ISO 9001:2015

# Annual Report 2023

## All India Coordinated Research Project on Agroforestry

## ICAR-Central Agroforestry Research Institute

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CAFRI

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**Supervision & Guidance**
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# Preface

Agroforestry is one of the best practices for the diversification of agricultural enterprises and integration of the agricultural enterprises for ensuring better returns and reduced risks associated with a variable climate. Currently, it is being practised by millions of farmers the world over and has traditionally been a way of life and livelihood in India for centuries. But now, with technological interventions, it **is** contributing significantly to land use and farm income diversification, and natural resource management and can be one of the major factors in the economic transformation of farmers. The recent studies by ICAR-Central Agroforestry Research Institute, Jhansi have shown that 28.427 m ha area under agroforestry in 15 agro-climatic zones of the country. While we began agroforestry research and development with an basic and strategic research, demonstrating the efficacy and motivating the people and other stakeholders for systematic integration of trees into conventional farming systems. Now with the adoption of the National Agroforestry Policy, it is more important to access industrial perspectives and quantify the environmental services to call on policy makers to push for concerted efforts on agroforestry.

The All India Coordinated Research Project initiated by ICAR in 1983 has contributed tremendously to providing tree-based land use options. The coordinating centres are conducting recurrent surveys to design new technologies based on the requirements of the stakeholders and evaluating different tree species and their germplasm for higher productivity and adaptability. This annual report summarizes the salient achievements of the coordinating centre and detailed results of each centre.

The guidance received from Dr Himanshu Pathak, Secretary, DARE and DG, ICAR is gratefully acknowledged. The mentorship role of Dr. S.K. Chaudhari, Deputy Director General (NRM), and Dr. Rajbir Singh, Assistant Director General (Agronomy, Agroforestry and Climate Change) suggestions helped in implementing the project activities. I am grateful to all the Vice-Chancellors and Directors of Research of SAU's and Directors of ICAR institutes, for participating in this project. A special thanks are due to OIC's (Agroforestry) at all coordinating centres for their efforts in executing the project at their respective centres.

I record my thanks to all the Scientific, Technical and Administrative staff of CAFRI, Jhansi for their help in the working of this project. My special thanks are due to the scientists of the Project Coordinating unit of the Project for their sincere efforts and help in the execution of the project and preparation of this report.

**(A. Arunachalam)**
Director, ICAR-CAFRI &
Project Coordinator, AICRP-Agroforestry

# Contents



# 1. कार्यकारी सारांश/Executive Summary

कृषिवानिकी सर्वोत्तम प्रथाओं में से एक है बेहतर रिटर्न सुनिश्चित करने और परिवर्तनशील जलवायु से जुड़े जोखिमों को कम करने के लिए कृषि उद्यमों के विविधीकरण और कृषि उद्यमों के एकीकरण के लिए। कृषिवानिकी पर अखिल भारतीय समन्वित अनुसंधान परियोजना पूरे एशिया–प्रशांत क्षेत्र में एक अनूठी नेटवर्क परियोजना है, और इसने वृक्ष–आधारित भूमि उपयोग विकल्पों के विकास में जबरदस्त योगदान दिया है। सभी 37 समन्वय केंद्र (एसएयूएस में 26, आईसीएआर में 10 और आईसीएफआरई में 01) हितधारकों की आवश्यकताओं के आधार पर नई प्रौद्योगिकियों को डिजाइन करने और उच्च उत्पादकता और अनुकूलनशीलता के लिए विभिन्न वृक्ष प्रजातियों और उनके जर्मप्लाज्म का मूल्यांकन करने के लिए आवर्ती सर्वेक्षण कर रहे हैं। परियोजनाओं के अधिदेशों को प्राप्त करते हुए, केंद्र सीमा वृक्षारोपण (हर मेड पर पेड़) जागरूकता अभियान, टीएसपी और एससीएसपी कार्यक्रमों में भी सक्रिय रूप से भाग ले रहे हैं।

पिछले वर्ष में, 6 केंद्रों ने अपने–अपने क्षेत्रों में निदान और डिजाइन अभ्यास जारी रखा और विशिष्ट सिफारिशें जैसे कि कम ज्ञात अनाज, स्यूडोसेरेल्स और दालों के स्वदेशी जर्मप्लाज्म का उपयोग थलीसैंण ब्लॉक, पौड़ी गढ़वाल जिला, उत्तराखंड में किया जाता है। ऐलेन्थस एक्सेलसा भी खेत की सीमा पर लगाए जाने वाले पेड़ हैं और पारंपरिक रूप से प्रोसोपिस सिनेरिया, टेकोमेला अंडुलता, बबूल निलोटिका, ए. ल्यूकोप्लोआ, और ए. निलोटिका किस्म के कुपरीफॉर्मिस राजस्थान के सीकर, झुंझुनू, बीकानेर और चुरू के कृषि क्षेत्रों में पाए जाते हैं। तेलंगाना राज्य के भद्राद्रि कोठागुदम जिले में यूकेलिप्टस आधारित कृषि–सिल्वी प्रणाली या सिल्वी–देहाती प्रणाली प्रमुख है। होमस्टेड बागवानी, नर्सरी प्रबंधन, नारियल आधारित बहुस्तरीय प्रणाली, धान के खेत में टर्मिनलिया टोमेंटोसा बांध वृक्षारोपण, आम आधारित बागवानी–कृषि प्रणाली और काजू आधारित बागवानी–कृषि प्रणाली महाराष्ट्र के रत्नागिरी जिले की दापोली तहसील में प्रमुख हैं। वृक्ष सुधार गतिविधियों के संबंध में, बांस प्रजातियों सहित लगभग 40 वृक्ष प्रजातियों का परीक्षण चल रहा है और इन वृक्ष सुधार गतिविधियों के परिणामों को विशिष्ट कृषि–जलवायु क्षेत्रों के लिए उपयुक्त क्लोन/किस्में/चयन जारी करने के लिए संसाधित किया जा रहा है।

सिस्टम अनुसंधान के संबंध में, अधिकांश केंद्र प्रथाओं के पैकेज में सिफारिश के लिए उपयुक्त फसल किस्मों की स्क्रीनिंग सहित उद्देश्यों के साथ मौजूदा कृषि वानिकी प्रणाली (मॉडल) परीक्षणों/प्रयोगों का मूल्यांकन करना जारी रख रहे हैं। कुछ केंद्रों ने मेलिया आधारित औषधीय कृषिवानिकी मॉडल और आम आधारित कृषि–बागवानी प्रणाली जैसे नए रास्ते भी स्थापित किए हैं। कृषिवानिकी प्रणालियों की समग्र गणना और मूल्यांकन के लिए

Agroforestry is one of the best practices for the diversification of agricultural enterprises and integration of agricultural enterprises for ensuring better returns and reduced risks associated with a variable climate. The All India Coordinated Research Project on Agroforestry is a unique network project in the entire Asia-pacific region, and it has contributed tremendously to the development of tree-based land use options. All the 37 coordinating centres (26 in SAUs, 10 in ICAR and 01 in ICFRE) are conducting recurrent surveys to design new technologies based on the requirements of the stakeholders and evaluating different tree species and their germplasm for higher productivity and adaptability. Achieving the mandates of the projects, the centres are also actively participating in boundary plantation (Har Med Par Ped) awareness campaigns, TSP and SCSP programmes.

In the last year, 6 centres continued the diagnostic and design exercise in their respective areas and specific recommendations such as indigenous germplasms of lesser-known cereals, pseudocerels and pulses are used in the Thalisain Block, Pauri Garhwal District, Uttarakhand; also *Ailanthus excelsa* are trees being planted on farm boundary and traditionally Prosopis cineraria, *Tecomella undulata, Acacia nilotica, A. leucoploea,* and *A. nilotica* variety *cupresiformis* found in agricultural fields of Sikar, Jhunjhunu, Bikaner and Churu in Rajasthan. In Bhadradri Kothagudam district, Telangana state, Eucalyptus based Agri-silvi system or Silvi-pastoral system are predominant. Homestead gardening, nursery management, coconut based multi-layered system, Terminalia tomentosa bunds plantation in paddy field, mango-based horti-agricultural systems and cashew based horti-agricultural system are predominant in Dapoli Tahsil of Ratnagiri District, Maharashtra. With regard to tree improvement activities, about 40 tree species including bamboo species are currently under trial and the results from these tree improvement activities are being processed for releasing clones/varieties/selection suited for specific agro-climatic zones.

With regard to system research, most of the centres are continuing to evaluate the existing agroforestry system (models) trials/experiments with objectives including screening of suitable crop varieties for recommendation in the package of practices. Some centres have also established new trails like Melia based medicinal agroforestry model and Mango-based agri-horticulture

मौजूदा परीक्षणों के वर्ष 2022–2023 के परिणामों को सारणीबद्ध किया गया है।

अनुसूचित जाति उप योजना (एससीएसपी) गतिविधियों और उप जनजातीय योजना (एसटीपी) गतिविधियों के तहत 50000 से अधिक पौधे वितरित किए गए। एआईसीआरपी–कृषिवानिकी केंद्रों ने 2022–2023 के दौरान 60000 से अधिक किसानों को लाभान्वित करने के लिए कृषिवानिकी प्रौद्योगिकियों की शुद्ध पहुँच दर्ज की। इसके अलावा, हमारे केंद्र कृषिवानिकी अभ्यासकर्ताओं को कृषिवानिकी/वृक्ष–केंद्रित कृषि–सलाह प्रदान करते हैं। 2022 के दौरान कृषिवानिकी पर एआईसीआरपी के समन्वय केंद्रों के लिए कृषिवानिकी पर एक वीडियो प्रतियोगिता आयोजित की गई थी और सर्वश्रेष्ठ को पुरस्कार प्रदान किए गए थे। इस वार्षिक रिपोर्ट में प्रकाशनों के संदर्भ में वैज्ञानिक आउटपुट सहित अन्य गतिविधियों और उपलब्धियों का भी विवरण दिया गया है।

system. The results of the year 2022-2023 from the existing trials are tabulated for the overall computation and evaluation of the agroforestry systems.

More than 50000 seedlings were distributed under Schedule Caste Sub Plan (SCSP) activities and Sub Tribal Plan (STP) activities. The AICRP-Agroforestry centres registered a net outreach of agroforestry technologies to benefit over 60000 farmers during 2022-2023. In addition, our centres provide agroforestry/tree-centric agro-advisories to agroforestry practitioners. A video competition on agroforestry was organized for the coordinating centres of AICRP on Agroforestry during 2022 and the best were conferred prizes. The other activities and achievements including including scientific output in terms of publications, are also detailed in this annual report. .

# 2. Introduction

The All India Coordinated Research Project (AICRP) on Agroforestry was started in 1983 with 20 centres and it has now expanded to 37 centres – 26 in SAUs, 10 in ICAR Institutes and 1 in ICFRE Institute representing all agro-climatic zones in the country (Figure 1). The Coordinating unit of AICRP-Agroforestry was shifted from ICAR Headquarters to CAFRI, Jhansi w.e.f. 1st April, 1997 with the following specific mandates:

- ✓ Screening and genetic upgrading of selected plant species for their compatibility in different agroforestry systems
- ✓ To optimize tree-intercrop combination for different regions
- ✓ Performance enhancement of the pre-dominant agroforestry systems being already practiced by the farmers
- ✓ To upgrade and refine the existing technologies for higher productivity and sustainability.

**Objectives:**

- Diagnostic survey and appraisal of existing farming system and agroforestry practices and farmers' preference.
- Collection and evaluation of promising tree species, cultivars of fuel, fodder and small timber for agroforestry interactions.
- Studies on management practices of agroforestry systems such as agri-silviculture, boundary plantation, silvipasture, silvi-horticulture, agri-silvi-horticulture, multistorey, homestead, etc.
- To analyze economics of agroforestry systems.
- To explore and attribute the role of agroforestry in environment protection.
- To conduct studies on post-harvest technology, fishery, apiculture, lac, *etc*. in relation to agroforestry systems.

ICAR-Central Agroforestry Research Institute (ICAR-CAFRI), formerly the National Research Centre for Agroforestry, is a multidisciplinary premier research institute of the Indian Council of Agricultural Research (ICAR) with a major focus on integrating trees, crops, and livestock on the same farmland. The institute is in Jhansi, Uttar Pradesh (25.5° N 78.5° E), India and has a total area of 254.859 acres (214.079 research farms and 40.78 office & residential area). CAFRI is the only dedicated research institute of the country working on key research areas of agroforestry with 31 scientists, 16 technical, 12 administrative and 8 skilled supporting staff as its sanctioned cadre strength. CAFRI has developed robust agroforestry models and package of practices for different agroclimatic conditions covering small and marginal farmers and provides technical backstopping to the States and stakeholders.

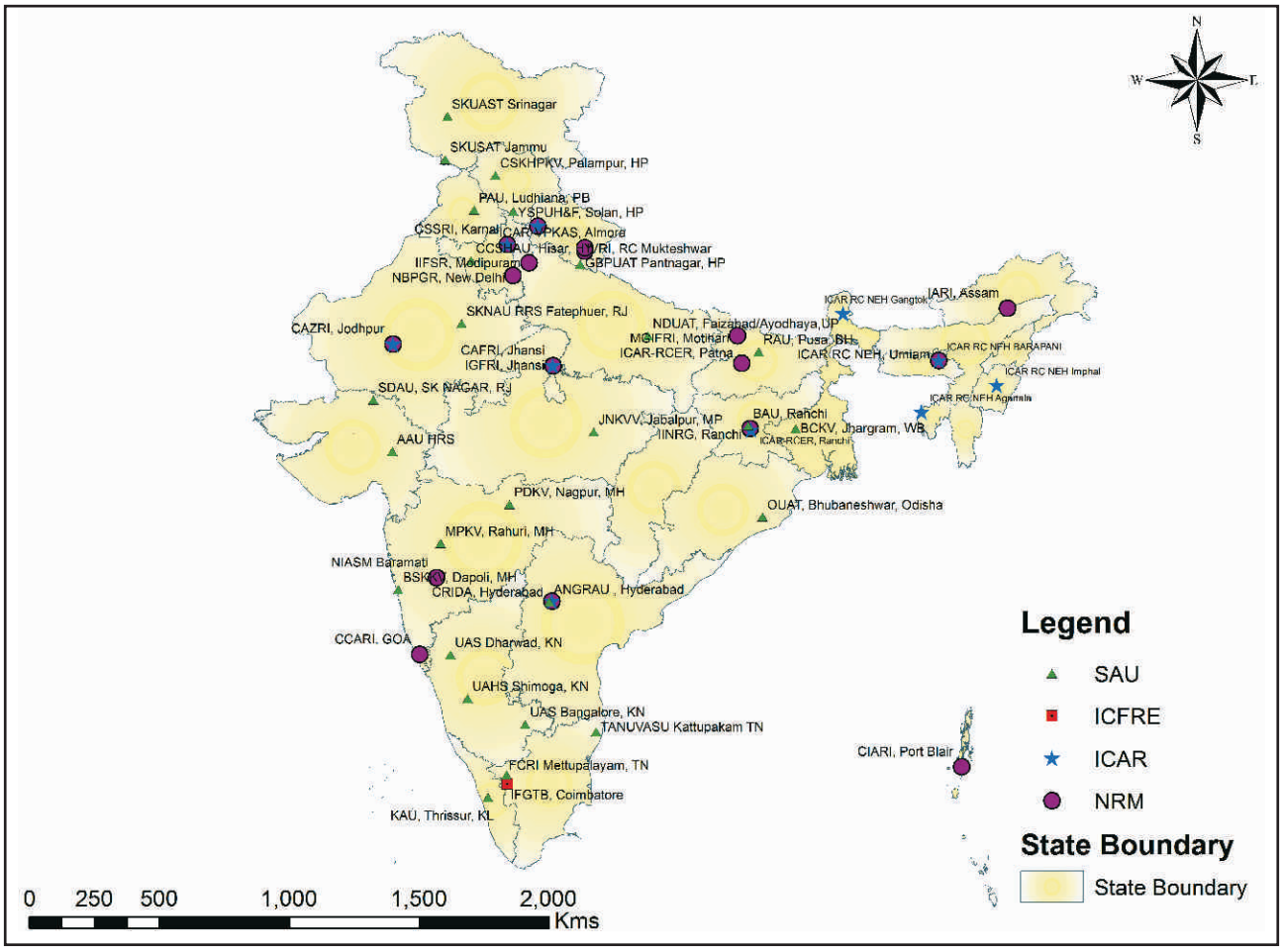



**Figure 1. AICRP-Agroforestry Centres across the country**

# 3. Salient Achievements

## SK UNIVERSITY OF AGRICULTURAL SCIENCE & TECHNOLOGY-K, SRINAGAR

### i) Tree germplasm Collection, Evaluation and Improvement

**Survey, collection, multiplication and evaluation of the best clones of cricket bat willow (*Salix alba* var. *Caerulea*) in Kashmir.**

During the year 2018, the cuttings were collected from other 2 sources *viz.,* Pulwama I and II and Anantnag I & II (Five trees from each district) for evaluation in the nursery. After the end of the third growing season, the maximum height of 3.51m was recorded for Pulwama 1 with a collar diameter of 19.08mm. During 2019, the cuttings were collected from two districts of North Kashmir Baramulla and Bandipora, for evaluation under nursery conditions. After the end of the third growing season, the maximum survival of 100 percent was recorded for all sources. The best performing saplings were distributed to TSP farmers, and sold at Kisan Mela to buyers for planting in their agroforestry Systems. Baramulla-2 source also performed comparatively better in terms of height (2.45m) and collar diameter (15.01mm). As per QRT recommendation, fifteen clones of *Salix* were collected from Dr. Y.S. Parmar University Solan (H.P.) in February 2021 and were transplanted in the nursery for further evaluation. After completing one growing season 100% survival was recorded in all 15 clones.

### ii) System Research

**Evaluation of Apricot-based Agroforestry system under temperate conditions in Kashmir**

After the completion of the ninth growing season, the apricot-based Agroforestry system at Benhama revealed a good potential for the stakeholders, Apricot with maximum height of 4.68 m and collar diameter of 94.28 mm was recorded when grown in combination with Orchard grass, followed by height of 3.94 m and collar diameter 89.19 mm with Lucerne. No. of branches (26.29) and fuelwood production (3.80 kg/tree) were recorded maximum in $T^2$ (Apricot + Orchard grass). Among the four fodder species *viz.* Timothy, Orchard grass, and, Tall fescue sown in interspaces and control (natural grass), Orchard Grass performed better with green fodder yield of 24.30 t/ha followed by tall fescue with yield of 16.23 t/ha. Fruit average of 9.45 kg per tree was recorded from Apricot trees and after processing, the oil content was also estimated from the kernals. Average oil content of 39.51% was recorded.

**Evaluation of different grasses under apple orchards for developing a workable horti-pasture system under the mountain region of Kashmir valley**

At the end of the ninth growing seasons, the maximum height (3.23m) and collar diameter (64.90 mm) of apple plants were recorded in combination with Sainfoin ($T_4$) followed by 3.09 m height and collar diameter of 58.80 mm with red clover ($T_3$). The maximum number of branches (19) and (18) were recorded in $T_4$ and $T_3$ respectively. The plant spread varied from 1.08 in $T_5$ to 1.07 m in $T_4$ among the different treatments. The maximum fuelwood per tree (2.64 kg) was recorded in $T_3$ (Apple + red clover) which was at par with $T_4$ (Apple +sainfoin) and $T_2$ (Apple + Tall fescue). Although all the growth and yield parameters of apple trees were minimum in $T_5$- Control (Apple + Natural grass). Among the various fodder grasses/legumes *viz.,* Orchard grass, tall fescue, red clover, Sainfoin and control (natural grass) sown in interspaces, Sainfoin performed better with 18.99 t/ha of green fodder followed by Orchard grass with yield of 14.50 t/ha. An average 29 kg of fruit per tree was recorded in $T_2$ followed by 23 kg in $T_1$ (Apple +orchard)

**Evaluation of Walnut based Agroforestry system under temperate conditions of Kashmir valley**

At the end of the eighth growing seasons, height, collar diameter, number of branches and Plant spread of walnut plants were recorded. The maximum tree height (3.25), collar diameter (86.15 mm), No. of branches per tree (35.56) and plant spread 2.93 m was observed in $T_1$ (Walnut + Lucerne). Again, the maximum fodder yield (19.20 t/ha) was obtained in $T_1$ (Walnut + Lucerne) followed by $T_2$ (Walnut + Orchard grass) with yield of 14.10 t/ha. After harvest, CITH-Walnut -1 performed better in terms of fruit weight (29.14 gm per fruit) followed by CITH-Walnut-3 (21.10 gm per fruit) minimum fruit weight was recorded in Sulieman (13.02 gm per fruit). The analysis of soil at the end of ninth years revealed that slight increase in organic carbon and nitrogen over initial years. However no particular trend was observed in EC, P and K levels.

**Establishment of trial on Salix based silvi-pastoral system under temperate conditions of Kashmir valley**

The trial has been laid out in the month of late February, 2020.This experiment was laid to evolve different grasses under the allies of *Salix alba* var corella. After the completion of second growing season 100% survival was recorded for salix in the combinations. The maximum mean height (3.36 m) and collar diameter (20.10 mm) were recorded in salix raised in combination with sainfoin. Among the various grasses *viz., Dactylis glomerata*

(Orchard grass), *Festuca arundinacea* (Tall fescue) and Sainfoin, the performance of Sainfoin was observed better with green fodder yield of 33.00 t/ha followed by 32.45 t/ha in case of *Salix* + *Dactylis glomerata*+ Sainfoin.

**Performances of pulses in fruit-based agroforestry systems under degraded land conditions of Benhama Ganderbal**

Among the different treatments, pod yield of 1.37 t/ha, and grain yield of 0.84 t/ha was obtained when rajmash was intercropped with apricot followed by 1.31 and 0.79 t/ha, and grain yield, respectively. When rajmash was intercropped with peach. Also pod yield of 1.33 and grain yield of 0.77 was obtained when moong was intercropped with Apricot.

## SK UNIVERSITY OF AGRICULTURAL SCIENCE & TECHNOLOGY-K, JAMMU

### I) Tree Germplasm Collection, Evaluation and Improvement

Four collections of *Terminalia chebula*, including 3 collections from Himachal and one from J&K are being maintained.

### ii) System Research

**Effect of pollarding on branch wood biomass of *Melia composita***

An experiment was conducted to study the effect of pollarding on the production of small wood in *Melia composita* planted at a spacing of 6 m x 4 m laid out in randomized block design with four treatments $T_0$ (unpollarded), $T_1$ (pollarded at the age of 3 years), $T_2$ (repeat pollarding of $T_1$ trees after 2 years) and $T_3$ (pollarded at the age of 5 years). A decrease in dbh was recorded in all the pollarded trees as compared to control (unpollarded). Maximum (35.79) number of shoots were recorded again in $T_0$ treatment (control), followed by $T_1$, $T_3$ and $T_2$ treatments, respectively. Maximum (367.40 kg) fresh branch wood biomass was recorded in $T_0$ (control) whereas, the maximum (154.25 kg) fresh leaf biomass was recorded in $T_1$. Branchwood biomass was higher in $T_0$ (unpollarded) since the tree canopy was not altered compared to all other treatments. Higher leaf biomass was observed in $T_1$ (pollarded at age of 3 years) since it was pollarded once and had well developed young branches. Overall, all the pollarded treatments $T_1$, $T_2$ and $T_3$ have higher values for all the growth parameters.

## Dr. YS PARMAR UNIVERSITY OF HORTICULTURE & FORESTRY, NAUNI, SOLAN

### i) Tree Germplasm Collection, Evaluation and Improvement

(a) *Grewia optiva* germplasm collected : 49 entries

(b) *Morus alba* : 39 entries

(c) Number of species in the arboretum: 18

(d) Number of species in the bambusetum: 22

### ii) System Research

Evaluation of the established agroforestry systems in the mid hills of Himachal Pradesh indicated that the poplar-based agroforestry system gathered the most stem biomass (73.44 Mg $ha^{-1}$), branch biomass (18.76 Mg $ha^{-1}$) and leaf biomass accumulation (7.36 Mg $ha^{-1}$). Similarly, the maximum vegetation carbon density (65.44 Mg $ha^{-1}$) and leaf-litter carbon density (0.66 Mg $ha^{-1}$) was higher in poplar-based agroforestry system while the highest soil carbon density (114.69 Mg $ha^{-1}$) was in bamboo-based agroforestry system.

A preliminary attempt was made to determine the area under the agroforestry system vis-à-vis other major land use systems and observed the use of eleven bands of Sentinel 2 data and three bio-physical parameters provided better estimation of the area under agroforestry practices in the Kangra district, which was found to be 185347.29 ha (32.43%) with overall accuracy of 79.77 per cent and kappa coefficient of 0.743. The net C-sequestered in agroforestry systems over the simulated period of 30 years is 76.29 Mg C $ha^{-1}$ with estimated $CO_2$ mitigation potential of 2.07 million t $CO_2$ equiv. annually in Kangra district by agroforestry systems. About 9-18 per cent of district total area found to be highly suitable for the agroforestry, whereas 23-34 per cent moderately suitable and 10-27 per cent area is recognized as marginal suitable.

