

**TAMIL NADU AGRICULTURAL UNIVERSITY
COIMBATORE**

**XII FIVE YEAR PLAN
(Agricultural Education and Research)**

Revised Draft of Approach Paper

EDUCATION, RESEARCH AND OUTREACH STRATEGIES

1. INTRODUCTION

Growth of Agriculture and allied sectors is crucial for the overall accelerated performance of the country's Economy. As against the targeted growth rate of 4 per cent in agriculture and allied sectors during the XI plan period at all India level, the annual average growth attained was only 2.03 per cent in the initial three years starting from 2007-08. The share of primary sector of the India's GDP in fact declined from 19.0 per cent during 2004-05 to 14.2 per cent during 2010-11 at 2004-05 prices. Out of this, agriculture contributed 12.3 per cent. However, agriculture remains as the source of employment for 58 per cent of the work force in the Country and despite the Green Revolution, the country is home for one-fourth of the worlds' hungry and poor. During the last one decade, in-spite of having achieved national level (macro) food security and the boost in the overall GDP growth, agricultural production and rural income growth have slowed down considerably and outstripped by the population growth rate. With little reduction in the number of undernourished and poor people, the country is far behind in achieving the Millennium Development Goals and the targets set at the World Food Summit in 2002.

Food Requirements: In order to achieve balanced nutrition and inclusive growth, considering the trend of diversification of the food basket and experience on the factors underlying growth during the past decade, attaining and maintaining a steady growth in cereals, pulses and oilseeds is essential and

an accelerated growth of livestock, fishery, forestry and horticulture sub-sectors will be required. Since land is a shrinking resource for agriculture, the pathway for achieving these goals has to be higher productivity per units of arable land and water. Factor productivity will have to be doubled, if the cost of production is to be reasonable and the prices of our farm products are to be globally competitive.

FAO Global Perspective Studies Unit, 2006, has projected that food consumption levels in India from current average level of about 2,400 kilocalories per capita per day will increase to about 3,000 kilocalories per day in 2050. By then, the population may stabilize at 1.5 billion. As is typical of countries with rising incomes, the share of calories derived from cereals is declining in India, and is projected to fall below 50 per cent by 2050. Conversely the share of calories derived from higher-value foods like fruits and vegetables, vegetable oils and livestock products is projected to increase. In aggregate terms, projected demand for cereals (for direct human consumption) is projected to rise from 159 million metric tonnes in 1999-2001 to 243 million tonnes in 2050, an increase of 53 per cent, or 0.9 per cent per year. This growth will help decline number of undernourished from 221 million people (about 22 per cent of the population) now to 70 million people (about 5 per cent of the population) by 2050. Similarly, the consumption of fruits and vegetables, eggs, chicken and milk is also projected to increase from 108, 2, 1 and 66 million tonnes in the year 1999-2001 to 208, 6, 10 and 146 million tonnes in the year 2030 and to 257, 9, 18 and 196 million tonnes in the year 2050.

The realization of the above projections must overcome the challenges of natural resource degradation and depletion, climate change, increasing input costs and demand for bio-fuels, on-farm – non-farm employment integration, and market volatility. Soil health deterioration, micro nutrient imbalance, fast receding water tables (all the same under utilization of under-ground water

resources in many places), water quality and arsenic pollution and poor water and nutrient use efficiencies must be corrected and reversed through knowledge-based participatory approaches. As per the FAO projections, since India's production will exceed direct human consumption by sizeable margins for cereals, fruits and vegetables and milk, the country must enhance its competitiveness in these commodities for higher income to the farmers and for greater integration of Indian markets with the global market. **This calls for further intensifying agricultural research in all related areas and for Government to come out with appropriate policy measures.**

Vision for agricultural research during XI plan

As the agricultural education and research systems in the state have to face new challenges in the coming years, the education and research systems have to respond effectively to these challenges to produce outputs that are economically viable and efficient. The processes that lead to these outcomes have to be reoriented in the competitive, demand-driven model. The advent of modern information and communication technology revolution should be effectively harnessed to make the education, research and extension activities socially relevant.

Research has to be focused more on society's needs. It has also to take note of changes due to globalization, technological development, and growing emphasis on value addition. At the same time, time and resource limitations necessitate prioritizing and optimizing research activities. The thrust areas in which research are being undertaken, strategies to achieve the targets and specific research programmes such as crop improvement, crop management and crop diversification, crop protection, and post-harvest technologies required to achieve the XI plan targets are discussed in the following sections.

Strategies for revamping agricultural research during XI plan

The University encourages multi disciplinary research for addressing the problems of farming community. Research on transgenic (Biotechnology), QTL mapping of genes for insect resistance were also intensified. Research focus was also on integrated pest management to develop more cost-effective methods and devices. To provide marketing intelligence and information to the farmers, marketing intelligence cell was created in the university and the cell periodically supplies price information through electronic media to the farmers. Similarly, weather forecasting was also undertaken by the University for the benefit of the farmers. Emphasis was given to development, production and dissemination of hybrids of various crops to break the yield barriers. Research on precision farming was given due weightage in research resources allocation. Pulses were grown in the marginal soils and there was not much technological breakthrough in pulses. To meet the huge demand and supply gap the university was focusing on improving production and productivity of pulses in the rice fallows of Cauvery Delta regions of Tamil Nadu. With a view to have balanced application of fertilizer and manures and to optimize the yield of individual crops, the University allocates sizeable resources for popularizing the Integrated Nutrients Management (INM) methods. Researches on dryland agriculture, wasteland development and agro-forestry have been intensified.

In cognizance of the changing environment research has to be reoriented to suit the taste and preferences of the international markets particularly in vegetables, fruits, flowers and medicinal plants. Research programmes have also been focused on value added products and post harvest technology. To discuss and evaluate the ongoing research programmes for their social relevance and identify new emerging research area, University conducts Scientific Workers' Conference and Crop Scientists' Meet periodically. Experts cutting across the different disciplines of the University, development departments, policy makers

and farmers participate in these forums. The monitoring mechanisms of the research programmes have completely been decentralized for effective implementation of the research projects.

Agricultural Research and Education attracts very meager public resources. Presently less than one per cent of gross domestic product from agricultural sector was invested in agricultural research and education, which was far below as empowered to developed countries. So the major challenges for the university will be to find adequate resources to sustain and expand their activities. University was making all-out efforts to strengthen its resource mobilization and keeps improving the infrastructure and to upgrade the human resources on a continuous basis.

The university was generating resources from the private/international and national funding agencies through interface and MoUs. The scientists were motivated to propose research projects on frontier areas for resources mobilization. The university also brought in the consultancy project mode for encouraging the scientists to provide consultancy services on cost basis. The University has introduced a novel plan of venture capital to support the research stations for their own fund generation and bring competitive environment in the university.

In the university, Planning, Monitoring and Evaluation Cell (PME) was set up to train the research managers for judicious use of resources and prioritizing their research activities under the resource crunch situations. The administrative set up of the university was completely computerized to reduce cost and improve the delivery system. University undertakes large scale production of seeds and vermi-compost for generation of funds. Mass production of bio-pesticides and bio-fertilizers were also being undertaken by the university to promote environmentally sustainable agricultural technologies. University was interfacing with the State Government in agricultural policy formulations.

1.1. Status of Agriculture in Tamil Nadu

Tamil Nadu occupies seven per cent of the Nation's population, four per cent of the land area and three per cent of the water resources at all India level. It is also one of the most socially and economically progressive states in the country. The GSDP growth rates during the periods of the Ninth Plan (1997-2002) and Tenth Plan (up to 2005-06) however were only 4.9 per cent and 5.9 per cent, respectively and were lower than the growth rates of the all India GDP, which stood at 5.5 per cent and 7.0 per cent for the same periods.

The most disturbing dimension of the growth process in the State in the last few years have been the unbalanced growth of different sectors within the economy. The contribution of the primary sector of which agriculture is the main component, to the GSDP of the State's economy has declined from about 25 per cent in 1993-94 to 13.3 per cent in 2005-06. However, there is no concurrent fall in the percentage of the total population dependent on agriculture which remains at 56 per cent. Hence the falling relative share of agriculture is a reflection of the severe challenge to the livelihoods of thousands of rural families.

In this background, the State's Eleventh Five Year Plan had been drafted keeping in view the objective of attaining a growth rate of 8.5% as envisaged by the Union Planning Commission for the country as a whole. The issues and challenges faced by the country's agriculture are also largely applicable to the state of Tamil Nadu. The revitalization of the State's agrarian sector had therefore been given the top most priority in the Eleventh Plan. The attainment of higher agricultural growth is the key to poverty reduction in rural areas. Agriculture in Tamil Nadu at present however contributes only 9.92 per cent (2009-10) to the Net State Domestic Product but supports around 49 per cent of the work force. However, 56 per cent of the population (those living in rural area), in one way or the other, is dependent on agriculture for their livelihood. The Growth rates achieved in the different sub sectors constituting the state

domestic product in agriculture during the most part of the Eleventh Plan Period recorded cumulatively a negative growth of 0.51 per cent per annum until 2009-10 as against the 4 per cent target envisaged, which is of great concern to the policy makers, planners and scientists.

The area under agriculture in the state is declining. The breakthrough in agriculture will thus, ultimately have to come from technology with right vision that places the farmer and his welfare at the center of the action. For this, the State should exploit its comparative advantage in the production of certain crops and should, accordingly plan its agriculture research and production strategy. The role of TNAU therefore becomes crucial.

