations conducted by Department of Forage Crops under AICRP on Forage Crops and Utilization (FCU). Cultivation of these varieties paved the way for dairy farmers to triumph in their contribution to white revolution. During the period from 2010 to 2020, a total of 301 FTD's were conducted for crops like Bajra Napier hybrid grass and Guinea grass with improved varieties and technologies in different districts of Tamil Nadu. Planting materials and other critical inputs were supplied to the farmers to conduct FTDs in an area of 0.5 acres. FTDs were conducted in different districts of Tamil Nadu such as Coimbatore, Tiruppur, Erode, Salem, Namakkal, Trichy and Dindigul districts.

FTD activities conducted by CCSHAU, Hisar, Haryana: At Haryana, in *kharif* season, cowpea, Pearl millet and teosinte were demonstrated with improved package and practices from 2013-2019. In *rabi* season, berseem and oat varieties were demonstrated under forage technology demonstration from 2011-12 to 2019-20. Seeds of released varieties were given to the farmers for fodder cultivation. Assessment of gaps was done and on the basis of gap assessment, improved recommended technologies were demonstrated. A total of 67 demonstrations of berseem were conducted during the period 2013-2020 under AICRP-FC&U with coverage of 8.39 acre area. In Oat, a total of 118 demonstrations were conducted from 2011-2020 covering an area of 14.77 acres. During *kharif* season, a total of 110 demonstrations were conducted from 2013-2019 with coverage of 13.81 acre area.

FTD activities conducted by IGKV, Raipur, Chhattisgarh: For the conduction of demonstrations on fodder production technology seeds of improved varieties were supplied to the farmer. Demonstrations of improved fodder production technology including new crops and varieties at farmer's field were demonstrated at different parts of the state from 2014-15 to 2019-20. The major objectives of demonstrations were to introduce fodder crops in the area and educate the farmers towards nutritional feed and fodder for livestock. Fodder crops are new for the Chhattisgarh state and area under cultivated fodder is very limited. Rural farmers and dairy farmers are not growing fodder crops in cultivated land and they depend on dry fodder and concentrate for feeding. In *Kharif* season crops like maize, annual sorghum, perennial sorghum and bajra napier hybrid were demonstrated with improved package and practices. In *Rabi* season berseem and oat crop was introduced by front line demonstration in irrigated conditions. Seeds of improved varieties were given to the dairy farmers or for community land cultivation by farmers-participatory approach. Oat is a new crop for the area as fodder crop and this crop is very liked by the farmers. Farmer is now taking seed production of oat to maintain the production every year. Total 174 numbers of demonstrations were conducted since 2014-15 under AICRP-FC&U with coverage of 175.5 acre area. Total 238 farmers/community farmers benefited by the demonstrations.

FTD activities conducted by ANDUAT, Kumarganj, Ayodhya: Eastern part of UP though progressive in crop cultivation, but the forage availability as well as sensitization among the farmers is very poor. Forage FTDs has made a significant effect on the adoption pattern of dairy farmers towards forages for the benefit of their dairy animals which can be verified with increase in the milk production of dairy animals in eastern UP. During 2017-18 to 2019-20 total 381 demonstrations were conducted by the centre in different fodder crops.

FTD activities conducted by JNKVV, Jabalpur, Madhya Pradesh: Fodder crops *viz* Maize, Rice bean and Hybrid Napier in Kharif season, and Berseem and Oats in Rabi season have been demonstrated since 2011 by JNKVV, Jabalpur (MP), near block Panagar of district Jabalpur. Villages UrduaKhurd, Maniyari, Gurgawan, etc were selected for conducting the demonstration, as the farmers of the selected villages were mostly engaged in cattle rearing, dairy and vegetable production. These demonstrations were conducted with the aim of introducing high yielding nutritious fodder varieties with improved technology in the farmer's fields, augmenting high fodder production, following the concept of "Seeing is believing". From 2011 to 2019, in total 325 forage technology demonstrations were carried out near Panagar block of district Jabalpur. Out of the total 107 demonstrations were conducted on berseem,77 on Oat ,53 on Maize and rice bean each and 35 on Hybrid Napier. These demonstrations were carried out aiming at increasing the area under fodder crop in the villages by convincing and motivating farmers to cultivate fodder crop in their land to eliminate the nutrition deficiency in animals.

FTD activities conducted by UAS, Mandya, Karnataka:

In Karnataka fodder crops are grown in an area of 6.59 Lakh ha which comprises major crops of fodder maize, sorghum, bajra, cowpea, lucerne and napier-bajra hybrids as a pure as well as intercrop/mixed crops in regular cropping system. Totally 734 forage technology demonstration were conducted during 2013 to 2019 involving 8 important forage crops and varieties of the region with the purpose of introducing high yielding varieties and production technologies for enhancing green forage yield and quality, to overcome the scarcity of fodder, reducing the cost of milk production and better utilization of available resources.

FTD activities conducted by BAIF, Urulikanchan, Maharashtra: Dairy is the main subsidiary business to the farmers in Western part of Maharashtra. The major fodder crops grown in the area by farmers were maize, sorghum, Bajra x Napier hybrid and Lucerne. In the *kharif* season FTDs were conducted in forage crops like maize, pearl millet, Bajra x Napier Hybrid, whereas in *rabi* season crops were forage oat, lucerne and berseem. For the production of cereal and legume green fodder from the same piece of land, cropping systems like intercropping maize+ cowpea and Bajra+ cowpea were also demonstrated in *kharif* season. New crops like fodder bajra, cowpea, oat and berseem were introduced in the area. New technologies/ new varieties generated out of AICRP fodder crops research were demonstrated through FTDs. BAIF, Urulikanchan centre has actively participated in the transfer of technologies through Fodder Technology Demonstration (FTD) in both *kharif* and *rabi* season of every year. In all 469 FTDs were conducted at farmer's fields during 2009-2020 and season wise number was 271 and 198 in *kharif* and *rabi* respectively.

FTD activities conducted by SKRAU, Bikaner, Rajasthan: SKRAU, Bikaner centre of All India Coordinated Project on Forage crops and Utilization has been conducting forage technology demonstrations since inception of the project in Bikaner, Jaisalmer, Churu, Nagaur, Sikar districts of arid region of Rajasthan. Since the inception of the AICRP on Forage crops and Utilization Project at this centre about 500 demonstrations on different crops viz., pearl millet, sorghum, cowpea, cluster bean, Lucerne, oat, perennial crops like napier bajra hybrid, perennial grasses, Dhaman and Sewan grass were conducted and evaluated. The data on green forage yield were collected and evaluated from FTD plots as well as control plots, which are given in table below: In demonstration plots there was an increase of about 15-25 % in green fodder yield over the farmers practice (control plot), which varied with crops.

FTD activities conducted by BCKV, Kalyani, West Bengal: Forage Technology Demonstrations (FTDs) have been conducted during *kharif* and *rabi* season and were distributed in different Districts of West Bengal, namely Bankura, Paschim Medinipur, Jhargram, Birbhum and Purulia district under red & laterite zone and Kolkata, Howrah, Burdwan, Hooghly, Nadia and North 24 Parganas, South 24 Parganas, Jalpaiguri, Coochbehar districts. FTDs were conducted during Kharif season on Forage maize (cv. J 1006, African tall), Ricebean (cv. Bidhan ricebean 1, 2 & 3) and BN hybrid (cv. CO3, CO4 & CO 5 respectively). FTDs were conducted during rabi season on Berseem (cv. Mescavi, Wardan), Lathyrus (cv. Nirmal, Ratan, Prateek) and Oats (cv. OS-6, Kent respectively). In all 471 FTDs were conducted at farmer's fields during 2015-16 to 2019-20.

FTD activities conducted by GBPUA&T, Pantnagar, Uttarakhand: Maize, pearl millet, sorghum, cowpea (Kharif season), berseem, oat, ryegrass, BN Hybrids (Rabi Season) are major fodder crops grown for green fodder in the state particularly Tarai and Bhabar region of the state, so Maize, sorghum, cowpea, berseem, oat and BN Hybrid were preferred for FTDs. Total 469 FTDs were conducted from 2014-15 to 2019-20 in Almora, Nainital and U.S. Nagar districts of Uttarakhand. The 284 FTDs were conducted mainly in U.S. Nagar as the university campus is situated at U.S. Nagar district followed by 52 in Nainital district as it is a border district and also nearby area of the university campus.

FTD activities conducted by CSK HPKV, Palampur, Himachal Pradesh: CSK HPKV, Palampur centre has contributed significantly toward the development of improved forage varieties their production and protection technologies for all the agro-climatic zones of the state, since its inception 1970. In Himachal Pradesh, cultivated fodder crops dominate during *rabi* season, whereas, during *Kharif* season natural grasslands, pastures and unculturable lands are major sources of fodder to the livestock. Keeping in view, the predominance of grasslands, pastures, field bunds, community lands etc. and occupancy of arable land under gain and cash crops, main emphasis was given to supply the planting material of perennial forage species. Demonstrations on improved farm technologies were conducted in *Setaria* grass, Napier bajra hybrid, tall fescue grass, white clover, oats and annual rye grass. Total 827 FTDs were conducted during 2009-2020.

FTD activities conducted by KAU, Vellayani, Kerala: The All India Coordinated Research Project on Forage Crops was started in 1971 at the College of Agriculture, Vellayani. Forage Technology Demonstrations (FTD) were conducted at 382 locations during the period 2009 to 2020 in Kerala .The scheme was mainly conducted in Bajra Napier Hybrid, the most popular fodder crop in Kerala for the variety–Suguna. It was also done for the guinea grass variety Harithasree and fodder cowpea variety Aiswarya.

FTD activities conducted by AAU, Jorhat, Assam: Perennial forage crops like Hybrid Napier, Setaria, Congosignal, Guinea and Para havebeen made popular among the farmers. Among annual crops oat is the most popular crops followed by maize and sorghum. Among legume crops farmers started growing cowpea and ricebean. Relay cropping of lathyrus is common practice in rice crops in selected pockets particularly in flood affected areas and the rice areas where long duration rice varieties like ranjit and bahadur are grown. As a result of concerted effort of forage scientists, the farmers were encouraged to adopt technologies for making the nutritious fodder available with their available resources. Total 543 FTDs were conducted during 2011-12 to 2019-20.

FTD activities conducted by CAU, Imphal, Manipur: Oats, napier, maize, rice bean, cow pea, and other grasses havestarted to become a popular fodder and forage crops in NEH Region, Manipur in particular. As a result of extensive extension activities by the AICRP on Forage Crops, the farmers have started its cultivation. The area under its cultivation is gradually increasing. AICRP on Forage Crops & Utilization, CAU, Imphal initiated a fodder promotional program as Fodder Technology Demonstration (FTD) from the year 2011-12 among the dairy farmers of Manipur. Regular training, demonstration and interaction programmes were conducted to promote fodder crops and its cultivation technology. Total 205 FTDs were conducted during 2011-12 to 2019-20.

FTD activities conducted by PAU, Ludhiana, Punjab: Forage Technology Demonstrations (FTDs) have been conducted during *Kharif* and *Rabi* seasons every year in various districts of Punjab like Ludhiana, Patiala, Sangrur, Kapurthala, Moga, Tarntaran, Barnala. FTDs were conducted in berseem, oat, maize, BN Hybrid and ryegrass. Total 665 FTDs were conducted during 2015-16 to 2019-20.

FTD activities conducted by MPKV, Rahuri, Maharashtra: Forage technology demonstration were started from *Kharif,* 2009 to demonstrate improved fodder production technologies including new varieties under farmers field through AICRP-Forage Crops and Utilization, Mahatma Phule Krishi Vidyapeeth, Rahuri, District Ahmednagar, Maharashtra. The predominant fodder crops of Maharashtra state are Maize, Sorghum, Lucerne, Hybrid Napier, Pearl millet *etc.* Guinea, Para and Marvel grass are grown in small areas as perennial grasses for fodder. The crop residues contribute a major portion of dry fodder. Under the Fodder Technology Demonstration programme different annual as well as perennial

fodder crops were conducted from the year 2009-10 to 2018-19 on the farmer's field of four districts of Maharashtra. Total 313 FTDs were conducted during 2009-10 to 2018-19.

FTD activities conducted by PJTSAU, Hyderabad, Telangana: Forage technology demonstrations were initiated at PJTSAU, Hyderabad during 2009 under the aegis of the All India Coordinated Research Project on Forage Crops & Utilization. Demonstrations of remunerative practices in perennial fodder (BN hybrids), maize, cowpea and multicut fodder bajra were conducted during *kharif* while during *rabi*, crops viz., oats and Lucerne were conducted. Total 647 FTDs were conducted during 2009-10 to 2016-17.

Impact of FTDs: Technology transfer programme always have impact at individual and community level. The FTD programme under AICRP on Forage Crops &Utilization through its different centers has disseminated the advanced fodder technologies at village level which helped a large number of farmers in those villages. Farmers have realized the importance of new fodder crops/varieties and their production technologies in achieving the higher green fodder yield. Other benefits of the FTD programme were:

- The new fodder crops and varieties were brought under cultivation by a large number of farmers.
- Due to availability of balanced green fodder, the cost on concentrate feed is reduced which ultimately reduced the cost of milk production.
- The demand for fodder seed and planting material of new crops/varieties increased over the period.
- Good linkages were developed with state Agricultural Dept. and KVKs.

Impact of improved forage technologies on yield of different forage crops in various states

State	Impact
Rajasthan	• Increase of about 15-25% in GFY over the farmers practice (control plot).
Uttar Pradesh	• FTDs on fodder crops under varietal evaluation have shown 23.28% to 29.82% increase over local check. Whereas, the increase under Integrated Fodder Management varies from 49.60 to 52.65% in Eastern part of UP.
Haryana	• Technology demonstrations conducted during different seasons and locations, the various fodder crops showed increase in green fodder yield ranging from 1.3-17.1, 3.3-11.3, 7.5-15.1 and 9.9-11.3% over local practice for oat, berseem, fodder pearl millet and teosinte, respectively.
Madhya Pradesh	• The yield increased by 23.25% in Maize and by 22.35% in Rice bean with the B:C ratio of 3.10 and 2.31 respectively. The yield increase by practicing improved technology was 37.43% in Berseem and 25.04% in Oats with B:C ratio of 2.13 and 2.21 respectively.
Punjab	• The introduction of new technologies has led to 12 to 15% increase in productivity of fodder crops. New released varieties of various fodder crops especially oats and berseem seem to providehuge quantities of green fodder yield than the old varieties.
Himachal Pradesh	• Increase in fodder yield recorded was • In Setaria grass, 40% in the year of establishment and 150% in subsequent years • In NBH, 28% in the year of establishment and 160% in subsequent years • In Oats, 30-50% increase • In Tall fescue grass, 20% in the year of establishment and 80% in subsequent years • In Clovers,5% in the year of establishment and 50% in subsequent years • In Rye grass, a new crop in the state and have high acceptability among farmers.

Maharashtra	• Total green fodder production from 73.68 ha area of FTD under different crops at farmers field was about 31678 q, and the estimated gross income generated was approximately Rs. 76 lakh. • Milk yield of milking cattle was increased up to 1-2 litre/day because of good quality fodder as a result increase in total income of farmers.
Karnatka	• Improvement in green forage yield ranges from 7.6 to 21.1% with an average of 13.0% in different forage crops. • Improvement in milk yield by 1.5 to 2.5 litres/day/cow.
Kerala	• The crop was introduced for the first time through FTD and hence we couldn't compare the performance of KAU fodder varieties with existing varieties in farmer's field. BN hybrid variety Suguna recorded a range of yield potential in farmer's field from 150- 250 t/ha, guinea grass variety Harithasree recorded 50-70t/ha and cowpea Aiswarya recorded GFY of 18-23t/ha. Farmers were happy with the performance of the varieties and through the programme, these varieties were popularized in the adjoining areas too.
Chhattisgarh	• Through demonstrations, improvement green fodder yield to the tune of 300-350 q/ha in maize, 400-450 (4 cuts) q/ha in berseem, 400-500 (2 to 3 cuts) q/ha in oats, 800-1000 (5-6 Cuts/year) q/ha in perennial sorghum, 800-1200 (5 Cuts/year) q/ha in Napier Bajra hybrid, 400-425 (2-3 cuts) q/ha in sorghum compared to farmers practice.
Assam	• Through demonstrations, increase in yield to the tune of 100-200% in perennial crops and 100-130% in annual crops was observed.
Manipur	• Increase in green fodder yield to the tune of 10-15% in different crops. • Increased lactation period due to increase in fodder availability and milk yield increased by approximately 2 to 4 litre.
Tamil Nadu	• Increase in green fodder yield to the tune of 13.56, 12.92, 10.36, 14.1, 11.64% in Maize, guinea grass, BN hybrid, cowpea and Lucerne respectively over the farmer's practice.
Uttarakhand	• The average increase in green fodder yield under FTDs over farmers' practices was recorded in range of 16-26% in cowpea, 21-30% in maize, 17-20% in sorghum, 28-40% in berseem, 12-28% in oat and 43-72% in B N Hybrid.

Forage Technology Demonstrations: Impact in unravelling the fodder crisis in Tamil Nadu

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Introduction

Tamil Nadu possessing 4.56% of India's livestock population contributes 4.39% to country's milk production and 7.88% to meat production. The state contributes 5.29% to the total value of output from livestock in the country. Tamil Nadu has vast resources of livestock as 245 lakhs, which play a vital role in improving the socio economic conditions of the rural people. As per the 20th livestock census the total livestock population of the state is 24.5 million and that of poultry at 120.7 million.

Majority of the cattle reared by the farmers comprise high milk yielding cross bred cattle like Jersey/Holstein Friesian and among buffaloes graded buffalo. The average milk yield of cross bred cow is 7.214 litres per day with 4% of fat content (sample survey estimate). The average milk yield of buffaloes is 3.827 litres per day with 7.5% of fat content. (Source: Department of Economics and Statistics; Advance estimates at current prices). However, the sustainable development of livestock sector is seriously impacted mainly by the perennial challenge of fodder scarcity. Inadequate quantity and quality of feed is the major constraint affecting livestock production and productivity. As per the season and crop report 2017-2018 the western districts namely Erode, Thiruppur, Karur, Salem, Namakkal, Dharmapuri and Krishnagiri have increasing proportion of lands under fodder. The other districts have not sown large areas under fodder and hence generally Tamil Nadu remaining a fodder deficit state with the deficiency percentage varying between 30-40%.

Forage Technology Demonstrations

Department of Forage Crops, Centre for Plant Breeding and Genetics, TNAU, Coimbatore has been pioneering in forage research and development which is very well evident from the spread of forage varieties over all the states of India and abroad. Studies on fodder crops began as early as 1929 in the Botany section of the then Agricultural College, Coimbatore, Tamil Nadu. A separate department for fodder research, first of its kind in India came into existence in the year 1976 at Tamil Nadu Agricultural University, Coimbatore. It was identified as one of the centres of All India Coordinated Research Project on Forage Crops by the Indian Council of Agricultural Research in 1976.The Department of Forage Crops had released 29 high fodder yielding forage varieties including eight national varieties for general cultivation. Among the varieties released, Bajra Napier hybrids CO (CN) 4 and CO (BN) 5, Perennial fodder sorghum varieties CO (FS) 29 and CO 31, Lucerne CO 2 and *Desmanthus* CO 1 are very popular among the farmers and have revolutionized milk production in Tamil Nadu as well as in different states of India.

Beside varieties, this Department has developed suitable package of practices for the improved varieties to maximize forage productivity with minimum inputs. These varieties and technologies have heralded a new era in fodder research and development at national level. The fodder varieties and technologies released by Department of Forage Crops, TNAU, Coimbatore are proverbial to the dairy farmers across Tamil Nadu and its neighboring states of Kerala, Andhra Pradesh, Karnataka and Maharashtra through forage technology demonstrations conducted by Department of Forage Crops under AICRP on Forage Crops and Utilization (FCU). Cultivation of these varieties paved way for dairy farmers to triumph in their contribution to white revolution.

Forage technologies related to the green fodder yield of improved fodder varieties, plant population, balanced nutrients, seed/sett treatments were demonstrated to the farmers. Farmers were selected based on their willingness, acceptance, attending the training programme and enquiries made for new technologies/improved varieties. In addition, contact farmers from department of veterinary and animal husbandry and department of agriculture were also selected. Villages for FTD were selected based on the potentiality towards the improved fodder crop varieties and its technologies.

Forage Technology Demonstrations Conducted

During the period from 2010 to 2020, a total of 129 FTD's were conducted for crops like Bajra Napier hybrid grass and Guinea grass with improved varieties and technologies in different districts of Tamil Nadu. The details of FTD's conducted are given in Table 1. Planting materials and other critical inputs were supplied to the farmers to conduct FTDs in an area of 0.5 acres. FTDs were conducted in different districts of Tamil Nadu such as Coimbatore, Tiruppur, Erode, Salem, Namakkal, Trichy and Didigul districts.

Table 1: Details of fodder technology demonstrations conducted

Crop	Year	Season	Variety	District/ village	No. of Demo	Mean GFY (t/ha) Demons-tration plot	Control plot	% Increase over control
Fodder	2010 -11	Kharif	African	Coimbatore	4	42.4	37.6	11.3
Maize	2011-12		Tall	Coimbatore & Tiruppur	8	41.1	35.2	14.4
	2012 -13			Coimbatore, Tiruppur & Erode	5	43.6	36.4	16.5
	2013-14			Coimbatore & Tiruppur	5	42.7	36.1	15.5
	2014-15			Coimbatore, Tiruppur, Salem, Erode & Namakkal	15	40.8	34.3	15.9
	2016-17			Coimbatore & Karur	5	43.2	37.7	12.7
	2017-18			Coimbatore	5	44.5	38.3	13.9
	2018-19			Coimbatore & Tiruppur	5	41.9	36.8	12.2
	2019-20			Coimbatore, Tiruppur & Erode	5	40.6	35.3	13.1
Total					**57**			
Fodder	2010 -11	*Kharif*	CO	Salem & Namakkal	4	196.1	174.1	11.2
Sorghum	2011-12		(FS)29	Erode & Namakkal	4	192.8	163.2	15.4
Total					**8**			
Guinea	2010 -11	*Kharif*	CO	Tiruppur	3	326.3	285.1	12.6
grass	2011-12		(GG)3	Coimbatore	1	341.2	302.6	11.3
	2012 -13			Erode & Salem	5	336.0	299.4	10.9
	2013-14			Coimbatore, Tiruppur Erode & Dindigul	5	327.1	280.1	14.4
	2014-15			Coimbatore Tiruppur, Erode, Salem & Namakkal	10	338.5	300.1	11.3
	2015-16			Coimbatore	3	329.6	280.3	15.0
	2016-17			Coimbatore, Tiruppur & Erode	15	332.2	298.1	10.3
	2017-18			Coimbatore, Karur & Dindugal	10	340.2	302.1	11.2
	2018-19			Coimbatore, Erode & Tiruppur	10	335.0	289.6	13.6
	2019-20			Coimbatore, Erode & Tiruppur	10	328.1	280.4	14.5
Total					**72**			

BxN	2010-11	*Kharif*	CO	Coimbatore & Tiruppur	5	407.1	355.8	12.6
hybrid	2011-12		(CN) 4		7	426.2	365.2	14.3
	2012-13				5	421.3	365.2	13.3
	2013-14				10	432.3	367.2	15.1
	2014-15				10	439.2	366.2	16.6
Total					**37**			
BxN	2015-16	*Kharif*	CO	-	-	-	-	-
hybrid	2016-17		(BN) 5	Coimbatore, Karur & Dindigul	5	396.9	354.5	10.7
	2017-18			Coimbatore, Erode & Tiruppur	5	420.9	359.3	14.6
	2018-19			Coimbatore, Erode & Tiruppur	5	405.2	350.9	13.4
	2019-20			Coimbatore, Erode & Salem	5	399.2	346.8	13.1
Total					**20**			
Fodder	2010-11	*Rabi*	CO	Coimbatore	4	32.1	28.1	12.5
Cowpea	2013-14		(FC) 8	Coimbatore, Tiruppur & Erode	10	32.4	27.8	14.2
Total					**14**			
Fodder	2015-16	*Rabi*	CO 9	Coimbatore, Tiruppur, Erode &	10	28.9	24.3	15.9
Cowpea				Salem				
	2016-17			Coimbatore, Tiruppur, Theni &	5	31.2	26.8	14.1
				Vellore				
	2017-18			Coimbatore & Dindigul	5	29.1	25.4	12.7
	2018-19			Coimbatore & Tiruppur	5	30.1	26.5	12.0
	2019-20			Coimbatore, Tiruppur & Erode	5	25.3	21.3	15.8
Total					**30**			
Lucerne	2010-11	*Rabi*	CO 1	Coimbatore & Tiruppur	10	99.1	84.2	15.0
	2011-12			Coimbatore, Tiruppur & Erode	10	101.2	85.4	15.6
	2012-13			Coimbatore & Tiruppur	10	101.1	86.2	14.7
	2013-14			Coimbatore, Tiruppur & Erode	10	93.2	82.1	11.9
Total					**40**			
Lucerne	2015-16	*Rabi*	CO 2	Coimbatore & Theni	3	135.2	121.2	10.4
	2016-17			Coimbatore & Tiruppur	5	141.2	121.9	13.7
	2017-18			Coimbatore & Tiruppur	5	135.2	120.1	11.2
	2018-19			Coimbatore & Tiruppur	5	132.2	116.2	12.1
	2019-20			Coimbatore, Tiruppur & Erode	5	130.2	116.1	10.8
Total					**23**			

A total of 301 FTD's were conducted with improved varieties and technologies in cereal fodders like perennial fodder sorghum and fodder maize in different districts of Tamil Nadu. FTDs were conducted in Coimbatore, Tiruppur, Erode, Salem, Karur and Namakkal districts of Tamil Nadu. In legume fodders, a total of 107 FTD's were conducted with crops like fodder cowpea and Lucerne with improved varieties. FTDs in legume fodders were conducted in Coimbatore, Tiruppur, Erode, Salem, Namakkal, Trichy, Theni, Vellore and Didigul districts of Tamil Nadu districts.

Achievements through Forage Technology Demonstrations

Bajra Napier hybrid grass CO (BN) 5 released during 2012 has heralded a new era in fodder research and development at National level. It is a boon for dairy farmers owing to its high crude protein content (14%) and winter hardiness. It plays major role in enhancement of rural livelihoods indirectly. Due to

the impact of technology demonstrations, 90.21 lakhs of stem cuttings of CO (BN) 5 have been supplied from TNAU across different districts of Tamil Nadu and 18 states of India and also four countries *viz.*, UAE, Australia Africa and USA. The details of Bajra x napier hybrid grass CO (BN) 5 spread into different states of India is depicted in the Indian map (Fig. 1).

Fodder sorghum variety CO (FS) 29 released during 2001 is perennial in nature. The multi cut nature of this variety has been derived from Sudan grass. It is having the green fodder yield is 160-170 t/ha/year with 8.41% crude protein and less fibre (24%). Seeds of this variety was produced the tune of 7.41 tonnes and distributed to the farmers of Tamil Nadu and different states of India (Fig. 2).

Fig. 1: Adoption of Cumbu Napier hybrid grass CO (BN) 5 in India

Fig. 2: Adoption of of Perennial fodder sorghum CO (FS) 29 to 19 states in India

Impact of Forage Technology Demonstrations

1. Forage seed producers:

Through the varietal and technological interventions demonstrated by Department of Forage Crops through Forage Technology demonstrations, several farmers turned in to forage crop seed and planting material producers. As per the concept of FTD, the above farmers has served as a resource person to other visiting farmers for up scaling the technologies *viz.,* seed production in fodder crops and cultivation of improved fodder crop varieties. They impart training to the visiting farmers and instrumental in the dissemination of TNAU released high yielding forage varieties and latest production technologies. Impact may be well explained from Example of Shri. R. Pattadurai from Erode District, the farmer realized the net income of Rs.7.70 lakhs in his 5.75 acres of

cultivable land from seeds sale of *Desmanthus CO1,* Multicut fodder sorghum CO (FS) 29, Fodder cowpea CO (FC) 8/CO 9 and Cumbu Napier hybrid grass CO (BN) 5

Another example is Shri. S. Natarajan, Coimbatore, who earns a net profit of Rs. 2,50,000 annually from sale of cuttings of BN hybrid grass CO (CN) 4 and Guinea grass CO (GG) 3, and fresh fodders of Cumbu Napier hybrid grass CO 3, CO (CN) 4, CO (BN) 5, Guinea grass CO (GG) 3fodder maize (African Tall), fodder sorghum CO (FS) 29 grown on his 3.5 acres rainfed land.

2. Forage entrepreneurs:

The FTD also motivated some farmers as green fodder producers. They produce and supply quality green fodders to the cattle growers of nearest cities and villages after meeting their own demand. They also served as model for reducing the cost of milk production through feeding quality fodder. Many farmers from neighbouring villages and other states were motivated by their innovative ideas and which turned them to go for fodder cultivation.

Example: Smt. Backiyam, (Coimbatore District) who grow fodder in her 2.5 acres of land. 1.5 acre {(BN hybrid CO (CN) 4, Guinea grass CO (GG)} 3is allotted for feeding her own livestock *i.e.*, four milch cows, two heifers, six goats and one horse. she could feed nutritious and balanced fodder to the animals which resulted in the improved milk yield and reduced cost onpurchased inputs. one acre produce is maintained for selling the green fodders which increased the income. In this practice, she realized the net income of Rs.5.95 lakhs it is almost double the income when compared to conventional practice of growing commercial crops only.

Shri. K. Subbaiyan, (Coimbatore District) switched over to the cultivation of Lucerne in his two acres of land from the cultivation of vegetables, greens and curry leaf. He has also raised the Lucerne as intercrop in 18 acres of 2 years old coconut plantations. He is making Lucerne Meal from the excess and salerace courses *etc.,* for feeding horses. He is earning a additional net profit of Rs. 1,00,000.00 Per year

- Thiru. K. Shanmuganathan, 47, Melathavitupalayam, Kattuputhur, Thottium, Trichy District has expressed that milk yield has been enhanced up to 2 liters per cow per day by feeding CO (CN) 4.
- Thiru. V. Sureshbabu, Kuttai Thottam, Pannimadai, Coimbatore had an experience of getting enhanced milk yield of 1 lit./day/animal due to feeding of CumbuNapier hybrid grass CO (CN) 4.

- Thiru. P.R. Prakash, Maamara Thottam, Pannimadai, Coimbatore District has appreciated Cumbu Napier hybrid grass CO (CN) 4 and testified that the milk yield has been enhanced up to 2 liters per cow per day and able to feed the cows all the 7 days.
- Tmt. Vijayalakshmi a dairy farmer who has 80 cows and grows CO (BN) 5 grass on seven out of 30 acres farm at Agrahara Nattanmangalam, a village in Salem district claimed that, earlier she was feeding the animals with 30 kg of CO (CN) 4 fodder and 5 kg of concentrates daily. Then later she switched to feeding 30 kg CO (BN) 5 and reduced concentrated cattle feed of 3 kg which resulted in same 15 litres of milk yield with more fat and SNF (Solid not fat) content.
- Thiru. P. Meganathan, 1/142, Melarajaveethi, N. Puthupatti, Namakkal District opined that the Multicut fodder sorghum variety CO (FS) 29 is a "fortunate -thing" to farmers like me.
- Thriu. R. Velappagounder, 9/93, Thirumalaigiri, Kalappanaickenpatty, Namakkal District has benefited by harvesting not only green fodder yield but also seed from Multicut fodder sorghum variety CO (FS) 29.
- Thiru. S. Kulanthaivel, Kanakkan Thottam, A.G. Pudur, Coimbatore District appreciated that Guinea grass CO (GG) 3 has grown taller and cows consume without rejection.
- Thriu. T. Thiruvengadam President, Pasumai Farmers Society (NABARD), Preumpathi, Pollachi, Coimbatore has experienced enhanced milk yield of 1 lit./day/animal by feeding CO (BN) 5 and getting additional income of Rs. 750 per month.

Therefore, forage technology demonstrations have definitely paved the way for achieving quantum jump in fodder production to solve the quality fodder crisis in Tamil Nadu as well as in India through up scaling improved fodder varieties and technologies.

Impact of Forage Technology Demonstrations on Fodder Production in Haryana

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Introduction

Haryana has attained statehood on November 1, 1966, hosting less than 2% of India's population. With an area of 44.2 thousand Km^2, Haryana occupies approximately 1.37% of the total geographical area. Haryana has emerged as a distinct state just after three decades of its existence. One of the world's oldest and largest ancient civilizations, the Indus Valley Civilization also sites in Hisar and Fatehabad districts of Haryana state. Haryana is self sufficient in food production and also known as the "Bread Basket of India". It holds important place in terms of adoption of latest technologies in agriculture and it is counted as one of the leading states for Agriculture production in the country. The major *Kharif* crops are rice, jowar, bajra, maize, cotton, jute, sugarcane, sesame and groundnut whereas the *Rabi* crops are wheat, gram, linseed, rapeseed and mustard, oat and berseem. About 86% land is arable, out of that 96% is cultivated and about 75% of the area is irrigated through tube wells and canals. Rice, wheat, rapeseed & mustard, bajra, cotton and sugarcane are the major crops grown in Haryana with considerable scope for agricultural diversification as well as off farm opportunities. Allied sectors like dairying, poultry, fishery, arid-horticulture, mushroom farming, bee keeping, agroforestry etc. also play important role in self sufficiency of the state.

Status of livestock in Haryana

Livestock farming is the heart and soul of Haryana. Traditionally, agriculture and animal husbandry has been the main source of livelihood in the state. Livestock farming has played an important role in employment generation and earnings stemming from efficient livestock management, processing the produce and effective marketing of the products across the nation. There are almost 4900 different species of animals in the state including buffaloes, cattle, donkeys, goat, horses, pig, and sheep. Haryana is also home to some of the best breeds of livestock like Holstein-Friesian, Sahiwal, Hariana, and Tharparkar cows, Murrah buffaloes, Beetal goats, breeds of sheep including Dale, Hisar, Chokla, and Nali sheep, Yorkshire pigs, and Potou donkeys. As per Livestock Census-2019, livestock population of the State is 71.3 lakh including 19.3 lakh cattle and 43.8 lakh buffaloes (Table 1). According to a state report published in 2012, the livestock sector contributes almost 30 percent to the State Agricultural GDP. Milk, meat and poultry make up an essential part of the state's indigenous cuisine and their production has increased since the inception of the state. Milk production has increased over 5 times and the production of egg has increased about 160 times. The per capita per day milk availability in the State is 878 grams as compared to the national average of 329 grams. Haryana is the only State in the country to make available pasteurized A-2 cow milk through VITA booths in the State. The current growth of livestock sector must be accelerated through progressive policies and balanced emphasis on buffalo, cattle, poultry, fish and dairy sector. The genetic improvement of local breeds like Murrah, Hariana and Sahiwal would bolster the dairying and animal husbandry sector of the state. Emphasis on good management and improved feed and fodder resources will also help in faster growth of livestock sector, going forward.

Table 1: Livestock population in Haryana state

Species	2012, 19th census (million)	2019, 20th census	% Change
Cattle	1.8	1.9	5.6
Buffalo	6.1	4.4	-28.2
Goats	0.37	0.34	-8.1
Sheep	0.36	0.29	-19.4
Total Livestock	8.63	6.93	-50.1
Poultry	42.8	46.3	8.1

Source: DAH&D, Haryana

Production and productivity of livestock in state

The nutritive values of the feed and fodder have a significant impact on productivity of livestock. It is observed that in Haryana, the farmers feed their animals with what is readily available to them i.e. by-products of their agricultural activity, or what they can cheaply purchase locally. Thus the milch animals are left dry in nutritive feeding. The diet is usually a mix of dry fodder, green fodder and some form of concentrate, and is often low in digestible crude protein and total digestible nutrients. Ultimately these conventional practices reduce the potential of milk production. Milk production in Haryana state was 98.09 lakh tonnes in 2017-18, 107.3 lakh tonnes in 2018-19 and 117.3 lakh tonnes in 2019-20. However, the increase in milk production was nearly same i.e. 9.4 and 9.3% from 2017-18 to 2018-19 and 2018-19 to 2019-20, respectively. However, per capita milk and egg availability is higher in Haryana as compared to national average (Table 2). The production of major livestock products in Haryana state is given in Table 3.

Table 2: Per capita availability of major livestock produce

Year 2018-19	Haryana	National
Per capita milk availability (g/day)	1085	394
Per capita egg availability (No./annum)	224	79

Source: Animal Husbandry Statistics Division

Table 3: Production of major livestock produce

(a) Milk production

Year	Milk production (in Million Tonnes)		
	Haryana	India	% national share
2017-2018	9.81	176.3	5.56
2018-19	10.7	187.7	5.71

Source: Basic Animal Husbandry Statistics, DAHD&F, Govt. of India and Dept. of Animal Husbandry & Dairying, Govt. of Haryana

(b) Egg production

Year	Egg production (in billion)		
	Haryana	India	% national share
2017-2018	5.5	95.2	5.8
2018-19	6.1	103.3	5.9

Source: Basic Animal Husbandry Statistics, DAHD&F, Govt. of India and Dept. of Animal Husbandry & Dairying, Govt. of Haryana

(c) Meat production

Year	Meat (in Million Tonnes)		
	Haryana	India	% national share
2017-2018	470.3	7655.6	6.1
2018-19	512.0	8114.4	6.3

Source: Basic Animal Husbandry Statistics, DAHD&F, Govt. of India and Dept. of Animal Husbandry & Dairying, Govt. of Haryana

Status of feed and fodder in Haryana

The use of compounded feed, scientifically blended and nutritionally balanced, greatly help in improving the yield performance of milch animals. At present, due to non-availability of conventional raw materials, the Cattle Feed Plants in the organized sector (Co-operative and Private Plants) are running short of their rated capacity. Therefore, to improve the capacity utilization of cattle feed industry, all-out efforts need to be made to utilize the available non-conventional raw materials to manufacture good quality compounded feed. There is tremendous pressure of livestock on available feed and fodder in Haryana, as land available for fodder production has been decreasing day by day. The farmers are always biased in the choice of crops. The small land holdings do not permit the farmers to divert the land use from food production purpose to cultivable fodder production. Poor management practices also reduce the fodder production. The area covered under fodder crops during *rabi* 2019-20 was approximately 0.81 lakh hectares and during *kharif* 2020 it is approximately 1.87 lakh hectares (Table 4 and 5). The fodder crops like bajra, guar, cowpea, oats and some fodder grasses are grown in drier parts of Haryana state. However, the crops i.e. jowar, maize, berseem and lucerne are grown in irrigated parts. There is deficit of 48% in the supply of green fodder; however the state is surplus in dry fodder by 49% of demand. The fodder seed production also shows a decreasing trend as it is evident from 273.6, 203.9 and 194.4 MT fodder seed production during 2017-18, 2018-19 and 2019-20, respectively (Fig. 1).

Table 4: Area and Production of fodder Crops in Haryana during *Rabi* 2019-20

Crop	Berseem	Oat	Other	Total
Area ('000' ha)	56.87	14.07	10.22	81.16
Production ('000' tonnes)	39.81	3.52	6.13	49.46

Table 5: Area covered under fodder for the year, *Kharif* 2020

Crop	Area covered (in '000' hectares
Fodder Sorghum	179.7
Other fodder crop	7.49
Total	187.2

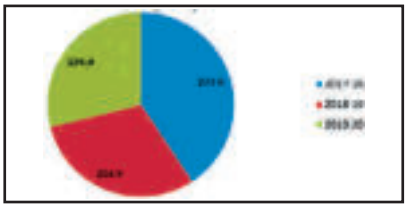


Fig. 1: Fodder seed production (in MT) in Haryana from 2017-2020

Forage Technology Demonstrations

Forage Technology Demonstration (FTD) is a wonderful approach to demonstrate the production potential of newly released varieties to the farmers. It also helps in interacting and solving the problems of farmers related to fodder production. The researchers can directly showcase their technology at the farmer's field. A total of 295 Fodder Technology Demonstrations were performed during different seasons and locations of Haryana with the following objectives:

Objectives

- To acquaint the farmers with the latest released fodder species, their potentiality like productivity, nutritional efficiency and palatability.
- Awareness creation about fodder production technology like describing about the benefits of cultivation of high yielding varieties of fodder crops.
- On-farm evaluation of fodder technologies to narrow the gap between yields realized on farmers' fields and those on research stations.
- Providing the basic advice to the farmers to enable them to withstand in competitive market.
- Encouraging adaptive research on fodder production technology through providing necessary feedback from the farmers' field.
- Demonstration of improved methods of utilization of forage crops.
- Encouraging farmers to multiply their own quality seed multiplication for next season.
- Improving performance of the livestock holdings of the beneficiary farmers.

