Tamil Nadu Agricultural University,
Coimbatore, Tamil Nadu, India.
www.tnau.ac.in
www.agritech.tnau.ac.in

TAMIL NADU AGRICULTURAL UNIVERSITY

PROGRESS TOWARDS PROSPERITY

TAMIL NADU AGRICULTURAL UNIVERSITY
COIMBATORE - 641 003
TAMIL NADU, INDIA

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TAMIL NADU AGRICULTURAL UNIVERSITY AT A GLANCE

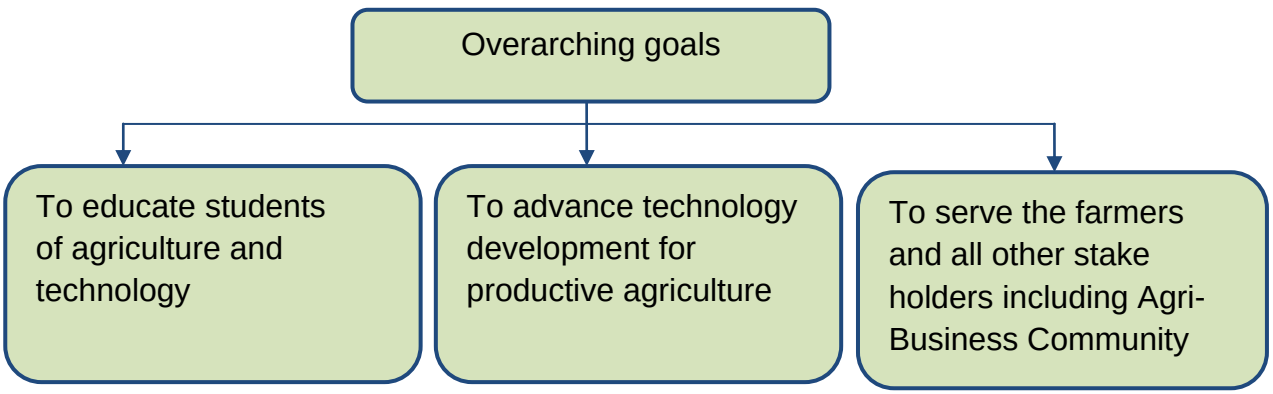
Genesis

Tamil Nadu Agricultural University (TNAU) rated as the best Agricultural University in India by Indian Council of Agricultural Research, New Delhi is an institute of excellence for higher education in Agriculture and allied subjects. The TNAU had begun as an Agricultural School at Saidapet in Chennai in 1868 and blossomed as a College in Coimbatore during 1906. In 1920, the college was affiliated to the University of Madras with the introduction of a three-year degree program. Till 1946, the Agricultural College and Research Institute, Coimbatore was the only institute for agricultural education for the whole of South India. In 1958, it was recognized as a Postgraduate Centre offering Masters and Doctoral degrees. The Agricultural College and Research Institute, Madurai was established in 1965. These two colleges formed the nucleus of the Tamil Nadu Agricultural University, when it was established in 1971 offering four year B. Sc. (Agri.) degree program. In the year 1972, the degree programs namely; B. Sc. (Horticulture) and B. E. (Agriculture) were started. In furtherance, in 1979, the faculty of Horticulture was established. To nurture the home grown innovations, in 1980, B. Sc. (Home Science) was started at Madurai campus. The third Agricultural College was started at Killikulam in 1984 and the fourth at Navalur Kuttappattu, Tiruchirappalli in 1989. B.Sc. (Forestry) program was started during 1985. at Mettupalayam. Currently the B.Sc. (Horticulture) and B. Tech. (Agricultural Engineering) degree programs are shifted from Coimbatore and offered at Horticultural College and Research Institute, Periyakulam and Agricultural Engineering College and Research Institute, Kumulur,

respectively. A new Horticultural College and Research Institute for Women at Navalur Kuttappattu, Tiruchirappalli, offering B. Sc. (Horticulture) was established during 2011. A unique programme B. Sc. (Sericulture) was started during 2011 at TNAU, Coimbatore and is currently offered at Forest College and Research Institute, Mettupalayam. During the year 2014, three more constituent Agricultural College and Research Institutes have been started at Tiruvannamalai, Pudukottai and Thanjavur districts. During the year 2015, the B.Sc (Home Science) degree has been discontinued and B.Sc (Food Science and Nutrition) has been introduced at the Home Science College and Research Institute, Madurai.

Mission and Vision of the University

TNAU's stand in the global arena is based on the newer technologies and innovations generated, scholars groomed with a thirst in research, with scientific spirit and agility among the farmers in acquiring and adopting the technologies. TNAU's research is centered towards developing time tested, cost effective, eco friendly and sustainable technologies for the upliftment of farmers.



Purpose

- To transform lives of farmers through broad based quality education offered in agriculture and technology including horticulture and forestry
- To provide need based technologies to the stake holders which will sustain environments and economies locally, regionally, and globally.

Mission

1. To impart education in various branches of agriculture and allied sciences & technologies as the university may determine.
2. To further the advancement of learning and pursuit of research in agriculture, allied sciences, and
3. To update agriculture knowledge and allied sciences of the farmers through appropriate extension technology in cooperation with the Government departments concerned.

Vision

- To become the most important driver in nation's economy and the world's top university in agricultural education and technology

The long term and short term agenda for education, research and extension are decided by the three supreme bodies *viz*. Academic Council, Research Council and Extension Council respectively, with inputs from primary stakeholder organisation namely; the Board of Studies / Regional Research Council and Regional Extension Council from the Agro-Climatic Regions in the state of Tamil Nadu for the smooth execution of all the three activities.

UNDER GRADUATE AND POST GRADUATE EDUCATION IN TNAU

In the backdrop of changing agricultural situation and developments in science and technology, besides the ongoing B.Sc. (Agriculture), B,Sc. (Horticulture), B.Tech (Agricultural Engineering), B.Sc. (Forestry), B.Sc. (Sericulture) and B.Sc. (Food Science and Nutrition), TNAU introduced unique technology programs viz., B. Tech. (Food Process Engineering) during 1998-1999, B. Tech. (Biotechnology) and B. Tech.(Horticulture) during 2002-2003, B. Tech. (Energy and Environmental Engineering) during 2004-2005 and B. Tech. (Bioinformatics) during 2006-2007. Owing to the developments in agricultural and information sciences and agri business and to capitalize on these potentialities, two courses, viz., B. S. (Agribusiness Management) and B. Tech.(Agricultural Information Technology) were started during 2007-2008. At present, TNAU is offering the following 13 Undergraduate degree programs of four year duration (eight semesters).

Academic programmes

Current number of academic programme / courses offered

Programmes	**Level of study**
Under Graduate Programmes	
B.Sc. (Agriculture)	Under Graduate
B.Sc.(Hortculture)	Under Graduate
B.Sc. (Forestry)	Under Graduate
B.Sc.(Food Science & Nutrition)	Under Graduate
B.Sc.(Sericulture)	Under Graduate
B.Tech (Agricultural Engineering)	Under Graduate

U.G. Courses offered by the University on Self –financing mode	
B. Tech. (Biotechnology)	Under Graduate
B. Tech. (Horticulture)	Under Graduate
B. Tech. (Food Process Engineering)	Under Graduate
B. Tech. (Energy and Environmental Engineering)	Under Graduate
B. Tech. (Bioinformatics)	Under Graduate
B. S. (Agribusiness Management)	Under Graduate
B. Tech. (Agricultural Information Technology)	Under Graduate
Post Graduate Programmes - Masters	
33 Programmes	Maters Program
The following programmes have students on self financing mode	
MBA (Agri Business Management)	PG
M.Sc., (Biotechnology)	PG
Post Graduate Programmes - Doctoral	
26 Programmes 4 Programmes 27 Programmes	Ph.D. (Regular) Integrated Ph.D. Part time Ph.D
ODL Programmes	
18 Programmes	Certificate course
3 Programmes	P.G. Diploma
3 Programmes	Post Graduate
1 Programme	B.F. Tech (3 years duration)