2. TAMIL NADU AGRICULTURAL UNIVERSITY

Tamil Nadu Agricultural University (TNAU) is serving the country through six avenues; agricultural education, research, extension, open and distance learning, agribusiness development programmes and agricultural policy support. There are 11 colleges functioning in 8 campuses, 36 research stations, 14 Krishi Vigyan Kendras and five Plant Clinic Centres. The University also provides affiliation to 5 Agricultural Colleges to offer Degree courses and 5 Agricultural Institutes to offer Diploma courses. The University has a complement of 9166 employees comprising; 1274 teaching (13.9 per cent), 1259 administrative staff (13.7 per cent), 2940 grass root employees (32.0 per cent) and 3693 students (40.4 per cent). Female gender contributes as much as 46% in the work force and 54 per cent in student community. The programmes proposed, initiatives taken by TNAU during the XI FYP period, the gaps and challenges ahead in agriculture sector and the strategies and programmes for XII FYP period for achieving the targeted 4 per cent growth are outlined below.

2.1. Physical Activities proposed under 11th Plan

2.1.1. Agricultural Education

Starting of New Courses on

- Energy and Environmental Engineering
- Bio-informatics
- Plant Health (Bio Security)
- Organic Agriculture
- Precision farming
- Agri-Business Management
- Sericulture
- Nano Technology

Starting Para-Agri Technological Courses

- Export Trade
- Natural Resource Management
- Dryland Horticulture
- Agricultural Technology information and communication
- Starting Vocational Programme (Focus on ODL)
- Introducing and scaling-up e-learning techniques
- Creation of Virtual University
- Linkage with ICAR Institutes and International Universities for Education and Research and faculty exchange

2.1.2. Agricultural Research

The thrust areas included

- Conservation of PGR through establishment of Department of Plant Genetic Resources
- Genetic Engineering and Bio-Technology-Transgenic crops

- Hybrid and High yielding varieties
- Soil fertility & soil Health
- Supporting green manure seed production
- Quality control of Bio-fertilizers
- Disease and pest management
- Research on farm machinery
- Agri-Business and Farm Advisory support/WTO
- Facilitating transfer of technologies, like HYV, SRI, IPM, Micro-Irrigation and IFS on major agricultural and horticultural crops by Water Technology Centre (TN-IAMWARM project).
- Extension Education to establish a strong coordination between TNAU and State Departments and to demonstrate precision farming techniques and new technologies.

2.2. Achievements and Initiatives taken during the XI FYP Period in TNAU

2.2.1. Education

Indian Council of Agricultural Research, New Delhi, has provided the Certificate of Accreditation for the education programmes of TNAU 2001 onwards. In this century old campus, which started with 8 students, at present there are 3693 students. Many foreign students from Iran, Egypt, Sudan, Nepal, and Ethiopia choose to undergo studies at present at this institute. Considering the need for developing human resources for various fast growing agricultural activities new undergraduate programmes viz., B.Tech (Energy & Environmental Engineering), B.Tech (Bio informatics) and B.Tech (Agricultural Information Technology), and B.S [Agri Business Management], courses were initiated during XI FYP period in self support mode and B.Sc (Sericulture) was started as a government sponsored programme. The students admission strength in self supporting courses increased from 196 in 2008 to 305 currently. Diploma in

Agriculture was started in five research stations of TNAU. PG Diploma in Capital and Commodity Markets and Organic Farming, M.Tech in Nanotechnology and M.Tech in Environmental Engineering and Ph.D in Agribusiness Management were also started during XI plan period. On the whole, currently 13 Under Graduate programmes, 30 Master and 27 Doctoral level programmes are being offered. A new Horticultural College and Research Institute for women has been started during the academic year 2011-2012 at Trichy to ensure better women empowerment.

Dual Degree programmes: TNAU in collaboration with National and Over Seas Institutions initiated collaboration with the Universities in USA and Canada to offer dual degree programmes, one at UG level and two at PG level. Under Graduate students from B.Sc (Agriculture), B.Sc (Horticulture) & B.Tech (Horticulture) are being given a chance to earn an additional degree from the Nova Scotia Agricultural College, Canada. Similarly, at the post graduate level, i) M. Tech Food Processing and Marketing at TNAU and Master of Professional Studies in Food Science and Technology by Cornell university, USA and ii) M. Tech Biotechnology and Business Management at TNAU and Master of Professional Studies in Plant Breeding by Cornell university, USA are being offered for the benefit of the students. So far, 24 students have completed the dual degree programme successfully. MoUs have been signed with 23 Over Seas Universities and 50 National Institutions to help Masters and Ph. D students to do extra mural research and to facilitate credit transfer.

In the academic year 2011-12, a PG Diploma programme on Plant Health Management in collaboration with National Institute of Plant Health Management, Hyderabad has been initiated.

E – resources: TNAU is the pioneer in implementing '**technology enhanced learning**' like hosting open courseware materials in TNAU website, e-class rooms, wi-fi connections in hostels and exam halls and video

conferencing. Teachers of TNAU have quickly responded to the changing times and adopted ICT tools (Information & Communication Technology) for teaching. The Online examination, video streaming of class room lectures and e-lectures have been adopted in the University as first of its kind in India. The ICAR has also recognized the caliber of the University and assigned it with the responsibility of developing e-courses for the agriculture degree programme under the National Agricultural Innovation Project. An Advanced Digital Language Laboratory was established to improve the communication skills of the students. The computer centre with internet facility is open for 18 hours in a day to access e-journals. The culture of owning lap-top computers is encouraged.

Students welfare: The Directorate of Students' Welfare (DSW) is the hub of the Tamil Nadu Agricultural University wherein students are provided career counseling and job placement for all constituent colleges. This Directorate has made stupendous achievement by placing over 500 graduates through campus interviews in nearly 45 organizations during the year 2010 alone. Job Fair is being conducted annually to ensure that students get their placement ahead of graduation. The centre has opened an **"Overseas Employment Unit"** which facilitated graduates to get placement in organisations abroad. This receives overwhelming response from students and industries across the globe. A state-of-the-art **"Communication Laboratory"** has been established to improve the soft skills and employability of the graduates. Besides placement, annually at the least 30 students from TNAU are getting opportunity in the western countries for pursuing their higher studies with scholarships and research assistantships. It is worth mentioning that TNAU graduates bagged the most prestigious Commonwealth Scholarship consecutively for the past four years.

TNAU records the highest employment rate among the 53 State Agricultural Universities of India. In the scientists recruitment conducted by

“Agricultural Scientists Recruitment Board”, a substantial number of the TNAU candidates are being selected. In the previous year, 445 Agricultural graduates got postings as ‘Agricultural Officers’ and 1500 Diploma candidates were posted as “Assistant Agricultural Officers” in the Department of Agriculture.

TNAU students are also provided coaching for civil services examination in the evening hours, for a period of six months. Besides reading materials, CD-ROMs are made available to the students to take up tests for self-evaluation. Mock tests are conducted three times during the course to assess the progress of students. In the past four years, 81 students have cleared Civil Services (Main) examination which is about 40 per cent of the candidates from Tamil Nadu.

Distance Education: TNAU is also offering many correspondence courses through the Directorate of Open and Distance Learning. At present, 21 certificate courses in Tamil, 9 certificate courses in English, 3 PG diploma and 3 PG courses are being offered. All the courses have gained wide popularity within a short period of time. A new three years degree programme, “Bachelor of Farm Technology” in Tamil medium was started in 2010 exclusively for the farmers, as first of its kind in India. A total of 229 farmers have joined this programme during 2010.

2.2.2. Research

Research is carried out in all College campuses and 36 Research Stations spread over all the seven agro climatic zones of Tamil Nadu. TNAU is now operating 1076 research projects, including 604 external agencies and private agencies funded research projects. All the research programmes in TNAU are reviewed thoroughly in the Annual Crop Scientists Workshop for Rice, Millets & Forages, Pulses, Oilseeds & Biofuels, Sugarcane, Cotton, Horticulture, Palm and Forestry including agricultural engineering and social sciences component which are held each for two days. After the review, decisions on continuation of existing schemes,

closure of completed projects or projects that may not yield significant research output and proposal of new projects, are taken. As a result, the research programmes are taken up only based on the importance and need. During the XI FYP period, 38 new varieties and hybrids of various crops, 13 new farm implements and 16 management technologies were released for the benefit of the farming community. The University has obtained 7 patents and submitted applications for 18 more patents.

Impact of TNAU varieties, implements and technologies will be taken-up through the Centre of Excellence in Social Sciences planned to be established and also the PME Cell proposed to be strengthened during the XII Plan for which proposals have been included in the Approach Paper.

System of Rice Intensification: The System of Rice Intensification (SRI) is a tremendous success with 36.8 per cent increase in yield. The overall average yield recorded under SRI was 7432 kg ha⁻¹ while under conventional practice it was only 5482 kg ha⁻¹. Besides, 30 per cent water saving was also achieved. Through the World Bank funded TN-IAMWARM project, TNAU has taken up demonstration in 3892 ha in two years between 2007 and 2009.

Tamil Nadu Precision Farming Project (TNPFP): Tamil Nadu Precision Farming Project is a State sponsored mega demo project implemented through Turn Key mode by the Tamil Nadu Agricultural University in Dharmapuri and Krishnagiri Districts in 400 ha (1000 acres). Due to the unprecedented level of acceptance and adoption by the farmers, the program was scaled up to 12800 ha under NADP with the budget of Rs.100.54 crore. Precision Farming technology has also spread over to 33000 ha. Doubling of crop yield and high quality of farm output has created a revolution in vegetable cultivation. Subsequently, farmers have gained confidence and established "Dharmapuri Precision Farming Agro Services Limited" and "Erode Precision Farming Producers Company Limited". Farmers are also trying to establish "Tamil Nadu Precision

Farming Marketing Company Limited” to undertake marketing of their produce on their own.