In melia-based agroforestry system, the melia tree spacing of 8 m × 5 m recorded the highest rhizome sprouting (63.33%), plant height (121.08 cm), leaf length (58.95 cm), rhizome length (14.88 cm), weight of mother rhizome per plant (62.13 g), yield (18.88 t/ha), number of leaves per plant(6.72), number of tillers per plant (2.62), and and seed rhizome weight (22.68 g). Moreover, the different mulch treatment has variable influence on the growth and yield The maximum yiled was observed in Melia composita mulch, composed by FYM and RDF.

In morus-based agroforestry system, the yield of the Colocasia crop was reduced (about 12%) significantly compared to the open cropping system. However, the morus based agroforestry system have significantly higher number of corms per plant (9.83), corm fresh weight (24.62 g) and seed rhizome fresh weight (135.78 g). Among the different mulch treatments, the application of the *Toona ciliata* mulch with FYM and RDF enhanced the yield by 40% over the treatment containing FYM and RDF only.

The body growth parameters (body weight, average daily gain, body height, body length, and heart girth) of crossbred calves were not affected when the replacement of the concentrate mixture was done with 20 per cent Azolla meal. However, the replacement of concentrate

mixture with 10 per cent leaf meal and 10 per cent Azolla resulted in 33.03, 3.41, and 4.21 per cent lesser body weight gain, body weight and body length, respectively as compared to the standard feeding practices

The replacement of concentrate with Azolla @ 20 per cent resulted in no significant change in average milk yield (8.15 vs 8.26 kg/day) as compared to control groups. Moreover, the replacement of concentrate with Azolla and LLM @ 10 per cent each resulted in higher milk fat, milk SNF and total solid percentage as compared to other treatment groups. Overall, in crossbred cow's ration Azolla meal can be used @ 20 per cent to substitute concentrates without altering the milk yield and milk composition.

The application of jeevamrit @ 10% recorded the maximum root length (22.75 cm), shoot length (36.74 cm), root to shoot ratio (0.62), root weight (200.86 g) and yield of the radish crop under apple-based agroforestry systems. Moreover, the application of the different levels of Ghanjeevamrit have non-significant influence on the yield of the radish crop growth parameters, however, the maximum yield was recorded with the application of Ghanjeevamrit @ 1 t $ha^{-1}$. Also, the highest yield of the pea recorded under treatment jeevamrit @ 10% (101.42 q $ha^{-1}$) and Ghanjeevamrit @ 1 t $ha^{-1}$ (94.67 q $ha^{-1}$). Both the yield of pea and radish was enhanced with the application of the different treatment compared to the control condition.

In high density apple-based agroforestry system, an increase in the concentration of jeevamrit from 10-20% leads to enhanced growth and yield of the Pea with pod yield increased by about 8%. Similarly, the application of Ghanjeevamrit @ 2.0 t $ha^{-1}$ recorded the maximum pea plant height (61.78 cm), shoot dry weight (4.00 g), root dry weight (0.41 g), pod weight (6.63 g), number of grains per pod (8.22) and pod yield (119.19 q $ha^{-1}$). Moreover, the highest yield of the coriander was recorded under the treatment jeevamrit @ 20% (16.0 q $ha^{-1}$) and Ghanjeevamrit @ 2 t $ha^{-1}$ (15.98 q $ha^{-1}$). Both the yield of pea and coriander were enhanced with the application of the different treatment compared to the control condition.

## CSK HIMACHAL PRADESH KRISHI VISHWAVIDYALAYA, PALAMPUR

### i) Tree Germplasm Collection, Evaluation and Improvement

Out of the best 8 superior seed sources of *Toona ciliata* under field evaluation, since 2012, HPI(c) 22 seed source of Solan attained a significantly higher stem height and DBH in comparison to all other seed sources and it was 89.52 and 122.01 per cent higher than HP 4(c)87. The least performing germplasm source was from Kangra. Seed sources from Mandi *i.e.*, HP5(b) 48 and HP5(b) 71 were the next two best performing in terms of growth parameters.

In case of *Sapindus mukorossi*, out of the best performing 8 seed sources under field evaluation since 2012, AS11 of Dhraman was found to be the best performing in terms of growth parameters, of height which were statistically at par with AS2 from Chuari; AS5 and AS8 from Mangla, Distt. Chamba. In case of DBH, it was significantly highest in AS8 followed by AS2. Seed source As1 from Barin and Chamba were the least performing one.

### ii) System Research

**Development of Harar based silvipastoral system for North Western Himalayan region**

Different treatments had a significant effect on all the growth parameters of tree and grasses. *Terminalia chebula* attained significantly maximum height (2.19 m), collar diameter (70.17 mm), secondary branches (13.17) when grown with clover followed by that attained when grown with Brachiaria + clover. Number of fruits per plant ranged from 3 to 15 and there was 69-80% pulp recovery. Green and dry fodder yield of the system was significantly highest in case of Setaria + clover (17821.8 kg/ha and 4423.08 kg/ha, respectively) followed by Setaria pure. The most important aspect is that quality green fodder could be harvested from the system from April–June when the indigenous grass (T7) was still not rejuvenated from severe winter. Significantly maximum number of cattle (3) or sheep (12) could be fed with Setaria+ clover followed by

Setaria pure (2 and 11 respectively) as harsh winter affected the productivity of the grasses to a great extent. Cutting treatments had a significant effect on the forage quality parameters of the two grasses and the legume when grown pure or in combination. In the total carbon sequestered in the system, per cent contribution of grass/legume cover was in the range of 49.80-88.36% whereas trees contributed in the range of 5.45-57.51 t/ha.

**Evaluation of *Leucaena leucocephala* germplasm as tree fodder in silvipastoral agroforestry system in mid hills of Himachal Pradesh.**

Leucaena variety K8 was found to be high (1081.3 kg/ha) fodder yielding as compared to K636 (947.4 kg/ha). Total tree fresh fodder production was maximum in case of Pollarding twice which provided quality tree fodder twice in a year (1092.8 kg/ha) followed by that obtained through pollarding once in the month of June.

Quantitative and qualitative evaluation of different varieties of *Morus alba* for fodder under mid-hill conditions of Himachal Pradesh

There was a remarkable increase of 50.3% and 51.2% in the total fresh fodder yield of two varieties China white (V1) and Kanwa-2 (V2) respectively when pollarded twice in comparison to the farmer's practice of lopping. In case of V3 (S-146), V4 (Ghoshuramay) and V5(S-1635), total yield under treatment of lopping was higher than that obtained in pollarding especially in case of V4. Nutritional analysis in the second year of field evaluation revealed that V1 (China White) and V4 (Ghoshuramay) were qualitatively better varieties of *Morus alba*.

**Performance of Turmeric under different spacings and mulches in *Toona ciliata* based Agroforestry system**

Different kinds of mulch had a significant effect on number of sprouts/day. With the application of Prunus leaves as mulch, daily emergence count was more as compared to other treatments irrespective of spacing treatments and it followed a gradual curve over the period of twenty two days. Plant height recorded at periodic interval was also maximum in plots having Prunus mulch. Turmeric will be harvested in the next year after two years.

## ASSAM AGRICULTURAL UNIVERSITY, HRS, KAHIKUCHI

### i) Survey, Diagnostic and Design

Soil consists of new alluvium on both banks of the Brahmaputra and old alluvium towards the foothills. Soils are sandy loam in texture, acidic in reaction, though a large area in the riverine tract is neutral. The average annual rainfall in this zone is about 1800 mm. Rainfall in the southeastern part of the zone is low and it increases towards the north and west. The shallow rivers flowing from Bhutan hill with torrential currents cause enormous loss of animal lives, properties and crops every year. The farmers rear animals like cows, bullock, buffalo, pig, goat and birds (duck, hen, and pigeon) for their livelihood security. No common grazing land is available for which the animal depends on stall feeding. The edible crop residue, grasses, legumes and leaves of various trees contribute the roughage for the animals.

Some of the fodder tree used by the farmers is *Artocarpus heterophyllus, Ficus hispida, Ficus gibbosa, Ficus infectoria, Streblus asper, Anthocephallus cadamba, Leucaena leucocephala, Albizia* spp., *Terminalia tomentosa* and bamboo species.

Firewood is one of the major sources of fuel and is generally obtained from trees growing in homesteads, farm land and nearby forest areas. In addition *Sterculia vilosa, Lagestromia speciosa, Bischofia javanica, Trewianudi flora, Terminalia arjuna, Albizia procera, Albizia lebbeck, Albizia lucida, Toona ciliata, , Cassia fistula, Cassia javanica etc.*, are grown for fuel wood and timber. Trees such as *Tectona grandis, Dalbergia sissoo* are used as timber.

### ii) Tree Improvement

Ninety-five saplings of *Gmelina arborea* collected from 19 seed sources were planted June 2001. These were collected from six different sites *viz.* 4 from Goalpara, 3 from Dudhnoi, 3 from Damara, 4 from Boko,2 from Byrnihat and 3 from Silchar. Seed source from Byrnihat (AAU 15 & AAU 16) registered 29.13m & 27.15m and Silchar (AAU 17 & AAU 18) registered 25.97m & 27.83 m tree height respectively, in 21 yrs old plantation AAU 15, AAU 16, AAU 17 & AAU 18 registered dbh of 45.36, 44.85, 49.99and 51.48 cm respectively, in 21 years. AAU 18 (Silchar), recorded the highest timber volume of 3.253 $m^3$/tree, biomass of 1789.47 Mg/ha, and aboveground C stock of 894.74 Mg/ha.

In *Acacia mangium* for timber, the average of 73 superior trees attained 26.9 m plant height and 41.97 cm dbh, 9.31 m canopy diameter, and 439.2 $m^3$/ha timber volume in 21$^{st}$ year. Timber volume and tree biomass of the standing tree were 439.2 $m^3$/ha and 491.5 Mg/ha, respectively. Aboveground C stock observed was 245.23 Mg/ha.

### iii) System Research

In *Acacia mangium* based Silvipastoral system, maximum plant height (17.23 m), dbh (36.13 cm), timber volume (471.93 $m^3$/ha), tree biomass 504.98 (Mg/ha) and aboveground carbon stock (252.49 Mg/ha) was recorded in intercrop plot where tree spaced at 5 m x 4 m.

In the Jackfruit-based AF system, a tree height of 8.87 m was recorded in the intercrop plot whereas it was 8.74 m in tree without crop. volume, tree biomass and aboveground C stock for jackfruit were higher in inter-crop plots, being

57.59 $m^3$/ha, 106.79 Mg/ha, and 54.91Mg, respectively. However, the canopy diameter (8.18 m) was higher in sole jackfruit.

In nearly 6th year plantation of *Gmelina arborea* based Agrisilvicultural system, maximum tree ht. (7.35 m) collar girth (30.34 cm) were observed insole tree plot and Cowpea-Toria sequence as intercrops respectively. Max annual increment of tree ht (399%), collar girth (299%) and canopy diameter (258%) recorded in GG-Toria sequence as intercrop.

In Coconut based agroforestry system, Rs. 6,17,730 per ha from 8 yr crop cycle and Carbon Sequestration potential: 20.21 Mg per ha.

Muli bamboo attained 12.08 m in height and 13.52 cm in girth. The mean yield of matured bamboo and B:C ratio were 33640000 no./ha and 3.64, respectively. In *Bambusa balcooa*, mean plant height (25.37 m), spread (5.32 m), new culm (21.76 no.), total culms (147.98 nos.), canopy diameter (32.68 m), biomass (187.34 Mg/ha) and harvestable yield (1280.57 no./ha) of *Bambusa balcooa* was recorded in 14 years after plantation. In *Bambusa tulda*, mean plant height (20.69 m), spread (3.82 m), new culm (33.53 no.), total culms (117.97 no.), canopy diameter (11.52 m), biomass (227.39 Mg/ha) and harvestable yield (2261.58 no./ha) was observed in *Bambusa tulda* in 14 years after plantation.

The performance of *Tectona grandis* for timber, aboveground C-Sequestration recorded was 249.05 Mg/tree.

The soil properties of existing agroforestry system including bulk density, total porosity, microporosity, macroporosity, CEC, mean weight diameter, moisture content, and pH were improved in the agroforestry systems and observed at par with the undisturbed forests system. Total organic carbon (TOC), total nitrogen (TN), microbial biomass carbon (MBC), basal respiration (BRS), metabolic quotient (q $CO_2$), total bacteria, total fungi and fluorescent group of bacteria are significantly higher in surface soil as compared to subsurface soil.

Some colonies of bacteria and fungi have been isolated from various sources of organic manures under agroforestry systems, studied morphological and biochemical and will outsource for the identification of efficient strains as polyphenols, lignin degraders.

## PUNJAB AGRICULTURAL UNIVERSITY,LUDHIANA

### i) Tree Germplasm Collection, Evaluation and Improvement

| | | |
|---|---|---|
| Poplar (*Populus deltoides*) | : | 210 |
| Eucalyptus | : | Clones 45 |
| Shisham (*Dalbergia sissoo*) | : | Clones 28 |
| Burma dek (*Melia composita*) | : | 44 |

***Melia composita* tree improvement:** A multi-locational trial of *Melia composita* was established in 2016 to screen 20 progenies at PAU, Ludhiana and 14 progenies at Ruldu Singh Wala, Bathinda at 4 x 2.5 m spacing in a well-replicated and randomized block. After six years, the maximum DBH was that of progeny 19 (21.1 cm), followed by progeny 20 (20.47 cm) and progeny 3 (18.92 cm) at Ludhiana. Similarly, at Bathinda, out of 14 progenies, the minimum average diameter was observed in progeny 14 (13.55 cm) and the maximum average diameter in progeny 3 (21.55 cm), followed by progeny 1 (20.32 cm).

Another trial of *Melia composita* was established in 2021 to screen 15 FRI clones and 4 PAU progenies. The seedlings were planted at 6 x 4 m spacing in a replicated and randomized block. After one year of growth, height was higher in clone 19 and clone 18 (6.20 m and 5.35 m, respectively), whereas DBH in clone 10 and clone 19 (6.35 cm and 6.23 cm, respectively) than other sources.

**Poplar tree improvement:** A multi-locational trial for the evaluation of 12 clones of poplar was established at PAU Ludhiana. After 6.5-year growth, the tree volume ranged from 0.180 $m^3$ to 0.243 $m^3$ per tree. Four clones recorded higher values for volume than the overall mean and were in order of FNR-558 >Ranikhet> L-47/88 > FNR-544.

**Shisham (*Dalbergia sissoo*):** A zonal clonal trial was established at three locations, *i.e.*, PAU, Ludhiana; GBPUA&T, Pantnagar; and HAU, Hissar. The DBH and height recorded at age 6 years. The top rank with respect to diameter at breast height (DBH) was found in PS52, and was followed by PS 38 and PS 54. Clone PS 52 registered the highest tree height value and was followed by PS 20 and PS 38.

**Eucalyptus tree improvement:** A trial based on 14 eucalyptus clones was established at PAU Ludhiana during 2016. After 6 years of planting; Clone PE-11 has recorded overall superiority in volume index (15.61%), tree height (7.41%) and DBH (3.77%) than existing commercial clone C-413. Clone PE-11 has about 37% more clear bole height; 8% more stem straightness thanexisting commercial clone C-413 which is most essential characteristics for wood-based industries.

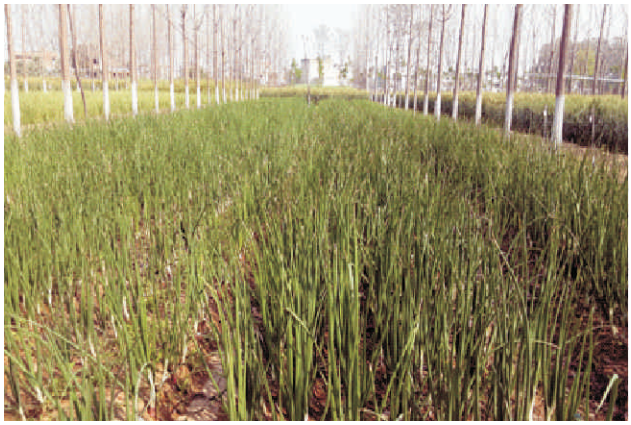
### ii) System research

**Different spacing of poplar and intercrops:** During March 2021, poplar block plantation was established at two spacings 10 m x 2 m and 8 m x 2.5 m with 500 plants/ha. After 1.5 year, mean DBH and height of poplar planted at a spacing of 8 m x 2.5 m was 12.83 cm and 9.39 m, respectively. Whereas, the average DBH and height of poplar planted at a spacing of 10 m x 2 m was 11.39 cm and 9.73 m, respectively. During rabi and kharif season, different crops *viz.* onion, wheat, baby corn, pearl millet

(fodder) and sorghum (fodder) were inter-cultivated with poplar trees.

**(a) Pearl millet and sorghum:** Two newly released pearl millet fodder varieties (PCB 165 and PCB 166) were intercropped under different spacing of poplar during *kharif* season. The fodder yield of PCB 166 was significantly higher (57500 kg/ha) than PCB 165 (51400 kg/ha). Tree spacing also significantly influenced the green fodder yield; higher fodder yield was observed under poplar block plantation with wider spacing of 10 x 2 m (56700 kg/ha) than 8 x 2.5 m (52300 kg/ha) spacing. Amongst sorghum varieties SL 44 and SL 45; fodder yield of SL 45 (55000 kg/ha) was significantly better than SL 44 (51000 kg/ha). Higher Fodder yield (57400 kg/ha) was recorded under wider spacing (10 m x 2 m) than 8 x 2.5 m spacing of poplar plantation.

**(b) Onion:** Two onion varieties (Punjab Naroya and PRO-7) were intercropped under poplar block plantation during end December. The higher yield of onion (13100kg/ha) under wider tree spacing (10 x 2m) than 8 x 2.5 m spacing (12300kg/ha). There was 6.5% increase in onion yield under 10 x 2m tree spacing than 8 x 2.5 m tree spacing. Onion variety PRO 7 gave higher yield than Punjab Naroya.



**(c) Wheat:** Ten wheat varieties namely BWL 8855, HD 3286, HD 3086, DBW 222, DBW 187, PBW 826, PBW, 824, PBW 803, PBW 725 and PBW 677 were grown in poplar block plantations. PBW 826 and PBW 824 out yielded the rest of the varieties; PBW 826 recorded 5130 kg/ha closely followed by PBW 824 variety with 5020 kg/ha yield under poplar block plantation.

**Cultural practices of intercrops in poplar plantation:** The average tree height, diameter and crown spread was 16.8 m, 20.8 cm and 22.5 $m^2$ of 6 year poplar plantation, respectively.

**(a) Garden pea:** The variety Punjab 89 produced the maximum pod yield followed by Mithi phalli; while the performance of Matar Ageta-7 and AP-3 was poor. 1st November sown garden pea resulted in the highest pod yield 8040kg/ha at par with 15th October sown crop. Overall there was 42% reduction in yield of garden pea under five year old poplar.

**(b) Mustard:** The study was conducted to evaluate the effect of sowing time on productivity of Indian mustard varieties under poplar. The results indicated that 15th October sown crop produced a significantly higher yield under poplar (1332 kg/ha) whereas 15th November sown crop recorded a significantly lower yield. PBR 357 variety recorded the highest yield (1158 kg/ha) under poplar.

**(c) Raya:** In another experiment to study the nitrogen requirement of raya varieties under poplar plantation; an increase in seed yield with different N levels was significant up to 150 % RDF (N:P:K - 150:30:15 kg/ha). Among varieties, PBR 357 recorded significantly higher seed yield than PHR 126 and RCH 1. Application of 150 % RDF resulted in 44.1 % increase in seed yield over control.

**Development of Eucalyptus based AF system (Zonal trial):** The trees were planted in September 2016 and different crop rotations of rabi and kharif crops were grown. The DBH and height did not differ significantly among various treatments of crop rotations after six year of growth. However, DBH was maximum in berseem – cowpea rotation (15.99 cm) than other rotations. The mean DBH and height of the eucalyptus trees were 15.8 m and 17.79 cm, respectively. The yield in 6 year old trees was lower than the yield of sole crops (without trees). The wheat crop recorded 2613 and 2512 kg/ha of grain yield in wheat-moong and wheat-mustard rotation, respectively. The corresponding values under open conditions were 3829 and 3523 kg/ha. The mustard crop recorded yield of 321 kg/ha as compared to 537 kg/ha in open.

**Nutrient return through litterfall in Melia plantation:** A study was conducted to assess the nutrient return through litterfall under three spacings of *Melia composita i.e.*, 5 x 3 m, 7 x 3 m (paired at 2.5 m) and 7 x 3 m in an agroforestry system in an 8 year old plantation. Total litterfall (6.24 t $ha^{-1}$) and return of macro (N 44.90, P 8.37 and K 52.82 kg $ha^{-1}$) and micronutrients (Fe 11.85 kg $ha^{-1}$, Zn 369, Mn 450 and Cu 51.52 g $ha^{-1}$) was highest in 5 x 3 m and lowest in 7 x 3 m spacing. The nutrient return through litterfall varied as K > N > Fe > P > Mn > Zn > Cu under all spacing.

## GB PANT UNIVERSITY OF AGRICULTURE & TECHNOLOGY, PANTNAGAR

### i) Survey, Diagnostic and Design

Duirng the year, D & D survey was conducted in Thalisain Block in Pauri Garhwal District of Uttarakhand. Indigenous

germplasms of lesser-known cereals, pseudocerels and pulses are used. Homegardens with horticulture trees are prevalent, yet at the hilly stair form fields forest trees are available. All the work is shouldered by the ladies of the families. Migration of boys for education and able men for employment is major issue.

### ii) Tree Germplasm Collection, Evaluation and Improvement

Duirng 2022-23, *Madhuca longifolia* (Mahua) was added in the arboretum. Beside this, in previous years to identify the indigenous and exotic multipurpose tree species, 94 + 54 species including 7 + 6 species of bamboos have been collected and are being evaluated for their growth pattern, phenology, insect pests and disease incidence, *etc.* Poplar germplasm bank consisting of 110 clones have been maintained at spacing of 80× 60 cm at the centre.

**Shisham coordinated trial**

Five locations (*viz.* Hissar, Ludhiana, Pantnagar, Ayodhya & Pusa) with 8 genotype selections (5 Pantnagar + 3 PAU). The measurements for the same genotype vary across different locations. This suggests that environmental factors specific to each location can impact the measured trait. Some potential selections to consider are, PS 38 in PUSA, PS 52 in Ludhiana and Ayodhya, PAUL-5 for Hisar 9 (based on DBH only) and PS 90 for Pantnagar (after only one year of growth).

### System Research

Identification of suitable varieties of soybean for the Agroforestry system on the basis of shade adaptive and population density response

The mean performance of soybean varieties were found to be significantly higher in the open farming system as compared to partially shaded environments except for plant height, the number of primary branches and biological yield which recorded significantly higher observations under shade. The sub subplot treatments affected only four traits as high plant population densities significantly favoured plant height, leaf area, biological yield while higher observation for seed yield per plant was reported in medium population densities. The treatment interactions revealed that the variety PS 1241 outperformed the rest of the varieties in both open farming and partially shaded conditions. A significantly positive and strong correlation with seed yield was recorded for biological yield, 100 seed weight, number of seeds per pod, harvest index and number of nodes per plant in soybean. These types of correlations could be kept in mind for practising indirect selection under productivity target breeding programmes in crop breeding for the Agroforestry system.

Analysis of physicochemical and biochemical properties of soils from the Open field ecosystem and Poplar-based agroforestry ecosystem in autumn and winter under different crops

All findings indicated that agroforestry systems enhanced the soil nutrients. The enhancement in soil organic matter by increased litterfall, tree root exudates, leads to increased microbial biomass in the soil which enhances the activity of several soil enzymes. Increased enzymatic activities are indicators of soil health and provide information about the nutrient status thus soil fertility of the soil. The interactions between soil enzymes and various nutrient present in soils are very important for soil fertility, however, these interactions seem complex and need further investigations. It was found that agroforestry system greatly enhances the soil carbon, nitrogen and potassium levels. However, the effect of agroforestry on phosphorous levels was not that prominent, still, the phosphorous levels in agroforestry were similar to fertilizer treated CRC soil. Thus, agroforestry has great potential as integrated nutrient management tool.