Industrial Internship at Foreign Countries for UG Programmes

Name of the student	I.D. No.	Name of the Institution and country
2013-14		
SHARMILA MANOHARAN	BTG-10-013	ALSA Solar System Limited, L.L.C., Post Box No. 53250, Abu Dhabi, UAE
2014-15		
Annamalai.R	BTF 11-007	M/s. Masfi, Dubai
PREETHISRI.L.K	BTF 11-031	
SWEETHA.C	BTF 11-051	
SHAHANA.K.T	BTF 11-040	Al Rawabi Dairy Co. L.L.C., Al Khawaneej, P.O. Box: 50368, Dubai
2015-16		
M.LEELA	BTH-12-036	Central National Research Scientifique, France
RA.SREE JANANI	BTB-12-039	University of Queensland, Australia
T.D.KAREN	BTB-12-013	Michigan State University, USA

P.G. Programme - Salient features

- Admission through entrance examination on all India basis
- Trimester Pattern adopted from 2014-15
- Part time Ph.D Programmes introduced to help industry / Agri-business executives
- Credit Transfer arrangement made to enable two way mobility of TNAU and Non-TNAU students from different countries to pursue higher studies
- Agricultural Graduate Students Conference – an annual event conducted since 2013, to enhance scientific temper and rigour among PG Scholars

- During the year 2014, 113 PG Scholars were availing fellowships offered by ICAR, UGC and GOI and six PG Scholars availed fellowships offered by Pvt., Industry.
- Special lectures are arranged making use of the Visiting Scholars / Scientists / Experts / Examiners to expose PG Scholars to the world view of development in Science and Technology and its applications
- MOUs have been signed to have internship to research scholars in private industries and Public and overseas Institutions for PG research
- Private industry / Financial Institutions / Agri-business are involved by the HODs concerned of the Disciplines for syllabus revision, within the overall frame work suggested by the ICAR.
- Structure of the curricula and syllabi of reputed Institutions available on-line are consulted in syllabus revision.

Linkages and Beneficiaries

More than 200 MOUs since 2009 have been signed with 39 foreign universities and 170 national institutes. This is an on going process and fresh MOUs are signed with new institutions.

Details of beneficiaries of linkages in terms of short visits, student-teacher exchange activities:

Category	No. of Beneficiaries at	
	National Institutes	International Institutes
Teachers	225	61
Students / Researchers	162	9

No. of teachers getting awards during the last five years:

- National : 30
- International : 4

E-Content Development

The e-course contents were developed by TNAU under ICAR-NAIP project for the following courses at National level for the use of SAUs throughout India.

i. B.Sc. (Agriculture) - TNAU - Lead Centre

ii. B.Sc. (Horticulture) - TNAU - Sub Centre

iii. B.Tech (Agricultural Engineering) - TNAU - Sub Centre

Distance Education Programme

The Directorate of Open and Distance Learning, one of the constituent units of the Tamil Nadu Agricultural University started in April 2005 is vested with the responsibilities of offering distance learning programmes through correspondence mode viz., Certificate courses, Diploma, B.F.Tech Degree, PG Diploma and PG Degree programmes for the benefit of various segments of the farming community, entrepreneurs, self help groups and other learners who aspire for correspondence education and interest in establishing agro based industries in rural areas.

EXAMINATION AND EVALUATION

The Controllerate of Examinations is vested with the responsibility of conducting and monitoring the examination related activities of 13 undergraduate programmes in 28 colleges, all the Master, Doctoral, Diploma and Open and Distance Learning Programmes. Paperless

examination has been introduced on experimental basis. On line examination is in vogue for mid semester examinations.

UNIVERSITY LIBRARY

The University Library caters the information needs of teachers, students, research scholars, extension personnel and farmers. At present the Library has crossed 1,80,674 books and back volumes. 2190 books are newly added and 49 e- books are purchased for perpetual access during 2014-15. For the benefit of users, the library subscribed 140 (print) Indian journals and 12 (print) foreign journals. Apart from CeRA the students have access to all the digitized documents and subscribed Databases. Facility has also been created to access e- books and e- journals subscribed in the TNAU Central Library from the constituent college libraries. The Library is providing Online Public Access Catalogue to the teachers, scientists and students. Two touch computers were placed to search OPAC at the Ground floor of the library to search and retrieve the information of the holding of the library.

Under the NAIP e- Granth Project (2013-14) 7.80 lakhs (0.78 million) pages were digitized and 2994 documents were uploaded to Krishikhosh website. With the help of world cat, TNAU users access the materials of 200 million documents available in 72,000 libraries across the globe. Under this project nearly 50,000 library catalogue records have been added to the world cat.

Details of facilities in the Central library for research:

- No of books and back volumes - 1,80,674
- No of journals - 3410 (including e-Journals)

STUDENT PLACEMENT

The Directorate of Students Welfare involves in promoting capacity building and employability of agricultural graduates to meet the requirement of the industry. The Under Graduate and Post Graduate students of TNAU are facilitated and guided for their better placement and higher studies. The Directorate of Students' Welfare (DSW) in Tamil Nadu Agricultural University, Coimbatore is the nodal centre of Students' Counseling and Placement activities for all the constituent colleges of the university. The vision of the Directorate is to build confidence and competence among agricultural graduates to enable them to compete globally and promote job opportunities at national and international levels.

The core activities of DSW are

- Job placement,
- Facilitating for higher education abroad
- Career Counseling.

Placement

A webpage is also maintained for the job opportunities for agriculture graduates and is periodically updated.

Job Fair: The Directorate of Students Welfare organizes the Job Fair annually. As many as 600 -700 passing out students-both PG and UG from all constituent colleges of TNAU participate in the fair. On an average 20 organisations participate in the programme.

On campus and Off Campus Interviews are conducted periodically based on the demand from the organizations. The graduates are recruited by leading agro based companies like seed, biofertilizers,

biopesticides, private banking sectors, non-governmental organizations and the corporate sectors. The placement is being done by conducting written test, Group discussion and Personal Interview. The employers are facilitated by the Directorate of Students Welfare to select candidates of desired skills. The last five years close to 2000 students were placed in different industires and financial institutions.

Higher Education Abroad – Under Graduate level

Dual Degree Program (On-going programme)

TNAU has signed MOU with **Dalhousie University, Canada** to offer Dual Degree Program for UG students of B.Sc. (Ag.), B.Sc. (Horti.) and B.Tech. (Horti.) in B.Tech (Environmental Landscape Horticulture). The program was started in the year 2009-10. Number of students admitted in this program up to 2014-15 is furnished.

Year	No. of students selected
2009	2
2010	8
2011	6
2012	3
2013	3
2014	1
Total	23

INTERNATIONAL CELL, DIRECTORATE OF PLANNING AND MONITORING

To face the pressure of globalization from all directions, the universities have to internationalize their education process. TNAU has set out to make its presence felt globally through internationalization of its programmes and opening new avenues of association for global student community. From the inception TNAU has introduced credit based trimester system in the beginning and semester system of education later-on to facilitate transfer of credits at national and international level. A number of MOUs have been signed with leading foreign universities whereby sharing of the facilities in the university and exchange of teachers and students can be made possible. (Table 1)

Table 1. MOUs signed with Foreign Institutions in the last three years

Year	Total No. Of MOU signed	MOU signed with foreign institutions	Percentage of MOU signed with Foreign
2012	64	14	21.87
2013	79	9	11.39
2014	55	12	21.81

The mission of the TNAU-International Cell created on September 2014 is to enhance the international activities by organising interaction meetings with foreign universities for students and faculty exchange, arranging for signing MOUs, organising conferences and seminars, arranging for guest speakers and scholars to visit the University, and coordinating research activities on topics related to international importance. The cell is functioning with the following objectives:

a. To create data-base on faculty and student exchange programmes
b. To provide facilities to identify opportunities abroad for TNAU students.
c. Capacity Building of TNAU students to capture international opportunities through training programmes, seminars and workshops.
d. Shape TNAU's international agricultural education and research policy as per globalisation needs.