Sustainable Sugarcane Initiative (SSI): SSI improves the productivity of water, land and labour, all at the same time, while reducing the overall pressure on water resources. The technology package has been standardized. The yield increase is 60 to 90 tons per hectare.

Management of invasive Papaya mealy-bug through parasitoid: Outbreak of papaya mealy bug, *Paracoccus marginatus* was noticed during 2008 on papaya, mulberry, tapioca, jatropha, vegetables, fruits, cotton, plantation crops, spices and flowers crops in different parts of Tamil Nadu causing extensive damage going up-to 90 per cent. Management of this pest through classical biological control by importing three parasitoids viz., *Acerophagus papayae*, *Anagyrus loecki* and *Pseudleptomastix mexicana* from USA through NBAII (National Bureau of Agriculturally Important Insects), ICAR, Bengaluru proved to be effective. TNAU obtained the nucleus culture of the parasitoids from NBAII on 25.09.10. Training on mass multiplication of mealy-bug parasitoids was given to Plant Protection scientists of TNAU to take up mass production throughout Tamil Nadu. So far about 10 lakh parasitoids have been produced and released by TNAU in various parts of Tamil Nadu which effectively controlled the mealy bug.

Drip fertigation in Red gram: One of the ways of improving productivity of red gram is by growing it under controlled irrigation by using drip fertigation system. The technology package has been standardized. The yield increase is from 1350 to 1850 kg per hectare.

National Agricultural Innovation Programme (NAIP): TNAU is the lead centre for five Consortium projects implemented in India, viz., developing e-resources for B.Sc.(Ag), establishment and networking for market intelligence, developing value chains for flowers, and industrial agro-forestry and agribusiness

planning and development. TNAU is also the co-operating centre for eight consortium projects viz., value chain in mango and guava, policy analysis and gender, mass media for agro-information, value chain on biomass based decentralized power generation, wild honey and milling industry, soil organic carbon dynamics and risk assessment and insurance products. These projects are operated in consortium mode and farmers and agri-business participate.

Tamil Nadu Irrigated Agriculture Modernization and Water Bodies Restoration and Management Project (TN-IAMWARM): It is a Multidisciplinary Project funded by the World Bank. The project has been implemented in the 63 selected sub basins of Tamil Nadu to cover an *ayacut* area of 6.83 lakh ha. The objective of the project is to achieve sustainable economic growth through maximization of water productivity. In this project, TNAU mainly concentrates on transfer of technologies for maximizing production per unit of water and land, leading to increased farm income. Under this project, technology demonstrations have been taken up by TNAU for SRI technology of rice and for cultivation of low water requiring crops such as; garden land pulses, maize, groundnut, sunflower, sesame and cotton.

Protected Cultivation: Technologies for protected cultivation, especially for vegetables and cut flowers have been developed and disseminated.

Farm mechanization: TNAU introduced manually operated cono weeders. Subsequently, SRI power weeder was developed and is now successfully manufactured and supplied through private entrepreneurs.

Food Processing: The Post Harvest Technology Centre at TNAU is involved in developing food processing technologies and also providing training to rural men and women for working in processing units. The PHTC has trained 1780 people in the last four years.

Seed Centre: The Seed Centre established during the XI Plan period takes up production and distribution of quality seeds for all crop varieties of TNAU. Seed production is taken up in 32 centres for 175 varieties of different crops. Seed production activity was strengthened with the implementation of a Rs.605 lakh ICAR Mega Seed Project. University has supplied breeder and certified seeds of various crops to the tune of 2196 quintal in 2007-08, 4464 quintal in 2008-09 and 6619 quintal in 2009-10. Other than breeder and foundation seeds, the University is also supplying 'Truthful labeled' seeds based on demand.

Automatic Weather Stations (AWS): Weather forecast plays an important role in deciding crop management. Therefore, 385 Automatic Weather Stations have been sanctioned for all the blocks in the state, of which AWS has been installed in 224 blocks. The daily weather parameters for these 224 blocks are made available through websites.

2.2.3. Establishment of New Directorates and Departments

A new Directorate of 'Natural Resource Management' and five new departments namely 'Plant Genetic Resources, Nanotechnology, Department of Medicinal and Aromatic Crops, Remote Sensing & GIS, and Trade & Intellectual Property Rights' were established to take up research in strategic areas.

Ramiah Gene Bank: The Department of Plant Genetic Resources was established during 2010 which maintains the Ramiah Gene bank with 3000 cubic feet of cold storage space for medium and long term storage of Plant Genetic Resources. This gene bank has a capacity to store seeds of 50,000 germplasm accessions of various crops in long term (-20° C) and another 50,000 in medium term storage conditions (5° C). At present, 13000 germplasm accessions in various crops have been deposited in the Ramiah Gene Bank. The Department also focuses on initiating fingerprinting and allele mining activities for tagging useful genes for nutritional traits, pest and disease resistance traits. A

comprehensive data base TNGRID (Tamil Nadu Genetic Resources Integrated Database) will be created as an inventory of information on Plant Genetic Resources.

Nano-science and technology: The Tamil Nadu Agricultural University is the first State Agricultural University in India to establish an exclusive Department of Nano Science and Technology with an initial investment of Rs. 12.0 crore. This department is equipped with Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM), Atomic Force Microscope (AFM), Raman Spectrophotometer, Ultra Probe Sonicator, GC-MS, Ultra Centrifuge, Ultra Microtome, Confocal Microscope, X Ray Diffraction (XRD), Spray Drier, Gas Permeability Tester (GPT), Carbon and Metal Evaporator and Ion Sputter. Evolving nano-formulations improve the use efficiency of agricultural inputs while preserving the natural resources. The Nanotechnology Center is currently working on nano-inputs (nano-fertilizers, nano-herbicides, nano-pesticides), biosensors (seed sensor and early detection of diseases), food systems (nano-films and nano encapsulation of functional foods) besides nano-remediation of pollutants in soil and aquatic systems.

Remote Sensing and Geographic Information System (RS&GIS): It was established to generate and assemble data on natural resources and integrate them with other spatially referenced data. The Department has a strong infrastructure which includes Remote sensing data visual interpretation facilities, Digital image processing facilities–workstations and software, Global positioning system, Large format digitizer, Large format scanner, Large format printer, Hyperspectral ground truth radiometer in 350 to 1050 nm range and Analytical laboratory for soil, water and plant samples. RS & GIS has many important applications like crop acreage estimation, crop health monitoring, crop yield and production estimation, land use planning, land degradation mapping,

soil erosion assessment, soil moisture estimation and hyper spectral remote sensing.

Trade and Intellectual Property: The Department of Trade and Intellectual Property was established on 1st April 2010 in the Directorate of CARDS. The department identifies and files the patentable products / processes of the TNAU scientists. As on date, 7 inventions of TNAU have received patent, 21 inventions have been filed and more than 18 inventions have been identified for filing. In association with the Centre for Plant Genetic Resources, TNAU, 64 crop varieties have been registered under PPV and FR as extant varieties and 9 more crop varieties have been identified for registration as extant varieties. In collaboration with Protection of Plant Varieties and Farmers Rights Authority, New Delhi, the Department is imparting training and sensitizing all stakeholders on IPR related issues. In coordination with Federation of Indian Export Organization (FIEO), Chennai, the department organizes export seminars and workshops. The Department is also providing expert advice to GI registry for granting GI for agricultural commodities.

2.2.4. Agribusiness Development

To commercialize the viable technologies developed at TNAU, Agribusiness Incubator was established in 2007-08. Totally 12 technologies including Coconut Tonic, Panchgavya, Egg removing device, SRI power weeder, *Pesudomonas* and *Trichoderma*, have been commercialized so far. TNAU Private Seed Sector Research Consortium has been established to enhance production of good quality seeds of TNAU varieties and hybrids and distribution to farmers.

2.3. Extension Education

Transfer of technology is taken-up by TNAU through KVKs, Research Stations and Teaching campuses and also through technology enabled services.

KVKs: New technologies disseminated to the farmers through the 14 Krishi Vigyan Kendra (KVKs). On Farm Trials, Field Demonstrations, Farmer's day, Trainings and Technology weeks are undertaken to disseminate the research findings. To keep pace with the era of Information Technology, TNAU has also made many required changes in an innovative way.

TNAU Agri-Tech Portal: The University has uploaded complete details of all the technologies in two lakh pages of TNAU Agri-Tech Portal. This is a very valid source of information to the extension functionaries located in 385 blocks and district head quarters, besides, farmers and all the Stake holders around the world. (www.agritech.tnau.ac.in)

Market information and intelligence: Tamil Nadu Agricultural University operates the **Domestic and Export Market Intelligence (DEMIC)** unit (www.tnagmark.tn.nic.in) and provides forecasts of prices of agricultural produces before sowing and also prior to harvest. In the last five years, DEMIC has made 325 price forecasts of different commodities and the results have been published in seven English dailies and six Tamil dailies for important commodities like maize, cotton, turmeric, groundnut, sesame, black gram, chickpea, coconut, tomato, chillies, onion, coriander, potato, etc.

