Fodder Resources Development Plan for Goa

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

An ISO 9001:2015 Certified Institute

Sardar Patel Award for Outstanding ICAR Institute (Large) for 2015

भाकृअनुप
ICAR

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भा.च.चा.अ.सं.
IGFRI

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Technical Bulletin: Fodder Resource Development Plan : 01/2020

Citation:
ICAR-IGFRI (2020). Fodder Resources Development Plan for Goa. ICAR-Indian Grassland and Fodder Research Institute, Jhansi.

Published on:
November, 2020

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

Printed at :
Darpan Printers & Lamination, Agra (U.P.)
7007122381, 9415113108

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सचिव एवं महानिदेशक
TRILOCHAN MOHAPATRA, Ph.D.
SECRETARY & DIRECTOR GENERAL

सत्यमेव जयते

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FOREWORD

The scenario of livestock growth, fodder availability and land use pattern of Goa is entirely different from other states of the country as the very meager area is under farming, permanent pasture and grazing. The state has witnessed a decrease in the livestock number in the past two decades. The share of fodder resources from cultivated fodder crops is less than 10 percent of the total requirement of the state. Thus, the state is facing a shortage of green fodder.

The Goa state has about 5,387 ha area under horticultural crops, namely coconut, arecanut, mango, cashew, banana and others. The interspaces between trees in orchards remains unutilized that can be effectively and economically used for cultivation of shade loving fodder crops by adopting available technologies. The fodder scarcity in the state can be meticulously reduced if the state utilizes those niche areas for fodder production.

A comprehensive fodder resource development plan for Goa state has been prepared by the ICAR-Indian Grassland and Fodder Research Institute (IGFRI), Jhansi in consultation with all the stakeholders of the state. It incorporates the analysis of existing situations and suitable technologies to increase fodder production of these technologies. I am confident that this document would serve as a guide to plan and implement fodder development programs to make the state self-sufficient in fodder requirement.

I appreciate the efforts made by ICAR-IGFRI in bringing out this important document.

Date the 22nd October 2020
New Delhi

(T. Mohapatra)

Fodder Resources Development Plan prepared as a part of

National Initiative for Accelerating Fodder Technology Adoption (NIAFTA)

ICAR - Indian Grassland and Fodder Research Institute, Jhansi

Themes of NIAFTA

A. Developing State Fodder Resources Development Plan
B. Disseminating fodder production technologies for enhanced productivity and improved management.
C. Promoting alternate land usage
D. Focusing fodder based rationing
E. Utilizing fodder processing technologies for value addition.

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Document Formatting and Cover Design

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Acknowledgements

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

Looking into shortage of green and dry fodder in the country the idea and vision of the development of state wise fodder plan for different states of the country was visualized by Dr. Trilochan Mohapatra, Hon'ble Secretary DARE and Director General, ICAR. During his visit to IGFRI-SRRS, Dharwad on 17th June 2019, he advised to develop state wise fodder resource development plan which covers the broad areas as per requirement of the state. We are highly grateful to him for his insight guidance, encouragement, continuous support and suggestions in preparation of this document. We are also thankful to Deputy Director General (Crop Science), ADG (FFC) and other officers of the ICAR who extended their support during the development of fodder plan of Goa.

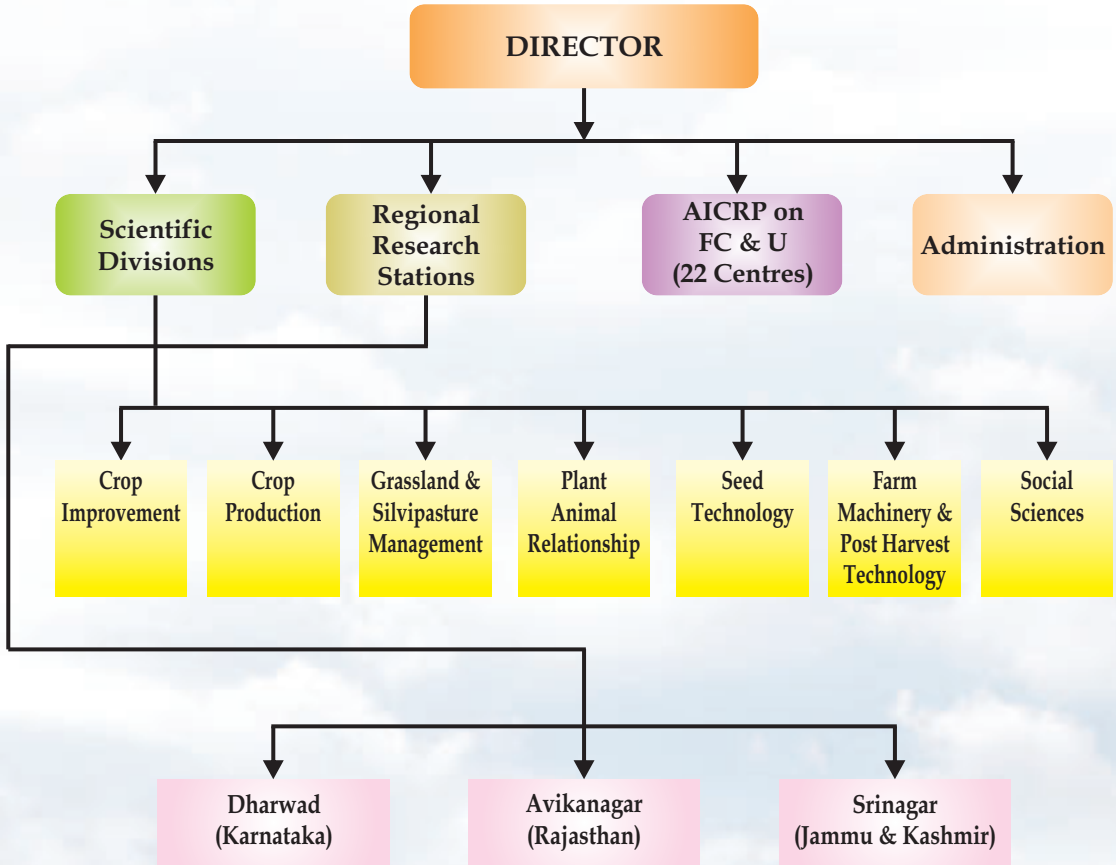
We express our sincere thanks to Government of Goa, especially to Dr. Pramod Sawant, Hon'ble Chief Minister of Goa who inaugurated the interactive workshop held at the ICAR-CCARI, Ela, Goa on September 20, 2019 in colaboration with Directorate of Animal Husbandry, Goa. In this, We also extend our thanks to Dr. Eaknath B. Chakurkar, Director, ICAR - Central Coastal Agricultural Research Institute, Goa; Dr.Santosh V. Desai, Director (AHVS), Dr. Madhav Kelkar, Director (Ag), Dr. A. Misquita, DD (AHVS) for their support in organizing interactive workshop and showing keen interest in developing plan for augmenting forage and livestock sector in the state with special focus on pasture development on waste lands and impart training to state government officers. We also thank to other participants including officials of state government, KVK personnel, veterinary officials, etc., who actively participated in the workshop and provided their valuable suggestions for the improvement of plan.

The efforts made by our team from ICAR-IGFRI, Jhansi in preparation of fodder plan for the state and organizing interactive workshop are praise worthy. This fodder plan is prepared as a part of the activities of our programme 'National Initiatives on Accelerating Fodder Technology Adoption (NIAFTA)', whole team of the programme and Nodal Officer, Dr. Purshottam Sharma, Principal Scientist, deserves special appreciation.