At present the University has established academic and research collaborations with more than 71 foreign Universities/Institutions through MoUs. Professors from overseas institutions have been visiting TNAU and collaborating with faculty and students. About 129 faculty members of TNAU have visited the following countries from 2011-12 to 2013-14 : **Cornell University, USA**; University of Adelaide, Australia; University of South Australia; Universita Politechnica delle Marche, Italy; University of Saskatchewan, Canada; McGill University, Canada; Durban University of Technology, South Africa; International Rice Research Institute, Philippines; Hebrew University of Jerusalem, Israel; Volcani Centre, Israel; N Parks, Singapore; Justus Leibzig University, Germany; Leibniz University, Canada; Chiba University, Japan; University of Tokyo, Japan; Chungbuk National University, South Korea. **University of Idaho, USA**. One senior professor from **University of Wisconsin, USA** was on **Fulbright Specialist Programme** at TNAU in 2012-13. The majority of the projects are funded by FAO, World Bank, IRRI, ICRISAT, CIDA, SIDA, US-AID, Rockfeller Foundation, Fullbright foundation, IFPRI and International Universities in Japan, USA, Germany, Canada etc. TNAU has Double Degree programmes with Cornell University USA, Novas Scotia College of Agriculture, McGill University, Saskatchewan

University in Canada. The Cell also arranges for internships for the final year undergraduate students in industries / institutions abroad. Presently the under graduate students are going for internship in United States of America, Germany, Australia, France, Singapore, Malaysia and middle east countries besides companies within the state and country.

AGRICULTURAL HUMAN RESORCE DEVELOPMENT PROJECT (AHRDP) IMPLEMENTATION AND FOLLOWUP IN TNAU

The World Bank aided Agricultural Human Resources Development Project was implemented in TNAU during 1995-2001, with the following objectives.

Objectives

- To improve the quality and relevance of higher agricultural education and in-service training programs.
- To strengthen the capacity for developing and managing agricultural human resources

Further, the project was intended;

- To enhance teaching standards through staff improvement
- To upgrade student education
- To improve University Administration

The major reforms made

i. Stakeholder Involvement in curriculum development and revision of syllabi for various Graduate and Post Graduate Degree Programmes

ii. Commercial Agriculture courses for entrepreneurship development and enhancing employability of graduates

iii. Greater focus on environment, use of bio-resources, landscaping, agriculture marketing and agri-business in curriculum and syllabi.

iv. Introduction of technology courses to cater to the job market on self supporting basis
v. Board of Management membership

Gains

i. Work Experience Programmes through industry / laboratory placements including overseas institutions to impart industry readiness among graduates and to expose them to corporate culture.
ii. Exposure to practical learning environment such as; IFS model, energy park, crop cafeteria, etc.,
iii. Class room modernization for effective teaching, communication and learning
iv. Laboratory Strengthening by modern equipments and gadgets
v. Establishment of computer laboratories
vi. Library modernization and e-resources
vii. Establishment of Students Welfare Centre
viii. Training of teachers (1100) in Educational Technology and few other specialized areas and Administrative staff (400) for improved execution of administrative functions in domestic institutions
ix. 161 teachers trained in reputed Overseas Institutions of 13 Countries

Outcomes

i. Number of Students succeeding in competitive examinations like JRF/SRF in ICAR examinations and ARS examination and civil services has increased.

ii. A large number of graduates are placed in banking sector and private companies including overseas organizations.

iii. Increasing number of graduate take up self employment

iv. Increase in number of graduates admitted for higher education in other National and Overseas Institutions besides TNAU.

v. Increasing trend in mobilization of research fund from GOI and other sources.

vi. TNAU is the first SAU Accredited by the ICAR in the year 1999-2000.

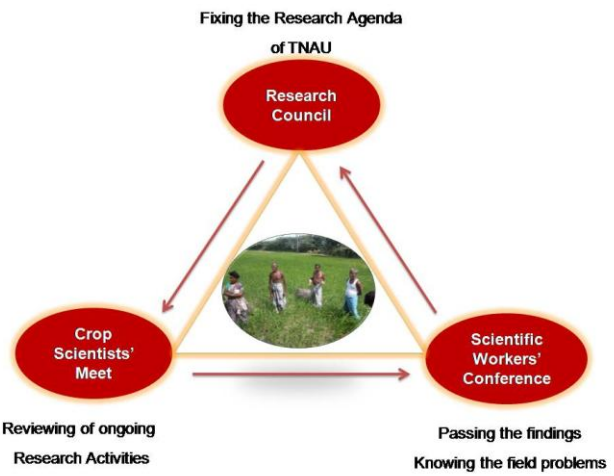
vii. TNAU was adjudged as the Best among SAUs in India twice between 1999 and 2010

viii. TNAU received the 1st Overall Excellence Award instituted by the FICCI for the year 2014, during the Higher Education Summit-2014 held jointly by India and UK in November 2014 at New Delhi.

RESEARCH

TNAU's stand in the global arena is based on the newer technologies and innovations generated, groomed scholars with a thirst in research with scientific spirit and agility among the farmers in acquiring and adopting the technologies. Basically, sound research can meet all the above requirements. TNAU's research is centered towards developing time tested, cost effective, eco friendly and sustainable technologies for the upliftment of farmers. During the 12th Five Year Plan period TNAU has embarked upon: a) Research for innovative solutions, b) Putting innovative solutions into practice and c) Promoting science and technology based agri business. TNAU is the only agricultural University in India following the 'centre concept to co ordinate research in related disciplines with in the university'. Seven such centres are functioning in TNAU. Besides research is carried out in the constituent colleges and 38 research stations spread all over Tamil Nadu.

The research agenda are decided based on the outcome from three annual meetings, *viz*, Research Council Meeting, Annual Crop Scientists' Meet and Scientific Workers' Conference. The roles of all the three components are given below as a schematic representation.



No. of teachers actively involved in research:

- Guiding M. Phil / Ph.D : 579
- Operating Research Projects : 750
- Offering Consultancy : 65

Research projects approved and completed during the last 5 years : 1279 nos.

Ongoing research project approved during last 5 years

Sl. No.	Name of the scheme	Number ongoing
1.	University sub projects	1210
2.	Tamil Nadu Government schemes	21
3.	ICAR fully financed	42
4.	ICAR Fully financed NAIP	10
5.	GOI sponsored schemes	136
6.	Private agencies Schemes	239
7.	Foreign agencies Schemes	32
8.	AICRP Schemes	63
9.	Collaborative Schemes with other Universities	74
	Total	1827

SIGNIFICANT OUTREACH INITIATIVES OF TAMIL NADU AGRICULTURAL UNIVERSITY

The Directorate of Extension Education (DoEE) is primarily responsible for expeditious transfer of the latest technologies emanating from various research programmes of the Tamil Nadu Agricultural University to the farming community and extension personnel. The following are the major activities carried out by the Directorate of Extension Education.

Krishi Vigyan Kendras (KVKs) – Technology Transfer Centres

Out of 31 KVKs in Tamil Nadu, 14 KVKs are under Tamil Nadu Agricultural University which are located in Madurai, Sirugamani, Tindivanam, Vriddhachalam, Vamban, Virinjipuram, Pechiparai, Sandhiyur, Ramnad, Sikkal, Tirur, Needamangalam, Aruppukkottai, and Papprapatti. All 31 ICAR funded KVKs in Tamil Nadu are under the technical control of Director of Extension Education, TNAU, Coimbatore.