## ACHARYA NARENDRA DEVA UNIVERSITY OF AGRICULTURE & TECHNOLOGY, KUMARGANJ, AYODHYA

### Tree Germplasm Collection, Evaluation and Improvement

**Shisham clones:**

Five shisham clones from HAU, Hissar namely PP-09, PP-16, PP-21, PP-22 and PP-39 and local collections from Para Sultanpur, Baraipara, Ayodhya and Mai, Barabanki during 2016-2017. The highest tree height have been obtained in PP-39 (6.62 m) followed by PP-09 (5.58 m) and PP-21 (5.27 m). The maximum dbh was also recorded in the same clone PP-39 (14.72 cm) followed by PP-16 (11.53 cm) and PP-09 (11.14 cm). While in local collections Baraipara, Ayodhya performed better plant growth like tree height (5.94 m) followed by Para Sultanpur (5.61 m). Baraipara, Ayodhya clone showed higher dbh (11.26 cm) followed by Para Sultanpur (10.15 cm).

**Eucalyptus clones:**

Eucalyptus clones have been collected during the year

2010-2011, namely Eu-316, Eu-2135, Eu-3135, Eu-416A and Eu-416. The maximum tree height have been obtained in Eu-3135 (12.14 m) followed by Eu-2135 (11.71 m). Maximum dbh was recorded in same clone Eu-3135 (18.45 cm) followed by Eu-2135 (14.50 cm).

In shisham improvement project, PS-52 showed highest plant height (3.17m) followed by PS-54(2.53m) and L-1 (2.39 m). Higher dbh (8.50 cm) also recorded in same clone PS-52. The maximum number of branches (29) counted in PS-90 and L-1 (28). The higher crown spread (86.85 cm) was measured in PS-52 followed by PS-20 (78.40 cm).

**Agri-silviculture System**

As per paddy-mustard based sequence, significantly higher grain yield of paddy variety Sarjoo-52 (1.97 t $ha^{-1}$) was found under *Dalbergia sissoo* and mustard variety Varuna (1.04 t $ha^{-1}$) have been achieved under *Casuarina equisetifolia* based agri-silviculture system. The maximum urd grain yield in variety Narendra Urd-1 (0.51 t $ha^{-1}$) which found significantly superior over other varieties of Urd under Dalbergia sissoo based agri-silviculture system.

As per organic fertilizers based experimentation, the maximum grain yield of paddy var. Sarjoo-52 (2.07 t $ha^{-1}$) has been obtained with the application of FYM 10 t $ha^{-1}$ under *Dalbergia sissoo*, while higher grain yield of wheat var. HD-2967 (1.91 t $ha^{-1}$) was also recorded by the application of same treatments *i.e.* 10 t $ha^{-1}$ FYM under same system *i.e. Dalbergia sissoo* based agri-silviculture system.

Significantly higher turmeric rhizome yield (6.27 t $ha^{-1}yr^{-1}$) has been obtained due to application of 50% recommended dose of NPK (120:80:80 kg $ha^{-1}$) + 50% FYM dose (recommended dose 20 t $ha^{-1}$) as compared to other treatments under agri-silvi-horti system.

In the *Dalbergia sissoo* based silvi-pastoral system, the maximum annual green fodder yield was found for Pennisetum purpureum (Napier)-46.19 $ha^{-1}$, followed by Panicum maximum (32.68 t $ha^{-1}$) and *Brachiara mutica* (27.29 $ha^{-1}$). It is interesting to mention here that Napier grass (*Pennisetum purpureum*) is most important grass and demanded more by the farmers in our condition.

Under Eucalyptus based agroforestry system for Indo-gangetic plains, from plant growth performance, amongst 5 treatments including control (open area), the maximum tree height (9.72m) and dbh (14.69 cm) were recorded $T_1$ treatment (Moong-Wheat). The maximum number of branches (56) recorded in $T_2$ (Moong-Mustard) and crown spread (2.81 m) in $T_1$-Moong-Wheat. The higher Moong grain yield (0.46 t $ha^{-1}$) as *Kharif* intercrop was obtained in $T_1$ (Moong-Wheat) treatment as compared to $T_3$-Moong-Mustard (0.38 t $ha^{-1}$) under system, while in open area higher Moong yield (0.55 t $ha^{-1}$) was obtained as compared to system in $T_1$ treatment. The higher wheat grain yield as *rabi* intercrop (1.93 t $ha^{-1}$) was recorded in $T_3$ treatment in Urd-Wheat ($T_3$) under system, while in open area comparatively higher grain yield of Wheat (2.49 t $ha^{-1}$) was also observed in the $T_3$ treatment.

## Dr. RAJENDRA PRASAD CENTRAL AGRICULTURAL UNIVERSITY, PUSA SAMASTIPUR

### i) Evaluation of Different Genotypes of Shisham (*Dalbergia sissoo* Roxb.) for Agroforestry System in the Indo-Gangetic region

In the shisham (*Dalbergia sissoo*) genotype evaluation trial, the best performance was observed with PS-38 in the $6^{th}$ year of establishment which registered the maximum height (7.60 m), DBH (18.15 cm), and volume (0.158 $m^3$) closely followed by PAUL#1 genotype.

### ii) Evaluation of Different Clones of Poplar (*Populus deltoides* Bartr.) Plantations for their Growth and Productivity

Growth parameters for 6-year-old plantations of seven poplar clones showed the maximum plant height with PP 9-J1 (14.30 m) and G-48 (12.53 m). Both the poplar clones, G-48 (17.51 cm) and PP 9-J1 (15.23 cm) were also superior with respect to DBH. The maximum volume was also recorded with G-48 (0.151 $m^3$) followed by PP 9-J1 (0.099 $m^3$). These two clones also exhibited relatively higher biomass and hence are suggested for ensuring higher $CO_2$ mitigation (106.6–129.8 Mg $ha^{-1}$) and higher C sequestration rate (1.61 – 1.96 Mg $ha^{-1}$ $year^{-1}$).

### iii) System Research

Performance of Semal (*Bombax ceiba* L.) based agri-silvicultural system in calcareous soil.

Performance of turmeric under 7-year-old semal plantations showed the yield reduction of turmeric and it was higher (28.2%) in the higher-density plantation (5×2 m spacing) and lower (13.9%) in the lower-density plantation (5×5 m spacing). Volumes of the stem were also found significantly superior under the lower density of the plantation.

**Bamboo plantations in Dhab (riverside) area of Gandhak river**

To utilize the barren sandy soil of the Dhab area of Burhi Gandhak river, the bamboo plants are being irrigated with a sub-surface drip irrigation operated by a floating boat-mounted solar energy-based pumping system. At the age of the 4-year-old plantation, the overall survival was recorded at 80%. The height and girth of these bamboo plants showed almost 1.25 times more growth than that grown in control (*i.e.* plants grown without irrigation and fertilizer). The total net primary production and rate of carbon fixation were 60.51 and 24.86 Mg/ha/year, respectively.

## ORISSA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, BHUBANESHWAR

### i) Tree Germplasms Collection, Evaluation and Improvement

**EVALUATION OF TREE SPECIES**

Out of Seven entries of *Gmelina arborea* collected from three states of India *viz.* Odisha, West Bengal and Assam The entries of Durgaprasad (Odisha) was recorded significantly highest plant height (6.12 m), basal girth (27.68 cm) and crown spread (7.62 m) at 90 months after planting.

### ii) System Research

Relative performance of four Rhizome inter crops (Mango ginger, Turmeric, Colocasia and Arrowroot) was studied in agrisilvihorticultural system involving three major fruit tree species (Mango, Jackfruit and Cashew). Turmeric produced the highest net return of Rs. 4,34,920, Rs 3,86,250 and Rs 3,68,400 /ha/yr with BCR 3.41, 2.97 and 2.83 with three fruit trees *i.e.* Jackfruit, Mango and Cashew respectively followed by Mango ginger.

*Acacia mangium* with Setaria (height 18.5 m, DBH 17.8 cm and crown spread 13.3 m) after 90 month, however the maximum green forage yield was obtained from Guinea (16.2 t/ha) from three cuttings and Thin Napier was the next best with a yield of 14.5 t/ha . In the system approach, highest benefit: cost ratio based on Net return was obtained from Guinea grass (2.93) in association with *A. mangium*.

The *G. arborea* in agrisilvi system after 90 months of planting recorded the highest tree height & basal girth of (8.36 m and 41.24 cm) and *G. arborea* + cowpea-toria recorded the highest Arhar equivalent yield of 2,548 kg/ha and the net return of Rs. 1,27,820 /ha and BCR of 1.01.

In Mango + Turmeric agrihorticultural system, the yield attributes such as the fresh rhizome yield (651.42 g/clump), dry rhizome yield (127.02 g/clump), curing percent (19.5%) were maximum in the same treatment having RDF + VC + BF, however Curcumin percentage (7.23%) of rhizome was highest in the treatment having no organic and inorganic fertilizers. The soil microbial population *viz.* Azotobacter (548.43 x $10^4$cfu), Azospirillum (522.53 x $10^4$cfu) and fungal count (234.73 x $10^4$cfu) at 180 DAP were maximum in the same treatment having RDF + VC + BF. The maximum mango fruit yield (8.72 t $ha^{-1}$) was recorded highest in the treatment RDF + FYM + BF. The net returns (Rs. 70, 8050 $ha^{-1}$) and the B:C ratio (3.62) were maximum in the treatment having RDF + VC + BF.

*Tectona grandis* (Nuapada Provenance) with paired row planting of Pineapple was gave highest value of aboveground biomass(1,06,650 ton/ha), below ground biomass(26,625 ton/ha), total biomass of the system (1,33,275 ton/ha) ,carbon stock (66,638 Mg/ha) and $CO_2$ assimilation (2,44,561 ton/ha) followed by single row spacing of Pineapple 0.8×0.6 $m^2$ of Chandaka provenance .

## BIDHAN CHANDRA KRISHI VISHWA VIDYALAYA, RRS, JHARGRAM

### I) Tree Germplasm Collection and Evaluation

Out of 18 germplasms of *Gmelina arborea*, six superior germplasms (Acc. No. 6/05, 11/05, 1/05, 5/10, 6/10 and 1/10) are selected based on periodic biometric observations of their growth parameters. A total of 29 nos. of germplasms of *Acacia auriculiformis* are evaluated for genetically superior mother and establishment of seed orchard and four (Acc. No. 4/02, 1/05, 2/05 and 2/10) of them are selected.

### ii) System research

Effect of alley cropping and mulching on early growth of Gmelina- ber agroforestry system - Mulching improved the growth of Gmelina as reflected in DBH, height as well as crown spread. It has influenced shoot length, girth and fruit yield of ber also. Further, alley cropping of pigeon pea improved organic carbon, available nitrogen and phosphorus status in the Gmelina - ber agroforestry system. System return increased from Rs. 34073/- in Gmelina - ber to Rs. 42921/- with the inclusion of pigeon pea as intercrop and alley cropping and mulching increased system profit by 19%.

Studies on the growth and productivity of different intercrops grown within the row spaces of *Neolamarckia cadamba* - mango agroforestry system - Maximum wood volume yield (12.22 $m^3$/tree) was in sole *N. cadamba* and the lowest wood volume was in *N. cadamba* – mango. Maximum Mango fruit yield (7.04 t/ha) was recorded both in sole mango. The inclusion of silvi components and intercropping favoured the height of mango plants but reduced fruit yield. Pigeon pea grown within the rows of *N. cadamba* – mango-based agroforestry system recorded the highest values of available N (188 kg/ha), K (227 kg/ha), and available P (36.3 kg/ha). Organic carbon in this system varied from 3.03 g/kg in Sole mango to 3.86 g/kg in *N. cadamba* – mango - pigeon pea. Net return from the agroforestry system was higher in *N. cadamba* - mango + cowpea + toria (Rs 193500/ha) than *N. cadamba* – mango (Rs 178837/ha) or sole mango (Rs 147800/ha) or sole *N. cadamba* (Rs 39092/ha).

Studies on the growth and productivity of different intercrops grown within the row spaces of *Dysoxylum binectariferum* - mango – based agroforestry system - Analysis of soil after growing of intercrops indicated that Greengram - toria grown with *D. binectariferum* + Mango based agroforestry system was with highest values of

available N (311 kg/ha) and K (255 kg/ha), and highest value of available P (34.7 kg/ha) with pigeon pea. Organic carbon in this system varied from 4.20 g/kg in sole green gram + toria) to 5.2 g/kg in *D. binectariferum* + Mango + greemgram - toria. Among the *D. binectariferum* + Mango based agroforestry systems maximum net return (Rs. 27433/ha) and maximum Pigeon pea Eq. yield (AEY) 21.10 q/ha and maximum BCR of 3.01 with alley crops Cowpea – toria.

Studies on the growth and productivity of different intercrops grown within the row spaces of *Melia dubia* - *Citrus sinensis* – based agroforestry system – The plantation of *M. dubia – C. sinensis* was established in July 2022 at Regional Research Station (Red & Laterite Zone), BCKV, Jhargram – 721507 (22°45' N, 87°01' E and 9.75m above mean sea level) on sandy-loam (containing 43.9% sand, 49.8% silt, and 6.3% clay), degraded lateritic soil.

Studies on the effect of seed priming with selenium and ZnO nanoparticles on germination, and growth of *Gmelina arborea* – Seed priming improved germination and vigour attributes. Priming with either Se or ZnO-NPs alone or in combination reduced the time to start of emergence, time to reach 50% germination, and mean emergence time compared to the control, while emergence index and vigour index parameters improved over the control. Priming with selenite and selenate combination recorded higher shoot length compared to their single application. It was an all-three combination (ZnO-NPs + selenite + selenate) that produced the maximum root length of Gmelina seedlings.

Evaluation of Gmelina based Agri-silvicultural system (common experiment for humid and sub-humid zone) – *G. arborea* with cowpea-toria recorded the highest plant height (3.8 m), basal girth (6.8 cm), crown spread (171 cm) and estimated timber (0.010 $m^3$/tree) followed by *G. arborea* + *pigeon pea* and *G. arborea* + green gram – toria after forty-eight months of plantation. Organic carbon in this system varied from 0.34% in green gram – toria to 0.42% in cowpea – toria. Pigeon pea equivalent yield of *G. arborea* + cowpea - toria recorded the highest pigeon pea eq yield of 2227 kg/ha and a net return of Rs. 20410/ha and BCR of 2.24. Cultivation of legume as intercrop improved not only soil fertility but also provided an additional net return of Rs 20810/- from cowpea-toria as alley crops.

## BIRSA AGRICULTURAL UNIVERSITY,RANCHI

### i) Tree Germplasm Collection, evaluation and improvement

**Evaluation of Multipurpose Tree Species (MPTs) for Adaptability and Growth performance at Ranchi District**

After four years of plantation of multipurpose tree species, the maximum average height (9.51 m) was observed in treatment having species *Acacia auriculiformis* followed by species *Dalbergia sissoo* (4.54 m). Whereas, maximum DBH (7.72 cm) were observed in species *Acacia auriculiformis* followed by in species *Melia azedarach*. (4.99 cm). The maximum height and DBH increment were found in species *Acacia auriculiformis* (3.12 m) and (4.30 cm) respectively. Data on soils revealed that maximum improvement in soil pH (5.29), organic carbon (0.37), N and P 198.11kg/ha and 11.92 kg/ha respectively in Neem followed at par in Gamhar. whereas, maximum available potassium (98.32 kg/ha) is found in Karanj.

### ii) System Research

**Evaluation of *Gmelina arborea* based Agri-Silvicultural System**

After five years of establishment of plantation, Analyzed data of height increment of trees with different field crops revealed that significantly maximum height growth increment (0.78 m) was recorded in (Gamhar with Cowpea), followed by height growth increment (0.65 m) in treatment combination of (Gamhar with Black gram). Whereas, minimum height growth increment (0.42 m) was observed in treatment T4 sole Gamhar. So far as DBH increment is concerned that significantly maximum DBH (8.35 cm) and growth increment (0.75 cm) was recorded in (Gamhar with Cowpea) and minimum DBH growth increment (0.42 cm) was recorded in treatment sole Gamhar.

In *Kharif* season, Black gram equivalent yield (q/ha) was calculated for other two crops *viz.*, cowpea and Pigeon Pea. Significantly Black gram recorded maximum yield 8.28 q/ha in treatment combination T3 – *Gmelina arborea* + Black gram and minimum equivalent yield (4.83 q/ha) was recorded in *Gmelina arborea* + Cowpea. In Rabi, Significantly maximum yield of mustard was recorded 10.40 q/ha in *Gmelina arborea* + Mustard followed by sole mustard.

Significantly maximum soil pH (5.46), organic carbon percentage (0.38), available Nitrogen (199.33 kg/ha) and available Potassium (99.43 kg/ha), respectively was recorded in treatment combination Gamhar with *Pigeon pea* (*Cajanus cajan*). Whereas, maximum Phosphorous content was recorded in the treatment combination of Gamhar with cowpea *i.e.* 12.29 kg/ha. Higher net return was calculated in Gamhar+ Green gram-Mustard (Rs.101301) treatment combination whereas, minimum net return was in Sole Gamhar (Rs.22058). Similarly in term of B:C ratio, it was found in Sole Gamhar (15.71) followed by Sole Pigeon pea (4.38) and minimum B:C ratio was found in Sole Cowpea-Mustard (1.80)

**Performance of Fodder crops with Bakain (*Melia azedarach*) Tree Species under Silvi-Pastoral System**

After five years of experimentation, analyzed data of

height increment revealed that Bakain recorded maximum height growth increment (2.38 m) with *Stylosanthes hamata* followed by (1.93 m) height growth increment of Bakain with *Arachis glabrata*. Whereas, minimum height growth increment (0.64 m) in Bakain was observed in treatment combination Bakain with Bracharia. Maximum DBH growth increment in Bakain is concerned, it was found maximum (3.93 cm) with *Stylosanthes hamata* and minimum DBH growth increment (0.98 cm) was observed in Bakain with *Brachiaria mutica*. Fodder crop yield revealed that Bakain + Brachiaria grass yielded maximum (824.37 q/ha) fodder followed by Bakain + Hybrid Napier grass yielded 765.85 q/ha. Whereas, minimum fodder yield were recorded in sole Stylo *i.e.* 344.43 q/ha.

Significantly maximum soil pH (5.43) and available nitrogen (202.10 kg/ha) was recorded in treatment combination in Bakain + Stylo whereas, maximum organic carbon (0.36%) in Sole Charabadam and phosphorous content (16.45 kg/ha) was recorded in treatment combination Sole Brachiaria grass. Maximum available Potassium content was recorded in treatment combination Bakain + Charabadam (72.79 kg/ha). Significantly minimum soil pH was recorded in $T_5$ sole Bakain (5.12), organic carbon(0.27%) and available Nitrogen(158.98 Kg /ha) in Bakain + Brachiaria grass, $P_2O_5$ (14.27 kg/ha) in Bakain + Stylo and $K_2O$ was recorded in sole Bakain (49.47 kg/ha), respectively.

Economics of Bakain *(Melia azedarach)* based Silvopastoral system was calculated on the basis of selling rates of different produces of tree and grasses. The net return and B:C ratio were calculated for all the treatments. The higher net return and B:C ratio was found in Sole Charabadam (239528 and 14.09) followed by Bakain + Charabadam (148464 and 8.48) and minimum was found in Sole Bakain (905 and 1.13), respectively.

**Performance of field crops in Alley of Tephrosia**

Blackgram equivalent yield (q/ha) was calculated for all the four crops *viz.*, Soybean, Finger millet, Groudnut and Green gram. Significantly groundnut (var. BG-3) recorded maximum equivalent yield (20.98 q/ha) in treatment combination Tephrosia + Groundnut and minimum grain yield (5.10 q/ha) was recorded in Green gram (var. Pusa Vishal) in treatment Tephrosia + Greengram. After four years of establishment of Tephrosia hedgerow under Alley cropping based Agri-silviculture system, revealed that significantly maximum soil pH (5.64) and available potassium (134.83 kg/ha) was recorded in treatment combination in Tephrosia + Finger millet.

Maximum organic carbon (0.49%) and phosphorous content (14.63 kg/ha) was recorded in treatment combination Tephrosia + Soybean. Maximum nitrogen content was recorded in treatment combination Tephrosia + Ground nut. Net return and B:C ratio was found higher in treatment combination Tephrosia + Finger millet- Field pea (Rs. 188910 and 4.29) followed by Tephrosia + Groundnut-Lentil ( Rs. 125245 and 2.66) and minimum net return and B:C ratio was found in Tephrosia + Black gram-Mustard (Rs. 54198 and 1.20).

## CHAUDHARY CHARAN SINGH HARYANA AGRICULTURAL UNIVERSITY, HISAR

### i) Tree Improvement

Progenies of 18 CPTs of burma-dek (*Melia composita*) exhibited significant variability w.r.t growth characters in the field. At the age of seven years after plantation, MCB2 from Haryana exhibited highest diameter at breast height (23.6 cm) followed by MCPAU1 (22.8 cm) and MCS6 (19.9

Fourteen clones from Dr. Y.S. Parmar University of Horticulture & Forestry, Nauni, Solan observed for growth performance in field as multi-location trial. At the age of 8 years, dbh being the most prominent criteria in tree growth was recorded maximum (27.3 cm) in 9607 followed by clone 5503 (23.2 cm). Among different clones under study; clones 9607 (27.3 cm), 5503 (23.2 cm), T-59 (22.1 cm), 6503 (20.6 cm) and T-50 (20.6 cm) showed higher dbh indicating that these clones have lot of potential to produce utmost biomass in semi-arid regions and can be exploited in subsequent improvement programmes.

Coordinated trial of shisham with eight clones showed significant variability for growth traits. At the age of six years after plantation, the basal diameter differed significantly and ranged from 11.5 to 16.3 cm with the general mean of 13.9 cm. The highest basal diameter (16.3 cm) was observed in clone PS-38 closely followed by PS-90 (15.2 cm) and PS-20 (15.2 cm) and lowest (11.5 cm) in PS-54.

### ii) System research

After 6 years of age poplar planted at 8×3 m attained

significantly higher gbh (74.9 cm) than other spacings (7×3, 6×3, 5×3, 4×3 and 3×3 m) and it was about 16.82% higher than closer spacing (3×3 m). The maximum green fodder yield of sorghum (31.0 t/ha) was found under 8×3 m spacing of poplar plantation.

In national trial of eucalypts planted (Oct 30, 2016) at 8×2 m spacing, the seed yield of mustard (1.02 t/ha) was recorded in eucalyptus based agroforestry system however, it was found maximum in control (1.88 t/ha). The reduction in yield of mustard was 45.74% under eucalypts based agroforestry system over control (sole crop).

Significantly higher kinnow fruit weight (225.3 g), juice content (118.5 g), peel weight (115.3 g), TSS (8.85) and phenolics (1.22%) were recorded under agri-horti system than agri-silvi-horti system, however, the total sugar content (6.87%) was found higher under agri-silvi-horti system as compared to agri- horti system.

Eight years old poplar and eucalypts planted on field bunds resulted significant reduction in green fodder yield of sorghum as sown in East-West and North-South bund planted poplar and eucalypts at different distances from tree line. On an average, the maximum green fodder yield.

## SRI KARAN NARENDRA AGRICULTURE UNIVERSITY, RRS, FATEHPUR SHEKHAWATI

### i) Survey, Diagnostic and Design

This year survey was undertaken in some area of Sikar, Jhunjhunu, Bikaner and Churu and seeds from selected trees of *P. cineraria* were collected and sown in nursery for evaluation. Pearl millet, Sesamum, Groundnut, Greengram, Clusterbean, Cowpea and Mothbean are the main crops of the Kharif season. Wheat, Barley, Mustered and Gram are grown as irrigated crops in Rabi season. *Ailanthus excelsa* trees planted on boundary of the farm and traditionally *Prosopis cineraria, Tecomella undulata, Acacial nilotica, A. leucoploea,* and *A. nilotica* variety cupresiform is found in agricultural fields. *Capparis deciduas, Acacia tortilis, Prosopis juliflora* found in the wasteland and panchayat land. Some progressive farmers planted Aonla, Beal, Pomegranate, Ber, Citrus species as horti-agriculture models. Some farmers planted *Acacia senegal* local known as khairi on farm boundary as live fencing to protect the farm from animals.

### ii) Tree Germplasm Collection, Evaluation and Improvement

Growth performance of different provenances of *P. cineraria* (Rajasthan) result revealed that the Raj 6 is performing better than other provenances in mean tree height (1.10 m) and mean collar diameter (2.5 cm) after 7 years of growth.

Growth performance of 21 years old *Prosopis cineraria* PGC-2 (Bhuj) was performing better with mean tree height 3.1 m and mean dbh 12.20 cm than other provenances of Gujarat.

Growth performance of 19 years old plus trees of *P. cineraria* result revealed that maximum tree height and dbh registered for PCF 15, 4.65 m and 12.5 cm, respectively.

