# DOUBLING FARMERS' INCOME BY 2022

## STRATEGY DOCUMENT FOR TAMIL NADU

सत्यमेव जयते

Indian Council of Agricultural Research
Department of Agricultural Research and Education
Ministry of Agriculture and Farmer's Welfare
New Delhi

भाकृअनुप
ICAR

# DOUBLING FARMERS' INCOME BY 2022

## Strategy Document for Tamil Nadu

Indian Council of Agricultural Research
Department of Agricultural Research and Education
Ministry of Agriculture and Farmer's Welfare
New Delhi

# Preface

The agricultural sector continued to receive attentions of the policy makers and stakeholders since India is an agrarian country. A number of initiatives has been taken to improve the performance of the sector. Among these initiatives for the first time in our history, Hon'ble Prime Minister of India exhorted to "Double the Farmers' Income" by March 2022. The Prime Minister's call to double farmers' income by 2022 has brought renewed interest among stakeholders in the country. Dr. Ramesh Chand, Member, NITI Aayog, during a meeting convened for the Vice Chancellors and Directors on 14-15th February 2017 also suggested several strategies to double farmers' income and this has also become nucleus for preparing this document to double farmers' income in the state.

To fulfill the above major agenda, the Secretary (DARE) and DG, ICAR constituted a State Level Co-ordination Committee (SLCC) to prepare strategic document for implementation of programs to double farmer's income by 2022. Accordingly, in Tamil Nadu, the first State Level Co-ordination Committee Meeting was held on 27.03.2017 at State Planning Commission, Chennai. During this meeting, several sub-committees/task forces drawing members from the development departments and scientists from Universities and ICAR institutes was also formulated. The general frame work for the preparation of the document for Tamil Nadu State was also designed. Subsequently, consultation meetings were organized with committee members for deriving their inputs and this strategic document was prepared.

This document throws further light on the technologies available, the gaps and the ways and means to fill such gaps through specific interventions. The new avenues for raising the income of the farmers are also being explored. The challenges that the stakeholders of agriculture and allied sectors face and the means of resolving such challenges are well brought by the committee members in this document.

We are thankful to the committee members and experts for their valuable inputs and contributions for bringing this document.

**Dr. Bakshi Ram**
**Director,**
**ICAR-Sugarcane Breeding Institute Coimbatore.**
**Convener - State Level Coordination Committee**

**Dr. K. Ramasamy**
**Vice-Chancellor, TNAU, Coimbatore.**
**Chairman - State Level Coordination Committee**

Place: Coimbatore
Date: 30.12.2017

# CONTENTS

# LIST OF TABLES

## LIST OF TABLES (Contd.)

## LIST OF TABLES (Contd.)

# LIST OF FIGURES

## Executive Summary

The Secretary (DARE) and DG, ICAR has constituted a State-wise Co-ordination Committee for doubling farmer's income by March, 2022. In Tamil Nadu, the Committee consisted of the Vice-Chancellor of Tamil Nadu Agricultural University as the Chairman and Director, ICAR-Sugarcane Breeding Institute as Convener with members (Heads of Departments) drawn from the Departments of Agriculture, Horticulture, Agricultural Engineering, Agricultural Marketing and Agri-Business, Animal Husbandry and Dairy Development, Fisheries and Vice-Chancellors of Veterinary and Fisheries Universities. Besides, the Directors of ICAR Institutes in Tamil Nadu State are also nominated as members.

The Committee is to develop a concrete action plan to double the farmers' income and share such action plans to the Indian Council of Agricultural Research.

In the compliance with ICAR office order No.5-4/2017-Cdn (Tech) dated 6th March, 2017, the action plan for doubling the income of farmers in Tamil Nadu was prepared. The report consists of five chapters wherein after the introductory chapter, the current status of growth of agriculture and allied sectors were discussed. This was followed by a discussion on technological perspectives wherein the major challenges and the opportunities existed to meet such challesnges were thrashed out. Besides, such technologies are delivered through an extension system and the changes needed in the delivery to farmers are discussed.

In the last chapter, the action plan to achieve a higher growth was suggested. The major focus of such plans is to reduce the yield gaps through better crop and livestock management strategies. The research and technology dissemination thereof plays a major role in such transformations. Besides, adequate infrastructure for post-harvest management and value addition has to be created and wherever needed, the support from the State and Central Government has to be enhanced. Such steps would further motivate the farmers/fishers to be an effective partner to achieve the state agenda and at the same time ensure these farmers the benefit that could emerge out of the changes anticipated through doubling the farmer's income by March, 2022.

## CHAPTER I

# INTRODUCTION

### 1.1 Back Ground

The Secretary (DARE) and DG, ICAR has constituted a State-wise Co-ordination Committee for doubling farmer's income by March, 2022. In Tamil Nadu, the Committee consisted of the Vice-Chancellor of Tamil Nadu Agricultural University as the Chairman and Director Sugarcane Breeding Institute ICAR as Convener with members (Heads of Departments) drawn from the Departments of Agriculture, Horticulture, Agricultural Engineering, Agricultural Marketing and Agri-Business, Animal Husbandry and Dairy Development, Fisheries and Vice-Chancellors of Veterinary and Fisheries Universities. Besides, the Directors of ICAR Institutes in Tamil Nadu State are also nominated as members. The State is requested to formulate such committees so as to propose actionable plans for the state agriculture.

### 1.2 Constitution of the Committee

To prepare the document for various sectors like crop, horticulture, animal husbandry, mechanization, fisheries, production and market linked technology delivery system, five sub-committees were formulated. The details of sub-committee along with the members in each committee is furnished below

**Subcommittee I (Agriculture and Allied Sectors)**

- Vice-Chancellor, TNAU – Chairman
- Director, ICAR-Sugarcane Breeding Institute - Convener
- Director of Agriculture - Member
- Director, Horticulture and Plantation crops - Member
- Director, ICAR-National Research Centre on Banana - Member
- Chief Engineer, Department of Agricultural Engineering – Member
- Project Coordinator, ICAR-CICR, Coimbatore - Member
- Commissioner, Department of Marketing and Agri Business - Member
- Director, Seed Certification - Member

- Head, Central Water Commission, Coimbatore - Member
- Head, ICAR- IISWCR–RC, Ooty – Member
- Head, ICAR-CIAE Research Centre, Coimbatore - Member

**Subcommittee II (Animal Husbandry and Dairy Development)**

- Vice-Chancellor, Tamil Nadu Veterinary and Animal Sciences University - Chairman
- Director, Animal Husbandry – Member
- Dr. K. Sudeep Kumar, Director, Extension Education, TANUVAS - Member
- Dr. Ramesh, Director, Production Studies, TANUVAS – Member
- Dr. Mani, Dean, CPPM, Hosur
- Dr. Sankarsubramanian, Additional Director, DDH, Chennai - Member
- Dr. Tensingh, Professor and Head, Madras Veterinary College, Chennai – Member
- Dr. P. Sakthivel, Additional Director, DDH - Member
- Dr. V. Vijayakumaran, Joint Director, Krishnagiri
- Dr. Rajendran, Joint Director, Trichy
- Dr. Ravindran, Joint Director, Thiruvarur

**Subcommittee III (Fisheries)**

- Vice-Chancellor, Tamil Nadu Fisheries University - Chairman
- Commissioner of Fisheries, Government of Tamil Nadu - Member
- Dr. K.K. Vijayan, Director, ICAR- Central Institute of Brackishwater Aquaculture – Member
- Dr. D. Sukumar, Director, CEFIMAPP, TNFU - Member
- Dr. Stephan Sampath Kumar, Director, CESA, TNFU – Member
- Dr. M. Nagoor Meeran, Director, DEE, TNFU, Nagapattinam - Member
- Dr. T. Ravishankar, Principal Scientist, ICAR-CIBA, Chennai - Member
- Dr. Lakshmi Latha – Principal Scientist, ICAR-CMFRI, Chennai - Member
- Thiru K. Rengaraj – Additional Director, DOF, (Inland Agency) - Member

**Subcommittee IV (Research and Development)**

- Vice-Chancellor, TNAU – Chairman
- Vice-Chancellor, Tamil Nadu Veterinary and Animal Sciences University - Member
- Vice-Chancellor, Tamil Nadu Fisheries University - Member
- Director of Research, TNAU – Member
- Director of Research, TANUVAS – Member
- Director of Research, TNFU - Member
- Director Planning and Monitoring, TNAU - Member
- Dr. V. Venkatasubramanian, Principal Scientist, ICAR-SBI, Coimbatore - Member

**Subcommittee V (Integration and Convergence)**

- Vice-Chancellor, TNAU - Chairman
- Member Secretary, State Planning Commission - Member
- Executive Director, TAWDEVA - Member

In the process of preparation of action plans, the sub-committee studied the existing productivity of various crop and livestock activities, their potentials and the strategies to enhance the productivity and income levels of farmers. Area specific technologies to cater to different agro climatic zones are supplemented and better adoption levels are aimed. The sustainable intensification of production and diversification into high value agricultural operations have also been attempted and feasibilities of up scaling are proposed in the document. Finally, the institutional mechanism to review and monitor implementation of such action plans is defined.

### 1.3 Meeting/Consultation Details and Documents Referred

- The first meeting was held on 27.3.2017 at State Planning Commission, Chennai to formulate a frame work for preparation of the report. Various sub-committees and modalities for preparation of action plans are also discussed in the above meeting.

- The second meeting of the committee members was held on 07.04.2017 at TNAU, Coimbatore to discuss the current status, technological perspectives, technology delivery system and policy issues.
- The third meeting of the committee members was held on 04.05.2017 at TNAU Coimbatore to discuss the draft report.
- The fourth and fifth meetings were held on 10.10.2017 and 03.11.2017 at New Delhi to finalize the Strategic document.

Several Government publications Vision 2023, Policy Note of Government of Tamil Nadu, State Agricultural Plan prepared under NADP (RKVY) and ICAR SBI-vision 2020, 2025, 2030 and 2050 were consulted for preparation of the Strategic document.

### 1.4. Time Line

The time line for preparation of this document is 2017-18 to 2021-22 and the plans need to be prepared and shared with ICAR. The Committee is to develop concrete strategies to double the farmers' income. In the compliance with ICAR office order No.5-4/2017-Cdn (Tech) dated 6$^{th}$ March, 2017, the strategic document for doubling the income of farmers in Tamil Nadu was prepared.

### 1.5. Doubling Farmers' Income (DFI)

The DFI committee has estimated Rs.57,511 as farm income during 2015-16 in the Tamil Nadu state. The targeted farm income by March, 2022 is Rs.1,15,138 (at 2015-16 prices) which is equivalent to Rs.1,62,010 of prevailing prices in 2021-22 (Source: DFI Committee, DACFW).

### 1.6. Structure of the Report

The strategic document is prepared with ten chapters wherein after the introductory chapter; the profile of Tamil Nadu State is presented. This was followed by a discussion on agricultural infrastructure and government programmes. In order to highlight the technological perspectives, wherein the major challenges and the opportunities existed, the productivity gaps and constraints is discussed in the fourth chapter. Beside agriculture, the development potentials of allied sectors like horticulture, animal husbandry etc. is discussed in the fifth chapter. The role of technologies and their delivery through an extension system are discussed in the sixth chapter. The issues like

value chain development, needed market linkages and the trade potentials are discussed in the seventh chapter. In the eighth chapter, the policy suggestions, investment requirements and the role of government are discussed. The Implementation Plan and Institutional Responsibilities are discussed in the ninth chapter. In the last chapter, the proposed activities to double the farmer's income and recommendations were highlighted.

## CHAPTER II

## PROFILE OF TAMIL NADU STATE

Tamil Nadu State is located in the Northern hemisphere in the hot zone between 8° and 13° N latitude and between 78° and 80° E longitude. Tamil Nadu is the 11th largest State in India by area and the 7th most populous State. The State lies on the eastern coast of the southern Indian peninsula neighbored by Puducherry, Kerala, Karnataka and Andhra Pradesh States. Tamil Nadu is bound by the Eastern Ghats in the North, the Nilgiris, the Anamalai Hills and Palakkad in the West, Bay of Bengal in the East, Gulf of Mannar and Palk Strait in the South East and Indian Ocean in the South. The Eastern most point is formed by the Point Calimer and the Mudumalai wildlife sanctuary in the Western most point. The Pulicat Lake is situated in the Northern extreme. Cape Comorin or Kanyakumari is the southern-most tip of Tamil Nadu. Western and Northern part of the State has lofty hills while the East and South are Coastal plains.

Tamil Nadu is the 5th largest contributor to India's GDP and one of the most urbanized States in India. The State has the highest number (10.56 per cent) of business enterprises in India, compared to the population share of about six per cent. Tamil Nadu has a coastline of about 1,076 km which is the country's third longest coastline. Tamil Nadu has a wide variety of minerals like lignite (almost 90 per cent of India's reserves), magnesite (45 per cent) and granite (over 40 per cent) reserves in India. Tamil Nadu contributes 15 per cent of the total salt production in the country. Forest covers over 17 per cent of the State's geographical area with several protected areas of Tamil Nadu including wildlife and bird sanctuaries.

In Agriculture front, the Government of Tamil Nadu has resolved to usher in a Second Green Revolution formulated to achieve equitable, competitive and sustainable growth in agriculture. There are about 82 lakh farm holdings in the State who depend on agriculture and allied sectors for their livelihoods whose income has to be at least doubled in the next five years. Considering this, the Government initiated various measures especially in planning to prepare road maps "Vision 2023", "Doubling the Yield and Tripling the Farm Income", District Agricultural Plan, State Agricultural Plans and State Agricultural Infrastructure Development Programme under RKVY and District and State Irrigation Plan under PMKSY. Such initiatives would help in drawing implementable action plans, convergence of efforts and focus the constraints in a better tactical and strategic level.

## 2.1. Agro Climatic Zones in the State

Based on the rainfall pattern, altitude and irrigation sources, Tamil Nadu state is divided into seven agro-climatic zones and the districts covered under each zone is shown in Table 2.1.

**Table 2.1 Agro-Climatic Zones and Coverage of Districts**

| Sl. No. | Zones | Districts |
|---|---|---|
| 1 | North Eastern Zone | Kancheepuram, Tiruvallur, Cuddalore, Vellore, Villupuram and Tiruvannamalai |
| 2 | North Western Zone | Dharmapuri, Krishnagiri, Salem and Namakkal (Part) |
| 3 | Western Zone | Erode, Coimbatore, Tirupur, Theni, Karur (Part), Namakkal (Part), Dindigul, Perambalur and Ariyalur (Part) |
| 4 | Cauvery Delta Zone | Thanjavur, Nagapattinam, Tiruvarur, Trichy and parts of - Karur, Ariyalur, Pudukkottai and Cuddalore |
| 5 | Southern Zone | Madurai, Sivagangai, Ramanathapuram, Virudhunagar, Tirunelveli and Thoothukudi |
| 6 | High Rainfall Zone | Kanyakumari |
| 7 | Hilly Zone | The Nilgiris and Kodaikanal (Dindigul) |

The North Eastern Zone is located between 8°5’ and 13°2’ North latitude and 76°15’and 80°22’ East longitude, covering an area of 31,065 Sq. km equivalent to 23.9 per cent of the State area. The North-Western zone is located between 11° and 12°55′ North latitude and 77°28′ and 78°50′ East longitude covering an area of 16,150 Sq. km equivalent to 12.4 per cent of the State area. The climate in the zone ranges from semi-arid to sub-humid with frequent occurrence of drought. The monthly distribution of rainfall found maximum in September-October months with a secondary peak during May months. The maximum temperature ranges from 23° to 42°C and the minimum from 10° to 14°C and being an interior region, the diurnal range of temperature is large particularly in summer.

The western zone is located between 9°10’ and 12° North latitude and 70°30’ to 78° East longitude. The altitude of the zone ranges from 160 to 450 m above MSL. The climate in the zone ranges from semi-arid to sub-humid with frequent occurrence of drought. Four distinct rain seasons are south-west monsoon (June-September), north-east monsoon (October-December), winter (January-February) and summer (March-May). The annual rainfall of the zone varies from 524 to 1428 mm with an average of 780 mm. Of the total rainfall, 48.4 per cent is received during north-east

monsoon and 32.2, 18.6 and 2.8 per cent during south west, summer and winter seasons respectively. The maximum temperature of the zone ranges from 26.9 to 42.1°C and the minimum from 16.2 to 24.5°C.

The Cauvery Delta Zone lies in the eastern part of Tamil Nadu between 10°00′ and 11°30′ North latitude and 78°15′ and 79°45′ East longitude. Cauvery River traverses the delta. A fair width of sandy beach occurs including the sand bars on the sea surface of the river delta, stiff clay seashores and marshy tidal swamps with mangroves. The terrain is an open plain sloping gently towards east and devoid of any hills or hillocks. The altitude ranges from 6 to 250 m above MSL.

The Cauvery delta zone has diverse climatic conditions as the zone includes coastal belt as well as inland area. Cyclonic storms and high humidity occur in coastal belts. The coastal belt is favored by high rainfall and when it proceeds to the interior, the rainfall intensity decreases. The mean annual rainfall is 1,192 mm. North-east monsoon alone contributes about 52.5 per cent of the total rainfall followed by south-west monsoon with 30.5 percent. Hot weather season accounts for 11.4 per cent while, the winter season receives only 5.6 per cent of the annual rainfall.

The Southern zone is located between 8 and 10°.55’ North latitude and 79° 50 East longitude. This zone comprises of flat plains and intermittent hills at varying altitudes ranging up to 700 m high. The topography is undulating with the gradient sloping towards the east. The major river systems are *Vaigai, Manimuthar, Sarguni, Gundar* and *Arjuna Nadhi*.

The climate of the southern zone is generally semi-arid and only a small portion comes under– sub-humid. Thus, frequent drought occurs. Summer is very hot. The zone comes under rain shadow area. The rainfall ranges from 700 to 1277 mm with a mean of 876.4 mm. North-East monsoon accounts for 54.9 per cent of total rainfall and forms the main cropping season. South-West monsoon accounts for 23.9 per cent of total rainfall of this zone. Winter rainfall is negligible and summer rainfall forms 13.0 per cent. The maximum temperature ranges between 30.0° and 37.5°C, while the minimum temperature varies from 20.0° to 27.0°C.The temperature is more or less similar in most parts of this zone. However, along the Western Ghats, the minimum temperature tends to below.

The High rainfall zone of Tamil Nadu is located between 77°50′ and 77°36′ East longitude and 8°03′ and 8°35′ North latitude. The climate is sub-humid influenced by both the south-west and north-east monsoons, because of the proximity of sea and the

Western Ghats. There is not much variation in the mean monthly temperature, which varies from 23.9°C (minimum) to 36.7°C (maximum).

The hilly zone comprises the Nilgiris, the Shervarays, the Yelgiris, the Anamalais and the Palani hills. The rainfall varies from 1000 mm at the foot of the hills to 5000 mm at the peaks. The maximum temperature varies from 15°C to 24°C and that of minimum ranges from 7° to 13°C.The soil is mainly lateritic. The major crops are vegetables, potato and tropical and temperate fruit crops. At the foot of the hills, hill tribes raise minor millets. At higher altitudes, wheat cultivation is common during winter season. The coverage of Agro climatic zones and importance of Agricultural Allied sectors are shown in Figure 1 and 2.


**Fig.1. Agro Climatic Zones and their Coverage Across the State**

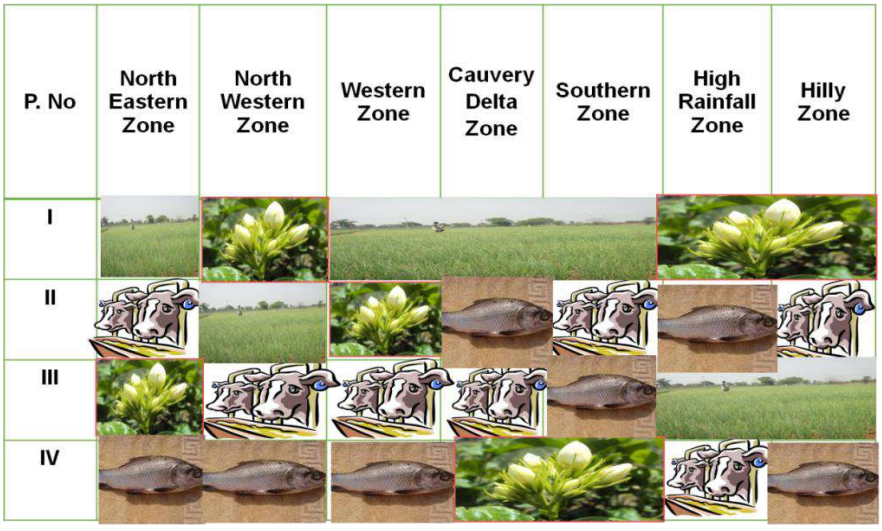



**Fig. 2. Importance of Agricultural and Allied Sectors in Different Agro-Climatic Zones**

## 2.2 Land Use and Cropping Pattern in Tamil Nadu State

Land is the basic resource over which all the agricultural operations are carried out. The land use statistics indicate the way in which the available land area is put under various uses. Land as a scarce resource, has to be managed effectively. Therefore, the details on the land use pattern since 1979 in Tamil Nadu State is furnished in Table 2.2.

**Table 2.2 Land Utilization Pattern in Tamil Nadu State**

**(Area in Lakh Hectares)**

| Sl. No. | Classification | Average area TE 1979-1980 | | Average area TE 2005-2006 | | 2014-2015 | |
|---|---|---|---|---|---|---|---|
| | | Area | % | Area | % | Area | % |
| 1. | Forests | 20.25 | 15.58 | 21.18 | 16.27 | 21.25 | 16.30 |
| 2. | Barren and Uncultivable land | 6.10 | 4.69 | 5.07 | 3.89 | 4.88 | 3.70 |
| 3. | Land put to non-agrl uses | 16.82 | 12.94 | 21.26 | 16.33 | 21.99 | 16.90 |
| 4. | Cultivable waste | 3.51 | 2.70 | 3.74 | 2.87 | 3.25 | 2.50 |
| 5. | Permanent pastures and other grazing lands | 1.65 | 1.27 | 1.12 | 0.85 | 1.07 | 0.84 |
| 6. | Land under missed crop and groves not included net area sown | 1.95 | 1.50 | 2.82 | 2.16 | 2.35 | 1.80 |
| 7. | Current fallow | 12.57 | 9.67 | 8.03 | 6.16 | 9.98 | 7.70 |
| 8. | Other fallow lands | 4.56 | 3.50 | 16.95 | 13.01 | 17.33 | 13.40 |
| 9. | Net area sown | 62.56 | 48.15 | 50.10 | 38.49 | 48.19 | 37.00 |
| 10. | Total geographical area | 130.01 | 100.00 | 130.15 | 100.00 | 130.33 | 100.00 |
| 11. | Area sown more than once | 13.52 | - | 7.51 | - | 11.75 | - |
| 12. | Gross cropped area (9+11) | 76.11 | - | 51.45 | - | 59.94 | - |
| 13. | Cropping intensity (12÷9) | 121.60 | - | 114.67 | - | 124.38 | - |

Source: Tamil Nadu – An Economic Appraisal, Evaluation and Research Department, Government of Tamil Nadu, Chennai.