(Vijay K Yadav)
Director (Acting)
ICAR-IGFRI, Jhansi

Contents

Organogram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ICAR-IGFRI - A Profile

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

The ICAR-Indian Grassland and Fodder Research Institute (ICAR-IGFRI), Jhansi, was established in 1962 to conduct organized scientific research on grasslands and fodder production, conservation and their utilization. On 1 April, 1966, it became part of the Indian Council of Agricultural Research (ICAR). Subsequently All India Coordinated Research Project on Forage Crops and Utilization was started in 1972 with ICAR-IGFRI, Jhansi as head quarter for multi-location testing of forage varieties and technologies in different agro climatic zones of the country through 23 coordinating centers and 15 as volunteer centre's at various State Agricultural Universities/NGO/ICAR under the National Agricultural Research System. The institute consists of seven multi-disciplinary division *viz.*, Crop Improvement, Crop Production, Farm Machinery and Post-Harvest Technology, Seed Technology, Social Science, Grassland and Silvipasture Management and Plant Animal Relationship. It also has five units *viz.*, PME, HRD, ATIC, ITMU and AKMU and facilities like Library, Central Research Farm, Dairy and Central Instrumentation Lab. The institute has three regional stations located in Avikanagar (Rajasthan), Dharwad (Karnataka) and Srinagar (Jammu & Kashmir) to conduct focused forage research on arid, semi-arid and temperate climatic conditions, respectively and a grassland center at Palampur (Himachal Pradesh).

Mandate

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

The institute has successfully served the country for 58 years achieving several milestones in generation of fodder technologies. Institute was conferred with "Sardar Patel Outstanding ICAR Institution Award in the year 2015" for his remarkable progress and contributions in the field of forage research, capacity building and infrastructure development. Institute is an ISO 9001: 2015 certified institute. The institute is endeavoring in basic and applied research in both cultivated as well as range species in the fields of intensive fodder production systems, alternative fodder sources, grasslands, silvi and horti-pasture systems, seed production technology, farm mechanization, post-harvest conservation and utilization, livestock feeding and

management, etc. Institute is striving through numerous research projects at various levels like institute, inter-institute, externally funded national and international collaborative projects to address the persistent problems of fodder shortage and lack of quality forages. The institute is undertaking several new initiatives in forage research in new frontier areas.

Proven Technologies of Institute

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

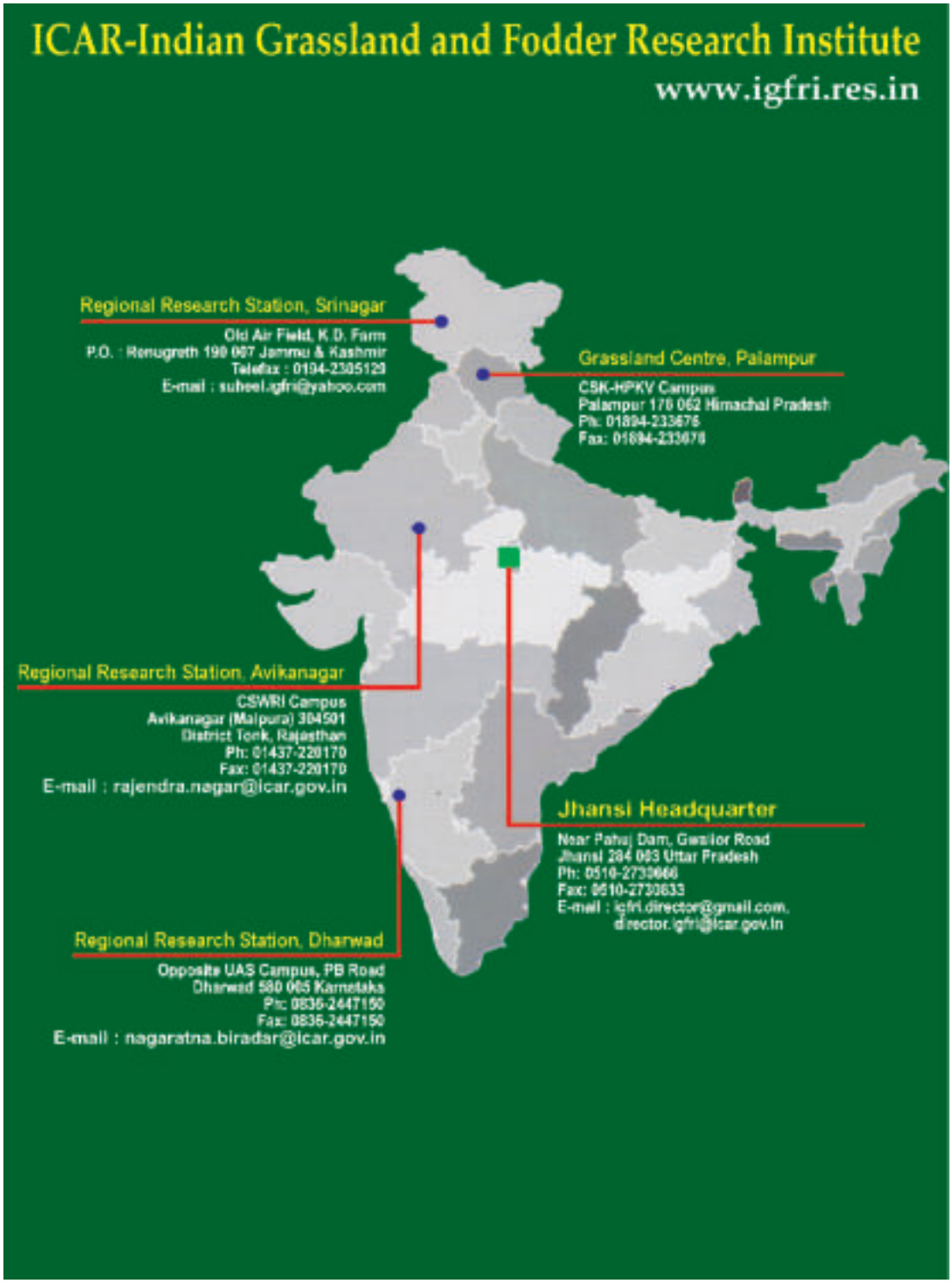
Accelerating Fodder Technology adoption

Transferring knowledge and skills are the essential component required for execution and implementation of resource conservation based projects in the country. The institute is organizing training and skill development programmes regularly of varying duration for farmers, students, state government officials, field functionaries in the field of soil and water conservation The research institutes has signed MoUs with more than 20 Gaushalas for transfer fodder production technologies. Field demonstration on validated technologies for resource conservation and productivity enhancement in red soils of Bundelkhand region are operating at full fledge. Several outreach programmes such as Adarsh Chara Gram A cluster of three villages, Mera Gaon Mera Gaurav (MGMG), National Initiative on Fodder Technology Demonstration (NIFTD), Network Project on Bhadawari Buffaloes, Participatory Fodder Production in Mango Orchards, Farmers FIRST Programme, NICRA, TSP, SCSP, NEH, DFI-Kisan Mitra and NIAFTA have been initiated and implemented.

ICAR has established in institute the Agri-Business Incubation Centre (ABIC) to provide technical knowhow to farmers, educated rural youth and develop entrepreneur.

NIAFTA: New Initiatives

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

A. Introduction

The coastal state of Goa is situated along the Konkan tract bound by Arabian sea on the West and the states of Karnataka and Maharashtra on the other three sides (Figure 1). Geographically Goa lies between 14°53′54″ and 15°40′00″N latitudes and 73°40′33″ and 74°20′13″E longitudes with a total area of 3702 km^2. Goa is endowed with rich natural resources and therefore houses innumerable number of industries. Mining (iron ore and manganese), pharmaceuticals, iron and steel industries are present in North Goa, while mining and ship building industries are present in South Goa. Goa has also emerged as a manufacturing base for several leading companies in areas such as fertilizers, tyres and tubes, cement, electrical machinery, fish-net making machines, automatic washing machines, printed circuit boards, pharmaceuticals and pharmaceutical machinery. Besides industries, the state is also known for tourism. Goa is traditionally known as a tourist paradise for its natural scenery, beautiful beaches and cultural diversity. It attracts several foreign tourists who usually outnumber domestic tourists. As industry and tourism are the frontrunners, status of agriculture is primarily overlooked in the state. Many of the essential food items like milk, vegetables and fruits are regularly imported from neighboring states mainly Karnataka and Maharashtra to meet local demand. The state also faces unique phenomena of nutrient leaching due to its undulating topography and heavy rainfall. Animal husbandry thus becomes essential to rejuvenate these soils. Cropping pattern of the state is oriented largely towards cash crops like arecanut, cashew, coconut, pineapple etc. Amount of residues obtained from these perennial crops meagre and possess poor fodder value. Paddy is the major cereal crop and paddy straw thus available is able to fulfill only partial demand of livestock. The state as a whole suffers with fodder shortage which thus calls for addressing it systematically by developing fodder plan. This document outlines agriculture and livestock scenario along with the technological interventions required to address the issue of fodder shortage in the state. Technological

Figure 1: Map of Goa

interventions suggested for the state are drawn from research conducted at ICAR-IGFRI, Jhansi and other related institutes.