Site selection and size of FTDs

The selection of villages was done on basis of non adoption of improved and recommended varieties. After the selection of villages, most approachable side of farmer's field was selected, so that the performance of demonstrated technology can be seen by other farmers. Individual farmers in different districts of Haryana were selected for the demonstrations. Preference was given to the farmers involving in the milk production or dairy farming in different villages of Haryana. The size of demonstration was one kanal or according to availability of resources among the farmers.

Critical input for demonstration

For the conduction of demonstrations on fodder production technology seeds of improved varieties were supplied to the farmer directly or through KVKs. In *kharif* season seed of fodder cowpea variety and teosinte was distributed among farmers for the cultivation. In *rabi* season seed of released varieties of berseem and oat was supplied for demonstration to the farmers.

Implementation of demonstration

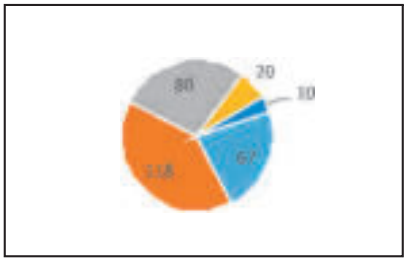
For the implementation of Forage Technology Demonstartions Krishi Vigyan Kendras (KVKs) of particular districts were approached. For the demonstration of *kharif* or *rabi* season fodder crops, all the farmers were informed well in advance to have ample time for field preparations for the sowing.

Monitoring

Farmer's fields were monitored by the university scientists from time to time. The scientists from AICRP and KVKs also monitored the demonstrations for successful results. Regular feedbacks were also taken from the farmers to cater their problems if any.

Demonstration of fodder crops at farmers field

In *kharif* season crops cowpea, Pearl millet and teosinte were demonstrated with improved package and practices from 2013-2019. In *rabi* season berseem and oat varieties were demonstrated under forage technology demonstration from 2011-12 to 2019-20. Seeds of released varieties were given to the farmers for fodder cultivation (Table 6). Assessment of gap was done and on basis of gap assessment, improved recommended technologies were demonstrated. A total of 67 demonstrations of berseem were conducted during the period 2013-2020 under AICRP-



FC&U with coverage of 8.39 acre area (Table 7). In Oat, a total of 118 demonstrations were conducted from 2011-2020 covering an area of 14.77 acres (Table 8). During *kharif* season, a total of 110 demonstrations were conducted from 2013-2019 with coverage of 13.81 acre area (Table 9). The improved fodder yield of tested varieties under Forage Technology Demonstrations during *rabi* and *kharif* seasons is depicted in tables 10 and 11, respectively. Forage Technology Demonstrations conducted during different seasons and locations, the various fodder crops showed increase in green fodder yield ranging from 1.3-17.1, 3.3-11.3, 7.5-15.1 and 9.9-11.3 per cent over local practice for oat, berseem, fodder pearl millet and teosinte, respectively.

Table 6: Crops and varieties during *Rabi* and *Kharif* seasons under Forage technology demonstrations AICRP-Forage Crops, CCS HAU, Hisar (Haryana)

Crop	Varieties	Farmer's practice
Berseem	HB 1, HB 2	Local variety
Oat	OS 346, OS 6, Kent, HJ 8, OS 377, OS 403	Local variety
Cowpea	CS 88	Local variety
Teosinte	Improved teosinte	New crop introduced
Fodder pearl millet	HC 10, HC 20, FBC 16	Local strain

Table 7: Number of beneficiaries and area under Forage technology demonstrations of Berseem connected under AICRP-Forage Crops, CCS HAU, Hisar (Haryana)

Year	No. of demonstrations	District	Season	Area (Acres)	No. of Beneficiaries
2013-14	8	Hisar	*Rabi*	1.0	8
2014-15	15	Hisar, Kaithal, Bawal	*Rabi*	1.88	15
2015-16	16	Hisar, Bhiwani	*Rabi*	2.0	16
2018-19	13	Hisar, Fatehabad, Nuh, Rewari, Yamunanagar, Ambala, Karnal	*Rabi*	1.63	13
2019-20	15	Hisar, Jhajjar, Yamunanagar	*Rabi*	1.88	15
Total	67	-	-	8.39	67

Table 8: Number of beneficiaries and area under Forage technology demonstrations of Oat connected under AICRP-Forage Crops, CCS HAU, Hisar (Haryana)

Year	No. of demonstrations	District	Season	Area (Acres)	No. of Beneficiaries
2011-12	12	Hisar	*Rabi*	1.5	12
2012-13	5	Hisar	*Rabi*	0.63	5
2013-14	10	Hisar	*Rabi*	1.25	10
2014-15	15	Hisar, Kaithal, Bawal	*Rabi*	1.88	15
2015-16	15	Hisar, Bhiwani	*Rabi*	1.88	15
2016-17	16	Hisar, Kaithal, Yamunanagar, Panchkula, Kurukshetra, Karnal	*Rabi*	2.0	16
2017-18	8	Hisar	*Rabi*	1.0	8
2018-19	12	Hisar	*Rabi*	1.5	12
2019-20	25	Hisar, Jhajjar	*Rabi*	3.13	25
Total	118	-	-	14.77	118

Table 9: Number of beneficiaries and area under Forage technology demonstration during *Kharif* seasons connected under AICRP-Forage Crops, CCS HAU, Hisar (Haryana)

Year	Crop	No. of demonstrations	District	Area (Acres)	No. of Beneficiaries
2013	Forage Pearl Millet	10	Hisar	1.25	10
	Forage Cowpea	5	Hisar	0.63	5
2014	Forage Pearl Millet	15	Hisar	1.88	15
2015	Forage Pearl Millet	15	Hisar	1.88	15
2016	Forage Pearl Millet	5	Hisar	0.63	5
	Forage Cowpea	5	Hisar	0.63	5
2017	Forage Pearl Millet	5	Hisar	0.63	5
	Forage Cowpea	5	Hisar	0.63	5
2018	Teosinte	5	Hisar	0.63	5
	Forage Pearl Millet	15	Hisar	1.88	15
2019	Teosinte	5	Hisar	0.63	5
	Forage Pearl Millet	15	Hisar	1.88	15
	Forage Cowpea	5	Hisar	0.63	5
	Total 110	-	13.81	110	

Table 10: Fodder yield of tested varieties of Oat and Berseem under Forage technology demonstration connected under AICRP-Forage Crops, CCS HAU, Hisar (Haryana)

Year	Crop	Improved variety	Improved green fodder yield (q/ha)	
			range	average
2011-12	Oat	HJ 8 (MC)	510-575	535.5
		OS 346 (SC)	450-480	466.0
2012-13	Oat	HJ 8 (MC)	495-595	540.0
		OS 346 (SC)	415-510	467.0
2013-14	Oat	OS 346 (SC)	475-525	496.5
	Berseem	HB2	575-650	616.3
2014-15	Oat	HJ 8 (MC)	540-600	569.0
		OS 346 (SC)	500-525	514.0
	Berseem	HB2	550-710	652.0
2015-16	Oat	OS 403 (SC)	520-610	543.0
	Berseem	HB2	510-660	593
2016-17	Oat	OS 377 (SC)	242-1125	647.0
2017-18	Oat	OS 403 (SC)	475-550	514.0
2018-19	Oat	HJ 8 (MC)	620-650	636.0
		OS 403 (SC)	520-550	534.2
	Berseem	HB2	642-975	750.3
2019-20	Oat	HJ 8 (MC)	620-670	647.0
		OS 403 (SC)	520-565	544.2
	Berseem	HB2	720-850	786.6

Table 11: Fodder yield of tested varieties during *Kharif* season under Forage technology demonstration connected under AICRP-Forage Crops, CCS HAU, Hisar (Haryana)

Year	Crop	Improved variety	Improved green fodder yield (q/ha)	
			range	average
2013	Forage Pearl Millet	HC 20	460-600	536
	Cowpea	CS 88	340-400	368
2014	Forage Pearl Millet	HC 20	260-380	336
2015	Forage Pearl Millet	HC 20	320-360	340
2016	Forage Pearl Millet	HC 20	310-330	325
	Cowpea	CS 88	400-440	420
2017	Forage Pearl Millet	HC 20	310-360	336
	Cowpea	CS 88	290-350	322
2018	Teosinte	ITS-4*	490-520	505
	Forage Pearl Millet	HC 20	310-330	315
2019	Teosinte	ITS-4*	450-480	467
	Forage Pearl Millet	FBC 16	305-330	317
	Cowpea	CS 88	280-310	291

* Genotype tested

Project Coordinator and monitoring team visiting FTD's at farmer's fields

Fodder Technology Demonstrations at Farmer's Field

Conclusion

Forage Technology Demonstrations of oat, berseem, cowpea, fodder pearl millet and teosinte were found effective for farmers in changing mind set, attitude, skill and knowledge of improved practices of cultivation and adaptation of these crops. Farmers and scientist relationships also improved by this and built confidence among them. The farmers who have conducted forage Technology Demonstrations farmers are good primary source of knowledge or information on improved practices of fodder crops cultivation and also source of good quality seed in locality and surrounding area for next season. Hence, Forage technology demonstrations help in speedy and wider dissemination of the improved proven technology to the farming community.

Transfer of technology through forage technology demonstrations to accelerate fodder production in Chhattisgarh

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Background

Chhattisgarh is known as "Rice Bowl" of the country, rich in bio diversity. Geographical area of the state is around 138 lakh ha with net sown area of 46.51 lakh ha, which is 34% of its total geographical area. About 57% area has medium to light soil. Chhattisgarh has one of the richest bio-diverse areas in the country with around 63.4 lakh ha area under forest cover, which is 46% of its total geographical area. Chhattisgarh state is divided into three Agro-climatic zones *viz.* Chhattisgarh Plains, Bastar Plateau and Northern hill zone covering 51.0%, 28.0% and 21.0% of the geographical area, respectively. The total population of the state is around 2.55 crore, of which about 70% population is engaged in Agriculture. There are around 37.46 lakh farm families in the state, with about 80% farmers falling under Small & Marginal category. Paddy, Soybean, Urd & Arhar are the major *Kharif* crops while *Rabi* season is mainly led by Chickpea and *Lathyrus*. Other Crops of the state are Maize, Millets, Moong, Wheat, Groundnut *etc*.

Status of livestock in Chhattisgarh

The total livestock population is 535.78 million in the country with 302.79 million bovine populations (Cattle, Buffalo, Mithun and Yak) as per 20th Livestock Census 2019. Total number of cattle in the country is 192.49 million in 2019 showing an increase of 0.8% over previous census. Chhattisgarh is rich in livestock wealth and integral part of rural area. The state has about 158.72 lakhs livestock population out of which 99.84 lakhs are cattle, 11.75 lakhs are buffaloes, and the remaining 47.13 lakhs are other animals, which include sheep, goat, horse and other species. Livestock productivity in the state is poor.

Production and productivity of livestock in state

The average yield of nondescript cows that account for 55 percent of total milk output is less than 1.0 kg/day and one half of the country's average milk productivity. The crossbreed cows and buffaloes

Table 1: Livestock population in Chhattisgarh state (in lakhs)

Species	2012, 19th census	2019, 20th census	% Change
Cattle (Indigenous)	96.34	97.17	0.86
Cattle (Exotic)	1.77	2.67	50.85
Buffalo	13.90	11.75	-15.47
Goats	32.25	40.05	24.19
Sheep	1.66	1.80	8.43
Pigs	4.39	5.27	20.05
Horse,Pony,Donkey,Mule	0.05	0.008	-84
Total Livestock	150.36	158.72	5.56
Poultry	179.55	187.12	4.22

Source: Livestock development department, Government of Chhattisgarh (http://agriportal.cg.nic.in)

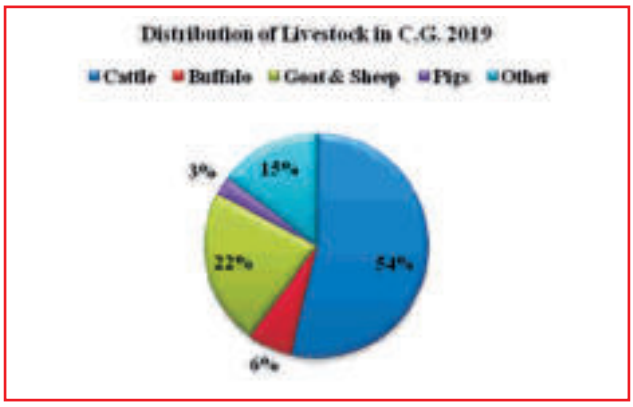

Fig. 1: Distribution of livestock in Chhattisgarh 2019

yielded 3.8 and 2.78 kg milk per day which is far lower than the national average. Per capita milk availability was 137g/day in 2017-18 which is far away from national average 375 g/day. Availability of egg was 60 eggs /day/ capita in the state. Per capita meet availability in the state was 1-0.879 kg during 2017-18. Milk production during 2017-18 was 1469 thousand tones and contributes only 0.83 per cent in national milk production. Nearly two percent egg contributed by Chhattisgarh state in national egg production.

Table 2: Per capita availability of major livestock produce

Year 2017-18	Chhattisgarh	National
Per capita milk availability (g/day)	137	375
Per capita egg availability (No)	60	74
Per capita meet availability (kg)	1-0.879	--

Source: Livestock development department, Government of Chhattisgarh (http://agriportal.cg.nic.in)

Table 3: Production of major livestock produce

Year 2017-18	Chhattisgarh	National	% Contribution
Milk production(000 Tones)	1469	176347	0.83
Egg production (In Lakh)	17718	952173	1.86
Meet production (000 kg)	55234	765563	7.21

Source: Livestock development department, Government of Chhattisgarh (http://agriportal.cg.nic.in)

Status of feed and fodder in Chhattisgarh

In Chhattisgarh state, two major sources of fodder supply are crop residual and fodder from common property resources like forests, permanent pastures and grazing land. The availability of cultivated fodder is very rare. As majority area in the state follows mono cropping approach with paddy, the availability of different varieties of fodder is also scarce. During *Kharif* grasses available in fellow land are use as fodder. A significant portion of crop residue, particularly paddy and wheat straw, is being wasted, as there is no system for chopping of straw. Whole straw is being fed to the cattle resulting in waste of fodder. The non-availability of green fodder has posed major threat for dairy development in the state. Cultivated fodder is only three percent in the state. Farmers are only dependent on paddy straw to feed the livestock, paddy straw contribute 89 % of dry fodder in the state which is less nutritious than green fodder. Therefore, Identification of suitable green fodder crops and varieties and suitable cultivation practices are necessary to boost fodder production on marginal and wastelands in the state. In the absence of superior quality livestock, farmers are reluctant to grow fodder crops as they can

divert their precious land resources for cultivating other cash crops for higher returns. Rice field bunds may be the solution for this problem, which is abundantly present in Chhattisgarh.

Table 4: Estimates of green fodder availability ('000t) and deficit/surplus status

Particular	In '000 tonnes
Cultivated land	11217.7
Cultivable wasteland	140.4
Source Fallow Land	210
Pasture Land	3104.5
Forest	1666.4
Total green fodder availability	16339
Total green fodder requirement	24430.8
Percent Availability	66.9
Percent Deficit (-)/Surplus (+)	-33.1

Source: Roy, A. K., Agrawal, R. K., Bhardwaj, N. R., Mishra, A. K. and Mahanta, S. K. (2019). Revisiting National Forage Demand and Availability Scenario In: Indian Fodder Scenario: Redefining State Wise Status. ICAR- AICRP on Forage Crops and Utilization, Jhansi, India, pp. 1-21.

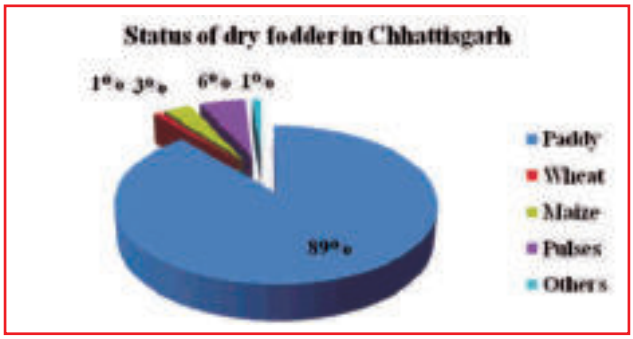

Fig. 2: Percent contribution of different crops in dry fodder in Chhattisgarh

Reasons for shortage of feed and fodder in Chhattisgarh

High livestock population with low productivity, shortage of community grazing land, lack of proper fodder management in grazing land, fragmented and small land in state, small farmers in the state giving priority to commercial crop cultivation, fodder production in very insignificant land in the state, lack of technical knowledge about fodder production, unavailability of good quality fodder seed in adequate quantity in state and lack of fodder seed production chain in the state is the major causes of fodder shortage.

Front Line Demonstrations

Front Line Demonstrations (FLDs) are unique approach to demonstrate production technology, popularized new varieties and understand the problems of framers for the improvement in research according to feedback from farmers. FLDs provide an opportunity for researchers to showcase their technology directly in farmer's field and fine tune or modify the technologies for easy adaptation. Front line demonstrations are tool to demonstrate the production potentiality of improved package of various crops under the farmer's conditions. During demonstration programme emphasis was given to increase production and productivity of demonstrated crop.

Objectives

Front line demonstration was carried out in different part of Chhattisgarh with the objectives of

- To demonstrate improved production technologies of fodder crops on the farmer's fields.

- Popularize new crops or newly improved varieties in farmers field for adoption in large are.
- To bring synergy among planers, researchers, farmers, dairy industry for the improvement of livestock sector in the state.
- To increase the area under fodder crops through demonstrations, field days, trainings and exposure visit of farmers.
- To accelerate the dairy sector in the state.
- Seed multiplication programme with framer's participation.
- Awareness development for promotion of green fodder cultivation among the farmers/dairy entrepreneurs.
- Training programme on fodder production for farmers of Chhattisgarh.

Selection of site for demonstrations

For the demonstrations, selection of site was done with the help of officials of agriculture department and Krishi Vigyan Kendra (KVK) of respective district. Selected site for demonstrations was easily accessible and at central point of the village to attract large number of audience/farmers for more impact, easy monitoring and feedback. For the better impact demonstrations was conducted in cluster approach. Framers involved in livestock rearing were selected for the demonstration. Demonstration was done at individual farmers field or community land for maximum impact. Beneficiaries of demonstration were small and marginal farmers.

Size of FLDs

The size of demonstration was 0.2 hectare to 0.4 hectare depending upon the size of plot available with small and marginal farmers. Preference was given to the farmer involving in the milk production or livestock management in the village. Individual farmer or community land was selected for the demonstration.

Critical input for demonstration

For the conduction of demonstrations on fodder production technology seeds of improved varieties were supplied to the farmer. In *Kharif* season seed of fodder maize, sorghum, perennial sorghum and cutting of bajra napier hybrid was distributed for the cultivation. In *Rabi* season improved varieties seeds of berseem and oat were supplied for demonstration. Due to limitation of funds only seed was provided to the farmers. Demonstration was done only with the regular fund and resources of AICRP-FC&U. No separate fund for FLDs was given to the center.

Implementation of plan

For the implementation of programme field level works of state government and Krishi Vigyan Kendra (KVK) of respective district was approached. Prior to the launching of the demonstrations, all participating agencies/persons may be informed well in advance about the date and venue the neighboring farmers may also be invited. Farmers were educated regarding the technologies and objectives of the FLDs in detail. Field preparation was done by the respective farmers or community for the sowing.

Monitoring

Regular monitoring of demonstration was done by the scientist of AICRP and KVK for success of demonstration and getting feedback from the farmers. Mentoring was also done by the university regularly. Monitoring was also done by the scientist from different state and project coordinating in each season, necessary suggestions was also given by the monitoring team to improve the quality of demonstration.

Demonstration of fodder crops in farmers field

Demonstrations of improved fodder production technology including new crops and varieties at farmers field were demonstrated at different part of state from 2014-15 to 2019-20. The major objectives of demonstrations were to introduce fodder crops in the area and educate the farmers towards nutritional feed and fodder for livestock. Fodder crops are new for the Chhattisgarh state; area under cultivated fodder is very limited. Rural farmers and dairy farmers are not growing fodder crops in cultivate land, majority they are depend on dry fodder and concentrate for feeding. In *Kharif* season crops like maize, annual sorghum, perennial sorghum and bajra napier hybrid was demonstrated with improved package and practices. In *Rabi* season berseem and oat crop was introduced by front line demonstration in irrigated condition. Seeds of improved varieties were given to the dairy farmers or for community land cultivation by farmers-participatory approach. Oat is new crop for the area as fodder crop and this crop is very liked by the farmers. Farmer is now taking seed production of oat to maintain the production every year. Total 174 numbers of demonstrations were conducted science 2014-15 under AICRP-FC&U with coverage of 175.5 acre area. Total 238 farmers/community farmers were benefited by the demonstrations.

Fig. 3: Front Line Technology Demonstration AICRP-Forage Crop, IGKV, Raipur

Table 5: Front line demonstration connected under AICRP-Forage Crops, IGKV, Raipur (2014-2019)

Year	No of demonstrations	Season	Crop	Area (Acres)	No of Beneficiaries
2014-15	35	*Kharif*	Maize	15	15
		Rabi	Berseem	20	20
2015-16	20	*Rabi*	Berseem	10	10
		Rabi	Oat	10	10
2016-17	43	*Kharif*	Maize	10	10
		Kharif	Perennial sorghum	10	10
		Rabi	Berseem	11	11
		Rabi	Oat	12	12
2017-18	47	*Kharif*	Maize	23	23
		Kharif	Perennial sorghum	13	13
		Rabi	Berseem	11	11
2018-19	11	*Kharif*	Maize	3	13
			Perennial	2	10
			Napier	1	10
			Denanath Grass	.5	10
			Maize	2	15
			Perennial sorghum	2	15
2019-20	10	*Kharif*	Maize	10	10
	10	*Rabi*	Oat	10	10
Total	174			175.5	238

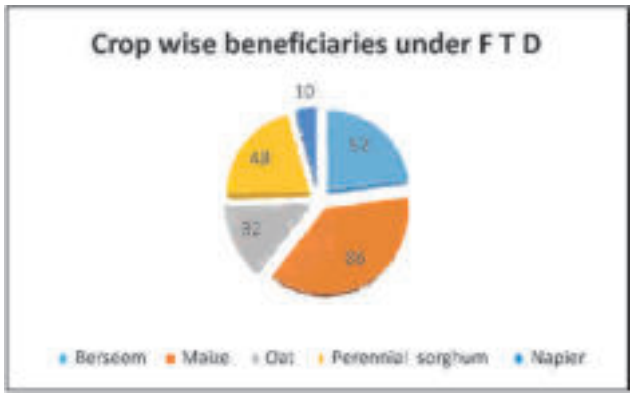

Table 6: Area and season of front line demonstration under AICRP-Forage Crops, IGKV, Raipur (2014-2019)

Year	Season	Block	District
2014-15	*Kharif*	Arang, Dharsiwa	Raipur
	Rabi	Arang, Dharsiwa	Raipur
2015-16	*Rabi*	Arang, Dharsiwa ,Tilda	Raipur
	Rabi	Arang, Dharsiwa ,	Raipur

2016-17	*Kharif*	Dhamda,Arang, Dharsiwa ,Bastar,Kurud	Raipur, Bastar, Dhamtari
	Rabi	Dhamda and Arang	Raipur
2017-18	*Kharif*	Dharsiwa, Ambagarh Chowki,	Raipur, Rajnanadgaon
	Rabi	Dharsiwa, Arang, Mainpat	Raipur, Ambikapur
2018-19	*Kharif*	Mainpat,Arang	Ambikapur,Raipur
2019-20	*Kharif*	Arang	Raipur
	Rabi	Arang and Dharsiwa	Raipur

Table 7: Crops and varieties under front line demonstration AICRP-Forage Crops, IGKV, Raipur (2014-2019)

Crop	Varieties	Farmer's practice	Improved green fodder yield q/ha (Range)
Maize	African Tall, J-1006	Very poor local variety	300-350
Berseem	Mescavi, Wardan Bundel Berseem-2,JB-5	No local check in the area	400-450 (4 cuts)
Oat	Kent, RO-19,JHo-822	New crop introduced	400-500 (2 to 3 cuts)
Perennial sorghum	COFS-29	New crop introduced	800-1000 (5-6 Cuts/year)
Bajra Napier Hybrid	RBN-13,CO-5	Very old cultivar, yield poor	800-1200 (5 Cuts/year)
Sorghum	MFSH-3,SSG-59-3 Mega sweet, PC-23	Very poor local variety	400-425 (2-3 cuts)

Community fodder land development programme

A village-centric approach towards a sustainable rural economy to revive the agricultural economy "Narwa, Garuwa, Ghurwa and Baadi: Gaon la bachana sangwari" is collective action to ensure water conservation, livestock development, compost usage, and cultivation of vegetable and fruit started by the Chhattisgarh government. The mission, called *'Suraaji Gaon Yojana'* (or well-governed village), is implemented by the government in the state. Under the scheme every village has been instructed to keep at least 3 acres government land reserved for *Gauthan* and in each *Gauthan* fodder production and management is done by the *Gauthan* management committee. After launch of this programme cultivation of Bajra Napier Hybrid, perennial sorghum, fodder maize, oat etc. are cultivate by the *Gauthan Samitee*. Detailed round the year program, training and material support is provided by the AICRP and KVKs.

Fig. 4: Community fodder production at Gauthan Korea district, Chhattisgarh

New crop introduced through FLD

Fodder oat crop introduced through front line demonstration in the state for cultivation. Oat variety Kent, RO-19 and JHO-822 was very liked by the farmers. Two to three cutting was taken by the farmers with the yield potential 500 to 550 q/ha. Some farmers are also taking seed production to maintain the crop. Seed yield of this varieties are 15-25 q/ha in farmers field. Climate and soils are suitable for this crop in the state.

Capacity building programme

Time to time trainings, field visits, exposure visits, workshops *etc* programme were organized to build up capacity of the stake holders including dairy sector rural farmers, students and planners towards fodder production. Chhattisgarh government launched *GUTHAN* concept at every village, under this programme five acres land are reserved for fodder production in each *GUTHAN,* trainings are very useful for the state government, community fodder land management committee and individual farmers to know about the feed and fodder. Trainings and recommendations of crop varieties are done under the umbrella of AICRP in the state.

Table 8: Trainings, field visits, exposure visits conducted under AICRP-FC&U

S.No.	Trainings, field visits, exposure visits	Number
1.	Training for state government	03
2.	Training for KVK's staff	04
3.	Tanning on fodder production under TSP	50
4.	Training of input dealers under DESI programme for feed and fodder	12
5.	Exposure visits	02
6.	Field visits UG, PG and Ph.D students on fodder block	06
7.	Training of GUTHAN management committee	04
8.	Visit of APC, V.C. IGKV, Raipur along with Directors, Deans, PC, SMS and scientist in forage demonstration block.	12

Fig. 5: Hands on training on fodder production

Seed production programme

Demands of quality fodder seeds of improved varieties are very high in the state. To find out quality seed timely, for dairy sector, individual farmer and government scheme are difficult in the state. Proper seed production chain of fodder crops are not established in the state till now. By the effort of AICRP-FC&U, seed production of bajra napier hybrid, perennial sorghum, maize, oat *etc.* are started in community farmer land, KVKs and university farm to fulfill the demand of state. By joint effort of KVK Korea and AICRP FC&U seed production of BN hybrid CO (BN) 5, perennial sorghum COFS-29 stated in 10 acre community by the *Panchayat samitis* of *Manendragadh,* Sonhat , Khadganwa and Baikunthpur blocks of Korea district. A total revenue of Rs. 2.92 lakhs as income was received by sale of two budded stem cuttings, by 10 village *Panchayat samitis*. *Looking to the* successes of KVK Korea,

seed production of bajra napier hybrid COBN-5, Oat, Maize stated by the KVK Mahasamund under the guidance of AICRP-FC&U in the year 2019-20. With the help of Durg district administration seed production of fodder crops started by KVK Durg from *Kharif* 2020 with the technical support of AICRP. A new full flash fodder seed production farm started at Collage of Agriculture and Research Station Bhatapara by the financial support of RKVY in 50 acres land is under progress. Established BNH and perennial sorghum and maize completed in *Kharif* for seed production in this farm.

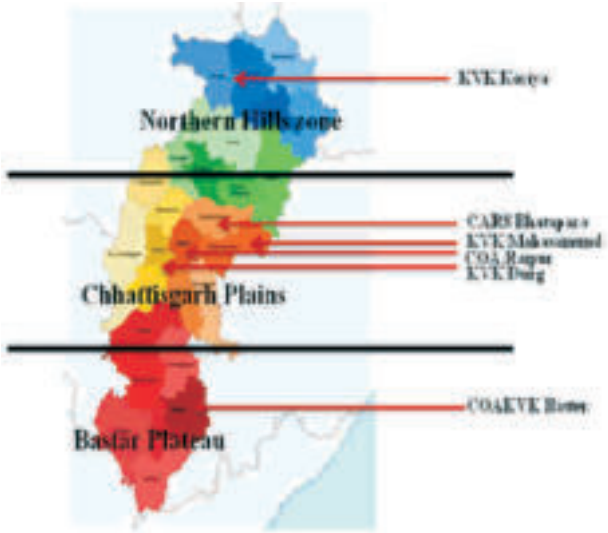

Fig. 6: Location of fodder seed production farm/Community land at Chhattisgarh

Fodder Crop cafeteria in KVKs for crop and variety demonstration

Crop Cafeteria plays an important role to showcase crops, new varieties and suitable technology for particular area for the technology transfer among farming communities. To educate in fodder crops and technology, fodder crop cafeteria was established in each *Krishi Vigyan Kendras*of Chhattisgarh with the help of university fund. Total 26 KVKs participated in this programme and established fodder crop cafeteria in front of KVK building to show suitable crops and varieties of the region. Cafeteria provides practical experiences based on principle of '*Seeing believes'* and face to face views along with KVK's technocrat for adaptation of crops and technology. For successful establishment of fodder crop cafeteria in different KVKs of Chhattisgarh, mini kits of fodder crops and varieties was arranged by the AICRP-FC&U Raipur center in *Kharif, Rabi* and summer season along with technical guidance.

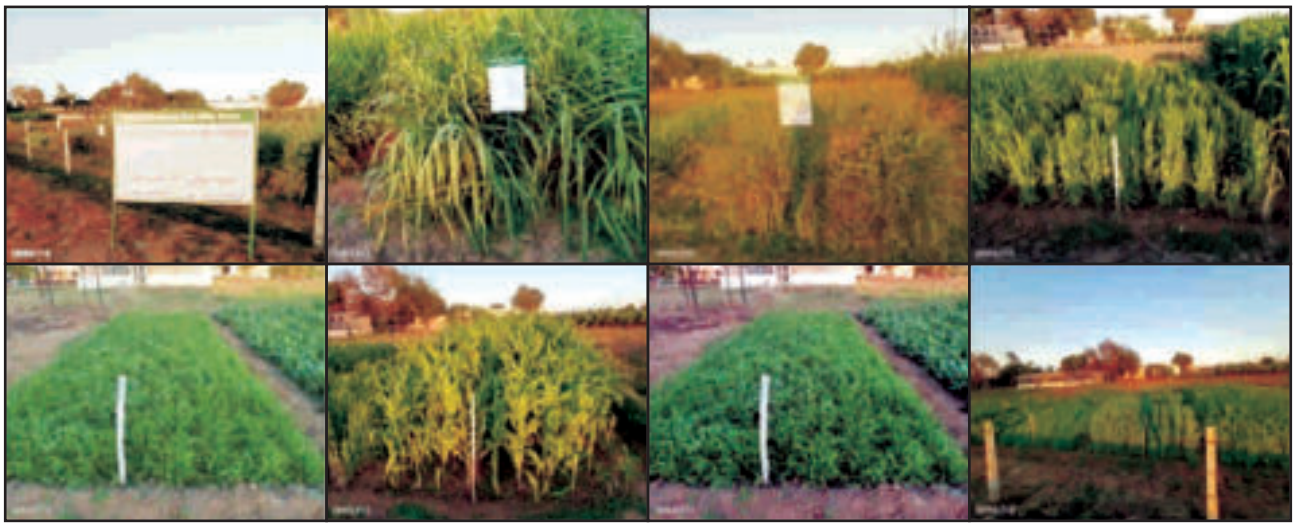

Fig. 7: Fodder Crop cafeteria at IGKV, Raipur

Fig. 8: Fodder Crop cafeteria at different KVKs

Impact

Farmer Charan Lal Sahu district- Raipur State-Chhattisgarh was selected for the front line technology demonstration. Berseem during the year 2014-15. Now former harvested five cuttings of berseem and excess forage was given to the dairy near by the city. Additional berseem was sale to the dairy @ Rs 3 / kg and earns additional Rs 36,173 in three month which was more than any crop grown traditional in Chhattisgarh during *Rabi.*

Fig. 9: Berseem Field Shri Charan Lal Sahu

Praful Taunk (District- Mahasamund) started fodder production during 2015 in small area as FLD. After surplus production of fodder, he started silage preparation of maize and sells to dairy @ 6 Rs/kg

and earns double than green fodder. Now he earns a net income of Rs. 60,000 per acre. This is the milestone for other farmers to generate income through fodder production

Fig. 10: Fodder crop ready for sale (farmer details) Praful Taunk, village- Semariya, Chhattisgarh

Forage Technology Demonstrations in Eastern Uttar Pradesh: A Brief Report

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Forage Technology Demonstrations (FTDs) is a unique approach to provide an direct interface between researcher and farmers as the scientists are directly involved in planning, execution and monitoring of the demonstrations for the technologies developed by them and get direct feedback from the farmers' field about the crops like wheat, rice and pulses production in general and technology being demonstrated in particular. This enables the scientists to improvise upon the research programme accordingly. In FTDs, the subject matter scientists provide technological inputs to extension scientists to organize the demonstrations. Thus, FTDs provide an opportunity to researchers and extension personnel for understanding the farmer's resources and requirement to fine tune and/or modify the technologies for easy adaptability at farmers' fields.

Forage Technology Demonstrations (FTDs)

Demonstration is a form of applied research through ICAR/SAUs system on latest notified/released varieties along with full package of practices on selected farmers' fields with a view to demonstrate the potentiality of the technologies to (a) participating farmers (b) neighboring farmers and other agencies; (c) to analyze the production (d) performance of the technologies for scientific feedback.

Objectives

- To demonstrate improved Crop Production Technologies of Rice, Wheat and Pulses on the farmers' fields;
- To popularize the newly notified and improved varieties/technologies for varietal diversification and efficient management of resources.
- To bring synergy among planers, researchers, farmers and industry for parable interface through seminars/symposium on emerging themes of importance in the field of Rice, Wheat and Pulses production for deciding strategies for development of these crops.

Selection of technology, site and beneficiary

The need and necessity of demonstration was based on the emerging issues. The technology decided was discussed along with the results of the station trials in the National Group Meeting and the technical programme was finalized.

Participatory approach was followed in conducting demonstrations associating scientists and farmers, so that we effective implementation leading to better adoption and diffusion of technology. Other equal size plots of the demonstrating farmers or the equal size of plot of neighbouring farmers in the same farming situation was treated as control plots for objective comparison of the results. Selection of the site was decided in consultation with extension unit of SAU and KVKs The farmers were selected absed on their interest to grow fodder and livestock holdings. Preference for FTDs were given to the Socio-economically backward/Small Marginal/SC/ST/Women.

Table 1: Fodder technology demonstration in eastern UP during 2017-18

Thematic Area	Name of KVK	Technology demonstrated	No. of Farmers	Area (ha)	Yield (Q/ha) Demonstrations			Check	% Increase
					High	Low	Avg.		
Varietal evaluation	Ambedkar Nagar	BL 13	12	0.50	672.0	610.0	646.4	564.9	14.84
	Azamgarh	BL 13	30	1.00	729.0	652.5	690.8	560.7	23.20
	Balrampur	Bundel Berseem-3	12	0.80	469.0	393.0	431.0	332	24.72
	Basti	BL 02	2	0.50	995.0	935.0	965.0	750	28.66
	Basti	JHO 822	30	2.80	375.0	312.0	345.0	275	25.45
Feed/ Fodder Management	Ayodhya	NDO1	10	1.00	524.00	475.00	499.50	391.00	27.75
	Siddharth Nagar	Vardan	20	2.00	745.0	685.0	710.0	585.00	21.36
	Siddharth Nagar	NB 21	16	0.80	855.0	790.0	825.0	640.0	28.91

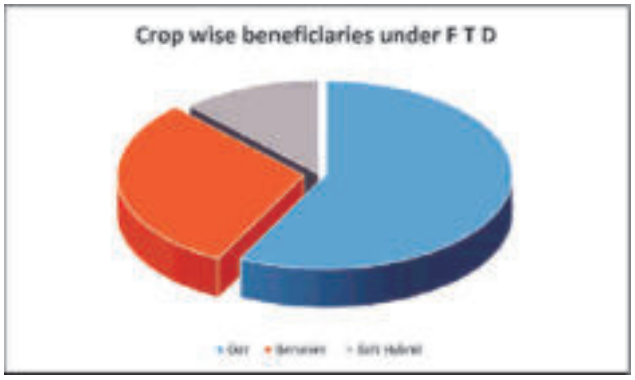

Fig. 1: Crop wise beneficiaries under F T D conducted by Ayodhya centre

It is evident from table 1 that FTDs on fodder crops under varietal evaluation has shown 14.84 per cent to 28.66 per cent increase over local check. Whereas, the increase under feed and fodder management varies from 21.36 per cent to 28.91 per cent during 2017-18 in Eastern part of UP.

Table 2: Fodder technology demonstration in eastern UP during 2018-19

Thematic Area	Name of KVK	Technology demonstrated	No. of Farmers	Area (ha)	Yield (Q/ha) Demonstrations			Check	% Increase
					High	Low	Avg.		
Varietal evaluation	Ambedkar Nagar	Berseem	25	1.00	640.30	554.40	598.26	500.02	16.40
	Balrampur	Berseem	15	0.60	419.40	326.20	369.54	264.11	28.53
	Siddharth Nagar	Berseem	10	1.00	678.10	542.30	612.24	458.62	25.09
	Ayodhya	JHO-822	20	2.00	292.35	215.20	253.78	162.90	35.81
	Ayodhya	NDO-1	10	1.00	530.00	480.00	505.00	395.00	27.85
	Basti	JHO-822	26	2.60	343.80	275.80	310.12	233.42	24.73
Feed/ Fodder Management	Azamgarh	Napiar grass	5	0.13	140.70	90.60	115.68	51.42	55.56
	Azamgarh	Napiar grass	5	0.13	120.65	80.84	105.42	52.71	50.10

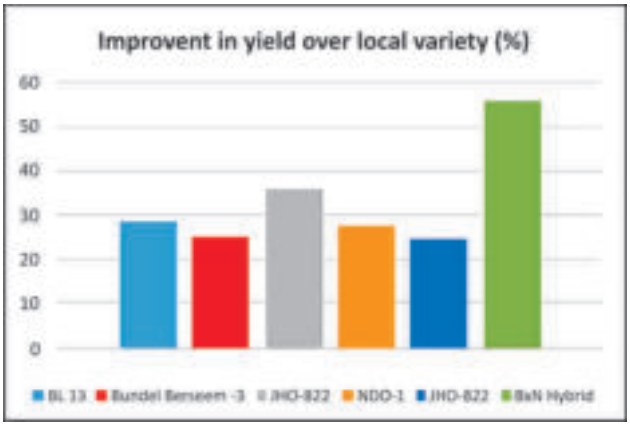

Fig. 2: Improvent in yield over local variety (%)

Table 2 revealed that FTDs on fodder crops under varietal evaluation has shown 16.40 per cent to 35.81 per cent increase over local check. Whereas, the increase under feed and fodder management varies from 50.10 per cent to 55.56 per cent during 2018-19 in Eastern part of UP.

