

Paper II – Subject Paper

Agriculture (Diploma Standard) Code: 431

Unit I: Agronomic Principles, Practices and Meteorology (30 Questions)

Agriculture – Definition – Branches of agriculture – Classification and status of major crops in Tamil Nadu. Factors affecting crop production. Cropping systems definitions - principles - intercropping - types, Principles and Practices of Agricultural Operations – Tillage definition and types - Intercultural Operations, Implements and Tools in Agriculture – Growth stages and yield prediction.

Meteorology – Agricultural Meteorology – Definition - Importance in Crop Production - Atmosphere – Components and its importance – Weather Parameters and their role in Crop Production. Rainfall – Spatial and Temporal Variability in Tamil Nadu across Seasons – Agro Climatic Zones of Tamil Nadu. Automatic weather stations and its components - Agroadvisory services.

Irrigation - water movement in soil – soil moisture constants – available soil moisture - effect of water stress on crop yield – water use efficiency – water requirement of major crops – critical stages of water requirement – irrigation scheduling – types and advantages – Irrigation methods – Micro irrigation – Flagship schemes and policies of Tamil Nadu - Irrigation water use efficiency – management of poor quality irrigation water - soil erosion due to water and control.

Weeds – definition and importance of weed control in crop production – classification of weeds – methods of weed management. Herbicide classification based on mode of action - method of application - common and new herbicides available in the market – weed control practices for major crops – parasitic, problematic and aquatic weed management - integrated weed management – concepts and practices.

Agronomic practices including climatic and soil requirements, land preparation – seeds and sowing – varieties – fertilizer management – irrigation – weed control – harvesting – Production technologies for cereals, millets, pulses, oilseeds, commercial crops, mulberry, forages and green manure crops.

Unit II: Farming system, Dry Farming and Agro-Forestry (10 Questions)

Integrated farming system – models and components – Schemes of Tamil Nadu. Cropping schemes – Crop calendar of operation of major crops - Dry Farming – Definition and Present Status in Tamil Nadu – Soils of Dry Farming Tracts and their limitation to Crop Production – Major Crops of Dry Land. Suitable Dry Land Technology for increased Crop Productivity – Pre-

monsoon sowing – Conventional Crop Production Vs Alternate land Use in Dry Land – Drought and disaster effects and management – crop insurance schemes - Integrated Farming Systems in drylands. Erosion - Classification of Erosion – Soil moisture conservation practices – agronomical, physical and biological methods - Cultivation Practices – Water Harvest – Farm Ponds – Percolation Ponds –Weather aberrations and Contingent Crop Planning – Watershed development – definition and components. Land use classification – Role of Forests – Agroforestry – Definition and types – Social Forestry, Urban Forestry – Agroforestry Systems - Shifting Cultivation – Alley cropping – Wind Break and Shelter Belts – Agroforestry Practices – Teak, Casuarina, Ailanthus, Neem, Bamboo, and Acacia production and management practices

Unit III: Soils and Fertility Management (30 Questions)

Definition of Soil – Its main components – Soils of Tamil Nadu. Soil physical, chemical and biological properties and their significance in crop production. Soil Micro Organisms - Importance of Organic Matter on Soil Properties. Acid, Saline and Alkaline Soils and their reclamation. Soil and water pollutants and management. Irrigation water – Qualities of irrigation water - Water testing. Soil Fertility – Major, Secondary and Minor Plant Nutrients. Soil Fertility evaluation, Soil sampling and testing and fertilizer recommendations – Soil health card. Fertilizers – Nitrogenous, Phosphatic and Potassic Fertilizers – Complex and Mixed Fertilizers, Efficient use of Fertilizers – fertilizer management in major crops. Identification and management of major and minor nutrient deficiency symptoms in plants. Biostimulants – New age fertilizers – Crop Boosters - Remote sensing – GIS and GPS. Bio-Fertilizers – Groups of Bio-Fertilizers – Bacterial, Fungal, Algae and Azolla.