B. Agro-climatic zones

The state of Goa has only two districts *viz.*, North Goa and South Goa. Agriculture in Goa is one of the important economic activities in the state. Located between the Arabian Sea and the Western Ghats, Goa faces problems for enough cultivable land to feed its own population. Goa has ideal agro climatic conditions, 300 days of sunshine, average 3000 mm of annual rainfall, tropical temperature zone, fertile soil etc. (Figure 2). It has varied soil types *viz.*, lateritic (81%); Sandy loam to silt loam in texture; highly acidic (pH 5.5-6.5); Sandy to sandy loam (11%) along sea coast; Alluvial (8%); and land types *viz. Khazan land*: Below sea level; monsoon paddy, *rabi* vegetables are common, *Ker land*: Flat above sea level; *rabi* paddy, vegetables pulses multiple crops through irrigation are possible; and *Morod land*: Upland or terraced field; horticultural crops and rainfed rice are major ones. The major crops include rice, ragi, sugarcane, cowpea, groundnut, mango, cashew nut, coconut, banana, spices, tuber crops and vegetables. The coastal areas are exposed to salinity and do not qualify as good agricultural areas, while the inland areas are not productive enough. Rice and fish being the staple diet of the people, paddy becomes the principal crop in the scenario of agriculture in Goa. Cash crops like coconut, cashew-nut, arecanut, mango, jackfruit, banana, pineapple are also grown in abundance. Cashew is an important crop in Goa. Sugarcane cultivation has been taken up only recently and a sugar factory has also been set up in Goa. Paddy being the principal crop of Goa, grown in two seasons, namely *kharif* or *sorod* and the *rabi* or *vaingan*. The main sources of irrigation for winter crops are the nallahs, rivers and streams, tanks, wells and canals. Crops grown in the *kharif* season consist of paddy, ragi (locally called nachani) and some pulses. Crops grown in the *rabi* season are comprised of paddy, pulses like horsegram, black gram, a variety of beans and some vegetables. The current crop husbandry in the region includes rice and rice based cropping systems dominating the lowlands of the region while cashew and coconut based systems in the uplands. Rice-rice system although is practiced to a limited extent, rice-pulse, rice-groundnut and rice-vegetable dominates the scenario. Cashew is grown less intensively mostly as mono

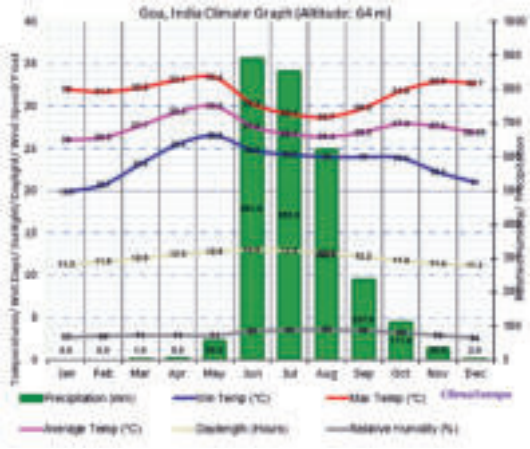

Figure 2. Climatic conditions of Goa

crop. Coconut orchards are often inter cropped with banana, spices like pepper, vanilla, etc. in the region. Horticulture is a major component in agriculture of Goa with two major plantation crops on large scale (cashew in 55672 ha and coconut in 25608 ha). The forest produce too makes up a significant part of the agriculture in Goa. The Government forest area is approximately around 1224.38 km^2, besides this, the forest land owned by private people and institutions is around 200 km^2. The important forests products are bamboo canes, Maratha barks, chillar barks and bhirand.

C. Interactive Workshop-IGFRI and State Department

As a step towards augmenting fodder production and its proper utilization for ensuring the fodder availability to the livestock in the state of Goa, ICAR-Indian Grassland and Fodder Research Institute (IGFRI), Jhansi in collaboration with the ICAR-Central Coastal Agricultural Research Institute, Goa and Department of Animal Husbandry and Veterinary Services, Govt. of Goa organized one day Workshop on "Fodder Production, Conservation and Utilization" at ICAR-CCARI, Goa on 20th September, 2019. The major agenda items of the workshop were to highlight the fodder scenario in the state, activities of ICAR- IGFRI, Jhansi in mitigating the fodder scarcity, modern methods of fodder conservation *viz.* silage and hay making, fodder based ration for livestock, modern high yielding varieties of fodder crops suitable for the state of Goa and advances in fodder crop production in Goa. The workshop was inaugurated by Dr. Pramod Sawant, Hon'ble Chief Minister of Goa (Figure 3) and attended by Dr. Eaknath B. Chakurkar, Director, ICAR - Central Coastal Agricultural Research Institute, Goa; Dr. Santosh V. Desai, Director of Animal Husbandry, Dr. Madhav Kelkar, Director of Agriculture, Dr. A. Misquita, Deputy Director of Animal Husbandry along with the Officers of State, Scientists from Krishi Vigyan Kendras (KVKs). In all a total of 69 officers attended the workshop. The technical presentations were made by the scientists of IGFRI Jhansi *viz.* Dr. A.K. Mishra, Head-PAR, on 'Fodder conservation and fodder based ration'; Dr. R.K. Agrawal, Principal Scientist, on 'Fodder production technologies'; Dr. B.G. Shivakumar, Head, SRRS, IGFRI, Dharwad on 'Advances in package of practices of fodder crops suitable to Goa state and Fodder Development Plan of Goa State'; Dr. K. Sridhar, Principal Scientist, SRRS, IGFRI, Dharwad on 'Fodder varieties suitable to Goa state'; Dr. P. Sharma, Principal, IGFRI, Jhansi on 'Transfer of technology activities of IGFRI'. In the workshop fodder resources development plan for state was presented and suggestions were invited. The salient recommendations emerged from the workshop has been incorporated in the preparation of fodder plan for the state. (Annexure-I).

Figure 3. Hon'ble Chief Minister of Goa, Dr. Pramod Sawant delivering his inaugural speech

D. Livestock Scenario

Livestock especially cattle are a traditional component of sub mountainous production systems. There is no recognized breed of cattle from the state of Goa. Majority of the cattle population of this state is nondescript. Major cattle breeds reared in the Goa are Sahiwal, Red Sindhi and Gir. Major cross breds reared in Goa are Jersey cross and Holstein Friesian (HF) cross. As per the 2019 livestock Census, there are about 132380 livestock population of which 60220 were cattle, 27210 were buffaloes, 9450 goats, 6600 sheep and 35480 pigs (Table 1). At present crossbreeding and grading up policy for non-descript cattle and buffaloes is being followed. Cattle are maintained under stall-fed and semi intensive system. Dairy cows in the villages are kept in semi-open housing with concrete/brick floor and GI sheet/asbestos roof. Farmers are purchasing feed ingredients for preparing concentrate ration either from Goa Dairy or nearby market. Cow dung and urine are being used for biogas production. There are no recognized livestock markets in the state of Goa.