Daily Market Intelligence (DMI): e-Extension centre of TNAU in Collaboration with Centre for Development of Advanced Computing (C-DAC) is providing Daily Market Information to the farmers in quick time through internet and mobile phone, since 2008-09. Around 40,000 farmers are availing the price information through Mobile Handsets. Data collected from 13 important markets in south India namely, Chennai, Bangalore, Cochin, Coimbatore, Ottanchatram, Trichy, Hosur, Kumbakonam, Madurai, Mettupalayam, Panruti, Thalaivasal and Thirunelveli are sorted, organised and published in the website www.tnau.ac.in and www.indg.in by 1.00 pm daily. The registered farmers will receive daily market information through SMS over mobile. Other services available are;

Wholesale and retail prices of 160 commodities (68 vegetables, 34 fruits, 37 flowers, 13 spices and 8 plantation crops), details of the 1,500 wholesalers with address and phone numbers, and previous day / week / monthly market data are also made available.

Agri-Clinics to promote Self employment: TNAU trained 102 graduates to offer private extension consultancy through Agri Clinics and Agri business Centres. TNAU associated with the Government and Mini Soil Testing Labs were established in all the 385 blocks through 50 per cent Government subsidy.

2.4. Awards won

On account of the impact created through the innovative and committed efforts, Tamil Nadu Agricultural University was conferred with the following awards in the last two years:

1. National KVK Award for 2009 by Indian Council of Agricultural Research, New Delhi.
2. Sardar Patel Outstanding ICAR Institution Award 2010 by Indian Council of Agricultural Research, New Delhi.
3. Gold Award 2011 in 14th e Governance Awards by Government of India.
4. Best Agri Business Incubator 2011 by Network of Indian Agri Business Incubators (NIABI).
5. Krishi Shiksha Award 2011 for Best State Agricultural University (Runner Up) by Mahindra and Mahindra Ltd., Mumbai
6. Agricultural Leadership 2011 award by Agriculture Today, New Delhi

3. GAPS AND CHALLENGES AHEAD

The TNAU always endeavoured to be ahead of time in its preparedness to perform education, research and technology delivery functions and in recent years has added agri-business promotion and policy interfacing as its responsibilities. In future however, the following gaps and challenges are perceived to affect agricultural growth in Tamil Nadu which require solutions:

Yield gap: Larger yield gaps are witnessed in several crops. In the case of paddy, the yield gap – II was estimated at 800 kg/ha (20 %). In the case of pulses, it was 202 kg/ha for black gram (95 %) and 211 kg/ha for green gram (58 %). The yield gap – II was 25 per cent for cotton and 30 per cent for sunflower.

Inter regional variations in productivity: There are inter district variations in productivity of important crops such as paddy with a larger productivity of more than 4000 kg of rice per hectare in districts like Theni, Erode and Kanyakumari and less than 2000 kg per hectare in districts like Ramanathapuram, Sivagangai, Thiruvarur and Nagapattinam. For sugarcane, the productivity was less than 90 tons in districts like Perambalur, Madurai, Vellore, Karur, Thiruvannamalai, Dharmapuri, Thiruchirapalli and Kanyakumari. In the case of Cotton, the yield varied between less than 1500kg to more than 2000 kg per hectare.

All these figures show the advantage that exists for certain crops in certain districts and the potential that exists to increase the productivity by adopting appropriate strategy. The efforts required thus clearly point out addressing issues affecting different crops in the districts/ sub-regions having advantage and test field application of critical technologies that would considerably increase yield.

The potential of the new technologies evolved remain to be exploited as indicated through huge technology transfer gaps at various levels. As regards the yield gap and also the inter regional variations in productivity, the TNAU experience as a result of implementation of TN-IAMWARM programme and precision farming programmes indicate that the yield of rice can be increased by more than 30 per cent and the yield of other crops can be increased anywhere between 40 and 200 per cent by following the SRI and Precision farming techniques as proved through the TNAU implemented large scale demonstrations. This only indicates the reason for yield gap to be the problems in transfer of technology. Therefore the development Departments (Agriculture, Horticulture, etc.) may take effective measures for transfer of proven technologies to bridge the yield gap and enhance the agricultural production. The limitations of the current approaches to research and technology transfer needs are addressed on a continuous basis by bringing-in greater stakeholder involvement in the process of technology generation.

Improving productivity in rainfed areas: Rainfed areas account for about 60 per cent of the gross cropped area. Productivity in these areas has been low on account of poor input use by resource poor farmers, low risk bearing ability, etc. Hence research, technology development and transfer activities have to be strengthened so as to develop innovative farming systems, production technologies and institutional approaches that could provide better returns to the farmers.

Shrinking and Deteriorating Natural Resources: Demand for land and water for various competing uses is increasing rapidly hence production per unit of these resources has to be increased further and conservation and *insitu* harvest of water has to be given importance.

Declining organic content in cultivated soils: Continuous cultivation and lack of adequate organic manure to enrich the soil are gradually reducing the organic content in the soil, which in the long run could affect the productive capability of the land.

Climate change: Temperatures in the Gangetic basin and similar other regions are expected to rise by 0.1° to 0.3°C by 2010, and by 1.0° to 3.5°C in next 90 years of this century (Perry, *et. al.*, 2007). When this happens, it will shrink the Polar Regions, enhance the temperate climate zone of the world, and alter the pattern of rainfall in different parts. India and other South Asian countries are expected to be most adversely affected. Mechanisms for risk mitigation are poor or absent. Hardly 10% of farmers are covered by crop insurance. Farm families are also not covered by health insurance (National Commission of Farmers' Reports, 2005, 2006). Technology development process has to factor in these expected adverse changes so as increase productivity even under adverse climatic conditions. These conditions apply to this state also.

Crop Health Surveillance under Farmer Crop Management System (FCMS)

In recent years, as we know farmers of Tamil Nadu are experiencing unprecedented outbreak of pests and diseases which causes economic damage to Agriculture, Horticulture, Forestry and Sericulture crops. Outbreaks of minor pests and diseases becoming major ones have been reported in recent years. Several invasive pests have gained entry into our country in the recent past. A few of them have established well on major crops and also spread to all over India very quickly. To overcome this problem and to prevent the spread to adjoining areas, a sound pest and disease surveillance programme is very essential. It becomes imperative for the field functionaries to have a thorough knowledge on the diagnosis of the symptoms of damage caused by the pests and diseases on the crop.

FCMS programme involves observations by the plant protection scientists of TNAU positioned in different research stations in various districts and by the extension functionaries of the Department of Agriculture and Horticulture. The surveillance programme encompasses fixed plot survey and roving survey on the incidence and damage by pests and diseases in major crops by the University scientists and extension functionaries of the Department of Agriculture, Horticulture, Forestry and Sericulture.

The supporting methodology includes observations on the activity of pests by setting up light traps, pheromone traps, spore traps, etc. The weather data from Automatic Weather Stations (224 blocks) will be utilized to study their influence on the pests and diseases.

Interpretation of the data collected

KVKs and Plant Clinic Centres of TNAU have been identified in each district of the state for collaborative interpretation of the surveillance data gathered every week and the collected reports will be sent to Director (Centre for Plant Protection Studies) by the KVKs and Plant Clinic Centres for further analysis along with the data collected by the Professor and Head, Agricultural Entomology for forewarning of pest and diseases.

The forecasting of pests and diseases will be informed to forewarn the farmers through popular newspapers and media. The farmers are benefitted by taking precautionary measures in curtailing the outbreaks of pests and diseases in advance. The information regarding the use of biocontrol agents for managing pests and diseases are also intimated to the farmers to take up timely plant protection measures.

Poor Farmer-Market Links: High levels of food production in limited areas, with a widespread distribution system, have undoubtedly affected market prices in food-grains. In the absence of price support systems in large parts of

the country, increases in productivity have led to localized gluts, with local prices crashing, and thereby retarding the incentives to increase production.

Declining labour availability for agriculture: The labour availability for agriculture is becoming an acute problem especially during peak operations period, when large number of labourers is required for a short span of time over a large cultivable area. Farm mechanization that is suitable for the predominantly marginal and small farms of Tamil Nadu has to be further popularized / systems should be developed to enable farmers of all size of holdings to mechanize farm operations.

3.1. STATE PLAN SCHEME FOR R&D TO TNAU (XI Five Year Plan)

Govt. of Tamil Nadu extends financial support for establishment and operation of TNAU. Out of the total budget, 58 % is contributed by the State Government through Plan and NADP schemes. The budget support for research happened to be meager. The ICAR and GOI sponsored research programmes accounted for approximately 68 percent, the private investment for research was nearly 30 percent and the state support was two percent only. The financial support by Government to TNAU under plan scheme and NADP including IAMWARM is as follows:

Plan - Financial performance for the years from 2007-08 to 2011-12

Sl. No.	Sub-Head	2007-08		2008-09		2009-10		2010-11		2011-12
		Allotment	Expr.	Allotment	Expr.	Allotment	Expr. (un audited)	Allotment	Expr. (un audited)	Allotment made in interim budget
1	State plan	4618.61	4044.03	5118.47	4422.59	5638.31	5466.06	5145.33	5145.33	7208.36
2	State plan – IAMWARM	974.26	974.26	1460.75	1228.43	2458.68*	610.51	3127.73**	859.91	4303.97***
3	State plan – NADP	-	-	4480.90	1581.70	3069.53#	2462.70	1452.83##	846.00	1452.83###

* includes a spill over provision of Rs.232.32 lakhs for the year 2008-09

** includes a spill over provision of Rs.1848.17 lakhs for the year 2009-10

*** includes a spill over provision of Rs.2267.82 lakhs for the year 2010-11

includes a spill over provision of Rs.2899.20 lakhs for the year 2008-09

includes a spill over provision of Rs.606.83 lakhs for the year 2009-10

includes a spill over provision of Rs.606.83 lakhs for the year 2010-11

4. XII FIVE YEAR PLAN: GOAL, OBJECTIVES, STRATEGIES AND PROGRAMMES

Goal

The goal is to help the agriculture sector to be resilient and grow in the midst of adversities and help farmers to increase their income.