Table 3: Fodder technology demonstration in eastern UP during 2019-20

Thematic Area	Name of KVK	Technology demonstrated	No. of Farmers	Area (ha)	Yield (Q/ha) Demonstrations			Check	% Increase
					High	Low	Avg.		
Varietal evaluation	Ambedkar Nagar	SSG-998	17	1.00	339.50	275.40	305.75	234.57	23.28
	Ambedkar Nagar	Wardan	25	1.00	419.40	326.20	277.60	198.35	28.53
Integrated	Azamgarh	Hybrid Napier	05	0.13	140.60	90.50	115.46	52.64	52.65
Fodder Management	Azamgarh	Hybrid Napier	05	0.13	120.36	80.60	98.62	50.10	49.60
Varietal evaluation	Basti	JHO-822	26	2.60	343.53	275.90	306.58	218.20	29.82
	Ayodhya	NDO-1	10	1.00	535.00	485.00	510.00	398.00	28.14
	Gonda II	CO 3	20	1.00	715.00	658.00	686.90	505.50	26.36
Integrated Nutrient Management	Siddharth Nagar	Wardan	10	1.00	645.00	602.00	618.70	495.38	22.36
Varietal evaluation	Sultanpur II	Berseam	15	0.60	449.40	336.20	386.54	364.10	26.53

Impact

Eastern part of UP thogh progressive in crop cultivation, but the forage availability as well as sensitization among the farmers is very poor. Forage FTDs has made a significant effect on adoption pattern of dairy farmers towards forages for the benefit of their dairy animals which can be verified with increase in the milk production of dairy animals in eastern UP. Increase in forage acerage and quality will defiantly play a greater role in doubling farmer's income. FTDs on fodder crops under varietal evaluation has shown 23.28 per cent to 29.82 per cent increase over local check. Whereas, the increase under Integrated Fodder Management varied from 49.60 to 52.65 per cent.

Forage Technology Demonstrations in Madhya Pradesh

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Introduction

Livestock plays an important role in Indian economy, as our country with vast livestock resources, ranks first in total buffalo population and second in cattle and goat population in the world. India with 2.3% share of global geographical area supports nearly 20% of the livestock population of the World, notably among them are buffalo (55%), goat (20%), cattle (16%) and sheep (5%). Also, with 187.7 million tons production of milk, India ranks first in the world (DAHD&F report). About 20.5 million people depend upon livestock for their livelihood. It provides livelihood to about two-third of the rural community and provides employment to about 8.8% of population in India. Further, the livestock sector in India contributes 4.11% GDP and 25.6% of total agricultural GDP. The desired annual growth of agriculture sector @ 4% can be accomplished by enhancing productivity from the livestock sector. This would require a steady supply of fodder for supporting the livestock population. Having only 4% of total cropping area under fodder cultivation has resulted in a gross deficit of green fodder (36%), dry fodder (40%) and concentrates (57%). Also, as compared to the requirement, availability of feed and fodder is low. Therefore, the need of the hour is, to fulfill this shortfall in demand for fodder (which is over 55%) from crop residues and agricultural by-products.

Fodder deficit can mainly be attributed to our limitations in increasing the area under fodder crops, limited availability of good fodder varieties/hybrids, lack of quality seeds of improved varieties/hybrids, poor quality of dry fodder like paddy/wheat straw etc. Besides, low priority accorded to investment in fodder production, lack of post-harvest management for surplus fodder, poor management of grazing/pasture lands and inadequate research, extension and manpower support have only aggravated the situation. (Dash, 2017). Thus**,** Fodder Technology Demonstrations (FTDs) were started during XI Plan with the key objectives of disseminating and demonstrating the available forage crops production technologies on the farmer's field in forage deficit regions for augmenting fodder productivity. The ICAR- Zonal Project Directorate as the Nodal Institution is coordinating the implementation of this programme through AICRP on forage crops across the country. The requirement of seed / slip to implement the programme has also been worked out. Demonstrations were made on Maize, Ricebean, Berseem, Oat and Hybrid Napier as fodder crop.

Emergence of the Concept of FTD

Forage Technology Demonstrations (FTD) is one of the most powerful tools of extension. Because farmers, in general, are driven by the perception that 'Seeing is believing'. Farmers lack knowledge about the scientific methods of production of crops, more often than not. Earlier, the farmers used to cultivate based on the knowledge transmitted to them by their forefathers and through the generation. The level and purity of knowledge deteriorated leading to a grossly unscientific agronomic, nutrient management and pest management practices. As a result, of these they often fail to achieve the desired level of yield associated with high cost of cultivation. The objective of Forage Technology Demonstrations (FTDs) is to demonstrate newly released crop production and protection technologies and its management practices in the farmer's field to study the constraints of production, factors contributing for higher production and thereby generate production data and feedback information.

While demonstrating the technologies in the farmers' field, the scientist are required to study the factors contributing higher crop production, field constrains of production and thereby generating production data and feedback information. Forage Technology Demonstrations were conducted on farmers field to show better impact of the demonstrated technologies with the objectives (a) To demonstrate the productive potential of newly released technologies those likely to be released in near future to farmers' conditions (b) To get first hand feedback on the contributory or limiting factors for achieving the productive potential of the new technology (c) To prepare technical leadership in the village and to convince extension functionaries and farmers together about the potentialities of technologies for further wide scale diffusion and (d) To organise need based training programmes for Subject Matter Specialists, Extension Workers, Farmers etc. (e) Act as a source of generating data on factors contributing higher crop yields and constraints of production under various farming situations.

Vision, Mission, Objectives and Functions of FTD

Forage Technology Demonstrations are conducted under the project AICRP-Forage crops, was initiated in 2011 by JNKVV, Jabalpur in district Jabalpur with following vision, mission, objectives and functions:

Vision

Meeting the technological requirement of forage production and feeding systems for high livestock productivity with improved cultivars, eco-sustainable production, feeding and processing technologies.

Mission

Generating and disseminating technologies for enhanced quality of forage and livestock productivity in socio-economic and environmental perspectives

Objectives

- Enhancement in forage productivity
- Technology dissemination and capacity building
- Promote forages for desirable and efficient means of utilizing land resources for food and forage production
- Direct and encourage research and education to expand forage production, utilization, and marketing

Functions

- Collection, evaluation, documentation and conservation of forage genetic resources.
- Basic and strategic research on improvement, production and utilization of fodder crops and grasslands. Coordinating and collating research work on forages and grasslands.
- Provide consultancy and expertise in the area of forages and grasslands.
- Technology transfer and human resource development.
- To coordinate multi-location testing programmes at the national level for identification of appropriate varieties and production technologies for different agro-ecological conditions.

Methodology

Under AICRP-Forage crops project, fodder crops viz Maize, Rice bean and Hybrid Napier in *Kharif* season, and Berseem and Oats in *Rabi* season have been demonstrated since 2011 by JNKVV, Jabalpur (MP), near block Panagar of district Jabalpur. Villages UrduaKhurd, Maniyari, Gurgawan, etc were selected for conducting the demonstration, as the farmers of the selected villages were mostly engaged

in cattle rearing, dairy and vegetable production .These demonstrations were conducted with the aim of introducing high yielding nutritious fodder varieties with improved technology in the farmers fields, augmenting high fodder production, following the concept of "Seeing is Believing". From 2011 to 2019, in total 325 forage technology demonstration were carried out near panagar block of district Jabalpur. Out of the total 107 demonstrationswere conducted on berseem,77 on Oat ,53 on Maize and rice bean each and 35 on Hybrid Napier.These demonstrations were carried outaiming at increasing the area under fodder crop in the villages by convincing and motivating farmers to cultivate fodder crop in their land to eliminate the nutrition deficiency in animals.

Fig. 1: FTD on Berseem

Achievements

Under AICRP-Forage crops project, Forage technology demonstration by JNKVV, Jabalpur were started from *Kharif*, 2011 to demonstrate improved fodder production technologies including new varieties under farmers field through coordinating and cooperating centres of AICRP (FC&U). A total of 141 and 184 FTD's were conducted during *kharif* and *Rabi* seasons, respectively under annual, perennial and multi-cut fodder crops. The description of Forage Technology Demonstration allocated and conducted by AICRP in given in Table 2 and 3.

Table 1 shows that, with the induction of Fodder Technology demonstration in 2011, there is continuous increase in yield of the fodder crops by using improved technology in comparison to farmers practice. It was found that in *Kharif* season from 2011-2019 on an average, the yield increased by 23.25 % in Maize and by 22.35 % in Rice bean with the B:C ratio of 3.10 and 2.31 respectively.

Table 1: Fodder Technology demonstration (2011-19) in *Kharif* season

S.No.	Crop	Year	No. of FTDs	GFY (q/ha)		% increase	B:C ratio	
				IT	FP		IT	FP
1.	Maize	2011 (k)	5	430	335	22.09	2.71	1.74
		2012 (k)	8	445	352	20.89	3.19	1.66
		2013 (k)	10	440	330	20.45	3.14	1.62
		2014 (k)	5	437	345	21.05	3.21	1.66
		2015 (k)	5	445	325	26.96	3.23	1.79
		2016(k)	5	425	315	25.88	3.10	1.68
		2017(k)	5	440	346	21.36	3.15	1.75

		2018(k)	5	450	340	24.44	3.07	1.72
		2019(k)	5	445	330	26.13	3.11	1.74
		Total	**53**	441.8	336.4	**23.25**	3.10	1.70
2.	Rice bean	2011 (k)	5	310	258	16.72	2.00	1.42
		2012 (k)	8	360	272	24.44	2.35	1.36
		2013 (k)	10	352	270	23.29	2.31	1.33
		2014 (k)	5	340	260	23.52	2.39	1.39
		2015 (k)	5	330	255	22.05	2.34	1.33
		2016(k)	5	365	275	24.65	2.41	1.40
		2017(k)	5	340	270	20.58	2.35	1.35
		2018(k)	5	330	255	22.72	2.40	1.37
		2019(k)	5	345	265	23.18	2.30	1.33
		Total	**53**	345.7	264.4	**22.35**	2.31	1.36
3.	Bajra x	2011 (k)	7	326	-	-	-	-
	Napier	2012 (k)	8	295	-	-	-	-
	hybrid	2013 (k)	10	302	-	-	-	-
		2014 (k)	5	317	-			
		2015 (k)	5	310	-			
		Total	**35**	**310.0**	-	-	-	-
		Grand Total				**141**		

GFY – Gross Fodder Yield, IT-Improved Technology, FP- Farmers Practice

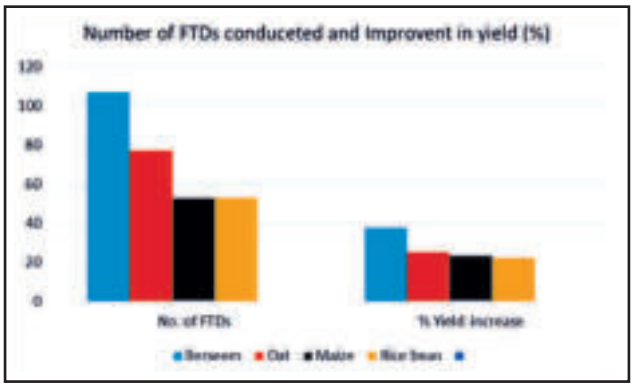
Similarly, Table 2 depicted that in *Rabi* season also, from 2011-2019, in comparison to farmers practice, the yield on an average increased by practicing improved technology by37.43% in Berseem and 25.04% in Oats with B:C ratio of 2.13and 2.21 respectively. Also, total number of FTD conducted were 107 in berseem and 77 in oats.

Table 2: Farmers Technology demonstration (2011-19) in *Rabi* season

S.No.	Crop	Year	No. of FTDs	GFY (q/ha) IT	GFY (q/ha) FP	% increase	B:C ratio IT	B:C ratio FP
1.	Berseem	2012 (R)	17	740	485	34.45	4.36	2.08
		2013 (R)	20	748	481	35.69	4.32	2.09
		2014 (R)	15	750	475	36.33	4.33	2.11
		2015 (R)	10	760	465	38.81	4.39	2.14
		2016 (R)	10	755	460	39.07	4.41	2.13
		2017 (R)	10	750	475	36.66	4.35	2.23
		2018 (R)	10	780	470	39.74	4.39	2.14
		2019 (R)	15	775	475	38.70	4.35	2.12
		Total	**107**	**757.2**	**473.2**	**37.43**	**4.36**	**2.13**

2.	Oat	2012 (R)	11	530	405	23.58	3.28	2.07
		2013 (R)	10	538	402	25.27	3.26	2.05
		2014 (R)	10	510	390	23.52	3.21	2.09
		2015 (R)	10	515	395	23.30	3.27	2.10
		2016 (R)	8	535	410	23.36	3.31	2.06
		2017 (R)	10	540	390	27.77	3.29	2.09
		2018 (R)	9	530	400	26.00	3.25	2.10
		2019 (R)	9	545	395	27.52	3.21	2.14
		Total	**77**	**529.7**	**404.6**	**25.04**	**3.26**	**2.21**
		Grand Total			**184**			

GFY – Gross Fodder Yield, IT-Improved Technology, FP- Farmers Practice,



Number of FTDs conduceted and Improvent in yield (%)

Fig. 2: Harvesting of Fodder crop

Conclusion

It can be concluded that to meet the increasing need dairy products, steady supply of fodder is required for supporting the livestock population, for which there is need to cover more and more area under fodder crops. Further, for augmenting fodder productivity, improved forage crops production technologies should be disseminated amongst farmers and demonstrated on the farmer's field in forage deficit regions. The farmers need to be convinced and motivated for cultivating fodder crop in their field by demonstrating them the positive impact of fodder production. Promoting and expanding the utilization of forages can help in improving the economic and social well-being of all farming

community. Also, FTD can meet the technological requirement of forage production and feeding systems for high livestock productivity with improved cultivars, eco-sustainable production, feeding and processing technologies.

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Forage Technology Demonstration-Extension tool

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Importance

Front Line demonstration is a proven extension mechanism with the objectives of demonstrating the usefulness of the latest improved crop production and protection technologies to the farmers as well as extension workers with a view to reduce the time gap between technology generation and its adoption. It also enables the scientists to obtain direct feedback from cotton farmers and suitably reorient their research programs, develop appropriate technology packages and to create effective linkage among scientists, extension personnel and farmers.

Livestock scenario in the state

According to the 2019 Livestock census in the state, total bovine population is 144.94 lakh heads, among which the population of cattle is 117.50 lakhs and that of buffaloes is 27.30 lakhs respectively. Out of 117.50 lakhs cattle population, 80.65 lakhs are indigenous, 36.99 lakhs are crossbred. There was significant increase of 78 per cent in cross bred cows in the state. The population of sheep is 111 lakhs with increase of 54 per cent and that of goats is 61 lakhs with increase of 38 per cent (*Source*: Directorate of Animal Husbandry and Veterinary Services, GoK, Bangalore).

Fodder scenario in Karnataka

In Karnataka fodder crops are grown in an area of 6.59 Lakh ha which comprises major crops of fodder maize, sorghum, bajra, cowpea, lucerne and napier-bajra hybrids as a pure as well as intercrop/mixed crops in regular cropping system. The frequent droughts necessitates to increase productivity with climate resilient genotypes and to utilize non agricultural lands & unconventional fodder resources as alternate source for fodder development. The crop residues still contributing more than 71 % to the total fodder availability, which necessitates better utilization of dry fodder through processing and nutrition enrichment, apart from these, development and promotion of high yielding leguminous fodder crops and top feeds necessitates to improve green fodder productivity and quality. In the state, the availability of green fodder, dry fodder and concentrates are 85, 15 and 7.5 million tonnes against the present requirement of 122, 25.4 and 29.5 million tonnes with a net deficit of 30, 40.95 and 74.50 per cent, respectively. To meet the current level of green fodder demand by livestock and its annual growth in population, the deficit in green fodder and dry fodder has to be met from either increasing productivity, utilizing untapped feed resources, increasing land area under fodder crops or through the adoption of some innovative strategies and educating farmers through forage technology demonstration and training.

Table 1: Details of FTD's conducted

Sl. No	Crop	Variety	Number of FTDs
1	B x N Hybrid	Co-3 & BNH-10	94
2	Guinea grass	JHGG-08-1	70
3	Fodder Maize	African Tall	90
4	Multi cut fodder sorghum	CoFS-29	90
5	Fodder Bajra	BAIF Bajra-1	60

6	Fodder Oats	OS-6 & Kent	90
7	Fodder Cowpea	KBC-2, MFC-08-14 & MFC-09-1	125
8	Lucerne	RL-88 & Co-1	115
	Total		**734**

Totally 734 forage technology demonstration were conducted during 2013 to 2019 involving 8 important forage crops and varieties of the region with the purpose of introducing high yielding varieties and production technologies for enhancing green forage yield and quality, to overcome the scarcity of fodder, reducing the cost of milk production and better utilization of available resources. The details of forage technology demonstrated are given in Table 2.

Table 2: Details of forage technology demonstrated

Year	Technology	Number of farmers	GFY q/ha Range Mean		DMY q/ha Range Mean	
			Farmers Practice	Improved Practice	Farmers Practice	Improved Practice
Kharif 2013	Guinea grass variety	10	734.4	807.2	144.0	163.9
	JHGG-08-1		(599.0-893.0)	(672.0-957.0)	(127.6 -188.1)	(110.8- 190.2)
	Fodder Cowpea	10	268.8	289.9	55.1	60.0
	Variety: KBC-2		(218.1-307.3)	(232.0-334.0)	(42.9-64.0)	(47.2-67.3)
	Fodder Maize	10	259.7	283.4	52.2	57.5
	Variety: African tall		(214.0-2940)	(243.0-327.0)	(42.2-66.3)	(46.32-67.66)
Kharif 2014	Guinea grass	10	646.4	685.1	103.9	110.7
	Variety: JHGG-08-1		(479.6-811.8)	(545.0-821.7)	(80.0-127.1)	(89.9-128.4)
	Fodder Cowpea	10	262.8	298.8	53.9	66.25
	Variety: MFC-08-14		(204.5-340.9)	(235.0-383.0)	(41.1-72.6)	(54.1-84.3)
	Fodder Maize	10	275.5	312.1	55.8	69.2
	Variety: African tall		(247.4-293.9)	(286.0-334.0)	(49.8-63.2)	(62.2-74.8)
Rabi 2014	Fodder Oat	10	303.1	335.7	62.0	69.3
	Variety OS-6		(251.5-366.2)	(276.4-383.4)	(52.8-72.5)	(53.1-79.6)
	Lucerne	10	387.5	437.2	80.1	98.2
	Variety RL-88		(336.8-447.8)	(395.3-493.7)	(72.2-91.8)	(91.4-115.9)
Kharif 2015	Guinea grass	10	645.1	681.9	370.9	386.1
	Variety: JHGG-08-1		(540.1-720.6)	(569.7-773.7)	(360.7-388.3)	(359.3-406.5)
	Fodder Cowpea	10	265.8	297.1	55.4	71.0
	Variety MFC-08-14		(222.2-303.8)	(245.4-342.5)	(43.3-66.3)	(61.4-89.0)
	Fodder Maize	10	480.6	535.7	99.5	123.2
	Variety African Tall		(402.0-600.4)	(453.7-657.6)	(80.4-127.9)	(105.3-154.9)
	Fodder Bajra	10	422.7	472.2	60.3	71.0
	Variety: BAIF Bajra		(363.0-502.7)	(398.3-561.7)	(50.2-72.3)	(61.4-89.0)
Kharif 2016	Bajra x Napier Hybrid	10	1208.8	1416.4	148.7	212.9
	Variety: Co-3		(1038.2-1437.8)	(1210.1-1685.1)	(127.7-176.8)	(184.2-267.0)
	Crop: Guinea grass	06	341.7	467.4	68.5	92.6
	Variety JHGG-08-1		(278.5-415.8)	(359.7-563.7)	(53.3-79.9)	(71.3-103.6)
	Fodder Cowpea	10	281.26	355.68	61.7	82.3
	Variety: MFC-08-14		(228.6-298.2)	(295.4-382.5)	(54.4-73.7)	(73.4-95.0)
	Fodder Maize	10	413.93	554.62	98.58	137.01

	Variety African tall		(366.5-499.2)	(483.7-667.6)	(83.9-116.7)	(107.3-158.9)
	Fodder Bajra	10	419.2	559.3	97.8	140.9
	Variety: BAIF Bajra		(349.7-499.2)	(482.9-687.6)	(82.1-125.5)	(125.5-178.9)
	Integrated crop	10	750.4	950.5	129.5	177.7
	Management Co-3		(658.6-835.3)	(828.1-1093.5)	(98.0-147.7)	(140.4-216.0)
Kharif 2017	Integrated Crop	10	2040.9	2313.0	318.6	375.8
	Management (Co-3)		(1448.0-2403.0)	(1794.0-2595.0)	(261.5-362.4)	(310.0-441.2)
	Fodder Maize	25	376.5	445.0	83.5	102.5
	Variety African tall		(312.0-445.0)	(384.0-503.0)	(63.2-106.3)	(83.2-126.6)
	Fodder Bajra	10	346.5	392.0	75.2	88.5
	Variety: BAIF Bajra		(315.0-403.0)	(356.0-432.0)	(64.9-88.7)	(79.4-99.1)
	Integrated crop	25	265.3	320.0	62.1	76.7
	Management technology		(207.0-313.0)	(261.0-372.0)	(47.6-75.2)	(66.2-92.6)
	(Fodder Cowpea: MFC-08-14)					
	Integrated crop	20	616.2	732.9	144.4	172.6
	Management technology		(510.0-725.0)	(633.0-832.0)	(112.2-175.6)	(133.4-199.5)
	(Multi cut Fodder Sorghum:					
	CoFS-29)					
	Guinea grass	10	710.3	797.2	115.8	141.7
	(Variety JHGG-08-1)		(617.0-780.0)	(707.0-886.0)	(103.4-139.0)	(122.9-151.6)
Rabi 2017	Technology Intervention	5	348.9	399.4	73.4	88.7
	on Fodder Oat		(310.0-368.7)	(368.7-425.8)	(58.9-81.6)	(81.1-97.9)
	(Kent)					
	Technology Intervention	06	619.1	703.3	130.0	156.3
	on Fodder Oat		(580.0-612.6)	(678.4-739.8)	(110.2-137.7)	(142.5-170.2)
	(Kent)					
	Fodder Cowpea	10	346.5	392.0	75.2	88.5
	Variety: MFC-08-14		(225.0-298.4)	(299.5-388.1)	(42.8-64.0)	(68.9-84.2)
Kharif 2018	B X N Hybrid	10	741.5	858.2	115.4	131.3
	Variety Co-3		(589.0- 934.0)	(663.0-1136.0)	(87.14-149.15)	(98.9-170.4)
	Fodder Maize	10	398.5	456.6	78.2	89.8
	Variety: African tall		(375.0-475.0)	(415.0-549.0)	(71.4-93.4)	(82.4-101.4)
	Fodder Bajra	10	339.7	395.5	68.9	95.5
	Variety BAIF Bajra		(285.0-401.0)	(325.0-448.0)	(54.2-89.3)	(69.1-196.2)
	Integrated crop	10	270.3	325.9	56.6	68.4
	Management Technology		(235.0-315.0)	(293.0-356.0)	(47.3-65.3)	(63.6-76.2)
	in fodder Cowpea					
	variety MFC-08-14					
	Integrated crop	10	708.1	824.4	160.8	190.7
	Management in Nutrient		(585.0-827.0)	(682.0-943.0)	(128.1-198.6)	(156.1-239.1)
	Fodder Sorghum					
	Variety CoFS-29					
Kharif 2019	Integrated crop	10	780.5	884.6	112.2	123.0
	Management in B X N		(601.0-1056.0)	(635.0-1237.0)	(83.2-139.2)	(93.0-159.6)
	hybrid variety Co-3					
	Fodder Bajra	20	323.8	367.1	64.5	80.7

	Variety BAIF Bajra		(256.0-396.0)	(305.0-435.0)	(48.1-86.3)	(86.3-98.4)
	Integrated crop	20	265.2	316.3	54.6	64.6
	Management Technology		(212.0-305.0)	(265.0-376.0)	(45.4-70.1)	(51.7-74.3)
	in fodder Cowpea					
	variety MFC-08-14					
	Integrated crop	50	743.5	844.8	162.3	178.5
	Management In Nutrient		(589.0-887.5)	(656.0-1036.0)	(120.2-202.2)	(128.1-251.1)
	Fodder Sorghum					
	Variety CoFS-29					
Rabi- 2019	Lucerne	30	755	889	159	174
	variety RL-88		(294.0-710.0)	(341.0-726.0)	(62.0-141.0)	(68.0-150.0)
	Fodder Oat	30	240	283	51	58
	variety OS-6		(226.0-249.0)	(271.0-301.0)	(44.0-57.0)	(37.0-68.0)
	Fodder Oat	15	242.0	286.0	56.0	57.0
	variety RO-11-1		(233.0-251.0)	(276.0-298.0)	(54.0-59.0)	(43.0-67.0)

Impact

- Improvement in green forage yield ranges from 7.6 to 21.1 % with an average of 13.0 % in different forage crops.
- Higher palatability of introduced ne varieties of forage crops.
- No wastage of green forages.
- Soft stem and high leaf biomass
- No ligules on leaves in perennial grasses
- Quick regrowth in perennial grasses.
- Improvement in milk yield by 1.5 to 2.5 liters/day/cow.
- Seed/set replacement ratio in zone is 60% because of root slips/ sticks supplied to the farmers for free of cost by Karnataka milk federation through milk cooperative societies and UAS, Bangalore by establishing seed bank at KVK's, research stations and scientist framers participatory programmes in different districts.

Conclusion

The farmers are very much satisfied with introduction and supply of root slips/sticks/seeds of high yielding varieties of different forage crops, recommended production technologies, conservation and storage of excess fodders, grass-legume mixture cultivation to minimize the cost towards purchase of concentrated feeds for balanced nutrition, improvement in milk yield with lesser cost of production and utilization of farm bunds with cultivation of top feeds and perennial grasses and overall improvement of the livelihood of the farmers and harvested higher green biomass in lesser area and no wastage of fodder and reduced cost towards the purchase of feeds and improvement in fat content of milk with introduction of legume component and overall improvement in milk yield with lesser cost of production with grass legume mixture cropping system introduced through forage technology demonstration.

Fodder Technology Demonstration in Pune district of Maharashtra

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Introduction: Technology transfer is applied research through Research Stations involved in improvement of crop production. Latest notified/recommended varieties/hybrids along with full package of practices/ production and protection technologies on selected farm with a view to demonstrate the potentiality of the technologies to the participating farmers, neighbouring farmers and the Extension workers of the State Department of Agriculture and allied agencies. The concept of Fodder Technology Demonstration (FTD) is with the purpose of improving the adoption behaviour of farmers related to improved fodder crop varieties/ production technologies and to harvest the maximum yield potential in real farm condition, free supply of the essential inputs, guidance by scientific community, popularising the advantages of adopting improved technologies, extending the cultivation of improved fodder varieties and to maximise the technology dissemination process among the poor farmers and livestock rearing communities. BAIF, Urulikanchan center has participated in this programme since inception i.e. from year 2009.

Objectives: The overall objective of the programme was to transfer the new technologies of fodder production to farmer's field for increased and sustainable green fodder production. The key objectives are to:

1. Disseminate region specific new production technologies, varieties/hybrids emerged out from AICRPFCU programme to farmers field through demonstrations
2. Create awareness among the farmers, extension workers about new fodder technologies of fodder crops
3. Provide necessary inputs of FTDs to participating farmers in initial phase for their motivation
4. Generate data on green fodder yield of field demonstration plots
5. Network with other institutions for convergence

Concept of taking up demonstrations:

Dairy is main subsidiary business to the farmers in Western part of Maharashtra. The major fodder crops grown in the area by farmers were maize, sorghum, Bajra x Napier hybrid and Lucerne. Besides those crops, farmers were less aware about varieties of these fodder crops, their knowledge about new fodder crops, new varieties and their advanced production technologies was very low and thereby adoption of new technologies was not there. Many of the farmers were still practicing the traditional practices of fodder cultivation, using old varieties, no diversity among the crops. They were indecisive to contact the institutions involved in Research & Development of forage crops for gaining the knowledge, skills in fodder crops. Fodder crops were least priority for them and many times they used sugarcane as source of fodder when there was no other source. While boosting the dairy activity in the area there were hardly any efforts on developing the fodder resources at individual farmer level. Farmers have faced the problem of shortage of green fodder, irregular availability and quality of fodder which ultimately resulted in low milk production of milking animals and thereby increase in cost of production.

In order to conquer those situations, motivation of farmers, provide the trainings, establishing the FTDs on selected farmer's field at village level and demonstrate the performance of new crops/new varieties, their advanced production technologies to other farmers and extension workers was the way out. Hence the FTD programme was implemented by BAIF center in this area.

Selection of area/village/ farmers:

a. Area selection: Since the BAIF center is located in Pune district of Maharashtra, the focus was given on covering the villages and blocks in same district. FTDs were conducted in seven blocks namely Haveli, Daund, Purandhar, Shirur, Baramati, Khed and Indapur (Fig.1). The villages in irrigated area as well as rainfed area with low irrigation facility were selected for demonstrations.

Fig. 1: Center location and coverage of villages under FTD

b. Selection of villages: The programme was commenced with nearby villages located at 8-10 km from the BAIF center in Haveli and Daund blocks. As per the guidelines, efforts were made to cover few new villages for FTDs with new farmers every year. Further it was realised that actual need of FTD was in the fodder resource poor area where the farmers were small and marginal. So we tried to cover the villages in those areas also. Similarly the contacts were made with KVKs in Pune district and Mandal Officers of Agriculture Dept., to identify the potential villages for conduct of FTDs and accordingly the villages in Pune district located far away from center were also selected. Year and block wise coverage of villages under FTD is presented in Table-1 as well as location of villages in different blocks are shown in Fig.1. In all 105 villages were covered in seven blocks of Pune district under the FTD programme during last eleven years.

Table 1: Coverage of villages in different year

Year	Block	Number of villages
2009-10	Haveli, Daund, Indapur	9
2010-11	Haveli, Daund, Baramati	12
2011-12	Haveli, Daund, Baramati, Indapur	22
2012-13	Haveli, Daund, Baramati	20
2013-14	Haveli, Daund, Baramati	18
2014-15	Haveli, Daund, Baramati	19
2015-16	Haveli, Daund, Baramati	6
2016-17	Haveli, Daund	20
2017-18	Haveli, Daund	25
2018-19	Shirur, Haveli, Purandar, Daund	20
2019-20	Shirur, Khed	10

c. Selection of farmers: Prior to initiate the programme, meetings were conducted in each village to make aware the farmers about the FTD programme and its objectives, importance etc. During the meeting list of interested farmers was prepared for further communication. Small and marginal farmer having livestock with minimum resources like reserved land for fodder cultivation and irrigation

facility were also included in the list. Later on farmers were selected from the list to undertake frontline demonstrations. Priority was also given to identify few women farmers. The fields located on roadside were preferred while selecting the plots for demonstration. It could helped to create consciousness among the other farmers whoever have travelled from those roads.

Process involved in persuading the farmers about forage technologies:

Convincing the common farmers for adopting new technologies is difficult task unless they see the results at others farm. Nevertheless it becomes easy in case of lead farmers who always do experimentation of new things at their farm. Therefore few lead farmers were intentionally chosen in each village among the selected farmers. Group meeting was organised in each village separately for the selected farmers to orient them in detail about technology demonstrations, necessary preparations, inputs required and support under the programme, benefits etc. Similarly for the farmers identified by KVKs, the orientation programme was arranged by BAIF in consultation with the subject matter specialist (SMS) of respective KVKs. Posters, leaflets and folders of the new production technologies were distributed among the participating farmers for better understanding of the technologies.

Supply of inputs, technical guidance/ convergence with other government schemes:

The financial support for procurement and supply of inputs like seed, fertilizer and pesticide was available from the project for first seven years i.e. from 2009 to 2016. During that period the inputs were procured centrally and supplied to the FTD farmers at their doorstep. Later on the financial support was stopped. Under the circumstances, the participating farmers were convinced to purchase the seed from BAIF and other inputs from local market required for the FTD.

Technical guidance right from sowing to harvesting of crops was provided to the farmers by personal visits to individual farmer's field by project technical staff from time to time. Small group meetings were also arranged at one of the participant's field to make aware about the benefits of new fodder technologies over the conventional one.

In order to reach the technology on extensive scale and get wider publicity, it was necessary to take help of other schemes in the operational area. Therefore the FTD programme was linked with the schemes of Agriculture Department and mandates of KVK.

Implementation of the programme:

a. Number of FTDs: BAIF, Urulikanchan centre has actively participated in the transfer of technologies through Fodder Technology Demonstration (FTD) in both *kharif* and *rabi* season of every

year. In all 469 FTDs were conducted at farmer's field during 2009-2020 and season wise number was 271 and 198 in *kharif* and *rabi* respectively (Annexure-1). Year wise number of FTDs conducted is presented in Fig. 2.

Crops covered under FTD: In the *kharif* season FTDs were conducted in forage crops like maize, pearl millet, Bajra x Napier Hybrid, where as in *rabi* season crops were forage oat, lucerne and berseem. For the production cereal and legume green fodder from same piece of land, cropping system like intercropping maize+ cowpea and Bajra+ cowpea in was also demonstrated in *kharif* season. New crops like fodder bajra, cowpea, oat and berseem were introduced in the area. New technologies/ new varieties generated out of AICRP fodder crops research were demonstrated through FTDs (Annexure-1).

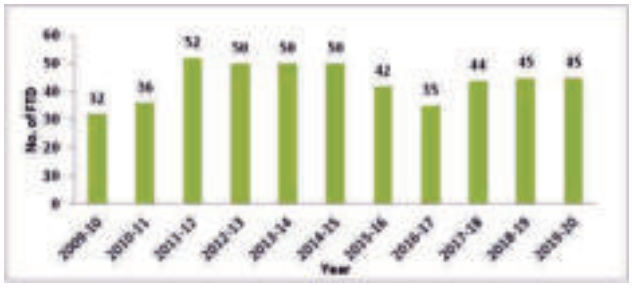

Fig. 2: Number of FTDs conducted over the period (2009 to 2020)

In Fig. 3 the crop wise number of FTDs is presented. The maximum numbers of FTDs were conducted in Bajra x Napier Hybrid (80) followed by fodder bajara (81) in *Kharif* season and in *rabi* season maximum FTDs were of Oat i.e. 114. The number of demonstration on intercropping system was 65.

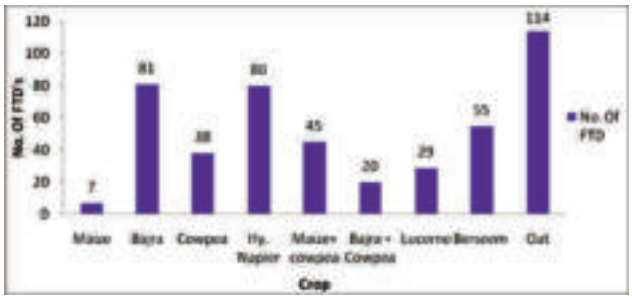

Fig. 3: Crop wise FTD conducted at farmer's field

c. Fodder crop varieties/hybrids promoted: In the area, before start of FTD programme farmers were growing A. Tall variety of maize, Maldandi (M 35-1) variety and multicut hybrids of sorghum, Yashwant Bajra x Napier hybrid and traditional perennial variety of Lucerne. Transfer of new varieties / hybrids and new production technologies generated through AICRP on forage crops to farmer's field through FTD's was one of the objectives of FTD. Accordingly new varieties of six fodder crops like cowpea, Bajra, lucerne, berseem, oat and Bajra x Napier hybrids were introduced and grown in FTDs. It created awareness among the farmers regarding the use of different fodder crop varieties and its performance. The percent wise distribution of FTDs of differ fodder varieties is given in Fig. 4. It is revealed that maximum percentage (25%) of field demonstrations were conducted under Kent variety of oat followed 18 % in BAIF Bajra-1variety of bajra.

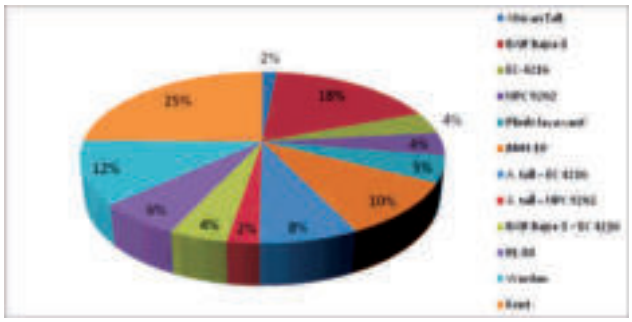

Fig.4: Percentage of FTDs under different fodder crop varieties

The standard package of practices were followed while establishing the FTD in addition to varietal demonstration as most of the farmers were not following it while cultivating the fodder crops earlier.

d. Area covered under FTD: Seasonal variation was there under the FTD considering the availability of resources at farmer level. The size of plot in *kharif* season was 0.20 ha/FTD whereas in *rabi* season it was 0.10 ha/FTD. Seven different crops in sole and intercropping system were covered under demonstrations in two seasons over the period from 2009-10 to 2019-20. Total area covered under 469 FTDs was 73.68 ha in five blocks.

Crop wise coverage of area under FTDs over the period is presented in Fig.5. It is observed from the Fig. that maximum area of 16.79 ha was covered under Bajra x Napier hybrid which was followed by fodder bajra with 16.11 ha during *kharif* season. In *rabi* season, oat and berseem were introduced for demonstration and in the beginning the farmers were compelled to grow them. Later on the demand and interest of farmers in these crops was increased as the quantity and quality of fodder was quite good. In *rabi* season maximum area of 11.8 ha was covered under the fodder oat and 5.8 ha under berseem crop. The area covered under intercropping system of fodder production i.e. bajra + cowpea and maize + cowpea was 7.2 ha and 4.6 ha respectively.

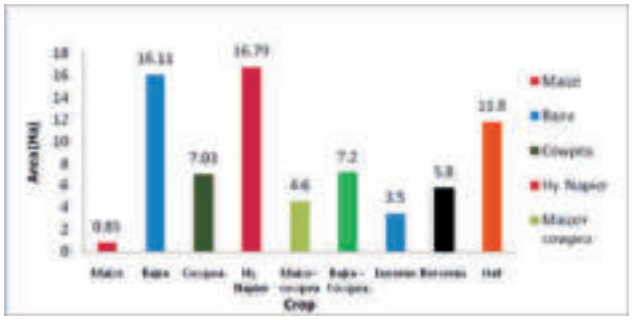

Fig. 5: Total area coverage under different fodder crop FTDs

e. Crop wise yield performance over the period: The data on green fodder yield (GFY) was recorded from each FTD on one square meter basis and converted into hectare (Annexure-1). In case of maize, bajra, cowpea and oat the GFY was for single cut, for Bajra x Napier hybrid and berseem it was two cut where as for lucerne it was for 5-6 cut. The crop wise GFY (q/ha) in respective years is given in Fig.6. It has been observed that in first 5-6 years the GFY of most crops was at higher side and following years it was reduced except oat and berseem. There was no consistency in GFY for crops for all the years. The major reason was that in first 5-6 years the FTDs were conducted in irrigated area whereas from 2016-17 onwards the FTDs were in resource poor areas where the irrigation water was limitation. The second reason could be the change in rainfall pattern during *kharif* season in later years. In case of oat and berseem, the maximum GFY was obtained in the year 2017-18 in rest of the years it was almost at par.