Educational Media Centre (EMC)

The Radio Recording studio was started on 30.05.1978 for production of Scientists' talk in digital format and to conduct farm school for broadcast through All India Radio (AIR) stations of Tamil Nadu & Pondicherry.

Later it was upgraded into a Video Library on 1-4-1987 with an aim to produce video films and modules in agriculture and allied subjects with telecast quality and to participate in showcasing events, exhibitions, farmers mela to document successful technologies, farmers' success stories and also to develope video modules.

The salient achievements of the video library are:

- Documentation of 1000 video 3GP clippings for cloud computing and accessed in iPad / Tablet / Android mobile / 3 GP mobile.
- Production of Complementary Educational Modules for Post Graduate Diploma in Agrl. Extension course sponsored by MANAGE, Hyderabad.
- Production of 200 Electronic Complementary Video Modules for PGDAEM (Both in English & Hindi).

TNAU Community Radio Station

Community Radio is an effective tool to disseminate the farm technologies to the farming community living around 18 km from the Radio Station.

Special features

- TNAU Community Radio Station is functioning as 'Velaan Palkalaikkazhaga Vivasaayee FM' at 107.4 MHz frequency since 2010.
- Daily broadcast of agricultural information for 6 hours benefits 10,000 farm families residing in 22 villages around TNAU campus.

e-Extension centre

Tamil Nadu Agricultural University has explored the power and potential of Information and Communication Technology (ICT) intervention in Transfer of Farm Technology which may accelerate the speed of flow of technology, weather data and price information to extension system and finally reach to the needy farmers. Effort on promotion of ICT will help the 'young minds' to be in the farming. The following are new media outreach initiatives of TNAU since 2008.

TNAU Agritech Portal (www.agritech.tnau.ac.in)

- An open access portal which transfer the Agricultural related information and new technologies to the farmers and extension officials.
- Dynamic and Multi Media Portal in bi-lingual (Tamil & English) covering around five lakh web pages.
- A to Z farming information for decision making at field level

- Received Specific Sectoral Award-Gold in National Award for e-Governance, 2010-2011 from Government of India and Sardar Patel Outstanding ICAR Institution Award for 2010.
- Daily visitors: 11,000-13,500
- Average time spent on site: 15-17.50 minutes
- Bounce Rate: 74.02%

Multiple Video Conference Facility (http://vcon.tnau.ac.in)

- Facility to invite, share, interact and educate on farm information among scientists, Extension Official and Farmers.
- Links 60 centres (14 KVKs + 36 RRS / ARS / HRS + 10 Colleges) of TNAU
- 24 Parallel session on topic wise and possible to share Power Point presentation with all users

Expert System for Agriculture and Animal Husbandry

- A knowledge based system with computer designed programme to facilitate the problem-solving in a narrow domain or discipline.
- Facilitate instant decision making process of the farmers through ICT enabled mechanism.
- Developed Expert System in multi-lingual format (English, Tamil, Malayalam and Kannada) for crops (Paddy, Sugarcane, Ragi, Coconut and Banana) and animal enterprises (Cattle and Buffalo, Sheep and Goat and Poultry)

Mobile based Agro Advisory System

- Experimentation with 1200 farmers in 3 districts of Tamil Nadu
- Reaching the farmers through mobile platform with mobile SMS, video and Audio conversation
- Direct interaction with experts in University Agricultural Extension centers for technology clarification
- Under the World Bank funded TN-IAMWARM programme the farmers were connected to scientist by sending crop damage images through email / SMS for real time response from scientist in terms of instant advice for taking remedial measures. This has been proven in multiple locations and currently handed over to the state Department of Agriculture for implementation.

Tamil Nadu Agricultural Weather Network (http://tawn.tnau.ac.in)

- Installed 385 Automatic Weather Stations (AWS) in all the 385 development blocks in the state.
- Provides 10 types of Agricultural related weather parameters at hourly interval
- Assists Agriculture Officer to develop weather based agro advisories to the farmers at block level and also to share medium range weather forecast by using these weather parameters.

Commercialization of research outcome

The Directorate of agribusiness development coordinates the commercialization of the technologies developed. SRI power weeder, solar crop drier and TNAU Stored grain management kit have been commercialized through Agribusiness Development with M/s Basaras Biocon (India) Pvt.Ltd, Chennai, M/s Rich Phytocare Pvt. Ltd, Theni, M/s

Unique Fabricators, Coimbatore and M/s Melwin Engineering, Coimbatore besides receiving royalty from three companies (M/s Bhuvicare Pvt.Ltd, Tirunelveli, M/s Nitta gelatin India Ltd, Cochin, M/s Renny Marketing, Coimbatore). The Directorate also has on Agri-Business incubator for refinement and up scaling of business ventures.

IMPORTANT AWARDS OBTAINED BY TNAU SINCE 2011-12

1. e-Governance GOLD AWARD, 2014-15

Agriculture Department, Tamil Nadu in collaboration with TNAU has won National Award for eGovernance GOLD AWARD, 2014-15 given by the Department of Administrative Reforms and Public Grievances and Department of Information Technology, Government of India on 30th January 2015.

2. Global Quality Award 2014

Global Quality Award 2014 was conferred on Tamil Nadu Agricultural University for Quality Education in Agricultural University on 10.01.2015 by Brands Academy, New Delhi.

3. Overall Excellence Award from Federation of Indian Chamber of Commerce and Industry (FICCI)

Tamil Nadu Agricultural University was conferred with the prestigious "Overall Excellence Award" by Federation of Indian Chambers of Commerce and Industry (FICCI). The award was given on November 13, 2014 in recognition of exhibiting overall excellence in the sphere of Indian Higher Education.

4. Education Excellence Award 2014

Brands Academy Education Excellence Award 2014 was awarded to Tamil Nadu Agricultural University on 23.08.2014 by Brands Academy, New Delhi.

5. Agri-Business Idol Camp Award for TNAU

The Agri Business Directorate of TNAU received the Agri-Business Idol Camp Award for innovative ideas during the NAIP innovation conclave held on 18-19, May 2014 by the Indian Council of Agricultural Research, Government of India.

6. National Intellectual Property Award, 2013 for TNAU

The National IP Award instituted by Indian Patent Office, Government of India. Department of Industrial Policy and Promotion (DIPP) and Intellectual Property Office, Government of India, in collaboration with Confederation of Indian Industry (CII) was conferred to Tamil Nadu Agricultural University as the Top Indian Academic Institution in Patent, 2013 on 26th April 2013.

7. Sardar Patel Outstanding Institution Award

Tamil Nadu Agricultural University got the Sardar Patel Outstanding Institution Award by the Indian Council of Agricultural Research in 2010.

SPECIAL PROGRAMME FOR DUAL DEGREE WITH CORNELL UNIVERSITY, ITHACA, USA FROM 2009 TO 2012

The Tamil Nadu Agricultural University (TNAU), Coimbatore, a leader in agricultural Education in South Asia, in partnership with Cornell University, Ithaca, NY, USA, an Ivy League university and the global leader for agricultural research and education is offering students in India and USA a dual master's degree program that integrates Cornell's Master of Professional Studies (MPS) and TNAU's Master of Technology (M.Tech). The course is the first dual degree offered by any Land Grant University of US origin in partnership with a State Agriculture University in India. Recent trends in cutting edge technologies and the global food industry have resulted in a demand for professionals with awareness and expertise in ground breaking trends in the areas of biotechnology, food processing, value addition and marketing complemented by international exposure and global perspectives. The program fills significant unmet needs for life science professionals who can effectively combine science, technology and management knowledge and skills together to benefit an industry characterized by high levels of global integration. The cohorts are also trained adequately to engage in rural development that can bring sustainable gains through enterprise development and technology transfer.