TE denotes Triennium.

It could be seen from Table 2.2, that the total geographical area of the State is 13 million ha. The area under forest is around 21 lakh ha accounting for 16 per cent of the geographical area. Over years, the area under forest had increased very marginally by about 1.01 lakh ha (1979-80 to 2014-15). The barren and uncultivable land is around 4.88 lakh ha in 2014-15 as compared to that of 6.10 lakh ha in 1979-80. Thus, a reduction of about 1.22 lakh ha over the period of 25 years could be witnessed. This down-trend is a good sign and might be due to increase in area under forest, waste land development program etc. However, still there exist scopes to reduce the extent of the barren land through wasteland development efforts. The area under cultivable wastelands was 3.25 lakh hectares in 2014-15, while it was 3.51 lakh ha in TE ending 1979-80.Thus, a very marginal decrease of about 0.26 lakh ha could be observed during the period under question. Other fallow lands, which are also otherwise considered as wastelands, have shown an alarming uptrend. While it was 4.56 lakh ha in TE 1979-80, it was almost 17 lakh ha in 2014-15.This upsurge is a serious concern that needs immediate attention with suitable action plans. The area under current fallows was also quite high in TE 1979 with 12.57 lakh ha and it had reduced by about 2.59 lakh ha to 9.98 lakh ha in TE 2014-15. This is a good sign and might be due to tapping more of ground water and stabilization of ayacuts under irrigation systems in some areas. Further reduction of current fallows is quite possible by the modernization of irrigation systems and adoption of water harvesting techniques, in addition to other moisture conservation measures.

The table also exhibits the fact that the net sown area has reduced considerably from 62.56 lakh ha in TE 1979-80 to 48.19 lakh ha in TE 2014-15. This is rather a disturbing trend this might be due to marked increase in lands put to non-agricultural uses, due to rapid industrialization and urbanization. Similarly, the area sown more than once had shown a drastic down-trend over the periods considered. Inspite of modernization of existing irrigation systems and more tapping of ground water, the steep fall in area sown more than once is of concern. There exists scope to arrest this down-trend through rehabilitation of the existing irrigation systems and structures and energization of pumpsets and motors at a faster rate through more public investments.

The cropping intensity for the State as a whole, as could be visualized from the Table 2.4, had decreased from 121.60 per cent in TE 1979-80 to 114.67 per cent in TE 2005-06 and 124.38 per cent in 2014-15.Any downtrend in the intensity of cropping must be reversed so as to keep agriculture growing. Thus, the preceding discussion about the land use statistics of Tamil Nadu State could lead to the following action plans

1. The down-trend in the net sown area must be prevented
2. Bringing into use of the under current fallows and cultivable waste under culturable land and also development of wastelands like barren and uncultivable land as well as other fallow lands.
3. Revising the decline in area under permanent pastures through Intensive fodder development activities and
4. Regulations in preventing diversion of lands to non-agricultural use.

**2.3. Cropping Pattern**

The area under major crops cultivated in the state is shown in Table 2.3.

**Table.2.3. Area under Major Crops**

| Crop | Area (Lakh Ha) | % |
|---|---|---|
| Rice | 17.80 | 38.44 |
| Millets | 9.30 | 20.09 |
| Pulses | 9.40 | 20.30 |
| **Total food grains** | **36.50** | 78.83 |
| Oil seeds | 5.00 | 10.80 |
| Cotton | 1.80 | 3.89 |
| Sugarcane | 3.00 | 6.48 |
| **Total** | **46.30** | **100.00** |

Source: Policy Note Agriculture 2017-2018, Government of Tamil Nadu

Among the various crops, food grains constituted 78.83 % of the area followed by Oil seeds (10.80%) and Sugarcane (6.48%). Among the food grains Rice constituted (38.44%) of the total area under major crops.

### 2.4. Natural Resource Endowments

Tamil Nadu with 7.0per cent of population in the country is endowed with only 3.0 per cent of the water resources of India. The State's water resources are dependent on rainfall. The per capita availability of water in the State stood at 900 cubic meters only as against the All – India level of 2200 cubic meters. All river systems in the State flow eastward from the Western Ghats. Palar, Pennaiyar and Cheyyar are the three important river systems in the Northern part of the State. Cutting across the centre of the state is the Cauvery river and in recent years, the river is drying up and along with its tributaries *viz*. Bhavani and Amaravathi, it is the most important source of canal irrigation. Vaippar, Vaigai and Tamirabarani are three important rivers in the south. The rivers naturally, graded almost to their heads with only slight interruptions of profiles when they pass through the Eastern Ghats. No river is perennial and depends much on monsoon.

The Tamil Nadu Water Policy, 1994 was formulated based on the National Water Policy, 1987. Taking into account of the National Water Policy, 2002, the State Water Policy has been redrafted emphasizing the need for utmost efficiency in water utilization and public awareness of the importance of its conservation.

#### 2.4.1. Rainfall

The amount and distribution of rainfall influence the pattern of cropping and crop growth in a locality. The agricultural production mainly depends on the timely onset of South-West and North-East monsoons and the quantum and spread of such rainfall across the months. The details of normal annual rainfall received in Tamil Nadu are presented in Table 2.4.

**Table 2.4. Month-Wise Distribution of Rainfall - Tamil Nadu**

**(in mm)**

| Sl. No. | Month | Normal | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2014-15 |
|---|---|---|---|---|---|---|---|
| 1. | June | 46.5 | 46.3 | 34.0 | 72.6 | 34.4 | 46.4 |
| 2. | July | 69.1 | 77.5 | 59.5 | 82.2 | 64.4 | 47.1 |
| 3. | August | 88.7 | 139.4 | 96.2 | 109.7 | 115.1 | 115.5 |
| 4. | September | 117.0 | 70.3 | 127.3 | 119.1 | 86.6 | 96.5 |
| S. West Monsoon | | 321.3 | 333.5 | 317.0 | 383.6 | 300.5 | 305.5 |
| 5. | October | 180.8 | 228.1 | 62.8 | 152.1 | 221.1 | 249.7 |
| 6. | November | 170.9 | 274.8 | 313.7 | 325.2 | 254.7 | 113.2 |
| 7. | December | 88.7 | 49.8 | 106.1 | 127.9 | 65.0 | 67.4 |
| N. East Monsoon | | 440.4 | 552.7 | 482.6 | 605.2 | 540.8 | 430.3 |
| 8. | January | 17.7 | 7.7 | 11.4 | 7.4 | 7.3 | 8.5 |
| 9. | February | 13.6 | 0.0 | 0.1 | 28.9 | 2.2 | 2.4 |
| Winter Season | | 31.3 | 7.7 | 11.5 | 36.3 | 9.5 | 10.9 |
| 10. | March | 18.1 | 29.5 | 2.1 | 8.6 | 4.6 | 21.7 |
| 11. | April | 42.5 | 35.2 | 22.0 | 93.1 | 37.6 | 108.6 |
| 12. | May | 67.4 | 64.5 | 102.6 | 38.3 | 44.1 | 110.9 |
| Hot weather | | 128.0 | 129.2 | 126.7 | 140.0 | 86.3 | 241.2 |
| Total | | 921.0 | 1023.1 | 937.8 | 1165.1 | 937.1 | 987.9 |

Source: Tamil Nadu Economic Appraisal, (various issues), Government of Tamil Nadu, Chennai.

From the table, it could be seen that relatively a higher amount of rainfall was received during the months of September, October, November and December. Nevertheless, variations exhibited between the normal (921.0 mm) and the actual rainfall received within the months and also among the years (937 mm – 1165.1 mm).

### 2.4.2. Irrigation Potential

The total water potential of the State including groundwater is 46,540 million cubic meters (MCM). The total surface water potential of the State is 24,160 MCM, including the contribution from neighboring states of Andhra Pradesh, Karnataka and Kerala. Of the total water potential, the surface water potential of about 2.4 million hectares has almost been fully (more than 95 per cent) tapped since the late sixties. round water is, therefore, the only alternative source available for further development. However, the recent developments in the status of availability of ground water across the regions (Table 2.5) is of great concern.

**Table 2.5 Status of Groundwater in Tamil Nadu**

| Sl. No. | Years of Assessment | Category of blocks | | | | | Total |
|---|---|---|---|---|---|---|---|
| | | Safe blocks | Semi critical blocks | Critical blocks | Over exploited blocks | Saline | |
| 1 | 1998 | 137 (35.5) | 70 (18.18) | 35 (9.09) | 135 (35.06) | 8 (2.07) | **385 (100)** |
| 2 | 2003 | 97 (25.20) | 105 (27.27) | 37 (9.61) | 138 (35.84) | 8 (2.08) | **385 (100)** |
| 3 | 2011 | 136 (35.32) | 67 (17.40) | 33 (8.57) | 139 (36.10) | 10 (2.61) | **385 (100)** |

Figures in parentheses denote percentage to total

Source: Report on Dynamo Ground Water Resources of Tamil Nadu as on Tamil Nadu, State and Ground water, Year book on 2011-12.

The ground water potential for future development has been estimated at 3142.27 MCM (2003). This balance potential is mostly distributed in 236 blocks compressing safe, semi- critical and critical categories. The ground water availability is found to be in safe condition only in 136 blocks (35.23 per cent) of Tamil Nadu State.

### 2.4.3. Sources of Irrigation

The major irrigation sources of the State are canals, tanks and wells. The sources of irrigation and percentage of net and gross area irrigated are indicated in Table 2.6.

**Table 2.6 Source-Wise Net Area Irrigated**

**(in Lakh Hectares)**

| Sources of Irrigation | 60-61 | 70-71 | 80-81 | 90-91 | 00-01 | 05-06 | 14-15 |
|---|---|---|---|---|---|---|---|
| Canal | 8.82 (36.0) | 8.84 (34.0) | 8.89 (35.0) | 7.69 (32.4) | 8.33 (28.8) | 8.00 (27.4) | 6.69 (24.54) |
| Tanks | 9.36 (38.0) | 8.98 (35.0) | 5.90 (22.0) | 5.31 (22.3) | 5.88 (20.4) | 5.75 (19.7) | 3.68 (13.50) |
| Wells | 5.98 (24.0) | 7.75 (30.0) | 10.67 (42.0) | 10.59 (44.6) | 14.49 (50.2) | 15.36 (52.6) | 16.84 (61.80) |
| Other sources | 0.46 (2.0) | 0.35 (1.0%) | 0.24 (1.0) | 0.14 (0.7) | 0.16 (0.6) | 0.72 (0.3) | 0.04 (0.16) |
| **Total** | **24.62** | **25.92** | **25.70** | **23.73** | **28.87** | **36.33** | **27.25** |
| % of NAI to NAS | 41.10 | 42.00 | 48.00 | 42.50 | 54.10 | 40.3 | 56.56 |
| Gross Area Irrigated | 32.35 | 34.10 | 32.94 | 28.94 | 34.90 | 33.97 | 33.94 |
| % of GAI to GAS | 44.20 | 46.20 | 50.90 | 43.60 | 55.10 | 46.30 | 56.62 |

Figures in parenthesis indicate per cent to total

Source: Tamil Nadu – An Economic Appraisal, (various issues), Evaluation and Research Department, Government of Tamil Nadu, Chennai.

It could be seen that the percentage of canal area irrigated has come down from 42.00 in 1950-51 to 24.54 in 2014-15. Similarly, the percentage of area irrigated by tanks declined from 30.00 in 1950-51 to 13.50 in 2014-15. On the contrary, wells have shown a constant rise from 24.00 percent in 1950-51 to 61.80 per cent in 2014-15. The other sources of irrigation had shown a constant declining trend. The percentage of net area irrigated to net area sown had shown an upward trend with a fall in 1990-91, 2005-06. The same phenomenon was observed in the case of gross area irrigated to total gross cropped area. The percentage of gross area-irrigated to total gross area sown had improved by 46.30 and 56.62 percent respectively during 2005-06 over 2014-15. The area under canal, tank and other source of irrigation had witnessed a downward shift between 2005-06 and 2014-15.

## 2.5. Important Development Indicators

### 2.5.1. Population

Tamil Nadu is the seventh most populous State in India with a population of 7,21,47,030, as of 2011. It is the seventh most densely populated State in India. In 2011, its population density was 555 persons per square kilometer, having increased from 511 in 2008, significantly higher than the Indian average of 382 persons/km$^2$.About 38 per cent of the State's population lives in urban areas, the highest in India. Tamil Nadu's population grew by 15.61 per cent between 2001 and 2011. The salient features of population in Tamil Nadu State are given in Table 2.7.

**Table 2.7 Salient Features of Population in Tamil Nadu**

| Year | Population (million) | | | Literacy rate (%) | | | Decennial growth rate (%) |
|---|---|---|---|---|---|---|---|
| | Total | Male | Female | Overall | Male | Female | |
| 1951 | 30.12 | 22.79 | 7.33 | 20.90 | 31.70 | 10.10 | 14.7 |
| 1961 | 33.69 | 16.91 | 16.78 | 31.40 | 44.50 | 18.20 | 11.9 |
| 1971 | 41.20 | 20.83 | 20.37 | 39.50 | 51.80 | 26.90 | 22.3 |
| 1981 | 48.41 | 24.49 | 23.92 | 46.80 | 58.30 | 35.00 | 17.5 |
| 1991 | 55.86 | 28.30 | 27.56 | 62.70 | 73.80 | 51.30 | 15.4 |
| 2001 | 62.41 | 31.40 | 31.01 | 73.50 | 82.30 | 64.40 | 11.7 |
| 2011 | 72.14 | 36.16 | 35.98 | 80.33 | 86.81 | 73.86 | 15.6 |

Source: Tamil Nadu - An Economic Appraisal, Evaluation and Applied Research Department, Government of Tamil Nadu, Chennai.

Population of Tamil Nadu State had increased from 30.12 million in 1951 to 72.14 million in 2011. There had been a gradual increase in female population unlike that of male population which witnessed a decline in 1961.Tamil Nadu has long standing commitment to education and ranks third in terms of overall and female literacy rate due to the efforts made through various plans. The overall literacy rate had increased from 20.9 per cent in 1951 to 80.33per cent in 2011. As regards the literacy rate of males, it had increased from 31.7 per cent in 1951 to 86.81 per cent in 2011. Similarly, the literacy rate of females had increased from 10.1 per cent in 1951 to 73.86 per cent in

2011. A concomitant of economic development and growth has been Urbanization. As per 2011 census, Tamil Nadu was the most urbanized among larger States with 48.40 per cent of urban population and ranked first in Urbanization among the 15 major States in the country. While the country's Urban population increased from 17.3 per cent to 27.8 per cent during 1951-2011, that of Tamil Nadu increased from 24.4 per cent to 44.0 per cent.

### 2.5.2. State Income

Tamil Nadu's gross State domestic product for 2007 is estimated at Rs. 2750,000 million (70 billion USD) in current prices. The State experienced a GDP growth rate of 12.1 per cent for this period. Possessing the third largest economy (2007-2008) among States in India, Tamil Nadu is also the most industrialized State in India. The per capita income for the period 2007-2008 for the State was Rs.43,000 ranking second among the South Indian States. It ranks third in foreign direct investment approvals (cumulative 1991-2002) of Rs.225,826 million ($5,000 million), next only to Maharashtra (Rs. 366,024 million ($8,100 million) and Delhi (Rs.303,038 million ($6,700 million) and the State's FDI investment constitutes 9.12 per cent of the total FDI in the country.

The details of Gross State Domestic Product over years and contribution of agriculture sector are furnished in Table 2.8.

**Table 2.8 Gross State Domestic Product**

**(Rs. in Crores)**

| Year | GSDP | Primary sector | Agriculture |
|---|---|---|---|
| 2008-09 | 321793.36 | 30794.11 | 25093.30 |
| 2009-10 | 356631.86 | 32797.27 | 26738.38 |
| 2010-11 | 403415.73 | 35169.87 | 28794.60 |
| 2011-12 RE | 433238.03 | 38727.67 | 31975.98 |
| 2012-13 QE | 447943.62 | 34777.27 | 27807.64 |

Source: Department of Economics and Statistics, Chennai

The share of primary sector to gross domestic product at factor cost in Tamil Nadu is furnished in Table 2.9.

**Table 2.9 Contributions of Sub-sectors to Primary Sector at Constant Prices**

**(Rs. in Crores)**

| Subsector | 2004-05 | | 2005-06 | | 2011-12 | |
|---|---|---|---|---|---|---|
| | Income | Growth (%) | Income | Growth (%) | Income | Growth (%) |
| Agriculture and Allied activities | 19035 | 19.51 | 20521 | 7.81 | 36673 | 9.95 |
| Forestry and Logging | 594 | (-) 0.31 | 589 | (-) 0.71 | 1949 | 2.49 |
| Fishing | 1690 | (-)14.76 | 2404 | 42.22 | 2748 | 3.40 |
| Mining and quarrying | 1055 | 6.36 | 1102 | 4.45 | 2055 | 13.15 |
| Primary sector | 22374 | 14.75 | 24616 | 10.02 | 38728 | 10.12 |

Source: Tamil Nadu – An Economic Appraisal. Evaluation and Research Department, Government of Tamil Nadu, Chennai.

It could be seen from the table above that within the four sub-groups of primary sector, agriculture and allied activities was the largest component which registered a growth of 9.95 percent. Among the other three sectors, forestry and logging registered a growth of 2.49 percent and mining and quarrying registered a growth of 13.15 percent. Though the income generation from fishing sub-sector was negative during the past few years; it turned positive and recorded an impressive growth of 3.40 per cent in 2011-12.

### 2.5.3 Per Capita Income

**Table.2.10. Per Capita Income**

| Year | Tamil Nadu | | All India | |
|---|---|---|---|---|
| | At current prices | At constant prices (Base= 2011-12) | At current prices | At constant prices (Base = 2011-12) |
| 2011-12 | 92,984 | 92,984 | 63,460 | 63,460 |
| 2012-13 | 1,05,032 | 96,355 | 71,011 | 65,568 |
| 2013-14 | 1,16,583 | 1,00,233 | 79,146 | 68,717 |
| 2014-15 | 1,30,197 | 1,06,034 | 86,454 | 72,862 |
| 2015-16 | 1,43,547 | 1,14,712 | 94,130 | 77,803 |

**Table.2.11. Different Components of Farm Household Income and Total Farm Household Income in Tamil Nadu**

| Year | Income from farming | Income from livestock | Income from non-farm business | Income from wages/salary | Total annual income |
|---|---|---|---|---|---|
| 2012-13 | 22,989 (27%) | 13,623 (16%) | 13,646 (16%) | 34,772 (41%) | 85,030 (100%) |
| Compound annual growth rates (2002-03 to 2012-13) of farm household income and total farm household income | 2.84 | 15.53 | 9.64 | 1.82 | 4.47 |
| 2015-16 | 28,309 (27%) | 16,776 (16%) | 16,804 (16%) | 42,819 (41%) | 1,04,708 (100%) |

Source: Farmers' Income in India: Evidence From Secondary Data. A study submitted to Ministry of Agriculture By Thiagu Ranganathan, Agricultural Economics Research Unit (AERU), Institute of Economic Growth (IEG) New Delhi – 110007 and 70$^{th}$round of National Sample Survey Organization (NSSO) conducted in January to December 2013.

The DFI Committee has estimated the extent to which farmer's income (income from crop agriculture, livestock, non-farm business and wages and salaries) would raise between the years 2015-16 to 2022-23. The details are furnished below Table. 2.12.

**Table.2.12. Targeted Income of Tamil Nadu Farmers**

**(Rs./annum)**

| Source | Base Year:2015-16 At 2015-16 Prices | | Terminal Year: 2022-23 At 2015-16 Prices | | Terminal Year: 2022-23 At Current Prices | |
|---|---|---|---|---|---|---|
| | Tamil Nadu | All India | Tamil Nadu | All India | Tamil Nadu | All India |
| Farm | 57,511 | 58,246 | 1,15,138 | 1,08,045 | 1,62,010 | 1,52,031 |
| Non-Farm | 76,057 | 38,457 | 1,02,538 | 48,108 | 1,44,282 | 67,693 |
| Total | 1,33,568 | 96,703 | 2,17,676 | 1,56,154 | 3,06,292 | 2,19,724 |

Source: DFI Committee, DACFW

### 2.5.4 Performance of Crop Enterprises

The growth rates of area, production and productivity of major crops of Tamil Nadu State are estimated and furnished in Table 2.13.

**Table 2.13. Growth Rates of Area, Production and Productivity of major Crops in Tamil Nadu State**

**(Per cent per annum)**

| Crop | 1990-1991 to 1999-2000 | | | 2000-2001 to 2014-2015 | | |
|---|---|---|---|---|---|---|
| | A | P | Y | A | P | Y |
| Paddy | 0.80 | 1.75 | 0.95 | 0.39 | 1.69 | 1.29 |
| Sorghum | -5.16 | -6.34 | -1.24 | -4.52 | -1.13 | 3.56 |
| Maize | 8.60 | 9.79 | 1.10 | 11.93 | 28.44 | 14.75 |
| Total Pulses | -4.02 | -2.33 | 1.77 | -0.43 | 0.06 | 0.50 |
| Sugarcane | 1.42 | 7.62 | 6.11 | -2.63 | -6.12 | -3.59 |
| Cotton | 3.72 | 4.52 | 0.77 | 1.98 | 1.63 | -0.35 |
| Groundnut | 1.38 | 6.10 | 4.66 | 3.86 | 1.51 | -2.27 |
| Chillies | -1.03 | 1.18 | 2.24 | -1.07 | 4.40 | 5.53 |
| Banana | -3.18 | 0.91 | 2.27 | -4.90 | -1.33 | 3.75 |

Note: A - Area, P - Production and Y - Productivity

During the period from 1990-91 to 1999-2000, it could be seen that sorghum, total pulses, chillies and banana exhibited a negative growth rate in area. With regard to the production, sorghum and total pulses exhibited negative growth rate. In terms of productivity, the growth rate was highest in sugarcane (6.11 per cent) and lowest in cotton (0.77 percent). Sorghum crop witnessed a negative growth rate in productivity. In maize and cotton, the growth in area contributed more for production while in sugarcane and groundnut the productivity contributed much for increase in production.