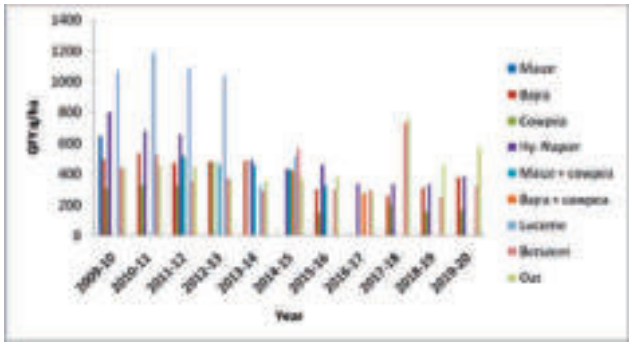

Fig. 6: GFY performance of different fodder crops over the year

f. Total green fodder production through FTD: Total 469 FTDs with different fodder crops were conducted on 73.68 ha area in last ten year. The total estimated green fodder production by different crops in FTDs is presented in Fig.7. It is observed that total estimated green fodder from all the crops under 469 FTDs on 73.68 ha area was 31678 q. Among the all crops under FTD, total green fodder production from Bajra x Napier hybrid was highest i.e. 8257 q followed by fodder Bajra with green fodder production of 6644 q. In *rabi* season oat recorded maximum green fodder yield of 5296 q. In legume crops maximum green fodder production was by Lucerne which was 3051.42 q followed by Berseem with 2350.05 q.

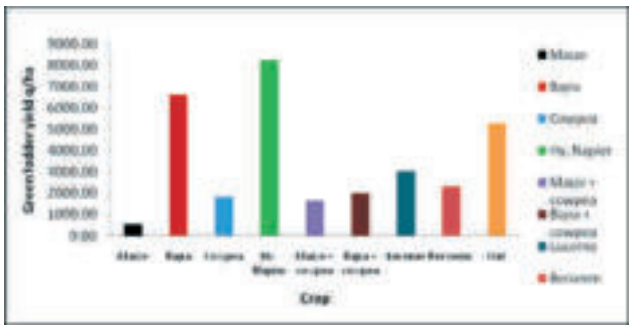

Fig. 7: Total green fodder production under different fodder crops through FTD's

Benefit accrued to farmers: Adoption of new varieties along with standard package of practices has always assisted in improving the crop yield. The rate of adoption by farmers is more in grain and economical crops whereas it is low in case of fodder crops. In FTD programme the demonstration of

new crops, new varieties along with standard package of practices has resulted in increase in fodder production as well as productivity at participating farmers field as direct benefit. Besides this major benefit there were other benefits ensued to the farmers which are listed below.

1. Total green fodder production from 73.68 ha area of FTD under different crops at farmers field was about 31678 q, and the estimated gross income generated was approximately Rs. 76 lakh.
2. Farmers were gained the knowledge of new crops and varieties of fodder crops over their traditional crops and varieties.
3. New skills on standard package of practices were acquired by farmers about the fodder crops.
4. Milk yield of milking cattle was increased up to 1-2 *l*/day because of good quality fodder as a result increase in total income of farmer.
5. Inputs such as seed, fertilizer and pesticides were received to the farmers free of cost at their doorstep for first seven years which has reduced the cost on production.
6. The performance of different fodder crops and varieties was seen by non participating farmers through FTDs in their villages itself and were more enthusiastic towards growing of those crops and varieties.
7. Diversity in fodder crops and their cropping system has resulted in availability of legume and cereal fodder for the milking animals resulting in increased milk production.
8. Few farmers have developed the small nurseries of Bajra x Napier hybrid and sold the planting material.

Impact: Technology transfer programme has always its impact at individual and community level. The FTD programme under AICRP on Forage Crops & Utilisation through BAIF center has disseminated the advanced fodder technologies in 105 villages of Pune district which could educate large number of farmers in those villages about these technologies. Farmers have realized the importance of new fodder crops/varieties and their production technologies in achieving the higher green fodder yield. Other than this there were other direct/indirect benefits of the FTD programme which are as under.

1. The new fodder crops and varieties were brought under cultivation by large number of farmers.
2. The green fodder produced out of 469 demonstrations has estimated the sufficient feeding of 26-27 adult animals every year.
3. Due to availability of balanced green fodder the cost on concentrate feed is reduced which ultimately decreased the cost of milk production
4. The demand of fodder seed and planting material of new crops/varieties was increased over the period.
5. Scope for enterprise development through Bajra x Napier hybrid nursery was perceived.
6. The intercropping of legumes with cereals cropping system helped to maintain the soil fertility and there by reduction in use of chemical fertilisers.
7. Good linkages were developed with state Agricultural Dept. and KVKs.

Response/feedback of farmers: Feedback from participating farmers was taken with very new approach. BAIF has launched a new initiative of Farmers Call Center named as "Sanvadini" in 2015 at Central Research Station, Urulikanchan Dist. Pune (M.s.). It is an outbound service to contact farmers involved in Dairy husbandry. The service aimed at providing technical guidance, input support and extension services such as veterinary care, breeding, supply of mineral mixture, balanced diet, feed and feed supplements, fodder crop seed and training of dairy farmers through experts. Sanvadini aimed to

identify the problems being faced by the farmers while rearing the animals, their needs and to generate a valuable database of Dairy Farmers, which can be further used for planning and development. All the data is collected using Customer Relationship Management. The calling is done by using calling software developed by Software Company. There are various features of the CRM such as call can be transferred to experts, farmers can be connected with the experts through conference call in when agents are not able to answer farmers query.

FTDs in different crops

Fodder Bajra- BAIF Bajra-1

Fodder cowpea- EC-4216

Hybrid Napier- BNH-10

Hybrid Napier- BNH-10

Fodder Oat- Kent

Lucerne- RL-88

Lucerne- RL-88

Guiding farmers on site

Monitoring visit by AICRP Scientist

Data collection of FTD for green fodder yield

Visit of dignitaries to FTD's

Annexure 1: Year wise details of FTD's conducted during 2009-2020

Year	Season	Village covered	Technology demonstrated	No. of beneficiaries	Average GFY (q/ha)	Yield of old technology/ variety	Percent increase
2009-10	*Kharif*	Shindaone, Khamgaon,	New variety of Fodder Maize-African Tall	7	650	602	7.38
		Urulikanchan, Koregaon mul,	New variety of Fodder Bajra- BAIF Bajra-1	2	494	425	9.92
		Tilekar wadi,	New Bajra x Napier hybrid- BNH-10	4	800	730	8.75
		Nathachiwadi	New crop- Fodder Cowpea	6	310		
	Rabi	Shindaone,	Line sowing method of Lucerne	4	1068	850	20.00
		Piparisandas,	New fodder crop- Oat	5	442		
		Nathachiwadi, Koregaon mul, Darekarwadi	New fodder crop- Berseem	4	439		
2010-11	*Kharif*	Koregaon Mul, Pimprisandas,	New variety of Fodder Bajra- BAIF Bajra-1	10	534	493	7.68
		Dahitne,	New Bajra x Napier hybrid-BNH-10	5	679	617	9.13
		Shindavne, Bhavrapur, Burkegaon	Introduction of new crop- Fodder Cowpea	6	327		
	Rabi	Koregaonmul,	Line sowing of Lucerne	5	1190	1020	14.29
		Piparisandas,	Introduction of new fodder crop- Oat	5	459		
		Holewadi, Medad, Undavade, Khanda, Malegaon, Burkhgaon	Introduction of new fodder crop- Berseem	5	528		
2011-12	*Kharif*	Galandwadi, Bhivare,	New variety of Fodder Bajra- BAIF Bajra-1	10	471	428	9.13
		Koregaon Mul,	New Bajra x Napier hybrid-BNH-10	10	658	609	7.45
		Piparisandas,	Introduction of new crop- Fodder Cowpea	6	326		
		Shindewadi, Undavadi, Taliye, Jalgaon KP, Medad, Jogawadi, Kurnewadi, Parawadi, Pandare, Malewadi	Intercropping of cereal and legume fodder (Maize + Cowpea)	4	516		
	Rabi	Galandwadi,	Line sowing of Lucerne	5	1090	895	17.89
		Malegaon,	Introduction of new fodder crop- Berseem	5	351		
		Gawadewasti,					

		Yawat, Piparisandas, Belwadi, Lhasurne, Malad, Sonegaon, Koregaon mul, Khorhale	Introduction of new fodder crop- Oat	10	451		
2012-13	*Kharif*	Koregaon mul, Hingangaon, Piparisandas, Patas, Navisandas, Khutbav, Medad, Korhale, Padare, Late, Malegaon, Thotewadi	New variety of Fodder Bajra-BAIF Bajra-1	10	480	439	8.54
			New Bajra x Napier hybrid - BNH-10	10	475	442	6.95
			Intercropping of cereal and legume fodder (Maize + Cowpea)	10	462		
	Rabi	Koregaonmul, Tupewasti, Dalib, Malad, Maladphata, Chaudharwad, Shetphalhavel, Boriandi, Survad	Line sowing of Lucerne	5	1038	865	16.67
			Introduction of new fodder crop-Berseem	5	368		
			Introduction of new fodder crop-Oat	10	360		
2013-14	*Kharif*	Galandwadi, Prayagdham, Darekarwadi, Hol, Hingangaon, Patas, Urulikanchan, Wanewadi, Jogwadi, Malshi, Ravdi, Sastewadi, Chaudhariwadi, Murte, Someshwar	New variety of Fodder Bajra-BAIF Bajra-1	10	487	441	9.45
			New Bajra x Napier hybrid - BNH-10	10	494	458	7.29
			Intercropping of cereal and legume fodder (Maize + Cowpea)	10	460	431	6.30
	Rabi	Khutbav, Galandwadi,	Line sowing of Lucerne	5	328	275	16.16
			Introduction of new fodder crop-	5	290		

		Koregaon mul, Urulikanchan, Bhandgaon	Berseem Introduction of new fodder crop-Oat	10 10	363		
2014-15	*Kharif*	Late, Chaudhariwadi, Bhagatwasti, Karangepul, Waki, Shindewadi, Ravdi, Naikwadi, Wanewadi, Hol, Koregaon mul, Nira, Wagalwadi, Theur, Urulikanchan	Intercropping of cereal and legume fodder (Maize + Cowpea) Intercropping of cereal and legume fodder (Bajra + Cowpea)	10 10	432 420	398 389	7.87 7.38
	Rabi	Khutbav, Bhandgaon, Pargaon, Tlekarwadi	Line sowing of Lucerne Introduction of new fodder crop-Berseem Introduction of new fodder crop-Oat	5 5 10	517 573 374	425	17.79
2015-16	*Kharif*	Kutwalwadi, Yavat, Supa	New variety of Fodder Bajra-BAIF Bajra-1 Introduction of new crop-Fodder Cowpea New Bajra x Napier hybrid - BNH-10 Intercropping of cereal and legume fodder (Maize + Cowpea)	10 5 1 11	302 150 460 326	278 415 298	7.95 9.78 8.59
	Rabi	Padvi, Piparisandas, Koregaonmul	Introduction of new fodder crop-Berseem Introduction of new fodder crop-Oat	5 10	301 386		
2016-17	*Kharif*	Wadki, Javibuwachi wadi, Urulikanchan, Tarde, Waghapur, Theur, Boriandi, Khamgaon, Fursungi, Bhartgaon, Zendeadi, Naigaon	New Bajra x Napier hybrid - BNH-10 Intercropping of cereal and legume fodder (Bajra + Cowpea)	10 10	337 276	311 255	7.72 7.61

	Rabi	Sagavi sandas, Alandi Mhatobachi, Fursungi, Boriandi, Tilekarwadi, Urulikanchan, Manjri, Shindwane	Introduction of new fodder crop-Berseem	5	298		
			Introduction of new fodder crop-Oat	10	296		
2017-18	*Kharif*	Wadki, Koregaon mul, Urulikanchan, Theur phata, Kunjirwadi, Hingangaon, Sangavi sandas, Boriandi, Wadki nala, Javajibuwachi wadi, Kasurdi, Khutbav, Singapur, Waghapur, Jejuri, Theur, Sahajpur, Manjri	New variety of Fodder Bajra-BAIF Bajra-1	9	263	245	6.84
			Introduction of new crop-Fodder Cowpea	5	198		
			New Bajra x Napier hybrid - BNH-10	10	336	306	8.93
	Rabi	Korgaonmul, Hingangaon, Asthapur, Vasunde, Tilekarwadi, Theur, Sangavi sandas, Urulikanchan, Kavthe, Waghpur, Kasurdi	Introduction of new fodder crop-Berseem	5	734		
			Introduction of new fodder crop-Oat	15	762		
2018-19	*Kharif*	Jagtapwadi, Tilekarwadi, Urulikanchan, Mukhai, Boriaindi, Yavat, Theur,	New variety of Fodder Bajra-BAIF Bajra-1	10	312	286	8.33
			Introduction of new crop-Fodder Cowpea	5	159		
			New Bajra x Napier hybrid - BNH-10	10	334	310	7.19

		Padvi, Koregaon Mul, Autadewadi, Dalimb, Hivre					
	Rabi	Sangvi Sandas, Koregaon Mul, Sakurde, Ashtapur, Warwand, Urulikanchan, Handalwadi, Tilekarwadi, Gar, Bhavarapur Hivre, Warwand, Sanaswadi	Introduction of new fodder crop-Berseem	5	253		
			Introduction of new fodder crop-Oat	15	462		
2019-20	*Kharif*	Pabal	New variety of Fodder Bajra-BAIF Bajra-1	10	377	351	6.90
			Intrroduction of new crop-Fodder Cowpea	5	168		
			New Bajra x Napier hybrid - BNH-10	10	388	358	7.73
	Rabi	Mhasewadi, Khopewadi, Parsul, Karpud, Kavthe, Talegaon, Khamgaon, Koregaon, Manjri	Introduction of new fodder crop-Berseem	5	322		
			Introduction of new fodder crop- Oat	15	582		

Fodder Technology Demonstrations in arid region of Rajasthan and its impact

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As per 20th livestock census, India has 536.76 million livestock population comprising 193.46 million cattle, 109.85 million buffaloes, 148.88 million goats and 74.26 million sheep population. Livestock production is an integral part of the farming system in the rainfed areas, especially in the ecologically fragile arid and semi arid areas. The contribution of livestock sector is much higher in Rajasthan as compared to other parts of the country. Rajasthan has livestock population of 56.8 million ranked second after UP. It comprises of 13.9 million cattle, 13.7 million buffaloes, 7.9 million sheep, 20.84 million goat (20th Livestock Census, 2019).

One of the notable characteristics feature of livestock feeding system in India is that almost, two third of feed requirement is met from crop residues. At the national level, out of 574.3 million tons of dry matter available, 62.5 per cent is accounted by crop residues (Raju, 2011). Land allocation to cultivation of green fodder crops is limited and has hardly ever exceeded 5 per cent of the gross cropped area (GoI, 2009). Gross cropped area is only 197.05 mha and whereas net sown area is around 139.51 mha as of 2015-16, out of this area about 10.25 mha land is under permanent pastures and other grazing land (Agricultural Statistics, 2019). Hence, the supply of feed has always remained short of normative requirement (Singh and Mujumdar, 1992; Ramachandra *et al*., 2007, Dikshit and Birthal, 2010, GOI, 2012).

Birthal *et al*. (2005) have found feed scarcity as the main limiting factor in the task of improving livestock productivity. The situation is further aggravated in Rajasthan where considerable area falls in arid and semi arid zones. To compensate for the low productivity of livestock, farmers maintain a large herd of animals, which triggers a vicious circle of continuous livestock increase. This causes sharp acceleration of environmental degradation consequent to surpassing carrying capacity and sustainability of natural environment.

Fodder pedestal, cheaper forage and feed techniques and their availability are requisite to increase livestock produce as the fodder alone comprises 70 per cent of the milk production cost. Presently, there is stress on accessibility of sum of forage and feed, as cultivated land obtainable for fodder cultivation has been declining. India currently is facing a shortfall of around 64 per cent feeds, 61.1 per cent green fodder and 21.9 per cent dry crop residues (Datta, 2013). In Rajasthan, particularly in arid region fodder availability situation is graver, livestock of this region relies upon poor quality wheat straw mainly procured from neighboring states like Punjab and Haryana with a meager quantity of green fodder in form of natural vegetation and grasses in a very short rainy season, which leads to poor animal health with low productivity. The gap between the requirement and availability of feed and fodder is increasing primarily due to decreasing area under fodder cultivation and reduced availability of crop residues as fodder.

There is continuous shrinkage of common property resources leading to over grazing in existing grasslands. The shortfall in green fodder availability can be reversed by increasing area as well as productivity of green fodder crops. Harsh climatic conditions of the region provide limited options of the fodder crops with poor green fodder yield. Several fodder crops varieties and agro-techniques suitable for this region have been evolved by scientists of Swami Keshwanand Rajasthan Agricultural

University, Bikaner; ICAR-CAZRI, and other institutes of ICAR. Dissemination of these generated technologies to the farmers' field is a very slow process, which needs to be hastened. Out of several techniques of transfer of technology, the laying out of demonstrations at farmers' field is the most effective way of behavioral change of farmers and ultimately the adoption of the technology. SKRAU, Bikaner centre of All India Coordinated Project on Forage crops and Utilization has been conducting forage technology demonstrations since inception of the project in Bikaner, Jaisalmer, Churu, Nagaur, Sikar districts of arid region of Rajasthan with the following objectives

Objectives

1. Introduction of new potential fodder crop *viz.*, napier bajra hybrid in the region.
2. To exhibit the production potential of the new fodder crop at farmers' field.
3. To make aware farmers about cultivation techniques of the new as well as existing fodder crops and perennial grasses *viz., Cenchrus ciliaris* and *Lasiurus sindicus*.
4. To make aware the farmers about the scientific intervention(s) for improving the green fodder yield of prevailing fodder crops like pearl millet, clusterbean, oat and Lucerne.
5. To promote improve fodder cultivation in the area where green grass are not available and accessible to the poor farmers for their livestock.
6. Demonstrations showcase how to –
    - assess the suitability of the species selected for local soil, water and climatic conditions
    - Assess the amount of fertilize, manure, water and other inputs required in the cultivation of the fodder in comparison with the control/traditional practice.
    - Evaluate the (economic) savings farmers can make out of the production and feeding to the cattle with comparison to the cost they have to bear for purchasing the dry fodder and concentrates.
    - Appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like drought, salinity etc on the sustainability of the production of fodder/s in the farmers field.

Keeping these objectives in view and to achieve the goal of increased green fodder production, fodder technology demonstrations were conducted adopting the following steps.

Conducting field demonstrations- important steps followed

Since field demonstration is often used as an extension method, it is sometimes laid out in a routine manner. A well conducted demonstration should help the scientists to give finishing touch to changing attitude of farmers and extension workers and improve their knowledge, understanding and skills. The following steps were followed in conducting field demonstration.

A. Planning Phase:

Know the Vicinity: The scientists of the AICRP on Forage crops felt the need to develop an understanding of the farmers, their farming systems, resources and established rapport with them. Therefore information on major fodder crops of the region, present level of use of inputs and productivity of major fodder crops of the area was gathered. The vicinity was known by different ways such as

- Visiting villages and farmers of Bikaner and adjoining districts
- Meeting people individually and in groups during their training programmes, University farm visits
- Exchanging information with local extension workers of State Agriculture Department of Bikaner, Nagaur, Churu and Jaisalmer districts.

Selection of Technologies: Proven technologies were selected which have higher potentialities in terms of higher green fodder yield and quality, and can fit in the existing farming systems and situations of the area/farmers. Technologies which were selected for demonstration are:

- Introduction of new fodder crop napier bajra hybrid variety Co-5 and guinea grass in the zone.
- Improved varieties of fodder pearl millet (Raj Bajra-1, Giant bajra, RBC-2) and sorghum (PC-6) with recommended dose of nutrients.
- Improved varieties of clusterbean (BG-1, BG-2, RGC-936, RGC-1003, RGC-1031, RGC-1055) and cowpea (Kohinoor, BL-2, COFS-29) with recommended dose of nutrients.
- Improved variety of Lucerne (Anand-2, Anand-3, T-9) and oat (Kent, UPO-212) with recommended dose of fertilizers.
- Improved varieties of perennial grasses viz, Bikaneri Dhaman of *Cenchrus ciliaris* and Jaisalmeri Sewan of *Lasiurus sindicus*.

Selection of Demonstration Site: Isolated farms were avoided. Demonstration sites were on primelocations, easily accessible for the farmers and extension workers of the State Agriculture Department. As far as possible, block of demonstration sites which had a good number of farmers of all categories of land holding and status were selected. While selecting the site attention was paid on, soil type, fertility status and irrigation facilities which were as representative of the region.

Selection of Demonstration Farmers: In selection of farmers, views and knowledge of field level extension workers of Department of Agriculture was also considered and they were involved in laying out demonstrations. A group of farmers land holdings in the selected demonstration block and who were willing to cooperate in the conduct of demonstration were selected. In majority of cases demonstration farmers were selected finally by holding a meeting in the village where the purpose of demonstration was clearly stated and suggestions were sought from the farmers. Any difference in opinion was sorted out tactfully otherwise there was a chance of having non cooperation from those who were not selected as demonstrating farmers which might ultimately jeopardize the very purpose of demonstration. During farmers' selection following points was kept in mind for getting good results:

i. Real farmers who work by own hand not (generally) by the hired labour and who are not (generally) involved in any other business, so that he pay proper attention on demonstration.
ii. Farmers who are really interested in conducting demonstration and intends to participate, contribute, share activities, resources and information with other farmers for speedy dissemination of technology.
iii. Farmers who have time to spend for the demonstration activities, participation in the meeting, training, contribution to the awareness programmes etc.
iv. Farmers who have family labour to employ in the demonstration activities so that the unused or underemployed labour gets used and money saved from hiring a labour.
v. Balance in selection while distributing the demonstration in a village so that all categories of farmers *viz.*, large, medium, small, general, SC, ST and both male and female farmers can be picked up as per the requirement and merit.

Package of Practices adopted: This was an important step in planning the field demonstrations. New technologies were collected from the SAU's /ICAR Institute and it was ensured that these technologies are frontier ones showing substantial increase in green fodder yields. Standard package and practices evolved for different Agro Climatic Zones of Rajasthan covering Bikaner, Churu, Sikar, Nagaur and Jaisalmer districts of Rajasthan were used against the farmers practice for comparison.

Supply of critical inputs: Critical inputs are those agricultural inputs which are vital to help the selected technologies to exhibit its production potentialities on farmer's field and not earlier being used by the farmers. Such inputs *viz.* seed, stem cuttings and fertilizers were arranged in time and only these critical inputs were supplied by the University. Other inputs were arranged by the farmers themselves. It was ensured that the inputs which were to be given by the farmers were available with them. Following critical inputs were supplied to the farmers for demonstration:

- Stem cuttings and root slips of napier bajra hybrid variety Co-5 and guinea grass.
- Seed of about half to one acre of annual fodder crops *viz.*, Oat (Kent & UPO-212, Lucerne (Anand-2, Anand-3 & T-9) pearl millet (Giant bajra, RBC-2, Raj bajra-1) Cluster bean (BG-1, BG-2, RGC-936, RGC-1003, RGC-1055 and RGC-1031), sorghum (PC-6) and cowpea (Kohinoor, BL-2, COFS-29)
- Seed of perennial grass varieties Bikaneri Dhaman of *Cenchrus ciliaris* (Dhaman grass) and Jaisalmeri Sewan of *Lasiurus sindicus* (sewan grass).
- Recommended dose of fertilizers (DAP and Urea) as per crop.

B. Conducting & evaluation Phase

Layout of Demonstration: Farmers were guided and assisted in laying out the field. Trainings about scientific cultivation of forage crops were imparted to all farmers in whose plots demonstrations are to be laid at the time of supply of critical inputs. The control plot was kept if needed; otherwise treated all other neighboring/surrounding plots as control plots. As fodder crops are generally grown in small areas as per number of animals, therefore about half acre plot as a control was adequate. Sometimes a control plot was not necessary in newly introduced crop like napier bajra hybrid. Since the inception of the AICRP on Forage crops and Utilization Project at this centre about 500 demonstrations on different crops *viz.*, pearl millet, sorghum, cowpea, clustearbean, Lucerne, oat, perennial crops like napier bajra hybrid, perennial grasses, dhaman and sewan grass were conducted and evaluated. All the production and protection technology other than interventions were applied in similar manner in demonstrated as well as in farmers practices. The data on green forage yield were collected and evaluated from FTD plots as well as control plots, which are given in table below: In demonstration plots there was an increase of about 15-25 % in green fodder yield over the farmers practice (control plot), which varied with crops (Table 1).

Table 1: Crop wise green fodder yield (GFY) performance under FTDs (Improved practice) and Farmers practice (control plot)

Year	Season	Crop	Variety	No. of Demo	Demonstration plot GFY (q/ha)	Control plot GFY (q/ha)	Increase % over control
2010-11	*Kharif*	Cowpea	Kohinoor, BL-2, COFS-29	5	385	310	24.2
		Clusterbean	B G-1 & BG-2	7	330	285	15.8
		Pearl millet	Giant Bajra	10	555	410	24.3
	Rabi	Lucerne	Ananad-3	6	380	315	20.6
		Oat	Kent	18	550	480	14.6
		Oat	UPO-212	5	525	450	16.7
2011-12	*Kharif*	Pearl millet	RBC-2	15	430	370	16.3
		Cowpea	Kohinoor	6	375	305	22.9
		Clusterbean	BG-1 & BG-2	6	310	260	19.2
	Rabi	Oat	Kent	16	565	505	11.9
		Lucerne	T-9	9	390	325	20.0

2012-13	*Kharif*	Pearl millet	RBC-2	15	455	390	16.7
		Clusterbean	RGC-936	10	305	260	17.3
	Rabi	Oat	Kent	15	500	415	20.5
		Lucerne	T-9	10	395	320	23.4
2013-14	*Kharif*	Pearl millet	RBC-2	20	440	360	22.2
		Clusterbean	RGC-1003	20	315	265	18.9
	Rabi	Oat	Kent	15	525	450	16.6
		Lucerne	T-9	10	370	315	17.5
2014-15	*Kharif*	Pearl millet	RBC-2	15	445	360	23.6
		Clusterbean	RGC-1031	10	305	245	20.4
		NXB hybrid	Co-5	9	620	-	-
	Rabi	Oat	Kent	26	540	455	18.7
		Lucerne	T-9	5	320	265	20.8
2015-16	*Kharif*	Sorghum	PC-6	15	520	430	20.9
		Clusterbean	RGC-1055	10	265	230	15.2
		NxB hybrids	CO-5	10	565	-	-
	Rabi	Lucerne	T-9	10	315	280	12.5
		Oat	Kent	15	560	515	8.7
2016-17	*Kharif*	Sorghum	PC-6	4	475	390	21.8
		Clusterbean	RGC-1031	17	270	225	20.0
		NxB hybrids	CO-5	8	535	-	-
		Guinea grass		2	315	-	-
	Rabi	Lucerne	T-9	5	360	325	10.8
		Oat	UPO-212	10	520	445	16.9
2017-18	*Kharif*	Cluster bean	RGC-1055	12	285	245	16.3
		NxB hybrids		4	510	-	-
	Rabi	Lucerne	T-9	2	345	305	13.1
		Oat	UPO-212	14	535	490	9.2
2018-19	*Kharif*	Cluster bean	RGC-1055	2	290	235	23.4
		NxB hybrids	CO-5	5	500	-	-
	Rabi	Lucerne	Anand-2	12	360	310	16.1
		Oat	Kent	1	540	480	12.5
2019-20	*Kharif-*	Cluster bean	RGC-1055	6	290	240	20.8
		NxB hybrids	CO-5	21	530	-	-
	Rabi	Oat	Kent	5	545	475	14.7
		Lucerne	Anand-2	5	380	335	13.4

Technical guidance: Presence of technical person of either University or extension personnel of Department of Agriculture was ensured at the time of important operations like seeding, harvesting and weighing of produce to impart necessary technical guidance to the farmers. Each operation was used as input of training of farmers. Questions from the farmers were encouraged at each of these operations. This was helpful in better understanding of the task/operations.

Benefits of FTDs

- **Increase in green fodder availability:** Due to FTD an increase of about 15-25 % in green fodder yield was observed over control plots.

- **Improvement in animal health:** Increased availability of green fodder to the animals eventually leads to the better animal health which curtailed the expenditure on concentrates and medicines etc. Owing to better health animals conceived at an early age and at regular intervals.
- **Increase in animal productivity:** Increase in green fodder availability to the animals enhanced the milk and wool yield by 8-10 % which ultimately increased the income of the farmers.
- **Availability of planting material:** The other significant benefit of laying out demonstrations in the region is that planting material of newly introduced crops like Napier bajra hybrids was made available to the farmers by University which was further multiplied and distributed among farmers at their own level.

Impact of FTDs: Livestock in arid region is primarily rely on grazing in degraded pastures and common property resources like gochar bhoomi, wastelands etc. With the inception of demonstrations in the area attitudinal and behavioral changes in farmers is noticed and now they realize that adequate and balanced ration to the animals is essential to harness the higher milk, wool and body weight for meat purposes. Now a lot of farmers have incorporated green fodder crops in their cropping scheme and started cultivation of green fodder crops for stall feeding of their animals for getting higher milk yield. Besides these following impact of FTDs is observed:

- Enhancement in awareness about new crops: Farmers of the region were not known with the perennial crops like Napier bajra hybrid and guinea grass. These crops were introduced in the region owing to that farmers became acquainted to these crops and their yield potential in the area.
- Increase in technical knowhow about existing crops: Farmers of the demonstration area became more acquainted about the scientific cultivation of existing fodder crops like pearl millet, cluster bean, oat, lucerne etc, their improved varieties and nutrition.

Response of farmers: An increase of about 15-25 % in green fodder yield was observed in FTDs which was appreciated by the farmers. They were satisfied with the performance of the technologies. Now farmers started taking keen interest in laying out the demonstrations and they have started cultivation of perennial fodder crop *viz.*, napier bajra hybrid in irrigated lands and perennial grasses *viz.*, sewan and dhaman in common lands and pastures to enhance the green fodder availability to their livestock. They have started advice other fellow farmers to adopt the fodder cultivation practices and they have exchanged the seed materials or planting material particularly of napier bajra hybrid with other fellow farmers.

Feed back: Farmers appreciated the technology demonstrated like, introduction of new fodder crop bajra x napier hybrid and improved varieties of fodder crops. Following other feedbacks were observed while conducting the FTDs:

- Farmers were satisfied with the results of FTDs and seeing the results farmers ask for more number of FTDs in the area so that more number of farmers can be benefitted.
- Being the perennial nature of bajra napier hybrid and having the capability of supplying green fodder in lean period, farmers appreciated this new fodder crop and they have demanded more planting material of higher yield potential.
- Farmers have a keen interest in multi-cut fodder crops and their high yielding varieties particularly of pearl millet, sorghum, oat and lucerne; and they have shown their willingness to purchase seed if available.
- Demand of other critical inputs *viz.*, fertilizers, pesticides etc.

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Fodder Technologies Demonstrations (FTDs) for productivity enhancement of food-forage system for livelihood security and economic generation of small and marginal farmers' community in West Bengal

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Background

70% of its total population of India, mainly the rural population, is dependent on climate sensitive sectors for their livelihood. Of the total rural workers, 19.5% and 19.3% respectively were cultivators and agricultural laborers. According to the Planning Commission, 23% of the total rural population lived below the poverty line in 2011-12 in the state of West Bengal. The agricultural economy of West Bengal is predominantly characterized and supported by the small and fragmented holdings. Almost 90 % of the total holdings of this state is sprawling over 54 lakh ha of net sown areas. The average size of holding is less than one ha and per capita availability of land is just 0.16 ha. Rice is the main crop in the state, which covers 42 lakh ha areas during *Kharif* and 15 lakh ha during *Rabi* season. The challenges of ushering agricultural productivity, which is now just below 2%, is showing sharp indication of dwindling productivity and becoming more complex with the vagaries of weather reflected through the changing rainfall pattern, distribution of mean temperature and increased frequency of extreme weather phenomenon like cyclone, heat/cold wave, flood and drought *etc*. While our state has to sustain almost 10 cores of population, it has to opt for climate-resilient agriculture and livestock production, amply deterrent to extreme climate stress and corrigible to increased erodibility of soil, water and biota. West Bengal is a highly dense populated state and has six distinct agro-climatic zones.

Land area for forage crops in West Bengal

India is blessed with large bovine population of 198 million cattle and 83 million buffaloes accounting for about 51 percent of Asia and about 19 percent of world bovine population. India also comprises of 20 percent goat and 4 percent of sheep population in world. Despite of this rich livestock population, the scenario of milk production in India is not commendable. The state of West Bengal is undoubtedly very rich in livestock population but with a very low productivity. One of the prime limitations is the non-availability of fodder land, which is only 1.8 per cent of total land in West Bengal as against 4.0 per cent of the national average.

Objectives and goals

1. Production of good quality green forage cum food, seeds/planting material of forage crops (both annual & perennial cereals and legume)
2. Seed multiplication programme with farmers' participation
3. Fodder Technology Demonstrations (FTDs) and dissemination with special reference to forage seed village concept
4. Supply of good quality seeds to the farmers in proper time
5. Combat the un-availability of green forage

6. Utilize residual moisture and nutrient through cultivation of grass pea (*Lathyrus*) as dual purposes (green forage + pulse seed production) and other forage crops particularly in western part and coastal/saline areas of West Bengal
7. Improve the cropping intensity by incorporating short duration forage cum food crops in rice based cropping sequence
8. Awareness development for promotion of green fodder cultivation among the farmers/dairy entrepreneurs among farming community
9. Workshop cum training programme for farmers
10. Transfer of technology to farmers

Main Components

Demonstration of FTDS in the Farmers' field

Demonstration of improved technologies including varieties at farmer's field is an effective way to impress upon the farmers for technological advancement linked enhanced forage production. This will not only educate the farmers for adoption of new technology, but also helping enhancing the seeds replacement rate for the new varieties for better green forage yield (GFY) per unit area per unit time.

Forage crops are grown by the farmers in this zone to a limited area following their age old practices for forage cultivation. Introduction of improved variety along with package of practices were demonstrated following farmer-participatory approach. Use of bio-fertiliser, appropriate seed rate, seed priming, life saving irrigation, timely sowing, foliar spray of 2% urea/DAP along with micronutrients (Zn, B and Mo) etc. were followed.

Capacity development programme:

Farmer training, demonstration, field visit, review meeting, travelling workshop etc. programme were organized to build up the capacity of the stake holders including farmers, extension workers, women (SHG). This certainly empower and encourage the farmers to grow forage crops (rice bean, maize, coix, forage mung bean, forage blackgram, cowpea, oats, berseem, lathyrus etc.) for proper utilization of waste land, upland and mid-upland which ultimately augment forage production in the state as well as country.

Seed production programme

It is need less to mention that the demand of quality seeds of improved variety of forage crops is very high. In fact, the seed replacement rate in case of forage crops are very low, not more than 8-10%. To meet the demand of quality seeds of improved variety of forage crops, seed production programme of suitable varieties were be taken up through farmers participatory approach. If, the quality seeds of the suitable improved variety of forage crops are being provided to the farmers well in advance at a reasonable price, the forage production will get a boost over the present production. For production, processing and marketing of the forage seeds, local NGOs/ Farmers Co-operatives were involved. For the selection of appropriate varieties, production of seeds following modern package-of-practices the farming community were sensitised following their capacity building program. The following steps were taken-

- Selection of waste land (uncultivable fallow), upland & mid-upland and suitable rice fallow areas, varieties (improved variety), farmers, NGOs/Farmers Co-operative/FPOs/CBOs for production of seeds.
- Identification of opportunities and constraints to develop efficient seed production and supply system, including policies and strategic seed reserve at the village/block level.
- Development of good & high seedling vigor by using micro-pot technique on forage crop in FTDs

- Establish model seed village programme.
- Study the economics (profitability and sustainability).
- Strengthening linkage between farmers and informal seed sectors and line departments.
- Creation of need based infrastructure for seed production, processing, storing, post-harvest technology (PHT) and marketing etc.
- Capacity building of the farmers/farmers organization involve with the seed production program.
- Prepare and distribute quality seed production manual in local language.

Economic importance of forage crops in FTDs: Its production and quality

Even today milk is the second largest agricultural commodity contributing to the GNP, next only to rice. So, increasing the productivity of the animals is of immense importance and for that matter the forages must get a legitimate place in the domain of agriculture. It needs no mention that for providing green fodder to the huge livestock population of the country a realistic approach is needed, particularly in the background of highly inadequate land availability exclusively for fodder production in most part of the nation (national average 4.0 %). To address this national issue the only option for the Agriculturists, particularly the forage workers, is to carry out extensive research on forage crops for maximizing fodder yield and quality which, in turn, will ameliorate animal health and may finally help minimizing malnutrition in the rural India (national average 48.0 %). It is believed that for a meaningful practical approach forage research needs attentions from other quarters also, such as Farmers' Cooperatives, Milk producers' Cooperatives, Seed Companies, various GOs and NGOs.

Forage Crops taken in FTDs programme

1) Gama is grown after harvesting of '*aman'* paddy (*Kharif* paddy). The crop is equivalent to sorghum so far as morphology is concerned. It has very high potentiality to withstand draught. The laboratory analysis reveals it contains very low amount of crude protein only (3.2-3.5%). Due to its draught withstanding and high disease resistance potentialities the farmers are still growing the crop. Attempts are being made to introduce high yielding sorghum varieties like M. P. Chari, PC-23, HC-308, Sweet Sudan in different district of West Bengal under FTDs programme.

2) Rice bean grown after harvesting of Gama fodder. Since 2005-06 cultivation of rice bean has been popularized as evidenced from the table for seed production by the Animal Resources Department, Government of West Bengal. Attempts are being made to introduce newly released rice bean varieties like Bidhan ricebean-1, Bidhan Ricebean-2, Bidhan ricebean-3 in different district of West Bengal under FTDs programme.

3) Coix is adopted in the low-lying and coastal areas during *Kharif.* There is a vast tract of land in the South 24 Parganas, North 24 Parganas, Nadia, Purba and Paschim Medinipur districts. District remains inundated with saline water no fodder crop can be grown in those areas except Coix. Thus the crop has been being grown by the farmers of those areas. There was huge demand for coix since no other fodder crop could sustain water stagnation.Attempts are being made to introduce released coix variety like Bidhan coix-1 in South 24 Parganas, North 24 Parganas, Nadia, Purba and Paschim Medinipur districts of West Bengal under FTDs programme.

4) In winter (*rabi* season) oat (cv. Kent, OS-6 etc.) is mainly grown as fodder crop. Since winter is of short spell in this part of West Bengal, therefore, the farmers mainly grow single cut forage oat crop as *rabi* fodder. In the years when the winter prevails for longer period, two cuttings are obtained from the same crop. However, seed production of oat is not an economical practice. But attempts are being made to produce seeds of oats for next year use in FTDs programme. We also attempt for '*paira'* or utera or relay cropping of oat in rice field in FTDs programme.

5) Presently, Hybrid Bajra Napier (BN hybrid) is gaining popularity as perennial and high yielding fodder crop. Since the crop yields fodder round the year, and it is resistant to diseases and pests, the crop is being preferred by the dairy farmers. Also its fast growing habit has drawn attention among the farmers. The crop gives very high amount of green fodder and once established, the crop continues to grow for 4-5years.Attempts are being made to introduce newly released BN hybrids like CO-3, CO-4 and CO-5 in the different *districts* of West Bengal under FTDs programme.

6) Practice of Para-grass in the non-saline alluvial soil and also in the low lying area is gaining importance as perennial fodder crop in many districts like Nadia, *South 24Parganas, North 24 Parganas, Purba & Paschim Medinipur and Burdwan*. Previously it was adopted at the government farms only. Presently the dairy farmers also have adopted the crop.

7) Lathyrus, common name '*Khesari'* also gaining popularity as dual purpose green fodder cum pulse crop. Mostly Western part of West Bengal after rainfed/*kharif* (*Aman*) Paddy, the farmers grow '*Khesari*' first cut as green forage and then left for seed production purpose.Attempts are being made to introduce newly released HYV and less ODAP content varieties of lathyrus like Nirmal, Ratan and Prateek in the different *districts (Nadia, Bankura, Purulia, Jhargram, Paschim Medinipur)* of West Bengal with special reference to sole and relay cropping under FTDs programme.