The initial courses are focused on i) Food processing and marketing and ii) Biotechnology and Business Management with further courses tailored to address other disciplines such as Agrl. Extension and rural development. The partnership will provide sustainable gains in institutional building at TNAU end and provide a considerable global integration opportunity for using Cornell expertise for our graduates and pave way for growth of agri-business industries in Tamil Nadu. The list

of students in Master of Professional Studies (MPS) & Master of Science (MS) are given below.

a. I batch MPS students (2009)

Sl.No	Name
1.	Chiranth, C.R.
2.	Vishakumari, V.
3.	Kiran Gadhave
4.	Roshni Vijayan
5.	Sumita Sen
6.	Rajaguru
7.	Revathi
8.	Banupriya
9.	Kalavathy Rajan
10.	Sreedath Tulamandi
11.	Pranjal Singh, KB
12.	Kriti saxena
13.	Supriya shahi

b. II batch MPS students (2010)

Sl.No.	Name
1.	Ms. R. Brinda
2.	Ms. M. Priyadharshini
3.	Mr. Arun Viswanathan
4.	Mr. P. Daniel Paul
5.	Mr. Shashank Gaur
6.	Mr. Manika Singh
7.	Mr. P. Krishnadasan
8.	Ms. R. Dhivyaa
9.	Mr. P. Dhyaneswaran
10.	Mr. Sandeep Singh Tomar
11.	Ms. Shruti Anand
12.	Ms. Rosalane Kithan
13.	Ms. Anitha N.R.

C. III batch MPS / MS students (2011)

Experience and knowledge gained in executing the ongoing Dual Degree MPS program at TNAU with Cornell University is the base on which the new program is built upon. In two years, 26 students have undergone MPS program at Cornell, in which 13 students were graduated in Jan. 2011. The MPS dual degree program has set trends for innovation in collaborative international education.

a. The two academic years have provided unprecedented recognition for this dual degree from Indian policy makers, industry partners and the international academic community. However, the MPS model provided exposure at Cornell mostly towards industry orientation and limits research opportunity.

b. The new program gave greater opportunity for students to pursue an intensive research degree with extended duration of stay at Cornell. This has also increased the options for the TNAU students to pursue MS at Cornell, facilitates joint faculty monitoring and joint research opportunities with Cornell University.

Sl. No	Name
1.	Mr. T.P.Parthiban - MS
2.	Ms. T.Philomin Juliana - MS
3.	Mr. Saurabh Gautam - MS
4.	Mr. Praghadeesh - MPS
5.	Ms. Devika - MPS
6.	Ms. J.Sowkya - MPS

D. IV batch MS students (2012)

Sl. No.	Name
1.	Ms. Divyashree C. Nageswaran
2.	Mr. Teddy S. Yesudasan
3.	Mr. S. Sathish Kumar

TNAU-Cornell Dual Degree program is a successful working Model in the country to strengthen international collaborations in Agrl. Education & Research. TNAU students have exhibited their outstanding performance through this program and the Director General-ICAR has also appreciated this program. The TNAU students are well placed in Industries and few are pursuing Doctoral program in US/Germany.

Mr. P.Dhyaneswaran	- Ph.D. Cornell University, USA
Ms. Kalavathi	- Ph.D. at University of Arizona, Arkansas, USA
Mr. Pranjal Singh	- Ph.D at University of Minnesota, USA
Ms. Divyaa Reddy	- Ph.D. at University of Cologne, Germany
Mr. Shashank Gaur	- Ph.D at University of Illinois, ICAR International fellow
Ms. Revathi	- Asst. Manager in Sathguru Management Consultants, HYD
Ms. Banu Priya	- Food technologist at Annapoorna Foods
Mr. Sreedath Thulamandi	- Asst. Director, Indian Institute of Packaging, Mumbai
Ms. Keerthi Saxena	- Manager - Purchase at Spaar Market, New Delhi.
Mr. Krishnadasan	- Food Safety and HACCP certification
Mr. Daniel paul	- Lecturer - Food processing at Karunya Univ., Coimbatore
Mr. Arun Viswanathan	- Food Technologist - Shakthi Dairy, Coimbatore

a. Cornell – TNAU dual degree program had provided the students a brainstorming exposure about education in US. The experience gained through this program is a big leap in their career in respect with all spheres.

b. Cornell has plenty of resources to offer to the students. The most striking feature about the university is its diversity in courses. Students can pick their own courses of their choice and according to ones interests. Ambient environment and infrastructural facilities at Cornell makes it one of the most preferred choice for international students.

c. The courses are highly informative and advanced which gave an insight about current research avenues. The field visits and labs had given practical experience on agricultural and breeding methods and food science in US. Friendly approach by the instructors and ease in carrying out discussions with professors and class members though seem to be minor importance but it had made significant contribution in planning research.

d. The most astonishing fact which fascinated the students is Cornell University's Mann library. It has huge collection of materials, manuscripts, literature both online and hardcopy resources. A strong review of literature leads to well tuned research. Cornell provides outstanding facilities to readers. Most of the students prefer to study in library rather than their houses, Eventually, Cornell Mann library has become their favourite study arena.

e. IARD course which the students underwent during the Fall break was one of the best trips to India with friends from US had made to relearn about Indian Agriculture. It had depicted Indian agriculture in a different perspective. This course had reinforced that 'India is a land of opportunities; people succeed when one finds right business at right time'.

f. In short, Dual degree program is like a power play of gaining knowledge, experience, exposure, social, cultural and personal development

Milestones

MoU signed between TNAU & Cornell University on 13.2.2008

MPS program converted into MS program approved by 112th Academic Council held on 18.4.2011

Ist graduation ceremony - 7.1.2011

IInd graduation ceremony - 4.1.2012

Batch	Year	No. of students	Course studied
I	2009	13	MPS-Plant Breeding)Cornell University & M. Tech (Biotechnology and Business Management) TNAU Master of Professional Studies (MPS-Food Science) Cornell University & M. Tech (Food Processing and Marketing) TNAU
II	2010	13	MPS-Plant Breeding) Cornell University & M. Tech (Biotechnology and Business Management) TNAU Master of Professional Studies (MPS-Food Science) Cornell University & M. Tech (Food Processing and Marketing) TNAU
III	2011	6	MS/MPS
IV	2012	3	MS

PG STUDENTS FROM AFRICA STUDYING IN TNAU

Sl. No.	**Name**	**Country**	**Degree Program**
1.	Hassen Shifa Gebeyo (12-613-011)	Ethiopia	Ph.D. Plant Pathology
2.	Gizachew Haile Gidamo (12-608-007)	Ethiopia	Ph.D. Biotechnology
3.	Adu Emmanuel Adeyemi (2014604111)	Nigeria	M. Tech. Agrl. Process Engg.
4.	Awah, Jane Ljeoma (2014600327)	Nigeria	M.Sc. Biotechnology
5.	Ahmed Auwal (2014600328)	Nigeria	M.Sc. Biotechnology
6.	Joseph Okpani Mbe (2014600819)	Nigeria	M.Sc. Genetics& Plant Breeding
7.	Isong Abaianyanga Edem (2014800809)	Nigeria	Ph.D. Genetics& Plant Breeding
8.	Eunice Iyabode Oloniruha (2014800305)	Nigeria	Ph.D. Biotechnology
9.	Kabagwira Angelique (13-544-009)	Rwanda	M. Tech. Soil and Water Conservation Engg.
10.	Uwase Rosine (13-544-010)	Rwanda	M. Tech. Soil and Water Conservation Engg.
11.	Prudent Safari (13-534-009)	Rwanda	M.Sc. Vegetable Science
12.	Nyampatsi Jean Claude (13-534-010)	Rwanda	M.Sc. Vegetable Science
13.	Florien Habimana (13-515-012)	Rwanda	M.Sc. Soil Science & Agrl. Chemistry
14.	Adam Juma Abdalla (12-642-001)	South Sudan	Ph.D. Bio-Energy
15.	Sara Shomo Hamad (13-613-009)	Sudan	Ph.D. Plant Pathology