Unit IV: Horticultural Crop Cultivation Techniques (10 Questions)

Status of major horticultural crops in Tamil Nadu – Methods of propagation of major fruit crops - role of growth regulators – Soil and climate requirement - production technologies - nutrient and physiological disorders and its management - post-harvest technologies for Mango, Banana, Grapes, Papaya, Sapota, Guava, Citrus, Pomegranate, Ber, Annona, Amla, Apple, Pear, Avocado, Dragon fruit, Plum and Pineapple.

Importance of Vegetables – Nutritive Value - Methods of propagation of major vegetable crops - role of growth regulators – Types of Vegetable Garden: Kitchen Garden, Nutritional Garden, Truck Garden, Commercial Garden - Soil and climate requirement - production technologies - nutrient and physiological disorders and its management - post-harvest technologies for Tomato, Brinjal, Chillies, Bhendi, Onion, Cucurbits; Cauliflower, Cabbage, Turnip, potato, beetroot carrot, greens and perennials.

Importance of flower crops – Methods of propagation of major flower crops - role of growth regulators – Soil and climate requirement - production technologies - nutrient and

physiological disorders and its management - post-harvest technologies for Jasmine, Rose, Chrysanthemum, Marigold, Tuberose, Crossandra, Cockscomb.

Garden Design – Formal and Informal Gardens – Components of Garden – Lawns and Lawn Making - Study of Important Flowering Annuals, Flowering and Foliage Shrubs – Flowering and Foliage Trees – Creepers and Climbers – Cacti and Succulents – Indoor Plants and Indoor Decoration – Cut Flowers – Flower arrangement – Bonsai Culture and dry flower decoration.

Importance of aromatic and spices, medicinal and plantation crops – Methods of propagation - role of growth regulators – Soil and climate requirement - production technologies - nutrient and physiological disorders and its management - post-harvest technologies for Spices – Pepper, Cardamom, garlic, Clove, Nutmeg, Cinnamon, Allspice, Turmeric, Ginger, tamarind, Coriander and Fenugreek. Plantation Crops – Coffee, Tea, Coconut, Arecanut, Cashew, Cocoa and Rubber. Medicinal Crops – Coleus, Gloriosa, Ashwagandha, Senna, Keezhanelli, Agave, Thulasi and Achorus.

Tissue culture and micropropagation of horticultural crops – Totipotency – Regeneration – Callus culture – Somaclonal variation – hardening of tissue culture plants.

Unit V: Breeding and Seed Production (20 Questions)

Field Crops – Importance – Classification – Agricultural and Industrial – Chemical Composition of Economic Parts in the Crops & Cereals, Millets, Pulses, Oilseeds, Fibres, Sugar and Starch Crops. Plant Photosynthesis – Respiration – Translocation of Assimilates. Floral biology – Reproductive and Pollination System in Plants – Mechanisms of promoting Self Pollination and Cross Pollination in crop plants – Plant genetic resources – importance – collection – characterization and conservation. Selfing incompatibility and male sterility- application and limitation – male sterility classification – GMS, CMS, CGMS, EGMS, and gametocides.

Breeding Techniques for Self Pollinated Crops – Pure line selection – Mass Selection – Hybridization and Selection – Pedigree Method – Bulk Method – Rice, Black gram, Groundnut. Two and three line breeding in rice. Breeding Techniques for Cross Pollinated and Often Cross Pollinated Crops – Mass Selection, backcross method - Heterosis Breeding – Development of Hybrids. Inbred development.

Single Cross – Double Cross and Poly Cross – Use of Male Sterile lines for Hybrid Seed Production – Synthetics and composites for crops like Maize, Cumbu, Redgram, Cotton, sorghum, Castor, Sunflower, Coconut. Breeding Methods for vegetatively propagated crops – Clonal Selection – Hybridization and selection for crops like Sugarcane, Tapioca, Potato and fodder crops. Mutation in crop improvement – Polyploid in Crop Improvement – Inter Specific Hybridization. Importance and success stories. Geographical indications, PPV & FR Act and IPR.