Objectives

The objectives of Agricultural Research and education during the XII Plan period are:

1. To produce graduates capable of Multi-tasking and to serve in Academic, corporate, service, banking and technology delivery sectors, besides taking-up self employment, all in a Globalising scenario.
2. To evolve varieties/ hybrids and integrated crop production technologies for sustained increase in yield and to meet the end users expectations in-terms of quality and food safety.
3. To ensure soil and water qualities and enhance out-put per unit.
4. To ensure service provision to enable farmers to take informed decisions based on price and weather advisory.
5. To further expand use of ICT in education, research coordination, administration and technology delivery.
6. To harness research out-put of frontier sciences to increase value added crop production, storage and processing
7. To investigate climate change and mitigation and to supplement disaster management programmes

Strategies

Broad strategies envisaged for achieving targeted agricultural growth in Tamil Nadu would cover four categories;

- a) Agricultural Education to cater to the Globalising agriculture needs
- b) Research for innovative solutions
- c) Putting innovative solutions into practice
- d) Promoting agribusinesses

4.1. Agricultural education

New education programmes and new institutions would be initiated based on the need for developing human resources. There are new developments discernible in the field of education.

Present	Future
Formal and standard with a disciplinary orientation	A combination of formal and non-formal with an inter disciplinary orientation
Few sources of funding and few stakeholders	Multiple sources of funding and a large number of stakeholders.
Largely insular and inward looking	Collaborative alliances with a variety of institutions in the country and abroad and participate with activities of stakeholders.
Lack of accountability	Accountability to its clients viz., students, local community, employers and the government
Poor linkage across stakeholders	Strengthening inter-linkages between various stakeholders of the university and getting feedback from the community of users to improve the academic programmes
Nature of governance is rigid, procedures static and adherence to established norms and procedures	Dynamic process, change oriented emphasis on flexibility

Future programmes will follow the new path some of which have already been followed in the university. Education infrastructure would be strengthened so as to improve the learning environment for the youth.

4.2. Research for innovative solutions

An analysis of commodity share through the modified congruence method was done for Tamil Nadu considering the area and production data for three years (Triennium ending 2009). The harvest values were evaluated at 2008-09 prices. The study results revealed the following.

Crop/ Group	Area, Value and Export weighted share	Rank
Rice	23.48	1
Coconut	9.29	2
Banana	9.17	3
Sugarcane	8.59	4
Groundnut	7.4	5
Cotton	4.6	6
Tea	3.21	7
Tapioca	3.16	8
Mango	3.13	9
Maize	2.90	10
Black gram	2.71	11
Sorghum	2.67	12
Green gram	1.43	13
Cashew	1.16	14
Turmeric	0.97	15

Note : The weighted share is; other cereals (7.88 %), other pulses (0.72 %), other oilseeds (1.1 %), other fruits (2.52 %), other vegetables (2.22 %) and other spices (2.09 %). Beside these, the importance of fodder crops needs to be visualized in the light of growing importance for animal based food and food products.

Thus, the research focus and allocation of resources for crops will be determined accordingly.

Specific Research Thrust Areas

- Crop improvement Research on developing new varieties and hybrids would continue so as to develop new varieties and hybrids that fulfill market needs and also possess important traits such as drought, pest and disease resistance and nutrient enrichment. Systems would be developed in consultation with the State Agriculture Department and Agribusiness Development Directorate of TNAU for involving private players for enabling mass production of the developed varieties and hybrids.
- Standardising Precision Farming Technologies for more crops of Tamil Nadu would be given impetus, which will help to increase yield of quality produce, conserve resources and maintain and enhance resource quality.
- Research would be strengthened to develop implements and machineries considering the needs of the farming community, particularly marginal and small farmers.
- Research will be taken up to reduce post harvest losses
- Developing bio technology and nanotechnology based solutions for enhancing productivity, enhancing post harvest life, value addition, enhancing input use efficiency and maintain resource quality
- Further intensification of Research on climate change and mitigation
- Market research to promote market led agriculture

Marginal and small farm profitability: Developing integrated farming systems models for improving the revenue generation of marginal and small farms. Institutional approaches such as group farming, contract farming, etc would be dovetailed to empower farmers in the market.

Improving productivity in Rainfed areas: Research and technology transfer initiatives for rainfed areas would be given a major emphasis in XII plan

including crop improvement, management and improvement in the organic content of soil to achieve marked improvement in the standard of living of marginal and small farmers, particularly in these less favoured areas.

Organic farming practices will be standardized to help farmers who want to take-up organic cultivation.

4.3. Putting innovative solutions into practice

Linking farmers to markets: High price spread and low farmers' share in consumer rupee for agricultural produce has contributed to the erosion of farm profitability. Farmers must be directly linked to processing units viz., oilseeds to oil mills, tapioca to starch industries, pulses to flour mills, rice to modern rice mills, fruits and vegetables to processing industries, etc., so that they can have direct link with the industry as in the case of sugar industry or directly linked to consumers through retails outlets (Farmers shandies / organized retailing), through contract farming. This arrangement should be able to weave in a consortium of financial institutions, input suppliers, extension agencies and marketing service providers. Research and outreach programmes will be implemented to develop models for linking farmers to markets. Studies on linking farmers to national markets will also be taken-up.

Market oriented agriculture must be the order of the day. Greater emphasis so far has been given to transfer of production technologies, but henceforth the first thing required is the market oriented farm planning and production. Research would be undertaken to formulate market advisories based on the market intelligence and assess its impact and recommend for larger adoption.

Targeted technology transfer: Special initiatives would be taken up for transfer of critical crop production technologies that would substantially increase yield of identified crops in potential districts. Market linkages would be facilitated by organizing growers and facilitating traders visit to the production

areas, interaction among growers and traders, exposure visit of growers to markets and tying up with appropriate Government agencies for procurement to meet the needs of the Government programmes. Comprehensive technology demonstration in large plots (one acre) in farmers' fields will be continued. Crops cultivated in a large area in each district and thus affect a larger dependant population would be selected. The major crops; are 1. paddy, 2. maize, 3.black gram, 4.green gram, 5.red gram (considering its common usage among the population), 6.ground nut, 7.gingili, 8.sun flower, 9.sugar cane, 10.mango, 11.banana, 12.turmeric, 13.chilli, 14.cashew, 15. tapioca, 16.onion, 17.tomato, 18.brinjal and 19.cotton.

Demonstrating food processing model: The Post Harvest Technology Centre at TNAU has been a viable model for providing custom hiring of processing facility for small famers, traders and prospective processors. Such centres would be facilitated to be created in districts to demonstrate the potential of this concept in enhancing farmers' revenues.

4.4. Promoting agribusinesses

Agribusiness Development: New initiatives would be formulated and implemented to promote rural youth to take up agribusinesses such as seed production, farm machineries and implements production, Production of bio-inputs such as; bio-control agents, vermi-compost, providing farm based services, etc., on a public private partnership mode involving agriculture department. This would provide off-farm employment for rural men and women and also contribute for extensive use of bio-inputs which have not been taken up on a large scale by large firms. The specific programmes that will be taken-up by TNAU during the XII Five Year Plan period under different broad areas are given below.

5. SPECIFIC STRATEGIES AND PROGRAMMES PROPOSED FOR IMPLEMENTATION DURING XII FIVE YEAR PLAN PERIOD

It is proposed to establish the following Centres of Excellence during the XII Plan period to promote intensive research for technology solutions, generation of inputs for education and capacity building for over-all improvement: 1. Hybrid Breeding; 2. Dry land Agriculture; 3. Organic Agriculture; 4. Precision farming; 5. Soil Health; 6. Social Sciences and 7. Agricultural Information Technology. Besides, it is also proposed to establish an Institute of Fodder Research and a Centre for Disaster Management as suggested during the first meeting of the Working Group on Agricultural Research and Education.

It is also proposed to strengthen/ establish the following advanced laboratories to ensure quality supply of inputs, food safety, resource and environment quality: 1) Referral Labs for Quality testing; 2) Micro-Analytical Laboratories (for Micro nutrients); 3) Residue Laboratories; 4) Bio-Fertilizer Laboratories; 5) Soil and Environment Research Centre at Thiruppur and 6) Insect Bio Systemic Centre.

Agricultural Mechanisation will be given thrust as transfer of population dependant on agriculture to non agriculture sector is the sign of development and consequently agricultural operations are to be largely mechanized. This will be taken-up by strengthening farms for complete mechanization for specific crops which will serve to further take up research and as demonstration farms.

Infrastructure in the teaching campuses and research farms will also be strengthened for effective delivery of services.

5.1. Agricultural Education

Programmes

1. Curriculum redesigning to fit to the International standards including the introduction of new degree programmes

2. Establishment of Centre of Excellence in Agricultural Information Technology and Media Management
3. Establishment of the Horticultural College & Research Institute for Women
4. Establishment of Sericulture College & Research Institute at TNAU
5. Digitization of books and development of web portal for TNAU Library
6. Strengthening infrastructure facilities in the seven constituent colleges of TNAU
7. Knowledge empowerment of farmers through Open and Distance Learning (BF Tech Programme)
8. Starting of Agricultural polytechnics will be encouraged through public-private participation with lending of expertise if necessary from TNAU.