Established Extension FTDs models in West Bengal:

1. Growing Coix around the bund of Rice field

Variety of Coix: Bidhan Coix-1 developed by BCKV, West Bengal, India

Bidhan Coix -1:

Green forage Seeds of Bidhan Coix -1

Para Grass in lowland area

Special characters of Bidhan Coix -1: Tolerance to salinity up to 9.6 dsm^{-1}, tolerance to partial submergence for 7 days. It can grow well along with paddy; especially in the border line of rice. Seed rate 20 kg ha^{-1}.Specific areas of its adaptation: North-east zone of the Indian Union comprising the states of Assam, Bengal, Bihar and Orissa. It is high in dry matter and Crude Protein and acceptability by the cattle. Reactions to stress are tolerant to submergence and withstand draught.

Average yield under normal conditions: 35-45 t ha^{-1} of green fodder and 6.0-7.0 t ha^{-1} dry matter yield. Coix is adopted in the low-lying and coastal areas during *Kharif.* There is a vast tract of land in the southern part of 24-Parganas District and Medinipur. District remains inundated with saline water no fodder crop can be grown in those areas except Coix. Thus the crop has been being grown by the farmers of those areas. Further, as information received from the Director-in Charge of the RSFPD, Kalyani, due to flood situation in Bihar and Jharkhand, there was huge demand for coix since no other fodder crop could sustain water stagnation. Coix also have released variety for the centre and entries were there. Realizing the fact that availability of land for fodder cultivation is most inadequate in West Bengal and drawing highly fertile cultivable land under fodder being almost impossible, a search for

identifying widely adapted plant species having high potentiality for being utilized as fodder was done at this centre when Job's tear (*Coix* sp.) emerged as a plausible choice. The centre has promoted and released variety on Job's Tear in the name of Bidhan Coix-1, which is suitable for marginal and saline tracts of the coastal West Bengal where livestock is a livelihood option considering poor quality agricultural lands and salinity.

Photograph of growing Coix around the bund of Rice field

2. Fodder crops in the borders and bunds of the crop fields of the farmers:

Further the Kalyani centre in its outreach activities promoted various fodder crops like napier, BN hybrid and guinea in the borders and bunds of the crop fields of the farmers. Both of these activities are taken up around the surrounding districts involving KVK partners, dairy shed areas and NGOs in the Sunderbans (coastal-saline zone) areas of South 24 Parganas district, Nadia, North-24 Parganas, Bankura, Purulia, Paschim Medinipur district under West Bengal.

Hybrid Napier in the borders and bunds of the crop fields

3. Growing of forage crops in problem soils:

Technology standardization has been taken up in laterite soils for Rice bean, *Aurundo donax* for low lying ecosystems in marshes and some work has been previously done in Coix. One grass species *i.e. Aurundo donax* has been identified as a potential fodder crop to be adapted in the water logged area round the area. The species has crude protein percentage to the extent of 8.6%; Dry matter percentage 19.7%. The dairy farmers of the locality where there is water stagnation round the year, they generally harvest this crop growing naturally and feed the animals.

4. Participatory seed production activities in FTDs programme:

Farmers in the outreach programs are encouraged to multiply their own seeds and such activities concentrate among the *kharif* forages, like ricebean, maize and winter forage crops mainly oats as dual purpose. A collaboration program on lathyrus (grasspea) was taken up with ICARDA and ATMA in the western part of the state in Paschim Medinipur, Jhargarm, Birbhum, Purulia and Bankura districts and Nadia, North 24 Parganas in new alluvial zone & South 24 Parganas district in coastal saline zone involves seed production and buy back of the produce.

Dual purpose Oat in the farmers' field

5. Under canopy legume crop:

Distributed the seeds of Ricebean (cv. Bidhan ricebean 1 and Bidhan ricebean 2), Berseem (cv. Mescavi, Wardan) and lathyrus (cv. Ratan, Prateek) to the resource poor farmers for popularizing as an under canopy legume crop in nutrient enrichment and fodder production in the mango, banana and guava orchards in different districts of West Bengal, like Nadia, North 24 Parganas, South 24 Parganas, Bankura, Purulia, Burdwan, Hooghly etc.

Berseem in banana, ber and guava orchard Lathyrus (dual pupose) in banana orchard

Government scheme for enhancing fodder production in the state of West Bengal:

Some Ad-hoc project of RKVY, ATMA and BGREI programme has started initiation for enhancing green forage production and seed production of forage crops in the state. Collaboration are needed with Department of Agriculture, Govt. of West & Department of Animal Husbandry and Fisheries, Govt. of West Bengal, KVKs under West Bengal, Regional Fodder Research Station, Kalyani, Govt. of India, & Regional station of NDRI (ICAR), Kalyani, West Bengal &West Bengal University of Animal Husbandry &Fisheries Sciences, West Bengal and other ICAR institutes related to forage crops & dry land technology.

Awareness development on 'seed production' of forage crops:

Seed production of grass pea (cv. Ratan, Prateek), oats (cv. Kent, OS-6)and ricebean (Bidhan ricebean-1 & 2)by farmers for their own uses as seed for the next year.

FTDs conducted:

Forage Technology Demonstrations (FTDs) have been conducted during *kharif* and *rabi* season and were distributed in different Districts of West Bengal, namely Bankura, Paschim Medinipur, Jhargram, Birbhum and Purulia district under red & laterite zone and Kolkata, Howrah, Burdwan, Hooghly, Nadia and North 24 Parganas, South 24 Parganas, Jalpaiguri, Coochbehar districts.

FTDs conducted during *Kharif* season on following forage crops:

- Forage maize (cv. J 1006, African tall),
- Ricebean (cv. Bidhan ricebean 1, 2 & 3) and
- BN hybrid (cv. CO3, CO4 & CO 5 respectively).

FTDs conducted during *rabi* season on following forage crops:

- Berseem (cv. Mescavi, Wardan),
- Lathyrus (cv. Nirmal, Ratan, Prateek) and
- Oats (cv. OS-6, Kent respectively).

Extension activities in FTDs:

FTDs conducted by BCKV, Kalyani in West Bengal

Year	Season	Number (Beneficiaries)	Yield farmers practice	Improved GFY (range) q/ha
2011-12	*Kharif* & *Rabi*	85 & 124	Very poor yield (local grass)	275-325
2012-13	*Kharif* & *Rabi*	92 & 96	-do-	282-356
2013-14	*Kharif* & *Rabi*	149 & 149	-do-	274-365
2014-15	*Kharif* & *Rabi*	160 & 152	-do-	285-382
2015-16	*Kharif* & *Rabi*	31& 22	-do-	295-385

Number of beneficiaries under FTDs in West Bengal:

Year	Number of beneficiaries under FTDs during *kharif* and *rabi* season		No. of Units conducted	
	Kharif	*Rabi*	*Kharif*	*Rabi*
2015-16	31	22	50	30
2016-17	49	22	62	36
2017-18	22	30	30	45
2018-19	43	50	51	50
2019-20	56	40	77	40

Improved green forage production and farmers economic condition:

Average green forage yields (GFY) were 298, 320 and 354 q/ha in case of Maize, Rice bean and BN Hybrid, respectively during *kharif* season. Average dry matter (DM) % was 19.5 %, 18.6 % and 17.5 % in case of Maize, BN Hybrid and Rice bean, respectively. The average crude protein (CP) % was 10.5%, 14.2% and 8.5% in case of Maize, BN Hybrid and Rice bean, respectively. Average green forage yields (GFY) were 378, 362 and 205q/ha in case of Berseem, forage Oats and Lathyrus, respectively during *rabi* season. Average dry matter (DM) % was 17.5 %, 16.8 % and 14.7 % in case of Berseem, forage Oats and Lathyrus, respectively. The average crude protein (CP) % was 14.5%, 14.2% and 16.3% in case of Berseem, forage Oats and Lathyrus, respectively.

FTDs programme play a vital role in maintaining secured livelihood with special reference to improve production potentiality of food-forage system and soil enrichment through production of biomass under changed climate as well as improve tribal farmers' income through production of green forage, meat, milk as they sell in the local market.

Table 1: Fodder Production Technologies adopted by farmers

Sl.No.	Fodder Production Technologies	Details	No. of farmers adopted
1	Growing of Coix in bundh of rice field during *kharif* season in Nadia, South 24 Parganas, Purba Medinipur districts	Coix cv. Bidhan Coix-1, Low land situation	30
2	Introduction of Coix as green forage crop in medium situation under Nadia, Bankura and Paschim Medinipur, North 24 Parganas districts during *kharif* season	Coix cv. Bidhan Coix-1, 1 cutting and then left for seed production	25
3	Planting of promising BN hybrid as boarder forage crop in the field during *kharif* season	BN hybrid cv. CO 3, CO 4 and CO 5, Used only FYM	200

4	Ricebean cultivation in different blocks of Nadia, North 24 Paraganas, Burdwan, Hooghly, Bankura, Purulia and Paschim Medinipur during *kharif* season	cv. Bidhan ricebean 1 & Bidhan ricebean 2	100
5	Ricebean grown as under canopy legume crop in orchards during *kharif* under Nadia, North 24 Parganas, Burdwan, Hooghly	cv. Bidhan ricebean 2 & 3, supply green forage upto winter	55
6	Ricebean grown during summer season	cv. Bidhan ricebean 1 & Bidhan ricebean 2, supply green forage during lean period	35
7	Introduction of cowpea as dual purpose crop in upland areas	Tender pod used as vegetable and remaining plant parts used as forage	35
8	Oat and berseem cultivation as green forage crop in Nadia, North 24 Parganas, Hooghly, Bankura and Purulia districts during *rabi* season	Oat cv. Kent, OS-6 & Berseem cv. Mescavi, Wardan	65
9	Utera cropping of dual purpose grasspea in rice fallow situation	Grasspea cv. Prateek, Ratan	125
10	Oat as utera cropping in rice fallow situation under Nadia district	Oat cv. Kent	28
11	Grasspea grown as under canopy legume crop as dual purpose in orchards during *rabi* season	Grasspea cv. Prateek, Ratan & Nirmal	60
12	Forage maize grown in upland areas of different districts of West Bengal during *kharif* season	Forage maize cv. J-1006, African Tall	30

Skill development of farmers, rural youth and women:

Farmer's & training on forage production technology

1. For tribal families/farmers at Arrah Gram Panchayet of Chhatna block of Bankura district of West Bengal on 28.07.16 during *kharif*, 2016 in red and laterite zone of West Bengal for skill development.
2. For tribal families/farmers at Bara Chaka village of Bankura-II block of Bankura district of West Bengal on 29.07.16 during *kharif,* 2016 in red and laterite zone of West Bengal.
3. For Women Self Help Group (SHGs) on forage production technology at Bab pur village, Santoshpur, PS-Dutta Pukur, Dist.- North-24 Parganas of West Bengal during *kharif*, 2016.
4. For tribal farmers as well distribution of inputs at 1. Kalikapur (Taaldangra block, Bankura district), 2.Rautari (Chakdaha block, Nadia district) and at 3.Panch Kahania (Haringhata block, Nadia district) of West Bengal during *rabi*, 2016-17.
5. for farmers and women SHGs of West Bengal as well distribution of inputs for skill development.

Organized farmers' meeting under FTDs:

Farmers Meet & training on forage production technology with farmers as well distribution of inputs at Arrah Gram Panchayet (Chhatna block, Bankura), Bara Chaka village (Bankura-II block, Bankura), Kalikapur (Taaldangra block, Bankura district), Baghmundi village (Baghmundi block, Purulia District), Sangar Batitaki village (Pingla block, Paschim Medinipur district), Rautari (Chakdaha block, Nadia district) and at Panch Kahania (Haringhata block, Nadia district) and Women Self Help Group (SHGs) at Bab pur village (Santoshpur, Dutta Pukur, North-24 Parganas) of West Bengal was conducted.

Awareness development on 'seed production' of forage crops: Seed production of grass pea, oats and ricebean by farmers for their own uses as seed for the next year.

Success stories under FTDs Programme:

Success story I

Gender farmer involved in use of fodder, dairy and biogas plant in Nadia District.

Succcess Story II

Three dairy farmers developed as entrepreneur as end to end approach in Nadia district.

i) 1) Mr. Haran Ghosh, 2) Mr. Amit Das & 3) Sri Kenaram Ghosh

Success Story III

One farmer also in Hooghly district developed himself dairy as a profession.

Success Story IV

Some farmers cultivated fodder (both annual & perennials) as their livelihood.

AICRP on FC & U, Kalyani Centre, BCKV play a key role for dissemination of forage technology among the farmers of different districts of West Bengal for increasing the productivity of forage crops, namely rice bean, cowpea, sorghum, BN hybrid, berseem, maize etc. as well as increasing area and income of resource poor farmers by cultivation of forage crops and developed dairy enterprise as profession.

Success glimpses:

Haran of Ghosh Nadia districts explains. Ever-since I have started feeding the cattle with the green fodder the cows give more and better qualitymilk, the density of the milk is also more and even the offspring health is also much more improved, comparatively. The AICRP forage – kalyani centre gave me initial seeds and knowledge to grow Bajra-napier (B-N) hybrid grass (cv. CO 3 & CO 4) year-round for continuous green forage supply to my cattle. Now, I grow fodder maize (cv. J 1006 & African Tall) and sorghum (cv. PC 23) during *kharif* season and oats (cv. Kent & OS-6) and Berseem (cv. Mescavi & Wardan) in winter.

Another farmer, **Biswanath Choudhury from Nadia** recalls, milk production has been my family business since the pre-independence time. With the help of AICRP on Forage Crops & Utilization, BCKV, Kalyani regarding green forage production and its importance in livestock management, I now use the modern and advance techniques. These resulted in quantitative and qualitative increase in milk and health of the cattle. Now I grow hybrid Bajra-napier, ricebean (cv. Bidhan ricebean 1 and Bidhan ricebean 2), cowpea, barseem, oats, sorghum, etc. In winter, I grow oats (as sole crop) and oats and mustard (as intercrops and mixed cropping) and in summer I grow fodder maize, rice bean and sorghum. On an average, I get 1 q of milk everyday. The selling price of milk is Rs. 27/ litre for wholesale and for retail sale its Rs. 40/ litre. Now my family is very happy.

Major outreach programmes undertaken:

1. The centre has promoted and released variety on Job's Tear in Bidhan Coix-1 suitable for marginal

and saline tracts of the coastal West Bengal, where livestock is a livelihood option considering poor quality agricultural lands and salinity. Further the centre in its outreach activities promoted various fodder crops like napier and guinea in the borders and bunds of the crop fields of the farmers. Both of these activities are taken up around the surrounding districts involving KKV partners, dairy shed areas and NGOs in the Sunderbans.

2. Development of variety for salinity and other abiotic stress conditions etc.: The major works of this centre pivots around Rice bean suited to water stress condition, marginal lands and saline stress conditions in Coix. New germplasm collected in Rice bean and undergoing breeding program in the centre conforms also to such areas.
3. Introduction of berseem (cv. Wardan, Mescavi) cultivation as green forage and Lathyrus as 'paira' crop as fodder cum food in Ranibandh and Sarenga area of Bankura district in western part of West Bengal *i.e.* red and lateritic zone.
4. Distribution of planting material (cuttings) of BN hybrid (cv. CO 3, CO 4& CO 5), forage maize (cv. J 1006 & Africal tall), ricebean (cv. Bidhan ricebean 1, Bidhan ricebean 2, Bidhan ricebean 3), coix (cv. Bidhan coix 1), fodder sorghum to the resource poor farmers were done in red and laterite zone of West Bengal, like Paschim Medinipur, Jhargram, Bankura and Purulia districts.
5. Lathyrus, common name '*Khesari*' also gaining popularity as green fodder crop. Mostly in Western part of West Bengal after rainfed/*Kharif* (Aman) Paddy, the farmers grow '*Khesari*' first cut as green fodder and rest for grain purpose as pulse.

Table 2: List of Progressive Farmers in FTDs:

Sl	Name	Address	Phone No.
1	Biswnath Chowdhury	Mohanpur, Gate No.-2, P.O.-Mohanpur, Block-Haringhata, Dist.-Nadia-741246	9475350760
2	Sri Haran Ghosh	Vill.- Dighapara, P.O.- Barojagulia, Block- Haringhata, Dist.-Nadia-741221	9800355562
3	Sri Kenaram Ghosh	Vill.-Panchkahania, P.O.-Barojagulia, Block- Haringhata, Dist.-Nadia-41221	7797367681
4	Murli Mohan Kuiry	Vill: Madla, Block: Bagmundi, Dist: Purulia	9932504916
5	Sri Mohan Jana	Pingla, Paschim Medinipur	8768018666
6	Durgapada Ghosh	Harmasra, Taldangra, Bankura	9641354884
7	Bijay Kumar Singha	Vill: Kudlung, Block: Bagmundi, Dist: Purulia.	7477471414
8	Sri Bapan Ghosh	Vill.-Teligacha, P.O.-Ghoragacha, Block- Chalkdaha, Dist.- Nadia-741245	8017156267
9	Sri Sankar Dey	Vill.-Bansbona, P.O.-Fatepur, Block- Haringhata, Dist.-Nadia.	9230518140
10	Sri Argha Kole	Vill.-Barakamalpur, P.O.-Bara, Block- Singure, Dist.-Hooghly-712306	9051606475

FTDs activities at farmers' field

Glimpses of Forage Technology Demonstrations (FTDs) in Uttarakhand

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Introduction

Indian Council of Agricultural Research (ICAR) evolved the new concept of field demonstrations on farmers' fields known as 'Front-Line Demonstration (FLDs)' It came into existence with the inception of the Technology Mission on Oilseed Crops during mid-eighties. The field demonstrations conducted under the close supervision of scientists of the National Agriculture Research System are called front-line demonstrations because the technologies are demonstrated for the first time by the scientists themselves before being fed into the main extension system of the State Department of Agriculture. Therefore, the FLDs provide a direct interface between researcher and farmers as the scientists are directly involved in planning, execution and monitoring of the demonstrations for the technologies developed by them and get direct feedback from the farmers' field about the different field crops production in general and technology being demonstrated in particular. This enables the scientists to improvise upon the research program accordingly. In FLDs, the subject matter scientists provide technological inputs to extension scientists to organize the demonstrations. Thus, FLDs provide an opportunity to researchers and extension personnel for understanding the farmer's resources and requirement to fine tune and/or modify the technologies for easy adaptability at farmers' fields. The program, Forage Technology Demonstrations' (FTDs) was conceptualized by AICRP-Forage Crops & Utilization, IGFRI, Jhansi on the line of frontline demonstrations (FLDs) scheme launched by ICAR on different field crops. Under the scheme of FTDs, the field demonstrations on different forage crops are planned to conduct on farmers fields in different agro climatic conditions by forage scientists. Among the forage crops, maize, sorghum, pearlmillet, clusterbean, teosinte, rice bean, cowpea, Indian bean (*Kharif* season) and berseem, oat, forage mustard, makhan grass (*Rabi* season) are important crops grown in the state. Besides, some of non-traditional legumes like stylo (*Stylosanthes scabra*), clovers-white (*Trifolium* repens) red (*T. pretense*) and Persian (*T. resupinatum*), butterfly pea (*Clotoria ternatea*), Indian clover (*Melilotus parviflora*), barley (*Hordeum vulgare*) and wheat (*Triticum aestivum*) are also grown for green fodder production. Besides some of the important grasses like BN hybrid, guinea grass (*Panicum Maxicum*), Anjan/ Dhaman/Buffel (*Cenchurs ciliarus*), Kikuyu grass (*Pennisetum clandestinum*), Spear grass/Kumaria grass (*Heteropogon contortus*), Godia /Chrysopogon grass (*Chrysopogon fulvus*), para grass (*Brachiaria mutica*), Setaria (*Setaria sphacelata*), rhode (*Chloris gayana*), Bakri (*Agrostis munoana*), Broome (*Bromus unioloides*), canary (*Phalaris minor*), Timothy (*Phelum pretebse*), Tall fescue (*Festuca arundinacea*), Kentucky (*Poa annua*) and rye grass (*Lolium perenne*) are also found in the barren and forest area of the state. The *rabi* season grasses requires low temperature so they are grown even at high hills of the state.

Objectives

- To demonstrate improved Crop Production Technologies on the farmers' fields,
- To popularize the newly notified and improved varieties/technologies for varietal diversification and efficient management of resources, and

- To bring synergy among planers, researchers, farmers and industry for parable interface through seminars/symposium on emerging themes of importance in the field of Rice, Wheat and Pulses production for deciding strategies for development of these crops.

Selection criteria

The FTDs program was initiated at Pantnagar centre during *Kharif* -2014-15 with 30 FTDs, 15 each of maize and cowpea in U S Nagar district. The farmers were selected for FTDs based on mainly following criteria;

- Distance from University,
- Leadership quality of farmers,
- Education and know-how of farmers,
- Interest of farmers,
- Socio-economic status of farmers.

The farmers are selected for FTDs in nearby areas of university and it may cover around 60 km in periphery of the university so that the scientists may visit the FTDs and return on the same day to the campus as it is required for proper monitoring of the demonstrations time to time. We also prefer better farmers having leadership quality so that he/she may influence other villagers for new innovations. Sometimes 'Gram Pradhan' and other members of Gram Sabha' are al preferred for FTDs as they have better resources and management skills. Besides, some other farmers of different social strata like OBC, SC and ST are given preference so that the new technology may percolate deeper in the society. The farmers' education is always important as the educated farmers can easily accept the new innovation compared to poor and illiterate farmers. The interest of farmers also pay important role to selecting farmers because we always prefer interested farmers for FTDs because they follow the instructions of the scientists and have skills to manage the FTDs and also help to record the yield data.

Total FTDs conducted

Total 469 FTDs were conducted during last 6 six years from 2014-15 to 2019-20 in mainly Almora, Nainital and U.S. Nagar districts of Uttarakhand (Table 1). The FTDs were conducted mainly in U.S. Nagar i.e. 284 because university campus is situated at U.S. Nagar district followed by 52 in Nainital district as it is a border district and also nearby area of university campus.

The FTDs were conducted as per the mandate decided during National Group Meet of AICRP-FCU. Table 2 indicates that minimum 60 FTDs on different fodder crops were conducted every year, which is more than mandate. The maize, pearl millet, sorghum, cowpea (*Kharif* season), berseem, oat, makhan grass, BN Hybrids (*Rabi* Season) are major fodder crops grown for green fodder in the state particularly Tarai and Bhabar region of the state, so Maize, sorghum, cowpea, berseem oat and BN Hybrids were preferred for FTDs.

Table 1: Total forage technology demonstration (FTDs) conducted in Uttarakhand from 2014-15 to 2019-20

S.N.	Year	Number of FTDs conducted Districts			
		U S Nagar	Nainital	Almora	Total
1	2014-15	46	19	-	65
2	2015-16	55	35	38	123

3	2016-17	75	25	-	100
4	2017-18	38	24	-	62
5	2018-19	30	29	-	59
6	2019-20	40	20	-	60
	Total	**284**	**52**	**38**	**469**

Table 2: Progress of Forage technology demonstrations from 2014-15 to 2019-20

S.N.	Year	Season	Number of FTDs/ Crop	Green fodder yield (q/ha)	
				Farmer practice	**Improved practice**
1	2014-15	*Kharif*	30	Cowpea : 250-300	Cowpea : 280-360
			(15 Cowpea + 15 Maize)	Maize : 300-350	Maize : 350-425
		Rabi	35	Berseem : 350-500	Berseem : 550-650
			(20 Berseem + 15 Oat)	Oat : 300-330	Oat : 320-380
				BN Hybrid : 450-500	BN Hybrid :720-950
2	2015-16	*Kharif*	68	Cowpea : 250-300	Cowpea : 280-370
			(02 BN Hybrid+14 Cowpea+	Maize : 300-350	Maize : 350-435
			20 Maize+32 Sorghum)	Sorghum : 320-375	Sorghum : 375-450
		Rabi	55	Berseem : 350-400	Berseem :550-680
			(35 Berseem + 20 Oat)	Oat : 325-350	Oat : 360-480
3	2016-17	*Kharif*	65	Cowpea : 230-270	Cowpea : 280-350
			(15 cowpea+25 Maize+25 Sorghum)	Maize : 300-325	Maize : 350-435
				Sorghum : 350-400	Sorghum : 400-480
		Rabi	35	Berseem :450-500	Berseem :550-680
			(20 Berseem +15 Oat)	Oat : 335-350	Oat : 370-480
4	2017-18	*Kharif*	32	Cowpea : 240-270	Cowpea : 280-350
			(5 cowpea +10 Maize +12 Sorghum)	Maize : 275-310	Maize : 350-435
				Sorghum : 360-400	Sorghum : 410-470
		Rabi	30	Berseem : 460-500	Berseem :550-720
			(20 Berseem +10 Oat)	Oat : 330-350	Oat : 375-420
5	2018-19	*Kharif*	39	Maize : 280-320	Maize : 350-410
			(19 Maize +20 Sorghum)	Sorghum : 360-400	Sorghum : 420-490
		Rabi	20	Berseem : 460-520	Berseem: 500-720
			(10 Berseem +10 Oat)	Oat : 320-350	Oat : 375-450
6	2019-20	*Kharif*	40	Maize : 280-330	Maize : 355-445
			(6 maize+34 Sorghum)	Sorghum : 370-400	Sorghum : 430-480
		Rabi	20	Berseem : 480-550	Berseem : 610-720
			(10 Berseem +10 Oat)	Oat : 330-350	Oat : 380-450
	Total		**469**		
			(274 in *Kharif* + 195 in *Rabi*)		

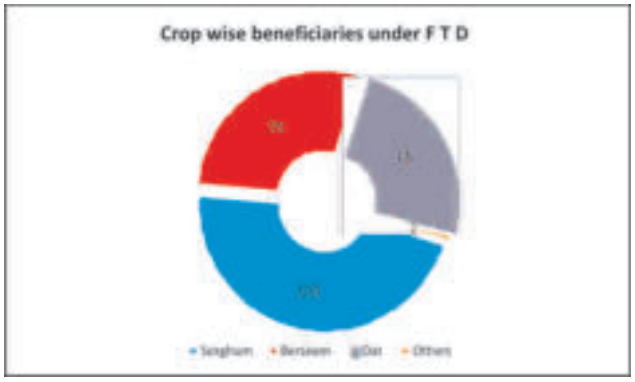

Fig. 1: Crop wise Forage technology demonstrations at Pantnagar

Impacts of FTDs

The results of FTDs indicates that the green fodder yield of all grown fodder crops was improved under improved technology over farmers' practices and the range varied with crops. The minimum increase in green fodder yield was recorded in oat i.e. 6-15% and maximum in 60-90% in B N Hybrid in 2014-15. In both 2015-16 and 2016-17, increase in sorghum yield under FTDs was recorded minimum while berseem had the highest increase in green fodder yield. Similarly, in 2017-18, 2018-19 and 2019-20, sorghum and B N Hybrid/berseem had the lowest and highest increase in green fodder yield, respectively (Table.3). The variable increase in green fodder yield was mainly due to change in variety, sowing time and management practices. The average increase in green fodder yield under FTDs over farmers' practices was recorded in range of 16-26% in cowpea, 21-30% in maize, 17-20% in sorghum, 28-40% in berseem, 12-28% in oat and 43-72% in B N Hybrid (Table.3). The FTDs were concentrated in one or two nearby villages for one to two seasons and the villages were changed for next year. However, the contacts and field visits continued even after leaving the village for FTDs, so that they can be monitored and persuaded for adopting the technology. The post survey of the FTDs was conducted and following impacts could be pointed out;

1. The farmers were happy with the new fodder varieties mainly because of;
   i. The germination and growth was better than local varieties,
   ii. The green fodder yield was higher than local varieties, and
   iii. There was no mixture in FTD varieties.
2. The regeneration capacity of introduced varieties were found better than local varieties,
3. Over all the increase in green fodder yield of fodder crops was recorded in range of 23-36%.
4. Farmers prefer sorghum in *Kharif* and berseem in *Rabi* season most for green fodder.
5. The selected farmers are, in general, very happy with the performance of FTDs as well as newly introduced fodder crop varieties.

Constraints in FTDs

Following constraints have been observed;

- Field inputs should be available timely for optimum sowing,
- Sufficient fund should be available for inputs,
- Poor transport facility restrict timely monitoring, so vehicle should be made available to the scientists.
- More awareness campaigns are required to mobilize farming communities for adopting the new agri-innovations.

Conclusion

FTDs are one of the excellent programs for improving the availability of green fodder production in the country and it should be intensified with more flow of funds as it will boost the dairy industry in the country and will help to increase farmers' income many folds in near future.

Table 3: Yield advantage under FTDs over farmers' practices in Uttarakhand

S.N.	Year	Season	Fodder crop	Green Fodder Yield (q/ha)		
				Farmer practice	Improved practice	Percent yield increase over farmers' practice
1	2014-15	*Kharif*	Cowpea	250 - 300	280 - 360	12 - 20
			Maize	300 - 350	350 - 425	16 - 21
		Rabi	Berseem	350 - 500	450 - 650	28 - 30
			Oat	300 - 330	320 - 380	06 - 15
			B N Hybrid	450 - 500	720 - 950	60 - 90
2	2015-16	*Kharif*	Cowpea	250 - 300	280 - 370	12 - 23
			Maize	300 - 350	350 - 435	16 - 24
			Sorghum	320 - 375	375 - 450	17 - 20
		Rabi	Berseem	350 - 400	550 - 680	57 - 70
			Oat	325 - 350	360 - 480	11 - 37
3	2016-17	*Kharif*	Cowpea	230 - 270	280 - 350	22 - 30
			Maize	300 - 325	350 - 435	16 - 34
			Sorghum	350 - 400	400 - 480	14 - 20
		Rabi	Berseem	450 - 500	550 - 680	22 - 36
			Oat	335 - 350	370 - 480	10 - 37
4	2017-18	*Kharif*	Cowpea	240 - 270	280 - 350	17 - 30
			Maize	275 - 310	350 - 435	27 - 40
			Sorghum	360 - 400	410 - 470	14 - 18
		Rabi	Berseem	460 - 500	550 - 720	20 - 44
			Oat	330 - 350	375 - 420	14 - 20
5	2018-19	*Kharif*	Maize	280 - 320	350 - 410	25 - 28
			Sorghum	360 - 400	420 - 490	17 - 23
			Berseem	460 - 520	550 - 720	20 - 38
		Rabi	Oat	330 - 350	375 - 450	14 - 28
			B N Hybrid	550 - 650	750 - 1050	36 - 62
6	2019-20	*Kharif*	Maize	280 - 330	355 - 445	27 - 35
			Sorghum	370 - 400	430 - 480	16 - 20
			Berseem	480 - 550	610 - 720	27 - 30
		Rabi	Oat	330 - 350	380 - 450	15 - 28
			B N Hybrid	550 - 650	750 - 1100	36 - 54
7	**Average of 6 years**		**Cowpea**	**242 - 285**	**280 - 358**	**16 - 26**
			Maize	**289 - 331**	**351 - 431**	**21 - 30**
			Sorghum	**348 - 395**	**407 - 474**	**17 - 20**
			Berseem	**425 - 495**	**543 - 695**	**28 - 40**
			Oat	**325 - 347**	**363 - 443**	**12 - 28**
			B N Hybrid	**516 - 600**	**740- 1033**	**43 - 72**
	Over all				**23 - 36**	

Farmers' meeting under AICRP-FCU

Recording of Green fodder yield at Farmers' Field

Monitoring of FTD (Berseem) at Farmers' Field

Extension of technology through multi media

FTD on Oat var. UPO-212

Forage Technology Demonstrations: An effective technology transfer tool for dissemination of improved forage production technologies in Himachal Pradesh

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Indian agriculture faces several constraints, especially in the areas of natural resource management and adoption of improved farm technologies to increase yield and farm profit while minimizing adverse environmental impacts (Choudhary *et al.* 2012). Among various crops, forages hold important position due to their role in livestock health and productivity and further in the GDP of the country. It is paradoxical that India, one of the major milk producing countries at global level, faces acute shortage of quality fodder to meet the requirements of its existing livestock population.

Himachal Pradesh, a North Western hill state of India is primarily a hill agrarian state. In the state crop farming, animal husbandry and pastoralism are intimately integrated. The rural economy mainly depends on crop farming, horticulture and livestock rearing, hence the optimum production and sustainability of these components is of prime concern to sustain the livelihood of the people living in the state. Hill agriculture is oriented towards mixed farming in which livestock rearing form an integral part of the economy. According to various surveys the dairy contributes about 35 to 55 per cent of the family income in the hills. In Himachal Pradesh about 80 per cent families are small and marginal. These families depend for their livelihood on agriculture and livestock rearing.

Sources of fodder

Hill region is a valuable treasure of fodder sources. Various fodder sources in the hilly region are as follows:

i. Pasture / grassland & grazing lands
ii. Barren & uncultivable lands
iii. Field bunds
iv. Fodder trees
v. Cultivated fodder crops
vi. Crop residues
vii. Weed growth of field

Pastures & grasslands, crop residues and tree fodder serves as the primary sources of feeding to the livestock in the region. Crop residues and fodder trees are mostly used during fodder lean (deficit) months *i.e.* May-June and November-December. In Himachal Pradesh the area under pastures and grasslands is 15.03 lakh hectares and area under cultivated forage crops is about 28 thousand hectare. Pastures alongwith other grazing resources like wastelands and community lands occupies an area of about for 24 lakh in the state. In addition to these resources cultivated forage crops, crop residues and fodder tree also contributes to mitigate the fodder shortage in the hills. During lean months, a large quantity of wheat straw is imported from the neighboring states to fulfill the fodder requirement in the hills.

Production status of fodder resources

Pastures and grasslands are one of the major sources of fodder but continuous grazing and overstocking of these resources has reduced their productivity, alongwith the dominance of unproductive and

unpalatable species and infestation of noxious weeds. The continuous grazing and overstocking of resources to a high extent has rendered the grasslands unproductive with dominance of unpalatable species and infestation with noxious weeds like *Stipa, Sabbucus, Aconitum, Cincifuga, Adonis, Artimesia, Lantana, Ageratum, Eupatorium* and *Eregeron* etc. In Himachal Pradesh, the demand of feeds and fodder for livestock is much higher than their availability. Presently there exists a wide gap between demand and supply of fodder in the state due to low productivity of forages on farmers' fields. The available fodder is not only insufficient but also poor in nutritive value; as a result, the productivity of the animals is very low. Whatever fodder resources are available, their availability is also seasonal. By and large, there is shortage of fodder from November to June, but during monsoon, plenty of greens are available and there is no shortage of fodder in the months of July, August, September and October. When the monsoon season is over, the grass from grassland is harvested in dry condition and stored as hay, which is fed to the animals during scarcity (Singh and Misri, 2012).

The over exploitation and unscientific management of resources has led to an alarming situation. But this situation can be improved by application of proven technologies and appropriate management developed by various research organization and institutes engaged in this field. Besides overgrazing and absence of improved grass and legume species, non-adoption of improved production technologies is also responsible for low production of fodder. Adoption of proven technological interventions can play a significant role in mitigating the fodder shortage in the region and improving the socio-economic conditions of the farmers.

Transfer of Technology

Transfer of generated technology to rehabilitate the fodder resources and improve the livestock productivity is essentially needed. Various research and developmental organization and agencies engaged in the task are:

- CSK HP Agriculture University, Palampur
- IGFRI, Regional Research Station at Palampur
- Department of Agriculture, Govt. of Himachal Pradesh
- Department of Forest, Govt. of Himachal Pradesh
- Department of Animal Husbandry, Govt. of Himachal Pradesh
- National watershed Programme
- Various NGOs etc.

Front line demonstrations, on farm adaptive trials, mini kit trials, training programmes, field/ farmers days and farmers fairs etc. are some of the most important pursuits under which the farmers are made aware of the methodologies for forage production and livestock management .

Forage Technology Demonstrations (FTDs)

Dr. K.D. Kokate, Deputy Director General (Agricultural Extension) inaugurated a workshop cum training programme in 2013 on National Initiative on Fodder Technology Demonstration (NIFTD) at Indian Grassland and Fodder Research Institute (IGFRI), Jhansi. Dr. Kokate emphasized upon bridging the gap in demand and supply of fodder at micro level. He also suggested for the preparation of district wise technological interventions, details on fodder deficit, livestock population, milk productivity, lactation period, income and health issues etc. Forage Technology demonstrations (FTDs) is one of the various approaches for the dissemination of technologies on farmer's fields. FTDs aim at to demonstrate improved technological interventions of forages on farmers' fields to demonstrate the potential of technologies under varied farming situations. Transfer of technology and bridging the gap

between recommended technologies and existing technologies can enhance the farm productivity and income (Choudhary *et al*. 2009).

ICAR- All India Coordinated Research Project on Forage Crops & Utilization {AICRP (FCU)} has contributed significantly toward the development of improved forage varieties their production and protection technologies for all the agro-climatic zones of the state, since its inception 1970 at CSK HP Krishi Vishvavidyalaya, Palampur (HP). It is worth mentioning that these recommended technologies will definitely help to improve the forage resources and their productivity on farmers' fields in the state.

Concept of FTDs

Low forage productivity in hills is mainly due the cultivation of forages under rainfed conditions, use of suboptimal management approaches and non-adoption of improved varieties. Present programme was undertaken to demonstrate and transfer the generated farm technologies through demonstrations in forages under different production systems with the objectives of enhancing productivity and profitability on farmers' fields. The overall purpose to conduct FTDs was to demonstrate improved forage varieties, their production and protection technologies and introduce best forage technologies on farmers' fields of the state. The interventions on one hand were aimed at benefiting the farmers where demonstrations were conducted and on the other hand horizontal dissemination of technologies was also considered.

Objectives

- To demonstrate the performance of improved forage varieties
- To introduce crop production scheme and enhance livestock productivity.
- To improve adoption of forage production technologies
- To improve the know-how and skill of livestock farmers with regard to improved forage production and management practices
- To develop and document base line information for further research and development
- To popularize, disseminate the new technologies to farmers and also see horizontal dissemination of technological interventions

Selection of farmers and execution of demonstrations

To achieve the objectives, Forage Technology demonstrations (FTDs) are being conducted on farmers' fields in Himachal Pradesh since *Kharif* 2009 to date. FTDs activities were initiated and are being executed on the fields of livestock rearing families. Selected areas and families over the years represented diverse agro-socio-economic situations. Baseline survey for livestock per family and the fodder deficiency problems being faced by dairy farmers was conducted for selection of the site for conduct of FTDs. Farmers willingness to adopt forage cultivation technologies was also taken one of the main criterion for selection of sites and farming families. Selection of forage species and other inputs was done keeping in view choice and need of the farmers based on baseline survey of the selected farming families. Areas were visited personally and group discussion were organized to get acquainted the farmers about recommended and improved forage production technologies with a view to strengthen the backward and forward linkage. In Himachal Pradesh, cultivated fodder crops dominate during *rabi* season, whereas, during *Kharif* season natural grasslands, pastures and unculturable lands are major source of fodder to the livestock. Keeping in view, the predominance of grasslands, pastures, field bunds, community lands etc. and occupancy of arable land under gain and cash crops, main emphasis was given to supply the planting material of perennial forage species. Demonstrations on improved farm technologies were conducted in *Setaria* grass, Napier bajra hybrid, tall fescue grass,

white clover, oats and annual rye grass. The detail of demonstration with respect to crops, their varieties and production technologies is presented in table 1. The forages grown according to farmers' practice

Table 1: Forages and their production technologies

Crop	Variety	Time of sowing / plantation	Mode of propagation	Fertilizer (NPK kg/ha)
Napier-bajra hybrid	NB- 37	July-August	Root slips	120:80:40
Setaria grass	PSS-1, S-18, S-25	July-August	Root slips/seed	120:60:40
Tall fescue grass	Hima 1, Hima 4, EC178182, Hima 14	July-August October-November	Root slips/seed	120:60:40
White clover	Palampur composite -1	October-November	Seed	20:60:40
Oat	Palampur -1	October-November	Seed	120:60:40
Rye grass	Him Palam rye grass-1	October-November	Seed	120:60:40

Details of Demonstrations conducted at CSK HPKV Palampur

The Forage Technologies Demonstrations activities under AICRP (FCU) by CSK HPKV Palampur were initiated during *Kharif* 2009. Year wise and crop wise details of forage demonstration conducted since 2009 is presented in table 2.