CURRENT INDO-US COLLABORATIVE PROJECTS:

I. US-India Consortium for Development of Sustainable Advanced Lignocellulosic Biofuel Systems (IUSSTF / JCERDC-SALBS / 2012 dated 22 November 2012):

US-Indo collaborative project is with the key objective of sustainable biofuel production from lignocellulosic biomass; The overall goal is to address second generation biofuel research and development priority area of the US-India Joint Clean Energy Research and Development Center and the technical goals are to develop and demonstrate commercially scalable lignocellulosic biofuels through sustained feedstock cultivation and supply, efficient pre-treatment and saccharification of biomass, engineered biocatalysts and novel processes for biofuel production and environmentally and economically sustainable practices.

Lead Institutions are

CSIR-Indian Institute of Chemical Technology, Hyderabad, India. and
University of Florida, Gainesville, FL, USA.

The Consortia partners are Indian:

1. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad, India
2. Directorate of Sorghum Research (DSR)
3. Jawaharlal Nehru Technological University (JNTU)
4. **Tamil Nadu Agricultural University (TNAU)**
5. Rajamata Vijayaraje Scindia Krishi Vishwa Vidyalaya (RVSKVV)
6. Indian Institute of Technology, Delhi (IIT-D)
7. Indian Institute of Technology, Madras (IIT-M)
8. Centre for Economic and Social Studies (CESS)

U.S.:

1. University of Florida (UF)
2. University of Missouri (UM)
3. Virginia Polytechnic Institute and State University
4. Montclair State University (MSU)
5. Texas A&M University (TAMU)

Industry Partners:

Indian:

1. Abellon Clean Energy Ltd, Ahmedabad, India
2. Hindustan Petroleum Corp., Ltd, India

U.S.:

1. Show Me Energy
2. Green Technologies Gainesville, FL, USA

II. Novel Archaeal Biomass deconstructing enzymes –laccase

Laccases (para-diphenol:dioxygen oxidoreductases, EC 1.10.3.2) are a diverse group of multicopper oxidases (MCOs) that catalyze the oxidation of a wide range of inorganic and aromatic compounds, particularly phenols, while reducing molecular oxygen to water. These enzymes are implicated in a variety of biological activities. The large range of substrates oxidized by laccases has raised interest in using them within different industrial fields, such as pulp delignification, textile dye bleaching and bioremediation. While laccases from eukaryotes and bacteria have been extensively studied, archaeal multicopper oxidase homologs are less understood. The first archaeal laccase (LccA of the haloarchaeon *Haloferax volcanii*) that oxidizes phenolics has been characterized at the protein level so far (Sivakumar Uthandi *et al*., 2010)

by us, which was highly active and secreted extracellulary. Enzymes from extremophilic archaea, such as these, are promising for industrial applications, as they have high intrinsic thermal and chemical stability. To cater to the needs of industries for various applications, it is desirable to produce biocatalysts in large quantities and at low cost. Our initial work on expression of the full-length *lccA* gene of *H. volcanii* in recombinant *E. coli* failed to yield high levels of protein. Consequently, we worked on the development of a recombinant expression system with modifications in the LccA protein sequence. Both the twin-arginine translocation (TAT) motif and the propeptide sequence were modified to produce the *H. volcanii* LccA protein in a soluble active form in *E. coli* (Sivakumar Uthandi *et al*., 2011).

CENTER FOR PLANT MOLECULAR BIOLOGY AND BIOTECHNOLOGY

International Agriculture and Rural Development (IARD) program

(Cornell University, USA)

This program of Cornell University comprises IARD 402 and IARD 602 courses. In IARD 402 course students are given assignment on Cornell blackboard website every week and students read the paper, understand and give their feedback before next assignment is uploaded. Course duration is 3 months from September to December first week. In IARD 602 course which begins in January every year (4^{th} to 17^{th} January), students are exposed to various agro and rural enterprises. Students have to contribute significant time in preparation towards the class and discuss the topic with faculty. Cornell faculty and students join in IARD 602 course, in which field trip covers two states. Students and faculty are grouped based on identified theme areas *viz*., agrl. systems, rural infrastructure and value addition. Each group visits different academic and research institutes, NGOs, industries to gain hands on experience. At the end of IARD602 course, group project is assigned to Indian and Cornell students. They discuss, present outline of the project during field trip. The detailed project paper is submitted in the month of April for evaluation by Cornell and Indian Faculty.

In 2013-14 and 2014-15, four students each (4 boys+4 girls) have been nominated for the above program and for the year 2015-16, six students (3 boys+3 girls) have been nominated.

TNAU students interact with Cornell faculty and students on various aspects of agriculture and Cornell students are exposed to Indian agriculture research, farmers' livelihood and agro industries.

Students are given a certificate by Cornell University once they complete IARD 402 and IARD 602 courses.

CPMB, TNAU activities with involvement of US agencies

IPMCRSP

The Integrated Pest Management Innovation Lab, or IPM IL (formerly the IPM CRSP), is a large, multi-year effort supported by USAID to introduce and maintain IPM best practices and foster sustainable farming systems in sixteen developing countries including India. Under Phase III, USAID under co-op agreement number EPP-A-00-04-00016-00, sub-award 425981- 19457, IPM-CRSP program was in operation from October 2005 to September 2009 (four years with a budget of US $ 106,000). The same programme, under Phase IV, in the name as Regional Integrated Pest Management, Research, and Education for South Asia, a research project that worked to advance food security in South Asia was extended for the period of October 2009- September 2014 (five years) with the total budget of US $ 255,173. This research work included developing Integrated Pest Management packages for vegetable crops with special emphasis on biocontrol, participatory IPM approach, strengthening network of linkages in IPM knowledge and expertise across all of South Asia, and undertaking significant and innovative graduate education. Under this program, farmer training, a short term course and two international workshops were organized. Currently, under USAID sponsored peanut IL, a grant of (US $15,000) was sanctioned to work on groundnut leaf miner taxonomy and ecology.

ABSPII

With the objective of making available the fruit and shoot borer resistant brinjal to the resource-poor farmers through public system, a network of public and private institutions has been established during 2004-05 with the support of Agricultural Biotechnology Support Programme (ABSP) II. The Network comprises Indian institutions such as, Tamil Nadu Agricultural University, Coimbatore, University of Agricultural Sciences, Dharwad, Indian Institute of Vegetable Research, Varanasi, Cornell University, USA and Mahyco, Jalna, India. This programme is financially supported by ABSPII and DBT, Government of India. In this program, TNAU has developed four open pollinated brinjal (eggplant) varieties expressing insect (fruit and shoot borer) resistance. All Bt genotypes had significantly higher marketable fruit yield as compared to their non-Bt counterparts. The expression of Cry1Ac protein has effectively controlled the FSB. The Bt brinjal had no effect on non-target pest and beneficial insects. Results of the biosafety trials on event EE1 demonstrate that the Bt brinjal is safe for environment and human beings. The Bt brinjal is awaiting approval from the Government of India.

Rockefeller Foundation's International Rice Biotechnology Program

Rockefeller Foundation, between 1985 and 2000, funded selected advanced laboratories in industrial countries and helped to build capacity to use biotechnology in rice crop improvement in developing countries. More than 25 faculty of TNAU had capacity building training in laboratories of developed countries and the support of the Foundation had a huge impact on the plant biotechnology program of TNAU.