Seed – Importance – Seed Quality Characteristics – Classes of Seed – Nucleus, Breeder, Foundation and Certified Seed – Guidelines for Seed Production – Multiplication Ratio – Seed Certification, general certification standards – Field Inspection and Certification – Seed Standards – Pollination and Role of Insects, Environmental and Edaphic Factors. Seed registration - Seed Production Techniques for Varieties and Hybrid in Rice, Maize, millets, Pulses, Cotton, Oilseeds, fodder crops and Important Vegetables: Tomato, Brinjal, Chillies, Bhendi, Lablab, onion and Cucurbits. Harvesting, Processing, Treatment, Storage, Seed Health and Marketing.

Unit VI: Plant Protection Principles and Practices (30 Questions)

Insects - Definitions – Characters – Economic Classification – Sericulture – Rearing of Mulberry silk worms – Apiculture – Role of Bees in Crop Productivity – Hiving Bees and Apiary Management. Beneficial Insects – Insect Pollinators – Predators and Parasitoids. Pest – Definition – Categories of Pests – Pest outbreak – Pest Monitoring – Pest Surveillance – Forecasting – Economic Threshold Level – Economic Injury Level. Pest Management Components – Cultural, Physical, Mechanical, Legal and Integrated Methods – Use of Resistant Varieties, Biological Control – Parasitoids, Predator and Microbial Agents.

Pesticides – Groups, Classification, Mode of Action – Formulation and Uses, Principles of Pesticides application – Hazards in the use of Pesticides and Environmental Pollution – Safe Handling of Pesticides new and organic pesticides – Pesticide residue - Behavior modifying chemicals – Use of Pheromones in pest management and behavioral modifying chemicals; approach.

Damage symptoms - life cycle and Integrated management practices of insect and non insect pests of Rice, Millets, Cotton, Sugarcane, Pulses, Oilseeds, Brinjal, Tomato, Bhendi, Cucurbits, Crucifers, Moringa, Tapioca, Chillies, Onion, Coconut, Arecanut, Turmeric, Curry-leaf, Coffee, Tea, Cardamom, Pepper, Betelvine, Flower crops, Mango, Citrus, Banana, Grapes, sapota, Guava, Pomegranate, Pests of stored materials and their management.

Plant diseases – definition, Causes of plant diseases – Fungi, Bacteria, Viruses and Mycoplasma – Categories of plant diseases – Mode of spread – Environmental factors influencing diseases outbreaks. Control exclusion – Eradication – Immunization – Protection – Cultural – Methods of Control – Bio control – Economics of the new technologies, Useful fungi – mushroom, cultivation of Oyster mushroom, Trichoderma – utility – Nematodes – Types – Symptoms – Management.

Fungicide – Characteristics – Major groups – Formulation and Applications – Phytotoxicity – Precautions in using fungicides – Antibiotics in plant disease management. Bio technology and its application in disease management – Assessment of crop diseases and losses – Plant

Disease Control - Principles - Integrated Pest Management of major diseases caused by Fungi, Bacteria, Virus and Mycoplasma in Cereals, Pulses, Oilseeds, Cash crops – Fruits – Vegetables – Plantation crops – Spices – Flowers and their management.

Unit VII: Livestock, Poultry Management, Artificial Insemination and Calf Rearing (10 Questions)

Significance and role of livestock and poultry in Indian economy – Various systems of livestock production – extensive – semi intensive – intensive – mixed – Integrated farming systems – Manure management methods – Definition of breed – classification of indigenous, exotic cattle and buffaloes – Breed characteristics of Sindhi, Kangayam and Umblacherry, Jersey, Holstein Friesian, Murrah and Surti. Breeding – importance of cross breeding.

Artificial Insemination – merits and demerits – Housing management – farm site selection space requirement for calves, heifer, milch animal and work bullocks – Type and design of house. – Systems of housing – Single row system – Double row system – head to head and tail to tail – merits and demerits – Care and management of new born calf and heifers – Care and management of pregnant, lactating animals and work bullocks.

Milk – Definition – clean milk production – methods of milking – hand and machine milking – Processing of milk – cooling Pasteurization – Definition – Various methods – Low Temperature Long Time and High Temperature Short Time – advantages and disadvantages.