Therefore, dairy animals, goats, poultry are brought from neighboring states. Along with the animals rampant diseases are also introduced in new areas. The productivity level of the animals in the state is very low. Being hot and humid climate, it favors the growth of microbes. Among the most prevalent diseases mastitis and reproductive disorders were the major health problems. Abortion due to brucellosis and other infections are common. Goa produces approximately one fourth to one third of its daily milk requirement of about four lakh litres and for the rest totally dependent upon the neighboring states. The major issue with dairy farming in Goa is low productivity due to non-availability of feeds and fodders. As compared to previous livestock census of 2012, the present census 2019 (Table 1) showed an increase in exotic/crossbred cattle from 17530 to 27500 whereas, the figure for indigenous/non-descript cattle show reverse trend declining form 39950 in 2012 to 32720 in 2019. Similar trend was observed form Buffaloes 31800 to 27210 for the same period and as also for goats 12960 to 9450 during (Table 2). The number of milch cows indigenous declined from 13400 to 11210 as also of milch buffaloes from 15190 to 12380 whereas the population of milch cows (exotic a/cross bred) increased from 9710 to 15800 (Table 3). The milk production is mainly from cattle (39730 tonnes) as also from buffaloes (16730 tonnes) (Table 4). Per capita milk availability (gm/day) declined from 98gm/day in 2013-14 to 71 gm/day in 2018-19.

Table 1. Livestock population of Goa (census 2019)

Species	(Number in thousands)
Cattle	60.22
Buffaloes	27.21
Sheep	0.66
Goat	9.45
Pig	35.48
Total	132.38

Table 2. Comparative categorization of livestock population between 2012 and 2019 census

(Number in thousands)

Year	Cattle						Buffaloes			Goat
	Exotic			Indigenous			Male	Female	Total	Total
	Male	Female	Total	Male	Female	Total				
2012	1.86	15.67	17.53	16.9	23.05	39.95	6.70	25.09	31.80	12.96
2019	1.62	25.88	27.50	11.58	21.14	32.72	4.86	22.35	27.21	9.45
% change	-12.90	65.15	56.87	-31.47	- 8.28	-18.09	-27.46	-10.92	-14.43	-27.08

Table 3. Comparative categorization of in milch livestock population between 2012 and 2019 census

(Number in thousands)

Year	Milch cows (Indigenous)	Milch cows (Exotic/CB)	Milch buffaloes
2012	13.40	9.71	15.19
2019	11.21	15.80	12.38
% change	(-)16.34	62.71	(-)18.49

Where CB = Cross bred

Table 4. Milk production during 2018-19 (in '000 tonnes)

	Buffaloes	Cattle	Goat	Total
Milk production	16.73	39.73	0.71	57.17

E. Fodder Scenario

There is an acute scarcity of green fodder in the state of Goa. As per one report, the annual requirement of concentrate, green fodder and dry roughages is about 1.23, 10.08 and 1.67 lakh tons, respectively. In terms of supply, the deficiency percentage is highest in concentrate at 93%, followed by 49% in green fodder and 50% in dry roughages. The feed resources available from existing agricultural practices meet roughly 40 per cent of the dairy industry requirement of green and dry fodder. With increased cross-breeding, the physical stature of dairy animals has improved considerably and their body weight now is in the range of 325-350 kg as against earlier body weight of around 150 kg. As a result, the demand for feed and fodder has further increased.

Large area is available under forests and cashew nut and coconut plantations. If this land is put under fodder production using available inter-row spaces then state can address the issue of fodder deficiency. The dry forage availability is suffering due to less cereal/pulse production as well as restricted grazing resources in forest areas. Land use pattern of Goa indicates negligible area under permanent pastures and grazing lands. Both green and dry fodder are in limited supply in different parts of the state. The major constraints for production of fodder by dairy farmers are small land holding or unavailability of land for fodder cultivation, scarcity of water or saline water, inhibitive cost of labour required for agricultural operations *viz.* sowing,

weeding, harvesting etc., requirement of manure and fertilizer, more growth time, non-availability of quality of fodder seeds and planting material round the year, fencing to prevent fodder crop from wild animals and natural calamities etc. However, recent efforts of Dept. of Animal Husbandry and Veterinary Services, Govt. of Goa has slightly eased the fodder situation.

Part-II : Fodder Resource Development Plan

The following strategies are proposed for enhancing fodder production, conservation and proper utilization for mitigating the fodder shortage in the state.

Green Fodder: The total annual green fodder requirement will be in the range of 3.99 - 4.48 lakh tonnes in the state.

Dry Fodder: The total annual dry fodder requirement will be in the range of 1.60-1.80 lakh tonnes in the state.

Feed: Similarly the total annual feed requirement will be in the range of 0.54-0.61 lakh tonnes in the state.

Strategies for enhancing fodder resources

A. Cultivated fodder resources

Since the fodder cultivation is taken on very negligible area as of now, the present supply of cultivated fodder in the state is <10%. Presently less than 1000 ha area are under fodder crops. Hence it should be planned to bring 5% of the cultivated area under fodder crops. The total cultivated area of Goa is estimated at 158000 ha. Thus 5% area comes to 7900 ha. Assuming a cropping intensity of 1.22, it will be about 10000 ha to have a reasonable and sustainable fodder supply in the state of Goa (Table 5). Of this, about 5000 ha should be brought under perennial fodder crops (Bajra x Napier hybrid-2500 ha, guinea grass-500 ha, perennial fodder sorghum-1500 ha, other grasses-500 ha), while another 5000 ha under annual fodder crops (fodder maize, fodder sorghum, fodder cowpea etc.). In case of perennial fodder crops propagated through stem cuttings or roots, micro-nurseries may be developed in each block with 40000 rooted slips/ha and in 5 ha area in each districts,

Table 5. Estimation of green fodder production potential for Goa state from cultivated area

	Total cultivated area	5 % of cultivated under fodder crops	Estimated cropping intensity	Total estimated area under fodder crops
Total cultivated area 50 % each of total estimated area is divided into Annual and Perennial fodder crops	158000 ha	7900 ha	1.22 %	10,000 ha
	Annual Fodder Crops		Perennial fodder crops	
	Grasses	Legumes	Grasses	Legumes
	Fodder maize, fodder sorghum, Bajra, Fodder beat, Fodder oats	Fodder cowpea, Horse gram, Velvet bean,	Bajra x Napier hybrid, guinea grass, perennial fodder sorghum and other grasses	Lucerne, Hedge lucerne, *Clitoria ternatea*, *Centrosema pubescens* etc.
Estimated fodder production (t)	Estimated @ 20 t/ha x 2500 ha = 50,000 t	Estimated @ 8 t/ha x 2500 ha = 20,000 t	Estimated @ 40 t/ha x 2500 ha = 1,00,000 t	Estimated @ 15 t/ha x 2500 ha = 37,500 t

thus in 2 years' time there will be sufficient planting material for whole state. Likewise the seeds will be multiplied at each block to get sufficient seed for whole state in 2 years.

Fodder production requires identification of suitable fodder crops, varieties and production technologies depending on the agro-climatic conditions and needs of livestock keepers. The important fodder crops, varieties and seed/planting material requirement have been presented in Table 6.

Table 6. Suitable fodder crops, varieties and seed/planting requirement

S.No.	Crop	Varieties	Seed/root slips/ stem cuttings per ha	Average yield (t/ha/annum)
i. Perennial fodder crops				
1	Bajra Napier (BN) Hybrid	CO-5, CO-6, DHN 6, CO-4, Swetika-1, BNH 10, RBN-13, Phule Gunwant	28,000 nos.	200-250
2	Guinea grass	BG-2, DGG-1, BG-4	40,000 nos.	150-200
3	Perennial fodder sorghum	CoFS 29, CoFS 31	10 kg/ha	100-150
4	Signal grass	DBRS 1	40,000 nos.	40-50
5	Nandi grass	Locally available	40,000 nos.	20-40
6	Lucerne	Anand-1, Anand -2, RL-88, CO-2	10 kg/ha	60-80
ii. Annual fodder crops				
1	Fodder maize	African Tall, J-1006	40 kg/ha	35-40
2	Fodder sorghum	SSV 74	15-20 kg/ha	25-30
3	Fodder cowpea	MFC 09-1, Swetha, BL 1, CO-9	20-25 kg/ha	15-20
iii. Fodder trees				
1	*Caliandra* spp.	Local species	Depend on spacing	10-20
2	*Moringa oleifera*	PKM 1, Bhagya	Depend on spacing	15-20

Round the year fodder production system: Bajra Napier Hybrid (BN hybrid) and guinea grass can be promoted either in open area or under orchards to meet the round the year green fodder requirement. BN Hybrid based cropping system intercropped with cowpea (Figure 4) has green fodder production potential of 170-175 t/ha and dry fodder potential of 30-35 t/ha per year under assured water supply.