Rockefeller Foundation funded a research project on “large scale germplasm characterization for drought resistance in rice” during 2003 - 2008. The project was completed with fulfilment of technical commitments which was certified as good. Under this project, a state of the art infrastructure facility, “Rain Out Shelter” in area of 10,000 sq.ft was established at Paddy Breeding Station (Estd. 1912). The facility is continuously used for screening rice varieties for drought resistance without interference from the rains which has empowered our capacity to carry out research to find technologies for mitigation of climate change.

Gates Foundation supported STRASA program

Stress tolerant rice for Asia and sub Saharan Africa (STRASA) is a project with a vision to deliver the improved varieties with enhanced stress (biotic and abiotic) tolerance to rice farmers of Africa and South Asia. TNAU is one of the network partners in the above program Phase I and II.

Under grand challenge_All children thriving program, a research project on improving food and nutrition of pregnant women and infants with collaboration from University of California_Davis, USA is under consideration for funding by DBT_BIRAC, Gates Foundation and USAID joint initiative.

Under the Bill & Melinda Gates Foundation (BMGF) funded STRASA (Stress Tolerant Rice for Africa and South Asia) project (primarily funded to International Rice Research Institute, Philippines), development of rice varieties endowed with the values of drought and submergence resistance was attempted. Two drought resistant cultures CB06702 and CB06803 are under advanced field testing in drought prone marginal

rice ecosystems of Tamil Nadu. One submergence tolerant rice variety, CR1009Sub1 was released in the year 2015.

Dr. S. Robin, Professor & Head, Department of Rice, TNAU was awarded a post doctoral fellowship by the Rockefeller Foundation in the year 1998-2000 to pursue training on rice molecular biology in Texas Tech University, Lubbock, TX.

Fulbright programs:

Under Fulbright program, the faculty of TNAU viz., Dr. R. Chandrababu has undertaken advanced research in Cornell University, USA.

Dr Hari Krishnan, University of Missouri and two Fulbright Fellows from US were hosted in TNAU sharing their expertise.

Dr. Sundaram Gunasekaran, University of Wisconsin, Madison was on Fullbright specialist programme in 2012-13 in TNAU.

Fulbright mentoring workshops: US-India Educational foundation organizes Fulbright mentoring workshops jointly with TNAU for potential applicants. These workshops guide applicants on the elements of a strong application.

Khorana scholars program

Government of India and Indo-US Science and Technology Forum (IUSSTF) offers Khorana scholarship to provide opportunities to Indian students to undertake research at University of Wisconsin-Madison and partner universities. Recently two undergraduate students of Biotechnology, R. Priyadarshini and D. Karen have secured the prestigious Khorana Scholarship to do internship in Indiana University, USA and Michigan State University, USA respectively.

Monsanto Beachell Borlaug international scholars program

Beachell Borlaug international scholars program offers fellowship of highly motivated students seeking a PhD in rice or wheat plant breeding. TNAU students in Biotechnology and Plant Breeding & Genetics *viz*., Mr. Ashish Rajurkar, Ms. Philomin Juliana, Mr. Sumeet Mankar Prabakar and Mr. R. Bharathiraja have won the prestigious Monsanto's Beachell-Borlaug International Scholars Fellowships to pursue Ph. D. research at Duke University, USA, Cornell University, USA, University of Saskatchewan, Canada and Cambridge University, UK, respectively.

Academic and research activities in Centre for Plant Molecular Biology:

The Centre for Plant Molecular Biology and Biotechnology (CPMB&B) was established in 1990, in collaboration with DBT to give an impetus to research in the field of plant biotechnology. It consists of three constituent Departments viz., Dept. of Plant Biotechnology, Dept. of Plant Molecular Biology and Bioinformatics and Dept. of Biochemistry. CPMB&B is offering two undergraduate courses viz., B. Tech. (Biotechnology) and B. Tech. (Bioinformatics), a master's program on M.Sc. (Agrl. Biotechnology) and Ph.D. in Biotechnology. Research activities at this centre are focused towards developing improved crop varieties in major crops viz., rice, maize, cotton, mung bean, brinjal, soybean, sorghum, banana, cassava etc., through various biotechnological approaches viz., tissue culture, marker assisted breeding and genetic transformation. This centre is carrying out about 40 externally funded projects to accomplish the above objectives. A brief note on the research activities is below.

Engineering insect resistant crops

- Under ABSP II supported programme, the scientists of CPMB&B have converted four popular brinjal varieties (vis., Co2, MDU1, KKM1 and PLR1) into Bt versions.
- Novel insecticidal proteins (cry2Ax1 and cry2Ai) have been isolated from indigenous isolates of *Bacillus thuringiensis* and such genes are being introduced into cotton, rice and tomato to impart resistance to target insects in these crops
- Genes encoding chemosensory proteins in *Spodoptera litura* and *Nilaparvata lugens* are cloned towards controlling major insect pests using RNAi approach. OR83b co-receptor and chitin synthase A were found to be the potential targets to manage insect pests using RNAi approach.

Biofortification

- Iron and vitamin A are two important limiting micronutrients in the diets of Indian populations. With a view to improve the nutritional quality of rice, the staple food crop of the South India, the centre is developing rice with enhanced levels of pro-vitamin A and iron employing biotechnology.

BBTV resistant banana

- Bunchy top virus is a devastating disease of banana causing huge loss to the farmers. Employing RNAi technology, local elite banana types are being engineered to tolerate virus infection.

Marker-assisted breeding for stress tolerant rice varieties

- Popular high yielding varieties of Tamil Nadu such as CO 43, ASD16, ADT43 and ADT 47 hve been improved for resistance against major pests/diseases namely, gall midge, bacterial leaf blight and blast using marker assisted breeding. Advanced progenies are under multi-location trials for assessing their performance.
- Superior near isogenic lines of local popular varieties (CO 43 and White Ponni) with enhanced tolerance against drought, salinity and submergence were developed and currently they are being tested under multi-location trials.

Medicinal and therapeutic rice:

- A traditional therapeutic rice variety “Kavuni” was characterized at biochemical and molecular level. Efforts are on-going to improve agronomic traits of this variety to enhance its yield potential.

Bioprospecting

- An anti-viral protein gene was isolated from bougainvillea and being introduced into tomato with a view to imparting resistance to viral diseases.
- Novel Bt genes such as *cry2AX1* isolated from indigenous Bt strains were patented and being employed in engineering rice, cotton and tomato for insect resistance.

Tissue culture

- Protocols for anther culture in cocoa and tomato are being developed.

- Development of *in vitro* culture techniques through somatic embryogenesis for propagation of elite coconut cultivars

Bioinformatics

- Bioinformatics research is focused towards developing databases for TNAU released varieties/hybrids of rice, millets and pulses. A tool for comparative codon usage analysis has been developed. Structural bioinformatics strategies are being used to study host-pathogen interaction in crops.

Others

- Genetic analysis of phosphine resistance among storage pests revealed that rph2 allele frequency varied in different storage pests and different food grain reserves. The frequency of resistance was above 50 percent in most of the populations.

MILLETS-THE MIRACLE GRAINS FOR WATER STARVED WORLD

Millets are a group of crops which are hardy and grow well in dry zones as rainfed crops under marginal conditions of soil fertility and moisture. These are some of the oldest food grains known to human kind and possibly the first cereal grains to be used for domestic purposes. Millets are also unique due to their short growing season. The name “Millet” has been derived from the word “mil or thousand” referring to the large number of grains that can be produced from a single seed. However, the Hindi word “Kadann” has come from a Sanskrit word “Kadannam”, which refers to foodgrains of the poor.