Table 2: Details of forage technologies demonstration conducted by CSKHPKV Palampur

Crop	Year												
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Setaria grass	8	53	25	9	20	42	4	2	2	33	64	21	283
NBH	9	53	21	11	13	42	2	2	2	34	34	20	243
Oats	10	28	23	4	31	36	1	9	-	9	20	20	191
Tall fescue grass	-	4	2	18	7	7	4	1	-	1	-	-	44
Clovers	-	-	4		7	5	4	-	1	2	-		23
Rye grass	-	-	-	-	-	-	9	-	4	9	7	14	43
Total	27	138	75	42	78	132	24	14	9	88	125	75	827

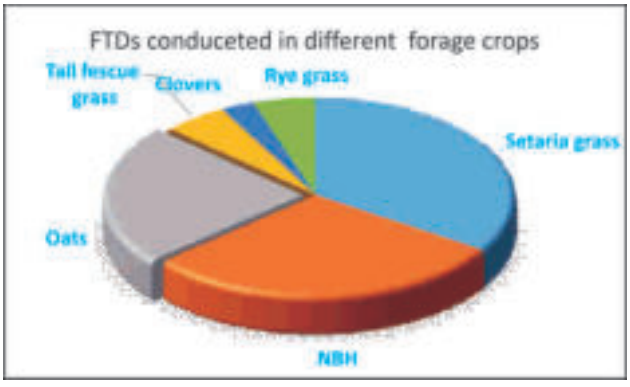

Fig. 1: Details of forage technologies demonstration conducted by CSKHPKV Palampur

Estimation of crop productivity and yield enhancements

The data on forage yield from demonstration plots and farmers' practices were collected through a random plot cutting methodology followed by personal interviews. The yield increase in demonstrations plots over farmers' practice was calculated using the following formula:

% Yield increase over farmer's practice

$$= \frac{\text{Yield in demonstration plot - Yield under farmer's practice}}{\text{Yield under farmer's practice}} \text{ X } 100$$

Earlier comprehensive study conducted under Operational Research Project for wasteland development on farmer's fields by Department of Agro-forestry CSKHPKV Palampur indicated increase in green forage yield as well as family income by 810% per hectare during the project period. In Himachal Pradesh, another study on dissemination of knowledge to the farmers on pasture improvement in dry temperate condition resulted in 3-4 times increase in herbage yield, increase in milk yield during lean months (winter) with increase in family income by 15-20% (Anonymous,2000). Present forage technology demonstration programme being executed by CSK HPKV Palampur under AICRP (FCU) also resulted in significant improvement in herbage yield on farmers' fields (Table 3).

Table 3: Impact on herbage production

Crop	Increase over farmers' practices
Setaria grass	40 % in the year of establishment and 150% in subsequent years
NBH	28 % in the year of establishment and 160% in subsequent years
Oats	30-50%
Tall fescue grass	20 % in the year of establishment and 80 % in subsequent years
Clovers	5% in the year of establishment and 50 % in subsequent years
Rye grass	A new crop in the state and have high acceptability among farmers

Farmer's feedback

The areas and farming families were visited during the season of demonstration execution as well as post demonstration period and feedback of the farmers were taken to improve the production technologies and also address other some related issues. Based on feedback improvements in few issues were suggested (Table 4).

Table 4: Farmers' feedback and suggested improvements

Technology demonstrated	Impact	Farmers' feedbacks	Action suggested	Further feedback
Planting of Napier bajra hybrid and Setaria grass	• Better acceptability among farmers due to better yield and longer seasonal distribution of compared to local grasses • Fits in the existing production system	• Initial varieties of Setaria shows poor acceptability due to high oxalate content which reduced the animal productivity • Persistency of NB hybrid was less under grassland situation	• Varieties PSS-, S-18 and S-25 and S-92 of setaria grass planted and got good acceptance due to low oxalate, better palatability and high yield of quality fodder • NB hybrid mainly suggested as bund risers	• Better acceptability of these varieties with recommended package • Very good acceptability of perennial grasses as bund risers
Bund risers Rehabilitation of biologically degraded lands i.e. management of weeds (*Lantana camara, Ageratum, Parthenium*) and planting of improved forages)	• Better acceptability on bunds • Farmers were convinced with the technological interventions but further spread of the technology at farmers levels was very poor	• Rat problem in upland situation • The operation is labour intensive and initial investments is more • Rehabilitation at one's area is difficult until surrounding areas are not made free of weeds	• Plant to plant distance increased • Need people participatory approach on campaign basis • Involvement of Govt. and NGOS agencies is of prime importance • Provision of funds • Need to create awareness among farmers about ill effect of these weeds.	•Better Acceptability

Adaptability by farmers/reason of non-adoption

The recommended varieties and production technologies have found a place on the farmer's fields with good adaptability. The technologies are also finding their place on other farmer's fields of the areas through horizontal dissemination. Regular demand of quality planting materials of improved forage species by different stakeholders (Table 5) clearly support the acceptability of recommended forage production technologies in the state.

Table 5: Supply of planting material of improved forage species

Years	2016-17		2017-18		2018-19		2019-20	
Species	Seedlings (No.)	Seeds (Kg)	Seedlings (No.)	Seeds (Kg)	Seedlings (No.)	Seeds (Kg)	Seedlings (No.)	Seeds (Kg)
Setaria grass	5,00,000	3	8,02,000	13	5,91,360	8	7,22,833	5
NBH	5,59,000	-	4,51,000	-	5,80,300	-	2,75,000	-
Temperate species	8,100	61	2,000	22	1,04,680	94	15,000	98
Total	11,40,000	64	12,55,000	35	12,76,340	102	10,12,833	103

Although, proven technologies have hold good promise on the farmers' fields but still there is a need to have more emphasis to transfer the technology to ultimate stakeholders. Although the farmers prefer the recommended technologies but there are some shortcomings as below, which slow down the rate of technology transfer:

- Poor socio-economic conditions of the farmers in the region do not favour more expenditure for inputs
- Small land holding do not allow the farmers to put more and more area under fodder crops
- More emphasis of farmers on grain and cash crops

The technologies are abundantly adequate for the enhancement of forage production and improvement of livestock productivity in the region. However, further research and refinement of these technologies is an on-going mandate of various Research and Development agencies located in the region. More involvement of local bodies (*Gram Panchayat*s, *Mahila Mandals,* NGOs and collaboration with officials of other departments like Forest, Animal Husbandry and Agriculture can further strengthen the forage dissemination activities in the state. Results of demonstrations of new crop varieties supplemented with production technologies serve as local proofs for convincing the farmers. Experimental results alone often fail to attract the attention of farmers. Farmers have more confidence if they are convinced that recommendations are practical and are based on local demonstrations. The farmer on whose field, the 'demonstration' is conducted become a model for others.

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Fodder Technology Demonstrations (FTD) in Kerala- A perspective

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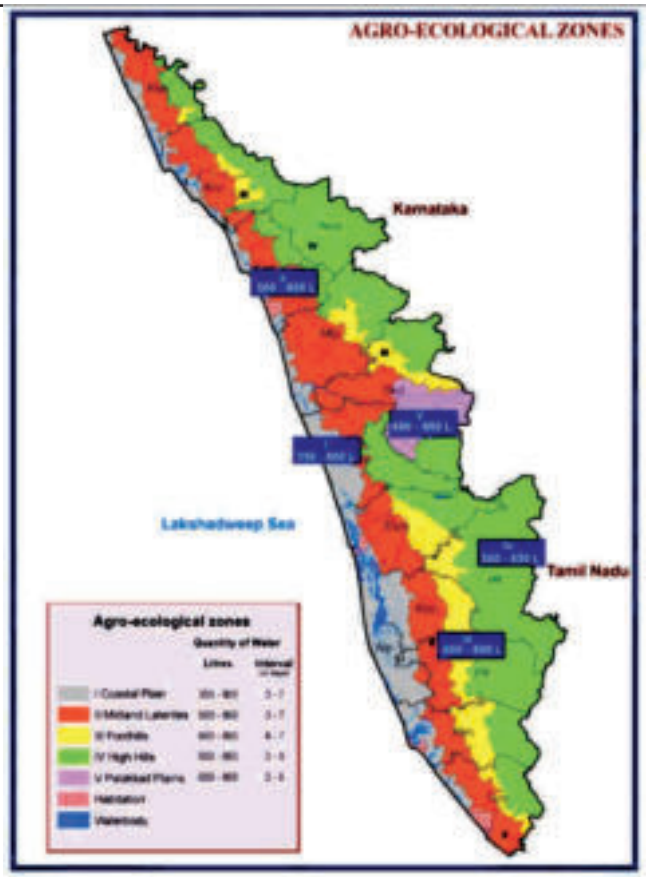

Kerala, the state with highest percentage of cross bred animals in India having higher potential for milk production, has a low average milk yield of only 7.508 kg milk per cow per day. The insufficiency in milk production leads to import milk from other neighbor states. Shortage of good quality green fodder is the main reason for low productivity. The green fodder plays a vital role in the milk industry. In Kerala, due to ever-increasing population pressure of human beings, arable land is mainly used for food and cash crops, and the per capita land availability is decreasing day by day. Thus there is little chance of having arable land accessible for fodder crops only. But Kerala has the lively mixed farming system called home gardens from time immemorial. Home gardens offer an array of opportunities for agrarian sector of Kerala. The components may be food crops, cash crops, animal husbandry activities etc. Inclusion of fodder crops into the existing homestead farming systems has a vital role in Kerala dairy farming sector. Coconut based cropping systems are popular in Kerala. This system is inimitable to Kerala and is highly intensive and diverse with a variety of crops and animals immediately surrounding the home. In Kerala, coconut is the main crop in the home gardens and these coconut gardens offer good opportunity for fodder production also. The development of the livestock sector has proved to be very important, as it is the major livelihood of over a million households.

In Kerala majority of livestock owning farmers are either small and marginal or even landless. Fodder crops are cultivated on 7,000 ha which produces green fodder to meet only about 2 per cent of the total dry fodder requirement of the State. The important sources of dry matter available are crop wastes such as paddy straw, banana pseudostems and leaves, coconut leaves, pineapple waste, jack

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The All India Coordinated Research Project on Forage Crops (ICAR) was started in 1971 at the College of Agriculture, Vellayani. In the initial phase the Centre carried out research on the agronomic aspects of forage crops suited to Kerala. Later forage breeding programmes were also initiated. Apart from the coordinated trials in Agronomy and Breeding, the Centre undertakes forage improvement and

management programmes of the University also. Research on Breeding and Agronomy of fodder crops suited to partially shaded coconut gardens is the focus of this centre. Germplasm collection, maintenance and evaluation were being done for guinea grass, napier grass, bajra, cowpea and rice bean. Research programmes were also taken up to develop bajra- napier hybrids and hybrid derivatives in cowpea and rice bean. The Package of Practices Recommendations of Kerala Agricultural University in the case of fodder crops like guinea grass, hybrid napier grass, congo signal grass, signal grass, fodder cowpea and rice bean were formulated based on experiments conducted at the Vellayani Centre.

Major achievements

Developed and released 8 promising varieties in 4 important fodder crops of Kerala (Guinea grass, hybrid napier, fodder cowpea and rice bean)

Variety characters are detailed below:-

Susthira:-A bajra napier hybrid developed by interspecific hybridization (IP22267 x FD462) followed by clonal selection. Tall variety with high tillering capacity, broad leaves, suited for warm humid tropics. GFY-300 t/ha/yr. CP 14.79%, Crude fibre – 13% .Suitable for uplands and homestead gardens in Kerala

Suguna: A bajra-napier hybrid developed by crossing Composite 9 and FD431. It is having high tillering capacity (40 tillers/plant) with long broad leaves. It has better quality with crude protein content (9.4%) and crude fibre (24.0%). The grass is nutritious, palatable and free from oxalates. The hybrid recorded a green fodder yield of 280-300 t/ha. It is suited for uplands, homesteads and rice fallows of Kerala.

Supriya: A bajra-napier hybrid developed by crossing TNSC 4 and FD 471. It is high tillering with 35 tillers per plant. It has better quality with crude protein content (9.0%) and crude fibre (26.0%). The grass is nutritious, palatable and free from oxalates. The hybrid recorded a green fodder yield of 270-290 t/ha. The variety is free from pests and diseases. It is suited for uplands, homesteads and rice fallows of Kerala.

Haritha: A semi perennial guinea grass variety developed by mutation breeding from FR600. It is shy flowering, has glabrous leaves, yields 60-70 t/ha and is suitable for partial shade in coconut gardens. The grass is nutritious, palatable and free from oxalates. It can be cultivated in coastal sandy tracts of Kerala throughout the year.

Marathakam: A high yielding guinea grass variety developed by mutation breeding from FR 600. It is semi perennial giving an yield of 70-80 t/ha with better fodder quality and tolerant to partial shade. The grass is nutritious, palatable and free from oxalates. It is suitable for cultivation in uplands and homesteads throughout the year.

Harithasree: A high yielding guinea grass variety developed by clonal selection from JHGG-96-3. It is high yielding and having better quality. The green fodder yield recorded is 80-100 t/ha. The crude protein content is 8% and crude fibre is 28%. The grass is nutritious, palatable and free from oxalates. It is suited for cultivation in uplands and homesteads of Kerala.

Aiswarya: An improved variety of fodder cowpea developed by hybridization and selection with green fodder yield of 29.92t/ha. The green fodder is highly palatable with crude protein content (18.5%) and crude fibre content(20.0%). It is recommended for cultivation in uplands and homesteads of three southern districts of Kerala

Surabhi: An improved variety of fodder rice bean developed by mass selection from the accession LRB 64.The variety has recorded a green fodder yield of 33.69t/ha in uplands and 38.25 t/ha in rice fallows. It is highly palatable with crude protein content (18.9%) and crude fibre content (20.0%).It is superior to cowpea in quality and fodder yield. The variety is recommended for cultivation in homesteads and rice fallows of three southern districts of Kerala.

Forage Technology Demonstrations (FTD)

It is a programme implemented under the AICRP on Forage Crops and utilization project, to popularize the fodder production technologies and make the farmers aware about new fodder crop varieties. Forage Technology Demonstrations (FTD) were conducted at 382 locations during the period 2009 to 2020 in Kerala .The scheme was mainly conducted in Bajra Napier Hybrid, the most popular fodder crop in Kerala for the variety –Suguna. It was also done for the guinea grass variety Harithasree and fodder cowpea variety Aiswarya.

In the initial years of scheme implementation, planting materials and other critical inputs were supplied to the farmers to conduct FTDs in an area of 0.5 acres. For the last 4 years inputs are not supplied through the scheme, but advice on scientific fodder cultivation aspects are given to dairy farmers.

Table 1: FTDs conducted by Vellayani centre

Year	Number of FTDs	Crops and Variety	Districts
2009-10	11	BN hybrid- Suguna Guinea grass- Harithasree	Trivandrum
2010-11	25	BN hybrid- Suguna Guinea grass- Harithasree Fodder ricebean	Trivandrum Kollam Pathanamthitta
2011-12	26	BN hybrid- Suguna Guinea grass- Harithasree Fodder ricebean	Trivandrum Kollam Pathanamthitta
2012-13	30	BN hybrid- Suguna Guinea grass- Harithasree	Trivandrum Kollam Pathanamthitta
2013-14	45	BN hybrid- Suguna Guinea grass- Harithasree	Trivandrum Kollam Pathanamthitta
2014-15	40	BN hybrid- Suguna Guinea grass- Harithasree	Trivandrum, Kollam
2015-16	50	BN hybrid- Suguna Guinea grass- Harithasree	Trivandrum, Kollam
2016-17	45	BN hybrid- Suguna Fodder cowpea- Aiswarya	Trivandrum, Kollam
2017-18	40	BN hybrid- Suguna Fodder cowpea- Aiswarya	Trivandrum, Kollam, Pathanamthitta Kottayam Malappuram Wayanad

2018-19	40	BN hybrid- Suguna Fodder cowpea- Aiswarya	Trivandrum, Kollam Pathanamthitta Kozhikode Malappuram Kottayam Malappuram Wayanad
2019-20	30	BN hybrid- Suguna & Susthira Fodder cowpea- Aiswarya	Trivandrum, Kollam Pathanamthitta Kottayam Wayanad
Total	**382**		

In all the fields, the crop was introduced for the first time through FTD and hence we couldn't compare the performance of KAU fodder varieties with existing varieties in farmer's field. BN hybrid variety Suguna recorded a range of yield potential in farmers field from 150- 250 t/ha, guinea grass variety harithasree recorded 50-70t/ha and cowpea Aiswarya recorded GFY of 18-23t/ha. Farmers were happy with the performance of the varieties and through the programme, these varieties were popularized in the adjoining areas too. In Kerala, since wage rates are very high, farmers are happy with perennial fodder crops like BN hybrid and Guinea grass. Even though, they are convinced with the importance of legumes in animal diet, less interest was shown for annual crops like Fodder cowpea and ricebean. Success stories of representative farmers are furnished herewith.

Training for FTD farmers

We have organized one day training for FTD farmers to train them on Scientific fodder production strategies and to collect the feed back from the farmers regarding the performance of the varieties in their field.

Success glimpses:

Hybrid napier has been the choice of fodder crop of farmers mostly engaged in homestead farming as it doesn't need complex machinery for harvesting a sizable load of green fodder. The crop can be

harvested manually and even a few plants can give enough fodder to feed an animal for a day. Being a crop of perennial nature, the only cost involved is land preparation prior to planting and during planting. Cultivating fodder crop in fallow lands ensures green fodder availability to the livestock throughout the year. It also helps in soil erosion prevention and ensures steady percolation of water into the soil during rainy season thereby improving the level of the ground water table. It also improves the income of the farmer. Through FTD scheme, we could popularize the high yielding fodder varieties throughout Kerala.

For a dairy farmer, the grass can be given throughout the year to animals as green fodder which reduces the quantity of concentrates in the feed. The cost of production of one kilogram of green grass comes to around two rupees in Kerala where the labour and input cost is high. The cost of establishment of the crop can be met through incentives provided by various departments like Kerala Livestock Development Board and Dairy Development Department. The rate of one kilogram of quality concentrate animal feed is about Rs. 23/-. When considering the overall animal health and breeding potential, it is advisable to feed the animal with green fodder compared to relying on concentrates more for their nutritional requirement. Through FTD programme under AICRP on Forage Crops &Utilization, Vellayani centre, we could popularize high yielding fodder varieties and scientific fodder production technology among dairy farmers throughout Kerala.

1. Sri. Subeesh from Ottasekharamangalam (Thiruvananthapuram) established a fodder unit in an area of 6 acres with advice on various aspects of scientific fodder crop management like installation of sprinkler in the field, nutrient and cutting management of the crop. Now the farmer sell approx.3000 kg green fodder daily to dairy farmers in different parts of Thiruvananthapuram
2. Sri.Arundev, retired army man a dairy farm owner of Thalayil village, Trivandrum started Nandini farm 10 years back with 10 cows. Now he has 70 cows which include HF, Jersy, Brown Swiss, Vechur, Kasaragod Dwarf etc. Along with dairy farm, he extended the fodder cultivation for 3.5 acres. The fodder cultivation became a successful venture and it helps to feed the cows with good quality green fodder. He started selling of planting materials to the farmers and now he is one of the Government certified nursery in Trivandrum producing planting materials of different fodder crops and earning additional profit of one lakh rupees per annum from nursery itself.

3. Sri. K.Wilson of Kakkamoola village cultivates *suguna* replacing rice in an area of 25 cents using improved technology during *Rabi* 2010-11. he is happy to substitute his agricultural land for cultivation of fodder crop because it is very much remunerative (double the yield). He is managing 4 cows with the green fodder from 25 cents

4. A real-estate cum building contractor, Sri. Avaneendranath from Balaramapuram in Thiruvananthapuram on advice of AICRP on Forage crops Vellayani centre, started cultivating Hybrid

Napier in his area. This resulted in his farm profitability due to reduction in quantity of concentrates fed to the animals (less cost of cultivation). He also realizes a supplementary income from selling quality planting material of bajra X napier hybrid to the fodder farmers from May- September which is the planting time of the crop.

5. Sri. Sukumaran is a vegetable and banana farmer from Kottarakara in Kollam District introduced and put fallow land to cultivable use that too with only initial investment of establishing the crop bajra X napier hybrid. He also observed that the crop didn't require much care and labour. Presently he has more than 3 hectares of land under hybrid napier cultivation. The farmer is earning additional income through sale of green fodder and quality planting material in the form of two noded cuttings of bajra X napier hybrid (Suguna, Co-3, Co-5).

Fodder Technology Demonstration Programme: An Effective Tool for Popularizing Scientific Fodder Production in Assam

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The state of Assam is situated between 90 – 96 degree East Longitude and 24 – 28 degree North Latitude. Assam is bordered in the North and East by the Kingdom of Bhutan and Arunachal Pradesh. Along the south lies Nagaland, Manipur and Mizoram. Meghalaya lies to her South – West, Bengal and Bangladesh to her West. The state has a total geographical area of 83700 lakh sq km with 33 districts and the human population was 3.12 crore (2011 census). The literacy rate is 72.19 percent. The economy of Assam is agrarian where more than 70 per cent of the population are engaged in agriculture, animal husbandry, fishery, sericulture etc. The contribution of agriculture to total GDP of state is 33 percent, while the contribution of livestock sector to total agriculture / total GDP is not available separately. The livestock sector plays a key role in the farmers' economy. This sector is responsible for providing food and nutritional security of the people by producing milk, meat, egg etc. Dairy farming is an important source of income to farmers. Besides producing milk and/or drought power, the dairy animals are also good source of farm yard manure. The farm byproducts in turn are gainfully utilized for feeding the animals. This sector is highly livelihood intensive and provides supplementary income to over 70% of rural and quite a few urban households. Feeding of dairy animal consist of roughage, concentrates and small quantities of vitamins and minerals. As cost of concentrates are more therefore growing green fodder round the year enables a farmer to cut the cost of feeding without affecting the productivity because 60% of total cost of milk production shared by feeding cost. So considering economic and nutritious feeding, growing fodder crop is very much necessary for farming system. The state has great potential to enhance productivity of cattle, goat and poultry by adopting various technologies. Although the research project was started in the year 1970 and developed promising production technologies of scientific fodder production, effort for popularisation of technologies has not been given due importance prior to introduction of fodder technology demonstration programme under AICRP on Forage Crops and Utilization. As a matter of fact the programme for popularization of technology was undertaken by the Department of Animal Husbandry which was not sufficient to effectively popularise the scientific fodder production technologies. The main constraints of low productivity of dairy animals are deficit in green fodder and dry fodder availability, lack of easy availability of seed and planting materials of improved forage crops, lack of technical knowledge for scientific fodder production, lack of knowledge on

proper nutrition and animal health care, insufficient programme for capacity building for scientific fodder production, lack of sufficient credit facility for fodder production, high cost of concentrate feed.

Agro climatic Zones of Assam

The geographical position of the center is located at 95.50^0 E longitudes, 25.80^0 N latitude with an elevation of 86.6 m above mean sea level. Physiographically the state of assam is devided into six Agro climatic Zones viz Upper Brahmaputra Valley Zone,North Bank plain Zone,cetral Brahmaputra valley Zone ,Lower Brahmaputra Valley Zone,barak valley Zone and Hill Zone.Jorhat falls under agro climatic zone of Upper BrahmaputrValley Zone of Assam.

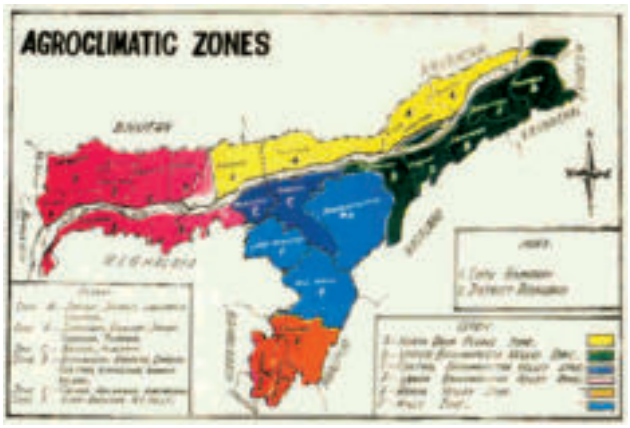

Fig. 1: Agro-climatic Zones of Assam

The general climatic condition of this region is subtropical humid. The rainfall intensity is highest during monsoon season, which normally starts from April and ends in September. Normally the intensity of rainfall decreases from the month of September and dry spell continues from October and reaches the minimum during December/January. Average annual rainfall of the state ranges from 1750 mm to 2000 mm. The soil of the upper Brahmaputra valley zone is derived from the alluvial deposits of the river Brahmaputra and its tributary. The soil is acidic in nature (pH 5.1-5.6). The status of soil available nitrogen is medium but low in available phosphorus and potash. The textural class of the soil ranges from sandy loam to sandy clay loam.

Popularization of fodder production technology in Assam

The abundance of natural vegetation in Assam makes the dairy farmers unaware of the importance of scientific fodder production for profitable dairy farming during the period 20 -25 years back. When farmers started rearing improved breed at the same time there is large shrinkage of natural vegetation it becomes necessary to go for fodder cultivation in their homestead. But the limitation is non-adoption of right variety of forage crops, scientific management practices for getting nutritious and productive fodder crops as well as lack of knowledge on scientific preservation of fodder crops. In addition to this the dairy farmers were unaware of economics of dairy farming. As rice is the main competitive crop the focus of the farmers is only on rice crops and other food and vegetable crops. Moreover the knowledge on round the year fodder production programme is also limiting the sustained production of green fodder. With the introduction of Fodder Technology Demonstration makes the way to popularise the scientific fodder production throughout Assam involving KVKs, RARS, NGOs, DCS and other link departments like Dept. of Animal Husbandry and Department of Dairy Development. Besides, with the help of AICRP on Forage Crops and Utilization all the leading SAUs joined hand for augmentation of scientific fodder production by providing suitable crop varieties and appropriate scientific advisement for the dairy farmers. The advantage of agroclimatic condition of Assam is that it is very much suitable for growing diversified forage species including both annual and perennial fodder. Besides, numbers of indigenous species of top feed i.e. fodder trees are found growing luxuriantly with high pruning tolerance. Although rice is the only and most favourite crop growing in Assam there is ample scope for growing fodder crops during fallow period i.e. during summer and *rabi* seasons. Because the rice during *kharif* is grown mostly under puddled condition, so both the *rabi* and summer seasons are very much suitable for growing forage crops which helps to meet the green forage requirement during lean

period. In spite of limitations of planting materials and seed of forage crops introduction of fodder nurseries for perennial fodder crops makes the planting materials easily available to the dairy farmers at their easy reach. Not onlythat for many farmers fodder nurseries become easy source of income with high benefit cost ratio. As such numbers of perennial forage crops like Hybrid Napier, Setaria, Congosignal, Guinea and Para has been made popular among the farmers. Among annual crops oat is the most popular crops followed by maize and sorghum. Among legume crops farmers started growing cowpea and ricebean. Relay cropping of lathyrus is common practice in rice crops in selected pockets particularly in flood affected areas and the rice areas where long duration rice varieties like ranjit and bahadur are grown. As a result of concerted effort of forage scientist the farmers were encouraged to adopt technologies for making the nutritious fodder available with their available resources. Food-forage-based systems provide a support to small and marginal farmers by adjusting a substantial part of their land exclusively for forage production in grain crop based rotations. Efficient cropping system with respect to biological potential along with increased efficiencies of land and water are to be evaluated for specific regions (Yadav*et al.,* 1998). Forage needs to be integrated in the existing food based cropping system as crop intensification either in space (intercropping) or in time (sequential cropping) or both. Food-fodder based crop rotations have been evaluated for their profitability and were found more remunerative than other in many agro-climatic and management situations. Forages offer a great scope in contingent planning as short duration catch/intercrop or alley crop under different resource use situation to support livelihood through enhanced livestock productivity. With the current growth trend in livestock products strategies should be oriented towards promotion of forage based cropping system or inclusion of forages as sole, mixed or intercrop in existing cropping situation to narrow down the gap in demand and supply matching with agro-economic environmental condition(Agrawal *et al.*, 2008). Efficient crop sequence in intensive agriculture promotes productivity per unit area per unit time and provides more economic benefits to the farmers. Many farmers are using forages for positive results on any land, but particularly, on marginal crop land. The numerous benefits in any situation include: Increased soil fertility when legumes are used; increased soil quality; better water filtration and internal drainage; less disease in subsequent cereal crops; reduced weed populations; increased yields in subsequent crops; better economics in subsequent crops; greater and deeper carbon sequestering for greenhouse gas reduction. The livestock sector is the backbone of India's economy in terms of income, employment, equity, sustainability, foreign exchange earnings In India, cultivated fodder is limited to less than 4.5 per cent of the area under cultivation. Present area under fodder crops in India is around 8.6 million hectare. Further increase in the acreage of the fodder crops is not possible due to increased competition between various land uses for the cultivable land in the country. Only way to meet the fodder needs of livestock may be possible by increased productivity per unit land area and also through integration of fodder crops in the existing cropping systems.

Problems of Food-forage systems:

The main problems of forage based crop intensification programme may be enlisted as follows

- Variable agro ecological conditions
- Traditional livestock production systems
- Labour and capital investments
- Farmers' confidence in the profitability of investments
- Extension systems
- Availability of persistent species and variety

The following are some of the probable strategies for increasing productivity of forage crops.

- Evolving intensive fodder production systems with efficient utilization of land and other farm inputs for maximum forage production.
- Non competitive land use strategy
- Identifying and growing improved fodder varieties on the basis of - High production potential, better quality traits, adaptability to different agro climatic zones, suitability to different farming situations.
- Developing a system for assessing farmers' needs and arranging timely supply of quality seed.
- Scientific preservation of surplus fodder

Capacity building of the farmers and officers

It is very important to impart knowledge to the target group if we want make a programme successful. Keeping in view the urgent need of popularising fodder production technologies and preservation training programme for dairy farmers and officers of different link departments have been undertaken during last decade. Prior to active extension programme like FTD there was limited awareness among farmers regarding good quality fodder. However in association with the officers of the Department of Veterinary and Animal Husbandry, Govt. of Assam and Department of Dairy Development, Govt. of Assam, AICRP on Forage Crops and Utilization have been undertaken some programmes for popularizing scientific fodder cultivation prior to introduction of FTD programme. These efforts were not sufficient to bridge the gap between demand and availability of nutritious forage to dairy animals. Gradually with the establishment of fodder nurseries in farmers field, KVKs and Regional Research Station of AAU.

The main objective of capacity building is to train the farmers as well as the officers and scientist involved in promoting fodder development programme in respect of all issues of dairy farming. These include scientific fodder production of both perennial and annual fodder, growing of fodder tree for top feed, developing fodder nurseries, seed production programme, preservation of green fodder, enrichment of dry fodder, animal health care, non conventional sources of feed and fodder etc. Multidisciplinary resource persons were involved to train the target group of trainees on aforesaid topics. Besides training on integrated farming systems also imparted to enhance farm income and ecofriendly production system. Awareness camp/Exhibitions/ Exposure visit was organized. Special awareness camp has been organised for flood affected areas also which helped the farmers to overcome shortage of fodder during flood stress period. A special programme was also undertaken to develop fodder nurseries in school also. Thereby the teachers and school children were taught how to grow fodder scientifically and how to take care of their domestic animal.All the children planted perennial fodder in their home garden by taking rooted slips from the fodder nursery they developed in their school. The teachers and students also supplied green fodder to dairy animals kept in animal camp of flood affected areas. Training also provided to nos of groups of school dropout students to encourage them for growing fodder crops and scientific dairy farming. All these programme has shown positive impact on capacity building on scientific fodder production in remote areas as well and could bridge the gap of availability of planting materials at easy reach of the farmers. All these efforts resulted positive effect on increasing productivity and profitability of farm income.

Fig. 2: Training and interaction programme

Farmer's field day and exhibition on forage crops

It is an integral part of popularising fodder technologies to organise Farmer's field day and participating in farmers' fair to demonstrate and interact with farmers and other interested visitors for dissemination of improved technologies and clarifying the doubts instantly on the spot itself. Every year we have organised training cum field day at selected site of FTD. We also regularly participated in farmers' fair organised by RARS, Titabor and SRS, Buralikson under Assam Agricultural University. Moreover RAWEP students also encouraged to organise a special stall on fodder crops so that they can transmit improved technology among the farmers of RAWEP villages. Farmers were also taken to the fodder fields and nurseries to have practical knowledge on this aspects and make them clarified about their doubts and queries arises during interactions. These approaches become very effective to grow interest of the farmers for growing fodder crops and eliminate their hesitation to interact with the scientist and officers of link departments.

Fig. 3: Field day on fodder crops

Fodder technology demonstration

Fodder Technology Demontration (FTD) is a seeing is believing and learning by doing approach. This is also a suitable tool for technology validation and refinement for developing full proof technology. Table -1 shows the details of fodder technologies undertaken from 2011-2019. During last decade lots of improvement has been observed in respect of productivity and diversity of forage crops. It has been revealed that irrespective of crops there was significant improvement in yield of fodder crops under improved production technology as compared to farmers practice. Moreover farmers were tought to make diversified use of forage crops. For example congosignal and setaria grass can be fed to goat, pig and poultry also.

Table 1: Fodder Technology Demonstration Programme on annual fodder undertaken by Assam Agricultural University, Jorhat

Year	Season	Crops	Variety	Number (Beneficiaries)	GFY Improved practice (q/ha)	Increase over farmers practice (%)
2011-12	*Kharif*	Rice bean	Bidhan-1	4	250-300	50-120
		Maize	Africal Tall	10	300-320	100-130
	Rabi	Oats	Kent	20	350-450	100-230
	Perennial	Hybrid Napier	CO-3	10	1200-1400	100-200
		Setaria,	Kazungula	10	1100-1200	100-200
2012-13	*Kharif*	Rice bean	Bidhan-1	5	300-320	70-110
	Rabi	Oats	Kent	15	350-450	100-130
	Perennial	Hybrid Napier	CO-3	10	1200-1400	100-200
		Setaria,	Kazungula	10	1100-1200	100-200
		Congosignal	DRSB-7	10	1200-1300	100-200
2013-14	*Kharif*	Rice bean	Bidhan-1	5	300-320	300-350
		Maize	African Tall	8	320-370	100-150
	Rabi	Oats	Kent	15	300-350	100-200
			JHO-822	12	350-370	100-150
	Perennial	Hybrid Napier	CO-4	10	1300-1500	100-210
		Setaria,	Kazungula	10	1100-1300	120-150
		Congosignal	DRSB-7	5	1200-1400	100-200
2014-15	*Kharif*	Maize	J-1006	10	400-450	450-500
		Napier hybrid	Co-4	10	1300-1400	100-200
	Rabi	Oats	Kent	15	300-350	100-150
			JHO-822	10	350-370	100-150
	Perennial	Hybrid Napier	CO-4	10	1300-1500	100-150
		Setaria,	PSS-1	10	1200-1300	100-150
		Congosignal	DRSB-7	10	1200-1400	100-150
2015-16	*Kharif*	Rice bean	Bidhan-2	10	320-350	50-100
		Teosinte	Sirsa	6	250-300	70-100
	Rabi	Oats	JHO-822	12	350-390	70-120
			RO-19	12	350-400	100-140
	Perennial	Hybrid Napier	CO-4	10	1200-1400	100-120
		Setaria,	PSS-1	10	1100-1300	100-130
		Congosignal	DRSB-7	10	12001300	100-140
2016-17	*Kharif*	Maize	J-1006	10	350-450	100-150
		Teosinte	TL-16	7	250-300	70-120
	Rabi	Oats	Kent	10	300-350	80-130
			JHO-822	10	365-400	400-450
	Perennial	Hybrid Napier	CO-5	20	1300-1500	100-200
		Setaria,	PSS-1	10	1200-1300	100-200
		Congosignal	DRSB-7	10	1300-1400	100-170

2017-18	*Kharif*	Maize	African tall	6	320-350	70-120
		Teosinte	TL-16	7	250-300	70-120
	Rabi	Oats	JHO-822	10	330-380	90-140
			RO-19	5	360-400	90-140
	Perennial	Hybrid Napier	CO-5	10	1300-1600	100-170
		Setaria,	PSS-1	10	1200-1400	100-190
		Congosignal	DRSB-7	10	1300-1600	100-200
2018-19	*Kharif*	Maize	Africal talll	7	350-400	90-130
		Cowpea	BL-2	5	250-300	80-130
	Rabi	Oats	JHO-822	5	300-350	110-160
	Perennial	Hybrid Napier	CO-5	10	1300-1600	100-180
		Setaria,	PSS-1	10	1100-1200	100-200
		Congosignal	DRSB-7	10	1200-1400	100-200
2019-20	*Kharif*	Teosinte	TL-16	5	350-450	450-470
		Cowpea	BL-2	5	250-350	90-130
	Rabi	Oats	JHO-822	5	320-350	80-130
	Perennial	Hybrid Napier	CO-5	12	1300-1600	100-200
		Setaria,	PSS-1	10	1200-1300	100-200
		Congosignal	DRSB-7	10	1200-1400	100-200

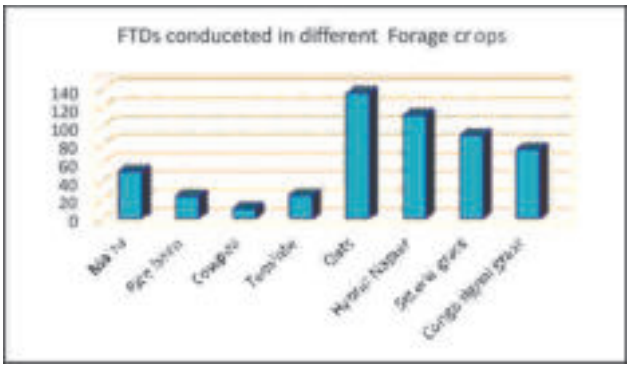

Fig. 4: Cropwise FTDs conduceted in different forage cops at Jorhat

We collaborated with KVKs, RRS as well as NGOs and DCSs. Fodder nurseries helped for horizontal expansion of technologies even after withdrawal of programme from a particular village. The direct impact of adoption of technology is reflected on reduction of cost of cultivation on milk production, improvement of health of animals and income generation by selling rooted slips of perennial grasses. A new approach of raise and sunken bed was introduced to develop the land configuration for growing both upland as well as lowland grasses. This technology is very suitable to convert unproductive medium to low land rice field for growing perennial fodder crops. The raised bed is suitable for growing Hybrid Napier, Setaria etc and forrws are suitable for growing lowland grass like para and little para. Mostly rice fallows were utilized for growing annual fodder crops and in selected areas rice field bunds were utilized for growing perennial fodder crops. Besides non competitive land like dike of pond boundary areas were also utilised for growing perennial grasses. Farmers were contacted by mobile as well as time to time visit in their field for effective implementation of technologies. Many farmers were also trained for making them self sufficient in respect of forage seed particularly of oat. As there is temporary waterlogged condition during summer in rice field, teosinte has been given to such areas for overcoming temporary waterlogged condition.

Fig. 5: Fodder technology demonstration

Role of media

The FTD programmes in different approaches are well covered by different media which has been through news paper, radio and television. Numbers of radio and TV programmes has been performed by the scientists to cover all the aspects of fodder production technologies. Response of farmers through these programmes is very encouraging. Particularly farmer's response is very effective through radio programmes. Besides several success stories has been covered by different media including news paper. Leaflets on different fodder production technologies has been published and distributed among the farmers for easy adoption of technologies.

Feedback

Although systematic study on impact of FTD has not been undertaken but the response of farmers on fodder production technologies are very encouraging. Dairy farmers are very much interested to know the scientific information on fodder production and utilization. They are benefited economically by growing fodder crops at the same time productivity of animals are also realised by them. The farmers from different corners of the state used to take advice either from the scientist of AICRP on Forage Crops and Utilization or from the scientist of KVKs and RRSs. Now people get milk and milk products at their easy reach. This indicates that with the increase in population the availability of milk and milk products is also increasing. However, quantitative data base is urgently required to know the actual status of the impact of these fodder production technologies. For this, well planned approach is required from competent authority through sponsored programmes. These data base will help the planner, development agencies, policy makers to fulfil the objectives of doubling farmer's income.