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

B. Fodder production through Horti and Silvi-pasture systems:

The horticulture crops occupy about 60.5% of the total cropped area with fruits, vegetable, cashew, coconut and spices. Cashew is major crop covering 55672 ha followed by coconut which occupies 25608 ha. Similarly, the area under different tree species *viz.,* Teak, *Albizia lebbeck, Terminalia paniculata* etc. is also substantially high in Goa state (Table 7). Due to limitation of the availability of land, the need is to identify fodder crops with emphasis on large-scale cultivation in the existing horticulture and silviculture crops of the state. This will help in production of additional quality fodder to mitigate the demand of the state and help in reduction of the purchases from other states. The crops like cashewnut, coconut, mango, jackfruit, amla, saputa, papaya, banana, pineapple, black pepper, nutmeg etc. are largely cultivated in the state and interspaces of these horticultural and silvicultural crops are the potential area for the promotion of fodder cultivation in the state. The use of chemical fertilizer and pesticide in Goa is limited. This will be an added promotional factor for cultivation of fodder and production of organic milk in the state. The cultivation of fodder crops in the existing systems under organic concept is more sustainable and remunerative which needs to be promoted. Due to needs of various non-agricultural activities like tourism, mining, housing and industry, Goa faces a tremendous pressure on the cultivable land. Added to this is the undulating terrain and non-availability of adequate irrigation facilities. The land holdings are also small to promote any commercial cultivation of fodder and pasture crops. Considering these factors, promotion of horti-pasture and silvi-pasture systems is one of most potential sector that needs to be promoted for mitigating the shortage of fodder in the state (Table 7). Horti and silvi pasture systems can serve the purposes of forage, fruit, and fuel wood and ecosystem conservation along with arresting the soil loss and conserve moisture. The intervening spaces among trees in fruit orchards largely left leaving that space unkept and unattended due to shortage of labour and mechanization. Technology for cultivation of fodder in these inter tree spaces has been developed and can used for cultivation of annual/perennial forages. Through planning if 50% of inter spaces of the fruit orchards can be used for fodder production it can produce about 5.0 lakh tones which can fulfill whole green fodder requirement Goa.

Table 7. Area & average yield of various fruits/ plantation crops in Goa

S.No.	Name of the crop	Area (ha)	Average yield (kg/ha)
1	Cashew Nut	55672	395
2	Coconut	25608	4995 Nos.
3	Arecanut	1677	1590
4	Mango	4494	4204
5	Banana	2398	9791
6	Pineapple	341	16258
7	Other fruits (Sapota, papaya, lemon etc.)	3699	10783
8	Oil palm	823	2529
9	Trees spices	101	26

Table 8: List of forage grasses, legumes and shrubs/tree species suitable for horti and silvi-pasture systems of Goa state

A. Harti-Pasture System		
Fruit crops	**Grasses**	**Legumes**
Cashew, Mango, Aracanut, Sapota, Oil palm, Jack fruit etc.	*Dichanthium annulatum, Panicum maximum, Pennisetum clandestinum, P. polystachyon, Setaria sphacelata, Pennisetum pedicellatum, Brachiaria ruziziensis, Tripsacum laxum*	*Clitoria ternatea, Desmodium heterophyllum, Stylosanthes hamata, S.guiensis, Centrosema pubescens, Macroptilium atropurpureum*
B. Silvi-Pasture System		
Trees/Shrubs	**Grasses**	**Legumes**
Teak, *Albizia lebbeck, Albizia amara, Acacia tortilis, Syzygium Ailanthes malabarica, Erythrina variegate Bauhinia purpurea, Erythrina variegata, Leucaena leucocephala, Trema tomentosa, Pithecellobium dulce, Gliricidia sepium cumini* etc	*Sehima nervosum, Themada triandra, Pennisetum pedicialatum, Chloris guyana*	*Stylosanthes scabra,* Velvet bean, *Desmodium intortum*

Figure 5. Mango and Grazing Guinea based hortipasture system

Figure 6. Pomogranite and Hedge lucerne based hortipasture system

Figure 7. Sapota and Guinea based horti-pasture system

Figure 8. Teak and *Brachiaria ruziziensis* based silvipasture system

Figure 9. Fodder production from sapota Orchard

C. Fodder Production from permanent pasture/grazing lands

Rangelands are extensive areas which are unfit for arable farming and are mostly under natural vegetation where animals graze. The vast arid and semi arid tracts including Himalayan rangelands involving the seasonal pattern of animal migration and other forest grazing areas depict the true nature of Indian rangelands. These vast areas could be developed as model grassland with increasing production potential with rich genetic diversity of forage plant species in different eco-climatic conditions, variety of habitats and niches.

In the state of Goa there are about 1305 ha area is under permanent pasture/grazing which are presently in very poor and degraded conditions. Rejuvenation and replanting with suitable grass species range grasses like dinanath grass (var. Bundel Dinanath 2), *Dichanthium* (var. Phule Marvel-1 (Marvel 90-4), JHD 2013-2), *Sehima* (var. Bundel Sen grass-1), *Chryosopogon* (var. Bundel Dhawalu grass-1), *Stylosanthes hamata* and *Stylosanthes guianensis* through seed pellets or by sowing can provide cheaper source of green fodder and will also to livestock keepers in reducing production cost substantially.

Figure 10. Silvipasture on CPRs

D. Fodder on non-competitive lands

Grasses like signal grass and grazing guinea grass could also be promoted as rainfed grasses in other niches such as farm pond embankments, bunds (Figure 11), uncultivated farm lands (Figure 12), in orchards, rain water outlets etc. to meet the green fodder at farm level. Fodder yield to the tune of 1.75 to 2.50 kg green fodder per meter per cut and on an average in 4 cuttings 7.0- 11.0 q green fodder per 100 meter bund length is possible in a year. Besides additional farm productivity, it also works as a guard crop for main crop, reduces water and soil erosion.

Figure 11. BN hybrid planted on bunds

Figure 12. Grazing guinea planted on bunds

E. Alternative fodder resources

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

a. Moringa as alternate protein source

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

Figure 13. Moringa crop established at ICAR-IGFRI

b. Azolla as alternate fodder

Azolla farming, in general, is inexpensive and it can be multiplied in natural water bodies for biomass production. Biomass productivity is dependent on time and relative growth rate and efficiency of the species. Azolla is a highly productive plant. It doubles its biomass in 3–10 days, depending on conditions and it can yield upto 37.8 tonnes fresh weight/ha (2.78 t DM/ha dry weight). Azolla is very rich in proteins, essential amino acids, vitamins (vitamin A, vitamin B12, Beta Carotene), and minerals including calcium, phosphorous, potassium, ferrous, copper, magnesium. On a dry weight basis, Azolla has 25-35% protein, 10-15% mineral content, and 7-10% comprising a combination of amino acids, bio-active substances and biopolymers. During lean/drought period it provides sufficient quantity of nutrients and acts as a feed resource.

Figure 14. Azolla production unit at ICAR-IGFRI

c. Hydroponic fodder production

Hydroponics is science of soilless growing of plants in nutrient rich solutions at regulated temperature and humidity. Hydroponic growing systems produce a greater yield over a shorter period of time in a smaller area than traditionally grown crops. Hydroponic fodder systems are usually used to sprout cereal grains, such as barley, oats, wheat, sorghum, and corn, or legumes, such as alfalfa, clover, or cowpea. It may fit for those producers who do not have local sources for forage. HFP may offer a ready source of palatable feed for small animal producers (poultry, piggery, goat. rabbits).