Nutrition – Definition – Ration – Balanced composition of concentrate feed for dairy animal, calf and work bullock – Requirement and importance of green fodder, carrying capacity and forage cycle.

Diseases – classification – Viral, bacterial and metabolic – General control and preventive measures. – Viral Diseases – Foot and mouth – Bacterial diseases – Anthrax, Haemorrhagic septicemia and Black quarter – Metabolic – Tympanites, Ketosis and Milk fever – Mastitis and its control – Zoonotic diseases (Anthrax, Tuberculosis, Brucellosis and Rabies) – Prevention and control.

Sheep and Goat farming – classification of breeds of Indian and exotic origin – Systems of rearing – Housing management – Type design – Floor diagram – Space requirement for adult and young stock – Nutrition – common tree Fodder for small ruminants – Common ailments of sheep and goat – Sheep pox – Foot and Mouth – Blue Tongue – Enterotoxaemia – Ecto and Endo parasites Systems of poultry rearing – Backyard, Intensive systems; Nomenclature of commercial layers and broiler strains – Care and management of day old chicks – Brooder management. Systems of housing – Deep litter and cage systems – merits and demerits – Raised platform housing – Floor space requirement – litter management – care and management of layers and broilers.

Poultry Nutrition – composition of chick mash grower, layer, broiler starter and finisher mash – Feed Conversion Ratio / dozen eggs or kilogram of meat. Classification of Poultry diseases – Viral – Bacterial – Protozoan – Causative organisms, symptoms, causes and prevention – Viral diseases – Ranikhet disease - Infectious bursal disease - Bacterial disease – E. coli – Coryza – Salmonellosis – Protozoan – Coccidiosis – Vitamin and mineral deficiencies – Schemes, Policies, Subsidies in Animal Husbandry by Tamil Nadu.

Unit VIII: Farm Machinery, Post Harvest Technology and Energy and Environment (10 Questions)

Thrashing Floor, drying floor. I.C. Engines – Types, Introduction – Preventive maintenance and minor repairs. Tractor – Different systems of a tractor – Hydraulic system – Clutch and Transmission system – Hitching of implements to Tractor – Power Tiller – and matching Implements. Seeders and planters. Plant Protection equipment –Harvesting machinery. Agricultural Pumps – Types of pumps – Custom hiring centre – e-vadagai.

Post Harvest losses in durable and Perishable crops – Moisture content – Methods of Determination – Drying – Sun Drying – Mechanical Drying – Merits and Demerits. Shelling and Decortication – Rubber Roll Sheller – Centrifugal Dehusker. Parboiling of Paddy – Merits and Demerits – Polishing – Milling of Corn and Pulses – Principles and Methods – Seed Treater – Types of Seed Treater. Storage of Grains and Seeds – Condition for safe storage – Value addition and suitable machineries for major food grains.

Energy Resources and Forms of Energy – Conventional and Non - Conventional Energy – Solar Energy – Merits and Limitations - Energy from Bio-Mass – Technologies – Classification and types of Bio-Gas Plants – Bio-Gas from Plant Wastes – Utilization of Bio-gas. Bio Fuel Plant – Gasifiers – Smokeless Chulas.

Ecology – Natural resources – Environmental Pollution and Management – Atmospheric Pollution – Particulate emission by industries and automobiles – Smog – Acid rain – Ozone hole – Global Warming – Causes, Effects and Control measures –Traditional farming methods – Eco-Safe technologies in agriculture.

Unit IX: Commercial Agriculture (20 Questions)

Bio-control agents - Role in pest and disease management – Categories of bio-control agents. Setting up a bio-control laboratory. Mass culture of tobacco caterpillar (*Spodoptera litura*) and gram pod borer (*Helicoverpa armigera*)- synthetic diet – mass production of SINPV and HaNPV. Mass production of *Trichogramma* spp., *Chrysoperla*, coccinellid predators, *Trichoderma viride*, *Pseudomonas fluorescens* and Entomo-pathogenic nematodes

Biofertilizers – Microorganisms for crop nutrition – Types – Sources of good quality strains – Facilities – equipment – and raw materials required – Types and specification of carrier material – production of azospirillum, azotobacter, Glucano acetobacter, phosphate solubilizer, potash releasing microorganism, PGPR, azolla, BGA, PPFM, and AM fungi – Shelf life and storage of carrier and liquid based biofertilizers – constraints in mass production – storage and preservation – quality standard of commercial biofertilizers – quality control biofertilizer lab in Tamil Nadu.