Fodder Technology Demonstration Programme: An Effective Technology Transfer Tool for Adoption of Fodder Production Technology in Manipur, India

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In Manipur most of the green fodders which are fed to the animals are mostly the grasses, weeds and shrubs that are abundantly available during *kharif* season in the valley and hill areas. Soon after the end of *kharif* season, green fodder scarcity become more prominent among the dairy farmers of Manipur. During the lean period, most of the milch animals are fed with concentrates and straw to meet the nutritional demand of the animals. Moreover, local grass is collected from the far distance to feed the milch animals which leads to drudgery and more time spent on this activity. Lack of winter fodder was identified as a major issue among the dairy farmers of Manipur which leads to less lactation period and milk yield and thereby forcing the dairy farmers to sell their milch animals due to less milk production. The most serious constraints encountered by the members in different areas of breeding, feeding, management, health care and fodder production in improved dairy farming practices were high cost in treatment of breeding related problem, high cost of feed ingredients, scientific management of dairy animals, high cost of veterinary medicines, and land for fodder cultivation respectively (Asheibam Shyam Singh *et al.* 2012).

As far as extension of fodder cultivation in the NEH region of India is concerned, it is comparatively recent. It was first introduced in the NEH region by the Regional Station for the Forage Production and demonstration Kalyani (WB). During this period, cultivation of fodder crops remained confined to Government farms only, and the success of fodder cultivation was one of the main problems, due to lack of cultivation technology and local farmers were not using fodder. Its commercial introduction in the NEH region started earnestly in late 2000, after the establishment of an AICRP on Forage Crops at CAU, Imphal. These activities were further strengthened by extensive research on production technology demonstration. To find an alternative forage crop for rainfed areas research was initiated on forage and fodder crops and it is continuing. Until now a number of varieties which is suited in NEH region are identified and technology was also generated and make available to the dairy farmers of NEH region of India, particulars in the state of Manipur.

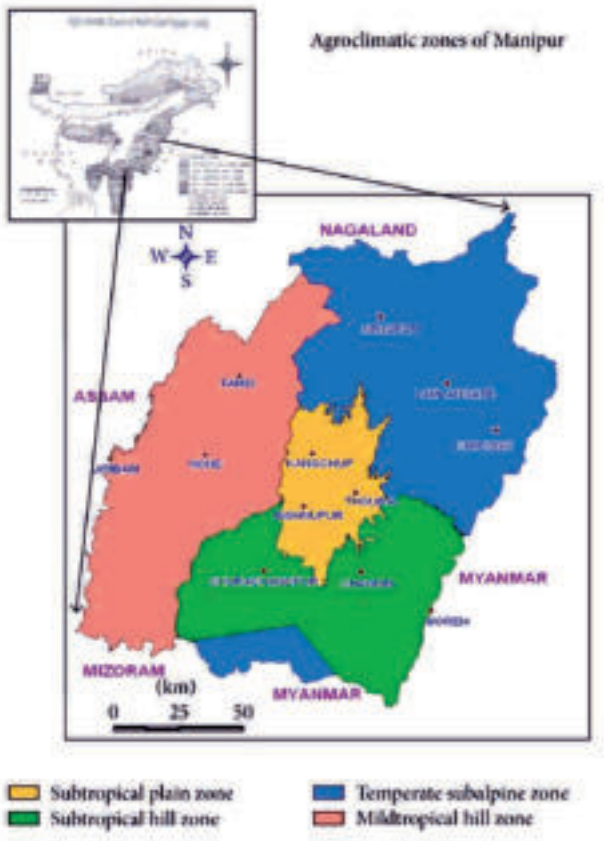

Fig. 1: Agro-climatic Zones of Manipur

Introduction and acceptability of Fodder crops in Manipur

The entire agricultural scenario in the state of Manipur is beset with conflicts, paradoxes and inherent limitations of the natural resources. Land, the basic

input is the greatest limitation. The continuous land fragmentation has led to an alarming proportion of small holdings. The situation is worst in the state of Manipur where most of farmers own a land holding of only 0.65 ha. At the same time the greatest paradox is that all small farmers rear animals to complement their earnings, but do not have enough land to produce fodder for their sustenance. The farmer's bias for the cultivation of food crop in his small holding is well understood. The NEH region represents the sub tropical climate beyond 800m MSL where arable agriculture holds no promise; up to this altitude, the days are sunny, temperatures are adequate for farming during winter. Rice is the only and most favourite crop growing in the plain areas. Consequently the area under forage crops has not increased above a level of 1% of total cultivated lands in the area for the last many years. As far as Manipur is concerned, the true temperate conditions start in valley basins (average altitude 400m above mean sea level). Severe winter, absolute lack of sufficient irrigation for more than three winter months and uncertainty of winter rains compel the farmers not to go in for a labour and resource intensive uncertain food crop, and most of the land remained fallow during winter.

Inspite of all these limitations Oats, napier, maize, rice bean, cow pea, and other grasses has started to become a popular fodder and forage crops in NEH Region, Manipur in particular. As a result of extensive extension activities by the AICRP on Forage Crops, the farmers have started its cultivation. The area under its cultivation is gradually increasing.

Human Resource Development

Knowledge regarding feed and fodder for livestock is very limited in Manipur and other part of NEH Region. There is no awareness among farmers regarding good quality fodder. During 1990s, the Department of Veterinary and Animal Husbandry, Govt. of Manipur started fodder production programme at Imphal West district of Manipur. Under this programme different annual as well as perennial fodder crops were grown and were made available to the dairy farmers at subsidy rate. But due to negligence and lack of technology and support by the Department, the programme was not able to sustain shattering the hopes of dairy farmers of getting green fodder throughout the year. Since then, little or no fodder development programme was conducted to benefit the dairy farmers of Manipur. As an effort to address the issue, AICRP on Forage Crops & Utilization, CAU, Imphal initiated fodder promotional program as Fodder Technology Demonstration (FTD) from the year 2011-12 among the dairy farmers of Manipur. Regular training, demonstration and interaction programmes were conducted to promote fodder crops and its cultivation technology. Awareness camp/Exhibitions/ Exposure visit was organized. Master training programme on fodder production technology was also organized for SMS, ATMA, Farm manager and Milk producers NGOs persons jointly with Directorate of Extension Education, CAU, Imphal under human resource development programme. Detailed information on fodder production technology, hay, silage, fodder production on bund, fodder tree and fodder seed production was provided in this training programme.

Seeds of improved varieties of fodder oat and perennial grass legume mixture were distributed among the dairy farmers of Manipur. Through this promotional program, it was reported that the lactation period was increased due to increase in fodder availability and milk yield increased by approximately 2 to 4 litre.

Fig.2: Training and interaction programme

Approach used to sensitize the farmers

Before making any programme related FTDs, Milk producers NGOs and KVKs of respective district was approached to identify the needy dairy farmers for particular area. Selection of FTDs beneficiaries was made with the help of Milk producers NGOs and KVKs for smooth function of the programme. Poor and interested dairy farmers were given priority and FTDs beneficiaries were also change every financial year. Fodder production technology was demonstrated in individual farmers field or community land. Time to time visit in farmer's field and interaction was done by the fodder scientist and necessary suggestions were given to improve the quality of demonstration as and when required.

Farmer's field day on forage crops

Farmer's field day on forage crop was organized regularly, where more than 60 dairy farmers participated in each field's day. Interaction and exchanged of idea was also done with the scientist and also among the farmers. Experts from different department were also invited and address the gaps in scientific production technology of livestock, rationale of agro-chemicals and Integrated Pest Management (IPM), etc. Farmers were also taken to the fodder fields and highlight the performance thereby compared with their own performance. Interaction and discussion was also held with farmers for assessment of overall impact of various technological interventions on performance of fodder crops over local practices. These programmes provided enough opportunity to a large number of farmers to visit the crop and exchange their ideas and at the same time also helped in identifying their issues and problem and accurate technologies were intervened to solve the issues and problem.

Fig. 3: Farmer's field day

Fodder technology demonstration

The technologies found suitable from on- farm testing were undertaken for front line demonstrations. These demonstrations were conducted on farmers' fields in association with the farmers under the technical supervision of AICRP on Forage Crops staff. Demonstration of improved technologies including varieties at farmer's field is an effective way to impress upon the farmers for technological advancement linked enhanced forage production. This will not only educate the farmers for adoption of new technology, but also helping enhancing the seeds replacement rate for the new varieties for better green forage yield (GFY) per unit area per unit time. For the technology demonstrations individual farmer having livestock or community land was selected. Seeds of new and improved varieties of fodder crop were supplied to the farmer, full package and practices were adopted to grow the crop. Time to time visit in farmer's field was done by the fodder scientist and necessary suggestions were given to improve the quality of demonstration as and when required. In *Kharif* improved varieties of maize, rice bean, annual sorghum, signal grass and cuttings of bajra napier hybrid were provided for one acre land to each individual farmer. In *Rabi* season oat crop was selected for the demonstration. Fodder oat crop was first time introduced in the state and crop was very much liked by the farmer.

Table 1: Fodder Technology Demonstration Programme at Central Agricultural University, Imphal

Year	Season	Crops	Variety	Number (Beneficiaries)	GFY farmers practice (q/ha)	GFY Improved practice (q/ha)
2011-12	*Kharif*	Rice bean	Bidhan-1	5	300-320	300-350
	Rabi	Oats	Kent	5	350-450	450-500
2012-13	*Kharif*	Rice bean	Bidhan-1	5	300-320	300-350
	Rabi	Oats	Kent	5	350-450	450-500
2013-14	*Kharif*	Rice bean	Bidhan-1	10	300-320	300-350
		Maize	J-1006	10	400-450	450-500
	Rabi	Oats	Kent	10	300-350	350-400
			JHO-822	10	350-370	350-450
2014-15	*Kharif*	Maize	J-1006	10	400-450	450-500
		Napier hybrid	Co-4	5	2500-3000	3000-3500
	Rabi	Oats	Kent	10	300-350	350-400
			JHO-822	10	350-370	350-450
2015-16	*Kharif*	Rice bean	Bidhan-2	10	320-350	350-370
		Napier hybrid	Co-4	5	2500-3000	3000-3500
	Rabi	Oats	JHO-822	10	350-370	350-450
			OS-6	10	365-400	400-450
2016-17	*Kharif*	Maize	Local	10	350-450	450-470
		Napier hybrid	Co-4	5	2500-3000	3000-3500
	Rabi	Oats	Kent	5	300-350	350-400
			OS-6	5	365-400	400-450
2017-18	*Kharif*	Rice bean	Bidhan-2	5	320-350	350-370
		Napier Hybrid	Co-4	5	2500-3000	3000-3500
		Maize	Local	5	350-450	450-470
	Rabi	Oats	JHO-822	5	350-370	350-450
			OS-6	5	365-400	400-450
2018-19	*Kharif*	Maize	Local	5	350-450	450-470
		Napier hybrid	Co-4		2500-3000	3000-3500
	Rabi	Oats	Kent	5	300-350	350-400
2019-20	*Kharif*	Maize	Local	5	350-450	450-470
		Napier hybrid	Co-5	5	2500-3200	3000-4000
	Rabi	Oats	Kent	5	300-350	350-400

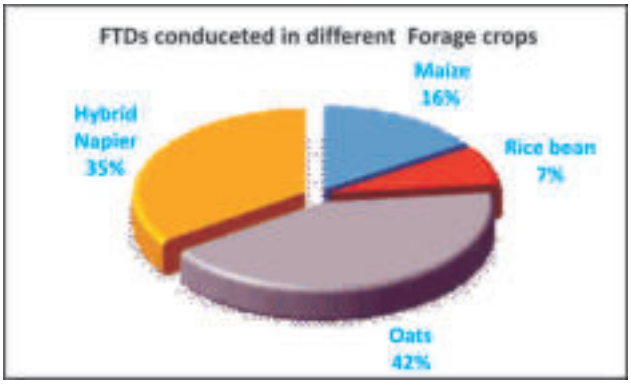

Fig.4: FTDs conducted in different Forage crops

Fig. 5: Fodder technology demonstration

Communication through mass media

With the help of mass communication methods *viz.*, TV, Radio, News paper coverage wide publicity was given to fodder production. Pamphlets were published in local language and distributed to farmers to create awareness on fodder production. A book entitled "Fodder production in NEH Region" was published in 2019, which is first of its kind in NEH Region. The press and media have played a vital role in covering fodder cultivation activities taken up by AICRP on Forage Crops.

Fig. 6: Communication through mass media

Seed and planting material produced

AICRP on Forage Crops & Utilization, CAU, Imphal is maintaining the bulk plots of perennial fodder varieties for supply of fodder slips to farmers, line departments, voluntary organizations and other KVKs. Fodder cuttings are being supplied to the farmers. More than 200 tonnes of fodder slips were supply to farmer's of different organizations. Seed of oat, maize are also produced and make available to the dairy farmers of the region.

Programme participants and communities reached

Although there are many promising/high yielding fodder species in other states, it is not well known to the dairy farmers of Manipur due to poor knowledge about the crop. Most of the dairy farmers of this region have been utilizing one or two home-made feed ingredients as concentrate to feed dairy cattle

Fig. 7: Seed production programme

along with wild grasses, weeds/chaffed paddy straw and green grasses to some extent. Only farmers with a strong financial background are using commercial marketed concentrate mixture. As an effort to address the issue, AICRP on Forage Crops & Utilization, CAU, Imphal initiated fodder promotional program as Fodder Technology Demonstration (FTD) from the year 2011-12 among the dairy farmers of Manipur. Regular training, demonstration and interaction programmes were conducted to promote fodder crops and its cultivation technology. Seeds of improved varieties of fodder crops, perennial grass and legume mixture were distributed among the dairy farmers of Manipur. After introducing oat as a fodder crop during winter season and other fodder crops and perennial grass during *kharif*, collection of local grass from far distance has been reduced, leading to a reduction in drudgery and saving of time spent on this activity. In the past, a minimum period of one to two months were spent by the herders for collection of grass since getting one load of fodder took 3-4 hours. Presently, due to fodder availability nearer to homes, people are able to utilize the time saved to focus on other income generating or household activities.

Vertical and horizontal expansion of technology

By the effort of AICRP on Forage Crops & Utilization, CAU, Imphal, planting material, seeds of fodder crop, production technology and seed production horizontally spread in Thoubal, Churachandpur, Bishnupur and Senapati district of Manipur.

Response of farmer's

The responses of farmers in this FTDs programme were over whelming. Looking into the positive results of rejuvenation package, the farmers having decline trend in their local practices of adjoining area also adopted the improved technology. These programmes helped lot to sensitize the dairy farmer to think about the green fodder and other allied source of income for income generation.

Feedback

The awareness on the benefits of fodder technology demonstration was created among the dairy farmers. Farmers got familiarity with the high yielding varieties of fodder and forage crops. Organization of Front Line Demonstrations in cluster approach is good practice to influence not only the participating farmers but also the neighboring farmers. Through this promotional program, it was reported that the lactation period was increased due to increase in fodder availability and milk yield increased by approximately 2 to 4 litre. As the demonstrations are conducted under the supervision of the scientist in farmer's fields they are more authentic and results could to generalize to that vicinity. The economic details of the demonstrations give us a green signal to further popularize them among the farming community for large scale adoption.

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Enhancement in productivity of fodder and livestock through Fodder Technology Demonstrations (FTDs) in Punjab state

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Livestock comprises one of the major components of the economy of Punjab, contributing about 29.9 percent to the State Domestic Product and one third to the gross value of agricultural output. The gross cropped area is 7.739 million hectare and the area sown more than once is 3.704 million hectare with the cropping intensity of 186%. The net irrigated area is 4.019 million hectare (By canals- 26.2%, By Tube wells- 72.5% and by others – 1.3%). The gross irrigated area is 7.442 million hectare and the percentage of net irrigated sown area is 96.17%. The total number of land holdings are 10.93 lakh out of which 2.04 lakh (18.7%) are marginal farmers, 1.83 lakh (16.7%) small farmers and 7.06 lakh (64.6%) farmers hold land above 2 hectare. Punjab (land of the five rivers) is one of the most fertile regions on earth. Punjab State which has earned a name of "Food Basket of the Country" & "Granary of India" has been contributing 40 percent of rice and 50-70 percent of wheat for the last two decades. Punjab is not only self sufficient in producing food grains but also contributes around 60% food grains to the central pool. The Agriculture in Punjab state is highly intensive in terms of land, capital, energy, nutrients, agriculture inputs and water etc. With only 1.5% of geographical area of the country, Punjab has produced about 22% of wheat, 10% of rice and 13% of cotton of the total produce of these crops in the country. Punjab state is divided into five Agro climatic zones which are categorized as Sub-mountain undulating zone, Undulating plain zone, Central plain zone, Western plain zone and Western zone. About 9.0 lakh hectare area in the state is under fodder cultivation constituting about 8 per cent of gross cropped area. Sorghum, bajra/ pearl millet and cowpea are the important *kharif* fodders covering around 24 per cent, 14 per cent and 3 per cent of the total area under fodder cultivation in the state. Berseem and oats are the important *rabi* fodders, sharing about 34 per cent and 12 per cent of the total area under fodder cultivation. Maize fodder is also cultured during summer season covering about 4 per cent of the total area under fodder cultivation covering about 0.22 lakh hectares.

Fodder Acreage: In Punjab, the area under fodder crops is estimated at 9.0 lakh ha (Package of Practices for crops of Punjab, *Kharif* 2020, PAU, Ludhiana). The area under permanent pastures and other grazing land is 6.0 thousand ha only. The area under *kharif* and *rabi* fodder crops is 5.39 and 3.59 lakh ha respectively. Livestock population is estimated to be 81.2 lakh including cattle and buffaloes (62.4 lakh adult animals). The total green fodder production in the state on dry matter basis was estimated 3.31 million tonnes. The total available dry fodder was estimated to be 18.71 million tonnes. Among different districts, Firozpur contributed highest percentage followed by Sangrur, Ludhiana, Patiala, Moga, Bathinada and Gurdaspur. These 7 districts shared more than half of total dry fodder production of the state.

Objectives

- Introduction of new fodder crop varieties in the existing crop rotation.

- Demonstration of superior practices with regard to fertilizer use, water and soil management in the production of cultivated fodders,
- Study of these practices with regard to new and promising species of fodder crops and grasses.
- Evolution of fodder calendars suitable to the region.
- Demonstration of improved management of village grazing lands and natural grasslands.
- The study of their proper utilization in combination with a forage crop.
- Demonstration of improved methods of utilization of forage crop.
- Demonstration of different methods of fodder conservation and utilization.
- Demonstration of economics of fodder crops cultivation and animal production.

Improved Technologies and their Demonstrations in Farmer's fields

Demonstrations of improved varieties, production and protection technologies is one of the most effective ways to aware the farmers about development of new improved varieties and their enhanced yield and other characteristics. This will help in the adoption of new technologies by farmers thereby increase in farm income.

Forage crops selected for FTDs

- **Berseem:** Berseem is an annual legume crop grown in almost all districts of Punjab. Farmers are cultivating high yielding varieties BL 42 & BL 43 which provide green fodder starting from November till first fortnight of May.
- **Oat:** Oat is also an annual winter season fodder grown by farmers in mostly sub mountainous and central regions of Punjab. Earlier it is grown in smaller areas but due to availability of improved and high yielding cultivars, acreage under oat has been increased. Most popular varieties grown by farmers are OL 10, OL 11 and OL 12.
- **Ryegrass:** Ryegrass is a winter forage grass with shiny leaves.
- **BN hybrid:** Bajra Napier hybrid (BN hybrid) is a perennial fast growing fodder, gaining popularity among dairy farmers. BN hybrid provides green fodder round the year. Most common varieties grown by farmers are PBN 342 and PBN 346**.**
- **Maize:** Maize is another popular fodder crop among farmers of Punjab especially for making silage. Cultivar J-1006 is most famous among dairy farmers and used for making silage.

FTDs conducted

Forage Technology Demonstrations (FTDs) have been conducted during *Kharif* and *Rabi* seasons every year in various districts of Punjab like Ludhiana, Patiala, Sangrur, Kapurthala, Moga, Tarntaran, Barnala.

***Kharif* season**

- Forage maize - J 1006
- BN hybrid - PBN 346

***Rabi* season**

- Berseem (BL 42),
- Oat – Kent

Table 1: FTDs conducted by PAU, Ludhiana Centre

Year	Number of FTDs conducted		Total
	Kharif	*Rabi*	
2015-16	BN hybrid-60, Maize-60, Bajra-55	Berseem-10, Oat(MC)-15, Ryegrass-25	225
2016-17	BN hybrid-70	Berseem-10, Oat(MC)-20, Ryegrass-10	110
2017-18	BN hybrid-100	Oat(MC)-20, Ryegrass-20	40
2018-19	BN hybrid-200	Oat(SC)-20, Oat(MC)-20	40
2019-20	BN hybrid-200	Oat(SC)-50	250

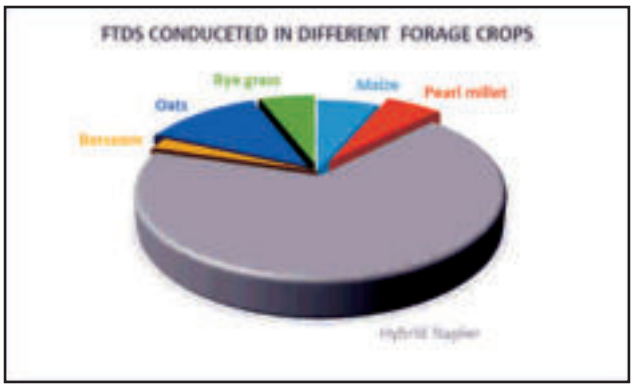

Fig. 1: FTDs conducted by PAU, Ludhiana Centre

Skill development programmes for farmers

Trainings on skill development of the farmers regarding production, protection technologies has been organized time to time in order to educate and enhance the knowledge of rural youth regarding selection of improved varieties, their complete package of practice and protection techniques. This will improve the economic status of farmers and their livelihood.

Table 2: FTDs of Bajra Napier Hybrid 346 conducted by PAU, Ludhiana centre during *Kharif* season

SN	District	Number of farmers	Average Green fodder Yield (q/ha)	Improvement over Farmers' practice
1.	Ludhiana	19	1829	14
2.	Patiala	3	1860	15.5
3.	Barnala	9	1870	14.5
4.	Sangrur	6	1874	125
5.	Bathinda	1	1840	15.0
6.	Ferozepur	1	1940	15.0

7.	Moga	2	1775	14.0
8.	Fatehgarh Sahib	1	1680	13.0
9.	Hoshiarpur	1	1640	14.0
10.	Ambala	8	1910	15.0
11.	Jalandhar	6	1765	15.5
12.	Kapurthala	6	1720	14.5

Table 3: FTDs conducted by PAU, Ludhiana centre during *Rabi* season

Sr. No.	Name of District	Number of farmers	Average Green fodder Yield (q/ha)	Improvement over Farmers' practice
	Berseem BL 42			
1.	Ludhiana	20	972	16.0
2.	Patiala	1	1030	12.5
3.	Sangrur	12	1016	12.0
4.	Bathinda	1	1015	13.0
5.	Moga	2	1055	15.5
6.	Fatehgarh Sahib	2	1020	15.0
7.	Hoshiarpur	4	1033	15.0
	Oats OL 10 & Kent			
1.	Ludhiana	9	679	14.5
2.	Patiala	2	600	14.0
3.	Barnala	2	700	13.5
4.	Sangrur	8	684	13.0
5.	Bathinda	3	720	12.5
6.	Ropar	4	690	14.0
7.	Moga	3	672	14.0
8.	Fatehgarh Sahib	2	660	14.0
9.	Mohali	3	670	15.0
	Rye grass PBRG 1			
1.	Ludhiana	10	820	12.5
2.	Patiala	1	800	13.5
3.	Sangrur	12	763	13.0
4.	Ropar	2	793	13.0
5.	Fatehgarh Sahib	2	798	13.5
6.	SBS Nagar	7	748	12.5

Impact of new technologies in farmers' fields

The new technologies offer potential pecuniary benefits to farmers via increasing yields, and savings in management costs and input use. Moreover, the introduction of technology has led to 12 to 15 percent increase in productivity of fodder crops. New released varieties of various fodder crops especially oats and berseem providing huge quantities of green fodder yield than the old varieties.

Innovative Technologies for Sustainable Fodder Production in Maharashtra

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Agro-climatically, the Ahmednagar district region falls in the scarcity zone of Maharashtra with semi-arid climate. The average annual rainfall is 520 mm with 55 rainy days. The rainfall is erratic and ill distributed. Downpours of high intensity along with heavy winds are also experienced occasionally. The dry spells of various durations are of common occurrence during July and August. Annual average maximum temperature of the area is 38^0 C with a range of 33^o C to 42^o C. The average minimum temperature is 17^oC with a range of 8.0^oC to 23^0C. The mean per cent relative humidity during the crop season ranges between 27 and 86 %. The main occupation of farming community in Ahmednagar district of Maharashtra is agriculture and the animal husbandry is the secondary occupation. The major rock formation is basalt or Deccan trap. The soils belong to the soil class Entisol / Inceptisol with medium to deep in depth. The clay content is about 45 % with maximum water holding capacity at 38-40 %. There is a slightly gradual slope from South to North. Some plots have drainage problem. The soils are low in available nitrogen, medium in available phosphorus and high in available potash and low in organic carbon. The soil pH is between 7.5 and 8.1. Forage crop is a plant grown primarily for livestock feeding of which all or nearly all plant parts are harvested by man. Forage is specific term which includes specially grown grasses, legumes, cultivated forages, grasslands and pasture herbage, crop residue, hay and silage crops. Forages are the basic sources of raw material in diet of livestock of all kinds. The importance of these crops in growth and development of agriculture inclusive of resource conservation, maintenance of soil fertility, soil and water conservation, the environmental balance and vital role in the livestock industries needs no description. After independence constraints of livestock production have been identified. Among the various constraints, the problem pertaining to feeds and fodder to livestock is more serious in nature. Energy is the more deficient followed by protein, minerals, carotene, vitamin A and D.

In consideration with the problems, position and growing needs of forages, it is necessary to practice various forage production approaches and no single approach will be an absolute answer. This is typical situation and it calls for strengthening forage crops research, development and production programme covering various areas of Maharashtra.

Livestock and forage scenario in Maharashtra

Maharashtra has about 3.31 crores livestock population which needs about 11 crores tons of dry fodder. However, only 6 crores ton dry fodder is available from all sources, it means about 42 % fodder is still deficit for livestock in Maharashtra. Breakup of available fodder indicate that 60 % fodder supplied by crop residues, 9.3 % through field weeds, 6.60 % from the crops that failed to produce grains, around 3.16 % fodder from irrigated fodder crops, 10.30 % from forest grasses, 5.37 % from permanent pastures and 5.27 % from grazing lands, waste lands, current fallows etc. From this, it could be seen that around 97 % available fodder is of poor quality.

Table 1: Area and productivity under different green forage crops in Maharashtra

Forage crops	Area (ha)	Productivity of green forage(tones /ha)
Sorghum (*kharif*) (*Sorghum bicolor*)	40,100	35-50
Sorghum (*Rabi*) (*Sorghum bicolor*)	13,300	25-40
Maize (*Zea mays*)	12,500	50-60
Berseem (*Trifolium alexandrinum*)	1,900	60 -70
Lucerne or alfalfa (*Medicago sativa*)	1,200	125-150
Oat (*Avena sativa*)	2,000	500-550
Guinea grass	3,100	150-175
Bajra x Napier hybrid	12,900	200-250
Other forage crops	18,400	20-25
Grasses	6,98,000	5-10
Total	8,03,400	-

Source: Krishidarshani, MPKV, Rahuri, 2014

Table 2: Livestock in Maharashtra **(In thousands)**

Year	Cattle	buffaloes	Sheep & goat	Other live stock *	Total live stock	Sheep & goats/ 100 ha of grazing & pastureland	Livestock/ hundred ha. of net area cropped	No. of Live-stock per lakh of populn[n]
1961	15,328	3,087	7,273	360	26,048	512	144	66
1966	14,729	3,042	7,326	352	25,449	522	140	57
1972	14,705	3,301	8,038	317	26,361	491	164	52
1978	15,218	3,899	10,199	326	29,642	650	162	51
1982	16,162	3,972	10,376	410	30,919	673	175	48
1987	16,983	4,755	12,068	448	34,255	950	189	48
1992	17,441	5,447	13,015	489	36,393	940	202	45
1997	18,071	6,073	14,802	692	39,638	1,104	223	50
2003	16,738	6,084	13,624	612	37,058	1,016	213	39
2007	16,184	6,073	13,301	397	35,955	1,064	206	37
2012	15,484	5,595	11,016	394	32,489	885	189	29
2019	13,993	5,604	13,285	189	33,071	NA	NA	NA

Source: Livestock Census, Economic Survey of Maharashtra 2019-20, page 131 NA – Not Available

*Other livestock includes pigs, horses and ponies mules, camels and donkeys

Livestock Population

The total livestock population has been increased by 1.79 % as per census 2019 compared to previous census, 2012. The major increase in total livestock population was noticed in Sheep and Goat (Table 3). To meet the quality fodder requirement for livestock it is necessary to popularized new fodder improved varieties and its production technology.

Table 3: Livestock population in Maharashtra **(In thousands)**

Category	Livestock Population		% Changes
	2012	2019	
Cattle	15,484	13,993	(-) 9.63
Buffaloes	5,598	5,604	(+) 0.16
Sheep and Goats	11,016	13,285	(+) 20.60
Other Livestock	394	189	(-) 52.03
Total Livestock	32,489	33,0710	(+) 1.79

(Source: Livestock census, Govt. of Maharashtra 2012 and 2019)

Dairy Development in Maharashtra

Dairy is a supplementary activity to agriculture, which has potential for generating additional income and employment opportunities for rural household besides improving nutritional standards. As per the 20th Livestock censes 2019, the total livestock in the state was about 331 lakh and the category wise population is given in Table 3. The state ranks 7th in India in milk production. Milk production and per capita availability of milk is given below.

Table 4: Milk production and per capita availability of milk

Year	Milk production (lakh MT)		Per capita availability(grams per day)	
	Maharashtra State	All India	Maharashtra State	All India
2016-17	104.02	1,636.94	243	352
2017-18	111.02	1,763.46	256	375
2018-19	116.54	1,877.49	266	394

Source: Office of the Commissioner of Animal Husbandry, GoM,
Published in Economics Survey of Maharashtra 2019-20, page 118.

Concept

Majority of the population in the state comprises marginal and small farmers. The livestock an integral part of farming systems are reared under the well recognized systems: sedentary, semi migratory and migratory. In the region, animal husbandry has assumed a special significance as an effective instrument for improving the socio economic conditions of farmers. Transfer of Forage Technology Demonstration (FTD) is a form of applied research through AICRP (FC) centers/ IGFRI and its RRF involved in improvement of fodder production. Forage technology demonstration were started from *Kharif,* 2009 to demonstrate improved fodder production technologies including new varieties under farmers field through AICRP-Forage Crops and Utilization, Mahatma Phule Krishi Vidyapeeth, Rahuri, District Ahmednagar, Maharashtra. Latest notified/ recommended hybrids/ varieties along with full package of practices / forage production and protection technologies on selected farm with a view to demonstrate the potentiality of the technologies to the: Participating farmers, Neighboring farmers, Extension workers of the state department of Agriculture and allied agencies to analyze the production constraints if any and to assess the performance of the technologies for scientific feedback**.**

Main forage crops

The predominant fodder crops of Maharashtra state are Maize, Sorghum, Lucerne, Hybrid Napier, Pearl millet *etc.* Guinea, Para and Marvel grass are grown in small area as perennial grasses for fodder. The crop residues contribute a major portion of dry fodder. Important varieties grown for green fodder by the farmers in Maharashtra state are as below:

Table 5: Important forage varieties in Maharashtra State

SN	Name of crop	Name of varieties
1.	Maize	African Tall
2.	Bajra	BAIF Bajra-1, Giant Bajra
3.	Sorghum	Ruchira, Phule Amruta, Phule Godhan, Maldandi 35-1
4.	Lucerne	RL-88
5.	B x N Hybrid	Phule Jaywant, BNH-10, Phule Gunwant, DHN-6, CO-5
6.	Oat	Kent, Phule Harita, Phule Surabhi
7.	Berseem	Wardan
8.	Marvel grass	Phule Gowardhan (Irrigated), Phule Marvel-06-40, Phule Marvel-1
9.	Cowpea	Shweta, EC 4216, UPC 9202, UPC 5286
10.	Stylosanthes	Phule Kranti
11.	Anjan grass	Phule Madras Anjan-1, CAZARI-75

Forage based cropping sequences

Under assured irrigation condition, Major food fodder cropping sequences are

- Maize/Bajra (grain) - Wheat/gram (grain)-Sorghum (fodder)
- Hybrid Napier and Lucerne as sole crops on small area as perennial fodder crops
- Bajra / Sorghum (grain)-Annual Lucerne
- Maize /sorghum (fodder)- Maize /oats /Berseem (fodder)- Sorghum /Cowpea/ Bajra (fodder)
- Green manure- Sugarcane + Maize (fodder)

Under rainfed condition the cropping sequences are

- Soybean/Groundnut / Maize (grain)-Sorghum (grain and straw)
- Paddy (grain)- Cowpea / beans/barley (grain and straw)

Alternate land use system

- Silvipastoral system (Forestry + Pasture + Livestock)
- Agri-Silvipastoral system (Agriculture + Forestry + Pasture + Livestock)
- Horti-Silvipastoral system (Orchards + Pasture + Livestock)

Main agricultural crops whose residues being used as forage

The residues of major cereal, pulses and oilseed crops like sorghum, maize, paddy, wheat, bajra, minor millets, arhar, soybean, gram, green gram, black gram, ground nut etc. are used as major source of dry fodder for the livestock in Maharashtra. Besides, the entire sugarcane (chopped) and sugarcane tops are used as fodder during drought situation in Western Maharashtra.

Constraints in forage production

- Inadequate availability of quality seed of improved forage varieties.
- Farmers generally grow forage crops on marginal lands with minimum inputs.
- Lack of awareness among the farmers about improved forage varieties, improved crop production and protection technology.
- The area under forages is stagnant because of huge demand of food crops for feeding increasing human population.

- Lack of adoption of fodder preservation techniques such as making of hay, compact fodder block and silage etc, so that the fodder surplus during peak season could be effectively utilized during fodder lean period.
- Over grazing, poor management, low productivity of grazing lands and pastures lands.
- Non availability of credit facilities on easy terms for investment in agriculture for fodder production.
- The straws of the food crops are burnt after the harvest of grains which can be utilized during the shortage of fodder.
- Diversion of edible crop resides and green fodder of B×N Napier towards packaging and bio-fuel industry.
- In fodder crops, minimum support prize is not available hence; local market decides the cost of produce which is very low.

Development and Extension Needs

- There is need to enhance fodder crop production through improved agronomic practices and use of improved seed at farmer level. Extension services need to be activated and intensified.
- New and promising varieties of cultivated fodder crops need to be brought under seed production chain. Farmers companies have to be encouraged for seed production programme.
- Training of dairy farmers in fodder production and utilization technologies needs to be campaigned.
- Extension to promote balance feed, feeding chaffed feed and proper storage of fodder to avoid losses need also to be emphasized.
- There should be focused programme on regeneration, promotion of silvipasture or Gochar, revenue and wastelands, which will not only meet shortage of feed and fodders but will give equal access to poor and improve environment also.
- Promotion of techniques of treatment of straws and feed supplements as entrepreneurial activity than treatment at farmer level.
- Pasture development activity should be integral part of soil and water conservation programme.

Government policies and support needed

- Subsidy for year round fodder production needs to be increased like perennial horticultural crops.
- Financial support to the institutions/ NGOs involved in Livestock Development Programme for organizing trainings and exposure visits of dairy farmers.

Objectives

The objectives of the Fodder Technology Demonstration (FTD) programme are to provide quality seed material of elite cultivars of fodder crops, increase fodder availability in rural and dairy catchment area and increase milk production by supplementing fodder and thereby ensuring employment generation in rural areas. The Forage Technology Demonstration programme was implemented in Ahmednagar, Nasik, Pune and Sangali districts of the Maharashtra state. The main objectives are:

- To show the production potential of the recommended forage varieties/hybrids, production and protection practices of forage crops to farmers and to the extension agencies for rapid transfer of technology for productivity and production.
- Assessing the popularization and production constraints.

- Assessing the performance of demonstration technologies in the socio economic conditions of farmers.
- To popularize the forage production technologies and make the farmers aware about various new fodder crop varieties.
- Availability of improved quality seed of forage crops for further dissemination.

Reason behind Selection of Farmers /Village/ Area

In Ahmednagar, Nasik, Pune and Sangali districts of Maharashtra, most of the green fodders which are feed to the animals are abundantly available during *Kharif* season. Soon after end of *kharif* season green fodder scarcity become more prominent among the dairy farmers of Maharashtra. More ever, local grass is collected from the far distance to feed the milch animals which leads to drudgery and more time spent on this activity. Lack of winter fodder was identified with major issue among the dairy farmers of Maharashtra which leads to less lactation period and milk yield and thereby forcing the dairy farmers to sell their animals due to less milk production. Under the Fodder *Technology Demonstration* programme different annual as well as perennial fodder crops were conducted from the year 2009-10 to 2018-19 on the farmer's field of four districts of Maharashtra. The demonstrations were conducted in different tahsils of various villages approach to have a better impact of improved technology. Over all year wise details of FTD conducted during *Kharif* and *Rabi* 2009-10 to 2018-19 are given in Table 6 and 7.

Table 6: Year wise details of Forage Technology Demonstrations (FTD) during *Kharif* 2009-10 to 2015-16

SN	Year	Name of crop	Variety	Tahsils	No. of villages covered	Number of demonstrations	Area covered (ha)	No. of farmers benefitted
1	2009-10	Hybrid Napier	Phule Jaywant	Rahuri	3	3	1.00	05
				Sangamner	1	1		
				Shrirampur	1	1		
		Maize	African Tall	Rahuri	1	1	0.20	01
		Bajra	Giant Bajra	Sangamner	1	1	0.80	04
				Newasa	1	1		
				Shrirampur	2	2		
2	2010-11	Bajra	Giant Bajra	Rahuri,	1	1	1.00	05
				Sangamner	1	1		
				Shrirampur	1	1		
				Kalwan	2	2		
		Maize	African Tall	Kalwan	2	2	0.80	04
				Shrirampur	2	2		
		Cowpea	Shewta	Rahuri	1	1	2.00	10
				Rahata	3	3		
				Sangamner	1	1		
				Kalwan	5	5		
3	2011-12	Bajra + Cowpea	Giant Bajra + Shewta	Rahata	1	1	1.00	05
				Rahuri	1	1		
				Shrirampur	2	2		
				Kopergaon	1	1		
		Maize	African Tall	Rahuri	1	1	1.00	05
				Kopergaon	1	1		
				Shrirampur	1	1		
				Akole	1	1		
				Rahata	1	1		
		Hybrid Napier	Phule Jaywant	Shrirampur	5	5	2.00	10
				Rahuri	4	5		

4	2012-13	Maize	African Tall	Rahuri	2	5	1.00	05
		Cowpea	Shewta	Rahuri	1	5	1.00	05
5	2013-14	Hybrid Napier	Phule Jaywant	Rahuri	3	4	2.00	10
				Rahata	3	3		
				Shrirampur	3	3		
		Maize	African Tall	Rahata	1	5	1.00	05
		Bajra	Giant Bajra	Rahata	3	5	1.00	05
		Cowpea	Shweta	Rahata	4	5	1.00	05
6	2014-15	Hybrid Napier	Phule Jaywant	Rahuri	4	8	2.00	10
				Sangamner	1	1		
				Rahata	1	1		
		Maize	African Tall	Rahuri	4	6	2.00	10
				Sangamner	1	2		
				Rahata	2	2		
		Bajra	Giant Bajra	Rahuri	5	6	2.00	10
				Rahata	1	1		
				Sangamner	1	3		
7	2015-16	Hybrid Napier	Phule Jaywant	Rahata	5	5	4.00	20
				Sangamner	4	4		
				Rahuri	6	6		
				Shrirampur	5	5		
		Bajra	Giant Bajra	Rahata	1	2	1.00	05
				Rahuri	1	1		
				Shrirampur	2	2		
		Maize	African Tall	Rahuri	1	1	1.00	05
				Rahata	2	2		
				sangamerr	2	2		
		Total (*kharif* FTD)		**117**	**144**	**28.80**	**144**	

Fig.1: Dr. Piyush M. Patel (Scientist, Agronomy, AAU, Anand) visited *Kharif* -2012 FTD trial at Rahuri Dist. Ahmednagar (M.S.)