During the period 2000-01 to 2014-15 sorghum, total pulses, sugarcane, chillies and banana exhibited negative growth rate in area. In other crops, the growth rate in area ranged from 0.39 percent/year in paddy to 11.93 percent/year in maize. As regards growth rate in production, barring sorghum, sugarcane and banana, all other crops exhibited positive growth rate. The growth rate in production was found to be maximum in maize (28.44 percent) and minimum in total pulses (0.06 percent).

While sugarcane, cotton and groundnut witnessed a negative growth rate in productivity, all the other crops showed a positive growth rate in productivity.

The declining trend in productivity in recent periods particularly in sugarcane, groundnut and cotton needs special attention and this trend has to be reversed. Similarly, the declining trend in the production in sugarcane and banana has to be arrested. Hence, appropriate strategy need to be adopted for increasing the area under sugarcane and banana and productivity in sugarcane, cotton and groundnut. During the year 2015-16, rice is cultivated in an area of 20.37 lakh ha with the production and productivity of 86.98 lakh tonnes and 4.269 tonnes/ha respectively. Cost of cultivation of principal crops in Tamil Nadu were also given in Annexure 2. The performance of other crops is also shown in the Table.2.14.

**Table 2.14. Area, Production and Yield of Various Crops in Tamil Nadu – Target and Achievement**

| Crop | 12th Plan Target | | | 12th Plan Achievement (till 2015-16) | | |
|---|---|---|---|---|---|---|
| | A | P | Y | A | P | Y |
| Rice | 22.00 | 100.01 | 4.546 | 20.37 | 86.98 | 4.269 |
| Millets | 15.00 | 60.00 | 4.000 | 9.01 | 37.92 | 4.209 |
| Pulses | 12.00 | 10.00 | 0.834 | 9.27 | 5.73 | 0.618 |
| Total Food Grains | 49.00 | 170.00 | 3.469 | 38.65 | 130.63 | 3.381 |
| Oil Seeds | 7.21 | 16.74 | 2.322 | 4.12 | 9.19 | 2.231 |
| Cotton (L. Bales) | 1.65 | 5.36 | 0.552 | 1.43 | 3.69 | 0.439 |
| Sugarcane (Cane) | 3.73 | 54.50 | 146.00 | 2.57 | 264.97 | 103.00 |
| Fruits | 4.42 | 139.05 | 31.46 | 2.94 | 62.61 | 21.30 |
| Vegetables | 3.79 | 145.36 | 33.92 | 2.93 | 78.92 | 26.94 |
| Plantation crops | 3.67 | 19.19 | 5.23 | 7.06 | 13.48 | 1.91 |

Note: Area (A) in lakh ha, Production (P) in Lakh Tonnes and (Y) Yield in t/ha

Source: Tamil Nadu an Economic Appraisal various issues (Evaluation and applied Research Department, Government of Tamil Nadu, Chennai)

Pulse crop was grown in an area of 9.27 lakh ha with production levels of 5.73 lakh tonnes and the yield obtained was 618 kg/ha resulting in gap of 220kg/ha set as target in the 12th Plan. Similarly, there is a shortfall in target set for achievement in the

12th Plan and the current level of performance. This no doubts calls for specific action plans first to achieve target set forth in the previous time horizons and further potentials to be tapped based on the future requirement.

### 2.5.6 Performance of Crop and Allied Enterprises at National Level

The State ranks first in productivity of crops namely Maize, Pearl Millet, Ground nut, Total Oil seeds, Cotton and Sugarcane. The productivity of Coconut and Rice stands second, Sun flower and Jowar ranks third and Coarse Cereals ranks fourth. However, the productivity of pulse crop is ranked eighth among the different pulse producing states in the country. Tamil Nadu ranks first in respect of Poultry fourth in Sheep, seventh in Goats, thirteenth in Cattle and fourteenth in Buffalo population in the country.

**Table 2.15. Productivity position of Tamil Nadu at National Level**

| Crop | Position of Tamil Nadu at National level | National average yield ( Kg/ha) | Average Yield in Tamil Nadu (Kg/ha) | Maximum yield achieved under farmers' field |
|---|---|---|---|---|
| Maize | 1 | 2,557 | 5,360 | 7008 |
| Pearl millet | 1 | 1,272 | 2,881 | |
| Groundnut | 1 | 1,400 | 2,699 | 3236 |
| Total Oilseeds | 1 | 1,037 | 2,294 | --- |
| Cotton | 1 | 461 | 718 | 944 |
| Sugarcane(MT) | 1 | 70 (tonnes/ha) | 103 tonnes/ha) | 271.7 |
| Coconut | 2 | 7,164 | 10,236 | 14,875 |
| Rice | 2 | 2,390 | 3,191 | 14200 |
| Sunflower | 3 | 753 | 1,625 | 1742 |
| Jowar | 3 | 953 | 1,485 | 5478 |
| Coarse cereals | 4 | 1,729 | 3,066 | --- |
| Food grains | 5 | 2,070 | 2,529 | --- |
| Total Pulses | 8(*) | 744 | 689 | |

* Leap from 14th position. (Source: Agricultural statistics at a Glance, 2015)

## CHAPTER III

# AGRICULTURAL INFRASTRUCTURE AND GOVERNMENT PROGRAMMES

### 3.1. Agricultural Infrastructure

The Infrastructure available through government agencies are furnished in Table. 3.1

**Table.3.1.Infrastructure Base in the State**

| Type | No |
|---|---|
| Veterinary Hospitals | 139 |
| Veterinary Dispensary | 2581 |
| Fertilizer control laboratory | 14 |
| Soil testing laboratory | 31 |
| Mobile soil testing laboratory | 16 |
| Pesticide testing laboratory | 15 |
| State Seed Farms | 41 |
| Seed Processing units | 116 |
| Bio fertilizer production units | 15 |
| Bio control Labs | 10 |
| Agricultural Extension Centres | 383 |
| Farmers Training Centre | 22 |
| State Horticultural Farms | 56 |
| Regulated Markets | 278 |
| Godown | 425 |
| Transaction Shed | 326 |
| Drying Yard | 329 |
| Cold storage units | 8 |
| Market Complex | 5 |
| Farmers Market | 179 |
| Specialized Market Complex | 18 |
| Union dairies | 17 |
| Federation dairies | 4 |
| Milk chilling Plants | 35 |
| Primary Agricultural Co-operative credit society | 4444 |

Source: Policy Note 2017-18 Government of Tamil Nadu

### 3.2. Supply of inputs

Seed, fertilizer, pesticides and credit are the major input requirement for the crop enterprises. The quality and timely supply of adequate quantity is very crucial to achieve better performance of the crops. In what follows the supply of such inputs is discussed.

#### 3.2.1. Seeds

Among the major inputs, production and supply of quality seeds is the most important one. The improved seeds have more genetic vigor for high yield potential and the fertilizers and the balanced nutrient management trigger the potentials for increasing the yield levels. Therefore, the timely and adequate availability of seeds along with other inputs like fertilizers and pesticides are the essentials to keep agriculture growing. The details of the quantities of seeds distributed from 2002-03 to 2011-12 are presented in Table 3.2

**Table. 3.2. Distribution of Improved Seeds by Crops**

**(in tonnes)**

| Sl. No. | Crops | 2002-03 | 2003-04 | 2004-05 | 2005-06 | 2011-12 |
|---|---|---|---|---|---|---|
| **I.** | **Food Grains** | | | | | |
| a. | Paddy | 15483 | 12985 | 10738 | 16681 | 75250 |
| b. | Millet | 363 | 351 | 363 | 489 | 6693 |
| c. | Pulses | 941 | 1273 | 1340 | 1424 | 4800 |
| | **Total (I)** | **16787** | **14609** | **12441** | **18594** | **86743** |
| **II**. | **Non – Food Grains** | | | | | |
| a. | Oilseeds | 4269 | 3127 | 3261 | 4171 | 12092 |
| b. | Cotton | 124 | 163 | 154 | 235 | 555 |
| | Total (II) | 4393 | 3290 | 3415 | 4406 | 12647 |
| | **Grand Total (I + II)** | **21180** | **17899** | **15856** | **23000** | **99390** |

Source: Tamil Nadu an Economic Appraisal – 2005-06 and 2011-12 to 2013-14 Evaluation and Applied Research Department, Government of Tamil Nadu, Chennai.

It could be seen from the table that 75,250 tonnes of paddy seeds were distributed to the farmers during 2011-12 and it was fairly higher than that distributed in the previous three years. About 6690 tonnes of millets were distributed in 2011-12 and it

is the maximum as compared to earlier years. Further, 4,800 tonnes of pulses were distributed to the farmers in 2011-12 and it was higher as compared to earlier three years. Thus, a total of 86,743 tonnes of food grain seeds were distributed to the farmers in 2011-12 and it was higher than that of previous three years. As regards, non-food grains, oilseeds and cotton seeds were distributed to the tune of 12,647 tonnes of which oilseeds accounted for 12,092 tonnes and cotton accounted for 555 tonnes. The production as well as distribution of seeds was almost on par, with minor variations in all the five years under question. The minor variations in the quantities of seeds produced and distributed among the five years, might be mainly due to the variations in the behaviour of the monsoons.

Perusal of the details on seed replacement rates achieved in 2003-04 and 2012-13 in Table 3.3 indicate that there is potential to achieve high SRR as the current coverage of high quality seed is very meagre especially in pulses and oilseeds.

**Table. 3.3. Seed Replacement by Crops - Percentage to Total Cropped Area**

| S.No. | Crop | 2003-04 | 2012-13 |
|---|---|---|---|
| **A.** | **Food Crops** | | |
| 1. | Paddy | 13.00 | 76.00 |
| 2. | Varietal sorghum | 1.50 | 51.00 |
| 3. | Bajra | 7.49 | 94.00 |
| 4. | Finger Millet | 10.57 | 55.00 |
| 5. | Maize | 2.40 | 99.00 |
| 6. | Pulses | 8.60 | 46.00 |
| **B.** | **Non-Food Crops** | | |
| 1. | Oilseeds | | |
| a. | Groundnut | 9.00 | 6.60 |
| b. | Gingelly | 12.00 | 47.00 |
| c. | Sunflower | 5.00 | 36.50 |
| e. | Castor (Irrigated) | 15.00 | 69.00 |
| 2. | Cotton | 10.00 (RF) | 100 (BT) |

Source: Statistical Handbook of Tamil Nadu, (various issues)

The shortfalls indicate the need for increasing seed production particularly in State seed farms. Moreover, in the recent years, the farmers buying behaviour with reference to seeds have changed towards the use of more and more purchased seeds. This trend again reinforces the need for production and distribution of more quality seeds each year. By adopting seed village concept involving local farmers in seed production, the required quantity of seeds in different varieties and crops can be produced to meet the requirement of the village and also help to increase the SRR. Besides meeting the requirement of the farmers in local village, the seeds can be supplied to the farmers in neighboring villages. Creation of adequate seed processing and storage godowns to ensure supply of certified seeds in right quantity at the appropriate time to the farmers to avoid crop loss, and godowns (depots) for fertilizer, pesticide and bio-fertilizer would ensure better distribution of inputs to farmers.

### 3.2.2. Fertilizer

The trend in quantity of fertilizer consumption in the State and per ha. consumption at State and National Levels is shown in Table 3.4.

**Table 3.4. Consumption of Fertilizer in the State**

| | Consumption ('000 tonnes) | | | Consumption (kg/ha) | | | |
|---|---|---|---|---|---|---|---|
| **Year** | **N** | **P** | **K** | **N** | **P** | **K** | **Total** |
| 2012-13 | 574.62 | 223.02 | 149.18 | 111.79 (86.53) | 43.39 (34.23) | 29.02 (10.61) | 184.21 (131.36) |
| 2013-14 | 549.35 | 197.11 | 159.20 | 86.77 (81.11) | 31.13 (27.28) | 25.15 (10.16) | 143.05 (118.55) |
| 2014-15 | 601.32 | 223.28 | 190.20 | 96.98 (84.86) | 36.01 (30.54) | 30.68 (12.68) | 163.67 (128.08) |

Figures in parentheses denote consumption/ha at All India level

Source: Agricultural Statistics at a Glance 2015

The disproportionate distribution of NPK in the consumption in a way indicates the imbalanced application of fertilizers by the farmers. Therefore, the farmers have to be educated and trained in the application of proper proportions of NPK in the crop fields.

Introduction of bio-fertilizers is yet another recent land mark that adds to the increased crop productivity with the least cost. However, it is yet to gain momentum among farmers and hence a special thrust in the plan may be given for popularizing bio-fertilizers among the farmers of Tamil Nadu.

### 3.2.3. Pesticides

The consumption of pesticides has been drastically reduced through various technologies. Compared to 10926 MT of technical grade pesticide consumption in 1984-1985, the consumption has declined to merely 2050 MT. About 3088 MT of dust and 4.98 lakh litre of liquid plant protection chemicals are distributed to farmers in the state during the year. Besides, through 150 model IPM villages, the Farmer Interest Groups produced and distributed 94 MT of *T. viridi.*

Farm Mechanization has been an important element of modernization of agriculture. Productivity of the farm depends considerably on the availability of farm power coupled with efficient farm implements and their judicious utilization. Agricultural equipments enable efficient utilization of various inputs such as seeds, fertilizers, plant protection chemicals and water for irrigation in addition to alleviation of drudgery associated with various farm operations and making farming an attractive enterprise.

Availability of adequate farm power is very crucial for timely farm operations for increasing production and productivity. There has been close correlation between farm power availability and productivity. Productivity of the farm depends considerably on the availability of farm power coupled with efficient farm implements and their judicious utilization. The power productivity relationship shows that those States having higher farm power availability/ha have higher productivity. It is reported that the additional requirement of food grains in future will be met, to a great extent, where in the demand for tractors, power tillers and other machinery will continue to increase in future also.

The farm power availability during the year 2007-08 was 1.23 kW/Ha. Currently, the farm power availability in Tamil Nadu is 1.83 kW/Ha against the requirement of 2.00 kW/Ha. Farm mechanization has been helpful to bring about significant improvement in agricultural productivity. Thus, there is strong need for mechanization of agricultural operations.

It is inevitable to use machinery and multiple use attachments to tractors, for compensating the non-availability of labor during peak seasons, and do the cultivation practices in time.

The demonstration of Self-propelled paddy transplanter, rotavator, disc plough, offset disc harrow, sub-soiler, post-hole digger, attracted the farmers and received well by the farming community due to less labor-Intensive operations and cost of cultivation. The planting and harvesting are “season” oriented, time bound and the demand of labor during “Peak agricultural seasons” will be more and farmers are finding it difficult to cope up with the situations. Further the zero till seed drill, raised bed planter, rotavator, paddy transplanter, rice tray nursery preparation machine, laser leveler, sugarcane machinery and turmeric harvester are also to be popularized in Tamil Nadu among the farming community and make them purchase to use in the farming operations.

The mechanization thus ensures reduction of drudgery associated with various farm operations as also to economize the utilization of inputs and thereby harnessing the potential of available resources. The priorities for mechanization are decided as per the actual requirement of various agro-climatic zones and involve land preparation equipment and crop production techniques for cereal crops, cash crops, oil seeds, pulses, horticultural crops etc.

The constraints in the promotion of mechanization include the varied requirement of equipment for each agro-climate zone, small and fragmented land holdings, low investment capacity of the farmers, inadequate irrigation facilities, know how status of the farmers, repairs and maintenance facilities etc.

### 3.2.4. Government Programmes

The list of major schemes/ programme implemented through Central/State Government is furnished below.

**Table 3.5. List of Government Programmes in the State**

| S.No. | Programme |
|---|---|
| 1. | Assistance to the farmers for quality seed production |
| 2 | Assistance to the farmers for the soil health |
| 3 | Assistance to the farmers for taking up plant protection measures |
| 4 | a. Assistance to the farmers for increasing the crop productivity<br>b. National mission on oilseeds and oil palm<br>c. National Agricultural Development Programme<br>d. National Food Security Mission<br>e. National Mission on Agricultural Extension and Technology<br>f. National Mission for Sustainable Agriculture<br>g. Assistance to increase productivity of Coconut<br>h. Assistance to increase productivity of Cotton<br>i. Mission on Sustainable Dry land Agriculture |
| 5. | Assistance to the farmers for crop insurance |
| 6. | Assistance to the farmers for Extension training and performance |
| 7. | Integrated Horticultural Development Scheme |
| 8. | Mission for Integrated Development Horticulture |
| 9. | Pradhan Mantri Kirshi Sinchayee Yojana |
| 10. | National AYUSH Mission-Medicinal Plant |
| 11. | Submission on Agricultural Mechanization |
| 12. | Land Development Scheme |
| 13. | Minor Irrigation Scheme |
| 14. | Provision of Solar Powered Pumping Systems |
| 15. | Tamil Nadu Irrigated Agriculture Modernization Project |
| 16. | Seed certification Seed Quality control and seed testing |
| 17. | Organic Certification |
| 18. | Pledge Loan to farmers and traders |
| 19. | Tamil Nadu Farmers Development and Welfare Scheme |
| 20 | Agmark Grading |
| 21. | Venture Capital Assistance Under Tamil Nadu Small Farmers Agri-Business Consortium |
| 22. | Scheme for free distribution of Milch cows and Goats/Sheep |
| 23. | Scheme for Poultry Development |
| 24. | Fodder Development |
| 25. | Scheme for control Of Livestock Diseases |
| 26. | National Live stock Mission |

## CHAPTER IV

# PRODUCTIVITY GAPS AND MAJOR CONSTRAINTS

### 4.1. Agriculture

The major strengths of the sector are

- Introduction of crop specific strategies like System of Rice Intensification (SRI) and SRI villages, Improved Pulses production technologies – System of Pulses Intensification (SPI) as whole village concept, Sustainable Sugarcane Initiatives (SSI) and precision Farming for agricultural and horticultural crops which are developed mainly to bridge the yield gap.
- Creation/Improvement in establishment of agricultural marketing infrastructure and promoting primary producer-owned agri business ventures.
- Increasing the cultivable area and diversifying the cultivation in favor of high value, organic horticulture and commercial crops while ensuring food and nutritional security for all.
- Assessing the requirement of agricultural inputs so as to meet the local needs effectively and ensuring availability of adequate quantity of inputs at appropriate time and that are to be locally produced.
- Reclamation of saline and alkaline soil, issue of Farmers' Integrated Handbooks (FIHB).
- Promoting hi-tech agriculture, precision farming and micro irrigation for efficient use of irrigation water – Promoting horticulture technologies and micro irrigation as whole village concept.
- Farm level interventions for 'end to-end' involvement of extension staff with individual farmer – conducting pre-season village campaigns (Uzhavar Peruvizha) in close coordination with the all allied disciplines. Capacity building for farm based research and agriculture innovation and excellence by the farmers Supply of gender friendly equipment such as power/cono weeders and markers.

### 4.1.1. Challenges

Agricultural operations are however constrained by sub-optimal water resources to a great extent. To ensure “more crop/income per drop of water”, special emphasis has been given for the cultivation of high value – less water intensive crops for effective land use system. As per the latest agricultural census in Tamil Nadu marginal and small holdings of less than two hectares accounted for 92 per cent of the total holdings and 61 per cent of the total operated area. Out of the 31 districts, in as many as 18 districts, the average size of holdings was below the State average of 0.80 hectare. The small size of land holdings inhibits investment in productivity enhancing measures and makes many agricultural holdings sub-optimal.

Such type of holdings challenges the process of marginalization of small and marginal farmers and casualization of agricultural laborers. To derive the best results and to empower them, these farmer groups have to be motivated either to form farmer’s groups or some type of institutional arrangements so as to get all the technical inputs in time and to ensure judicious use of various scarce resources.

Thus, agriculture sector continues to confront with the shrinkage of area under cultivation, gross mismatched between the drawal and recharge of ground water, growing conversion of agricultural land for non-agricultural uses that made disparities in yield rate of crops across the State, imbalanced application chemical fertilizers and the dominance of small and marginal farmers.

Water Use Efficiency (WUE) has to be increased by enhancing productivity of per unit of water for which strategies such as mass adoption of Micro Irrigation Mission approach, promotion of Precision Farming, SSI, SRI and Rainwater Harvesting structures for recharging groundwater are to be promoted.

### 4.2 Horticulture

Major initiatives for increasing the area acreage and productivity were taken up in the form of cultivation, rejuvenation of old orchards, canopy management, organic farming, post- harvest management, creation of marketing infrastructure and human resource development. The major challenges are

- Horticultural Parks for fruits, vegetables and spices have to be developed across

the State.

- More thrust has to be given to micro irrigation with fertigation
- Expansion of area under precision farming,
- Hi-density planting
- Organic cultivation wherever possible to meet the demand from niche markets and consumers through which income earning capacity of the farmer water can be enhanced.
- More emphasis on value addition by creating value addition centers and establishment of localized training to the farmers accordingly.

### 4.3. Agricultural Engineering and Mechanization

In Tamil Nadu mechanization in agriculture is still limited to usage of tractors and motor pumps. With availability of better paying service sector and construction jobs, increased migration from agriculture to other sectors is observed in Tamil Nadu during the last decade. To increase the productivity of the land and to cope with shrinking agricultural manpower, mechanization is not only necessary but also essential. The challenges in promotion of mechanization include non-standardized agricultural practices, atomistic land holdings, low investment capacity of farmers, lack of know-how and non-availability of service and maintenance facilities. Suitable policy and structural mechanisms have to be developed and support increased mechanization in all phases of agriculture.