### iii) System Research

In common experiment *A. excelsa* based agri-silviculture system under rainfed conditions the the average height and collar diameter registered in the range of 4.5 m to 2.5 m and 5.0 cm to 25.0 cm, respectively after 6 years of growth. In intercropping the highest yield in sol cropping system recorded in clusterbean (550 kg/ha) followed by cowpea (456 kg/ha) and green gram (450 kg/ha) and with tree same trends of crops yield clusterbean, cowpea and greengram recorded *viz.*, 466 kg/ha, 397 kg/ha and 285 kg/ha, respectively.

Evaluation of arid pulses under *H. binata* based agri-silviculture system maximum yield recorded in sole cow pea 625 kg/ha and with the tree highest yield also recorded for cow pea 541.67 kg/ha.

Effect of potting mixtures on germination, growth and survival of *Ailanthus excelsa* experiment the shoot length of *Ailanthus excelsa* was significantly influenced by potting mixtures and maximum shoot length (26.70 cm and 31.30 cm) was recorded in the soil: vermi (50:50) potting mixture followed by 100% soil (25.90 cm and 29.70 cm), respectively at 90 and 120 days after sowing of seeds. Number of leaves per plant and survival percentage was significantly affected by different growing media. The number of leaves per plant (3.19 and 3.34) and maximum survival percentage (60.92 and 54.92) after 90 and 120 days sowing were observed in soil: vermi (50:50) followed by 100% soil potting mixture.

An experiment was conducted to find out the effect of different growing media and containers on seedling vigour of *Prosopis cineraria* (L.) in arid climate conditions result revealed that maximum germination percentage 70.33% recorded after 15 days germination in 3:1:1 (Coco peat : Perlite : Vermiculte) in polythene bags (250 X 150 mm) in comparison to other treatments.

Effect of different growing media on germination, growth and survival of *Tecomella undulata* seedlings the germination percentage and survival percentage were significantly influenced by different growing media and maximum germination percentage was recorded 41.38 and 77.81% in $T_{10}$ : 1 : 3 : 3 and $T_4$ : 1 : 2 : 0 growing media (Soil: Sand: FYM) after 5 and 15 days of seed sowing. Highest survival percentage was observed in $T_6$ : 1 : 2 : 2 growing media *viz.* 63.67, 58.67 and 51.14% after 90, 120 and 150 days of seed sowing. Highest no. of leaves per

plant recorded (3.60, 3.87 and 4.12) and shoot length (15.22 cm, 16.87 cm and 19.64 cm) also recorded in $T_6$ : 1 : 2 : 2 growing media (Soil: Sand: FYM).

Effect of irrigation scheduling and mulching on establishment of budded Khejri (*Prosopis cineraria*) orchard the highest plant height, root collar diameter and number of branches per plant recorded 41 cm, 6.38 cm and 2.44, respectively in treatment (irrigation after 15 days with mulch) after six month of transplanting of seedlings in field.

Long term effect of different agroforestry systems on dynamics of physicochemical properties of soil result revealed that soil pH under agroforestry systems was declined significantly and lowest pH was recorded in *Acacia tortilis* based agroforestry system *i.e.* 7.41, 7.65 and 7.77 as compared to open field 8.92, 8.85 and 8.80 at the depth of 0-15 cm, 15-30cm and 30-45 cm, respectively. However, a significant improvement in organic carbon content was found in *Prosopis cineraria* base agroforestry system *i.e.* 0.45, 0.24 and 0.21% as compared to control 0.1, 0.07 and 0.07%.

In the experiment the effect of different agroforestry systems on biomass and carbon stock the highest soil organic carbon stock was recorded in *Tecomella undulata* + *Cenchrus ciliaris* based Silvi Pasture system *i.e.* 23.90 ton/ha followed by *Acacia tortilis* based forestry system *i.e.* 21.34 ton/ha. The highest carbon stock recorded in *Cenchrus ciliaris*+Nutans based Silvi pasture System *i.e.* 2.10 ton/ha followed by *Tecomella undulata* + *Cenchrus ciliaris* based agroforestry system.

## SARDARKRUSHINAGAR- DANTIWADA AGRICULTURAL UNIVERSITY, SARDARKRUSHINAGAR

### I) Tree Germplasm Collection, Evaluation and Improvement

Under old arboretum, Karanj (*Pongamia pinnata*) had cent percent survival, while anjan (*Hardwickia binata*) exhibited maximum height (14.50 m) whereas, ardusa (*Ailanthus excelsa*) exhibited highest collar diameter (66.24 cm). Further in 2007, 46 tree species, fruit species and shrubs were planted in a new arboretum under rainfed conditions. Maximum plant height (18.23 m) was recorded under eucalyptus and maximum collar diameter (47.27 cm) was recorded under ardusa (*Ailanthus excelsa*).

The evaluation of 10 plus trees progenies and 17 provenances of neem exhibited maximum height in plus tree progenies of neem, the progeny SKN-7 exhibited maximum plant height (14.27 m), whereas SKN-7 exhibited highest collar diameter (44.77 cm). Out of 17 neem provenances collected from different region of the state, provenance from Bharuch recorded highest (12.33 m) plant height and collar diameter (41.40 cm). Plant canopy N-S: 11.50 m was higher in SKN-4 and E-W: 13.80 m in SKN - 4, Provenance from Bharuch recorded maximum plant canopy (9.35 m N-S) and Vasda recorded maximum plant canopy (9.45 m E-W) and the highest Nimboli ranking in Godhara provenances (81.67%).

Evaluated thirty progenies of plus trees of neem under rainfed conditions. Among these Progeny No. 2 gave significantly higher plant height (11.63 m).

*Ailanthus excelsa* germplasm evaluation studies in rainfed condition revealed that among the thirty germplasm of ardusa Mithivavadi village seed sources is coming out to be the best performing in collar diameter (30.04 cm).

### ii) System Research

Maximum grain and straw yield (500 and 1800 kg $ha^{-1}$ respectively) of pearlmillet and grain yield (500 kg $ha^{-1}$) of amarathus crop in the pearl millet - amaranthus crop sequence were observed in middle part of the plot. In boundary plantation of ardusa + neem, ardusa plantation has maximum plant height (14.08 m) and plant collar diameter (51.91 cm) in south side. Whereas, in case of neem plantation, maximum plant height (8.40 m) was recorded in north direction and plant collar diameter (22.99 cm) was recorded in south direction.

During fifth year of ardusa based medicinal plants agroforestry system significantly the highest intercrop plant height was noted under the treatment of ardusa + kalmegh (59.93 cm). Significantly the highest Isabgol equivalent yield was recorded under the treatment of Kalmegh sole (57.97 kg/ha).

Melia + legume based agroforestry system, the significantaly highest seed yield (898 kg/ha) was observed under the treatment of Black gram sole and straw yield (2828 kg/ha) was observed under the treatment of cowpea sole and maximum tree height was observed under treatment of Melia + Clusterbean.

## MAHATAMA PHULE KRISHI VIDYAPEETH, RAHURI

### I) Collection, Evaluation and Maintenance of Germplasm

Among all the germplasm evaluated for various characters, *Khaya grandiflora* recorded highest plant height (25.95 m), collar diameter (60.00 cm), DBH (49.04 cm) and bole height (12.10 m).followed by *Anogeissus latifolia, Acacia tortilis* and *Terminalia bellirica* were also found promising for the growth characters.

Progeny of RHRAN-1 provenance recorded significantly highest plant height (15.25 m), collar diameter (48.10 cm), DBH (42.73 cm) and bole height (4.65 m) at the age of Twenty one year over rest of the provenances. The entry Sel-117 recorded significantly highest plant height (10.40 m), collar diameter (37.60 cm) and DBH (27.10 cm) whereas, where as the entry Selection 105 recorded highest bole height (4.70 m) among the various genotypes.

The *Acacia nilotica* provenance RHRAN-36 recorded significantly highest plant height (11.30 m) but at par with all the entries studied. The entry RHRAN-57 recorded significantly highest collar diameter (30.90 cm) and DBH (25.70 cm) but at par with all the entries. The entry RHRAN-6 recorded significantly highest bole height (4.90 m) whereas the entry RHRAN-41 recorded highest number of branches (7.20).

During tenth year of second coppice, The entry SRY-16 recorded significantly highest plant height (16.50 m), collar diameter (18.10 cm) and DBH (19.65 cm) over all the entries. Among the coppice of different eucalyptus clones, SRY-6 recorded significantly highest no. of coppice (3.50) but at par with all the entries studied.

### ii) System Research

The Pulses fodder system economics based on Sorghum equivalent yield (*Rabi* fodder) revealed that among all the treatments under investigation higher productivity $qh^{-1}$, GMR, NMR and B:C ratio (376 $qha^{-1}$, Rs. 74292, 20892 and 1.38) respectively was obtained in treatment $T_8$ (Sole crop Cowpea + Fodder Sorghum). In regards with intercrops based on sorghum equivalent yield higher productivity $qh^{-1}$, GMR, NMR and B:C ratio (371.46 $qha^{-1}$, Rs. 73660, 20260 and 1.39), respectively was obtained in $T_2$ (Teak + Cowpea + Fodder Sorghum). In terms of gross monetary returns significantly highest GMR was obtained in $T_8$ (Sole crop Cowpea + Fodder Sorghum) Rs. 74292. It was at par with $T_2$ (Teak + cowpea-fodder sorghum) Rs.73660.

The application of 150:80:80 g N: P: K plant produced higher bamboo height, culm and culmp girth and number of culm.

## Dr. PANJABRAO DESHMUKH KRISHI VIDYAPEETH, COA, NAGPUR

### i) Tree Improvement

Estimation of biomass productivity of different bamboo species (7 yrs old) showed that highest total biomass $culm^{-1}$ was recorded by *Bambusa bamboose* (25.91 kg) followed by *Bambusa vulgaris* (22.44 kg). Highest total biomass was recorded by *Bambusa bamboose* (Katang) (238.37 t $ha^{-1}$) followed by *Dendrocalamus strictus* (158.09 t $ha^{-1}$).

In another set of experiment on morphological and biomass productivity evaluation commercial bamboo species (30 month old), highest total biomass $culm^{-1}$ was recorded by *Dendrocalamus* as per (9.68 kg) followed by *Bambusa vulgaris* (green) (9.02 kg). Highest total biomass $clump^{-1}$ was recorded by *Thyrsostachys olivery* (70.74 t $ha^{-1}$) followed by *Bambusa pallida* (56.52 t $ha^{-1}$).

As regards evaluation of high yielding clones of *Melia dubia* under agrisilviculture system, highest tree bole height was attained by *Melia dubia* clone PDKV/MTP/4 (4.83 m) followed by PDKV/MTP/8 (3.60 m). Highest collor girth (80.33 cm), tree GBH (66.00 cm), woody volume $tree^{-1}$ (0.26 $m^3$), woody volume (105.27 $m^3$ $ha^{-1}$), total biomass (55.48 t $ha^{-1}$) and total carbon sequestration (27.74 t $ha^{-1}$) was attained by *Melia dubia* clone PDKV/MTP/5 followed by PDKV/MTP/6 and PDKV/MTP/4.

In an experiment on morphological and biomass productivity evaluation of commercial bamboo species under agrisilviculture system (12 month old), highest number of new culm $clump^{-1}$ was recorded by *Bambusa cacherensis* (8.33) followed by *Dentrocalmus stockssi* (6.67). Highest number of total culm $clump^{-1}$ was recorded by *Bambusa polymorpha* (12.00). Highest clump diameter was recorded by *Bambusa polymorpha* (51.67 cm) followed by *Dentrocalamus stockssi* (51.33 cm).

### ii) System Research

**Agroforestry system developed on the basis of allotted MPTS**

In an experiment on growth and productivity of trees species under citrus based Agroforestry System it was observed that highest cowpea grain yield (4.58 q $ha^{-1}$), straw yield (9.08 q $ha^{-1}$) and harvest index (33.52 %) was recorded under sole cowpea cropping followed by Nagpur mandarin + Intercrops (cowpea- mustard). Highest mustard grain yield (10.19 q $ha^{-1}$), straw yield (19.50 q $ha^{-1}$) and harvest index (34.32%) was recorded under sole mustard cropping followed by Nagpur mandarin + Intercrops (cowpea- mustard). Highest tree GBH (63.42 cm), tree height (8.33 m), tree volume $ha^{-1}$ (58.17 $m^3$ $ha^{-1}$), total standing biomass (62.01 t $ha^{-1}$) and total carbon sequestration (31.01 t $ha^{-1}$) was recorded by *Ailanthus excelsa* followed by Tectona grandis.

In an experiment on effect of fertilizers on growth and yield of Bamboo *B. balcooa* – Bhima under field condition, it reported that, highest culm height was attained in treatment T3 (5.45 m) followed by T4 (5.14). Maximum number of new culm $clump^{-1}$ was recorded by treatment T3 (3.15) followed by T4 (3.38). Highest number of total culm $clump^{-1}$ was recorded by treatment T5 (8.13). Highest clump diameter (46.00 cm), highest weight of branches $culm^{-1}$ (5.02 kg), weight of culm (6.85 kg), total biomass $culm^{-1}$ (11.87 kg) was reported in treatment T6. Soil fertility status was improved with the application of fertilizer.

In an experiment on effect of fertilizers on growth and yield of Manga Bamboo (*D. stockssi*) under field condition, it resulted that, highest culm height (5.90 m), new culm $clump^{-1}$(8.88), total culm $clump^{-1}$ (24.38) was attained in treatment T6. Highest weight of culm (1.989 kg), total biomass $culm^{-1}$ (3.105 kg) was recorded by treatment T4 followed by T5. Highest number of culm $clump^{-1}$ (24.38) and total biomass (27.539 t $ha^{-1}$) was recorded by treatment T6

followed by T4 (15.25 t $ha^{-1}$). Soil fertility status was improved with the application of fertilizer.

In an experiment on use of growth regulator in bamboo, it revealed that the, highest height of tiller (32.40 cm), collor diameter of tiller (6.60 mm), weight of rhizome per sapling (0.330 gm), root biomass weight per sapling (0.255 gm) and survival percentage (89.93%) was recorded in treatment of IBA 2000 ppm. Highest number of tiller (3.80) was attained in treatment of IBA 2500 ppm

## JAWAHARLAL NEHRU KRISHI VISHWA VIDYALAYA, JABALPUR

### i) Tree Improvement

In the Shisham (*Dalbergia sissoo*) provenance trial seven provenances collected from different locations of country. At the age of 12½ years, provenance received from NRC Jhansi (T7) recorded higher plant height (1049 cm), collar diameter (223 mm), dbh (184 mm) and proved superior over other provenances.

### ii) System Research

In *Dalbergia sissoo* based agroforestry system with marigold, the highest flower yield of 145.80 q $ha^{-1}$ was observed under open condition and proved significantly superior over 50% and 25% pruning but at par to 75% pruning. In integrated nutrient management practices, green manuring + enriched vermicompost @ 2 t $ha^{-1}$ gave flower yield of 149.29 q $ha^{-1}$ with net return of Rs 213733 $ha^{-1}$. The managed horti-silviculture system gave Rs. 242193 $ha^{-1}$ as compared to crop alone Rs 212900 $ha^{-1}$ and tree alone Rs. 43372 $ha^{-1}$.Similarly in rabi season Dalbergia sissoo + coriander based horti-silviculture system, maximum herbage yield of 5.86 g $plant^{-1}$ and 1954.12 kg $ha^{-1}$ was recorded under open closely followed by 75% and 50% pruning and proved superior over 25% and no pruning. The green manuring + enriched vermicompost @ 2 t $ha^{-1}$ proved beneficial and gave herbage (green leaf) yield of 2210 kg $ha^{-1}$ with net return of Rs. 54691 $ha^{-1}$ under Dalbergia sissoo. Whereas managed agroforestry system recorded higher monetary returns of Rs. 82197 $ha^{-1}$ as compared to crop alone (Rs. 49121 $ha^{-1}$) and tree alone Rs. 43372 $ha^{-1}$.

*Gmelina arborea* + greengram- mustard was recorded the highest arhar equivalent yield of 1533.9 kg $ha^{-1}$ as compared to sole arhar yield of 926.4 kg $ha^{-1}$. In *Gmelina arborea* based agrisilviculture system, the highest plant height (494.47 cm), collar diameter (95.07 mm) and dbh (72.84 mm) was recorded in sole *G. arborea* at the 6½ year after planting. Among the *Gmelina arborea* based agrisilvicultural system, *Gmelina arborea* + greengram - mustard was recorded the highest net return of Rs. 72955 $ha^{-1}$ and B:C ratio of 2.90 as compared to sole arhar which fetched the NMR of Rs. 46116 $ha^{-1}$ and B:C ratio of 2.57 per rupees investment.

In mango based agrihorticulture system, raised bed planting of soybean showed its superiority over ridge and furrow method as well as line showing with respect to seed (1010.70 kg $ha^{-1}$) and straw yields (2662.99 kg $ha^{-1}$) and raised bed planting fetched highest net returns of Rs. 31756 $ha^{-1}$ with B:C ratio of 3.05. Soybean variety JS 20-116 recorded seed (952.60 kg $ha^{-1}$) and straw yields (2497.55 kg $ha^{-1}$) and fetched highest net returns of Rs. 29948 $ha^{-1}$ with B:C ratio of 2.93 and proved significant superior over JS – 2069. In mango based agrihorticultural system highest seed and straw yields of 1151 and 2515 kg $ha^{-1}$ were recorded in variety JLS-66 and recorded highest monetary returns of (Rs. 45521 $ha^{-1}$) followed by JLS-27 (1001 kg $ha^{-1}$ and 2193 kg $ha^{-1}$).

Hand weeding at 30 DAS recorded the highest seed and straw yields of 1165 and 2446 kg $ha^{-1}$ and proved superior over application of pendimethalin @ 1000 ml $ha^{-1}$ as PE and weedy check. Whereas, net returns of Rs. 42965 $ha^{-1}$ was recorded under hand weeding at 30 DAS. Application of sulphur to linseed under mango plantation @ 40 kg $ha^{-1}$ recorded the highest seed and straw yields of 11.20 and 24.59 q $ha^{-1}$ which recorded the net monetary returns of Rs. 39362 $ha^{-1}$ with the highest B:C ratio of 3.03.

In *Dalbergia sissoo* based agrisilviculture system, planting of mustard as SMI along with application of sulphur @ 40 kg $ha^{-1}$ produced seed yields of 1221.20 kg $ha^{-1}$ with net returns of Rs. 23355 $ha^{-1}$.

Early planting (12 Nov.) of wheat variety GW-322 under *Millettia pinnata* gave grain yield of 47.51 q $ha^{-1}$ with harvest index of 40.37%. The agroforestry system sequestrated 171.71 t $ha^{-1}$ carbon.

The physio-chemical properties of soil were studied under different agroforestry systems and found that the improvement in soil organic carbon from 0.46 to 0.78, 0.48 to 0.64, 0.43 to 0.64 and 0.43 to 0.58 percent under *Gmelina arborea* (Pigeon pea fallow, cowpea-mustard, greengram-mustard), Dalbergia (rice-wheat and rice – mustard), Mango (millets-linseed, mango + soybean-linseed) and Guava (rice-wheat, green gram-wheat) based agroforestry systems, respectively. Similarly, the available N, P and K status of soil was also increased over their initial status in Gmelina during 6½ years was 198 to 274, 11.2 to 12.8 and 318 to 330 kg $ha^{-1}$, respectively. Whereas, in *Dalbergia sissoo* based agroforestry system the status of N improvement was negligible (208 to 2019 kg $ha^{-1}$) during 24 years. On the other hand, P and K both improved markedly from 12.5 to 16.8 and 336 to 394 kg $ha^{-1}$, respectively.

Under Mango (millets-linseed, soybean-linseed) based agrihorticulture system recorded improvement in status of N 21.5 kg, 2.0 kg P and 59 kg K $ha^{-1}$ during 5 years. Similarly, Guava (rice-wheat and greengram-wheat) recorded 30 kg

N, 4.3 kg P and 42 kg K improvement in NPK over their initial status of 193.5, 10.8 and 299 in mango based and 186, 11.5 and 318.0 kg NPK $ha^{-1}$ in guava based systems, respectively.

## PROFESSOR JAYASHANKAR TELANGANA STATE AGRICULTURAL UNIVERSITY, HYDERABAD

### Survey, Diagnostic and Design

Diagnosis and Design (D & D) survey of agroforestry systems in Central Telangana Zone (CTZ)

Most of the Agroforestry farmers in Bhadradri Kothagudam district in Telangana state are following Eucalyptus based agri-silvi system or silvi-pastoral system. Farmers prefer to grow cotton/chillies during 1st year; Sesame during 2nd year; Fodders or Pulses (mungbean, urdbean, cowpea *etc.*,) during 3rd and 4th year. Most of the absentee land lords are adopting eucalyptus alone as block plantation, while part time farmers/full time farmers are adopting eucalyptus + crops. Farmers are able to reap 62.5 t $ha^{-1}$ yield from eucalyptus under rainfed conditions, while 150-175 t $ha^{-1}$ under irrigated conditions.

### Tree Germplasm Collection, Evaluation and Improvement

The trial on collection and evaluation of neem germplasm was initiated during *Kharif* 2000. Among 42 lines collected during *kharif* 2000, only 11 were planted in the main field during *kharif* 2001. Of these 11 lines, the one collected from Ghatkesar of Ranga Reddy district designated as Line-42 proved promising. Another set of 12 collections were made during *kharif*, 2003. These were transferred to main field during *Kharif*, 2004. Of these collections, the line collected from Palepalli designated as Line-7 was proved superior.

The first set of neem germplasm evaluation trial was laid out during 2001 with 13 entries (12 lines + tissue cultured line and control). All entries performed better than the control. In respect of plant height, the Line - 42 registered the higher plant height of 16.3 m and is followed by line - 4 (16.2 m) and Line -35 (15.5 m). In respect of girth of plant, the Line - 42 recorded the highest mean value of 82 cm followed by Line - 44 (72 cm) and Control (66.0 cm).

The second set of Neem germplasm entries (12 Nos.) were collected and planted in 2002. Among these lines, L-15 recorded higher mean plant height of 12.9 m and girth of 96 cm. This was followed by line 10 (11.6 m) and line L-3 (9.1 m) for plant height. In case of mean girth, L-15 (96 cm), L-1 (95 cm) and L-3 (74 cm) recorded higher value.

In Neem multi location trial (MLT), among the 11 germplasm lines received from All India Coordinated Research Project on Agroforestry, Jhansi-U.P, Line-101 recorded higher mean tree height and girth (9.3 m, 74 cm) followed by Line-105 (8.5 m, 67 cm) and Line-114 (8.5 m, 57 cm).

In Pongamia germplasm, the entry SRJ-10868 recorded highest plant height (11.3m) followed by SRJ-44 (9.7 m), SRJ-45 (9.5 m). In respect of DBH, the entry SRJ-39 recorded highest DBH of 92 cm followed by SRJ-10868 (78 cm) and NGSR- 27 (68 cm).

Between the two *Melia dubia* clones, MTP-5 performed better with more height (13.15 m) and girth (56.7 cm) after 7 years of planting.

### System research

In the trial "Integrated Nutrient Management of different fodder crops in custard apple based horti-pastoral system" conducted during 2022-23, significantly higher herbage yield (18.5 t $ha^{-1}$) was obtained with *Panicum maximum* as compared to that of *Cenchrus ciliaris* (13 t $ha^{-1}$). Further, higher net returns and B:C ratio were obtained when custard apple was integrated with *Panicum maximum* (Rs. 37808 $ha^{-1}$, 1.98) over *Cenchrus ciliaris* (Rs. 27022 $ha^{-1}$, 1.7). Among nutrient management practices, application of 100% RDF to grasses resulted in significantly higher herbage (18.2 t $ha^{-1}$) and dry fodder yield (2.7 t $ha^{-1}$) besides higher net returns (Rs. 43,007 $ha^{-1}$) and B:C ratio (2.15) as compared to all other treatments. All the integrated nutrient management techniques were at par and significantly out yielded control, but significantly inferior to RDF.

The results of the experiment entitled "Response of different fodder grasses grown under *Melia dubia* based Silvi-pastoral system" revealed that the growth parameters like tree height, girth, total biomass, carbon stock and C-sequestration of *Melia dubia* were not significantly affected by raising of different fodder crops. When grown in integration with *Melia dubia*, the performance in terms of yield and economics of fodder crops was in the order of CO-5>CO-4>Guinea grass>APBN-1>Anjan grass>Multicut sorghum> Marvel grass. While, among sole crops, it was in the order of CO-4>APBN-1>CO-5>Guinea grass>Anjan grass>Multicut sorghum>Marvel grass. The yield reduction due to integration with *Melia dubia* ranged from 5-22% (5% in CO-5 to 22% in multicut sorghum). Further, reduction in net returns ranged from 12.9% in CO-5 and 83.8% in multicut sorghum).