Mushroom- Morphology: common edible mushrooms - Pleurotus, Calocybe - poisonous mushrooms - Laboratory techniques: sterilization - Media preparation, pure culture techniques, sub-culturing and storage. Spawn: types of spawn, mother spawn and bed spawn. Cultivation: Oyster mushroom, Milky mushroom – Problems in cultivation: Biotic and abiotic disorders - Uses of mushroom: as food, nutraceutical and pharmaceutical values, composting coir-pith and other agro-wastes – Post harvest technology: methods of preservation and value addition.

Fruit and Vegetable processing – Equipments and Accessories used in processing – Preparation of Squash, Syrup, Cordial, Nectar, Ready to serve beverages – Fruit juice concentrate – Paste, Powder, Bar – Jam, Jelly, Marmalade and Candy, Preserve – Pickles – Oil, Salt and vinegar – Tomato products – Ketchup. Sauce, Puree and Paste – Canning of Fruit and Vegetables – Dehydrated Fruit and Vegetables and Re-hydration – Preservation by low temperature – cut-out analysis of canned Fruit and Vegetables – Evaluation of Frozen Fruit and Vegetables – Osmotic dehydration

Seed Production – Selection of field – Maintenance of genetic purity – Removal of offtypes – Isolation distance - Manual emasculation and Pollination - Hybrids – Single cross - double cross – Production of hybrid seed – Varieties – seed production - Use of gametocide – Merits and demerits of hybrids and varieties - Selfing, emasculation and crossing technique in Rice, millets, oilseeds, pulses, Cotton, Tomato, Bhendi – clonal multiplication – Cumbu napier – Seed registration – Field inspection and certification.

Harvesting – Physical and chemical indices – Extraction techniques – Seed processing – Use of cleaner, grader – Seed treatment – Seed packaging – Seed storage – Sanitation – Certification procedure.

Nursery Technology – preparation of land and seed treatment – Sowing and raising of rootstocks (Fruits and Flower Crops) – Application of Liquid Manure and plant protection of rootstock – Potting materials and Preparation of pot mixture – Potting of Rootstock and Hardening - Selection of Scion Plants and Grafting, Aftercare of Grafted Plants, Graft Separation and Hardening – Preparation of Cuttings of Ornamental Plants, Treating the Cuttings with growth regulators and Planting in Mist Chamber in Beds/Polybags, Potting of

Rooted Cuttings and Hardening – Air Layering of Ornamental/Fruit Crops – Budding of Ornamental Plants (Rose) – Maintenance of Potted Plants – Packing and Marketing.

Organic composting - Nutrient potential of different organic manures – Preparation of FYM Compost – Composting methods - Preparation of enriched FYM – Coirpith composting – Sugarcane trash – Pressmud - Farm wastes and farm weeds - Parthenium composting – Determination of maturity indices of composts - Commercial utility of organic manures – Introduction to vermicompost – Types of Vermicompost - Materials for vermicomposting. Preliminary treatment of composting material – Small Scale vermicomposting – Large scale vermicomposting – Other types of vermicomposting – Requirements for vermicomposting – Bedding materials, container, pH, Moisture content, Temperature – Cover feed substrates - Selection of right type of worm species – Preparation of vermicompost beds – Collection of Vermicompost – Vermicompost efficiency – Transportation of live worms – Application of vermicompost

Unit X: Agricultural Extension Agricultural Economics and Digital Agriculture (30 Questions)

Rural Economics and Agricultural Economics – Meaning, importance and scope Sectors of Economy - Importance of agriculture in rural economy: Problems of rural economy – Population growth and its consequences. Agents of production: Land distribution – Size of land holding – Man-Land ratio - Subdivision and Fragmentation – Land reform – Ceiling on land holding, Tenurial reforms, Consolidation of land holdings

Co-operative farming and Bhoodhan movement – Success and failure. Rural labour: Meaning – Classification – Characteristics of rural labour – agricultural labour – Employment, wages and income - Minimum wages Act and other welfare measures.