Proposed Budget: ₹14850 lakhs

Anticipated Benefits

- Development of Human Resources to cater to the needs of education, research, extension, agriculture practices, management, agri-business, agri-preneurship development and policy making
- Strengthening the knowledge base of farmers on doing quality agriculture and horticulture crop husbandry practices

Indicators for Monitoring

- Increased graduate out-put
- Improved farming practice adoption by the farmers
- Greater number of TNAU graduates pursuing higher degrees in International Institutes
- Placement of graduates and placement in better positions (Entry level salary packages)
- Standard of curriculum and syllabi
- Stock of Learning Resources
- Quality of content and means of delivery
- Greater number of qualified agriculturists

Gender Benefits

More number of women scientists and graduates

5.2. Agricultural Research

5.2.1. Crop Improvement

Programmes

1. Collection, Characterization and Conservation of germplasm in crops of interest and strengthening the existing Ramiah Gene Bank and establishing Plant Genetic Resources Conservation Network
2. Evolution of Biotic and Abiotic stress tolerant varieties of rice, pulses, oilseeds, cotton with higher yield potential through integrative breeding
3. Creating centre of excellence for hybrid breeding at TNAU, Coimbatore and identification / development of new male sterility sources in major crops
4. Developing varieties / hybrids with high nutritive values such as improved Vit A, Fe and Zinc content and enhanced therapeutic values
5. Augmenting feed supply to animal population through breeding interventions
6. Climate resilient variety / hybrid development and developing genotypes for late monsoon and coastal ecosystem
7. Developing varieties with synchronized maturity in blackgram, greengram, soybean, cotton etc. to facilitate mechanized harvesting
8. Establishing quality testing centres for rice, millets, oilseeds, pulses, vegetables and mango
9. Establishment of Institute of fodder research and production
10. Developing pulse varieties exclusively for rice fallow situation

Proposed Budget: ₹ 12417 lakhs

Benefits & Impacts Expected

- The newly developed resistant genetic stocks / pre breeding materials / new varieties and hybrids will have resistant genes to overcome adverse climatic condition and can be grown directly by farmers or can be employed in the national breeding programmes.

Indicators for Monitoring

- Genetic stocks
- Number of varieties/ hybrids with higher yields and quality
- Greater levels of adoption

Gender Benefits Anticipated

- Women scientists' participation will help them to sharpen their research capabilities on this area. Besides, many of the operations during seed production require human intervention in which women labour participation will have an edge.

Relevance in the Green Economy context

- Development of resistant varieties coupled with higher yield in the major field crops will be developed which will minimize the pesticide usage and help to improve environment quality.
- Development of fortified varieties / hybrids with required minerals and vitamins to correct the deficiency that commonly occurs in human and animals will not only bring better prices for the produce to benefit local farmers, but also healthy food and better energy for consumers.

5.2.2. Crop Management

Programmes

1. Developing integrated farming system models for improving marginal and small farm profitability

2. Establishing Centre of Excellence for Dry land Agriculture at Dryland Agricultural Research Station, Chettinad
3. Establishing Centre of Excellence in Organic Agriculture at Agrl. Engineering College & Research Institute, Kumulur
4. Productivity Enhancing Management Technologies (Precision Farming Technologies) for Maize, Cotton, Oilseeds and Pulses
5. Providing weather based agro advisory services at *block* level in Tamil Nadu for minimising crop production risk including maintenance
6. Land resource inventory and GIS database for block, village and farm level planning
7. Establishing Centre for Disaster Management
8. Utilizing standardized package of practices for improving the pulse yield under rice fallow conditions
9. Pulse Drip Fertigation along with standardization of fertilizer for pulses as done in Maharastra
10. Focus on package approach to solve inter district field problems, wide yield variations etc., at least for one crop and few districts on pilot basis

Proposed Budget : ₹10391 lakhs

Benefits

- Overall farm productivity and income enhancement through minimization of risk and uncertainties
- Food, nutritional and fodder security for resource constrained farmers
- Improving the standard of living of farmers
- Efficient utilization of harvested rain water for supplemental micro-irrigation and nutrient use efficiency to enhance crop productivity and livelihood of dry land farmers.
- Reducing the risk in crop management through weather based agro-advisory services

- Saving of inputs, reduction in cost of cultivation, increased water use efficiency and increase in productivity and farm profit.
- Detailed block-wise soil resource information for crop planning

Indicators for Monitoring

- Higher yields
- Better grade produce
- Cost saving
- Input and resource saving
- Better price
- Higher income
- Better quality of life

Gender Benefits Anticipated

- Farm women will be empowered through the implementation of IFS through their enhanced role

Relevance in the Green Economy context

- Resource saving, better environment and ensuring equity among different groups of farmers in the attainment of benefits

5.2.3. Soil health management

Programmes

1. Establishing Centre of Excellence on soil health including problem soils, degraded lands, waste utilization and managing pollution at Agri. College & Research Institute, Trichy including Micro Analytical Laboratory for soil analysis
2. Establishment of Central Control laboratory for Bio fertilizers
3. Establishment of Soil and Environment Research Centre at Tirupur
4. Integrated Nutrient Management for soil organic matter buildup and fertility improvement

5. Problem soil management
6. Rehabilitation of Degraded lands
7. Microbial consortia development
8. Nanotech approaches for soil health maintenance
9. Development of advanced compost technology and pollution abatement

Proposed Budget: ₹ 4100 lakhs

Benefits

- Improving the soil quality thereby enhancing productive capacity of the soil
- To enable continuous monitoring of pollution levels and suggesting corrective measures to conserve soil and water resources in the problematic areas
- Waste utilization that will have environment friendly role in increasing production and simultaneously will help to reduce the pollution levels

Indicators for monitoring

- Organic content in the soil
- Soil and water quality

Relevance in Green Economy context

- Better environment management and ensuring the income of the farmers besides assuring availability of potable water for domestic use.

5.2.4. Crop protection

Programmes

1. Conservation of Insects Biodiversity and Establishment of Insect biosystematics centre
2. Development of Novel Plant bio-molecules based Bio-pesticides for eco friendly protection against major pests in agricultural crops and vegetables
3. Bio Ecology of nematodes and its management in vegetables under poly-house condition

4. Management of diseases of agricultural crops, cut flowers and vegetables through synthesis and experimentation using newer molecules
5. Strengthening residue laboratory
6. Strengthening the crop protection packages for improving the yield of pulses in rice fallow conditions

Proposed Budget : ₹466 lakhs

Benefits

- Serving as a Insect biosystematics repository centre
- Development of eco-friendly technology package with the superior endophytic / non endophytic PGPR strains and fungal antagonists suited for the management of diseases and nematodes
- Development of a novel water soluble formulation and liquid formulations suited to drip and fertigation system.
- Improving the standard of living of the farmers ventured in to the protected cultivation.

Indicators for monitoring

- Reduction in the cost of pest control
- Increased yields

Relevance in Green economy context

- Production of safe food with reference to eco friendly pest management and cleaner environment besides reducing cost of production across different farming groups

5.2.5. Horticulture

Programmes

1. Establishment of Centre of Excellence in precision farming (including taking up evaluation of olive cultivation in places like Yercaud)
2. Developing hybrids in coconut

3. Developing high yield, high starch and CMD resistant cassava varieties
4. Improvement of yield and imparting resistance to Sigatoka leaf spot disease in banana through breeding
5. Enhancing the productivity and quality of select horticultural crops through validation and demonstration of precision farming modules involving participatory approaches
6. Validating high density planting systems in horticultural crops (mango, guava, cashew)
7. Demonstration of protected cultivation of cut flowers and vegetables
8. Strengthening Micro Analytical Laboratory
9. Increasing GAP orchards in Tamil Nadu @ one orchard per district
10. Offering certificate training programme on protected cultivation

Proposed Budget : ₹2235 lakhs

Benefits and impacts expected

- Increased yield and quality of produce
- Reduced chemical usage
- Higher income to growers
- Increased supply of raw materials to starch and sago industries
- Empower the farmers to handle sophisticated technologies with ease and conviction
- Additional employment generation and industrial development
- Increased adoption of improved packages for enhancing the earnings of farmers

Indicators for monitoring: As given under benefits

Gender benefits anticipated

- More employment opportunities to women labourers in industries.

Relevance in the Green Economy Context

- Undue and overuse of fungicides and chemicals will be avoided thus protecting the environment and natural fauna, besides increasing efficiency and income across different sections of the society.

5.2.6. Quality seed production and distribution

Programmes

a. Breeder seed production and distribution

- Production and supply of breeder seeds in Agricultural Crops to meet the demand of public and private sector by TNAU

Proposed Budget : ₹504 lakhs

b. Augmenting quality foundation and certified seed supply

- Augmenting the production of foundation and certified seeds of pulses, oilseeds and millets under contract seed production for timely supply to the farmers of Tamil Nadu by TNAU and Dept of Agriculture

As regards organizing production and distribution of certified seeds, the proposal from TNAU already includes an outlay of Rs.11,520 lakhs which provides for production and supply of breeder seeds, foundation and certified seeds to meet at least 50 per cent of the total seed requirement of the recommended SRR of Tamil Nadu State in pulses, oilseeds and 10 per cent of maize hybrid seed requirement. TNAU will produce 100 per cent requirement of breeder seed and 20 per cent of foundation and certified seeds required for the State, while the Department of Agriculture will produce 80 per cent of foundation and certified seeds required for the State, by following contract seed farming. This will facilitate for availing the central government subsidy scheme for seed multiplication since single organization cannot avail dual subsidy.