The results of field experiment entitled "Response of bamboo to graded levels of fertilizer under irrigated conditions" revealed that the growth parameters like girth and height of *Bamboosa tulda* and *Bamboosa balcooa* didn't differ significantly in one year old plantation. But, no.of culms in *B. tulda* (7) were significantly higher than *B. balcooa* (4). It was also observed that the no. of branches per culm were significantly higher in *B. balcooa* (72) when compared to *B. tulda* (55). Among the fertilizer levels, $T_5$ (120: 48: 96 N - $P_2O_5$ - $K_2O$ g $plant^{-1}$ $year^{-1}$)and $T_7$ (160: 64:

128 N - $P_2O_5$ - $K_2O$ g plant$^{-1}$ year$^{-1}$) recorded significantly higher height (2.7m & 2.98m, respectively) over other treatments. Girth was significantly higher (6.27cm) in $T_7$ (160: 64: 128 N - $P_2O_5$ - $K_2O$ g plant$^{-1}$ year$^{-1}$) which on par with $T_2$, (120 : 24: 48 N - $P_2O_5$ - $K_2O$ g plant$^{-1}$ year$^{-1}$), $T_6$ (140 : 56 : 112 N - $P_2O_5$ - $K_2O$ g plant$^{-1}$ year$^{-1}$) and $T_5$ (120: 48 : 96 N - $P_2O_5$ - $K_2O$ g plant$^{-1}$ year$^{-1}$). The number branches per culm and no. of branches per node were significantly more in $T_7$ (83 & 9 respectively) over other treatments

In the experiment entitled "Performance of different commercial crops in marginal lands of *Melia dubia* based Agri-silvi system", the growth parameters like tree height, girth, total biomass, carbon stock and C-sequestration of *Melia dubia* were not significantly affected due to raising of different intercrops. The percent yield reduction in intercrops grown under *Melia dubia* when compared to respective sole crops were lowest in vetiver (-2%), ocimum, coriander (4%) followed by lemon grass (9%) and citronella (8%). The percent yield reduction was higher in cluster bean (75%) and aloe vera (25%) and also the net returns were also not economical compared to respective sole crops. The gross returns, net returns and B:C ratio in intercrops grown under *Melia dubia* were highest in lemon grass ((Rs. 268533 ha$^{-1}$, Rs. 127663 ha$^{-1}$, 4.81), citronella (Rs. 227600 ha$^{-1}$, Rs. 86730 ha$^{-1}$, 4.08), vetiver (Rs. 178000 ha$^{-1}$, Rs. 127000 ha$^{-1}$, 3.49), coriander (Rs. 117860 ha$^{-1}$, Rs. 82860 ha$^{-1}$, 3.37) and are comparable to sole crops. Thus, vetiver, ocimum, coriander, lemon grass and citronella are can be profitably grown as inter crops under *Melia dubia* based Agri-silvi system after 4 years of planting under shade. Soil parameters like OC content, available nitrogen, phosphorous and potassium in intercrops recorded higher values when compared to sole crops and this is due to leaf litter addition from the tree.

The agroforestry area was estimated in two districts of Telangana state using recognition software. It was found that the agroforestry area of erstwhile Khammam district is 30,038 ha, covering 1.80% of the total district geographical area (16,02,900 ha). Similarly, the agroforestry area in erstwhile Warangal district was estimated to be 3,753.44 ha which accounts for 0.29% of total district geographical area (12,84,600 ha).

Soil properties in different vegetation blocks of Agri biodiversity park, PJTSAU were studied. The soil microbial status in the root zone of different tree species was observed to be in the following order,

- Azotobacter count : Simaruba > Teak > Acacia
- PSB count : Simaruba > Teak > Acacia > Pterocarpus
- Pseudomonas count : Teak >Simaruba> Pterocarpus > Acacia
- Actinomycetes count : Ficus >Bahunia = Pterocarpus
- Fungi count : Tamarind > Teak >Bahunia
- Bacterial count : Neem > Mahua > Teak

Among tree species studied, significantly higher soil organic carbon was observed in root zone of mahua (0.84%) and teak (0.84%) at 0-15 cm depth over all other tree species. Significantly positive correlation is found between organic carbon and PSB, pseudomonas, actinomycetes & bacteria. This may be due to availability of more organic matter as food to microbes.

## Dr. BALA SAHEB KONKAN KRISHI VIDYAPEETH, DAPOLI

### Survey, Diagnostic and Design

Conducted Diagnostic and Design Survey in Sondeghar village of Dapoli Tahsil of Ratnagiri District, Maharashtra and identified some prominent agroforestry system on farmers field *viz.* homestead gardening, nursery management, coconut based multi-layered system, *Terminalia tomentosa* bunds plantation in paddy field, mango based horti-agricultural systems and cashew based horti-agricultural system.

### Tree Germplasm Collection, Evaluation and Improvement

Collection and conservation of species of Bamboo, *Garcinia mangostana* (Mangosteen), *Dalbergia latifolia* (Shisham), *Morus alba* (Mulberry), *Melia dubia, Gmelina arboria, Tectona grandis, Garcina indica, Mellittia pinnata, Acacia mangium, Santalum album, Anacardium occidentale, etc.* was done at the centre.

### System Research

Bamboo (*Dendrocalamus stocksii*) based Turmeric (*Curcuma longa*), Finger millet (*Eleusiane coracana*), Ginger (*Zingiber officinalis*) and Alpinia spp. (*Alpinia galanga*) agroforestry systems resulted in maximum yield at 8 m x 8 mspacing and Bamboo + Turmeric agroforestry system was found to be most beneficial compared to other systems.

*Bridelia retusa* (Asana) + mulberry agroforestry system recorded highest biomass yield (47.028 t/ha) and maximum arial fruit yam yield (3200 kgha$^{-1}$) was recorded under arial yam + mulberry agroforestry system.

The maximum growth performance of sandal (DBH, height, CAI) was recorded under Sandal + Jackfruit followed by Sandal + Jambhul agroforestry system. The early fruit yield was recorded by Guava, Karonda, Jam, Amla and Kokam under sandal based agroforestry system.

Integration of RDF along with vermicompost @ 3 kg tree$^{-1}$significantly improved soil fertility and overall growth of sandal. While, the aapplication of 100% RDF+ Vermicompost @ 7.5 t/ha + PSB @ 5 kg ha$^{-1}$ followed by 75% RDF+ Vermicompost @ 7.5 t/ha + PSB @ 5 kg ha$^{-1}$ was

significantly improved nutrient status of soil and yield of turmeric under Melia dubia based agroforestry system.

## TAMIL NADU AGRICULTURAL UNIVERSITY, FCRI, METTUPALAYAM

### I) Tree Germplasm Collection, Evaluation and Improvement

Kapok germplasm collected across Tamil Nadu were assembled and evaluated at farmers' field in Samanaickenpalayam, near Veerapandipirivu, Coimbatore District as well as at Horticultural College and Research Institute farm, Periyakulam. Among 25 kapok progenies evaluated in the farmer's field, the progeny from Varusanadu (CPT 18) recorded the higher value for height and girth at 18 and 24 months after planting. In Horticultural College and Research Institute farm, the progeny from Varusanadu (CPT 16) recorded maximum height and the progeny from Agamalai (CPT 6) yielded more number of pods per tree after 30 months after planting.

In the assemblage of germplasm of *Melia dubia* experimental trial, Melia MTP-2 variety recorded maximum height, DBH and volume at 24, 30 and 36 months after planting followed by pre-released culture Melia MTP-4. The lowest morphological performance was observed in Melia MTP-1 variety.

### ii) System research

Experiment on intercropping of cluster bean under different age gradation of *Melia dubia* ecosystem revealed that maximum pod length, pod yield, crude protein and dry matter content was observed in open condition when compared to 3 years and 6 years old *Melia dubia* plantation.

Studies on ecosystem services for multifunctional agroforestry system depicted that out of 12 timber trees, *Melia dubia* and *Neolamarckia cadamba* registered maximum volume and biomass at the end of third year. Among seasonal intercrops, brinjal and cluster bean recorded high yield when compared with other intercrops whereas other perennial components *viz.*, *Murraya koenigii* yielded higher followed by *Moringa oleifera*. Among four fruits species *viz., Annona squamosa, Psidium guajava, Citrus limon, Syzygium cuminii*, two species (*Annona squamosa, Psidium guajava*) were in fruit bearing during the study period. The total yield recorded from three flower components *viz., Jasminum grandiflorum, Jasminum sambac* in quadrat I and Nerium oleander in quadrat III. Among three flower components in multifunctional agroforestry, Nerium oleander recorded highest yield followed by *Jasminum grandiflorum*. Two fodder components *viz.*, *Megathyrsus maximus* recorded maximum yield.

An experiment on *Pterygota alata* based agroforestry system was conducted at FC&RI with four intercrops such as cowpea, blackgram, greengram and horsegram. Among the intercrops, cowpea produced highest number of pods, yield and harvest index when compared to other intercrops. However, highest B:C ratio was registered in greengram.

## TAMIL NADU VETERINARY AND ANIMAL SCIENCES UNIVERSITY, IAN, KATTUPAKKAM

### System Research

**Nano urea studies in *Panicum maximum* understorey of *Cocus nucifera* based hortipasture model for livestock integration**

Application of nano urea helps to increase the nutrient availability and absorption. Plant height, number of tillers, number of leaves, leaf length, stem girth are the important yield attributing characters. Application of nano urea did not show any significant variation (P>0.05) in plant height, number of tillers, number of leaves, leaf length, stem girth on 35$^{th}$ DAS (Day After Spraying) of nano urea and at harvest of the *Panicum maximum* in comparison with urea granules applied understorey of *Cocus nucifera*. Plant height of control and treatments were 189.0 cm and 190.5 cm, respectively and the biomass yield was 50.8 1.48 and 50.78 0.94 tonnes per hectare per harvest, respectively. But there is no significant difference between the two groups in different stages of application of nano urea and urea granules. The same trend was continued in second and third harvest. The study is continued for subsequent harvests.

**Nano urea studies in *Panicum maximum* in open system**

In open system, the yield of *Panicum maximum* was slightly higher compared to hortipastural system. Plant height, number of tillers, number of leaves, leaf length, stem girth was observed on 35$^{th}$ DAS (Day After Spraying) and at harvest. There is no significant variation (P>0.05)) of nano urea in comparison with urea granules applied on the above parameters. The number of tillers is one of the best

yield attributing characters. Number of tillers in control and treatment were 19.2 and 18.0 respectively and the biomass yield was 52.14  1.03 and 52.43  0.88 tonnes per hectare per harvest, respectively. But there is no significant difference between the two groups. The same trend was continued in second and third harvest. The study is continued for subsequent harvests.

**Nano urea studies in *Desmanthus virgatus* understorey of *Manilkara zapota* based hortipasture model for livestock integration**

In *Manilkara zapota* based hortipasture system plant height, numbers of leaves, leaf length were observed to assess the yield of the *Desmanthus virgatus* crop. There is no significant variation (P>0.05) was observed on 35$^{th}$ DAS (Day After Spraying) of nano urea in comparison with urea granules applied. The same trend continued during the later stages of crop growth such as at harvest also. The plant height and number of leaves are the important yield attributing characters. Plant height in control and treatment were 185.8 ± 12.80 cm and 186.3 ± 10.80 cm and respectively. The biomass yield of control and treatment were 13.99 ± 0.35 and 14.19 ± 0.70 tonnes per hectare per harvest, respectively. But there is no significant difference between the two groups on application of nano urea and urea granules. In second and third crop, the same trend continued. Since *Manilkara zapota* is eighteen-month old fruit crop, there is no shade effect in the hortipasture system.

**Evaluation of *Desmanthus virgatus* leaf meal in Japanese quails**

A feeding trial in 270 day old quails was conducted upto 5 weeks of age with inclusion of *Desmanthus virgatus* leaf meal at 0%, 3% and 6% in the concentrate feed. No

significant difference (P>0.05) was observed in the body weight between the treatment groups at the end of 5$^{th}$ week. Between treatment groups there exists a non significant difference (P>0.05) in the dressing percentage in quails. Non significant difference (P>0.05) was observed for the following cut up parts *viz.* breast, legs, wings, back, neck, heart, liver and gizzard. In the serum parameters, significant difference (P<0.05) was observed in *Aspartate aminotransferase* enzyme. Non significant difference (P>0.05) was observed in serum calcium and phosphorus parameters among the treatment groups. Hence, from the growth study in Japanese quails (upto 5 weeks) it was concluded that 6% *Desmanthus virgatus* leaf meal can be included concentrate feed can improve the growth performances in quails.

The feeding trial was continued to study the egg production performance from 6 - 16 weeks, Hen Housed Egg Production in Control, $T_1$ and $T_2$ were 62.39%, 62.13% and 58.59% respectively. Hen Day Egg Production in Control, $T_1$ and $T_2$ were 62.45%, 62.87% and 58.83%, respectively. Significantly (P<0.05) highest yolk colour (8.33) was observed in 6% *Desmanthus virgatus* leaf meal included quail concentrate feed followed by 3% *Desmanthus virgatus* leaf meal group (7.83). On relative quantification of carotenoids for mRNA gene expression of SCARB1 gene and VLDLR1 gene, treatment group $T_1$ (3% *Desmanthus virgatus* inclusion group) revealed the higher mRNA gene expression. Hence, it was concluded that upto 3% *Desmanthus virgatus* leaf meal included concentrate feed can improve egg production performances in Japanese quails.

**Effect of mulch on soil parameters in silvipasture system in degraded waste land**

Among different in-situ soil moisture conservation treatment *viz.*, *Cenchrus ciliaris* leaf mulch ($T_1$), *Stylosanthus sp.* leaf mulch ($T_2$), residue of left over Bajra napier grass + Goat manure ($T_3$), Crop residue (CN Hybrid crop residue) ($T_4$), *Gliricidia sepium* leaf mulch ($T_5$), Control (without any mulch) ($T_6$). The soil bulk density was higher in control compared to all other treatments. This might be reason for yield reduction in *Gliricidia sepium* in control. Highest yield obtained in residue of left over Bajra napier grass + Goat manure ($T_3$). Due to the effect of left over content of crop and goat manure, significantly high nitrogen content was noticed in $T_3$. Biomass yield in all the treatments were on par with each other compared to control. Hence, $T_3$ is the best treatment which increased the biomass yield along with improving soil physical properties.

**Evaluation of tree leaf meal based ration in transition sows**

A study was conducted in transition sows (14 days prior to farrowing) by supplementing with fibre through *Leucaena*

*leucocephala* leaf meal along with swine concentrate feed to reduce the farrowing stress. The control animals were fed with adult swine concentrate feed whereas the treatment animals were fed with adult swine concentrate feed along with 250 g of *Leucaena leucocephala* leaf meal per sow as fibre source. The birth weight of the piglets were (1.34  0.06 Vs 1.27  0.01) and weaning weight (7.65  0.11 Vs 7.60  0.56). There was a non significant difference (P>0.05) between the control and treatment group. At weaning, the percentage of mortality was higher in treatment group (15%) compared to the control (8%).

**Nutritive evaluation of fodders in silvipasture at different seasons**

Significant difference (P>0.05) was not observed in *Gliricidia sepium* between seasons. The ether extract content of *Stylosanthus scabra* was significantly (P<0.05) higher during summer season compared to other seasons. Significantly (P<0.05) highest value for total ash was observed in post monsoon season compared to other two seasons. Significantly lowest in vitro total gas production was observed in *Gliricidia sepium* during post monsoon season. Among *Gliricidia sepium* and *Stylosanthus sp*, the highest *In Vitro* True Digestibility Dry Matter (IVTDDM %) was noticed in *Stylosanthus scabra* in monsoon season. Non significant difference (P>0.05) was observed in methane (ml / 0.2g) and Methane (ml) / 100mg of True Digestibility Dry Matter (TDDM) between *Gliricidia sepium* and *Stylosanthus sp.* across seasons.

**Biomass yield of tree fodders in multi tier agroforestry model**

Among the different tree fodders in multi tier agroforestry model, *Sesbania grandiflora* recorded higher biomass yield (8.55 t/ha) followed by *Gliricidia sepium* (8.40 t/ha) in three seasons.

**Nutritive evaluation of fodders in multi tier agroforestry model**

In bajra napier hybrid grass, non significant difference was observed for crude protein and crude fibre contents. In *Desmanthus virgatus*, significantly higher crude protein value was observed in pre monsoon season. Among tree fodders in multi tier model, *Sesbania grandiflora* has the highest crude protein content across the seasons, closely followed by *Sesbania sesban*. Compared to tree fodders, bajra napier hybrid grass had higher crude fibre content. In total gas production, among the seasons in different combination of tree fodders with bajra napier hybrid grass, total gas production was least in pre monsoon season compared to monsoon and summer season. The similar trend was noticed in methane production (ml) / 100 mg of TDDM (True Digestibility Dry Matter) for bajra napier hybrid grass + *Sesbania grandiflora*, bajra napier hybrid grass + *Sesbania sesban* and bajra napier hybrid grass + *Gliricidia sepium*.

**Quantitative analysis of phytobiotics**

Significantly (P<0.05) lowest saponin and alkaloid contents were observed in *Sesbania grandiflora* and *Erythrina indica* respectively.

**Nutritive evaluation of common tree fodders in Kattupakkam campus**

Among the twenty common fodders in Kattupakkam campus, significantly (P<0.05) highest crude protein content was found in *Sesbania sesban* (23.83 %). For crude fibre, significantly (P<0.05) higher values was found in Ficus religiosa, *Hardwickia binata* and *Ficus benghalensis*. Highest in vitro true digestibility was observed in *Sesbania grandiflora* leaves (73.71 %). *Acacia auriculiformis* leaves had significantly lowest (P<0.05) methane production potential and *Sesbania grandiflora* leaves had significantly highest (P<0.05) methane production potential at 24 hours.

## UNIVERSITY OF AGRICULTURAL SCIENCES, DHARWAD

### i) Design and Diagnostic Survey

**In Northern Dry Zone:** *Tamarindus indica, Azadirachta indica, Hardwickia binata, Prosopis cineraria, Acacia nilotica etc.*, are very common tree species. In an irrigated area of this zone, Teak, *Melia dubia*, Sapota, Mango, Pomegranate, Papaya, Grapes *etc.* are dominant species.

**In Transitional Zone:** The predominant perennial components are Teak, Terminalia, Dindal, Sandal, Red Sanders, Mahagony, Mango, Sapota, Guava, Curry leaf, Jack, Jamun *etc.* Teak is planted on the bunds/ channels of irrigation. Perennial vegetables like Curryleaf and drumstick are very common in the farming system. Sandal, Mahagony and *Melia dubia* are being cultivated in the recent past on large scales.

**In Hill Zone:** The multi storied agroforestry systems are noticed in farmer's field. The important species of the zone are Arecanut, Coconut, Kokum, *Erithrina indica*, Jack, Tea, Cardamom, Jamun *etc.* The paddy is main field crop grown in low land conditions. Pepper is an additional component (climber) in this multi component system.

**In Coastal Zone:** Jack, Coconut, Cashew and Kokum are the main fruit tree species grown and also *Casuarina equisetifolia* and *Acacia auriculiformis* are mainly grown as wind breaks.

### ii) Tree Germplasm Collection, Evaluation and Improvement

The twenty neem provenances, the maximum volume of the neem tree was recorded in Bijapur (0.999 $m^3$/tree) and Raichur (0.94 $m^3$/tree) when compared to other provenances. The highest seed yield of neem was also

recorded in the Bijapur (6.31 kg/tree) and Raichur provenances (5.56 kg/tree).

The fourteen tamarind collections evaluated, the growth parameters were significantly higher among NTI-5 (9.95 m) and NTI-80 (9.95 m) when compared to other collections. The highest fruit yield of tamarind was recorded in NTI-14 (12.17 kg/tree), NTI-19 (12.05 kg/tree) and SMG-13 (11.88 kg/tree) as compared to other sources.

The ten tamarind clones evaluated, the maximum height was recorded in V-2 (13.45 m), PKM-2 (12.45 m) and TH (12.05 m) when compared to other clones. The highest fruit yield of tamarind was recorded in the PKM-2 (9.30 kg/tree) and V-2 (7.85 kg/tree) while the tartaric acid of tamarind fruits was highest in S-201 (16.6%) and S-132 (16.3 %) when compared to other tamarind clones.

The eleven provenances of *Pongamia pinnata*, the significantly higher height and volume of the tree was observed in the MTP-I (9.4 m and 0.087 $m^3$/tree, respectively) when compared to other provenances The highest seed yield of *Pongamia pinnata* was recorded in RAK-22 (4.90 kg/tree) and MTP-II (4.00 kg/tree) while the maximum wood moisture was recorded in the RAK-89 (47.39%) and MTP – III (45.98%) in comparison with other provenances and also there is improvement in soil chemical and physical properties.

In the multi location provenance trial on *Pongamia pinnata*, the maximum height and collar diameter at breast height were recorded in RAK-1 (5.03 m and 15.62 cm, respectively) followed by RAK-2 (4.53 m and 15.17 cm, respectively) when compared to other sources.

In the uniform and multi location trial on clonal evaluation of *Melia dubia* based agroforestry systems, the maximum height and DBH were recorded in the MTP-1 (9.95 m and 26.67 cm, respectively) followed by MTP-II (9.72 m and 24.04 cm, respectively) when compared to HN (Hole Narsipura) clone (8.98 m and 25.21 cm respectively).

In the multi location trial on fodder tree species in paired row system for leaf meal production, the maximum collar diameter was recorded in the *Gliricidia sepium* (6.35 cm) followed by *Sesbania grandiflora* (6.0 cm) as compared to other species. The number of branches and green biomass were significantly higher in *Calliandra calothyrsus* (11.00 branches per tree and 3371.04 kg/ha, respectively) when compared to other fodder tree species. Dry matter analysis carried out for the fodder tree species revealed that, in comparison with other fodder tree species, both *Moringa olifera* and *Sesbania grandiflora* were higher in energy and had good digestibility.

Among the seven *Carissa carandas* sources evaluated, significantly maximum height and collar diameter were recorded in the Tumakur (2.12 m and 39.10 cm, respectively) and Arabhavi (1.72 m and 33.00 cm, respectively) as compared to other sources.

Among the nine thornless bamboo species evaluated, *Bambusa balcoa* of Chandagad (8.4 m) provenance attained maximum height followed by *Dendrocalamus stocksiiof* Nasik (8.06 m) when compared to other bamboo species. The number of new culms were higher in *Bambusa balcoa* of Chandagad (7.43 culms) and *Dendrocalamus stocksii* of Dapoli (6.6 culms).

### iii) System Research

In an investigation of sapota - timber tree species based agroforestry models, the height and crown area was significantly higher in the *Pterocarpus marsupium* (14.95 m and 0.156 $m^2$/tree) when compared to other tree species whereas the highest volume was also recorded in the *Pterocarpus marsupium* (1.12 $m^3$/tree). Sapota tree growth was higher when grown alone (6.85 m) followed by Sapota + *Pterocarpus marsupium* (6.45 m). The yield on sapota fruit was significantly higher when sapota grown alone (41.00 kg/tree) and also in combination of Sapota + *Lagerstroemia lanceolata* (22.75 kg/tree) when compared to other timber tree species and also increases the available nutrient status in the system

The six tree borne oilseed species evaluated, maximum height was observed in *Azadirachta indica* (8.75 m) and *Madhuca indica* (8.35 m) as compared to other species whereas the maximum diameter at breast height was recorded in *Simarouba gluaca* (20.05 cm) and *Azadirachta indica* (18.76 cm) when compared to other tree species. However, the highest seed yield was observed in *Pongamia pinnata* (3.85 kg / tree).

The seven fodder tree species evaluated under agroforestry system, maximum collar diameter was recorded in the *Glyricidia sepium* (14.00 cm) followed by *Calliadra calothryus* (13.75 cm). The number of branches per tree and green biomass were significantly higher in *Calliandra calothryus* (36.20 branches/tree with 1335.0 kg/ha, respectively) when compared to other fodder tree species.

At ARS, Prabhunagar, the biomass and carbon sequestration was estimated in the natural forest in the four sloppy areas. Among the different slopes, the maximum density of tree species was observed in the middle area (3-5%) as compared to the plain, low and high area. Significantly higher biomass and carbon sequestration was recorded in the middle hill area (3-5%) as compared to top, terrain and low area of the hill. Among the tree species, significantly higher biomass and carbon sequestration was recorded in *Anogeissus latifolia* (47.80 ton/ha and 23.90 ton/ha, respectively) as compared to other tree species.

In an experiment to estimate the biomass and carbon sequestration of different timber tree species grown with sapota based agroforestry systems at ARS, Prabhunagar indicated that, the total biomass and carbon sequestration was significantly higher in *Eucalyptus tereticornis* (169.80 ton/ha and 84.90 ton/ha respectively) and *Tectona grandis* (98.5 ton/ha and 49.25 ton/ha, respectively) as compared to other timber tree species in the agroforestry system. Among the sapota trees, total biomass, carbon stocking and sapota fruit production was higher in sapota with *Lagestromia lanceolata* (10.45 ton/ha and 5.22 ton/ha, respectively) when compared to other agroforestry systems.