The State depends on ground water for irrigation and the farmers have to be motivated for solar energization of irrigation pump sets. Provision of solar energy is beneficial to the farmers on one hand and it also reduces the burden on the State Grid on the other. Besides, more agro-service centers have to be created at block level and promoting rural youth for custom hiring of farm machineries and equipment.

### 4.4 Agricultural Marketing and Agri Business

Owing to a number of factors such as inadequate storage facilities, lack of quick and economical means of transportation, poor withholding capacity of the farmers and urgent credit needs, the unorganized sector comprising wholesale merchants, commission agents and other intermediaries continue to dominate the sphere of agricultural marketing. Efficient market with a dynamic supply chain is indispensable for

the development of agricultural sector. The challenges are

- Enhancing the marketability of agricultural commodities by creating necessary modern infrastructure facilities and strengthening of existing markets by providing additional infrastructure facilities,
- Formation of Commodity Groups and forward linkage for direct purchase of agricultural produce by the traders/ buyers from farmers. Creating awareness among the farmers on market intelligence by providing market– led extension
- Information, Education, Communication and Capacity Building (IEC&CB) activities.
- Integrated approach from planting to marketing which includes choice of crops (mainly banana, mango, tapioca, spices, flowers crops) grading, packaging, storage and marketing in domestic and international markets.
- Commercialization of agriculture through market driven production approach by utilizing the infrastructure and market intelligence available.
- Encouraging setting up Agri/Horti processing units by arranging backward and forward linkages and also through venture capital assistance under Small Farmers Agribusiness Consortium.
- Minimizing post-harvest losses by creating required market infrastructure, cold chain and scientific storage facilities,
- Providing adequate pack houses with gamma irradiation facilities.
- Encouraging the private sector to set up agro processing industries and Food Parks for processing, at large scale with farmers' participation.
- Implementing Food Processing Mission with special emphasis on formation of State and District level Food Processing Mission
- Initiating Food Processing Business Incubator facilities near production catchments and Empowering farmers with knowledge on price forecasting, high price period, best priced market, quality parameters, pre and post-harvest technologies and value addition for different agricultural commodities and export opportunities for doubling their income through 'Market-led Agriculture'.

### 4.5. Agricultural Education and Agricultural Research

Agricultural Education and Research have to be focused more on the society's needs. It has to take more of changes due to globalization, technological development and growing emphasis on value addition. The thrust areas and strategies to be achieved have to be prioritized taking into consideration of positive impact and spin- off benefits.

- Agricultural education to cater to the globalizing agriculture needs.
- Crop improvement research on developing new varieties, hybrids and also to possess important traits such as drought tolerance, pest and disease resistance and nutrient enrichment especially in nutritional cereals.
- Standardizing precision farming technologies for more crops which will help to increase yield of quality produce and conserve resources.
- Strengthening research to develop implements and machinery considering the needs of the farming community, particularly marginal and small farmers besides paying attention to designing gender-friendly implements.
- Research activities to reduce post-harvest losses and to enhance value addition and emphasis to be given for nutritional cereals so that their consumption level increases.
- Developing bio technology and nanotechnology based solutions for enhancing input use efficiency, productivity, post-harvest life, value addition and maintaining resource equality.
- Research on Bio inoculants to augment nutrient availability and to reduce pest incidence rhizosphere engineering to enhance soil plant relationship
- Further intensification of research on climate change and mitigation
- Market research to promote market-led agriculture.
- The hiatus in agriculture is mainly due to deteriorating soil health, declining water resources, inadequate investment in rural infrastructure, spiraling prices of inputs and change in the mind sets of people viewing of agriculture as of low value.

Hence farmer farm oriented, crop focused, region specific strategies with adequate investment in developing rural structure is absolutely essential. In sum, the desired growth rate can be achieved only through crop based technology interventions

along with genetically improved seeds and newer technologies along with timely availability of inputs. In addition, development of value added process especially in millets and horticultural produces with market driven approach should be given priority. Under infrastructure development, weather proofing of food grain production, linking the river as much as economically possible to bring surplus water of one area to other, micro- irrigation, high efficiency of water, nutrients and energy are to be addressed.

Strict enforcement to avoid encroachment of the existing of tanks and also the inlet channels should be given due consideration. Water harvesting and storage structures must be improved and increased depending on the requirement so as to avoid runoff wastages. Storage capacity of the tanks should be enhanced with strengthening of the bunds and out let channels so that tail end areas also will avail tank irrigation and more area should be brought into cultivation. Maintenance of water bodies which leads the recharge of the groundwater so that over exploitation risks can be minimized. Cultivation of low fertile lands deprived of irrigation are to be used intensively for high value crops i.e., establishment of drought tolerant millet, fruit crops and agro-horti pasture. Integrated nutrient management including organic manures, green manures, compost, vermicompost and proper application of major nutrients along with bio fertilizer will avoid the yield reduction due to deficiencies and increase the yield.

Proposed strategies will lead to achieve 9 per cent growth in Agriculture production and double the income of about 82 lakhs farmers of Tamil Nadu by increasing the productivity by 50 per cent and above, increasing the cropping intensity, increasing the irrigation intensity and bringing fallow lands under cultivation. Strengthening of Agriculture infrastructure will ensure access to quality inputs, extensive adoption of innovative technologies like SRI, Micro irrigation, Precision farming resulting in increased water use efficiency. Besides, emphasis on organic farming, integrated farming systems, prevention of wild animal’s menace need adequate consideration and adoption in the appropriate agro-ecological zone.

### 4.6 Resources and Challenges

Since the scope of extensive cultivation is rather limited, efforts have to be taken up for intensive cultivation. However, the cropping intensity is hovering around 120 per cent only inspite of developmental efforts taken up since independence. The scope for bringing additional land under cultivation revolve around current fallows, cultivable

wastes and other fallow lands which accounted for nearly 20.00 per cent of the geographical area of Tamil Nadu State. Hence challenges are identifying the green signals of the aforesaid areas under cultivation. In fallow lands, efforts have to be taken for cultivation of fodder crops which would mitigate the deficiencies in the availability of fodder area.

Further net area irrigated to net area sown accounted for nearly 52.00 per cent. Hence efforts have to be taken up by bringing green revolution in the rainfed areas giving emphasis to short duration drought resistant millets and pulses. Since water is an essential input for agriculture, linking of rivers, water harvesting and restoration of traditional water bodies will improve the overall water availability in the State. Water use efficiency can also be achieved by modernization of irrigation system, improved service delivery, participation of farmers and popularization of micro irrigation. The major challenges would be

- Restoring the storage capacities of the old reservoirs and the tanks which are heavily silted up.
- Utilizing surplus flood flows draining into the sea by putting up small structures and conveying it to drought prone high level commands by pumping schemes.
- Removing the encroachments in water bodies and protecting them in an efficient manner.
- Augmenting ground water potential through construction of artificial recharge structures and rain water harvesting systems for sustainable ground water development and management.
- Augmenting the surface water potential byway of inter-basin transfer by inter-linking of rivers within the State.
- Increasing the water holding capacity, by Restoration, Renovation and Rehabilitation (RRR) of traditional water bodies.
- Preventing the pollution of water bodies such as rivers, streams, reservoirs, tanks, etc., and to reuse the treated effluent water for irrigation.
- Intensifying the public awareness and training activities on water management in order to increase the efficiency of water use by implementing change management.

### 4.7. Animal Husbandry

In livestock sector especially for cattle, the major challenge is increasing the fodder area and fodder availability. Decline in area under permanent pastures is the main reason for the shortfall of fodder requirement. Further emphasis has to be laid on optimum utilization of waste land to grow fodder. The fodder production has to be increased by promoting high yielding fodder varieties. Adequately providing proper infrastructure and equipment to the veterinary health care institution is yet another major challenge for the timely diagnosis and treatment of animal diseases. A mixture of technology, policy and institutional innovations needs to be combined for sustainable and equitable livestock sector growth.

**The major challenges are:**

- Provision of animal breeding, doorstep veterinary and emergency health care services, subsidized Artificial Insemination services, up gradation of milch animals, supply of feed, cultivation of fodder and insurance cover to animals of milk producers in cooperative fold.
- Ensuring clean milk production with quality testing at village level.
- Modernization of cooperative dairy infrastructure.
- Development of e-governance programs
- Bringing the landless laborers and marginal farmers especially women farmers into the fold of organized livestock rearing.
- Strengthening of Veterinary Services Delivery System and Diagnostic services.
- Improving the capability of frozen semen production stations.
- Providing marketing access and improving cold chain especially in milk handling and processing.
- Promoting Backyard Family Poultry.

### 4.8. Animal Husbandry Research

The major challenges are

- Ensuring breeds / technologies for sustained increase in yield and to meet the end users' expectations in terms of quality and food safety.

- Ensuring service provision and to enable farmers to take informed decisions based on prices of different animal products.
- Harnessing research output of frontier sciences to increase value added animal products, storage and processing.

## 4.9. Fisheries

### Strengths

- Tamil Nadu State is endowed with a coastal line of 1,076 kms, accounting for13.3 per cent of the Nation's Coastal line of 8118 kms.
- The State has 608 costal fishing villages with 1.05 million marine fisher folk and 2,24,000 inland fishermen spread in interior districts
- State possesses 0.19 million sq.kms of Exclusive Economic Zone (EEZ) accounting for 9.7 per cent of the country's EEZ of 2.02 m. sq. kms and a continental shelf of about 41,412 sq. kms.
- Diversified flora and fauna estimated at more than 3,509 species to support marine fisheries.
- The inland fisheries sprawl over 3.83 lakh hectares of water spread area comprising reservoirs, major irrigation and long seasonal tanks, short seasonal tanks and ponds, estuaries and backwaters
- Many fishermen cooperatives and fisher women cooperatives are functioning in the State.
- Sizable numbers of Mechanised Fishing boats-5,944; Traditional Crafts (motorised and non- motorised)- 34,920 (29,587+ 5,333); 5 Major Fishing Harbours, 4 Medium Fishing Harbours,36 Fish landing centres / Jetties and 254 Fish Landing Points
- Prospective farmers themselves work in the newer areas for developing or refining the technologies and have an aspiration to adopt something new
- Existence of an exclusive professional man power (Tamil Nadu Fisheries University), a first of its kind in India, at Nagapattinam, Tamil Nadu with an outlay of Rs.18.10 crores to impart professional fisheries education, research and training for enhancing fish productivity and utilization in the state of Tamil Nadu and
- A vibrant Fisheries Department with an annual budget of about 783 crores is an added strength to accelerate fisheries development in the State.

**Weaknesses**

- Reduced Catch Per Unit Effort (CPUE) in Fishing
- Many water bodies received water only during north-east monsoon
- Non-availability of adequate infrastructure facilities for seed production, rearing,
- fish landing and marketing
- Fish culture in natural and small water systems is being practiced by stock and
- harvest method and not by scientific culture method
- Lack of post-harvest facility like cold storage and fish processing unit at the shore.
- Largely inadequate fish seed production
- Low fish productivity of tanks
- Non-availability of stock size quality fish seeds throughout the year
- Lack of efficient fishing gears for operation in deep waters
- Inadequate training packages on fish culture, breeding and seed rearing, feed
- Formulation and fish diseases diagnosis etc.
- Paucity of funds to fish seed rearing centres
- Insufficient area for fish seed production
- Lack of hygienic handling of fish in marketing
- Low infrastructure support for artisanal fisherman impede the growth in fish
- production
- Poor technology adoption in the mechanized crafts and low hygiene are the major
- bottle necks in promoting export oriented fishing and product development
- Under-utilization of short seasonal tanks and
- Absence of dead storage level in the reservoirs affects the natural fish stock.

**Opportunities**

- Vast market and potential buyers
- Escalating demand for seed, and table fish
- Scope for ornamental fishes and demand for new varieties
- Increased awareness about the profitability of Integrated farming with Fisheries component
- Vast expansion of marine resources with diverse fishes in the off-shore area
- provides good opportunity for increasing marine fish catching
- Large scale coastal aquaculture is possible
- Mari culture, including pearl culture, spat production, lobster fattening and multiple newer fishing product preparations possible.
- Rehabilitating the affected and unutilized shrimp farms for mari-culture activities.
- Ample opportunities for developing coastal / back water shrimp farming on large-scale with greater rigor.
- Effective utilization of short seasonal tanks and ponds in the network of inland water ways for fish production
- Establishment of large scale seed production and supply centres and
- Availability of seeds of short duration aquaculture species viz. GIFT Tilapia, *Pangassius* sp. etc.

**Challenges**

- Frequent monsoon failures, vicissitudes of cyclones and occurrence of tsunami are the natural hazards that pose major threats to the growth of the fishery industry as a whole
- More micro players in the sector pushing down the prices and ultimately collapse the market
- Inadequate infrastructure for seed production discourages the farmers in taking up inland fish culture

- High input cost especially for feed and non-availability of low cost feed
- Improper waste disposal and environmental pollution by coastal / brackish water shrimp farming act as the threat for their own survival and growth
- High siltation of tanks and water ways and lack of periodic desilting activities and
- Import of fish from other countries

### 4.10. Productivity Gap

The yield gap was estimated based on the difference between average yield and the maximum yield achieved by the farmer. The details are furnished in Table 4.1.

**Table. 4.1. Yield Gap in Different Crops**

| Crop | Average Yield | Max. Yield (Achieved by farmers) | Gap |
|---|---|---|---|
| Rice (kg/ha) | 3190.0 | 5400-8000 | 2210-4810 |
| Maize (q/ha) | 53.0 | 76.0 | 23.00 |
| Red gram (q/ha) | 6.90 | 9.50 | 2.40 |
| Black gram (q/ha) | 6.90 | 9.90 | 3.00 |
| Ground nut (q/ha) | 27.00 | 29.80 | 2.80 |
| Cotton (q/ha) | 7.18 | 19.05 | 11.87 |
| Sugarcane (t/ha) | 103.0 | 120.0 | 17.00 |
| Banana (t/ha) | 40.0 | 30-60 | 20 |
| Mango (t/ha) | 5.5 | 8-10 | 2.5-4.5 |
| Tomato (t/ha) | 13.5 | 40 | 27.5 |

## CHAPTER V

# POTENTIALS FOR DEVELOPMENT OF HORTICULTURE, LIVESTOCK, FISHERIES, AGRO-FORESTRY AND POST-HARVEST PROCESSING

The allied sectors of agriculture including horticulture, sericulture, animal husbandry, etc. would provide additional employment opportunities and additional income to the farm families. Thus, the income of the farm families is supplemented by these allied sectors.

The State is endowed with agro-climatic conditions conducive for growing a wide range of horticulture crops such as fruits, vegetables, spices, plantation crops, flowers, medicinal and aromatic plants. Tamil Nadu shares 8.7 per cent of the production of these crops and 5.3 per cent of the area at All India level.

The details of area, production and productivity of major horticultural crops are furnished in Table 5.1.

**Table 5.1. Area, Production and Productivity of Horticulture Crops**

| S. No. | Core Groups | 2004-05 | | | 2005-06 | | | 2014-15 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | P | Y | A | P | Y | A | P | Y |
| 1. | Fruits | 2.36 | 44.98 | 19.07 | 2.55 | 48.56 | 19.07 | 2.87 | 58.77 | 20.48 |
| 2. | Vegetables | 2.15 | 63.08 | 29.29 | 2.32 | 68.00 | 29.36 | 2.54 | 69.27 | 27.25 |
| 3. | Spices and condiments | 1.43 | 8.05 | 5.62 | 1.54 | 8.68 | 5.64 | 1.65 | 10.05 | 6.11 |
| 4. | Plantation crops | 2.57 | 2.57 | 8.13 | 3.43 | 2.49 | 8.30 | 2.55 | 10.50 | 4.12 |
| 5. | Flowers | 0.23 | 1.87 | 8.06 | 0.25 | 2.02 | 8.11 | 0.26 | 2.74 | 10.35 |
| 6. | Medicinal plants | 0.05 | 0.05 | 0.09 | 1.82 | 0.06 | 0.11 | 0.14 | 1.29 | 9.20 |
| | **Total** | **8.79** | **126.20** | **14.70** | **9.21** | **135.08** | **14.71** | **10.01** | **152.62** | **15.24** |

Note: “A” denotes area in lakh ha, “P” denotes production lakh tonnes and “Y” denotes yield in tonnes ha

Source: Commissioner, Department of Horticulture and Plantation Crops, Chennai.

The area and productivity of major horticultural crops increased marginally by 5.8 and 0.28 per cent respectively during 2014-15. The total production of horticulture crops improved from 126.20 lakh tonnes in 2004-05 to 152.62 lakh tonnes in 2014-15.

The production of vegetables registered an increase of 63.08 lakh tonnes (2004-05) to 68.00 lakh tonnes in 2005-06 and further 69.27 lakh tonnes in 2014-15. The production of spices and condiments registered an increase of 8.05 lakh tonnes (2004-05) to 8.68 lakh tonnes in 2005-06 and 10.05 lakh tonnes in 2014-15. The production of flowers registered an increase of 1.87 lakh tonnes in 2004-05 to 2.02 lakh tonnes in 2005-06 and further 2.74 lakh tonnes in 2014-15. Moreover, the production of plantation crops increased of 2.57 lakh tonnes in 2004-05 to 2.49 lakh tonnes in 2005-06 and tremendously to the volume of 10.50 lakh tonnes in 2014-15.

The details of production and yield of selected horticultural crops are furnished in Table 5.2.

**Table. 5.2. Production and Yield Rates of Horticultural Crops**

| S.No. | Crops | Production ('000 tonnes) | | | Yield Rate (kg/ha) | | |
|---|---|---|---|---|---|---|---|
| **Fruits** | | **2004-05** | **2005-06** | **2014-15** | **2004-05** | **2005-06** | **2014-15** |
| 1 | Banana | 3462 | 4648 | 4505 | 42477 | 49104 | 43695 |
| 2 | Mango | 539 | 538 | 626 | 4554 | 4299 | 4438 |
| 3 | Jack | 25 | 38 | 14 | 8943 | 12346 | 4930 |
| 4 | Guava | 64 | 92 | 40 | 7995 | 10904 | 5244 |
| 5 | Grapes | 70 | 85 | 38 | 28176 | 32488 | 15321 |
| **Vegetables** | | | | | | | |
| 6 | Potato | 79 | 75 | 92 | 15705 | 14901 | 19732 |
| 7 | Tapioca | 4584 | 4857 | 3968 | 41298 | 38211 | 37663 |
| 8 | Sweet Potato | 21 | 30 | 8 | 15117 | 20857 | 20491 |
| 9 | Onion | 256 | 234 | 377 | 9677 | 8015 | 10797 |
| 10 | Brinjal | 101 | 76 | 101 | 12650 | 10690 | 10638 |
| 11 | Tomato | 22 | 278 | 265 | 12705 | 12627 | 12068 |

Source: Tamil Nadu – An Economic Appraisal, Evaluation and Applied Research Department, Government of Tamil Nadu, Chennai.

It could be seen that production of banana had increased from 34.62 lakh tonnes in 2004-05 to 45.05 lakh tonnes in 2014-2015. However, there had been a decline in the production of mango from 5.39 lakh tonnes in 2004-05 to 5.38 lakh tonnes in 2005-06 and increased to 6.26 lakh tonnes in 2014-15. In all the other fruit crops, there had been

an increase in production. In the case of vegetables, with the exception of sweet potato, tapioca and tomato, there had been an increase in production over years.

As regards the productivity, decrease in productivity was observed in all the chosen crops in 2014-15. Among the vegetables, a reduction in productivity was observed in Brinjal.

The low levels and high fluctuations in productivity in fruit trees and vegetables might be due to lack of knowledge among the farmers about high tech approach and also due to frequent failures of the monsoons and skewed distribution of rainfall. High investment requirements particularly in wasteland reclamation and irrigation facilities and long years of waiting time for an economic bearing of fruit trees are the important reasons that constrain the area expansion. Non- availability of ready market, difficulties in having good access to nearby markets and lack of institutional support for marketing are the other constraints that deter the farmers from venturing into the cultivation of horticultural crops. In what follows the district–wise performances in terms of growth trend in area, production and productivity of major horticultural crops are discussed

**5.1. Performance of Livestock**

At National level, Tamil Nadu ranks second in poultry population (117.3 million), fourth in sheep (4.8 million), 13$^{th}$position in Cattle (8.8 million) and 14$^{th}$position in Buffalo (0.78 million). The milk production amounts to 72.43 lakh MT and the per capita availability is 258 gm, whereas egg production is reaching as high as16,125 million Nos. leading to per capita availability of 210 Nos. per annum. Similarly, in meat production including poultry meat about 5.44 lakh MT is produced. The state is equipped with 17 District Cooperative Milk Producers Union with a processing capacity of 24 lakh litres/day. However, there exist further growth potentials in this sector with more focus on value addition and distribution.

Activities allied to agriculture *viz.,* Animal Husbandry, Fisheries and Poultry have the potential for providing significant employment opportunities to rural and urban population. Allied activities provide supplementary occupation to the people besides contributing to Gross State Domestic Product (GSDP).The dependence on the agricultural sector for supporting livelihood is well known while the allied sectors offer scope for absorbing surplus labour from the agriculture sector.

The total livestock population of the State which stood at 227.35 lakhs in 2012 had declined by 26.08 percent over that of 2007livestock census. The bovine (Cattle and buffalo) population in the State had witnessed steady decline between 1982 and 2012. While Sheep population showed sign of decline, the goat population had steadily increased during the reference period. The details of livestock particulars are furnished in Table. 5.3.