Rural Banking and Finance: Meaning and Concept – Classification and purpose

Sources of finance – Institutional and non-institutional – Government, cooperatives, nationalized commercial banks, regional rural banks and land development banks, private money lenders and other traditional sources – Establishment of NABARD and its role, Multi-agency, Service area approach. Rural industries: Importance and their classification – Investment needs – Generation of employment.

Types of agro-industries – Rural industries project - Khadi and Village Industries

Problems of rural industries – Potentials for development of agro- industries from agricultural products and wastes – Sugarcane, Cotton seed, Banana sheath, Forestry products – Rural technologies – Technology gap – Economic and social constraints in the spread of technology. Study of important and recent rural development schemes.

Marketing and agricultural marketing – Concepts - definition and scope – Classification of Markets – Structure – Characteristics of agricultural commodities: Problems in grading and standardization. Marketing costs and marketing margins. Price spread. Advantages and problems.

Cooperative agricultural marketing societies and regulated markets – Role of National Agricultural Cooperative Marketing Federation and TANFED. Role of specialized agencies viz., Food Corporation of India, Central Warehousing Corporation, State Warehousing Corporation in marketing of agricultural commodities and CCI – Role of Regulator Markets – Agmark – e-NAM.

Price support programmes – Buffer stock operations – Role of Commission on Agricultural Costs and Prices – Price stabilization. Agmark grading and commercial grading – Marketing information and intelligence – Marketing of agricultural inputs viz., seeds, fertilizers, plant protection chemicals and implements.

Sociology – Rural Sociology – Characteristics of rural society. Rural Youth – Their needs and aspirations. Basic rural institutions and voluntary agencies. Leadership – Classification, Characteristics and their influence. Motivation – Methods of Motivation. Social change. Adoption – Meaning, Stages, Adopter categories and their characteristics. Extension methods – Classification – Individual contact - group contact and mass contact methods. Extension aids – Audio aids, Visual aids and Audio Visual aids. Print and Electronic media. Photography, new achievements in communication technology – Transfer of Technologies through demonstrations – Field day – Exhibition – Mass media.

Visit to a village – Identifying resources, conducting participatory rural appraisal (PRA), conducting SWOT (strengths, weaknesses, opportunities and threats) analysis and preparing action plan for village development.

Visiting farmers – Analysis of farm resources and studying the life style of farmers, earnings, enterprises, expenditure pattern, technical information seeking behavior and dissemination of technologies. Finding the factors of adoption of technologies.

Problem diagnosis study – visiting farmers' fields, identifying technical and frequent problems like soil, pest, disease, disorders and other problems in agriculture, obtaining solutions from known sources and providing them to the farmers.

Visiting agro service centers – Studying the business techniques, farmers approach, distribution pattern, dealership pattern, knowing different agro chemicals available in markets and their prices, gaining experience in solving the farmers problems in agro service centers.

Visiting daily vegetable wholesale markets – uzhavar sandhai - assessing the price fluctuation and preparing price trend calendar for different vegetables. Preparing line chart for maximum

price of different vegetables grown in the district and identifying optimum sowing period for different vegetables.

Study the potentialities, prospects and to get clear knowledge about starting agro industries and food processing industries – PMFME – Schemes and policies of Government of Tamil Nadu in Agriculture – Establishment – Farmers group – FPO – Role and Functions.

Application of computer in agriculture - Multimedia Presentation – power point - Internet and E- Mail – Online reporting system – Major Apps and Web Portals (Uzhavan app, Agris net portal, Tamil man valam and latest apps) for improving livelihood of farmers - Application of artificial intelligence and IoT in agriculture