In a study on establishment and growth performance of Santalum album, the seedlings raised in the nursery and planted with seven host fodder tree species *viz., Sesbania grandiflora, Gliricidia sepium, Moringa olifera, Calliandra calothyrsus, Leucaena lucocephala, Albizia lebbeck, Bauhinia purpurea* as secondary host trees.

In a study on effect of integrated nutrient management and spacing on growth and productivity of red sanders, the seedlings raised in the nursery were planted in the block plantation. However, the wider spacing plantation performed superior with respect to growth and vigour

## UNIVERSITY OF AGRICULTURAL SCIENCES, BENGALURU

### I) Tree Germplasm Collection, Evaluation and Improvement

Twenty-seven tamarind germplasms were collected from different sources and planted in Clonal seed orchard at GKVK during 2010, 2011 and 2012. Among 27 germplasms higher plant height was observed in Hosakote-2 (8.15m) followed by NFN-4 (8.10 m) and higher bole height was observed in Hosakote-2 (2 m) followed by GKVK-1 (1.75 m). The higher diameter at breast height was observed in NFN-1(85 cm) followed by NFN-3 (80 cm) and the canopy spread on N-S and E-W direction was higher in NFN-3 (8.9 and 7.95 m, respectively) followed by GKVK-1 (8.6 and 7.35 m, respectively). Red tamarind has recorded higher yield compared to other germplasms. Higher fruit and pulp weight was recorded in Hosakote-3. Higher wood volume was recorded in NFN-10 followed by NFN-1. Highest carbon dioxide sequestration was recorded in NFN-10 followed by NFN-1.

Eight selections of *Pongamia pinnata viz.,* RAK-2015-01, RAK-2015-02, RAK-2015-03, RAK-2015- 04, RAK-2015-07, RAK-2015-08, RAK-2015-09 & RAK-2015- 10 were planted during 2017. The highest height was recorded in RAK-2015-10 (3.56 m), the highest bole height was recorded in RAK-2015-04 (1.19 m) and the highest girth at breast height was recorded in RAK-2015-10 (22.44 cm). The canopy spread on N-S and E-W direction was also higher in RAK-2015-10 (4.15 and 3.71 m, respectively). Among the different germplasm of *Pongamia pinnata* higher carbon sequestration was observed in RAK-2015-01 (3.67-t $ha^{-1}$) followed by RAK-2015-02 (3.56-t $ha^{-1}$).

### ii) System Research

Fruit crop *viz., Anacardium occidentale, Syzygium cumuni* and *Mangifera indica* based agroforestry system was established during 2010 with inter & intra row spacing of 10 m. Among these fruit crops, *Syzygium cumuni* recorded higher tree height (7.29 m) and bole height (1.30 m). The higher diameter at breast height was recorded in *Anacardium occidentale* (95cm) followed by *Syzygium cumuni* (86.36cm). The canopy spread on N-S and E-W direction was also higher in *Anacardium occidentale* (10 and 9.36 m, respectively) followed by *Syzygium cumuni* (7.89 and 7.31 m, respectively). Among the different fruit plants *Anacardium occidentale* had recorded maximum aboveground biomass (63.18 t $ha^{-1}$), below ground biomass (16.43 t $ha^{-1}$), total biomass accumulation (79.60 t $ha^{-1}$) and total carbon dioxide content (136.92 t $ha^{-1}$) when compared to *Mangifera indica* and *Syzygium cumuni*.

Significantly higher teak height (9.76 m), girth (56.43 cm), canopy spread (6.07 m N-S direction) and (6.07 m E-W direction) was recorded in 12 m X 3 m planting density, more leaves per clump (352.7), leaf area per clump (49037 $cm^2$), green fodder yield (86.53 t $ha^{-1}$) and dry fodder yield (19.71 t $ha^{-1}$) are recorded in sole CO-5. It also recorded higher gross returns (Rs. 157014 $ha^{-1}$), net returns (Rs. 100062 $ha^{-1}$) and B: C ratio (2.8).

The average tree and bole height of germplasms *viz.,* MTP-1 and MTP-2 were 10.07 m, 10.74 m and 5.11m and 5.49 m, respectively. The variation in tree height was mainly due to variations in soil fertility and other soil factors. The highest girth at breast height was recorded in MTP-1 (61.5 cm) compared to MTP-2 (51.63cm). The canopy spread on N-S and E-W direction was also higher in MTP-1 (7.39 m and 6.76 m, respectively) compared to MTP-2 (6.84 m and 6.46 m, respectively). After four years of planting intercrops were good up to flowering, later the crops were not produced any economic produce due to excess rain.

Highest sandal height recorded in 5m x 5m spacing followed by 5m x 4m and similar trend was recorded in collar diameter. Mulberry and Agase performed as good hosts. Soybean performed better intercrop in Sandal.

Highest Mahagony height was recorded in 5m x 5m spacing followed by 5m x 4m and similar trend was recorded for collar diameter. Higher yield of Cowpea and Soybean was observed in 5m x 5m spacing (2892 kg $ha^{-1}$ Cowpea and 2778 kg $ha^{-1}$ Soybean).

MTP-1 performed better than MTP-2. However, MTP-1 growth was good under rainfed condition than irrigated condition. MTP-2 performed better under narrow spacing with irrigation.

## KERALA AGRICULTURAL UNIVERSITY, THRISSUR

### i) Tree Germplasm Collection, Evaluation and Improvement

In the teak provenance evaluation trial, best performance was observed from Nilambur provenances at the 22nd year of establishment. Among the 30 different teak accessions from South India, the better ones were from Cherupuzha which registered the maximum height growth (15.25 m), DBH (0.197 m) and volume (0.327 $m^3$) closely followed by Nedumkayam-2, Nellikutha-5, Nedumkayam-1, and Karulai provenances.

### ii) System Research

In bamboo (*Dendrocalamus stocksi*) based agroforestry trial with medicinal intercrops, growth attributes of bamboo varied significantly due to spacing. As the spacing increased from closer to wider (8x8 m), most of the growth parameters were found to increase. The understory PAR transmittance decreased with decrease in spacing to the tune of 54.79, 43.52 and 34.15, respectively for 8x8m, 8x6m and 8x4m. The maximum litter fall was observed under closest spacing (10.11 Mg $ha^{-1}$) and lowest under widest spacing (7.86 Mg $ha^{-1}$).

The growth parameters of medicinal intercrops were found maximum at 8x8 m spacing of bamboo and lowest under open plot. The highest rhizome yield for Kasturi turmeric (25.22 Mg $ha^{-1}$) and turmeric (22.42 Mg $ha^{-1}$) was noted in open plot which was on par with the widest spacing of 8x8 m. In case of ginger, highest rhizome yield (19.92 Mg $ha^{-1}$) was observed at bamboo spacing of 8x8 m. The oleoresin content of Kasturi turmeric, turmeric and ginger was found higher (11.37, 9.07 and 4.84%) under intermediate spacing (8x6 m).

All the physico-chemical properties of soil under bamboo intercropping system and the soil under bamboo within 1 m distance from clumps decreased with increase in spacing and soil depths except for bulk density and soil pH. The EC, soil moisture, SOC, NPK, S, Ca and Mg was maximum under closest spacing (0.285 dS $m^{-1}$, 17.59%, 1.12%, 324.12, 28.60, 161.1 kg/ha; 10.06, 278.40 and 124.52 mg/kg, respectively) and lowest was under bamboo less open plot.

Total gross and net return/ha (bamboo + intercrops) was highest under 8x8 m spacing compared to open plot (sole crops) and as spacing decreased these returns also decreased. When compared to spacing and intercrop combinations, Kasturi turmeric, turmeric and ginger intercropped under widest spacing (8x8 m) showed better B:C ratio (3.25, 2.48 and 2.47, respectively). It is concluded that widest spacing (8x8 m) is more favourable to bamboo growth as well as for intercropping compared to the closer spacings.

Comparing the growth, yield, nutritive value, and survival of different tree species *Calliandra calothyrsus, Morus indica* and *Neolamarckia cadamba* are found to be ideal for triple hedgerow boundary planting with intensive harvesting under partially shaded small holder homestead farms.

Trial to standardize the vegetative propagation protocol of fodder calliandra revealed that, calliandra can be vegetatively propagated from soft wood coppice cuttings by overnight soaking with 50 ppm of NAA and using vermiculite as rooting medium under controlled conditions of mist chamber, preferably during summer season.

## UNIVERSITY OF AGRICULTURAL AND HORTICULTURAL SCIENCES, COF, PONNAMPET

The study was carried out in the remaining parts of the Kodagu district. It was observed that majority of the farmers keen to grow trees which are yielding fruits and commercial timbers

### i) Tree Germplasm Collection, Evaluation and Improvement

Collection and evaluation of bamboo resources for sustainable utilization has been continued. Significant difference in the growth performance of different species was evident. At the age of 39 months species like *Bambusa tulda, Denrocalamus latiflorus, Bambusa nutans* and *Dendrocalamus brandissi* were found to be promising.

Seeds from phenotypically superior mahagony trees were collected and 2000 seedlings were raised with identity for distribution to the farmers for field planting

### ii) System Research

**Development of *Dendrocalamus stocksii* Munro. based agroforestry practice for the tropical humid regions:**

After five years of planting the growth performance of *Dendrocalamus stocksii* was assessed under different spacing treatments and the data revealed that height growth, number of shoots per clump and clump girth did

differ significantly with spacing. Number of culms per clump is going to be a crucial factor in deciding the yield from each bamboo clump and the results clearly indicated that the number of culms per clump were 60 per cent higher in wider spacing (8m x 8m) compared to closer spacing of 4m x 4m and 30 per cent higher over T1 (8m x 4m). It is evident that the spacing had significant effect on growth and development of clump and wider spacing was found to be useful for overall growth of the clump as well as culm within the clump after five years of planting. It is a long term experiment and the intercrops like ginger and turmeric failed due to diseases and repeated growing of same crop lead to failure of the crops.

**ii. Establishment of Litsea based agroforestry models:**

An attempt on harvesting methods and assessment of the quality of the bark of *Litsea chinensis* after six years of planting in farmers field was made. Among the different harvesting methods bark harvesting in alternate strips was found to be better over other methods of harvesting. Nearly 99 per cent of bark recovery was observed in 10 months after harvesting in Alternate strip harvesting methods with an average bark yield of 1.71 kg per tree. It is prudent to mention that the quality of the was A grade after six years of planting.

# 4. Sub Tribal Plan (STP)

### SKUAST-K, SRINAGAR

Two Tribal Farmers' awareness cum training Programme were conducted under Tribal Sub Plan Agroforestry at Dushari, Rayil Gund kangan, Teshil and District Ganderbal.

Demonstrations on nursery technology for raising of conifer and broad-leaved species for employment generation and social upliftment in the rural areas of Ganderbal.

Agro-forestry system demonstrations, *viz.* Horti-pastoral, Silvi-pastoral and their package and practices were given to farmers by this centre. Besides 25 horti/agri. Tool kits comprising of spades, shovels, hoes, diggers, scissors, secateurs, knives etc. were also distributed to the tribal farmers of Dushari Ganderbal-Ganderbal.

Dozens of farmers participated in these awareness programmes and quality plant material was distributed among the beneficiaries: which include 1. Poplar 1700 seedlings 2. Willow 1500 seedlings 3. Elm 1500 seedlings 4. Wild Apricot 1000 seedlings 5. Morus 1500 seedlings.

Besides 200 Kg seed of different fodder grasses were distributed free of cost to farmers for fodder production and to develop different horti and Silvipastoral system.

### SKUAST-J, JAMMU

The activities were carried in the villages namely Naneter and Palai in Block Sumb of Samba district of Jammu and Kashmir during the year 2022-23. Visit by the scientists to discuss the issues regarding the adoption of agroforestry and other problems related to agriculture faced by the farmers were discussed. Possibility of laying out of an agroforestry trial on the farmer's field was discussed.

### CSKHPKV, PALAMPUR

Three agroforestry trainings were organized in Tribal district of Lahaul & Spiti and tribal belt of district Chamba of the state where in 105 farmers were trained on different aspects of agroforestry land use system. During the trainings, farmers were distributed quality planting material of vegetables, fruit and fodder trees, field implements and other training material. Overall a total of 8.45 $ha^{-1}$ area on farmers' fields in village Harer, Kandral and Balla in Distt. Kangra has been developed under different agroforestry systems through people's participation approach benefitting 177 beneficiaries and was monitored regularly. Gap filling of *Toona ciliata*, *Populus, Salix* and *Morus* saplings was done. In addition, fast growing grass *Setaria* root slips and fertilizers etc. were distributed to the farmers.

In Distt. Lahaul & Spiti, Salix clonal plants, interlinked chain wire and quality planting material of Apple spur variety were provided to the beneficiaries for plantation in the demonstrations of agroforestry systems developed on about 0.94 $ha^{-1}$. In addition, multicut Lucerne fodder and quality seed of pea was also distributed to the beneficiaries for growing under horti-pastoral and agrisilviculture systems.

### AAU, KAHIKUCHI

One exposure trip of the TSP farmers to HRS, Kahikuchi was organized. They visited the existing agroforestry systems, and vermicomposting unit of the centre. Some planting materials including saplings, rhizome, honey bee boxes and vermi bags are distributed to them.

### OUAT, BHUBNESHWAR

Twenty five farm families from Chandiapalla village in district Khurda received five numbers of pineapple sucker, Coconut, Arecanut, Mahogany, Acacia and Chillar saplings they were also provided twenty five okra, twenty five gm ridge gourd, ten gm brinjal and chilli seeds for backyard nutritional gardening. And booklet on "Good Agroforestry Practices".

Twenty five farm families from Majhisahi village in district Dehnkanal received twenty five okra, twenty five gm ridge gourd, ten gm brinjal and chilli seeds for backyard nutritional gardening. One brush cutter distributed on custom heir basis to the group of 25 farmers. Small garden tools and implements *viz.* Rosecane, polythene sheet for drying of seeds and Brush cutter were also distributed. Complex fertilizer and micronutrient and vermin compost also distributed for homestead gardening and booklet on "Good Agroforestry Practices".

### BCKVV, JHARGRAM

Establishment of one-hectare on-station mango-based agroforestry model for demonstration, the on-farm maintenance of 25 ha cashew-based agroforestry at Salboni block, one-hectare Sweet lime – Loombu agroforestry system at Haringhata block, raising 750 seedlings of Gmelina, Sal, Segun *etc.* raised in station nursery for distribution.

### BAU, RANCHI

The activities were organised in adopted villages Chetto and Turiamba in Bharno Block of Gumla Districts of Jharkhand state covering 100 families. Famers were made aware of activities like adopting Agroforestry practices, Agri-Horticulture practices, Silvipasture, Fishery, Bee-Keeping, *etc.* have been included. Technical supports have been provided continuously to the farmers for upliftment of socio-economic condition of farmers.

### SKDAU, SARDAR KRUSHINAGAR

The Sub Plan was implemented in Vagdadi village of Banaskantha district among 30 farmers. The tribal farmers have adopted different agroforestry systems viz. boundary plantation, horti pastoral systems, vadi project etc. Major activities implemented were supply of improved seeds of various intercrops *i.e.* moongbean (GM 4) and clusterbean (GG 2) were distributed to 5 and 5 farmers of Vagdadi, respectively. In rabi season oat (kent) was distributed to 10 farmers of Vagdadi village.

### PDKV, AKOLA

Conducted Training programme on tree plantation under the scheme in Girgao village, district Wardha on 23rd September, 2022 in which 1700 bamboo saplings distributed to thirty farmers and also conducted boundary plantation on farmers field.

### BSKKV, DAPOLI

Distributed thirty poultry birds and two Konkan kanyal male and female goat to the tribal farmers under the program. and also distributed 830 saplings of Mulberry, subabul, Mango, Coconut, Amla, Bamboo and Black pepper to the tribal farmers for boundary and block plantation and conducted two awareness program attended by 50 farmers and given information about agroforestry for the beneficiaries of villages Dudhere and Dahimbe from ratanagiri district. Conducted one training program at Deptartment of Animal Husbandry and Dairy Science farm, of the university under the scheme on 18.11.2022 on "Goat and poultry management under silvipastoral system".

### TNAU, METTUPALAYAM

In this program, Velliankadu village of Mettupalayam taluk in the Coimbatore district was selected based on PRA. Many of the beneficiaries owned farm lands ranging from 0.5 acres to 2 acres. Based on interview method, 30 scheduled tribes beneficiaries were selected. Velliangadu is one of the major tribal populated areas of this district. The primary occupation of the people is agriculture and allied activities. The farm implements, farm inputs, tree seedlings, seeds, training kits distributed were distributed to the beneficiaries. The tribal farmers were exposed to various agroforestry models and technologies such as multifunctional agroforestry practices, silviagriculture, silvihorticulture, silvipasture, mini-clonal technology and briquetting technology available at Forest College and Research Institute, Mettupalayam by means of conducting training and arranging exposure visit. The exposure visit aimed at disseminating the technologies developed by the institute to the farmers to enhance their livlihood besides introducing them to various industrial tree species. The long term outcomes are anticipated in the years to come.

### UAS, BANGALORE

On farm field demonstrations and training programmes under STP were conducted at M. Cherlupalli village Bagepalli taluk, Chikkaballapur district on 26.07.2022 and also distributed forestry seedlings *viz.*, silver oak, Mahagony and *Melia dubia*, horticultural seedlings *viz.*, Cashew, Coconut, Mango and Lemon and agricultural implements *viz.*, spade, sickle, varvari and basket to 100 identified schedule tribe beneficiaries.

### UAHS, SHIVAMOGGA

Under the scheme thirty piglets were distributed to fifteen tribal and twenty-five solar lamps were provide to twenty-five tribal school going children of Hebbale Devarapura villages in Kodagu district.

# 5. Schedule Caste Sub Plan (SCSP) Activities

### CSKHPKV, PALAMPUR

Under SCSP component, two interaction meetings and one agroforestry training were organized during the reporting period for the benefit of the schedule caste families covering theoretical & practical aspects of agroforestry land use technology and especially Animal Nutrition. Training was organized in village Mollichak in which 40 farmers participated. Total of 217 demonstration trials under agri-silviculture agroforestry system were raised in village Mollichak and Band Bihar during the reporting period. Benefits were given to the beneficiaries in terms of quality seed of wheat, oats, chari, bajra, potato, fodder trees, barbed wire for fencing, fertilizers and manures *etc.* as per the need for raising demonstrations. Good agronomical practices were demonstrated to farmers while raising demonstration trials. Farmers have benefitted and reported higher production and increased income because of the scheme.

### GBPUAT, PANTNAGAR

These activities were carried out through out the year of study in the hill and tarai regions of Uttarakhand. The women led self help groups were roped to decimate maximum benefits to the society. During the year different inputs *viz.* plantlets, small farming equipment, mushroom bags, vegetable seeds were provided to the beneficiaries. Beside these trainings on the site and at university research centers were provided with technical know-how to plant protection. Large scale plantation derives were also carried out with the help of NGO's.

### ANDUAT, AYODHYA

Turmeric seed NDH-1 distributed to the 70 SC farmers of Meen Nagar village, Dariyabad block. Paddy seed MPU-7029 distributed to the 60 SC farmers of Meen Nagar village, Dariyabad block. Mango, Teak and Karonda seedlings were distributed to the more than 100 SC farmers of Meen Nagar village, Dariyabad block.

### OUAT, BHUBNESHWAR

Fifty farmers in two villages Harijansahi and Haripur of Puri district (Each farmer provided 01 no. of fungicide (50 gm) & insecticide (100 ml) for their homestead agroforestry). Twenty five okra, twenty five gm ridge gourd, ten gm brinjal and chilli seeds for backyard nutritional gardening, one brush cutter distributed on custom heir basis to the group of 25 farmers. Small garden tools and implements *viz.* Rosecane, polythene sheet for drying of seeds and Brush cutter also distributed. Complex fertilizer and micronutrient and vermi compost also distributed for homestead gardening. They were also distributed booklets on "Good Agroforestry Practices".

Twenty five farmers from village Agapala in district Jagatsinghpur provided twenty five okra, twenty five gm ridgegourd, ten gm brinjal and chilli seeds for backyard nutritional gardening. Small garden tools and implements *viz.* Rosecane, polythene sheet for drying of seeds and Brush cutter also distributed. They were also distributed booklets on "Good Agroforestry Practices".

### BCKVV, JHARGRAM

The on-farm maintenance of 25 $ha^{-1}$ cashew-based agroforestry at Salboni block, one-hectare Sweet lime – Loombu agroforestry system at Haringhata block, and raising 20000 seedlings of different silvi species *etc.* at station nursery were done during the year.

### SKDAU, SARDAR KRUSHINAGAR

The Scheduled caste Sub Plan (SCSP) was implemented in Jethi village of Banaskantha district comprising of 45 farmers. The farmers have adopted different agroforestry systems *viz.* boundary plantation, horti pastoral systems, vadi project *etc.* under SCSP. Supply of improved high yielding variety seeds of various intercrops *i.e.* clusterbean (GG 2) was distributed to 13 farmers, Castor (GCH-7) was distributed to 15 farmers, Green gram (GM-4) was distributed to 17 farmers. In order to increase the fodder production of the SC farmers, the seeds of fodder crops oat (kent) was given under diversification covering 18 SC framers. High yielding variety of Wheat was distributed to 27 farmers and distribution of Tarpaulin to the 45 farmers of Jethi village of Amirgadh Block, Banaskantha district.

### PDKV, AKOLA

Distributed Gram seed (50 kg each), bamboo, teak sampling (100 sapling each), bamboo cutting saw materials and Krushi Sanvadini to 40 farmers selected under SCSP programme from Sawangi, Aamgao, Devali villages of Nagpur district.

### PJTSU, HYDERABAD

Distributed Sandalwood, Mango, Guava and Sapota for bund/border plantation and also distributed Red gram (PRG-176) seed along with chemicals (Carbendazim, Rhizobium, Imidacloprid for seed treatment and Neem oil to 30 farmer families in Avancha village, in Thimmajipet mandal of Nagarkarnool district of Telangana.

Two trainings were conducted on sandal wood cultivation and agroforestry importance and folders of sandal wood cultivation and bund / border plantation were distributed to 250 no. of farmers. The faremers after the training were

interested in growing bund/border plantation and also cultivating red gram with improved practices (seed treatment with chemicals and Rhizobium).

**BSKKV, DAPOLI**

Conducted one training program at Department of Animal Husbandry and Dairy Science farm of the university under the scheme on 03.03.2023 on "Goat and poultry management under silvipastoral system". Distributed five hundred saplings of Sandalwood, 100 of Teak, 100 of Khair, 100 of Cashew, 100 of Mango (*Mangifera indica*) 100 for development of agroforestry, boundary, block plantation and restoration of waste land through agroforestry species for farmers of Kherdi village of Ratnagiri district. Farmers also informed about agroforestry, importance of animal component in agroforestry and given some information about family financial stability through agroforestry. They were provided local language literature *e.g.* leaflets, pamphlets, folders, populars, university technologies, *etc.* to the SCSP farmers for increasing the awareness and future adoption strategies about agroforestry.

**TNAU, METTUPALAYAM**

Among the various villages visited by the scientific team, Chinnakalipati, Kuthamandipirivu, Kunipalyam, Chickathasampalyam, Illupanatham village of Mettupalayam taluk in the Coimbatore distirct was selected based on PRA which are thickly populated by major schedule caste *viz.* Adhidravidar. Based on interview method, thirty scheduled caste beneficiaries were selected. Many of the SC beneficiaries owned farm lands ranging from 0.5 acres to 2 acres. The primary occupation of the people is agriculture and farm workers. In this program, farm implements, farm inputs, tree seedlings and vegetable seeds were distributed based on their choice to increase their work efficiency and livelihood. This besides, under SCSP capital, GI wire and rechargeable LED torch lights were distributed to 30 beneficiaries to safe guard from wild animals and reduce man animal conflicts. All the beneficiaries were taken on a field visit to the agroforestry field station at FCRI and were explained about various profitable agroforestry models developed by the institute.

**TNVASU, KATTUPAKKAM**

A one day training programme on "Strategies for sustainable green fodder production" was conducted for 30 SC farmers on 08.02.2023.During this training programme, farmers were trained on sustainable green fodder production. Each farmer was provided with inputs such as coconut saplings (3 nos.), tree fodder saplings (5 nos.) and *Desmanthus virgatus* seeds (0.25 kg).

A one day training programme on "Backyard Poultry Production to improve the livelihood of the farmers" was conducted for 30 SC farmers on 09.02.2023. During this training programme, farmers were trained on backyard poultry production. Each farmer was provided inputs such as Aseel chicken (10 nos.) and native chicken feed (7.5 kg).

A one day training programme on "Popularizing tree leaf meal in concentrate feeding of native chicken" was conducted for 15 SC farmers. In this programme, poultry cage (1 No.), 15 Aseel chicks and 30 kg of breeder chicken feed to the farmers.