**Table. 5.3. Livestock Census of Tamil Nadu**

**(in Lakh)**

| Year | Cattle | Buffalo | Sheep | Goats | Others | Total | Poultry |
|---|---|---|---|---|---|---|---|
| 1982 | 103.66 (-4.03) | 32.12 (4.35) | 55.37 (4.69) | 52.46 (24.85) | 18.26 (135.31) | 261.87 (8.45) | 182.84 (27.88) |
| 1989 | 93.53 (-9.77) | 31.28 (-2.62) | 58.81 (6.21) | 59.20 (12.85) | 20.85 (14.18) | 263.66 (0.68) | 215.70 (17.97) |
| 1994 | 90.96 (-2.75) | 29.31 (-6.30) | 56.12 (-4.57) | 58.65 (-0.93) | 21.75 (4.32) | 256.79 (-2.61) | 238.52 (10.59) |
| 1997 | 90.47 (-0.54) | 27.41 (-6.48) | 52.59 (-6.29) | 64.16 (9.39) | 24.76 (13.84) | 259.39 (1.01) | 365.11 (53.06) |
| 2004 | 91.41 (1.03) | 16.58 (-39.51) | 56.00 (6.48) | 81.77 (27.45) | 3.73 (-84.94) | 249.42 (-3.85) | 865.90 (137.16) |
| 2007 | 111.89 (22.40) | 20.09 (21.17) | 79.91 (42.70) | 92.75 (13.43) | 2.96 (-20.64) | 307.59 (23.32) | 1304.84 (50.69) |
| 2012 | 88.14 (-21.22) | 7.8 (-61.17) | 47.86 (-40.10) | 81.43 (-12.20) | 2.12 (-28.37) | 227.35 (-26.08) | 1173.48 (10.06) |

Figures in parentheses indicate the percent of growth over previous censuses.

Source: Commissioner and Director of Animal Husbandry and Veterinary Services, Chennai – 6.

### 5.2. Performance of Fisheries

Tamil Nadu has a coastal length of 1076 km with a fish folk population of about 9.7 lakhs. The marine fish catch is about 4.66 lakh tonnes and Tamil Nadu exports about 86,000 tonnes of fish to other countries. Similarly, in the inland fishery, the State is endowed with 3.83 lakh ha of water resource and about 2.28 lakhs people are directly engaged in land fishing. The State is also able to harness the fish catch from the inland water and annually about 2.42 lakh tonnes of fish harvesting is done. The details are furnished in Table 5.4.

**Table 5.4. Fish Production in Tamil Nadu**

**(in Lakh Tonnes)**

| Sl.No. | Years | Inland | Marine | Total |
|---|---|---|---|---|
| 1. | 2003-04 | 0.77 | 3.81 | 4.58 |
| 2. | 2004-05 | 0.87 | 3.08 | 3.95 (-13.76) |
| 3 | 2005-06 | 1.56 | 3.90 | 5.46 (38.23) |
| 4 | 2011-12 | 2.24 | 4.27 | 6.51 (19.23) |
| 5 | 2015-16 | 2.42 | 4.66 | 7.08 (8.76) |

Figures in parentheses denote percentage change over previous year's performance

Source: Commissioner of Fisheries, Chennai-6 and Tamil Nadu–An Economic Appraisal, Evaluation and Applied Research Department, Government of Tamil Nadu, Chennai.

Overall fish production during 2015-16 was estimated at 7.08 lakh tonnes which accounted for an increase of 8.76per cent over the production in 2011-12.Marine fish accounted for about 66 per cent of total fish production. Currently the demand for fish increased due to changes in consumption pattern of growing population in the State. The fish resources in the inshore area had been over exploited. Further, there is a decline in fish catches in inshore areas due to depleted fish stock. The growing demand could be met from the exploitation of offshore resources to a optimum level by technological upgradation, skill upgradation and adoption of sustainable practices by creating adequate infrastructure.

In the case of marine fish market chains, these activities suffer from unhygienic conditions, poor handling of the fish and wastages. Small-scale fisheries are unable to gain access to more efficient marketing systems and supporting infrastructure (ice, cold storage, etc.) that would lead to better quality and prices. Besides, adequate process infrastructure facility in marine sector has to be created.

Inland fish catches are conditioned by aberrations of rainfall, less retention of water in the water bodies, inadequate fish seed and feed and absence of proper marketing. Efforts need to be directed towards the development of scientific storages and marketing of inland fisheries. To augment inland fisheries, the shortfall in fish seed

and feed has to be rectified. Inland fishery cooperative societies need to be promoted and strengthened and provided with necessary infrastructure and financial support to take up culture and capture fisheries with the active role of fisherwomen. Fresh water fish culture needs to be promoted in seasonal tanks/ponds owned by Panchayats.

### 5.3. Fish Export

Fish and fish products are exported from the State. There are 57 approved modern sea food processing plants and 64 approved dried fish production exporting centres functioning in the State. Over 4,000 persons are directly and 12,000 persons are indirectly employed in the export processing industry in the State. However, there was a fluctuating trend in the total quantity of fish and fishery products export in the State (Table. 5.5).

Of the total quantity exported, the export of shrimp alone accounted for as much as 63 per cent. Contrary to this trend, the value of earnings from fish and fishery products exports gradually improved from Rs. 2,800 crores in 2010-11 to Rs. 3,029 crores in 2011-12 (5.9%). Likewise, the average earnings per tonnes increased from Rs. 3.31 lakhs in 2010-11 to Rs.3.75 lakhs in 2011-12. The State's share in total quantity of fish products exports at the all India level was 10.6 per cent in 2010-11.

The State has rich potential for fish culture and Tamil Nadu is one of the major fish exporting States in India. The quantity of fish and fish products exported was about 8.5 lakh tonnes earning Rs. 4194 Crores in 2015-16.

**Table 5.5.Export of Fish and Fish Products**

| Year | Tamil Nadu | | All India | |
|---|---|---|---|---|
| | Quantity (tonnes) | Value (Rs. crore) | Quantity (tonnes) | Value (Rs. crore) |
| 2010-11 | 86,182 | 2,860 | 8,13,091 | 12,901 |
| 2011-12 | 80,738 | 3,029 | 8,62,021 | 16,597 |
| 2015-16 | 85,063 | 4,184 | - | - |

Source: Tamil Nadu–An Economic Appraisal Evaluation and Applied Research Department, Government of Tamil Nadu, Chennai.

The following are the infrastructure requirements identified in this sector:

- Infrastructure for fishermen community to enable scientific fish farming with backward and forward linkages and common facility centers. Further, by conducting sensitization workshops, providing training on different types of fish farming, and supplying refrigerated vans for transportation of fish
- Ice plants for fish storage by Fisheries Department
- Inland Fish farms
- Marie Fish Landing Centers

Thus, similar to agriculture sector, the livestock and fishery sector are facing new generation challenges and these challenges have to timely addressed for higher growth.

## CHAPTER VI

# ROLE OF TECHNOLOGY

### A. Strategy and Action Plan

Policy approach so far, has been diverted towards irrigated agriculture to increase agricultural production. Now the concern is that the gains from the green revolution areas have been plateauing out due to several factors and evidences suggest that the productivity and returns to investment have substantial trickle down benefits for poor not only in irrigated areas but also those in less favored areas. Hence, it is inevitable that rainfed areas need to be promoted. The major strategies to achieve higher growth could be

- Productivity Improvement by bridging the present yield gap
- Diversifying the cultivation in favor of high value horticulture and commercial crops
- Supply of Quality inputs in time through Special Purpose Vehicle (SPV)
- Bringing the fallow land under cultivation through cost-effective technology transfer
- Promoting Integrated Farming System on whole district saturation approach
- Promoting agri business venture duly with farmer’s participation
- Inviting more Public Investment and through PPP mode in creating agri infrastructure to act as growth drivers rather mere hard wares and
- Improving Knowledge Transfer to farmers through ICT enabled extension and market led agriculture

The approaches to achieve these growth parameters should be location specific and need to be drawn on felt need basis. The formulation of bottom-up plans would speed up the process of growth as they primarily address the concern of location specific and need based

### 6.1. Agriculture

In agricultural sector, considering the various challenges listed out in the preceding chapters, much emphasis has to be given for the enhancement of crop production, usage of balanced chemical nutrients, organic agriculture, integrated farming

system, integrated nutrient management and strengthening of infrastructural facilities. In what follows the performance of the crops across the districts action plans to double the income of farmers are discussed are presented and discussed

### 6.1.1. Enhancement of Cereal Production

**Rice**

The compound growth rate of area, production and productivity under rice crop in major districts of Tamil Nadu is presented in Table 6.1

**Table 6.1 Compound Growth Rate (CGR) of Area, Production and Productivity of Rice–District wise**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Ariyalur | -0.88 | 9.94 | 14.16 |
| 2 | Coimbatore | -12.77 | -9.89 | 1.61 |
| 3 | Cuddalore | 0.56 | -3.17 | -3.30 |
| 4 | Dharmapuri | -3.57 | -1.88 | 3.94 |
| 5 | Dindigul | 0.57 | 3.00 | 2.42 |
| 6 | Erode | 3.77 | 3.60 | -0.17 |
| 7 | Kancheepuram | -2.95 | -0.27 | 2.77 |
| 8 | Kanyakumari | -4.58 | -2.55 | 2.12 |
| 9 | Karur | 0.44 | 1.86 | 1.41 |
| 10 | Krishnagiri | 2.07 | 8.31 | 9.38 |
| 11 | Madurai | 1.51 | 3.75 | 2.20 |
| 12 | Nagapattinam | 0.58 | 2.82 | 2.23 |
| 13 | Namakkal | -3.36 | -2.67 | 0.72 |
| 14 | Perambalur | -13.19 | -6.87 | 7.28 |
| 15 | Pudukkottai | 1.05 | 0.23 | -0.81 |
| 16 | Ramanathapuram | 0.55 | 6.47 | 5.89 |
| 17 | Salem | -0.01 | 0.94 | 0.95 |

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 18 | Sivagangai | 0.24 | 2.53 | 2.28 |
| 19 | Thanjavur | 0.29 | 0.47 | 0.98 |
| 20 | The Nilgiris | -15.13 | -14.90 | 0.28 |
| 21 | Theni | -0.95 | 1.17 | 2.15 |
| 22 | Thiruvannamalai | 3.71 | 4.90 | 1.15 |
| 23 | Thiruvarur | 1.31 | 3.77 | 2.41 |
| 24 | Thoothukudi | 4.39 | 5.47 | 1.04 |
| 25 | Tirunelveli | 2.44 | 3.63 | 1.17 |
| 26 | Tiruppur | -1.37 | -1.25 | 4.83 |
| 27 | Thiruvallur | -0.90 | 0.07 | 0.99 |
| 28 | Trichy | 0.25 | 2.31 | 2.06 |
| 29 | Vellore | -0.19 | -0.38 | -0.18 |
| 30 | Villupuram | 1.74 | 2.08 | 0.34 |
| 31 | Virudhunagar | 0.70 | 3.02 | 2.30 |

Over the years, area under rice had grown positively in 18 districts viz. Cuddalore, Dindigul, Erode, Karur, Krishnagiri, Madurai, Nagapattinam, Pudukottai, Ramanathapuram, Sivagangai, Thanjavur, Thiruvannamalai, Thiruvarur, Thoothukudi, Tirunelveli, Trichy, Villupuram and Virudhunagar. However, in remaining 13 districts, this trend was negative. Similarly, the growth rate of production was found to be positive in 21 districts and negative in other 10 districts viz., Coimbatore, Cuddalore, Dharmapuri, Kancheepuram, Kanyakumari, Namakkal, Perambalur, The Nilgiris, Tiruppur and Vellore. Consequently, the productivity trend was positive in 27 districts of Ariyalur, Coimbatore, Dharmapuri, Dindigul, Kancheepuram, Kanyakumari, Karur, Krishnagiri, Madurai, Nagapattinam, Namakkal, Perambalur, Ramanathapuram, Salem, Sivagangai, Thanjavur, The Nilgiris, Theni, Thiruvannamalai, Thiruvarur, Thoothukudi, Tirunelveli, Tiruppur, Tiruvallur, Trichy, Villupuram and Virudhunagar, while it was negative in the remaining four districts. This implied that the downward trend in growth rates in productivity needs special attention.

Moreover, in Tamil Nadu, rice cultivation is taken up in three seasons namely kar/kuruvai/sornavari, samba/pishanam and navarai/kodai. Among these three seasons, controlled irrigation is possible, predominantly only in kar/kuruvai/sornavari. The samba season is totally depended on the supply of water through canal/tank irrigation and SRI technology practices can be adopted in these regions. Heavy tillers, healthy root development, vigorous crop growth and non-lodging nature ultimately resulting in high yield are the main features of this technology. Therefore, the overall strategy must be to increase production through productivity increase in all the districts of Tamil Nadu by adopting modern technologies like System of Rice Intensification (SRI) and also by the distribution of quality seeds, farm machineries and other management practices.

Besides, efforts need to be taken to supply critical inputs like bio-fertilizers, zinc sulphate, micro nutrients, bio-pesticides etc. Resorting to community nursery in rice growing areas, promotion of laser leveler and demonstration would increase the yield of crops. It is proposed to cover additionally 3.55 lakh ha. Under SRI in the next five years. Supply of 80,000 MT quality seeds, issuance of 17 lakh soil health cards and provision of incentives for practicing machine sowing and harvesting would lead to increase in production.

**Millets**

Millets form an important component of nutritional and livelihood security of resource poor farmers. These crops exhibit wide adaptation in marginal and currently occupy niche areas and provide farmers with opportunity for assured harvest, staple food, required nutrition and sufficient fodder in an environment characterized by scanty rainfall. Besides, these millets provide raw materials for agro industries such as poultry and cattle feed, value added products, potable alcohol, starch, bio fuel etc., Nevertheless, with the exception of maize, area under millets has drastically reduced and yield also considerably declined.

**Maize**

The area, production and productivity trend under maize crop in major districts of Tamil Nadu is presented in Table 6.2

**Table 6.2 Compound Growth Rate of Area, Production and Productivity of Maize Crop**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Ariyalur | 6.65 | 62.72 | 47.56 |
| 2 | Coimbatore | -14.22 | 9.03 | 23.92 |
| 3 | Cuddalore | 79.32 | 77.25 | -1.36 |
| 4 | Dindigul | 5.69 | 21.30 | 14.77 |
| 5 | Erode | 10.22 | 25.64 | 13.99 |
| 6 | Madurai | 33.36 | 43.85 | 7.87 |
| 7 | Namakkal | 36.02 | 57.90 | 16.08 |
| 8 | Perambalur | 23.11 | 37.72 | 11.87 |
| 9 | Pudukkottai | 39.04 | 62.97 | 17.21 |
| 10 | Salem | 16.98 | 31.57 | 12.47 |
| 11 | Thanjavur | 21.92 | 33.79 | 9.77 |
| 12 | Theni | 6.97 | 23.46 | 15.42 |
| 13 | Thoothukudi | 16.77 | 42.96 | 22.43 |
| 14 | Tirunelveli | 4.93 | 26.07 | 20.15 |
| 15 | Tiruppur | -2.60 | 10.59 | 9.42 |
| 16 | Trichy | 39.58 | 61.34 | 15.58 |
| 17 | Vellore | -5.30 | 10.16 | 16.33 |
| 18 | Villupuram | 43.25 | 68.69 | 17.81 |
| 19 | Virudhunagar | 8.45 | 22.12 | 12.61 |

Maize crop is cultivated in 19 districts with an average area of 2.53 lakh ha with a production of 11.86 lakh tonnes and the productivity is about 4,635 kg/ha. With reference to area, 16 districts of the State experienced positive growth, while three districts viz., Coimbatore, Tiruppur and Vellore had shown negative trend. Similarly, in production, all the 19 districts witnessed positive growth. The productivity of the crop witnessed an upward trend in 18 districts and only in Cuddalore district, the productivity declined. Thus, an increasing growth rates in area, production and productivity are quite perceptible in majority of the districts where maize is cultivated. Maize is thus one of the important crops introduced for crop diversification in Tamil Nadu State. Moreover, the growing poultry feed industry keeps demanding maize, as it is an important ingredient in feed mix.

**Sorghum**

The compound growth rate of sorghum in major districts of Tamil Nadu is presented in Table 6.3.

**Table 6.3. Compound Growth Rate of Area, Production and Productivity of Sorghum**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Ariyalur | -36.19 | -44.93 | -5.13 |
| 2 | Coimbatore | -11.16 | -3.85 | 7.16 |
| 3 | Dharmapuri | -2.82 | -0.58 | 3.16 |
| 4 | Dindigul | -5.41 | -4.02 | 1.47 |
| 5 | Erode | -55.33 | -47.65 | 17.18 |
| 6 | Karur | -4.49 | 1.83 | 6.62 |
| 7 | Krishnagiri | -6.32 | 22.95 | 23.46 |
| 8 | Madurai | -1.33 | -1.73 | -0.41 |
| 9 | Namakkal | -1.14 | -7.06 | -5.98 |
| 10 | Perambalur | -22.96 | -21.19 | 2.29 |
| 11 | Pudukkottai | -7.80 | -6.35 | 1.57 |
| 12 | Ramanathapuram | -0.68 | 4.68 | 5.39 |
| 13 | Salem | -1.64 | -2.55 | -0.92 |
| 14 | Theni | -0.92 | 11.32 | 12.35 |
| 15 | Thiruvannamalai | -14.27 | -11.92 | 2.74 |
| 16 | Thoothukudi | 1.53 | 13.20 | 11.50 |
| 17 | Tirunelveli | -1.85 | -1.03 | 0.82 |
| 18 | Tiruppur | -22.29 | 30.24 | 80.59 |
| 19 | Thiruvallur | -5.39 | -8.67 | -0.64 |
| 20 | Trichy | -3.99 | -6.02 | -2.11 |
| 21 | Vellore | -4.79 | -7.17 | -2.49 |
| 22 | Virudhunagar | 2.49 | 8.48 | 5.84 |

Sorghum is grown in 22 districts in the State with an area of 2,44,408 ha, production of 2,36,547 tonnes and productivity of 984 kg/ha. The growth rate of area was positive only in two districts viz., Thoothukudi and Virudhunagar. Similarly, the production was positive in seven districts viz., Karur, Krishnagiri, Ramanathapuram, Theni, Thoothukudi, Tiruppur and Virudhunagar, whereas the productivity recorded positive in almost all the districts with the exception of Ariyalur, Madurai, Namakkal, Salem, Thiruvallur, Trichy and Vellore districts. Thus, the negative trend in majority of the districts is seen. Due to changing purchasing power and food habits, the consumption of sorghum has declined in majority of small farmer / labor households. One of the important crops that replaced sorghum is maize.

**Bajra**

The compound growth rate of area, production and productivity under bajra crop in major districts of Tamil Nadu is shown in Table 6.4.

**Table 6.4. Compound Growth Rate of Area, Production and Productivity of Bajra**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Erode | -20.42 | -15.86 | 5.74 |
| 2 | Karur | -15.22 | -5.44 | 11.54 |
| 3 | Madurai | 8.40 | 14.33 | 5.47 |
| 4 | Perambalur | -27.57 | -19.87 | 10.63 |
| 5 | Theni | -3.76 | 6.37 | 10.53 |
| 6 | Thiruvannamalai | -13.53 | -9.61 | 4.53 |
| 7 | Thoothukudi | -7.82 | -1.82 | 6.51 |
| 8 | Thiruvallur | -16.03 | -15.72 | 0.38 |
| 9 | Villupuram | -13.32 | -9.74 | 4.13 |
| 10 | Virudhunagar | -10.42 | -3.39 | 7.84 |

Bajra is an important millet crop grown in 10 districts in the State with an area of 53,409 ha, production of 88,866 tonnes and productivity of 1,691 kg/ha. Perusal of table, exhibits the fact that Theni district alone witnessed positive growth in area. Similarly, Theni and Madurai districts had positive growth in production. In all other districts,

negative trend was observed for area and production. The productivity trend was positive in all the ten districts. In sum, the promotion of bajra crop in Tamil Nadu requires a thorough planning to increase area and production through input supplies, management practices, capacity building and special programmes, as this crop has got food value in terms of nutrition.

**Ragi**

The area, production and productivity trend under ragi crop in major districts of Tamil Nadu is presented in Table 6.5.

**Table 6.5. Compound Growth Rate of Area, Production and Productivity of Ragi Crop**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Dharmapuri | -14.01 | -11.99 | 4.70 |
| 2 | Erode | -5.72 | 0.69 | 6.80 |
| 3 | Krishnagiri | -3.31 | 9.25 | 13.19 |
| 4 | Perambalur | -24.60 | -20.15 | 5.90 |
| 5 | Vellore | -6.20 | -6.29 | 0.48 |

Ragi is yet another agricultural crop that comes under minor millet cultivated as a major food staple crop and for its nutritive value mostly in Dharmapuri, Erode, Krishnagiri, Perambalur and Vellore districts with an average area of 84,914 ha, production of 1,80,557 tonnes and productivity of 2,140 kg/ha. All the five districts, however, showed only negative growth regarding area expansion and positive growth in productivity. The production growth was positive in Erode and Krishnagiri districts although Dharmapuri, Perambalur and Vellore districts showed negative growth trend. Ragi is considered as a wholesome food especially for diabetics. Considering the increased demand of ragi for food purposes and decreasing area due to competing crops, there is an immediate need for enhancement of ragi productivity. The strategy, therefore, must keep increasing productivity and production of ragi in the State to meet the growing domestic demand. There exists scope for value addition also.

Thus, the overall production of millets could be enhanced by adoption of system of millet intensification and transplanting of seedlings in irrigated millet, precision farming

in maize, use of farm machineries, distribution of certified seeds, integrated nutrient management in maize and training farmers for adoption of precision farming. Promotion of value addition of millet crops will also augment the income of millet farmers. It is proposed to distribute 45,000 MT of quality seed, soil health management in 28,000 ha and conducting field demonstrations in 1.00 lakh ha.

Moreover, the maize crop improvement should be concentrated mainly on interventions like quality seed supply, soil health enhancement, integrated pest and disease management, irrigation management, farm mechanization, infrastructure, extension and special programs like millet mission.

### 6.1.2. Enhancement of Pulse production

Pulse crop is grown in Tamil Nadu in about nine lakh hectares and the average State productivity revolves around 600kg/ha. The productivity is considerably low due to poor crop management and lack of irrigation. Pulses are the major sources of cheap protein particularly for the vegetarians and poor. Therefore, there is a need to increase the production in the state. Pulses are more sensitive to excessive moisture and the un-usual continuous rain and flooding also devastate the entire rice-fallow pulses once in 3 or 4 years thus reducing production drastically in the State. Therefore, the development strategy must focus not only on productivity increase, but also on the water management / flood management tactics.

Pulse production could be increased by adopting precision farming, intensification of transplantation by providing incentives and adoption of System of Pulses Intensification (SPI) technology package, distribution of certified seeds, increasing area under rice fallow pulses, bund cropping and promotion of variety having synchronized maturity. It is proposed to produce and distribute 28,000 MT of quality pulse seeds, to undertake soil health management to cover 10 lakh ha in pulse growing areas and Integrated Pest Management in pulse crops.