India is the world’s largest producer and consumer of millets. These crops form an important component of nutritional and livelihood security of resource poor farmers of India. They exhibit wide adaptation in marginal production and niche areas and provide farmers with best available opportunity for assured harvest, staple food, required nutrition and sufficient fodder in environments characterized by scanty rainfall. These crops are climate change compliant. Besides, these millets also provide raw materials for agro industries such as poultry and cattle feed, value added products, potable alcohol, starch, bio-fuel *etc*.

Millets are highly nutritious, non glutinous and non acidic foods. Hence, they are soothing and easy to digest. They are considered to be the least allergic and most digestible grains available. Millets are rich in protein, minerals, dietary fibre, B complex vitamins such as niacin, thiamin, riboflavin, essential amino acids like methionine and lecithine. They are also rich in phytochemicals including phytic acid which lowers

cholesterol and helps to reduce the incidence of cardio vascular diseases and cancer. Owing to which these are called as ***"God's own grains* and *nutricereals"*** .

The nutritional content (per 100 gram) of these grains *vis-à-vis* major cereals is tabulated below.

Crop	Protein (g)	Carbo hydrates (g)	Fat (g)	Crude fibre (g)	Mineral matter (g)	Calcium (mg)	Phosphorus (mg)	Iron (mg)
Cholam	10.4	72.6	1.9	1.6	1.6	25	222	4.1
Cumbu	11.4	67.5	5.0	1.2	2.3	42	296	16.9
Ragi	7.3	72.0	1.3	3.6	2.7	344	283	3.9
Panivaragu	12.5	70.4	1.1	2.2	1.9	14	206	10.0
Tenai	12.3	60.9	4.3	8.0	3.3	31	290	5.0
Varagu	8.3	65.9	1.4	9.0	2.6	27	188	12.0
Samai	8.7	75.7	5.3	8.6	1.7	17	220	9.3
Kuduraivali	11.6	74.3	5.8	14.7	4.7	14	121	15.2
Maize	11.5	66.2	3.6	2.7	1.5	20	348	2.3
Wheat	11.8	71.2	1.5	1.2	1.5	41	306	5.3
Rice	6.8	78.2	0.5	0.2	0.6	10	160	0.7

Status of Millets in Tamil Nadu

In Tamil Nadu, the area under millet cultivation has come down by 71.17 per cent since 1980s and production has come down by 67.91 per cent. But, productivity has increased by 29.2 per cent.

Crop / Year	Area (lakh ha.)		Production (lakh tons)		Productivity (Kg/ha)	
	1980s	2010-11	1980s	2010-11	1980s	2010-11
Sorghum	5.4	1.97	8.86	2.5	852	1277
Cumbu	4.80	0.47	3.0	1.14	625	2453
Ragi	1.64	0.83	2.29	2.25	1396	2716
Other Small Millets	2.31	0.35	1.34	0.35	580	986

The increase in productivity in all the millet crops in the state is primarily accomplished by the release of several improved varieties and production technologies from Tamil Nadu Agricultural University.

Millets research in Tamil Nadu

The Department of Millets of Tamil Nadu Agricultural University is the oldest millet research station of the state. Established in the year 1923, this department has developed several millet production technologies with sharp focus on field problems and inter disciplinary approaches. The major objectives of the department of millets are

- Development of hybrids/varieties suited for rainfed/irrigated situations in millet crops.
- Breeding for shoot fly and grain mould resistance in sorghum
- Development of hybrids resistant to downy mildew in pearl millet
- Diversification of male sterile sources in pearl millet.

- Development of location specific varieties to suit the different agro-climatic regions in small millets.
- Evaluation of IPM for millets.
- Management of diseases through chemical and bio-control agents.
- Technologies for yield maximization, rainfed system, intercropping and physiological disorders.
- Conducting training programs for transfer of technologies on hybrid seed production and cultivation of varieties.
- Popularization of new varieties and technologies developed.
- Breeder seed production of released varieties.
- Collection, maintenance and evaluation of germplasm in millet crops.

Crop improvement research has resulted in release of five high yielding hybrids and 43 varieties in sorghum, nine high yielding hybrids and eight varieties in cumbu, 17 varieties in ragi and 26 varieties in other small millets.

Processing

Processing technology and machinery suited to small millets are not readily available. Hence much of the millets consumed are processed at household level by following a tedious method involving considerable drudgery. Increasing urbanization and decreasing time for domestic chores in rural households are discouraging traditional processing of millets. In the absence of specialized processing machineries for millets, it is processed in wheat or rice processing systems. Ragi is not husked and directly milled in the roller flour mill used for wheat milling. Much .of the husk is sieved out from the flour. All other small millets require de-husking, de-branning (decortication) and

milling since husk and bran are tightly bound with number of layers on the endosperm. Cone polisher, centrifugal rice sheller and rice polisher (50kg/hr to 200kg/hr) are also used to dehusk and polish these millets. The separation of the unhusked grain poses a serious problem during the milling process since there is only little variation in size and specific gravity of husked and unhusked grains. The parboiling of millet increases the shelling efficiency with less breakage. The grain recovery from these machineries is low varying from 63 - 79%, with 16 - 29% husk and 5 - 9% bran. The polished grain called 'millet rice' is either used directly or further milled in plate or hammer mill to semolina or flour. These processing add value to these millets three to four-fold and make them acceptable to the elite urban consumers as niche food or health food.

Value addition of millets

Recently, consumers have developed an interest on millet foods, based on their importance. But the availability of millet based processed foods is very low when compared to other products. Several value added products of millets *viz.,* breakfast receipies like Porridge, *Idli*, *Dosa*, *Roti*, *Chapathi*, *Uppma*, *Pongal*, *Kitchadi*, *Panniyaram*, *Adai*, Vermicelli, Sweets like *Halwa*, *Kesari*, *Adirasam*, *Kheer*, Sweet ball, *Kolukattai*, Sweet *adai*, snacks like *Vadai*, *Pakoda*, *Omapodi*, *Murukku*, *Thattu Vadai*, Hot *Kolukattai*, bakery products like bread, cookies, cake, other products *Vadagam*, Pappad, Health mix, Weaning food and Malt powder are currently being marketed and these enjoy very good consumer preference.

Technological interventions required

- Availability of quality seeds of high yielding varieties and hybrids
- Mechanized cultivation especially for sowing and harvesting
- Promoting utilization of Bio-inputs
- Integrated Nutrient Management
- Inter cultivation (Thinning, gap filling, weeding)
- Self seed maintenance (selection of panicles)
- Harvest at physiological maturity
- Promotion of primary processing and value addition
- Commodity group formation for high market price

Strategies to increase area and production in millets

Issues

- ❖ Mostly grown as rainfed crop under poor and marginal soils
- ❖ Sorghum being cultivated mostly for fodder purpose and not for grain
- ❖ Apart from maize other millet crops are not remunerative
- ❖ Processing is tedious
- ❖ Farmers are growing old traditional varieties
- ❖ Poor nutrient management
- ❖ Millet eating habit among the younger generation is poor

Strategies

- ❖ Replacing of low yielding varieties with high yielding varieties/hybrids
- ❖ Creating awareness to farmers on the importance of millets in the dietary requirement through training SHG/ farmers for production and value addition
- ❖ Organising field demonstrations to showcase the yield potential of the high yielding varieties/ hybrids with a package of nutrient management and production technologies

- Introduction of millets in the nontraditional districts where millets are not grown
- Increasing the area under small millets in the hilly areas
- Bringing in unutilized land in to cultivation of millets under rainfed / drought situations
- Self seed maintenance
- Promotion of processing industries and value addition
- Commodity group formation for higher market price and fixing minimum support price for Millets

These require strategic interventions by National and International agencies to tap the un-utilized potential of the water starved areas to produce and supply millets which are far more nutritious and serve as health food. It would go a long way in removing poverty in Asian and African Countries.