A one day training programme on "Popularizing anionic salt feeding to reduce the incidence of milk fever" was conducted for 15 SC farmers. In this programme, anionic salts and coconut saplings to farmers.

**UAS, BANGALORE**

On farm field demonstrations and training programmes under the scheme were conducted at Malakacheruvu village, Bagepalli taluk, Chikkaballapur district on 15.07.2022 and distributed the forestry seedlings (Silver oak, Mahagony and *Melia dubia*), horticultural seedlings (Cashew, Coconut, Lemon and Mango) and agricultural implements (Spade, sickle, varvari and basket) to 75 identified schedule caste beneficiaries.

# 6. Awareness Programme on Boundary Plantation "*Har Med Par Ped*"

To create awareness among the farmers and other stakeholders, ICAR-CAFRI Jhansi and coordinating centres of AICRP on Agroforestry organizes boundary plantation awareness progarmme and inform farmers and other stakeholders about importance for development of agroforestry and the scientific methodology of planting trees for boundary/bund plantation. In this context awareness programmes were conducted every month in different villages to highlight various agroforestry models developed including boundary plantation technology. Further, the information related to various benefits of agroforestry systems and suitable tree species for the different regions was provided to them. They were informed about suitable tree species for boundary plantation in their farmlands and seedlings of suitable tree species were also distributed to farmers. The details of the Boundary Plantation "*Har Med Par Ped*" conducted during the year are:

| Institutes name | Training | Date | Place |
|---|---|---|---|
| SKUAST-K, SRINAGAR | Boundary plantation | 13.09.2022 | Dushari Ganderbal |
| SPUHF, SOLAN | Boundary plantation | 10.08.2022 | Shamror village Solan district |
| AAU, KAHIKUCHI | Boundary plantation (5 nos.), bund plantation (1 no.), Sivipasture in agroforestry system | 06.04.2022 | Dihira, Assam |
| PAU, LUDHIANA | Boundary plantation awareness | 26.08.2022 | Kamalpur village district Sangrur |
| KAU, Thrissur | Awareness programme on border/ boundary planting on wet land Paddy fields | 28.06.2022 | State Seed Farm, Mannuthy |
| GBPUAT, PANTNAGAR | Boundary plantation awareness | 20.03.2022 | Haripura Harsan village, Udham Singh Nagar |
| RPCAU, PUSA | Boundary plantation awareness | 06.06.2022 | Harpur village, Biha |
| | | 17.08.2022 | Malikor village, Pusa Samastipur |
| BCKVV, JHARGRAM | Boundary plantation in a 25 hectares cashew-based agroforestry | 07.12.2022 | Jamda. Asanboni, Radhanagar West Midnapore |
| | | 01.03.2022 | Gaighata village West Midnapore |
| CCSHAU, HISAR | Boundary plantation awareness progamme | 29.12.2022 | Dau Majra Kurukshetra, district |
| MPKV, RAHURI | Boundary plantation awareness progamme | 2021 | Shri Bhaskar Madhav Shete from Gotumbeakhada village. |
| PJTSAU, HYDERABAD | Boundary plantation | 05.11.2022 | Avancha village Thimmajipet, |
| | | 07.08.2021 | Mandal |
| SKNAU, Fatehpur Shekhawati | Awareness programme on 'Bund/ boundary planting' | 02.09.2022 | Birania Village, Rajasthan |
| TNVASU, KATTUPAKKAM | Boundary plantation | 31.01.2023 | Thirukazhukundram village, Chengalpattu District |
| UAS, DHARWAD | Awareness programme on 'Bund/ boundary planting' | 22.07.2022 | Honnapur Village, Dharwad |
| | Importance of timber species and awareness on Biofuel Plants | 10.08.2022 | Mugad Village, Dharwad |
| TNAU, METTUPALAYAM | Boundary plantation programmes | 27.10.2022 | Pudukottai district |
| CSKHPKV, PALAMPUR | Awareness programme on boundary planting | 21.12.2022 | DugniMalahoo village, Distt. Kangra |
| JNKVV, JABALPUR | Awareness programme on boundary planting | 29.12.2022 | village Raipura, Panagar district Jabalpur |
| OUAT, BHUBANESHWAR | Awareness programme on boundary planting | 22.07.2022 | Haripur village District Puri |

| | | | |
|---|---|---|---|
| PDKV,COA, NAGPUR | Awareness programme on boundary planting | 23.09.2022 | Girgao village, District Wardha |
| ANDUAT, AYODHYA | Awareness programme on boundary planting | 28.02.2023 | Village Sidhauna, Ayodhya |
| BSKVV, Dapoli | Awareness programme on boundary planting | 22.11.2022 | Dudhere and Dahimbe villages |

# 7. Subsidiary Activities

### SKUAST-K, SRINAGAR

An arboretum of different multiple purpose tree species has been established at Benhama, Ganderbal. Till date about 43 different multipurpose tree species have been planted for ex-situ conservation.

Quality plant material of different multipurpose agroforestry tree species is being raised and distributed among farmers. During the period under report about 5500 plants of different tree species were distributed among farmers. Revenue to the tune of Rs. 2.5 lakhs generated from the sale of Broad leaved and conifer tree species.

### YSPUH&F, SOLAN

Produced about fifty thousand nursery plants of different agroforestry tree species *viz.*, *Morus alba, Grewia optiva, Bauhinia variegata, Cedrus deodara, Peltophorum pterocarpum, Melia composita, Sapindus mukorosii, Populus deltoids, Salix alba, Platanus orientalis, Dendrocalamus stritctus, D. hamiltonii, Bambusa tulda, Dendrocalamus asper, Phyllostachys bambusoids, P. aurea etc.* were supplied to farmers, Department of Agriculture, HFRI and various stakeholders of the state.

The Morus and Grewia based agroforestry systems are modified into the apple based agri-horti-silviculture system to demonstrate hill farmer to diversify their income and combat climate change.

High density plantation of *D. strictus, D. hamiltonii, Bambusa polymorpha, Bambusa tulda, Bambusa balcooa, Thyrostachys sikkimensis, Phyllostachys pubesens, P. negroid* were established.

Organization of the Van Mahotsav at the Department level in the University campus in the months of July and August 2022 under which around 1000 plants of different fodder and timber species were planted.

One day Training on Boundary Plantation conducted at Govt. Senior Secondary School, Shamror on August 10th, 2022.

### CSKHPKVV, PALAMPUR

Quality germplasm of the tree species: *Toona ciliata*, *Grewia optiva*, *Celtis australis*, *Leucaena leucocephala*, *Robinia pseudocacia*, *Populus deltoides*, *Salix* sp., *Sapindus mukorossi* and *Morus alba*, suitable for plantation on the farmers' field was raised in the farm nursery for further distribution to the farmers during the year.

During the reporting period, 38 ITKs related to different aspects of local important trees were collected.

A success story of technology dissemination on farmers' field at village Harer has been compiled in the form of a short video.

Conducted following training programmes during the year:

| S.No. | Date & Place | Number of Trainees | Women participants |
|---|---|---|---|
| 1. | Dated 13.4.2022<br>Village Sagnam (32.03 06° N and 78.05 70°E ), Tehsil Kaza, Distt. Lahaul & Spiti | 35 | 21 |
| 2. | Dated 26.7.2022<br>Village Guwadi, Tehsil Tisa (32°48' 43.10" N and 076° 07' 25.68" E) | 50 | 39 |
| 3. | Dated 22.03.23,<br>Village Maane(N 32 03' 18.07 and E078 13' 23.83 ),<br>TehsilKaza, Spiti, Distt. Lahaul & Spiti | 25 | 15 |
| 4. | Dated 06.03.2023<br>Village Mollichak (N 32°04´9.64´´, E 76° 33´4.30´´), Distt. Kangra | 40 | 31 |

### AAU, KAHIKUCHI

Training on Bund plantation and Agri-silviculture in Baska district and Tamolpur district

Nursery for tree seedling production obtained 80–90 % successful germination of *Tectona grandis, Gmelina arborea, Santalum album, Dalbergia sissoo, Azadirachta indica, etc.*

Demonstration blocks on Bund and boundary plantations along with intercropping had established.

### PAU, LUDHIANA

In a training programme organized in village Mardanpur district Patiala, farmers were made aware of the planting of good quality plants, spacing and direction of tree rows for getting higher intercrop productivity, fertilizer application to the trees, intercropping along the tree line and management of intercrops, insect pest and disease management of the system. Farmers' queries regarding the protection of crops along the tree lines from birds, water

requirement of eucalyptus, government schemes for planting trees and the future prospects of tree planting. Good quality seedlings of clonal eucalypts were also distributed among the farmers (20 plants/farmer for 25 farmers).

### GBPUAT, PANTNAGAR

On the occasion of local plantation festival 'Harela' plantation derive was carried out Agroforestry Research Center, GBPUA&T Pantnagar in which Hon'ble V.C. Dr. A.K. Shukla, Director Experiment Station Dr. A. S. Nain, Dean Student Welfare Dr. Brijesh Singh and several other dignitaries participated and planted trees.

A total 04 short term (01 day) trainings were organized for Agroforestry techniques and Mushroom cultivation.

### RPCAU, PUSA SAMASTIPUR

Field Visit of Biodiversity Park and Bamboo Plantation in Dhab Area, RPCAU Pusa by Shri Mukul Kanitkar of Akhil Bhartiya Sanghatan mantra, Bhartiya Shikshan Mandal and team from Research for Resurgence Foundation (RRF) in the presence of Dr. Krishna Kumar, Hon'ble Vice-Chancellor, RPCAU Pusa and Dr. M.N. Jha, Director Education, RPCAU Pusa and all the faculties of Department of Forestry, RPCAU, Pusa on 20-07-2022.

Field Visit of Biodiversity Park and Bamboo Plantation in Dhab Area, RPCAU Pusa by Dr. P.K. Mishra, Hon'ble Chancellor, RPCAU Pusa and dignitaries Dr. Sudhir Shukla, ICAR-IISR, Lucknow; Dr. Sanjay Singh, FRCER, Prayagraj; Dr. Nitin Kulkarni, IFP, Ranchi and Dr. H.B. Singh, ICAR-NBAIM, Mau in the presence of Dr. Krishna Kumar, Hon'ble Vice-Chancellor, RPCAU Pusa and all Deans/Directors/ Registrar/ Comptroller of RPCAU Pusa with all faculties of Department of Forestry, RPCAU, Pusa on 28-07-2022.

### OUAT, BHUBANESHWAR

Dr. S.C. Mohapatra gave a radio talk on topic "Intercropping in agroforestry systems to enhance productivity & profitability" through FM station, AIR, Puri on Dt. 04.04.2022.

Mrs Sasmita Behera gave a radio talk on topic "Lata jatiyaphasala re samanyutaroga o pokaparichalana" through FM station, AIR, Puri on Dt. 12.09.2022.

Scientists of the centre acted as extension resource persons of World Agroforestry Project center at Nuapada & Belpada blocks of Odisha.

### BCKVV, JHARGRAM

Resources of a sum of rupees four lakh twelve thousand seven hundred and two only have been generated from the Project during the year through gate sale *etc.*

In convergence with the ongoing ATMA project work with the Directorate of Agriculture, Government of West Bengal, a total of thirteen capacity-building trainings and distribution of seedlings have been conducted to motivate the farmers on the importance and need of location-specific adoption of agroforestry for higher income with the members of total thirteen Self Help Groups ofJhargram block of Jhargram, Gangajalghati Block of Bankura, Salboni block of Paschim Medinipur and Jhalda I, Jhalda II of Purulia involving local extension wing of agricultural directorate, Government of West Bengal, two philanthropic civic society organisations.

### SDAU, SK NAGAR

The demonstration on ardusa and teak boundary plantation was initiated on farmer's field. Four farmers of the Banaskantha were selected for the agroforestry based demonstrations. The total area of the plantation was 2.80 ha.

The agrisilviculture model (ardusa boundary plantation + clusterbean) developed at Salempura village of Banaskantha district, produced 510 kg seed yield, 1290 kg fodder yield and 10110 Rs net realization from clusterbean under rainfed condition. The ardusa recorded average plant height (10.42 m) & girth (41.0 cm) were recorded under rainfed conditions.

The agrisilviculture model (ardusa + greengram) developed at Bharkavada village of Banaskantha district, produced 410 kg seed yield, 620 kg fodder yield and 8080 Rs net realization from Greengram under rainfed condition. The average plant height (8.72 m) & girth (31.1 cm) was recorded in of ardusa under rainfed conditions.

The agrisilviculture model (Teak+ greengram) developed at Visol village of Mehsana district and recorded 400 kg/ha seed yield of greengram and 600 kg/ha of straw yield . The growth parameters of the ardusa, recorded average plant height (8.45 m) & plant girth (31.40 cm) under rainfed conditions.

### PDKV, NAGPUR

Maharashtra Bamboo Promotion Foundation (MBPF), Mumbai has sanctioned Rs. 4.40 lakh for organizing Bamboo Mitra Prashikshan (Skill Development Trainings) for creating awareness among the farmers for management of Scattered bamboos occurring on private lands. Accordingly, we have organized 4 rounds of Bamboo Mitra Training and we have trained 99 participants. Participants were introduced with scientific management, identification, nursery, plantation, colour coding harvesting, dressing, grading, farm waste management, marketing of bamboo.

Conducted World Bamboo Day programme at AICRP on Agroforestry, CoA, Nagpur on dated 19$^{th}$ September, 2022 with participation of forest officer and farmers.

## PJTSAU, HYDERABAD

Conducted plantation programme at Agri biodiversity park, Rajendranagar on 16.02.2023, attended by University authorities and other dignitaries and voluntaries of DELL Technologies Pvt. Ltd. Nearly 4000 no. of saplings of different tree species, shrubs, commercial woody species and ornamental plants were supplied by DELL Technologies Pvt. Ltd., and Learning Links Foundation, Hyderabad. Nearly 25 saplings of different palm species were planted on the hands of dignitaries.

**Farmers training or other training programme conducted**

| Title of training | Venue | Year | Organized by | No. of participants |
|---|---|---|---|---|
| Training on bund plantation importance | Avancha, Thimajipet Mandal, Nagarkurnool district. | 18.04.2022 | Dr. A. Krishna | 30 |
| Training on sandal wood cultivation practices | Avancha, Thimajipet Mandal, Nagarkurnool district. | 18.04.2022 | Dr. T. Chaitanya | 30 |
| Training programme on agroforestry systems and sandal wood cultivation | Avancha village, Thimmajipet mandal, Nagarkurnool district. | 05-11- 2022 | Dr. T. Chaitanya and Dr. A.V. Ramanjaneyulu | 30 |

## JNKVV, JABALPUR

A exhibition was organized on bamboo and millets products during the National Seminar on "Production, Processing and Marketing of Millets: Issues and Solutions" held at JNKVV, Jabalpur on 1-2nd March 2023.

Awareness programme organized to mark World Forestry Day at the Department of Forestry at JNKVV, Jabalpur on 21nd Mar 2023 by the staff of AICRP for creating awareness about the forest and its biodiversity among the students.

## TNAU, METTUPALAYAM

**Farmers training or other training programme conducted**

| Sl. No. | Name of the training | Date | Beneficiaries |
|---|---|---|---|
| 1. | Training on Biomass Briquetting Technology | 01.06.2022 & 02.06.2022 | 38 |
| 2. | Awareness training on Agroforestry Business Incubation for the Agricultural Officers of different zones in Coimbatore | 13.07.2022 | 22 |
| 3. | Training on Multifunctional Agroforestry Technologies to Agricultural Officers | 02.08.2022 to 04.08.2022 | 30 |
| 4. | Training on "Multifunctional Agroforestry technologies to farmers | 10.08.2022 to 12.08.2022 | 31 |
| 5 | Training on Agroforestry Technologies to Additional Director of Agriculture (ADA) Officers | 16.08.2022 to 18.08.2022 | 30 |
| 6 | Training on Agroforestry based Value Chain Model for FROs of Kundal Forest Academy, Maharashtra | 30.08.2022 | 38 |
| 7. | Seminar on Scope of Village Forestry at Panchayat Level to the Members to Pudukottai district panchayats | 27.10.2022 | 66 |
| 8. | Training on Livlihood Improvement through Agroforestry to Sirumugai block farmers | 24.03.2023 | 30 |

## UAS, DHARWAD

A programme was organized in the field of Sri. Mahaveer Kasamalagi of Mugad Village in Dharwad Taluk. The scientists were provided the information on importance of timber species planting on the bunds and their gestation period of return. Around 40 farm women were participated and they have also interacted with the scientist about the use of biofuel plants and further collection of seeds. At the end of the programme teak plants were planted on the bunds in an area of two acres land.

Tree plantations were made during the following celebrations as indicated below in the UAS, Dharwad.

| Sl. No. | Name of the Activity | Month | Days | Date |
|---|---|---|---|---|
| 1 | World Environmental Day Celebration UAS, Dharwad | June | 01 | 05.06.2022 |
| 2 | International Biofuel Day Celebration at Biofuel Park | August | 01 | 10.08.2022 |

**Training Programme conducted**

| Sl.No. | Subject | No. of the Participants | Name of the Villages |
|---|---|---|---|
| 1 | Importance of Agroforestry | 45 | Mugad |
| 2 | Importance of Biofuel Trees and its importance | 32 | Honnapur |
| 3 | Integrated Nutrient Management for Extension functionaries | 40 | Dharwad |
| 4 | Problematic Soils & their reclamations | 40 | STU, UAS, Dharwad |
| 5 | Nutrient Deficiencies and its Remedies | 50 | ISARD, Dharwad |

## UAHS, SHIVAMOGGA

The centre involved in raising of quality planting materials of important tree species and bamboo. Totally around 1,00, 000 plants were produced and distributed to various end users.

Participated in Farmers mela at University head quarter and provided technical information on Tree cultivation to the Farmers.

Organized Agroforestry Technology Workshop on 21st March,2023 by involving Academic Institutes ( College of Forestry Ponnampet, IWST - ICFRE, Industries: Vanadurgi Agar Wood Private Limited, N Ranga Rao and Sons, Mysore and West Coast Paper Mill, Dandeli, NGO: Industry Foundation, SARA).

## BSKKV, DAPOLI

Nursery unit under revolving fund for producing quality planting materials for the farmers.

Successfully demonstrated agroforestry system in farmer field of Sh. Ashok Dev Kadam of village Kherdi, Tahsil Dapoli, in Ratnagiri district. According to the farmer the silvipastoral agroforestry system including animal component is very much feasible and profitable and can be easily adopted by the farmers.

# 8. Awards and Recognitions

**Awards and Recognition including participation in important National/International Events Symposium/ Conferences *etc.***

### SKUAST-K, SRINAGAR

Best paper presentation award (oral) 1st position ICAR-IGFRI, Srinagar centre, ICAR-NAHEP Birsa agricultural University Ranchi and NADCL, Baramulla at University of Kashmir, 2022

### SKUAST-J, JAMMU

'National Seminar on Agriculture & Beyond' organized by Society for Community Mobilization for Sustainable Development, 12th-14th May, 2022

Institutional changes for inclusive & sustainable agricultural development organized by Division of Agricultural Economics & ABM, SKUAST-Jammu, 21st-23rd December, 2022.

International Conference on "Sustainable Agricultural Innovations for Resilient Agri-Food Systems" from at SKUAST-Jammu organized by Indian Ecological Society, 13th-15th October, 2022

### YSPUH&F, SOLAN

Dr. D.R. Bhardwaj, C.L. Thakur, Rohit Bishist and Prashant Sharma presented papers through online mode in 5th World Congress on Agroforestry held at Quebec City Canada in virtual mode during July 17th-20th, 2022

### CSKHPKVV,PALAMPUR

Centre was awarded third prize for video competition on Transfer of technology on Farmers' field for the year 2021-22 during the AGM held at Jhansi

Interactive Workshop on "Roadmap for Agroforestry in different agro-climatic regions of India" organized by Indian Society of Agroforestry.

### AAU, KAHIKUCHI

IVth International Conference on ICAAAS-2022 held during 12th-14th June, 2022 at Himachal Pradesh University, Summer Hill, Shimla, H.P., India.

Centre was awarded third prize for video competion on Transfer of technology on Farmers' field for the year 2021-22 during the AGM held at Jhansi.

Dr. Ranjita attended International Training Programme on "Diversification of costal agroecosystems for climate resilience and livelihood security" organized by ICAR-Central Coastal Agril. Res. Institute (Goa) & Centre for International Forestry Res. – World Agroforestry (ICRAF), New Delhi, on dated 7th-11th November, 2022.

VIIth International Conference in Hybrid Mode on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2022) scheduled to be held on 21st–23rd November, 2022 at Birsa Agricultural University, Ranchi, Jharkhand, India.

3rd International Web-Conference on Natural Resource Management for Global Food Security and Sustainable Development Goals during December 2nd-3rd, 2022.

### GBPUAT, PANTNAGAR

Dr. Salil Tewari - Appointed as Member, Board of Management, FRIDU, Dehradun under distinguished scientist category, 2017-20 (now extended for 2020-22)

### PAU, LUDHIANA

Indian Society of Agroforestry Gold Medal conferred to Dr. Rishi Gill. Attended virtual 5th World Congress on Agroforestry, Quebec City, Canada during July 17th-20th, 2022.

### RPCAU, PUSA SAMASTIPUR

Won 2nd prize on the eve of the Republic Day (26th January, 2023) Jhanki, wherein Dr. R.K. Meena, Assistant Professor (Agroforestry) was one of the members.

Thematic Pandal on Natural Farming during Kishan mela (23rd-25th February, 2023) won 1st prize wherein Dr. R.K. Meena, Assistant Professor (Agroforestry) was one of the members.

R.K. Meena participated and presented a research paper at International Conference on Advances in Agriculture, Veterinary and Allied Sciences for Improving Livelihood and Environmental Security, from 28th-30th September, 2022.

R.K. Meena Participated and presented a research paper online at the National Conference on the Ozone layer, its depletion and impact on living beings (ODIL-2022), during 16th-17th September, 2022.

R.K. Meena and S.L. Singh participated and presented a research paper at International Conference on Natural Farming for Revitalizing Environment and Resilient Agriculture during, 17th-20th Mach, 2023.

### OUAT, BHUBANESHWAR

Awarded prize on short videography on Homestead agroforestry systems of Coastal Odisha by ICAR-CAFRI, Jhansi.

IVth International Conference on Innovative and Current Advances in Agriculture and Allied sciences, Himachal Pradesh University, Summer Hill, Shimla, HP (Hybrid mode, 12th-14th June, 2022.

Winter school on "Role of Science and Technology in sustainable Agriculture, Horticulture, animal husbandry and allied Sectors: A Retrospective and Prospective Approach", ICAR-IGFRI, HP, Palampur, H.P. (Online Mode), 9th-29th November, 2022

Vth International Conference on " Global and research advances in agriculture and allied sciences", BAU, Ranchi (Hybrid mode), 26th-28th November, 2022

International conference on "New generation Horticulture for Prosperity" from, OUAT, Bhubaneswar, OUAT, Bhubaneswar, 21st- 22nd January, 2023

Winter school on "Emerging problems and recent advances in agriculture and allied sciences: Basic to molecular approaches (EPRAAS-2023)", Astha Foundation (Online mode), 26th February to 18th March, 2023.

### BCKVV, JHARGRAM

Dr.Benukar Biswas, OIC accepted the invitation for the lead presentation entitled "Agroforestry regenerates ecosystem services in degraded dryland" at the International Conference on Innovations to Transform Drylands, during 21st-23rd February, 2023 at ICRISAT, Hyderabad, India.

Dr. Biswas acted as (a) member, State Level Technical Committee on System of Assured Rice Production Technology by Directorate of Agriculture, Government of West Bengal; (b) visiting expert, Pradhan Mantri Krishi Sinchayee Yojana Watershed Development Component under MELD system at Government of West Bengal, (c) lead expert for West Bengal Accelerated Development of Minor Irrigation Project (WBADMIP), Government of West Bengal.

Dr. Biswas acted as a reviewer of Scientific Reports (Springer Nature), Agronomy for Sustainable Development (French National Institute for Agriculture, Food and Environment – Springer), Journal of the Indian Society of Soil Science (Indian Society of Soil Science), International Journal of Fruit Science (Taylor & Francis); Archives of Agronomy and Soil Science (Taylor & Francis); Journal of Soil Science and Plant Nutrition (Springer Nature) and Annals of Applied Biology (John Wiley & Sons), Agronomy Journal (American Society of Agronomy- John Wiley & Sons), Journal of Agriculture and Food Research (Elsevier), International Journal of Plant Production (Springer Nature).

Dr. Biswas acted as Associate Editor, International Journal of Agriculture Science Bioinfo Publications.