Hydroponic system consists of a framework of shelves on which metal or plastic trays are stacked as shown in Figure 15. After soaking overnight, a layer of seeds is spread over the base of the trays. During the growing period, the seeds are kept moist, but not saturated. They are supplied with moisture and nutrients, usually via drip or spray irrigation. Seeds will usually sprout within 24 hours and in 5 to 8 days have produced a 6 to 8 inch high grass mat. Peri-urban small farms, landless animal farms and steep hill farms having no agricultural land but possess small pig, poultry and or cow units can benefit from either of the two or combining the hydroponic fodder-cum-sprouted grain technologies. Hydroponic fodder cannot substitute green fodder and hay completely, as it lacks in fibre content. But it is definitely a better substitute for packaged feeds.

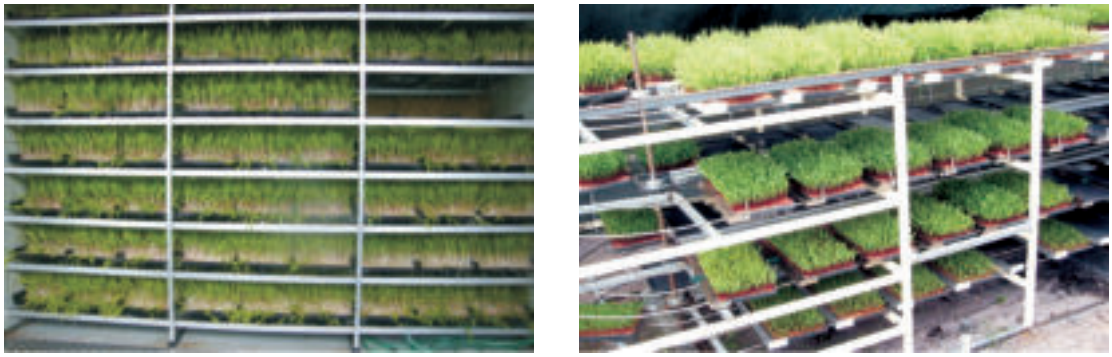

Figure 15. Hydroponic fodder production system

F. Crop residue quality enhancement

Rice, ground nut, cowpea and sugarcane crop residues can contribute about 20-30% dry matter, if properly enriched and utilized. These dry fodders are low in protein content, low in palatability, digestibility and incapable to support even maintenance requirement of the adult ruminants, if fed as such. Urea treatment offers an opportunity to transform crop residues of poor quality into a valuable feed resource by refining it for rapid adoption at farmer's level for greater economic reward. Urea treatment of straw increases its N content resulting into enhanced microbial activity and ruminal digestion of the straw. In addition, urea treatment also exerts its effect on lingo-cellulose complex, wherein the lignin forms the complex with cellulose, thus preventing its microbial digestion. Urea also acts as preservative and application of urea solution on the straw and subsequent storage of treated straw

Figure 16. Mechanized urea treatment during threshing operations

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

Chaffing of forage for ensiling Trench silage Stack of the silage

Figure 17. Silage preparation

G. Fodder conservation technologies – Hay, bales, silage, feed block

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

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

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

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

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

Technology for leaf meal preparation has been developed in the IGFRI, Jhansi (Figure 18). Farmers can learn the technique of leaf meal preparation, storage and utilization through training programmes and demonstrations.

Figure 18. Leaf meal preparation

H. Custom Hiring Center

These need to be developed to provide equipments, machinery etc. to the farmers at affordable cost. Use of new machineries and technologies will enhance production, reduce drudgery and cost. The custom hiring centre should have all important implements/machinery required for fodder production (Table 9).

Table 9. List of equipment's, machinery for custom hiring centre

Prime Movers or General Machines	Land preparation/ Tillage machine	Sowing/ Transplanting machine/ Intercultural machines	Harvesting Machines
Tractors			
(i) Tractor 2WD (above 20-40 PTO HP)	(i) Disc harrow	(i) Seed cum fertilizer drill	(i) Tractor drawn crop reaper/ reaper cum binder
(ii) Tractor 2WD (above 40-70 PTO HP)	(ii) Cultivator	(ii) Self-propelled rice transplanter (4-8 rows, manual and power operated)	(ii) Engine operated reaper/ reaper-binder
(iii) Tractor 4WD (above40-70 PTO HP)	(iii) leveler blade	(iii) Post hole digger	(iii) Power weeder (engine operated above 2 bhp)
Power Tillers	(iv) Cage wheel	(iv) Raised bed planter	(iv) Power weeder (engine operated above 5bhp)
(i) Power Tiller (below 8 BHP)	(v) Furrow opener	(v) Multi crop planter (5tines)	(v) Power operated horticulture tools for pruning budding, grating, shearing etc.
(ii) Power Tiller (8 BHP & above)	(vi) Drainage/ Mole plough	(vi) Ridge furrow planter	(vi) Manual/ Engine operated tree climber for coconut harvesting
	(vii) Weed slasher	(vii) Pneumatic vegetable transplanter	(vii) Paddy thresher
	(viii) Bund former	(viii) Plastic mulch laying machine	(viii) Fruit harvester-picker for cashew
	(ix) Crust breaker	(ix) Raised bed planter with inclined plate planter and shaper attachment. (5-7tines)	(ix) Flail harvester/ shrub master
	(x) Roto-puddler	(x) Grass weed slasher	
	(xi) Roto-cultivator	(xi) Power weeder	
	(xii) Rotavator		

Part-III : Brief Action Plan

i. Identification of areas for fodder production

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

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

There are 2 districts having more or less identical agro-climatic conditions in the state of Goa. Bench mark survey may be initiated in 2 taluks each in North Goa and South Goa districts which will fairly give an idea about the possible conditions for propagation of fodder crops under varied situations.

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

An exercise was made during the workshop to elicit the opinion of the staff of the Dept. of Animal Husbandry and Veterinary Services, Govt. of Goa. Suitable fodder crops and their varieties would be more suitable for different agro-climatic conditions prevailing in the state of Goa and should outlined in the recommendations. The same may be used as guideline for identification of suitable fodder crops and varieties.

iv. Providing package of practices for fodder crops

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

v. Master trainers training at IGFRI/SAUs

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

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

Krishi Vigyan Kendras (KVKs) are operating in the state of Goa will be roped in to identify the needy farmers for training on fodder crops. Other stake holders like milk co-operatives, non-governmental agencies (NGOs) and progressive farmers will also be made partners in the process of creating awareness about fodder production.

vii. Conduction of frontline demonstration and training

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

viii. Strengthening of forage seed production chain

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

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

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

x. Enhance acreage and productivity in non-conventional areas

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

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

b. Production of fodder in problem soils *viz.* saline, sodic, alkaline, acidic, marginal soil having poor nutrient quality soil etc.

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

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

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

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

xii. Establishment of fodder banks

At times, livestock farmers are faced with extreme scarcity of fodder owing to natural calamities and unforeseen failure of crops, thus poses a great threat to sustainable animal husbandry and dairy. To tide over such situation of fodder scarcity, efforts will be made to educate the policy makers, heads of line departments to establish fodder banks at village clusters or tehsils for ensuring the supply of minimum quantity of fodder to livestock keeper so that their animals are not forced to go starvation. In addition, establishment of fodder ware houses with enriched dry fodder or silage bins will also be popularized.

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

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

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

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

xv. Impact analysis of technology adoption

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

Part-IV : Road Map

This project is conceived to be multi-task, multi-partner and multi-year activity. Hence a proper road map is necessary for making it more practical and result oriented. The following road map has been proposed under this project. There are several action points to be carried out in the process of implementation by several agencies (Table 10).

Table 10: Road map for the implementation of the proposed activities

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

The programme implementation plan is a time bound multi-stage oriented and aims to complete the activities in time frame in a logical way. It has been presented in Table 11 and Table 12.