**Red Gram**

The compound growth rate of red gram crop in major districts of Tamil Nadu is presented in Table 6.6.

**Table 6.6. Compound Growth Rate of Area, Production and Productivity of Red Gram**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Karur | -1.33 | 5.53 | 6.95 |
| 2 | Krishnagiri | 19.18 | 19.78 | 6.64 |
| 3 | Theni | -6.44 | 0.83 | 7.78 |
| 4 | Vellore | -4.93 | -4.28 | 0.72 |

Red gram is grown predominantly in four districts of the Tamil Nadu State covering about 31,163 ha of area, 22,603 tonnes of production and 601 kg/ha of productivity. The growth rate of area was positive only in one district viz. Krishnagiri. Similarly, the production was positive in three districts viz., Karur, Krishnagiri and Theni, whereas the productivity recorded positive in all the four districts. Thus, there is a need to increase area, production and productivity of red gram to meet the growing demand through adoption of red gram transplantation technology and implementation of programs like pulses mission, expansion of area under rainfed pulses etc

**Black Gram**

The growth rate of area, production and productivity of black gram is shown in Table 6.7. Black gram is cultivated invariably in almost 19 districts viz., Cuddalore, Dharmapuri, Erode, Kanyakumari, Karur, Nagapattinam, Pudukkottai, Ramanathapuram, Sivagangai, Thanjavur, Thiruvannamalai, Thiruvarur, Thoothukudi, Tirunelveli, Tiruppur, Thiruvallur, Trichy, Vellore and Villupuram of Tamil Nadu State with an area of 2,88,721 ha, production of 1,12,700 tonnes and productivity of 388 kg/ha. Most of the districts experienced positive growth trends regarding area, production and productivity. Therefore, the development strategy would sustain the growth through better management tactics practices.

**Table 6.7. Compound Growth Rate of Area, Production and Productivity of Black Gram**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Cuddalore | 4.63 | 6.49 | 2.02 |
| 2 | Dharmapuri | -6.56 | -6.10 | 1.10 |
| 3 | Erode | -9.14 | -6.26 | 3.17 |
| 4 | Kanyakumari | -17.04 | -17.09 | -0.07 |
| 5 | Karur | 19.31 | 21.72 | 2.02 |
| 6 | Nagapattinam | 3.93 | 1.03 | -2.79 |
| 7 | Pudukkottai | 1.10 | 2.70 | 1.59 |
| 8 | Ramanathapuram | 6.20 | 3.22 | -2.81 |
| 9 | Sivagangai | 4.08 | 5.70 | 1.55 |
| 10 | Thanjavur | 10.29 | 11.77 | 1.23 |
| 11 | Thiruvannamalai | -6.57 | -1.87 | 5.03 |
| 12 | Thiruvarur | 4.38 | 3.97 | -0.40 |
| 13 | Thoothukudi | 13.50 | 18.24 | 4.18 |
| 14 | Tirunelveli | -0.74 | 2.84 | 3.62 |
| 15 | Tiruppur | 17.95 | 48.06 | 29.63 |
| 16 | Thiruvallur | -11.49 | -9.99 | 1.72 |
| 17 | Trichy | 9.66 | 14.47 | 4.40 |
| 18 | Vellore | -15.60 | -13.76 | 2.10 |
| 19 | Villupuram | 6.17 | 10.28 | 3.87 |

**Green Gram**

The growth rate of area, production and productivity of green gram is shown in Table 6.8. With an area of 1.54 lakh ha, production of 53,605 tonnes and productivity of 343 kg/ha, green gram is grown in nearly 12 districts of the Tamil Nadu State. The growth rate of area was positive only in eight districts namely Nagapattinam, Thanjavur, Theni, Thiruvarur, Thoothukudi, Tirunelveli, Tiruppur and Virudhunagar. Similarly, the production was positive in all the aforesaid districts with the exception of Thanjavur, whereas the productivity recorded positive in half of the districts viz., Coimbatore, Theni, Thoothukudi, Tirunelveli, Tiruppur and Virudhunagar. The remaining districts recorded negative growth trend in area, production and productivity, and there exists a necessity to increase growth

rate of green gram to meet the growing needs of the population through special programs like accelerated pulses production programs.

**Table 6.8 Compound Growth Rate of Area, Production and Productivity of Green Gram**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Coimbatore | -9.75 | -5.47 | 5.54 |
| 2 | Erode | -20.67 | -20.78 | -0.13 |
| 3 | Nagapattinam | 8.64 | 3.31 | -4.90 |
| 4 | Namakkal | -9.58 | -12.12 | -2.81 |
| 5 | Thanjavur | 0.53 | -3.64 | -4.17 |
| 6 | Theni | 16.32 | 15.66 | 0.57 |
| 7 | Thiruvarur | 9.52 | 6.07 | -2.86 |
| 8 | Thoothukudi | 14.65 | 19.06 | 3.85 |
| 9 | Tirunelveli | 0.32 | 3.77 | 3.44 |
| 10 | Tiruppur | 7.48 | 36.73 | 23.07 |
| 11 | Thiruvallur | -3.60 | -4.95 | -1.40 |
| 12 | Virudhunagar | 1.60 | 3.02 | 1.40 |

### 6.1.3. Enhancing Oilseed Production

In Tamil Nadu, oil seeds are largely grown as rainfed crop and only 30 per cent of the area is under irrigated condition. Further, delayed monsoon affects the crops. The deficiency of secondary nutrients like sulphur and calcium and micro nutrients like zinc, boron, molybdenum and iron also limits the productivity to a considerable extent. Consequently, the farmers are reluctant to invest much on the inputs resulting in instability in yield. Hence, identifying and adopting crop management technologies suitable to the tracts are absolutely essential. Usage of bio-fertilizers, micronutrient mixture, insecticide, bio-pesticide, pheromone traps, tractor drawn seed drill (for groundnut), training of farmers on familiarization and usage of farm equipment, gypsum application (for groundnut) and certified seeds would enhance the production and productivity of oilseed crops considerably. In oilseed crops, seed storage is a problem due to high oil content which can be resolved through treating the seeds with halogen impregnated polymer in ground nut and sesame.

**Groundnut**

The average area under groundnut was 4.41 lakh ha with a production of 9.74 lakh tonnes and 2,238 kg/ha of productivity, covering almost 28 districts in Tamil Nadu State. Groundnut is yet another important oilseed crop, and its area and production performance had shown negative growth in majority of the districts. Despite a positive trend in growth of productivity in groundnut was observed in all the 28 districts except Thiruvannamalai. This necessitates the need to formulate appropriate strategy for groundnut to give more thrust on area and increasing productivity in all districts by implementing groundnut mission, integrated production improvement program for oilseeds etc. The compound growth rate of area, production and productivity under groundnut crop in major districts of Tamil Nadu during 2000-01 to 2014-15 is presented in Table 6.9.

**Table 6.9. Compound Growth Rate of Area, Production and Productivity of Groundnut**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Ariyalur | -4.57 | 41.23 | 45.75 |
| 2 | Coimbatore | -10.38 | -3.68 | 6.67 |
| 3 | Cuddalore | -10.10 | -8.12 | 2.68 |
| 4 | Dharmapuri | -10.44 | -7.19 | 5.32 |
| 5 | Dindigul | -2.18 | 0.47 | 2.79 |
| 6 | Erode | -7.51 | -6.68 | 0.91 |
| 7 | Kancheepuram | -5.09 | -0.98 | 4.34 |
| 8 | Kanyakumari | -15.36 | -12.44 | 3.44 |
| 9 | Karur | 1.66 | 4.89 | 3.18 |
| 10 | Krishnagiri | -0.53 | 7.86 | 11.37 |
| 11 | Madurai | -7.54 | -4.67 | 3.10 |
| 12 | Nagapattinam | 0.85 | 9.48 | 8.56 |
| 13 | Namakkal | -7.84 | -5.24 | 2.82 |
| 14 | Perambalur | -27.67 | -35.08 | 7.61 |
| 15 | Pudukkottai | -3.58 | -1.41 | 2.25 |
| 16 | Ramanathapuram | -8.31 | -5.41 | 3.17 |

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 17 | Salem | -7.25 | -3.77 | 3.75 |
| 18 | Sivagangai | -3.03 | -2.46 | 0.59 |
| 19 | Thanjavur | 4.25 | 10.16 | 5.67 |
| 20 | Theni | -9.69 | -3.66 | 6.67 |
| 21 | Thiruvannamalai | 1.34 | 0.21 | -1.12 |
| 22 | Thiruvarur | 12.14 | 23.00 | 9.69 |
| 23 | Tiruppur | -4.84 | 3.90 | 2.52 |
| 24 | Thiruvallur | -6.75 | -4.67 | 2.23 |
| 25 | Trichy | -1.43 | -0.24 | 1.21 |
| 26 | Vellore | -2.36 | 1.29 | 3.74 |
| 27 | Villupuram | -4.34 | -0.30 | 4.23 |
| 28 | Virudhunagar | -1.57 | 3.45 | 5.10 |

**Gingelly**

Gingelly is an important oilseed crop next to groundnut with an area of 58,422 ha, 29,060 tonnes of production and 508 kg/ha of productivity, grown in more than 10 districts of Tamil Nadu State. The growth rate of area was positive only in two districts namely Pudukkottai and Thanjavur (Table 6.10). Similarly, the production was positive only in four districts viz., Ariyalur, Karur, Pudukkottai and Thanjavur, and productivity was positive in Ariyalur, Erode, Karur, Pudukkottai, Thanjavur and Thoothukudi districts. Thus, the negative trend in majority of the districts is observed. Therefore, strategic planning must aim at increasing growth trend of area, production and productivity in gingelly through oilseeds mission program, especially in districts like Nagapattinam, Ramanathapuram, Salem and Thiruvarur.

**Table 6.10 Compound Growth Rate of Area, Production and Productivity of Gingelly**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Ariyalur | -15.41 | 0.66 | 21.43 |
| 2 | Erode | -2.69 | -2.46 | 0.24 |
| 3 | Karur | -1.96 | 2.21 | 4.25 |
| 4 | Nagapattinam | -2.21 | -6.09 | -3.97 |
| 5 | Pudukkottai | 0.60 | 2.24 | 1.64 |
| 6 | Ramanathapuram | -7.14 | -10.49 | -3.61 |
| 7 | Salem | -6.67 | -8.39 | -1.84 |
| 8 | Thanjavur | 2.15 | 3.38 | 1.22 |
| 9 | Thiruvarur | -10.41 | -11.35 | -1.00 |
| 10 | Thoothukudi | -10.10 | -5.37 | 5.27 |

**Coconut**

Coconut is grown in 24 districts of the State with an area of 4,00,562 ha, production of 57,028 tonnes and productivity of 14,230 nuts/ha. The growth rate of area, production and productivity was positive in majority of the districts of Tamil Nadu. However, a negative trend in area was observed in districts like Coimbatore, Dharmapuri, Erode, Kancheepuram, Ramanathapuram and Thiruvallur. Similarly, the production was negative in six districts viz., Dharmapuri, Erode, Kancheepuram, Kanyakumari, Ramanathapuram and Tirunelveli, whereas Kanyakumari, Ramanathapuram and Tirunelveli districts recorded negative growth trend for productivity. Though a positive trend in majority of the districts is observed, the need for sustenance development strategy in coconut to give full thrust on improving the productivity in many districts is to be targeted and among the 24 districts, Ramanathapuram district requires special attention. This crop has got also value addition potential in terms of oil, dried coconut powder, candy, coir pith making etc. The compound growth rate of coconut crop in major districts of Tamil Nadu is presented in Table 6.11.

**Table 6.11. Compound Growth Rate of Area, Production and Productivity of Coconut**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Coimbatore | -1.86 | 2.00 | 6.04 |
| 2 | Dharmapuri | -9.42 | -1.76 | 2.32 |
| 3 | Dindigul | 2.41 | 4.57 | 1.87 |
| 4 | Erode | -3.88 | -4.70 | 4.96 |
| 5 | Kancheepuram | -3.04 | -3.24 | 1.16 |
| 6 | Kanyakumari | 1.11 | -4.57 | -5.13 |
| 7 | Karur | 4.94 | 6.00 | 1.49 |
| 8 | Krishnagiri | 1.23 | 11.48 | 10.52 |
| 9 | Madurai | 1.24 | 5.87 | 2.82 |
| 10 | Nagapattinam | 1.67 | 6.06 | 5.41 |
| 11 | Namakkal | 13.22 | 13.57 | 4.67 |
| 12 | Pudukkottai | 5.68 | 17.31 | 10.64 |
| 13 | Ramanathapuram | -0.01 | -11.64 | -11.62 |
| 14 | Salem | 2.59 | 5.09 | 2.35 |
| 15 | Sivagangai | 1.73 | 5.21 | 2.90 |
| 16 | Thanjavur | 3.60 | 8.69 | 4.02 |
| 17 | Theni | 3.63 | 3.97 | 0.13 |
| 18 | Thiruvarur | 0.95 | 7.17 | 7.50 |
| 19 | Thoothukudi | 0.81 | 10.29 | 10.71 |
| 20 | Tirunelveli | 0.54 | -5.94 | -5.91 |
| 21 | Thiruvallur | -1.06 | 11.26 | 14.73 |
| 22 | Trichy | 1.30 | 9.47 | 8.84 |
| 23 | Vellore | 2.03 | 1.31 | 0.91 |
| 24 | Virudhunagar | 1.73 | 10.02 | 7.67 |

### 6.1.4. Enhancing Sugarcane Yield

In Tamil Nadu, sugarcane is grown under varied agro-climatic conditions. The change in climate has got significant influence over the sugarcane production system

across the state faced with frequent droughts, floods and diseases. Emerging crop scenario in sugarcane is a multidimensional one in terms of demand, production constraints, opportunities and technology landscape.

In Tamil Nadu, sugarcane is cultivated in 2.07 lakhs ha with an average productivity of 83.2 tonnes/ha. The total production of sugarcane is 172.18 lakh tonnes during 2016-17. However, the problems faced by sugarcane cultivators are high cost of cultivation, non-availability of good quality seed material, improper cultivation practices, unbalanced nutrient management and mono cropping resulting in low yields, increased pest and disease menace etc. Sustainable Sugarcane Initiative (SSI) is promising since it involves use of less seed sets, less water, optimum utilization of fertilizer and tend to achieve higher yields. Besides, it is an alternate to the conventional seed, water and space intensive sugarcane cultivation. This calls for provision of shade net, supply of critical inputs, training of the farmers and documentation. It is proposed to cover IPM and INM in 1.75 lakh ha by March, 2022 to increase the income of farmers. There is also need to develop short –duration sugarcane variety considering the water scarcity situation.

The growth in area, production and productivity of sugarcane was quite convincing with positive trend in more than 12 districts. The growth trend must be maintained to meet the growing demand for sugar. Therefore, the development strategy must focus on increasing sugarcane productivity as well as area increase in the years to come, so as to keep increasing production in almost all the districts especially in Madurai and Thiruvarur districts of Tamil Nadu State. However, the negative trend in area, production and productivity need to be reversed through proper strategy planning including the adoption of Sustainable Sugarcane Initiative (SSI), precision farming and production of other by-products like ethanol production etc. The area, production and productivity trend under sugarcane crop in major districts of Tamil Nadu during 2000-01 to 2014-15 is presented in Table 6.12.

**Table 6.12. Compound Growth Rate of Area, Production and Productivity of Sugarcane**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Ariyalur | -1.58 | 4.25 | -2.62 |
| 2 | Coimbatore | -18.64 | -16.69 | 0.60 |
| 3 | Cuddalore | -2.24 | -4.81 | -2.59 |

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 4 | Dharmapuri | 2.12 | 2.93 | 1.25 |
| 5 | Erode | 3.03 | 1.52 | -1.47 |
| 6 | Kancheepuram | -16.08 | -15.77 | 0.37 |
| 7 | Karur | -0.12 | 1.68 | 1.80 |
| 8 | Madurai | -3.15 | -3.54 | -0.40 |
| 9 | Nagapattinam | 1.48 | -1.65 | -3.09 |
| 10 | Namakkal | 11.37 | 5.78 | -5.02 |
| 11 | Perambalur | -8.33 | -5.25 | 3.36 |
| 12 | Pudukkottai | 4.88 | 5.04 | 0.15 |
| 13 | Salem | 6.41 | 5.00 | -1.33 |
| 14 | Sivagangai | 3.15 | 3.09 | -0.05 |
| 15 | Thanjavur | -0.96 | -0.83 | 0.15 |
| 16 | Theni | -5.57 | -4.00 | 1.66 |
| 17 | Thiruvannamalai | 7.21 | 9.87 | 2.48 |
| 18 | Thiruvarur | -6.98 | -7.30 | -0.16 |
| 19 | Tirunelveli | 3.88 | 1.75 | -2.00 |
| 20 | Tiruppur | 5.81 | 11.55 | 4.54 |
| 21 | Thiruvallur | 1.24 | 1.68 | 0.46 |
| 22 | Trichy | 1.75 | 1.70 | -0.04 |
| 23 | Vellore | -3.35 | -2.56 | 0.83 |
| 24 | Villupuram | 7.35 | 6.67 | -0.61 |
| 25 | Virudhunagar | 0.14 | -0.84 | -0.98 |

To achieve doubling of farmers' income, strategic planning becomes absolutely essential by taking into consideration of the core issues that cane cultivation addresses viz. resources availability, investments to be made, technological requirements etc.

Three possible means/strategies are suggested based on the current farmers' income and also the requirements of the farmers in the states where already higher income/return is achieved. An overview of the criteria to be considered, objectives to be addressed and approaches to be followed for reaching the goal of doubling the famers' income across the cane producing states are displayed below:

### 6.1.4.1 Approaches for Achieving the Goal of Doubling Farmers' Income

| Criteria | Objectives | Approaches |
|---|---|---|
| Increasing the yield and Recovery | To increase the income per hectare | Cultivation of suitable Varieties and use of cutting edge technologies like in land preparation, soil and water management, fertility management, selection of disease free planting materials, sett treatments, use of tools and machinery for prevention of harvest loss etc |
| Resource conservation | To reduce the cost of cultivation | Maximization of resource use efficiency for cost reduction and optimization of resource use. Use of resource conservation technologies, INM, precision farming techniques, augmenting bio-resources in the farm and less external input and sustainable farming practices. |
| Managing loss due to biotic and abiotic stress, climate change effects | Prevention of crop loss due to diseases and other stressors. | Effective disease management, use of IPM practices, periodical weather advisory and crop advisory during draught and flood, combating climate change effects through technological interventions and monitoring and surveillance of insects, pests and diseases across the county for their elimination and minimization of crop loss through integrated approaches. |
| Capacity Building and Reaching the unreached | Improving the farmers' capacity and ensuring the availability and accessibility of recommended technologies by the farmers | Establishing and strengthening linkages at all levels of research-extension-farmer-industry continuum and organizing farmers group and field school for horizontal spread of technologies and use of ICT |

### 6.1.4.2 Strategy of Improving Cane yield and Sugar recovery

The potential of the existing varieties and technologies remains indisputable, since record yields of 290 tonnes/ha has been achieved by innovative farmers using the existing varieties and technologies. Apart from the fact that the technology adoption remains at low levels in some agro climatic zones of Tamil Nadu. Since scope for improvement in yield is very much possible, the technological recommendations to increase the yield and recovery are displayed below

**Recommended Technological Interventions for Increasing Yield and Recovery**

| Technological interventions | Recommended Technologies | Problems addressed and Expected Out Come |
|---|---|---|
| **Varieties** | Co 86032, Co 86249, Co 87025, Co 87044, Co 94008, Co 99004, Co 2001-13, Co 2001-15, Co 0212, Co 0403, Co 06022, Co 06027, Co 06030, Co 09004 and CoG 6 | ➢ High yielding and high sucrose and tolerant to red rot.<br>➢ Variety has proved to be suited for almost all situations in the peninsular India.<br>➢ Co 86032 has contributed significantly in sustaining high productivity in the state. |
| **Planting system** | Wide row planting | ➢ Facilitates better spacing<br>➢ Conducive for intercropping<br>➢ Ideal for mechanization of farm operations and mechanical harvesting. |
| **Nutrient Management** | Soil testing and adoption of Integrated Plant Nutrient System | ➢ Soil test based fertilizer application takes into consideration the fertility status of the soil and ensures balanced fertilizer use. |
| **Ratoon management** | Ratoon management device | ➢ Ratooning is more profitable as compared to plant crop.<br>➢ Land preparation, planting operation and seed are not required.<br>➢ Saves Rs. 15 000 –Rs. 20 000 of cost of cultivation. |

### 6.1.4.3 Strategies to Reduce Cost of Cultivation

High cost of cultivation of sugarcane has resulted in reduced profits for farmers and has led to diversification towards cultivation of other remunerative crops. Cultivation of varieties and technologies suited for mechanization has become imperative now under the prevailing circumstances. Mechanical operations proved that it was superior to

manual operations. It reduced the cost of cultivation and enable efficient utilization of resources with better work output.

#### 6.1.4.4. Land Preparation, Weeding, Earthing Up, Irrigation and Harvesting

The studies show that the cost involved in conventional methods of land preparation is Rs 14,000/ha including 320 man-hour with 46 bullock pair hour/ha, while in mechanized cultivation, only Rs.10,300/ha was spent with reduction of Rs 3,700/ha in addition to saving of labour. Manual weeding with sickle is a very common practice costing Rs. 6,400/ha. Cost of mechanical weeding and inter culture is about Rs 3,250/ha and could save about 50 % of the expenses as compared to manual weeding.

Manual earthing up operation with spade is a common practice which cost about Rs 8,750/ha. Due to labour scarcity, farmers are using bund famer which cost about Rs 3,250/ha. The farmer could save about Rs. 5,500/ ha by employing machinery.

#### 6.1.4.5 Ratoon Management

Operations like land preparation, planting and seeds are not required in ratoon crop thereby making more profitable as compared to plant crop. Using the stubble shaver, stubble shaving is being done (Rs 1,500/ha). For manual stubble shaving, the farmer has to incur 100 labour hours and incurs a cost of about Rs.4,200/ha. In case of mechanical harvesting, sugarcane is harvested from the bottom portion; hence stubble shaving may not be required. Cost of mechanical stubble shaving is about 50 % lesser than manual practices followed for ratooning of sugarcane.