Dr. Biswas acted as a member organising committee of the National Conference on "Landscape Management for Preventing Flood and Reservoir Sedimentation" organised by the Indian Association of Soil and Water Conservationists, Dehradun, Uttarakhand, held during 22nd-24th September, 2022 / BAU, Ranchi (Jharkhand)

Dr. Biswas completed a five-day training programme on 'Data Analysis Using "R" Software' organised by the Centre for e-Learning in collaboration with the Dept. of Agricultural Statistics, Kerala Agricultural University, Thrissur from 21st-25th June, 2022.

Dr Biswas and Dr Panda virtulay participated in a one-day online workshop on the Importance of Plant Variety Conservation and the Implication of PPV&FRA on 24th January, 2023 held at ICAR-CAFRI, Jhansi. India.

### BAU, RANCHI

Twenty-one Days National Refresher Course (NRC 2022) On "Recent Technologies of Livestock Based Integrated Farming System for Doubling Farmers Income" (Through Online Mode) (1st-21st February, 2022) Organized by College of Veterinary Science and Animal Husbandry, Birsa Agricultural University, Ranchi, Jharkhand In Association with ICAR-National Agricultural Higher Education Project (NAHEP) & National Agriculture Development Cooperative Ltd (NADCL) Baramulla (UT of J & K).

Participated and presented a paper in VIIth International Conference in Hybrid Mode on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2022) 21st–23rd November, 2022 at BAU, Ranchi (Jharkhand) India.

### CCSHAU, HISAR

Received Best AICRP presentation award during Annual Group Meet of AICRP-Agroforestry held at ICAR-Central Agroforestry Research Institute, Jhansi, U.P. during 7th-9th October, 2022.

Dr. Chhavi Sirohi attended International Training Programme on "Diversification of costal agroecosystems for climate resilience and livelihood security" organized by ICAR- Central Coastal Agril. Res. Institute (Goa) & Centre for International Forestry Res. – World Agroforestry (ICRAF), New Delhi, on dated 7th-11th November, 2022.

Dr. Chhavi Sirohi received full funding form University of Laval, Canada in partnership with the International Union for Agroforestry (IUAF) and World Agroforestry (ICRAF) for participation in 5th World Congress on Agroforestry, held in Quebec, Canada during 17th-20th July, 2022.

### SDAU, SK NAGAR

Prof. Lalita Saini and Riddhi Joshi attended Training on Soft skills for personality development organized by SDAU, Sardarkrushinagar from 29th September to 01st October, 2022.

Dr. A.G. Patel, Prof. Lalita Saini and Riddhi Joshi attended National Conference organized by SDAU, Sardar krushinagar from 11th-13th November, 2022.

Prof. Lalita Saini attended twenty one days training on Water productivity enhancement in scarcity zones approaches and applications organized by Centre for Natural Resources Management, SDAU, Sardar krushinagar from 18th January to 07th February, 2023.

**PJTSAU, HYDERABAD**

Dr. A.V. Ramanjaneyulu received Reviewer Excellence award from Agricultural Science Digest on 30th May, 2022.

Dr. A.V. Ramanjaneyulu received Reviewer Excellence award from Legume Research – An International Journal on 27th October, 2022.

Dr. A.V. Ramanjaneyulu attended and arranged a PJTSAU stall during Global Organic Expo-2022 at IARI, PUSA, New Delhi from 26th-28th May, 2022.

Dr. A.V. Ramanjaneyulu Participated and acted as Panelist for Panel discussion on "Opportunities and challenges in organic farming" in Brainstorming workshop on "Organic Farming in India on 10th June, 2022 at ICAR-NAARM, Hyderabad.

Dr. A.V. Ramanjaneyulu attended Training on "Fertilizer Policy for sustaining soil health, role of fertigation" organized by the Fertilizer association of India Southern region in collaboration with PJTSAU on 21st July, 2022.

Dr. T. Chaitanya attended a lecture on Past, Present And Future of Digital Agriculture" by Prof. P. Raj Koshla, Head Division of agronomy, Kansas State University, USA on 30th July, 2022 .

Dr. A.V. Ramanjaneyulu attended a workshop on "Harnessing the potential of Natural Farming (Regenerative Agriculture) as a Low-emission development pathway for improved resilience, soil health, livelihoods and nutrition in India from 15th-17th September, 2022 at ICRISAT, Patancheru, Hyderabad.

Dr. A.V. Ramanjaneyulu attended Round table consultation with "Agribusiness experts of KDH, Munnar, Kerala on 23rd September, 2022.

Dr. A.V. Ramanjaneyulu attended Desi rice variety festival" organized by Farmers Co-operative in association with WASSAN, Hyderabad on 01st November, 2022 at WASSAN, Hyderabad.

Dr. A.V. Ramanjaneyulu attended inception workshop on "State Biodiversity strategy and action plan (SBSAP) 2022-2032 for Telangana state" (Telangana State Biodiversity Board, Hyderabad) on 22nd November, 2022.

Dr. A.V. Ramanjaneyulu participated in International Conference on vegetable oils 2023 (ICVO 2023) Research, Trade, value chain and policy at PJTSAU auditorium organized by ICVO, ICAR - IIOR, Rajendranagar from 17th-21st January, 2023.

Dr. A.V. Ramanjaneyulu participated in inaugural work shop on Strategies for building community-based institutions and protocols for sustainable water sheds on 23rd January, 2023 at NIRD, Hyderabad..

**PDKV, NAGPUR**

Dr. P.D. Raut attended International Training Programme on "Diversification of costal agroecosystems for climate resilience and livelihood security" organized by ICAR-Central Coastal Agril. Res. Institute (Goa) & Centre for International Forestry Res. – World Agroforestry (ICRAF), New Delhi, on dated 07th-11th November, 2022.

Participated in Agro Vision held at Nagpur, dated 25th-28th November, 2022.

Participated in Agro Tech at Dr. PDKV, Akola, dated 27th-31st December, 2022.

Participated in State Agriculture Exhibition held at Sillod, Dst. Aurangabad, Maharashtra dated 01st-5th January, 2023.

Participated in District Agriculture Exhibition held at Nagpur dated 04th–7th January, 2023.

Dr. V. M. Ilorkar and Dr. Arati P. Deshmukh attended International conference on "Tree Based Diversified Land Use System" at NAU Nvasari, Gujarat, on 15th-17th February, 2023.

**SKNAU, FATEHPUR SHEKHAWATI**

Dr. Dharmendra Tripathi participated in Organic farming training at DEE, Jobner 16th-18th January, 2023 jointly organized by SKNAU and Anand Gujarat.

Dr. Dharmendra Tripathi Participated in state launch of TOFI programme at Rajasthan Agricultural Research Station, Durgapura, Jaipur on 06th February, 2023.

Dr. Dharmendra Tripathi participated in workshop on QPM under TOFI programme at Jaipur on 17th March, 2023 and delivered lecture to different stakeholders on fruit based agroforestry system in Rajasthan.

Dr. Dharmendra Tripathi participated in International Agribusiness-conclave on Pearl Millet at RARI Durgapura on 21st-22nd March, 2023.

Dr. Dharmendra Tripathi participated in Workshop at world agroforestry centre at Jaipur on 31st March, 2023 and shared agroforestry experience and technology.

**JNKVV, JABALPUR**

S.B. Agrawal, Yashpal Singh and Poornima Malviya staff on AICRP on AF project participated in National Seminar on "Production, Processing and Marketing of Millets: Issues and Solutions" jointly organized by Jawaharlal Nehru Krishi Vishwa Vidyalaya & Jabalpur and National Bank for Agriculture and Rural Development, Bhopal, Madhya Pradesh on 01st-02nd March, 2023.

### TNAU, METTUPALAYAM

Received First prize for Video Competition from ICAR-CAFRI, Jhansi during Annual Group Meet 2022 of AICRP on Agroforestry.

MAFBIF received Tamil Nadu best startup incubation award.

### TANUVAS, KATTUPAKKAM

Dr. S. Chinnamani Award for Excellence in Agroforestry Extension for the year 2022 -Kattupakkam Centre has been selected for this award.

S. Gunasekaran and L. Radhakrishnan received second prize in "Video competition award - 2022" on the theme agroforestry adoption in farmers field.

M. Suganthi received "Kumaran Sivaraman Award for innovative young scientist of TANUVAS" for innovative fodder production methods.

### UAS, BANGALORE

Best Agroforestry based Integrated Farming System Demonstration awarded by University of Agricultural Sciences, GKVK, Bangalore in Krishimela-2022.

Best Service Employee Award in Technical Series to Mr. Ranganatha, S.C. awarded by University of Agricultural Sciences, GKVK, Bangalore.

### UAHS,SHIVAMOGGA

Dr Ramakrishna Hegde, Professor and OIC has been identified as External Expert Group member for the evaluation of All India Coordinated Research Projects under Indian Council of Forestry Research and Education, Dehradun.

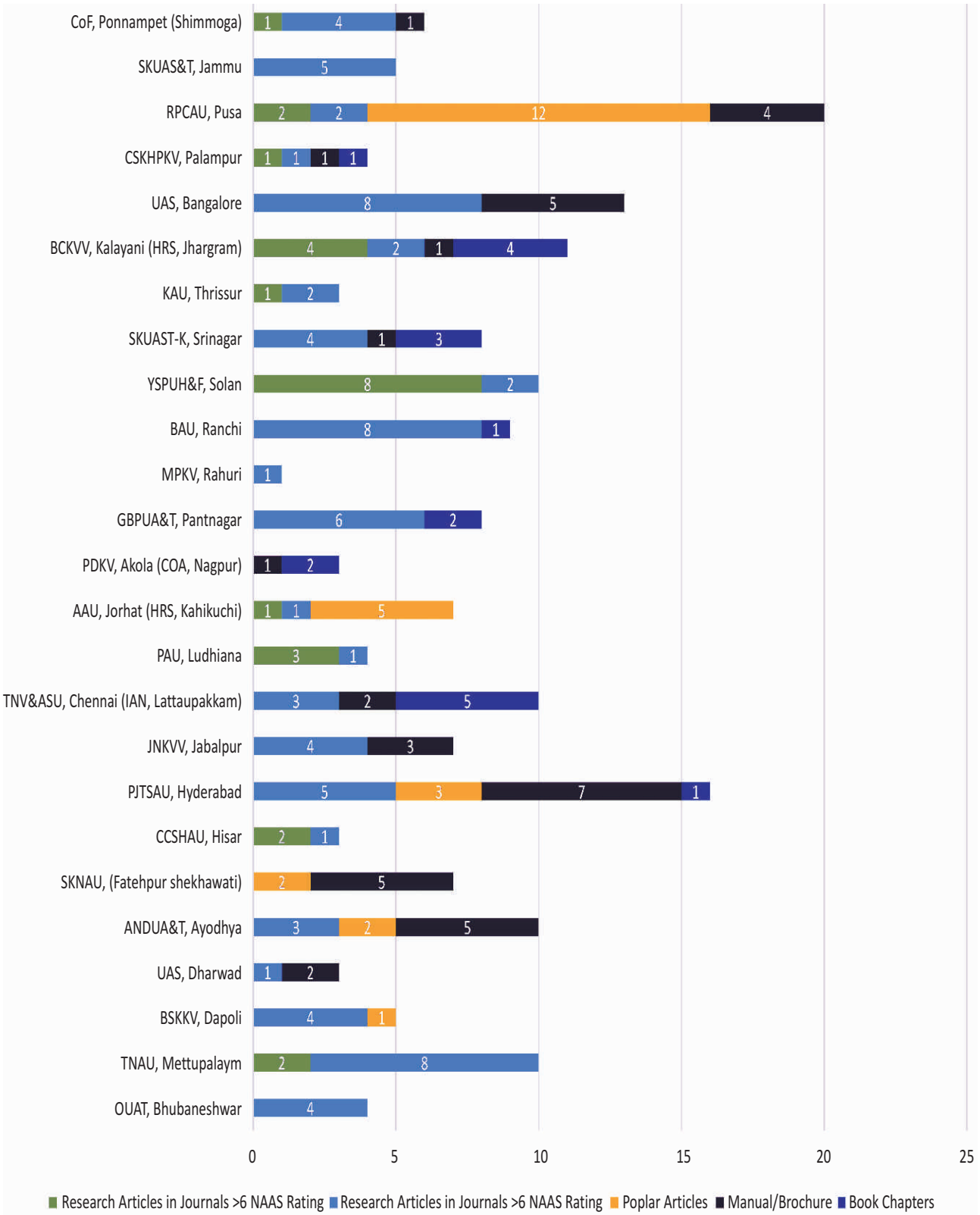
Dr Ramakrishna Hegde was invited to deliver guest lecture on Sustainable Sourcing of Jigat: Role of industry, academia, and farmers in the All India Agarbathi Manufactures Expo 2022 held at Bangalore on 26$^{th}$ November, 2022.

### BSKKV, DAPOLI

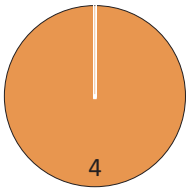
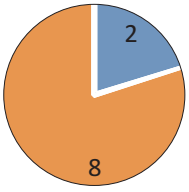
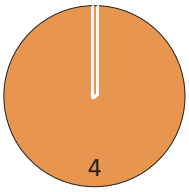
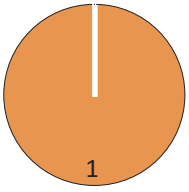
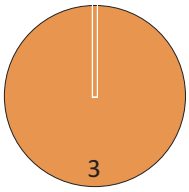
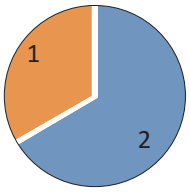
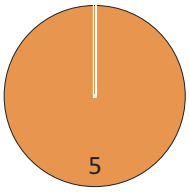
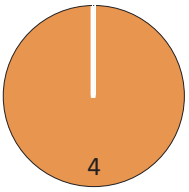
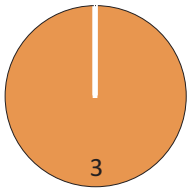
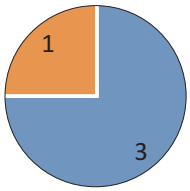
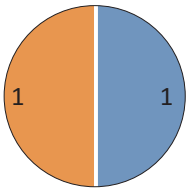
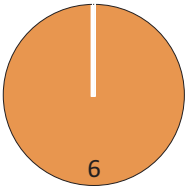
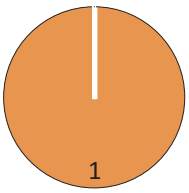
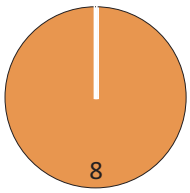
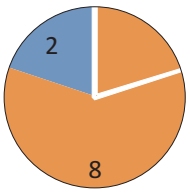
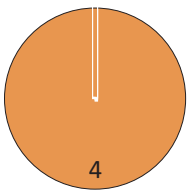
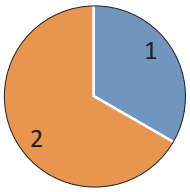
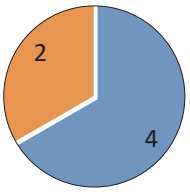
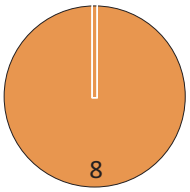
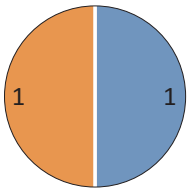
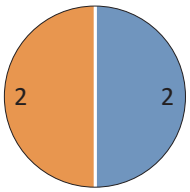
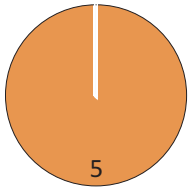
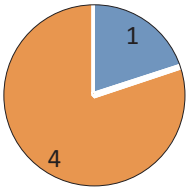
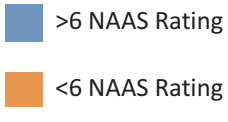
Dr. R.L. Kunkerkar and Dr. S.S. Desai received Best poster presentation award in National Conference of Maharashtra Society of Agricultural Economics held at Goa State during 5$^{th}$-6$^{th}$ May, 2022.

Dr. N. Meshram attended International Training Programme on "Diversification of costal agroecosystems for climate resilience and livelihood security" organized by ICAR- Central Coastal Agril. Res. Institute (Goa) & Centre for International Forestry Res. – World Agroforestry (ICRAF), New Delhi, on dated 7$^{th}$-11$^{th}$ November, 2022.

# 9. Research Publications

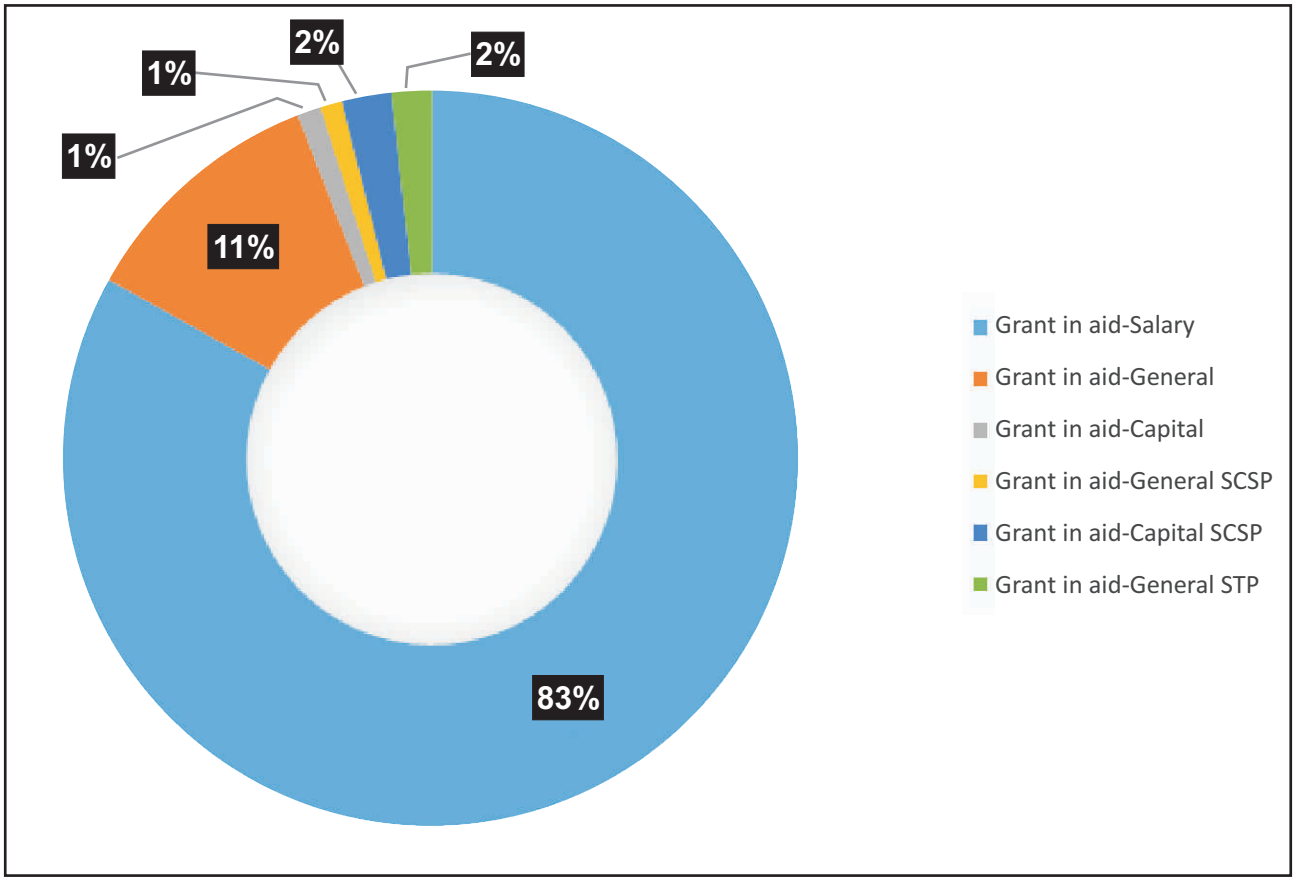



**Summary of publications for the year 2022-2023**

| OUAT | TNAU | BSKKV | UAS, Dharwad |
|---|---|---|---|
|  |  |  |  |
| **ANDUA&T, Ayodhya** | **SKNAU, (Fatehpur shekhawati)** | **PJTSAU, Hyderabad** | **JNKVV, Jabalpur** |
|  |  |  |  |
| **TNVASU, IAN,Kattaupakkam** | **PAU, Ludhiana** | **AAU, Jorhat (HRS, Kahikuchi)** | **GBPUA&T, Pantnagar** |
|  |  |  |  |
| **MPKV, Rahuri** | **BAU, Ranchi** | **YSPUH&F, Solan** | **SKUAST-K, Srinagar** |
|  |  |  |  |
| **KAU, Thrissur** | **BCKVV, (HRS, Jhargram)** | **UAS, Bangalore** | **CSKHPKV, Palampur** |
|  |  |  |  |
| **RPCAU, Pusa** | **SKUAS&T, Jammu** | **CoF, Ponnampet (Shimmoga)** | |
|  |  |  |  |

**Scientific articles published in journals sorted based on NAAS rating**

# 10. Budget (Centre wise head-wise break up for 2022-23)




# 11. Staff Strength

| Sl.No. | Name of the centre | Scientist (02 at each centre) | Tech. | Supp. Staff | Total |
|---|---|---|---|---|---|
| 1 | OUAT, Bhubaneshwar | Dr. S.C. Mohapatra and Mrs. Sasmita Behera | 1 | 2 | 5 |
| 2 | TNAU, Mettupalaym | Dr. I. Sekar and Dr. K. Vaiyapuri | 1 | 2 | 5 |
| 3 | BSKKV, Dapoli | Dr. Suchitra S. Desai and Dr. N.A. Meshram | 1 | 1 | 4 |
| 4 | UAS, Dharwad | Dr. H.Y. Patil and Dr. S.T. Hundekar | 1 | 2 | 5 |
| 5 | NDUA&T, Faizabad | Dr. S.K. Verma and Dr. Anjali Tiwari | 1 | 1 | 4 |
| 6 | SKNAU, (Fatehpur shekhawati) | Dr. Dharmendra Tripathi and Vacant | 1 | 2 | 5 |
| 7 | CCSHAU, Hisar | Dr. Chhavi Sirohi and Vacant | 1 | 1 | 4 |
| 8 | PJTSAU, Hyderabad | Dr. A.V. Ramanjaneyulu and Dr. T. Chaitanya | 1 | 1 | 4 |
| 9 | JNKVV, Jabalpur | Dr. S.B. Agarwal and Shri Yashpal Singh | 1 | 1 | 4 |
| 10 | TNV&ASU, Chennai (IAN, Kattaupakkam) | Dr. S. Gunasekaran and Dr. M. Suganthi | 1 | 1 | 4 |
| 11 | PAU, Ludhiana | Dr. R.I.S. Gill and Dr. Navneet Kaur | 1 | 1 | 4 |
| 12 | AAU, Jorhat (HRS, Kahikuchi) | Dr. Kusum Deka and Dr. Kaberi Mahanta | 1 | 1 | 4 |
| 13 | PDKV, Akola, (COA, Nagpur) | Dr. V.M. Ilorkar and Dr. P.D. Raut | 1 | 1 | 4 |
| 14 | GBPUA&T, Pantnagar | Dr. S.K. Lavania and Dr. Ashutosh Dubey | 1 | 2 | 5 |
| 15 | MPKV, Rahuri | Dr. B.R. Najan and Dr. R.H. Kolse | 1 | 1 | 4 |
| 16 | BAU, Ranchi | Dr. P.R. Oraon and Dr. Anil Kumar | 1 | 1 | 4 |
| 17 | SDAU, SK Nagar | Dr. F.K. Chaudhary and Prof. Lalita Saini | 1 | 2 | 5 |
| 18 | YSPUH&F, Solan | Dr. Rohit Bishist and Dr. Prashant Sharma | 1 | 2 | 5 |
| 19 | SKUAST-K, Srinagar | Dr. G.M. Bhat and Dr. Megna Rashid | 1 | 2 | 5 |
| 20 | KAU, Thrissur | Dr. V. Jamaludheen and Dr. Asha K. Raj | 1 | 2 | 5 |
| 21 | BCKVV, Kalayani (HRS, Jhargram) | Dr. Benukar Biswas and Dr. Subhabrata Panda | 1 | 2 | 5 |
| 22 | UAS, Bangalore | Mr. Bhaskar, V. and Dr. Hanumanthappa, D.C. | 1 | 1 | 4 |
| 23 | CSKHPKV, Palampur | Dr. Rameshwar Kumar and Vacant | 1 | 1 | 4 |
| | **TOTAL sanctioned** | **46 (44 in position)** | **23** | **33** | **102** |

# 12. Directory of Key Personnel

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| 29. | Dr. Sanjay Verma | ANDUAT, Ayodhaya | anduataicrpaf@gmail.com/ ver.sanj@gmail.com | 07408006003 |

# Notes

# Notes

Swachh Bharat Abhiyan

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