Part-V : Implementation of Pilot Programme

Pilot project is proposed to be implemented in the selected areas to assess the acceptability, impact, refinement and methodology of technologies, if required. Pilot project is proposed to be implemented in both the districts in 10 selected villages. The detailed plan for implementation of pilot project is presented in the Table 11.

Table 11. Implementation level plan for pilot project

Sl.No.	Activity	Action points
1	Target area selection	• Selection of 2 districts (North Goa & South Goa) • Selection of 2 cluster of 5 villages in each district total 4 clusters for 2 districts • Selection of 1 to 2 ha in each cluster for technology demonstrations • Bench mark survey
2	Training	• Training of master trainers - 25 master trainers per batch and 1 batch from each district in 2 batches at IGFRI, Jhansi/ Dharwad. • Training of farmers; 10 from each village; 200 farmers in first year (4 training program for farmers of each cluster) • Exposure visit of progressive farmers and master trainers at IGFRI, Jhansi/IGFRI-SRRS, Dharwad/ICAR-CCARI, Goa/ NDDB, Anand.
3	Technology Demonstrations	• Selection of crop and varieties will be done after identifying suitable districts and village clusters both under annual and perennial crops for different seasons *viz.*, *kharif*, *rabi* and *zaid* • Silage should be encouraged • Since crop residue being a precious commodity, fodder banks using densification technologies can be developed • Annual fodder crops

		Bajra :DRSB 2, Giant Bajra , AVKB-19 Cowpea: MFC-09-01, MFC-08-14 Annual Lucerne: Anand-1, Anand -2 • Perennial fodder crops Hybrid Napier: CO-5, CO-6, DHN-6, DHN-15 Guinea grass: DGG-1, BG-2, Grazing guinea Signal grass: DBRS-1 (high rainfall areas) Perennial sorghum: CoFS-29,CoFS-31 Stylo- Stylosanthes guianensis
4	Suitable silvi-pasture/ horti-pasture system demonstrations	• In existing Orchard - 1 ha (Guinea, Grazing Guinea) • In new Orchard - 1 ha (Guinea, Grazing Guinea) Popular and potential fodder trees: Calliandra, Erythrina, Gliricidia, Sesbania Moringa can be a potential source of legume fodder in upland areas and may be explored
5	Need based Watershed/ micro irrigation facility development	• Suitable fodder species *viz.*, grazing guinea, signal grass, etc. to check soil and water erosion and enhancing water retention will be highlighted.
6	Rejuvenation of grasslands/ pasturelands/ CPRs	• The related activities will be taken up during post rainy season /with first *rabi* rains
7	Tapping rice fallow and other fallow areas for fodder production	• Suitable annual fodder crops *viz.*, fodder cowpea, oats etc. will be grown on residual moisture to ensure fodder supply during the period
8	Input supply	• Inputs *viz.*, seeds/rooted slips/, fertilizers, insecticides etc, small machinery and tools - improved sickles etc. will be supplied to farmers
9	Custom hiring centre in each village cluster	• Exploring and facilitating the farmers with chaff cutter, Bhusa urea enriching machinery, baling of paddy straw, dry fodder etc, complete feed block making machine, regular farm implements including tractors, harrow, seed drill etc.

Funding arrangements

Govt. of Goa, Govt. of India through various state and central schemes like RKVY etc. can meet the fund requirement. ICAR-IGFRI will provide technical support for formulation of such fodder development proposals for funding. The fund requirement for the implementation of pilot project is presented in Table 12.

Table 12. Approximate budget requirement for the implementation of pilot progamme

(Rs in Lakhs)

Item	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Training (Master trainer/ farmers/stakeholders)	4.0	4.0	4.0	2.5	2.5	17.0
Exposure visit of farmers/ stakeholders	3.0	3.0	3.0	1.0	1.0	11.0
Seed/Planting material	5.0	5.0	1.0	1.0	1.0	13.0
Micro Irrigation facilities	5.0	5.0	3.0	3.0	1.0	17.0
Other farm inputs small equipments etc	5.0	3.0	3.0	1.0	1.0	13.0
Custom hiring center equipments	25.0	10.0	1.0	1.0	1.0	38.0
TA/DA/ staff (SRF/YP/RA)/ Consultancy/Miscellaneous etc.	7.0	7.0	5.0	5.0	5.0	29.0
Total	54.0	37.0	20.0	14.5	12.5	138.00

(Rupees One Crore Thirty Eight Lakhs only)

Part-VI : Modalities

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

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

Annexure-I

Proceedings and Recommendations of Interactive Workshop

Workshop on Fodder Production, Conservation and Utilization

September 20, 2019

Organizers

Department of AH&VS, Govt. of Goa

ICAR- Indian Grassland and Fodder Research Institute, Jhansi

The workshop was organized at the ICAR-CCARI, Ela, Goa on September 20, 2019. The workshop was inaugurated by Dr. Pramod Sawant, Hon'ble Chief Minister of Goa and attended by Dr. Eaknath B. Chakurkar, Director, ICAR - Central Coastal Agricultural Research Institute, Goa; Dr.Santosh V. Desai, Director (AH), Dr. Madhav Kelkar, Director (Ag), Dr. A. Misquita, DD(AH) along with the Officers of State, Scientists from KVK (Total participants-69).

The following team of Scientists participated from IGFRI as resource persons and made presentations customized to state of Goa

Dr. A.K. Mishra, Head-PAR, IGFRI, Jhansi: Fodder conservation and fodder based ration

Dr. R.K. Agrawal, PS, IGFRI, Jhansi: Fodder technologies in brief and Forage resource development network in India

Dr. B.G. Shivakumar, Head, SRRS, IGFRI, Dharwar: Advances in package of practices of fodder crops suitable to Goa state and Fodder Development Plan of Goa State

Dr. K. Sridhar, PS, SRRS, IGFRI, Dharwar: Fodder varieties suitable to Goa state

Dr. P. Sharma, PS, IGFRI, Jhansi: ToT activities of IGFRI

Technical Support

Sri Shailendra Sinha, TO, IGFRI, Jhansi

Sri Sunil V. Shinde, STA, SRRS, IGFRI, Dharwar

Dr. Pramod Sawant, Hon'ble Chief Minister of Goa in his address appreciated the efforts of IGFRI, Jhansi. He called for technology gap analysis on fodder and animal husbandry. He told that both Directorate of Animal Husbandry and Directorate of Agriculture should work together proactively to enhance fodder supply in the state. The workshop was appreciated by the participants and all welcomed the direct interaction of Research Institute with line departments. Major outcomes and point of interventions were as follow:

- In the state of Goa, there is a shortage of good quality fodder and fodder seed production is not able to meet the requirement.

- Moringa can be a potential source of legume fodder in upland areas.
- Stylosanthes, cowpea, maize, sorghum were identified as popular fodder crops.
- Hybrid Napier (var. DHN 6, CO-5, CO-6) can be promoted for round the year fodder production system.
- Farmers are showing interest in para grass cultivation in waterlogged conditions.
- Identified popular crops and varieties for different fodder crops were:
    - Hybrid Napier: CO-5, CO-6, DHN 6, DHN 15
    - Bajra Composite: DSRB
    - Guinea grass: DGG 1, Grazing guinea
    - Congo signal grass: DBRS 1 (high rainfall areas)
    - Perennial sorghum: COFS 29, COFS 31
    - Cowpea: MFC-09-01
    - Annual lucerne: Anand 1, Anand 2
    - *Stylosanthes guinensis*
- The popular and potential fodder trees recommended were: *Calliandra*, *Erythrina, Sesbania* etc.
- Silage making should be encouraged.
- Ration balancing using fodder resources should be followed.
- Crop residue prices are relatively high and fodder banks using densification technologies should be developed.
- The fodder plan was discussed and it was decided to revise including above aspects.

The participants were of the view that the locally available dry fodder should be explored and developed. There are constraints of irrigation in hilly areas, small holding, non–availability of fodder seeds and scarcity of labour along with lack of information, knowledge and awareness etc. The SHG are to be developed. Use of sugarcane tops and areca nut leaves as fodder should be explored. Farmers should be trained and trials/demonstration of fodder crops should be conducted. Fodder crops which can be grown in salty areas of Goa should be identified. Buy back facility should be extended in respect of fodder and fodder seed production.