Proposed Budget : ₹11016 lakhs

(₹1016 lakhs budget to be received would be kept as seed money)

Benefits and indicators for monitoring

- Enhanced availability of quality seed and better area coverage
- Increased germination percentage
- Higher yields and better quality produce

Gender benefits anticipated

- Women scientists will play a prominent role in coordinating seed production programme. Seed production being a labour intensive activity will provide employment to more women labourers, particularly in hybrid seed production.

5.2.7. Complete mechanization

Programmes

1. Development of model Research Stations with modern technologies in campuses of Tamil Nadu to demonstrate the completely mechanized cultivation of identified crops

Proposed Budget : ₹1200 lakhs

Benefits

- The proposed machines are fully indigenous.
- Time saving
- Man power dependency will be minimized
- Cost effective
- Increase in the productivity
- Human drudgery will be less

Gender benefits anticipated

- Women labourers can easily use the machine with minimum drudgery

5.2.8. Food processing incubators

Programmes

1. Establishing Food Processing Business Incubator (FPBI) each one at 30 districts in Tamil Nadu

Proposed Budget : ₹15000 lakhs

Benefits

- Prospective entrepreneurs in food processing will be given technical and other support in establishing business
- Will help to increase volume of processed food while enhancing the quantum of value addition
- Will help to reduce the wastage of food
- Will help in promoting agro industrialization

Indicators for monitoring

- Number of trained persons
- Number of entrepreneurs

5.2.9. Agri-business development

Programmes

1. Establishment of Student Innovation Bureau
2. Establishment of Lab to Market Unit
3. Establishment of Entrepreneurial hub for quality bio-products

Proposed Budget : ₹1000 lakhs

Benefits

- Better value realization for the stakeholders in agri business

5.2.10. Research in frontier areas

a. Bio-Technology

Programmes

1. Development and Popularization of varieties in agricultural crops through biotechnological interventions with special reference to rice

2. Micropropagation, root and callus cultures for large scale production of secondary metabolites of pharmaceutical importance
3. Bio-fortification of Vitamin E in rice grains through genetic transformation
4. Microbial biotechnology based approaches to develop industrial products for application in agriculture and food sector

Proposed Budget : ₹360 lakhs

b. Bioenergy

Programmes

1. Design and Development of advanced reactors and devices for the recovery of energy and manure from bio mass and bio waste

Proposed Budget: ₹119 lakhs

c. Biofuels

Programmes

1. Inventory and assemblage of superior TBO's genetic resources of Tamil Nadu for biodiesel production

Proposed Budget: ₹21 lakhs

d. Nanotechnology

Programmes

1. Nanotechnological Approaches to sustain soil health and for ensuring Food Security

Proposed Budget: ₹270 lakhs

Benefits

- Improving nutritional quality and yield
- Bio-plastics / biopolymers production from microbial process based products
- Formulation of antimicrobial compounds to ensure the food security

- Improving the shelf life of fruits and vegetables and to remediate aquatic heavy metal pollutants through nano-technological approaches

Green economy context

- Improving quality of environment
- Green energy supplementation

5.2.11. Forestry research

Programmes

1. To inventorize and develop technologies through strong scientific innovations to improve the wood quality and for strengthening silvicultural practices to cater to the domestic and industrial needs

Proposed Budget : ₹100 lakhs

Benefits and impacts expected

- Alternative genetic resource development for productivity enhancement and rotation reduction
- Post-harvest technology and value addition
- Energizing the existing market system through improved supply chain
- Rural employment generation

Relevance in the Green Economy Context

- The forest based plantation programme will help to enhance the environmental services

5.2.12. Modernizing farms of identified Research Stations

Programmes

1. Strengthening the infrastructure of the century, platinum, gold and silver jubilee research stations

Proposed Budget : ₹9650 lakhs

5.2.13. Establishment of Regional Research and Development Centres

The State Planning Commission, Tamil Nadu while discussing proposals under Agricultural Research and Education for inclusion in the 12th Five Year Plan, expressed the need to establish Regional Centres with facilities at par with Coimbatore campus of the Tamil Nadu Agricultural University. The members of the Steering Committee on Agriculture and Irrigation also indicated that currently the farmers are finding it difficult to approach the scientists at the University in Coimbatore to redress their production and post production problems. It warrants creation of infrastructure and scientific manpower at Regional level under the University.

The Regional Research and Development Centres will therefore be established in four locations at Kovilpatti, Paiyur, Tirur and Thanjavur. The existing research stations in the above four places will be strengthened with additional infrastructure and staff to take up research, based on local problems, up scaling of technologies through large scale demonstration, exploring and promoting agri-business and capacity building, through training different stakeholders. These centres will also act as sources of feedback on technology related problems and stakeholder preferences, to design education, research, extension and agri-business promotion.

Each Centre will have 10 additional position of Professors from major disciplines. The centres will also be provided with additional laboratory space, lab equipments and vehicles including a bus for transportation of the trainees and farmers.

The estimated budget for four centres will include a recurring expenditure of Rs.5000 lakhs (staff and operating expenditure) and a non-recurring expenditure of Rs.4000 lakhs (one time grant for establishing additional space, laboratory equipments, vehicles) for the 12th plan period of five years.

Proposed Budget : ₹9000 lakhs

5.2.14. Establishment of Agricultural Research Station in Thiruvannamalai District

Thiruvannamalai is one of the backward districts in Tamil Nadu which requires closer attention. The major crops are rice, groundnut, pulses, millets, and sugarcane and horticultural crops like tapioca, vegetables and flowers. For making technological breakthrough in the farming systems and practice in the district for doubling agricultural production and the farmers' income as envisaged by the Government of Tamil Nadu, it is imperative that the agricultural technologies are locations specific and made accessible to farmers of the district. Therefore, for technology generation and effective dissemination of the technologies already standardized and to keep pace with the faster developments that are happening elsewhere in agriculture, it is essential to establish a Agricultural Research Station (ARS) in the district. Therefore it is proposed to include the present proposal for taking up necessary activities at a total cost of Rs.2000 lakhs during the 12th Five Year Plan.

Proposed Budget : ₹2000 lakhs

5.2.15. Research coordination

Programmes

1. Research priority setting, Project monitoring and Creation and maintenance of Data Bank for line departments and State Planning Commission. **The PME Cell in the Directorate of Research proposed to be strengthened during the XII Plan will also take-up in coordination with CARDS, impact studies of varieties, implements and new technologies.**

Proposed Budget : ₹1000 lakhs

Benefits

- Systematic approach to research prioritization for the agriculture sector
- Efficient allocation of resources to research for various crops / theme areas

- Data management of TNAU Research Activities for effective monitoring and evaluation
- Efficient flow of information in the agricultural system to achieve the targeted growth through e governance.

5.2.16. Social sciences research

Programmes

1. Establishing centre of excellence in Social sciences
2. Documentation of TNAU Technology Adoption and Constraints in various Agro – Climatic Zones
3. Value Chain Analysis for Major Agricultural Crops in Tamil Nadu State
4. Establishing and Networking of Agricultural Market Intelligence Systems
5. Amplification of Intellectual Property Rights Facility at TNAU, Coimbatore
6. Efficacy of crop insurance in Tamil Nadu
7. Estimation of opportunity cost of conversion of paddy lands into farm ponds in different agroclimatic zones of the state
8. Estimation of farmers' demand for construction of cold storage units
9. As regards food demand and gap and potential at Tamil Nadu level, a study will be taken up during the 12th plan period in the initial two years through the proposed Centre of Excellence in Social Sciences under the 12th plan proposals. Budget for the establishment of Centre of Excellence in Social Sciences has already been included in the budget proposed for TNAU.

Proposed Budget : ₹1000 lakhs

Benefits

- Will help in taking decisions relating to promotion of Agricultural production strategies, Marketing, Finance, Agri-business models, Management of Natural resources and feed back about impact and

constraints of technology adoption for refinement /initiation of new programmes.

5.3. Agricultural extension education

Programmes

- i. Strengthening IT based e-extension activities in TNAU including TNAU Agri-Tech Portal, Dynamic Market Information and Mobile based agro-advisory services – 994 lakhs
- ii. Establishment of Community Radio Centres in select locations and Agricultural Extension Education strengthening – 2406 lakhs
- iii. Participatory precision farming demonstrations in blocks and training on maintenance of drip systems – 2000 lakhs
- iv. Training the scientists on Team building and Stress Management – 50 lakhs
- v. Massive training to line department officials on latest technologies for capacity building – 150 lakhs

vi. Establishment of TNAU Regional Training Centres (TNAU RTCs) for imparting simulation training to the line department officials

Technology generation and development is increasing day by day. In order to update the latest technologies to the line department officials, It is necessary to give regular capacity building and skill development programme to the line department officials. To impart regional specific technologies and also for easy access, establishment of four TNAU Regional Training Centre (TNAU RTCs) at Cuddalore, Paiyur, Thiruvannamalai and Sivagangai covering entire part of Tamil Nadu is essential.

The existing research stations in the above places will be strengthened with required infrastructural facilities like establishment of training centre,

laboratory facilities, trainees hostel, teaching equipments besides transport facilities. For giving training on all the aspects, an exclusive multidisciplinary team of scientist is to be posted in all the four Regional Training Centre. The training centre will impart training on agriculture and allied aspects to all the development department officials and also to the progressive farmers.