#### 6.1.4.6 Settlings Transplanting Technique (STT)

Conventional planting of sugarcane with three budded setts requires about 8-9 t/ha planting material. Only 12,500 settlings per hectare are required in case of bud chip planting. Using bud chips and raising settlings in a nursery can save 80 per cent of the seed material compared to three budded setts. Sugarcane settling transplanter has been developed by ICAR-SBI and ICAR-CIAE, RC, Coimbatore. Sugarcane bud chip transplanter is a low cost alternative to sett planting.

#### 6.1.4.7 Soil Test Based Plant Nutrition System

Soil test based fertilizer recommendation approach considers soil nutrient deficiencies and corrective measures for achieving optimum yield. There is wide

variation in availability of nutrients. It varies between regions, soil types and between fields. Therefore it is best to follow 'field-based' approach to decide about the dosage. Application of green manures, farm wastes and factories wastes along with bio-fertilizers are found to be useful in supplementing the in-organic fertilizers and also maintain cane productivity as well as soil fertility.

#### 6.1.4.8 Wide Row Planting and Inter-Cropping with Short Duration Pulses and Vegetables

Under wide rows, as the availability of growth resources increases like solar radiation and space is more, medium canopied high yielding varieties of crops can be raised as intercrops. The yield and additional returns from intercrops will also be more compared to intercrops grown in closed spaced sugarcane. Growing of legumes as intercrops can also result in improvement in soil fertility. Green gram, black gram, soy bean, sunhemp, daincha, potato garlic, onion and pulses could be raised as intercrops in sugarcane. The expected net income is in the range of 10,000 to 40000 per acre by growing intercrops.

#### 6.1.4.9 Plant Protection Measures

Sugarcane eco system is comparatively less prone to economics yield loss if it's properly managed at farmers' level. A large number of pests and diseases attack sugarcane. To manage any pest or disease the best approach is an integrated approach involving cultural, mechanical, biological and chemical methods, employed in appropriate combination depending upon the pest or disease, the gravity of problem and economics. Integrated disease management (IDM) or integrated pest management (IPM) are best management practices to avoid productivity losses in sugarcane production.

#### 6.1.4.10 Mechanization of Farm Operations

In the conventional system, for cultivating sugarcane in an acre (0.4 ha) of land about 1170 man hours and 130 bullock pair hours are required, which is laborious hence it not only increases drudgery but also cost of production. Cost of cultivation excluding cost on family labor and fixed costs is around Rs.1,50,000 per acre; approximately 45-48% of the total cost goes to payment on human labour and only 15-16% is spent on machinery including transport.

### 6.1.4.11 Recommended Technological Interventions for Enhancing Input use Efficiency for Productivity Improvement

| Technological interventions | Recommended Technologies | Problems addressed and Expected Out Come |
|---|---|---|
| **Land preparation** | Laser leveller | Precise levelling in short period of time is another advantage of laser levelling. Better distribution of water which will save around 20-25 % of irrigation water. |
| **Variety** | Location specific variety | Choice of correct set of varieties for a particular agro-climatic location is very vital in reaping best possible harvest, given other crop production and protection inputs in required measures |
| | Healthy seed | A good seed in sugarcane is defined as sett obtained from a healthy crop. It should be free from pests and diseases should have a good germination of more than 85%. Genetic purity of a variety which plays a pivotal role in sugarcane and sugar production should be maintained. |
| **Planting system** | Settlings Transplanting Technique (STT) | Conventional planting of sugarcane with three budded setts requires about 8-9 t/ha planting material. There is possibility of utilizing bud chips and single budded settlings as seed material. Only 12,500 settlings per hectare are required in case of bud chip planting. Using bud chips and raising settlings in a nursery can save 80 per cent of the seed material compared to three budded setts. |
| | Inter-cropping with short duration pulses and vegetables | Growing of legumes as intercrops can also result in improvement in soil fertility and additional income to the farmers.<br>Green gram, black gram, soy bean, sunhemp, daincha, potato garlic, onion and pulses could be raised as intercrops in sugarcane.<br>Additional income to farmers within short span of 65-90 days. |
| **Water Management** | Drip system of irrigation | About 40 % saving water and 25% increase in the yield<br>It reduces labour requirement for irrigation.<br>Effective application of inorganic fertilizers.<br>Improvement in sugar recovery. |
| | Water conservation technologies | Mulching also suppresses weed growth besides conserving moisture. Wherever water is scarce, number of irrigations can be reduced by trash mulching and thus water can be saved. |

| Technological interventions | Recommended Technologies | Problems addressed and Expected Out Come |
|---|---|---|
| **Soil health management** | Improving SOM content: Trash composting and bio-compost application | Maintains the soil fertility and sustainability of sugarcane productivity |
| | Reclamation of soil salinity and alkalinity | Increase the resource use efficiency and crop productivity |
| | Diagnosis of subsurface hard pan and chisel ploughing | Soil compaction can be a serious and unnecessary form of soil degradation that can result in increased soil erosion and decreased crop production. Compaction of soil is the compression of soil particles into a smaller volume, which reduces the size of pore space available for air and water. |
| **Plant protection measures** | Integrated Pest Management (IPM) | Sugarcane eco system is comparatively less prone to economics yield loss if it's properly managed at farmers' level. To manage any pest or disease the best approach is an integrated approach involving cultural, mechanical, biological and chemical methods. |
| **Farm mechanization** | Mechanization of farm operations | Mechanization is the immediate option through which there is possibility of minimizing expenditure on human labor.<br>Timely intercultural operations<br>Saves considerable amount of labor<br>Reduces cost of cultivation<br>Improvement in cane yield and sugar recovery |

### 6.1.4.11 Proposed Action Plan by ICAR-SBI

ICAR-Sugarcane Breeding Institute had been successful in fulfilling research needs of crop more than hundreden five years through timely varietal and technological interventions in our country. 'Co' and 'Co- allied' varieties which is cultivated over 99% of cane area have played a significant role in sustaining and expanding cane area and sugar production. Looking ahead, a medium term planning precisely visualizing improvement of farmers' income was chalked out. This will serve as basic frame work for "doubling farmers' income" subject to on course correction as situation warrants. This approach is theme based and problem solving mode through multidisciplinary approach. Major focus will be on:

- ✓ Adoption of location specific improved sugarcane varieties
- ✓ Cultivation of tissue culture derived healthy seeds/setts of popular varieties

- ✓ Large scale adoption of settling transplanting technique
- ✓ Mechanization of sugarcane agriculture
- ✓ Improving resource use efficiency
- ✓ Deployment of micro irrigation and fertigation schedules for sugarcane
- ✓ Adoption of proper crop protection technologies to minimise crop losses due to diseases, pests and nematodes
- ✓ Market intelligence based sugarcane production system and product diversification
- ✓ Conservation of natural resources to ensure sustainability of sugarcane cultivation
- ✓ Technology transfer through ICT led communication system such as mobile app, CaneInfo, etc developed by the ICAR-SBI

Effort to integrate improved varieties with newer technologies in a mutually complementing way leading to technological innovations that will drive doubling of farmers' income by March, 2022.

### 6.1.5. Enhancing Cotton Yield

The district-wise growth trends in area, production and productivity of cotton in Tamil Nadu is presented in Table 6.13.

**Table 6.13. Compound Growth Rate of Area, Production and Productivity of Cotton**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Ariyalur | 30.80 | 82.12 | 31.55 |
| 2 | Cuddalore | 18.67 | 13.81 | -5.45 |
| 3 | Dharmapuri | 0.53 | 8.77 | 9.07 |
| 4 | Madurai | -5.34 | 4.74 | 10.64 |
| 5 | Namakkal | -5.52 | 4.17 | 10.25 |
| 6 | Perambalur | 15.41 | 19.97 | 3.95 |
| 7 | Ramanathapuram | -12.62 | -9.40 | 3.68 |

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 8 | Salem | 3.72 | 8.84 | 4.94 |
| 9 | Theni | -13.35 | -3.14 | 11.78 |
| 10 | Thiruvannamalai | -9.46 | -0.60 | 9.79 |
| 11 | Thiruvarur | -11.18 | -8.94 | 2.00 |
| 12 | Thoothukudi | -10.22 | 1.80 | 13.39 |
| 13 | Tiruppur | 5.00 | 87.07 | 80.31 |
| 14 | Trichy | 11.31 | 14.85 | 3.13 |
| 15 | Villupuram | 4.39 | 3.94 | -0.37 |
| 16 | Virudhunagar | -9.32 | -4.07 | 5.79 |

During the beginning of the 11$^{th}$ five year plan period, the area under cotton was on an average of 1.14 lakh ha with a production of 2. 48 lakh tonnes and the productivity was 364 kg/ha, covering almost 16 districts of Tamil Nadu State. Traditionally the cotton has been cultivated predominantly in Salem, Coimbatore, Erode, Madurai, Virudhunagar, Theni, and Tirunelveli districts. However, recently the area and production of cotton has been dwindling to the alarming level especially in Ramanathapuram, Theni, Thiruvannamalai, Thiruvarur, Thoothukudi and Virudhunagar districts. The crop development strategy must aim at reversing the recent trend to that of the past, so as to keep increasing cotton production and feeding the cotton textile mills in the State. The pricing is an important factor that merit consideration in addition to assured market demand through contract farming. Promotion of precision farming along with drip irrigation, advocacy of integrated pest management practices may be followed to increase area, production and productivity of cotton crop. The productivity of cotton depends on the quality of seeds especially on genetic and physical purity, adoption of Integrated Nutrient Management, Integrated Pest Management practices and other post-harvest technologies. Hence emphasize is to be given on quality seed procurement and distribution of certified seeds, supply of bio control agents, distribution of micro nutrient mixture and training programs to the cotton growers in the usage of INM/IPM technologies. Precision farming and distribution of power sprayers, battery operated power sprayers and cotton picking machine are the action plans suggested.

With regard to industries depending cotton as raw material, among 3740 mills textile mills in India, 800 textile mills are in Tamil Nadu, of which 300 mills are in Coimbatore District. The spindle capacity of this organized sector is about 12.6 million. Apart from this, there are more than 700 small scale sector units which contribute not less than 2.0 million spindles. These sectors on an average consume 7 million bales of cotton. Hence, Tamil Nadu alone consumes about 45% of the national cotton production and import cotton from other states like Gujarat, Punjab, Maharashtra and Andhra Pradesh.

The following technological supports are proposed for doubling the cotton farmers' income.

1. High density planting system of compact hirsutum cotton varieties with a spacing of 75 x 10 cm for irrigated situation and 60 x 10 cm for rainfed situation.
2. Under rainfed conditions with marginal rainfall, high density planting of long lint Arboreum varieties with a spacing of 45 x 10 cm.
3. For increasing the productivity of Bt cotton hybrids under irrigated conditions, polymulching combined with fertigation may be followed.
4. Cultivation of identified Bt cotton varieties for Tamil Nadu under both irrigated as well as rainfed conditions either at recommended spacing or with a spacing of 75 x 10 cm for irrigated situation and 60 x 10 cm for rainfed situation under high density planting system for increasing the productivity of the cotton crop.
5. For reducing the cost of harvesting, the tractor drawn picking machine being developed by ICAR-CICR, Nagpur has to be demonstrated for technical feasibility and adoption.

### 6.1.6. Soil Health Management

Healthy soils are thus the foundation for profitable, productive, and environmentally sound agricultural systems. In an agricultural context, soil health, most often refers to the ability of the soil to sustain agricultural productivity. Soil health management, is the management practices that improve soil health by increasing productivity and profitability.

It has been observed that the average productivity of major crops in Tamil Nadu is only about 60 per cent of the potential yield. One of the reasons is due to decline in

organic matter content of the soil of the State which reduced from 1.20 % in 1971 to 0.68 % leading to low soil fertility. The availability of organic manures to farmers has become scanty and costly. The importance of FYM/Green manuring/Bio fertilizer application in improving organic matter status of the soil has to be educated to the farmers. The total production of bio-fertilizers has to be stepped up. Similarly, crop based micronutrient mixtures need to be promoted. Soil amendments viz., gypsum and lime has to be supplied to farmers as reclamation measure for the acid and alkali soils. Besides, earthworm cultures through vermicompost units can be supplied. It is proposed to provide inputs and conduct demonstrations covering 8000 ha.

### 6.1.7. Promoting Integrated Farming (IFS)

In Tamil Nadu, the small and marginal farmers, constituting about 83 per cent of total farmers, are cultivating nearly 56 per cent of land area. This unique situation coupled with weather aberrations and inadequate capital investment is limiting the farmers to raise their income levels. Besides, the increasing demand on agricultural lands for urbanization and industrialization makes the rural population to migrate to urban centers. In this context, advocating IFS to the farming community is the only solution to generate sustainable income and employment opportunity at farm level besides augmenting crop productivity.

The Integrated Farming System has the in-built potential of higher productivity and higher income, efficient utilization of all available farm produce, employment generation, insulation against income loss during adverse years and sustained income all through the year. This system could bring a change in the living standard of the rural population with the additional benefit on soil health productivity and production. Hence, it is proposed to popularize the IFS in different agro-climatic zones of Tamil Nadu viz. Cauvery Delta Zone, North Western, North Eastern, Western Zone and Southern Zone by recommending wetland, garden land and rain fed model respectively. The wetland model is suited to the districts of Thanjavur, Thiruvarur, Nagapattinam, Trichy, Cuddalore and parts of Karur, Ariyalur and Pudukkottai. The components of wetland model for one hectare land is as follows.

**Table 6.14. IFS – Wetland Model**

| Components | Amount (Rs.) |
|---|---|
| Field Crop (0.80 ha. seed material for field, Vegetable and fodder crops) | 15,000 |
| Fish pond (0.04 ha-Excavation of pond with 500 fingerlings) | 75,000 |
| Milch Cows | 80,000 |
| Poultry Birds (Layers/Birds) 50 No. | 5,000 |
| Establishment of Vermicompost unit (12'/4'/2') | 25,000 |
| **The total cost of establishing one unit** | **2,00,000** |

**Table 6.15. IFS – Garden land Model**

| Components | Amount (Rs.) |
|---|---|
| Field Crop (0.90 ha. seed material for field, Vegetable and fodder crops) | 15,000 |
| Milch Cows (2 No's) | 80,000 |
| Bio gas plant (2 $M^3$) | 25,000 |
| Desi Poultry Birds (Layers/Birds) 30 No. | 5,000 |
| Goat unit (10+1 No's) | 30,000 |
| Establishment of Vermicompost unit (12'/4'/2') | 25,000 |
| **The total cost of establishing one unit** | **1,80,000** |

The rain fed models are suited to southern districts and the components for one hectare area is listed below

**Table 6.16. IFS – Rain fed Model**

| Components | Amount (Rs.) |
|---|---|
| Field Crop (0.90 ha. seed material for field, fruit trees and fodder crops) | 10,000 |
| Goat unit (10+1 No's) | 30,000 |
| Desi Poultry Birds 30 No. | 5,000 |
| Establishment of Vermicompost unit (12'/4'/2') | 25,000 |
| Mobile Sprinkler (1 Unit) | 20,000 |
| Excavation of Farm pond (0.04 ha) | 20,000 |
| **The total cost of establishing one unit** | **1,10,000** |

It is proposed to conduct demonstrations on IFS in 5000 ha.

### 6.1.8. Capacity Building

Action plans to improve the capacities of farmers, in the form of trainings, demonstrations, exposure visits, etc. are proposed. Promotion of innovation in application of information communication technology in agriculture and dissemination of knowledge plays a critical role in knowledge-based growth of agriculture. Therefore, it is imperative to update the professional skills of farmers and extension specialists in the latest knowledge and techniques in the field of their specialization to bring about the desired qualitative improvement and necessary orientation to solutions for the contemporary problems.

Agricultural development depends on the simultaneous growth of farm-level production and productivity and the value chains to which it is linked. These value chains include a wide range of small and large-scale activities that involve supplying farm inputs, processing, storing, distributing, wholesaling, retailing and exporting farm products. These activities can be referred to collectively as 'agro-industry'. There is a need to look at both farm-level investment, as well as investment in agro-industries and action plans need to be focused on these avenues.

### 6.1.9. Infrastructure

In order to enhance the production and productivity of crops, the infrastructure facilities have to be strengthened sufficiently. Hence, more emphasis will be given for Integrated Agriculture Extension Centre (IAEC), Strengthening State Seed Farm (SSF), Creation of Pesticide Testing Laboratory (PTL), establishing bio-units, establishing extension service centres to offer training to extension personnel, exposure visit to extension personnel and farmer groups and conduct of Farmers' Mela periodically.

The vision of organic agriculture in India has necessitated to recognize the need to change in farming system approach and initiated program to promote organic farming in a big way. The Network Project on Organic Farming (NPOF) for promotion of organic farming and the National Program for Organic Production (NPOP) to provide institutional mechanism for implementation of National Standards for organic cultivation and accreditation of certification agencies and inspecting agencies would pave way for the production and distribution of quality and safe food and also help in protecting the environmental degradation owing to indiscriminate use of chemicals in crop cultivation.

The diverse climatic regions in Tamil Nadu favor cultivation of a wide range of crops under the "organic" system of cultivation. The major focus is to improve the soil

fertility and productivity by encouraging biological cycles within the farming systems by involving microorganisms, soil flora and fauna, plants and animals etc.

### 6.1.10. Rain fed Agriculture

Tamil Nadu has a total geographical area of 13 million hectares of which about 6 million hectares are cultivable. Dry land farming occupies a predominant place consisting nearly 56 per cent of net cultivated area. Dry farming supports more than 50 per cent of the population of Tamil Nadu. Further, year to year variations in total amount of rainfall and skewed distribution of rainy days in a year are the major constraints in improving the productivity of rain fed crops. Hence, ways and means to conserve soil mixture and the excess rainwater and utilize such excess water for increasing of agricultural production is crucial. Drought resistant and short duration varieties of pulses and groundnut are suggested for cultivation in this rain fed areas. Reviving rain fed farming by way of rejuvenating the water storage structures and adopting the rain water harvesting techniques are the action plans suggested. It is proposed to demonstrate such technologies in 4,500 ha with a financial support of Rs. 30,000/ha.

### 6.1.11. Transformational Modules for Agricultural Crops

**Rice**

In Tamil Nadu state, rice cultivation is wide spread. The crop is raised not only in wet land condition (canal and tank irrigated) in Cauvery Delta regions but also under garden land (well irrigated) in western zone and also under rainfed conditions (Ramanathapuram and Nagapattinam). Promising varieties like Co51 and TPS 5 and TKM 13 are the fine varieties which can be grown as short duration and medium duration in the above tracts. In some of the rice growing tracts, rice-fallow pulse crop can be also promoted. There is also a need to concentrate these regions with specific interventions like SRI, seed subsidy, Minikit, Mechanized transplanting, inter-cultivation and harvesting to raise the income of the rice cultivators.

**Millet Plus Ground Nut**

In certain locations viz. Tirunelveli, Villupuram and Virudhachalam district, the crop sequence millet and groundnut is gaining momentum. Large scope for extension of area under these two crops in the above tracts exist provided the interventions like soil enrichment, mechanized harvesting, post-harvest operation facilities particularly for ground nut are upscaled.

**Red Gram Plus Vegetables**

In Dharmapuri, Tiruvannamalai and Krishnagiri districts vegetable cultivation is sequenced with red gram (another major pulse crop demanded by consumer). Red gram seedling transplantation offers greater scope to reduce the cost of cultivation and also to achieve a higher yield. Similarly, in vegetable cultivation supply of protray seedlings and protected cultivation with the available water has to be promoted.

**New Initiatives**

Due to climate change and vagaries of monsoon, the agriculture is put under drought and distress management. Under these circumstances, the know how to manage such crisis need to be transformed to the farmers. This would minimize the loss. Few drought mitigation strategies like application of crop boosters, technology development in stomatal regulation and root pruning would help in managing the crisis in an effective way. As new initiatives, location specific FLD's and Technology Innovation trails have to be conducted to safeguard the interest of farmers and tide over the crisis.

### 6.2. Horticulture

#### 6.2.1. Banana

Banana and plantain are the important staple foods that are critical to the nutritious and economic well being of millions of people across the globe. The fruit is part of the daily diet to more than 400 million people around the world and is the fourth most important global food commodity after rice, wheat and milk, in terms of the gross value of production. It is believed that 1000 varieties of banana subdivided into 50 groups are cultivated in more than 150 countries with the production of about 105 million tonnes per year. Among various continents, Asia has the lion's share of 60% in global banana production of which India contributes to 48% of the total production in Asia from 39% of the total area.

At present India is the largest producer of banana in the world contributing 29.1% to the global production of banana with a total production of 29.7 million tons from an area of 0.80 million hectares. In India the banana is grown in the regions from the humid tropics to humid subtropics and semi arid tropics like Tamil Nadu, Maharashtra, Gujarat, Andhra Pradesh, Karnataka, Uttar Pradesh, Madhya Pradesh, Bihar, West Bengal, Assam and Odhisha. The national average productivity is 38.25 tonnes per hectare and a maximum of 66 ton/ha was recorded in Gujarat, Maharashtra (58.2t/ha) and Tamil Nadu

(47.9 t/ha) thanks to the adoption of high yielding Cavendish clones coupled with improved technologies like high density planting, fertigation and use of tissue cultured plants. The largest area under banana cultivation is in Tamil Nadu state followed by Maharashtra, Gujarat, Andra Pradesh and Karnataka. Although location specific varieties like Rasthali (Silk), Poovan (Mysore), Ney Poovan, Thella Chakkarakeli, Karpuravalli (Pisang Awak), Nendran (French Plantain), Hill Banana (Pome-AAB) and Monthan (Cooking banana) are grown in large quantity in different regions of the country, the Indian banana trade mainly depends on Cavendish clones which is called by different names (Basrai, Robusta, Harichal, Grand Naine, Shrimanthi, Bhusaval and Pedda Pacha Arati) in different regions. The Cavendish clones occupies 52% of the total area under banana cultivation and contributes 64% of the total banana production.