Fig. 2: Dr. A.K. Roy, Project Coordinator, AICRP FC & U, Jhansi visited Oat FTD *Rabi*-2013 trials of MPKV, Rahuri Centre on 07.08.2013

Table 7: Year wise details of Forage Technology Demonstrations (FTD) during *Rabi* 2009-10 to 2018-19

SN	Year	Name of crop	Variety	Tahsils	No. of villages covered	Number of demonstrations	Area covered (ha)	No. of farmers benefitted
1	2009-10	Lucerne	RL 88	Rahuri	3	3	0.50	05
				Rahata	2	2		
		Berseem	Vardan	Rahuri	1	1	0.40	04
				Rahata	1	2		
				Shrirampur	1	1		
		Oat	Phule Harita	Rahuri	2	2	0.40	04
				Rahata	1	1		
				Shrirampur	1	1		
2	2010-11	Berseem	Vardan	Rahuri	3	5	1.00	10
				Rahata	3	5		
		Oat	Phule Harita	Rahuri	2	2	0.50	05
				Rahata	2	3		
3	2011-12	Berseem	Vardan	Newasa	1	1	1.00	10
				Rahuri	6	8		
				Shrirampur	1	1		
		Oat	Phule Harita	Rahuri	3	5	0.50	05
4	2012-13	Lucerne	RL 88	Rahuri	1	5	0.50	05
		Berseem	Vardan	Rahuri	1	5	0.50	05
		Oat	Phule Harita	Rahuri	3	10	1.00	10
5	2013-14	Lucerne	RL 88	Rahuri	1	1	1.00	10
				Rahata	1	1		
				Newasa	6	8		
		Berseem	Vardan	Rahuri	2	3	1.00	10
				Newasa	6	6		
				Rahata	1	1		
		Oat	Phule Harita	Rahuri	1	5	1.00	10
				Newasa	4	5		
6	2014-15	Berseem	Vardan	Rahuri	5	10	1.50	15
				Rahata	1	1		
				Newasa	2	3		
				Sangamner	1	1		
		Oat	Phule Harita	Rahuri	3	9	1.50	15
				Newasa	3	4		
				Sangamner	1	1		
				Rahatar	1	1		
7	2016-17	Berseem	Vardan	Rahuri	4	7	0.70	07
		Oat	Phule Harita	Rahuri	2	3	0.30	03
8	2017-18	Oat	Phule Surabhi	Rahuri	2	2	1.50	15
				Rahata	1	2		
				Shrirampur	1	2		
				Ahmednagar	1	1		
				Sangamner	3	4		
				Nandgaon	1	1		
				Sinnar	1	2		
				Jat	1	1		
9	2018-19	Oat	Phule Surabhi	Rahuri	2	2	1.00	10
				Shrirampur	1	4		
				Sangamner	1	1		
				Junnar	1	1		
				Kopergaon	1	2		
		Berseem	Vardan	Rahuri 4	6	1.10	11	
				Kopergaon	2	4		
				Junnar 1	1			
			Total (*Rabi* FTD)		**107**	**169**	**16.90**	**169**

Contact and convince farmers about forage technologies

AICRP on Forage Crops and Utilization, Mahatma Phule Krishi Vidyapeeth, Rahuri, District Ahmednagar, Maharashtra has developed many promising high yielding fodder species. They are not well known to the farmers of this region. As an efforts to address the issues this centre initiated fodder production programme as Fodder Technology Demonstration (FTD) from the year 2009-10 among the farm household of Maharashtra. FTD's are being conducted in the new villages every year so that the technologies can be spread in the large areas.

Fig. 3: Monitoring team member, Dr. H. P. Parmar (Scientist, Plant, AICRP on Forage Crop, Anand) visited *Rabi* FTD trials at village Rahata (M.S)

The year wise farm households engaged for fodder production and average Green Fodder Yield (GFY) quintal per hectare under FTD are depicted in Table 8.

Table 8: Year wise number of farm households engaged for forage production and average GFY under FTD during 2009-10 to 2018-19

S.N.	Season	Crop	Variety	No. of FTD's	Area covered (ha)	Average GFY (q/ha)
1.	*Kharif* - 2009	Hybrid Napier	Phule Jaywant	5	1.00	1240
		Maize	African Tall	1	0.20	630
		Bajra	Giant Bajra	4	0.80	455
2.	*Rabi*- 2009-10	Lucerne	RL-88	5	0.50	830
		Berseem	Wardan	4	0.40	708
		Oat	Phule Harita	4	0.40	561
			Total farm households	23		
3.	*Kharif* - 2010	Bajra	Giant Bajra	5	1.00	554
		Maize	African Tall	4	0.80	616
		Cowpea	Shweta	10	2.00	313
4.	*Rabi*- 2010-11	Berseem	Wardan	10	1.00	623
		Oat	Phule Harita	5	0.50	486
			Total farm households	34		
5.	*Kharif* - 2011	Hybrid Napier	Phule Jaywant	10	2.00	713
		Bajra + Cowpea	Giant Bajra + Shweta	5	1.00	415+228
		Maize	African Tall	5	1.00	632
6.	*Rabi*- 2011-12	Berseem	Wardan	10	1.00	677
		Oat	Phule Harita	5	0.50	566
			Total farm households	35		
7.	*Kharif* - 2012	Maize	African Tall	5	1.00	366
		Cowpea	Sweta	5	1.00	174

8.	*Rabi*- 2012-13	Oat	Phule Harita	10	1.00	527
		Berseem	Wardan	5	0.50	547
		Lucerne	Anand -2	5	0.50	686
			Total farm households	30		
9	*Kharif* - 2013	Hybrid Napier	Phule Jaywant	10	2.00	887
		Maize	African Tall	5	1.00	606
		Bajra	Giant Bajra	5	1.00	449
		Cowpea	Shweta	5	1.00	179
10	*Rabi*- 2013-14	Oat	Phule Harita	10	1.00	423
		Berseem	Wardan	10	1.00	375
		Lucerne	RL-88	10	1.00	722
			Total farm households	55		
11	*Kharif* - 2014	Hybrid Napier	Phule Jaywant	10	2.00	437
		Maize	African Tall	10	2.00	600
		Bajra	Giant Bajra	10	2.00	393
12	*Rabi*- 2014-15	Oat	Phule Harita	15	1.50	535
		Berseem	Wardan	15	1.50	364
			Total farm households	60		
13	*Kharif* - 2015	Hybrid Napier	Phule Jaywant	20	4.00	353
		Maize	African Tall	05	1.00	272
		Bajra	Giant Bajra	05	1.00	158
			Total farm households	30		
14	*Rabi*- 2016-17	Oat	Phule Harita	03	0.30	593
		Berseem	Wardan	07	0.70	674
			Total farm households	10		
15	*Rabi*- 2017-18	Oat	Phule Surbhi	15	1.50	603
			Total farm households	15		
16	*Rabi*- 2018-19	Oat	Phule Surbhi	10	1.00	653
		Berseem	Wardan	11	1.10	659
			Total farm households	21		
			Total	**313**	**45.70**	

Farmers were given knowledge of improved varieties of forage crops and scientific production technology *viz.*, time of sowing, recommended fertilize dose, irrigation management, cutting management, plant protection technologies through regular training, demonstrations and interaction programme; so making them awareness regarding quality fodder production for animals. The AICRP on Forage Crops and Utilization, MPKV, Rahuri, Maharashtra are using the resources of their respective institutions for carrying over the activities. Seed of improved varieties of fodder crops and fertilizers were distributed among the farmers of Ahmednagar, Nasik, Pune and Sangali districts of Maharashtra.

In *Kharif* season Napier Hybrid, Cowpea, Maize, Fodder Bajra etc. and in *Rabi*, Oat, Lucerne, Berseem, and production technology such as Bajra + Cowpea intercropping in *kharif* were introduced to dairy farmers as potential fodder crops by AICRP on Forage Crops and Utilization, MPKV, Rahuri, Dist- Ahmednagar (Maharashtra). Perennial fodder crops *viz.*, Napier Hybrid and Lucerne play an important role to meet the demand of nutritional green fodder during the lean period. Though cultivation of fodder crops is very important to the state but its promotion by AICRP on Forage Crops

Fig. 4: Sowing and initial crop condition of the FTD on shri. Shivaji Damodar Dahatonde, At post Chanda, Taluka- Newasa Dist. Ahmednagar (M.S.)

and Utilization, MPKV, Rahuri, Dist- Ahmednagar (Maharashtra), most of the dairy farmers of this area shown very keen interest in cultivation of fodder crops, in comparison to locally available grasses and weed. Improved fodder crops are more palatable, nutritious, provide multiple cuts and can overcome fodder scarcity during lean period. Fodder oats and Berseem have the potential to be an important *Rabi* fodder crops in the area of Maharashtra which also allowing for important land use intensification.

Small scale farmers with low livestock ownership make use of native and introduced grasses and fodder crops as their main feed source. Meanwhile sole crops maize silage and sole crop sorghum silage are encouraged and used in this region.

Fig. 5: Visit of monitoring team member namely, Dr. A. K. Mehta, Principal Scientist (PB) & OIC, AICRP on Forage Crops & Utilization, JNKKV, Jabalpur, and Dr. B. G. Shekara, Scientist, Agronomy, Mandya, Karnataka, visited *Rabi* FTD trial on 14.02.2014

Convergence with government schemes

Various schemes are implemented under National Livestock Mission and Rashtriya Krishi Vikas Yojana (RKVY) by Department of Animal Husbandry, Dairy Development and Fisheries, Department of Agriculture in Maharashtra for enhancing the fodder production. The salient feature related to fodder production, quality enhancement is given below.

- **Fodder Seed Production, Procurement and Distribution:** To overcome the shortage of certified fodder seed, the agency, i.e. Maharashtra State seed Corporation would produce Certified Fodder seed. This produce fodder crop seed would be distributed to livestock owners for the cultivation of fodder crops.
- **Fodder Production from Non-Forest Waste Land /Range Land / Grass land/ Non arable Land:** The component will enable improvement of degraded Non- forest wasteland/ rangeland / grass land / non arable land and enhance the problematic soils like saline soils, acidic soils and heavy soils. Vegetation cover provided will not give additional quantity of fodder but would also improve the fertility status of land by introducing suitable legumes.

- Assistance for introduction of Power Driven Chaff Cutter: Livestock owners would assist under this scheme for the purchase of power driven chaff cutter for the proper use and saving green and dry fodder, which would help to minimize the gap between requirement and availability of fodder.
- Establishment of Silage making Units: Livestock owners would assist under this scheme for the construction of Silo pit and purchase of power driven chaff cutter. During the period of surplus supply of green fodder, farmers are to be encouraged to take up silage making to make the quality fodder available during lean (shortage) period of fodder.
- Establishment of Fodder Making Block Units: The densified Fodder Blocks will be useful during drought/floods, etc, when the main objective is survival/maintenance of livestock population. The Fodder Blocks can be enriched with different nutrients either at the time of densification or preferably at the time of feeding.

Supply of Inputs

Demonstrations of *kharif, Rabi* and perennial fodder crops were taken at farmer's field to demonstrate the new production technologies to the farmers. The technology included new forage crops/varieties, sowing methods and management practices and the inputs such as seed, fertilizers, literature etc. were provided to the farmers through project support. The rest of the inputs viz., man / bullock power, plant protection measures etc. were used by farmers at their own cost.

Fig. 6: Visit of monitoring team Dr. Mareena Abraham (Prof. Plant Breeding) and Dr. Usha C. Thomas (Scientist- Agronomy, Kerala, Agril Univ, Vellayani) visited FTD trial of *Rabi*-2016-17.

The programme was monitored through field visits by the staff of AICRP-Forage Crops and Utilization, Mahatma Phule Krishi Vidyapeeth, Rahuri, District Ahmednagar, Maharashtra. The direct quantifiable benefits to farmer are given in Table 9.

Table 9: Direct quantifiable benefits through the FTD's demonstrations conducted by AICRP Forage Crops Research Project, MPKV, Rahuri (Maharashtra) (2008-09 to 2018-19)

SN	Name of Forage crop/variety	Total Area (ha)	FTD allotted	Total quantity of input allotted Seeds/sets (kg / No.)	Fertilizers (kg) Urea : SSP : MOP
	Year 2009 (*Kharif*) 0.20 ha for each farmer				
1	Hybrid Napier (Phule Jaywant)	1.00	05	12,500	500 : 475 : 100
2	Maize (African Tall)	0.20	01	15	45 : 60 : 20
3	Bajra (Giant Bajra)	0.80	04	08	160 : 200 : 40
	Year 2009-10 (*Rabi*) 0.10 ha for each farmer				
3	Oat (Phule Harita)	0.40	04	40	120 : 120 : 40
4	Berseem (Wardan)	0.40	04	12	20 : 200 : 40
5	Lucerne (RL-88)	0.50	05	15	25 : 250 : 50

Year 2010 (*Kharif*) 0.20 ha for each farmer					
6	Bajra (Giant Bajra)	1.00	05	10	200 : 250 : 50
7	Cowpea (Shewta)	2.00	10	10	100 : 500 : 00
8	Maize (African Tall)	0.80	04	60	180 : 240 : 80
Year 2010-11 (*Rabi*) 0.10 ha for each farmer					
9	Oat (Phule Harita)	0.50	05	50	150 : 150 : 50
10	Berseem (Vardan)	1.00	10	30	50 : 500 : 100
Year 2011 (*Kharif*) 0.20 ha for each farmer					
11	Bajra (Giant Bajra) + Cowpea (Shewta)	1.00	05	5 + 20	125 : 250 : 25
12	Maize (African Tall)	1.00	05	75	225 : 300 : 100
13	Hybrid Napier (Phule Jaywant)	2.00	10	20,000	1000 : 950 : 200
Year 2011-12 (*Rabi*) 0.10 ha for each farmer					
14	Oat (Phule Harita)	0.50	05	50	150 : 150 : 50
15	Berseem (Wardan)	1.00	10	30	50 : 500 : 100
Year 2012 (*Kharif*) 0.20 ha for each farmer					
16	Maize (African Tall)	1.00	05	75	225 : 300 : 100
17	Cowpea (Shewta)	1.00	05	15	50 : 250 : 00
Year 2012-13 (*Rabi*) 0.10 ha for each farmer					
18	Oat (Phule Harita)	1.00	10	100	300 : 300 : 100
19	Berseem (Wardan)	0.50	05	15	25 : 250 : 50
20	Lucerne (RL-88)	0.50	05	15	25 : 250 : 50
Year 2013 (*Kharif*) 0.20 ha for each farmer					
21	Hybrid Napier (Phule Jaywant)	2.00	10	20,000	1000 : 950 : 200
22	Maize (African Tall)	1.00	05	75	225 : 300 : 100
23	Bajra (Giant Bajra)	1.00	05	10	200 : 250 : 50
24	Cowpea (Shewta)	1.00	05	15	50 : 250 : 00
Year 2013-14 (*Rabi*) 0.10 ha for each farmer					
25	Oat (Phule Harita)	1.00	10	100	300 : 300 : 100
26	Berseem (Wardan)	1.00	10	25	50 : 250 : 50
27	Lucerne (RL-88)	1.00	10	25	50 : 250 : 100
Year-2014 (*Kharif*) 0.20 ha for each farmer					
28	Hybrid Napier (Phule Jaywant)	2.00	10	20,000	1000 : 950 : 200
29	Maize (African Tall)	2.00	10	120	450 : 600 : 200
30	Bajra (Giant Bajra)	2.00	10	20	400 : 500 : 100
Year-2014-15 (*Rabi*) 0.10 ha for each farmer					
31	Berseem (Wardan)	1.50	15	37.5	75 : 750 : 150
32	Oat (Phule Harita)	1.50	15	150	450 : 450 : 150
Year-2015 (*Kharif*) 0.20 ha for each farmer					
33	Hybrid Napier (Phule Jaywant)	4.0	20	40,000	2000 : 1900 : 400
34	Bajra (Giant Bajra)	1.00	05	10	200 : 250 : 50
35	Maize (African Tall)	1.00	05	75	225 : 300 : 100
Year-2016-17 (*Rabi*) 0.10 ha for each farmer					
36	Barseem (Vardan)	0.70	07	21	35 : 350 : 70
37	Oat (Phule Harita)	0.30	03	30	90 : 90 : 30
Year-2017-18 (*Rabi*) 0.10 ha for each farmer					
38	Oat (Phule Surabhi)	1.50	15	150	450 : 450 : 150

		Year-2018-19 (*Rabi*) 0.10 ha for each farmer			
39	Oat (Phule Surabhi)	1.00	10	100	300 : 300 : 100
40	Berseem (Vardan)	1.10	11	33	55 : 550 : 110
	Total	**45.70**	**313**		

SSP = Single super phosphate MOP = Murate of potash

Benefits Accrue to Farmers

To demonstrate the technology with improved package of practices, demonstrations were organized by providing critical inputs with technology kits. The demonstrations of different forage crops were organized with seed village concept with an objective to make available the quality seed of improved varieties in the cluster for next year season. Hands of training and method demonstration on technologies were also imparted at the time of distribution of critical inputs. For Forage Technology Demonstrations every year sets /seeds of improved varieties of Hybrid Napier (Phule Jayawant), Maize (African Tall), Bajra (Giant Bajra), Lucerne (RL-88), Berseem (Wardan), Oat (Phule Harita and Phule Surabhi), Cowpea (Shewta) and fertilizers as a critical inputs were supplied to the farmers. Farmers were benefitted by improving their knowledge and adaptability of:

1. Improved varieties of forage crops
2. Scientific production technology of forage crops *viz.*, time of sowing, recommended fertilize dose, irrigation management, cutting management in terms of different forage crops.
3. Quality fodder for animals
4. Storage of fodder
5. Involvement and technical knowhow of females in farming and allied business

Fig. 7: FTD of Berseem var. Vardan and Oat Var. Phule Harita at Wambori Tal. Rahuri during *Rabi*-2018-19

The improved technology of seven major *kharif* and *Rabi* forage crops were demonstrated on 45.7 ha of area in Ahemdnagar, Nasik, Pune and Sagali district of Maharashtra through FTDs. Total 313 numbers of farm households from 224 villages were covered in twelve tahsils. *viz.,* Rahuri, Rahata, Shrirampur, Newasa, Kopergaon, Ahmednagar, Sangamner, Nandgaon, Sinnar, Kalwan, Junner and Jat. Critical forage crop inputs viz., improved variety seed and fertilizers were provided to 313 farmers for demonstrations. Due to use of improved technologies, the green fodder yields (GFY) of seven major crops were increased. Informative publications of MPKV, sets of seven forage crops folders were supplied to 313 farmers. Awareness among the farmers about improved forage varieties, improved crop production and protection technology. Through this Forage Technology Demonstration ensure the availability of quality seed of seven improved forage varieties in four districts of Maharashtra. Farmers in catchment areas benefited for getting nutritional quality fodder for milch animals which are beneficial for increases the milk production. Thus, more income was generated through milk / meat

production. As per the opinion of beneficial farmers, they were enabling them to good harvest of green fodder yield (GFY) of improved forage crops. For example in the year *Kharif*, 2015 the improved varieties of B×N hybrid cv, Phule Jaywant, Bajra, cv. Gaint Bajra and Maize cv. African tall obtained 18.40, 32.92 and 18.38 per cent increase GFY over local varieties, respectively. They obtained good remuneration resultant for improving their livelihood. Therefore, it will be pertinent to improve their agricultural practices by dissemination of scientific production technology through FTD with providing critical inputs like improved varieties. These technologies were quickly adopted by farmers of nearly villages and enabling them to harvest good quality fodder of improved varieties of forage crops.

Fig. 8: Monitoring team of Dr. B. G. Shekara, OIC & P. S. (Agronomy) and Dr. P. Mahadevu, Sr. Scientist (Plant Breeding), AICRP on FC & U, ZARS, Mandya, UAS, Bangalore, Karnataka visited FTD at Shrirampur, Dist. Ahmednagar (MS) *Rabi-2017-18*.

Impact, Response of Farmers

This had wider impact in farmers with regards to:

1. Awareness of farmers in terms of improved fodder varieties
2. Knowledge of improved forage crops production technology viz., time of sowing, recommended fertilize dose, irrigation management, cutting management in terms of different forage crops.
3. Involvement and technical knowhow of females in farming and allied business.
4. Scientific animal nutrition and health care.
5. Production of nutritious fodder for the dairy animals, resulted into more income was generated through milk production.
6. Due to the knowledge imparted, the beneficiary farmers provided balanced nutrition to the milch animals. This resulted in increased monetary benefits to the farmers.
7. The beneficiary farmers cultivated B × N Hybrid-Phule Jaywant Maize- African Tall, Lucerne-RL 88, Oat variety Phule Harita and Phule Surabhi, as well as other high yielding varieties of forage crops and grasses with proper package of practices. This beneficial in production of nutritious fodder for the dairy animals.

The overall impact of the Forage Technology Demonstration (FTD) was organized in order to develop awareness about advance improved practices for sustainable livelihood and occupational security. The

benefitted as well as neighboring farmers get availability of improved quality seed of forage crops for further dissemination.

Fig. 9: Grand growth and higher GFY of Oat var. Phule Surabhi in FTD during *Rabi*-2018-19 at Sade Tal- Rahuri Dist. Ahmednagar (M.S.).

Suggestions

1. Inclusion of forage crop in cropping system under irrigated farming system.
2. Availability of quality seed of forage crops and planting material throughout the year.
3. Forage quality improvement
4. Storage of silage from Hybrid Napier and Maize for nutritious feeding in summer season
5. Encouraging use of chaff cutters to minimize fodder wastage
6. However, it is necessary to continue FTD programme for wider adaptation of the interventions for up-liftment of farming community of the Maharashtra State.
7. Use of innovative methods for fodder cultivation / storage / feeding.

Impact of forage technology demonstrations on forage scenario of Telangana

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Forage Scenario of State:

The popular forage crops of Telangana state comprises jowar, maize and cowpea while grasses like BN hybrids and para grass also dominate the crop scenario. Jowar rules the forage scenario as the most widely grown fodder crop in green as well as dry form. Increased area under maize in recent decades marked shift towards maize dry fodder. The statistics indicates that annual fodder crops dominate the forage scenario over the perennial fodders (Table 1). Seed distribution of forage crops by Department of Animal Husbandry also emphasizes in numerous sorghum varieties, maize, cowpea and a few crops from private enterprises. Minor legumes like Pillipesara and horse gram are less popular owing to their poor tonnage.

Table 1. District wise Fodder Development in Telangana state during the year 2020-21

Sl. No.	District	Perennial fodder (Acres)	Annual fodder (Acres)	Total Fodder Development (Acres)
1	Adilabad	90.60	19282.40	19373.00
2	B. Kothagudem	0.00	21437.00	21437.00
3	Hyderabad	0.00	0.00	0.00
4	Jagtial	120.60	26546.40	26667.00
5	Jangaon	247.85	10981.65	11229.50
6	J.Bhupalapally	33.75	4941.25	4975.00
7	J.Gadwal	0.00	8733.00	8733.00
8	Kamareddy	21.55	15407.45	15429.00
9	Karimnagar	124.45	6387.55	6512.00
10	Khammam	337.25	29230.75	29568.00
11	K.B. Asifabad	0.00	1595.00	1595.00
12	Mahabubabad	10.00	6889.00	6899.00
13	Mahabubnagar	123.00	20525.50	20648.50
14	Mancherial	16.20	7422.80	7439.00
15	Medak	82.10	5330.40	5412.50
16	Medchal	464.35	1343.65	1808.00
17	Mulugu	5.00	4615.00	4620.00
18	Nagarkurnool	82.70	11281.30	11364.00
19	Nalgonda	121.33	32658.67	32780.00
20	Narayanpet	115.00	5772.00	5887.00
21	Nirmal	204.50	17446.50	17651.00
22	Nizamabad	70.11	6440.89	6511.00
23	Peddapalli	52.25	12903.25	12955.50

24	R. Sircilla	109.20	11860.80	11970.00
25	Rangareddy	235.27	24823.73	25059.00
26	Sangareddy	0.00	17023.00	17023.00
27	Siddipet	0.00	12426.00	12426.00
28	Suryapet	26.50	22848.50	22875.00
29	Vikarabad	443.08	16466.92	16910.00
30	Wanaparthy	316.02	13848.98	14165.00
31	Warangal-R	266.15	11450.35	11716.50
32	Warangal-U	129.45	10550.55	10680.00
33	Y. Bhuvangiri	170.45	36404.55	36575.00
	TOTAL:	**4018.71**	**454874.79**	**458893.50**

Source: Department of Animal Husbandry, Telangana, 20-21

The population of livestock, on the other hand has been found increasing as indicated through the recent Quinquennial Livestock Census, 2019 (Table 2). Even in the present scenario the requirements for feed and fodder are met through crop residues (52%), forages from common property resources (CPRs) like forests, pastures and grazing lands (43%) and cultivated fodders (5%). Small farmers feed their cattle and buffaloes through grazing in fallows and CPRs, crop residues and to a small extent with cultivated fodder. On the contrary, shepherd rearing of sheep and goat seldom includes stall feeding and they are mostly reared through grazing in CPRs alone. Commercial dairying and ranching inevitably includes systematic cultivation of fodder crops.

Table 2. Livestock Population of Telangana State in 2012 and 2019 census

Sl.No.	Major Species Category	Population 2012	Population 2019	% increase/ decrease
1	Cattle	4880293	4231050	-13.30
2	Buffalo	4160419	4226306	1.58
3	Sheep	12835761	19063058	48.52
4	Goat	4575695	4934673	7.85
5	Others	243941	184063	-24.54
	Total Livestock	26696109	32639150	22.26

(Source: Quinquinneal Livestock Censes, 2012 & 2019, DAHDDF, Telangana State)

It is an indispensible fact that there was no increase in area under forage crops since decades. However, there was significant shift in crop preference where the perennial bajra napier hybrids took the front seat in recent decades. The University released APBN-1 during 1997 was one of the popular grassy fodder of state and also in a few neighboring states. Sorghum continues to be the most popular fodder crop of state, though new released varieties and the new technologies in crop production are adopted. Besides, the stringency in implementation of package of practices in forage crops, against the food grain and commercial crops was seldom observed. The State Department of Animal Husbandry also recommends the varieties to be grown along with package of practices through book in its website (Pandey and Roy, 2011) takers are a few. Secondly the subsistence agriculture, which is the major genre of agriculture of state is also responsible for stagnation of land under forage cultivation. Since decades these factors were thereby responsible for maintenance of same demand supply gap in green fodder scenario of state. Besides this, the winter crops popular nationwide viz., lucerne, berseem and oats are little known to the farmers of State. There is a perennial deficit of green fodders, dry fodders and concentrates which are primary reasons for low productivity in terms of milk and meat.

The Hyderabad center of All India Coordinated Research Project on Forage Crops & Utilization has been instrumental in the state in developing forage varieties and new technologies in fodder production. Forage technology demonstrations were initiated during 2009 under aegis of the All India Coordinated Research Project on Forage Crops & Utilization. Demonstrations of remunerative practices in perennial fodder (BN hybrids), maize, cowpea and multicut fodder bajra were conducted during *kharif* while during *rabi*, crops viz., oats and Lucerne were conducted (Table 3). Hedge lucerne was also included since 2015 owing to its promising performance in AICRP studies.

Table 3. Details of Forage Technology Demonstrations conducted during last decade

Crops & varieties	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	Total
Kharif									
Bajra Napier hybrid (APBN-1/Co-4)	-	4	6	9	20	20	25	25	109
Fodder Maize (cv. African Tall)	5	4	6	9	20	20	25	25	114
Fodder cowpea (cv.EC-4216/Bundel lobia-1/ Vijaya)	5	4	6	8	15	20	25	25	108
Fodder Bajra (cv. Giant Bajra/ Moti Bajra)	5	4	6	8	20	20	25	25	113
Rabi									
Lucerne (cv.RL-88/ Anand-2)	2	5	8	10	15	20	10	10	80
Oats (cv. Kent/ OS-6)	5	5	8	10	15	20	20	10	93
Hedge lucerne (local)	-	-	-	-	-	-	10	20	30
Yearly Totals	**22**	**26**	**40**	**54**	**105**	**120**	**140**	**140**	**647**

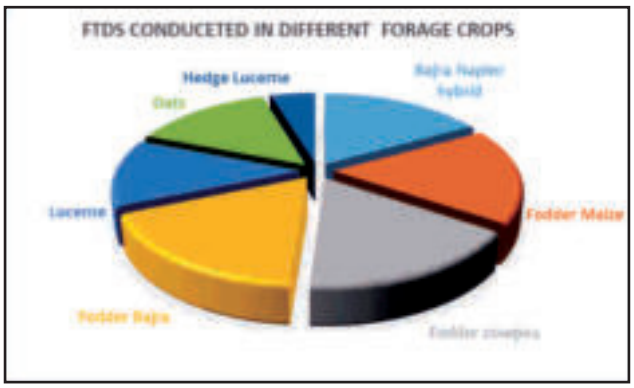

Fig. 1: Details of Forage Technology Demonstrations conducted

Six hundred and forty seven (647) demonstrations were conducted in farmer fields spread over all agroclimatic zones of the State. Emphasis was laid to impart knowledge on remunerative yields through simple practicable interventions. The farmer's practice and the improved practice were demonstrated as indicated in Tables 4a and b. Vital inputs like seed / planting material, fertilizer inputs were given to farmers and all the crop production aspects from sowing to harvesting were supervised. In all the crops demonstrated the fertilizers were applied as per recommendation. The yields under farmer's practice and from the demonstration plot were systematically recorded for each cut at the recommended intervals. The technology gap was calculated for each crop as the difference between potential yield and demonstration yield. The extension gap was worked out as difference between

demonstration yield and yield under farmer's practice. The percentage variation in technology gap for potential yield of crop was expressed as technology index (Singh et al., 2007).

The extension gap was found reducing with each year even after the period of demonstration and the technologies for better yields were imbibed by the farmers as evident through the success stories that evolved in consequent years.

Table 4a. Details of existing practices and improved methodologies implemented through *kharif* FTDs

S.No.	Operation	Existing Practice	Improved practice through FTD
a. Bajra Napier Hybrid			
1	Spacing	Varied widely between 30 cm to 90 cm	60 cm x 60 cm
2	Planting technique	Ambiguous opinion amongst farmers viz., a. Cutting length of planting material viz., one/two budded b. Angle of planting c. Placing of node inside soil	 a. Two budded stem cutting with slanting edges b. Inclined planting at 450 c. Buds at nodes facing up and planting one bud in soil and other facing sky
3	Cutting intervals	Once in three months depending on growth	Once every 45 days after first cut taken after 75 days
4	Cutting height from base of clump	Often 10 to 12 inches of stumps are left while cutting leading to poor regrowth	Advocated cutting leaving stump not more than 4 inches
b. Fodder Maize			
1	Spacing	Adopted 45 cm x 30 cm/ behind the plough at 45 cm x 10 cm	30 cm x 10 cm
2	Time of harvest	No particular stage of harvest is followed, hence the potential of crop in terms of GFY is not realized.	Advocated harvest at early dough and late dough for silage
c. Fodder Cowpea			
1.	Popularization & Spacing and	Not very popular in this agroclimatic zone	Encouraged to grow owing to its forage quality and short duration to fit in between main crops
d. Fodder Bajra			
1.	Popularization	Multicut varieties are not popular	Encouraged growing multicuts in dairy farmers
2	Cutting management	-	First cut after 45 days on panical initiation, second after 30 days of first cut and also a third cut after 30-40 days after second cut.

Table 4b. Details of existing practices and improved methodologies implemented through *rabi* FTDs

S.No.	Operation	Existing Practice	Improved practice through FTD
a. Lucerne			
1	Spacing	Varied widely between 30 cm to 90 cm	25 cm solid rows
2	Cutting management	30 to 45 days interval	25 days when well managed
3	Seed crop	Seed production was not looked into as commercial element	Technique of taking 1-2 forage cuts and leaving for seed set by February to May
b. Oats			
New introduction to area. Introduced in farmers fields following all package of practices.			
c. Hedge Lucerne			
New introduction to area. Introduced in farmers fields following all package of practices. Introduced as sole crop as well as intercrop in farmers fields. Crop established very well with no threat of pest and diseases. Seed production was also encouraged and farmer very happy as it sold Rs.600.00 per kg			

Results of 647 frontline demonstrations conducted indicated that there was a spectacular increase in green fodder yields of these crops with practice of the recommended package of practices as indicated in table 4a and 4b. The results triggered zeal in interested farmers with especially commercial motive. The demonstrations also indicated that there were 27.8, 23.5, 33.3, 48.7 and 53.6 percent yield increase in APBN-1, fodder maize African Tall, cowpea, multicut bajra and Lucerne, respectively with the simple practiceable interventions followed. Farmers were impressed with the crops of Oats and Hedge Lucerne which were new to them.

Table 5. Details of yields FTDs, extension & technology gaps and technology index in FTDs conducted between 2009 and 2017

Crops & varieties	FTD yield (q/ha)	Farmer's average (q/ha)	Increase % over the existing	Extension Gap (q/ha)	Technology Gap (q/ha)	Technology Index (%)
Bajra Napier hybrid (APBN-1)	2300/yr	1800/yr	27.8	500	200	8
Fodder Maize (cv. African Tall)	420	340	23.5	80	80	16
Fodder cowpea (cv. Bundel lobia-1/ Vijaya)	180	135	33.3	45	120	40
Fodder Bajra (cv. Giant Bajra)	600 (in3 cuts)	403.5 (in two cuts)	48.7	196.5	150	20
Lucerne (cv. RL-88)	800 (in 6-8cuts)	521 (in 5-7 cuts)	53.6	279	200	20
Oats (cv. Kent)	350	Introduction	-	-	150	30
Hedge Lucerne	850/yr	Introduction	-	-	150	15

Oats however performed well in areas around Hyderabad and northern Telangana where the winters are significantly cold. However in southern most parts of state their performance was not promising. There was no pest or disease observed in the crop but the potential yields were not realized. This could be more of a technology gap as the crop is a winter loving crop with better performance at lower temperatures. This gap observed could attributed to the variations in weather and soil conditions. Despite the practical implications of high seed rate and seed procurement, farmers showed interest in crop. A few enthusiasts also attempted seed production but in vain. Seed production was disappointment due to comparably higher winter temperatures in the state as against the seed production zones of country. However, farmers experienced the crop as a promising winter fodder crop with no fringes provided seed availability.

Hedge Lucerne was also an altogether new crop in the state. Though found in wild in state the forage potential as a cultivated crop was not realized. The crop was a direct hit with farmers owing to its soft foliage, low seed rate, nil record of pest and disease and easy cultivation. It was highly sought after crop though very late introduced in FTDs i.e., 2015. Palatability amongst cattle and small ruminants equally is also one of the reasons for crop preference by farmers. A few farmers also raised the crop under drip irrigation and the crop performance was highly impressive. Seed production of hedge Lucerne was also looked up as a commercial element by some and their efforts were highly rewarded with prices of Rs.600 to 800.00 per kg seed.

The extension gaps narrowed down from first year of FTDs to 2016 and indicated the shift of farmers from conventional methods to adaptation of latest production technologies. The new technologies will eventually lead to the farmers to discontinuance of old varieties with the new technology. These demonstrations had evolved several success stories which were emulated by the farming fraternity of the village. A few glimpses of are presented as follows;

Hedge lucerne under drip irrigatrion

1. Sri. Jaganmohan Reddy, Shamshabad Mandal educated farmer with 60 acres of land including 10 unirrigated started dairying with agriculture in his farm and initially started with a few local buffaloes. He was supplying was 120 liters of milk from his cattle to local Engineering College hostel. AICRP on forage crops Hyderabad centre, conducted FTDs in his field during 2014 to 2016 with APBN-1, Cowpea, Hedge lucerne in *Kharif* and Oats and lucerne in winter. He agrees that with new varieties of fodder, his milk yield almost doubled similar to profitability and income. Being enterpreneuring by nature had adopted drip irrigation in Hedge lucerne and subsequently in almost entire area. Now he supplies milk to an Engineering college.

2. Smt. Nagalakshmi, Divyasatekam, Muchintal is hardworking and full time care taker of 170 animal dairy at Divyasatekam, Mitchintal, Introduced BN Hybrids, perennial sorghum, lucerne, hedge lucerne in their farm which only produced traditional sorghum and paragrass. Now, employs only organic cultivation aiming at organic milk production for entire ashram with 500 plus incumbants.

3. Yadagiri laskshmi Narasimha Swamy Goshala, Yadagirigutt has a Goshala with 150 cows. Along with the officials of YTDA, AICRP-FCU, Hyderabad Centre has established a fodder block with two perennials viz., APBN-1 and *Desmanthes virgatus*. These fodders are well established to meet the demand of Goshala. The cows of Goshala which were fed with para grass of Musi are now being fed with nutritious fodders APBN-1 and Desmanthes with efforts of Scientists of AICRP-FCU and a volunteer SriDattatreya.

4. Forage technology demonstrations on APBN-1, maize and cowpea were conducted at field during 2010.**Janga Reddy, Ibrahimpatnam** industrious farmer from Ranga Reddy District. He conducted feed based experiment in his own farm by feeding APBN-1 and paragrass, the conventional fodder in his farm to different set of cattle and concluded that the fat content of milk increased when fed with APBN-1 fetching him better price for his milk. His enterprennnnneurship earned his the prestigious 'Rythunestham' Award and his story “Paadipantala

sameekrutham, rythu abyudayaniki soopanam - O rythu vijaya gaatha Sri.Janga Reddy, Kishanpalli, Ibrahimpatnam Mdl" was published as a popular article in Telugu agricultural monthly Journal published by University 'Vyavasaayam' during Dec, 2012.

Conclusion

Forage technology demonstrations conducted in the state of Telangana positively influenced the productivity of crops in terms of green fodder yields. The demonstrations narrowed down the yield gap remarkably besides imparting knowledge on improved practices for a remunerative crop. Introduction of oats and hedge Lucerne was highly successful through demonstrations as evident through the increased demand for seed.

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NOTES

About the editors

Dr. A.K. Roy, Principal Scientist (Genetics & Plant Breeding) and Project Coordinator AICRP on Forage Crops & Utilization has more than 30 years of experience of research and extension in the field of cultivated and range forage species. He has handled more than 30 projects on different aspects of forage crop improvement, Silvipastoral management and transforming the knowledge in real field activities to improve forage resources. He has 18 varieties and 25 unique & novel genotypes of different crops to his credit. He is recipient of several awards including TCT Award by British High Commission, ICAR Team Award for Outstanding Inter- Disciplinary Research as Team Leader, DBT Overseas Associateship, K.A. Shankarnarayanan Award, RMSI Gold Medal etc. and is Fellow of five academic and professional societies including National Academy of Agricultural Sciences. He has guided several Ph.D. & M.Sc. students and published more than 150 research papers in national and international journals of repute.

Dr. Rajiv Kumar Agrawal, Principal Scientist (Agronomy) has more than 28 years of experience of research, extension and training on different aspects of management of fodder crops. His work included nutrient management through various sources in round the year fodder production systems under rainfed as well as irrigated conditions. He is coordinating and guiding the research on the different aspects of management of fodder crops particularly hydroponic fodder production system, organic farming and biofortification of fodder being conducted at more than 25 centres in the country. He is recipient of ICAR-Vasant Rao Naik Team Award. He has guided several M.Sc. students and published more than 40 research papers in journals of repute.

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