Annexure-II

List of participants in Workshop on Fodder Production Conservation and Utilization at Goa on September 20, 2019

Sl. No.	Name	Designation	Contact No.
1.	Dr. Pramod Sawant	Hon'ble CM, Goa	
2.	Dr. Santosh V. Desai	Director (AHVS), Goa	2437244
3.	Mr. M. Kelkar	Director (Agri.), Goa	
4.	Dr. E.B. Chakorkar	Director, ICAR Complex, Goa	
5.	Dr. Rajendra	DD (AHVS), Goa	9607978107
6.	Dr. A.K. Mishra	Head, PAR, IGFRI, Jhansi	
7.	Dr. P. Sharma	PS, IGFRI, Jhansi	8299085947
8.	Dr. R.K. Agrawal	PS, IGFRI Jhansi	9415179141
9.	Dr. B.G. Shivkumar	PS, IGFRI, Dharwad	9731924228
10.	Dr. K. Shridhar	PS, IGFRI, Dharwad	9445277150
11.	Sri Shailendra Sinha	STO, IGFRI, Jhansi	
12.	Sri Sunil R. Shinde	STA, IGFRI, Dharwad	9900216686
13.	Dr. Ellette da gama	V.O.	9155011463
14.	Dr. A.S. Kunde	V.O.	7744841303
15.	Dr. Veena S. kumar	V.O.	9860226570
16.	Dr. P.V. Korgaonkar	V.O.	9422393302
17.	Dr. Govind	VOVD, Sal	7994741899
18.	Dr. Vilas Naik	Director	9423061339
19.	Dr. Greta	Director	9763129620
20.	A.V. Komart	V.O.	9881252520
21.	Dr. V. lapes	V.O.	9822686658
22.	Dr. Harsh Battuini	V.D	9884239116
23.	Dr. Jagriti B.	V.O.	8566045590
24.	Shri Antonio Sevy	V.O.	9822381175

25.	Dr. Thomas Edison	G.P.F.	7774031242
26.	Mr. Uday M. Kerkar	S.T.C.	7507801301
27.	Dr. P.S. Khade	V.O.	9423131714
28.	Dr. P.M. Rane	V.O.	9011722362
29.	Dr. Narendra R. Naik	V.O.	9607918122
30.	Dr. M.G. Umaye	V.O.	9423062348
31.	Dr. A. Nankhorkar	V.O.	9604852768
32.	Dr. R. Caldeen	V.O.	9607918138
33.	Dr. Anisha Pinheiro	V.O.	9607918162
34.	Dr. M.D. Patil	V.O.	9607918140
35.	Dr. Rachel J.R. Salema	V.O.	7092390454
36.	Dr. Natasha R. Coute.	V.O.	9579642087
37.	Dr. C.E. Fernandis	V.O.	9922201728
38.	Dr. S.S. Betkeller	A.D.	9421241460
39.	Dr. Mahant Chh. B.	V.O.	
40.	Mrs. Rajshri Nagvekar	Project Assistant II	9923965973
41.	Dr. S.D. Veluskar	V.D.	8459720969
42.	Dr. Evica canalli	V.D.	9655152656
40.	Mr. P.V. Malbankar	Vet. Hosp.	9765257141
41.	Mr. Mehesh	V.O.	9020578424
42.	Mrs. Clona Kodges	V.O.	9823509536
43.	Mr. Chander Kagwarkar	V.O.	
44.	Mr. R.M. Kulkarni	V.O.	9168178309
45.	Dr. N.C. Costa	V.O.	9607918146
46.	Dr. G.C. Lathale	V.D.	9607918127
47.	Dr. Saurabh Morajkar	V.D.	9403642438
48.	Dr. Yogesh Apte	V.D.	9822101003

49.	Dr. Udharwar Sv.	V.D.	7083835089
50.	Mr. S.S. Bhandari	V.H.	9822584613
51.	Mr. K.G. Desai	V.D.	9404926665
52.	Mr. Rajendra B. Prabhu	V.D.	7798974516
53.	Mr. Sadanand N. Parab	V.O.	9765257982
54.	Dr. R.G. Kimmy	Vet. Hosp.	9422056987
55.	Dr. Reema G. Paul	V.O., V.D.	9421739146
56	Dr. Agostino Mesquto	DD (AH), H.O.	9607918110
57.	Dr. M. Ferad	V.O.	7744836829
58.	Dr. Nalin	V.O.	9435580045
59.	Dr. Bipul Kumar G.	V.O.	9435628066
60.	Mr. M. Kerkor E.O.	S.T.C.	7507801301

Glimpses of Interactive Workshop at Goa

Annexure-III

Developed Fodder Crop Varieties from ICAR-IGFRI, Jhansi

Crop	Varieties	GFY (t/ha)	Recommendation for cultivation	Year of release
Berseem	Wardan	65-70	Whole country	1981
	Bundel Berseem 2	65-80	Central, NW zone	1997
	Bundel Berseem 3	68-83	NE Zone	2000
	JBSC-1	38-40	North west zone	2017
Lucerne	Chetak	140-150	North west central	1975
Oat	Bundel Jai 822	44-50	Central zone	1989
	Bundel Jai 851	40-50	Whole country	1997
	Bundel Jai 99-2	40-50	North West Zone	2004
	Bundle Jai 2004	50	North east and north west zone	2002
	Bundel Jai 2009-1	53-62	Central zone	2016
	Bundel Jai 99-1	35-40	Hill Zone	2007
	Bundel Jai 2010-1	27-34	South Zone	2015
	Bundel Jai 2012-2	33-37	South Zone	2017
	Bundel Jai 2015-1	25-30	Hill Zone	2018
Cowpea	Bundel Lobia 1	25-30	Whole country	1992
	Bundel Lobia 2	25-30	North Zone	1992
	Bundel Lobia 4	23-26	North-eastern Zone	2012
Guar	Bundel Guar 1	25-35	Whole country	1993
	Bundel Guar 2	30-40	Whole country	1994
	Bundel Guar 3	30-40	Whole country	1999
Field bean	Bundel Sem 1	25-35	Whole country	1993
Anjan grass	Bundel Anjan 1	30-35	Whole country	1989
Cenchrus	Bundel Anjan 3	30-35	Whole country	2006
ciliaris	Bundel Anjan-4	35-37	Whole Zone	2019
Dhaman grass *Cenchrus setigerus*	Bundel dhaman -1	13-15	Western part of country	2019
Dinanath grass	Bundel Dinanath 1	55-60	Whole country	1987
	Bundel Dinanath 2	60-65	Whole country	1990

BN hybrid	Swetika	100-120	Central, northern and north eastern areas	1983
Bajra-squamulatum hybrid	BBSH-1	30-33	Western and northern part of country	2019
Butterfly pea	Bundel clitoria-1 (JGCT-2013-3)	25	All India	2017
Bajra	AVKB-19 JHPM-05-2	50-60 70-80	Whole country Whole country except south zone	2007 2008
Guinea grass	Bundel guinea 1	40-50	Punjab, HP, Central UP, Maharastra, Tamilnadu	2004
	Bundel guinea 2	50-55	Rainfed conditions in semi-arid, tropical, sub-tropical and humid tropics	2008
	Bundel guinea 4	75-81	All guinea grass growing areas	2012
Sehima	Bundel Sen Ghas -1	18-20	Semi-arid, tropical and sub-tropical areas across the country	2007
Chrysopogon	Bundel Dhawalu Ghas-1	26-30	Rangelands under rainfed condition across the country	2007
Heteropogon	Bundel Lampa Ghas-1, IGHC-03-4	25-30	Rangelands under rainfed condition across the country	2007
Dichanthium	Bundel Marvel Grass-2013-2 (JHD- 2013-2)	35-45	NWZ particularly for Punjab and Rajasthan	2017

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Darpan Printers & Lamination, Agra. 7007122381, 9415113108