The estimated budget for establishment and running of all the four Regional Training Centre will include a recurring expenditure of (Staff, training cost etc.,) is Rs.1200 lakhs and non-recurring expenditure of Rs.1000 lakhs (one time grant establishment of training centre, laboratory facilities, trainees hostel, teaching equipments besides transport facilities) for the 12th plan period of five years. Budget requirement for five years Rs.2200 lakhs.

vii. Strengthening of KVKs - Establishment of Farm Information Centres / Regional Extension Centres in NGO operated KVK districts

Establishment of Farm Information Centres / Regional Extension Centres are very essential to transfer the TNAU technologies directly to farming communities in 16 NGO operated KVK districts of Tamil Nadu viz., Coimbatore, Erode, Karur, Ariyalur, Perambalur, Krishnagiri, Thanjavur, Kancheepuram, Thiruvannamalai, Namakkal, Sivagangai, Thoothukudi, Dindigul, Theni, Tirunelveli and Ooty.

The following ToT activities will be carried out by the centres.

- Implementation of On Farm Testing to solve the location specific problems and Front Line Demonstration for popularization of TNAU technologies
- Organizing 'Vocational Training' to rural youth, farm women
- Imparting training to extension functionaries on latest TNAU technologies
- To implement the NHM, NADP (Precision Farming), ATMA related programme and other government programmes from time to time.

Budget requirement for five years Rs.2500 Lakhs.

viii. Establishment of separate TV channel

A Separate Television Channel has been proposed to be started exclusively for farm related contents. The License will be obtained from the Ministry of Information and Broadcasting, Govt. of India, New Delhi by following the required norms for the mass media operations. At present the Govt. Channel Doordarshan is having Agriculture as one of its telecast contents which is often felt to be insufficient with regard to the allotted time. If a separate channel is exclusively started for Agriculture related information, the farmers will be much benefited. The channel will have base station at Coimbatore and substation in major TNAU Research stations as its hub. The success stories of the farmers, market prices, weather, day to day farming operations, Recommendations by the Agricultural Scientists will be covered for 12 hours daily in the new channel to be planned. Budget requirement for five years Rs.5280 lakhs.

Proposed Budget : ₹15580 lakhs

Benefits

- To enable effective technology delivery in coordination with the scientific and the extension community and bring-in ICT in a big, affordable and user friendly way.

5.4. Human resources development

Strengthening Human Resource is essential for the University to be prepared to handle the emerging new challenges and to be on track to deliver in future years. Therefore, augmenting scientific staff position and capacity building by way of training in the advanced areas of Education and Research are essential.

Besides, the expenditure pattern in TNAU also reveals that the share of State Government in the Infrastructure development, operating expenses

including contingencies and TA happens to be very minimal ranging between 0.5 to 1.0 % for TA, 25 to 35 % under Recurring contingencies. In view of enhancement of activities to meet the targets set by the new Government, the provision of funds to meet the operating expenses need to be enhanced.

Programmes

1. Appointment of new scientific man power to fill up vacancies
2. Provision of contingencies and travel allowances @ 1 lakh per scientist for effective utilization of available scientific and supportive man power
3. Training in frontier areas through National and International institutions

Proposed Budget : ₹12645 lakhs

Benefits

- To hone the scientific man power in the emerging areas of science and technology and make effective use of them in education, research and technology delivery processes.

6. BENEFITS AND BROAD INDICATORS OF AGRICULTURAL RESEARCH AND EXTENSION EDUCATION FOR MONITORING

The general indicators for monitoring beside specific indicators that are mentioned then and there are given below.

- Higher yield level/ quality of output (grade)
- Higher farm income
- Hybrids and varieties developed based on end user demand
- Greater proportion of exportable quality of produce
- Adoption of Weather based and Market information based crop planning by farmers
- Greater provision of Market formation and Market intelligence

- Post-Harvest Management (reduction in post Harvest-loss and higher self life).
- Higher percentage of processing
- Mechanization (types of operations and levels and comparison of Labour vs. Mechanized operations)
- Promotion of Agri-business through focused entrepreneurship development (Agri Business Incubator)
- Knowledge Empowerment of farmers (Number of farmers graduating and trained)
- Higher use of ICT in technology transfer and Agri Marketing
- Increasing water use efficiency
- Improving soil health through increased organic matter content and physico-chemical properties of soil.
- Greater number of farmers following soil test based manure and fertilizer application
- Greater number of farmers using INM & IPM
- Greater number of farmers using technology information systematically
- Increased participation of stakeholders in research planning, execution, transfer of technology (farmer Group/Association, water user association, etc).
- The specific benefits and indicators for monitoring are given then and there where necessary.

7. GENDER BENEFITS

- Changing Women participation in the process of technology development and dissemination
- Technologies that enhance scope of use by women
- Women participation in training and capacity building

8. GREEN ECONOMY CONTEXT

- Improvement in the soil and water quality
- Increase in organic matter content of soil
- Increase in the microbial load of soil
- Increased number of natural enemies
- Accrual of benefits of new varieties/ hybrids, technologies to different sections of the society
- Accrual of these benefits to the local population

9. POLICY MEASURES SUGGESTED FOR SOLVING CRITICAL PROBLEMS FACED BY SMALL AND MARGINAL FARMERS

- The crops most suited may be identified for each of the Agro-climatic regions and developmental assistance may be extended for supporting use of critical inputs / techniques particularly to the small and marginal farmers.
- All the soil and water conservation programmes may be supported through Government assistance for implementation both in private and public lands.
- Implementation of crop insurance programmes may be re-designed from the results that will be obtained from the proposed study under the XII Plan which will help to protect the farmers on one hand and avoid expenditure through loan waiver as the loans will be covered by the insurance. Government may tighten the recovery of crop loans during the normal production years.
- The programmes of the development departments may be reviewed for the programme content relating to demonstration of the proven technologies in the last five years so as to modify these approaches to help proven technologies to reach the farmers.
- Block level exercises may be conducted to receive inputs from farmers annually, as regards their needs and difficulty, to design and implement training modules. The assistance of TNAU can be availed for technical inputs and expertise.

10. BUDGET ABSTRACT

(lakh ₹)			
Sl. No.	Major focus area	Budget	
5.1.	Agricultural Education	14850	14850
5.2.	Agricultural Research <ul style="list-style-type: none"> ▪ Crop Improvement ▪ Crop Management ▪ Soil health management ▪ Crop Protection ▪ Horticulture ▪ Quality seed production and distribution ▪ Complete mechanization ▪ Food Processing incubators ▪ Agri business development ▪ Research in frontier areas ▪ Forestry research ▪ Modernizing farms of identified Research Stations ▪ Establishment of Regional Research and Development Centres ▪ Establishment of Agricultural Research Station in Thiruvannamalai district ▪ Research coordination ▪ Social sciences research 	12417 10391 4100 466 2235 11520 1200 15000 1000 770 100 9650 9000 2000 1000 1000	81849
5.3.	Agricultural extension education	15580	15580
5.4.	Human resources development	12645	12645
Grand Total		124924*	

* Out of the total proposed budget of Rs. 124924 lakhs, a sum of Rs.8484 lakhs under the production distribution of certified seeds and Rs.15000 lakhs under establishment of Food Processing Business Incubator (FPBI) will be spent by the development departments concerned. **Hence, the financial requirement for programmes proposed for TNAU will be Rs.1,01,440 lakhs only.**

An abstract of the year wise break-up of the budget and details of the projects are appended.

A. HI-TECH AGRICULTURE AND AGRICULTURAL RESEARCH

The future growth in productivity would be the outcome of the innovation in crop production technologies with the availability of fixed natural resources and hence Hi-Tech agriculture is the prime mover of productivity. The success of the second green revolution would be the outcome of such Hi tech, scientific management of natural resources, enhanced input and technology use efficiency, upscaled use of farm machineries and further converting cultivable waste and cultivable fallow into Productive lands. The architecture of the Hi tech – agriculture and agricultural research also need a revamp which would result in the change from production driven agriculture into market driven agriculture, which is the real achievement of Hi-Technologies . The sector as a whole has a large number of Technologies that to-day as lifted the country with the global trade.

Agriculture is not merely the crop cultivation system but is the provider of food, nutrition, health, environment services and economic growth that is both sustainable and socially equitable.

The Hi-tech agriculture, horticulture and agricultural research are presented in the context of management of natural resources water, genetic resource and seed stock, farm mechanization, effect of climate change on productivity, advanced research management and technologies, processing and value addition, group farming, organic production, farm eco tourism, application ICT in agriculture and their implications in maximising the efficiency and production of Hi-tech agriculture and horticulture are presented separately in the draft approach paper on Hi-tech agriculture and agricultural research.

BUDGET ABSTRACT (HI-TECH AGRICULTURE / HORTICULTURE)

S.No.	Item	Rs. in lakhs
I. INNOVATIVE PROJECTS FOR TNAU		
1	Farmer Participatory Operational Research	100.00
2.	R&D in ICT in Agriculture	100.00
3.	Research on Bio Char in Agriculture	100.00
4.	Model Eco Tourist Farm	50.00
6.	Participatory Farming Project	300.00
Total		650.00
II. SECONDARY AGRICULTURE		
1	Promotion of producers Companies and Commodity Groups by establishing Krishi Business Kendra	350.00
1.	TN Institute of farm mechanization	1000.00
2.	Centre of Excellence for Precision farming	Budget included in agriculture
3.	Centralised Referral lab for Micro Nutrients	500.00
4.	Advanced Centre of Research and Higher Learning	3000.00
Total		4850.00
Grand Total		5500.00

The detailed budget is provided under draft approach paper on Hi-tech agriculture and agricultural research by the Dept. of Horticulture and Plantation Crops, Chennai.