#### 6.2.1.1. Scenario of Banana Production and Marketing in Tamil Nadu

In Tamil Nadu, banana is the third important fruit crop and is grown all over the State. More than 20 varieties are commercially grown and the important commercial cultivars are Grand Naine, Poovan, Ney Poovan, Rasthali, Karpuravalli, Hill banana, Matti, Red Banana, Pacha Nadan, Monthan Nendran etc. Banana is mostly available in all seasons and in different varieties in the State. Thoothukudi, Tiruchirapalli, Coimbatore, Erode, Tirunelveli, Kanyakumari, Vellore and Thanjavur districts together accounted for 60.2 percent of the total area under banana during 2015-16. Total production of banana in the state of Tamil Nadu was 4.5 million tons from the land area of 1.03 Lakh ha. Thoothukudi is the leading banana producing district in the state with the production of 0.6 MT, contributing 13.80 percent with the land area of 0.09 lakh ha (9.30%) with the productivity of 64.85 MT per ha. Tiruchirapalli occupied second position in banana production with the production of 0.40 million tons in the land area of 0.08 lakh with the productivity of 55.15 MT per ha. It contributed 10.73 per cent of total banana production. Whereas, Theni occupied 3$^{rd}$position by producing 0.45 million tonnes with the highest productivity of 78.68 MT per ha. The district contributed 10.07 per cent of total state banana production.

The growth rates in Table 6.17 depicted that, fairly large number of districts had positive growth regarding area, production and productivity. Yet, few districts had negative growth, especially Tiruppur district which had shown the negative growth in area, production and productivity and Tirunelveliand Tiruppur districts had shown

negative growth both in production and productivity. In the case of area under banana, the negative growth was found in four districts namely Pudukottai, Thanjavur, Tiruppur and Trichy districts, though the remaining districts had shown the positive growth.

As the level of living of people is changing due to per capita income increase, the demand for protective foods like banana fruit is also increasing in the recent times.Hence, there is an urgent need to keep increasing the production of banana. The export potential also indicates importance of boosting banana production. The strategy, therefore, must keep increasing productivity and production of banana in the State to meet the growing domestic and export demand. There exist scopes for value addition also. The distribution of districts according to growth trends in area, production and productivity is exhibited in Table 6.17. Tiruppur district requires special attention.

**Table 6.17. Compound Growth Rate of Area, Production and Productivity of Banana**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Coimbatore | 3.18 | 5.22 | 1.46 |
| 2 | Cuddalore | 2.33 | 10.48 | 7.97 |
| 3 | Dindigul | 5.01 | 5.73 | 0.69 |
| 4 | Erode | 7.41 | 9.49 | 1.93 |
| 5 | Kancheepuram | 1.98 | 3.79 | 1.77 |
| 6 | Kanyakumari | 1.76 | 1.90 | 0.13 |
| 7 | Karur | 0.24 | 8.58 | 8.32 |
| 8 | Namakkal | 6.00 | 7.87 | 1.77 |
| 9 | Pudukkottai | -1.07 | 1.02 | 2.11 |
| 10 | Sivagangai | 4.65 | 6.51 | 1.78 |
| 11 | Thanjavur | -0.28 | 3.50 | 3.79 |
| 12 | The Nilgiris | 13.57 | 18.29 | 4.16 |
| 13 | Theni | 5.58 | 12.79 | 6.83 |
| 14 | Thiruvannamalai | 12.49 | 18.87 | 5.67 |
| 15 | Thoothukudi | 1.19 | 2.17 | 0.97 |
| 16 | Tirunelveli | 4.03 | -1.57 | -4.08 |
| 17 | Tiruppur | -8.84 | -8.12 | -3.62 |

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 18 | Thiruvallur | 4.30 | 4.78 | 0.46 |
| 19 | Trichy | -0.03 | 0.41 | 0.73 |
| 20 | Vellore | 10.58 | 11.59 | 0.91 |

Factors such as fertility of land, monsoon behaviour, rainfall, irrigation, application of fertilizers, climatic conditions, marketing facilities, prices, availability of agricultural laborers etc. determine the area and productivity of any crop. The banana cultivation once considered to be the profitable and the tool to enhance the farmers' income manifold become victim of monsoon failure, depleting natural resources and poor adaptation of sustainable agricultural technologies.

In Tamil Nadu, the total cost of cultivation is approximately Rs. 1.25 to 1.40 lakhs and the estimated gross income per hectare is from Rs. 1.60 to Rs. 1.75 lakhs. A farmer has to spend at least Rs. 100 on a plant till it attains the harvest stage. The marketing cost has been found to be higher due to commission charges, transport charges and loading and unloading charges. One of the study has suggested that measures need to be adopted to increase access of farmers to market information and they should be educated to sell their produce in the regulated markets which fetch higher returns as compared to village level marketing.

#### 6.2.1.2. Technological Gaps and Strategies

- Non-availability of good quality and virus free planting materials in spite of being the hub of banana activity
- Lack of awareness among the farmers on sustainable, market driven, improved production technologies such as fertigation, high density planting system, etc., and adoption of sustainable and energy efficient production system by following scientific and climate resilient farming practices.
- Non availability of suitable farm machinery and hence drudgery in farming operations
- Lack of high-through put post harvest management and handling practices and
- Non availability of suitable technology for waste utilization for the development of banana based enterprises.

The strategies to double the farmers' income are:

1. Disseminating the climate resilient, sustainable scientific agro-techniques with the integration of hi-tech plant and bunch care management along with the yield targeted nutrient dynamics and eco-system based resilient, sustainable pest and disease management solutions.
2. Enhancing business value of banana through utilization of ornamental, nutritional and therapeutic value bananas wealth of Tamil Nadu
3. Development of infrastructure for post harvest management practices, training modules for improved banana cultivation methods and post harvest handling which ultimately lead to sustainable bio-enterprise and skill development among clusters of banana growers
4. Developing the cost effective and sustainable export protocols through development of improved postharvest handling methods including smart packaging for export of fresh bananas.
5. Entrepreneurship development through value addition/ utilization of banana and banana waste like leaf, bracts, pseudo stem (fiber), rhizome, peel, central core etc.
6. To create cross functional convergence with development agencies, market linkages and assess the impact through technological incubation and cross cutting initiatives.
7. Low external Input Sustainable Agriculture approaches (LEISA); the production processes depend on less external inputs – manures, plant protection measures which would lead to better net incomes
8. Village knowledge centre digital dream, attracting and retaining youth in agriculture, market stabilization fund, national risk fund, direct transfer of fund and procedure to link Indian system to international system.
9. Establishment of supply chain management systems which includes warehouses, cold storage facilities
10. Implementation of watershed/water harvesting systems and adoption of PPP model in canals management for the sustainable irrigation of banana
11. Promotion of cooperative farming for the adoption of Prime Minister Fasal Bima Yojana for getting insurance cover against natural calamities.

### 6.2.1.3. Technological interventions to be followed for maximizing the profit with sustainability

| Details of the technological intervention | Benefits |
|---|---|
| **Varietal techniques** | |
| Rapid method of multiplication of true to type plantlets of a variety of choice, superior selections and new hybrids using macro propagation techniques for traditional varieties | Large quantity of true to type planting materials within short span of time can be achieved i.e. this technique can produce 50 – 60 plantlets within 4 – 5 months as against 6 – 10 suckers by a mother plant. It is good alternative to conventional and tissue culture technology |
| Cost-effective tissue culture protocols using Reverse osmosis water and table sugar as the low-cost water and carbon sources and Sago or Isabgol in combination with agar as the low-cost gelling agents. | Reduction of medium cost by 46-60% which will pave way for the tissue culture banana accessible to small and marginal farmers |
| **Agro-techniques** | |
| High density planting system with three suckers/hill" (4,600 plants/ha) with a spacing of 1.8m X 3.6m and with 75% N and K fertigation | 40% yield increase. Useful under fertigation, which reduces the number of laterals, water and fertilizer quantity. |
| Fertilizer tailoring (based on initial soil test values) based on STCR approach for targeted yield. | About 50% of the input cost particularly inorganic fertilizers cost can be minimized and the cost of cultivation can be reduced to Rs.62,500 from Rs.1,25,000 per ha.<br>It sustains the soil health and reduces the soil and water pollution |
| De-naveling of male bud and pre-harvest spraying of bunches with 2.0% Potassium sulphate solution (20g /liter of water) first immediately after the emergence of the last hand followed by a second spray 30 days later and covering the bunches with 100 gauge thick nonwoven polypropylene bags | This enhances the bunch grade, fruit quality and advances the fruit maturity by 5-7 days and fetches better price in the market. Yield increase by 10 to 15%.<br>By adopting this practice, the bunch weight will be more (upto 1.5 kg) than non-sprayed bunches**.** Besides the fruits may give good glossy appearance to fetch good market price. Also alleviates the potassium shortage during bunch development stage. |
| Adoption of Drip irrigation and fertigation schedule | 25% saving of fertilizer and 30% saving of water requirements and increase in yield by 30%. |
| Foliar spray of banana with Banana Shakti, micro nutrient mixture (2 %) at 3rd, 5th and 7th month after planting | Yield increase by 20 to 30% and profit increase by 1,25,000 to 1,87,500 per/ha |

| Details of the technological intervention | Benefits |
|---|---|
| Soil application with Cement Kiln Flue Dust (@ 1.25t per ha) and Distillery Effluents (@ 75kL per ha) as potassium sources in banana cultivation. | The cost of commercial MoP used can be reduced by 40% and thus about Rs.12,000/- per ha can be saved. |
| Regular irrigation to maintain optimum soil moisture (80-90% of available soil moisture) at 5 to 6$^{th}$ months after planting, which coincides with floral primordial initiation & development and flowering to first one month after flowering. | Adopting this practice may get normal bunch emergence and fruit development and provide normal profit in a water limited environment where banana is grown. |
| **Soil health improvement** | |
| Growing of sun hemp and in situ ploughing before planting | It adds organic manure and improves the soil health |
| Recycling of banana wastes after the harvest of bunches into vermicompost | It saves 78% of Nitrogen, 69% of $P_2O_5$ and 62% $K_2O$ required for the optimum production of banana besides it improves the soil health by enrichment of soil with organic carbon<br>It also improves the physic-chemical-biological properties of the soil |
| Intercropping with onion, beetroot, coriander, cauliflower, cabbage, French bean etc | Gives an additional income of Rs. 40,000 to 70,000/- per acre. Besides it reduces the soil *Fusarium* population (onion). |
| Crop rotation with onion, coriander, vegetables, maize | Improvement of soil health and reduction of pest and disease problems in banana cultivation. |
| **Plant protection** | |
| Paring and pralinage of the Sucker using systemic insecticide (Triazophos 2.5 ml/litre) and Carbendazim solution (1g/litre) for 30 minutes. | To kill the plant parasitic nematodes, corm weevil grub and aphids and also *Fusarium* pathogen, which are serious problem in Theni area. |
| Installation of longitudinal split banana stem traps @ 10/ac smeared with entomopathogenic fungi, *Beauveria bassiana* ( 3ml in 100 ml water) 15 ml per trap to control the banana weevils | For monitoring and management of corm and stem weevil in banana |
| Stem injection of systemic insecticide (Triazophos 2.5 ml/litre) using a disposable syringe to release 2ml at 2 ‘ from base and one more injection at 4’ from the base on the opposite side of the plant. | Prophylactic control method to prevent the infestation and also to prevent the spread of weevils as a post-harvest management |

| Details of the technological intervention | Benefits |
|---|---|
| Covering the emerging bunch at shooting stage with polypropylene bunch sleeve Soil application of *B.bassiana* /*Lecanicillium lecanii* (1 x 10 9 CFU /ml) at the rate of 100 ml per plant during last week of September to kill the grub and pupal stages. | Bunch sleeving after opening of all hands will not yield good result.<br>Blemishes free fingers due to rust thrips and banana scarring beetle |
| Soil drenching of Carbendazim 0.1% @ 2-3 litres/plant around the plant in the soil for three times (at the time of planting, 2nd month and 4th month after planting) and giving injection of 3 ml of Carbendazim 0.1% solution at 3rd 5th and 7th month after planting. | For the effective management of the *Fusarium* wilt disease |
| Bio-priming of banana plants with rice chaffy grain formulation of combination of endophytic *Penicillium pinophilum* Bc2 + rhizospheric *Trichoderma* sp NRCB3@ 100g of rice chaffy grain formulation for three times (at the time of planting + 2nd month + 4th month after planting) in the soil | Complete suppression of *Fusarium* wilt disease in cv. Grand Naine under field condition<br>Increased the plant growth and yield characters particularly bunch weight (170.5%) significantly with 100% harvest of good bunches compared to only 35% harvest in the control plants |
| Jaggery based liquid formulation of *T. harzianum* + *B. cereus* @ 2 litres/plant for 3 times (at the time of planting, 2nd and 4th month after planting) | |
| Drenching the banana plants with Zimmu leaf extract (50%conc) @ 1 litre/plant | |
| Foliar spray of the combined application of talc powder based formulation of *Penicillium* sp. (12DF) + *Emericella nidulans* (9DF) for five times at 25 days interval starting from 5th months after planting | 84.3% reduction in disease severity and 26.0% increase in the number of green leaves as compared to control plants<br>Maximum increase in the yield parameters such as number of fingers (up to 21.4%), number of hands (up to 30.2%) and bunch weight (up to 30.4%) |
| Spray schedule using Paraffinic oil 1% + fungicides viz. Propiconazole 0.1% or Companion 0.1% or Carbendazim 0.1 % or Nativo ((Trifloxystrobinn+ tebuconazole)1.4 g / litrein banana 5-7 times at 25-30 days interval | For the effective control of Eumusae leaf spot disease of banana |

| Details of the technological intervention | Benefits |
|---|---|
| Banana hands of (46, 48, 50 calliper) treated with *T. asperellem* ($10^8$ cells/ml), and packed without ethylene absorbent or Zimmuleaf extract (50%) and PC1 (0.1%). | Completely inhibited the emergence of postharvest diseases and extended the shelf life of banana up to 75 days |
| Virus indexing technology package/ Virus management with 25% higher than recommended dose of application of fertilizers | Quality planting material devoid of viral pathogens/ the loss due to virus disease is compensated. Famers who use certified planting material will get nearly 10-15% additional income |
| **Post harvest management** | |
| Pre & postharvest bunch handling practices includes bunch skirting, use of separation pads, retention of optimum number of hands, keeping the last finger, removing the flower remnants, harvesting at right maturity. Adoption of pre-cooling practices, hand removal, dipping in fungicidal solutions, use of right packaging methods, CFB boxes with proper ventilation and use of better cold chain management practices | Higher price realization<br>Better shelf life with proper market supply and avoiding market glut |
| **Processing & waste utilization** | |
| Utilization of market glut banana fruits for making banana puree, banana fig, jam, Jelly, Bar, clarified Juices, RTS, Squash, sip-up etc | Better price realization for the banana |
| Use of cooking/ raw banana for making baby food, health powders, cookies, extruded snacks, nutrient rich foods etc | Use of banana as supplementary source for various health benefits |
| Use of banana wastes like peel, flower and central core for making processed products like flower pickle, peel pickle, central core juice, candies, ice-cream mix, soup powders, healthy foods, minimal processing of central core stem | Secondary agriculture by utilization of banana wastes and additional income of approx. Rs. 50000/ acre |
| Utilization of banana pseudostem, peduncle for making banana fibres and use of secature waste for making vermi-compost<br>Utilization of banana waste as animal feed | Better waste utilization of 25-30 tons of Pseudostem per ha.<br>Climate resilient eco-friendly usage<br>Renewable energy sources<br>Additional income of Rs 75,000/ac |

| Details of the technological intervention | Benefits |
|---|---|
| **Use of machinery and avoiding farm drudgery** | |
| Developing paring and prolinage devises, staking and wind reflectors, mechanized harvesting and rope way conveyor transportation, pseudostem shredders, slicers, minimal processing units etc. | Reduction in postharvest losses<br>Good quality export grade banana<br>Increased energy efficiency |

**Action plan for the implementation of the technologies from 2017-18 to 2021-22**

| Year | Technology to be implemented | Method of implementation |
|---|---|---|
| **2017-18** | Collection and analysis of soil samples for macro and micro nutrients. Technologies related to improvement of soil health | Issuing soil health card - Dept of Agriculture/ Horticulture |
| | High density planting, macro propgation, adoption of fertigation schedule, site specific nutrient management for targeted yield, Good Agricultural practices such as proper intercultural operations, denavelling of male buds, bunch spray, foliar spray of micronutrients | Front line demonstration/ Method demonstration/ Training- ICAR-NRCB, HC&RI & Dept of Agriculture/ Horticulture |
| **2018-19** | Tissue culture protocols for rapid & cost effective multiplication of virus free quality banana plants | Transfer of technology to tissue culture industries by ICAR-NRCB |
| | Mass production of Foc & weevil effective bio-agents | Supply to the farmers by Dept of Agriculture/ Horticulture/ KVK |
| | Integrated pest & disease management practices | Training to the farmers by line departments |
| | Recycling of waste by making vermicompost | Training and demonstration by Dept of Horticulture in collaboration with ICAR-NRCB |
| | Utilization of market glut for making various value added products from raw & ripe banana<br>Use of banana wastes like peel, flower and central core for making processed products like flower pickle, peel pickle, central core juice, candies, ice-cream mix, soup powders, healthy foods, | Training and demonstration by Dept. of Horticulture in collaboration with ICAR-NRCB<br>Exposure visit to industries |

| Year | Technology to be implemented | Method of implementation |
|---|---|---|
| | minimal processing of central core stem<br>Utilization of banana waste as animal feed | |
| **2019-20** | Developing paring and pralinage devises, staking and wind reflectors, mechanized harvesting and rope way conveyor transportation, pseudostem shredders, slicers, minimal processing units etc. | Designing, production, evaluation & validation of machineries by TNAU, NRCB & CIAE<br>ToT to state departments & progressive entrepreneurs |
| **2020-21** | Developing paring and pralinage devises, staking and wind reflectors, mechanized harvesting and rope way conveyor transportation, pseudostem shredders, slicers, minimal processing units etc. | Designing, production, evaluation & validation of machineries by TNAU, ICAR-NRCB & ICAR-CIAE, RC.<br>ToT to state departments & progressive entrepreneurs |
| **2021-22** | Pre and post harvest bunch handling practices and adoption of export protocol. | Training and demonstration<br>Exposure visits to industries involved in export of banana |

**Policy interventions to be enacted and implemented**

- Commodity based cluster formation or cooperative farming for procurement of all the inputs on collective basis, better implementation of the technologies, credit approval, better price realization
- Creation and establishment of water sheds, micro-catchments, rain water harvesting and run off management at farm level
- Establishment of mass production of bio-agents units
- Establishment of quarantine units (in Theni district)
- Establishment of operational size ware houses, cold storage, & ripening facilities
- Development of better infrastructure with the emphasis on sea port facilities for export of banana
- Development of exclusive railway transport system connecting different banana growing regions
- Establishment of processing and value addition units to avoid losses during glut

- Special emphasis for the promotion of banana leaf and fibre` based industries including paper boards, bio-fuels, briquettes
- Subsidies and Tax holidays for encouraging the export of banana
- Allocation of less fund from the marketing of banana for carrying out result oriented problems
- Giving subsidy for digging well or bore well.
- Giving either free EB power or Solar power
- Supply of fertilizers and pesticides at subsidized rates and assure a good market for banana.
- Development of agricultural based industries and additional employment opportunities to the rural farming community so as to improve their earning capacity
- Distribution of conventional machineries / equipments such as power tiller, rotavator, cultivator and disc plough and other newly developed agricultural machineries/ implements to the farmers at subsidized rates
- Creation of improvised Uzhavar Santhai (for realising the profit), post harvest management, cold storage facilities, food processing, establishment of export zones, terminal markets to improve the marketing opportunities for agricultural produce.

**6.2.1.4. Transformational Module**

The action plan for increasing the income of the banana farmers is indicated by suggesting three location specific modules. The locations broadly cover three districts viz. Theni, Tiruchirapalli and Tirunelveli (**Annexure I)**

Theni district is considered as a hub for banana production and plays a major role in domestic and international market. In this district, banana is grown in large areas (Chinnamanur, Cumbum, Periyakulam, Bodinayakkanur, Uttamapalayam and Theni) with hi-tech cultivation practices like tissue culture, drip irrigation, intercropping, fertigation, post-harvest management practices. However, because of exploitation of soil and mismanagement of nutrients, indiscriminate use of pesticides, there is a enormous

problems of pest of disease incidences like Fusarium wilt, stem borers, corm weevil, nematodes and pre harvest diseases like Cigar end rot leading to sever yield loss and thus profit loss to the farmers and shifting to cultivation of other less profitable crops. Therefore, technological intervention for profitable cultivation of banana and thus increasing the income of the farmers is the need of the hour in this District.

The dominant soil types are red loam, lateritic soil, black soil, sandy coastal alluvium, red sandy soil and other soils including forests soils. Of the different types of soils, the red loam soil is predominant and it accounts for nearly 51 per cent of the total soils in the district. The different types of soils are favourable for growing diversified crops across the district. The annual average rainfall is around 950 mm and the major rainy season is North East monsoon period during which 50 per cent of total rain has been received in all the blocks except Cumbum which receives rainfall equally during south west monsoon, north east monsoon and winter season. The district receives about 20 per cent of its annual rainfall during hot weather period.

Theni district is endowed with agro-climatic conditions conducive for growing a wide range of horticulture corps such as fruits, vegetables, spices, plantation crops, flowers, medicinal and aromatic plants. The important horticultural crops like banana, grapes, mango, and coconut are grown predominantly under irrigation. The vegetable crops like tomato, brinjal, onion etc are also grown in the district. Thus, horticulture development in the district is crucial.

Tiruchirapalli district is situated in the Cauvery Delta Agro climatic zone. The River Cauvery irrigates about 51,000 ha in Trichy, Lalgudi and Musiri Divisions. The normal annual rainfall is 842.60 mm. Multi various crops are grown in this District and Agriculture is the main occupation for most of the people in the District. Alluvial sandy loam and loam soil constitutes major portion of the central regions, which form the Cauvery delta in the district. In Lalgudi, Manachanallur and Andanallur blocks, loamy soil is predominant. Red soil and black soil are predominant in the dry tracks of the district. Major horticulture crops cultivated in this district are fruits crops like mango, banana, guava and acid lime, vegetables like tomato, onion, brinjal, and tapioca, spices like chillies, coriander, tamarind and turmeric, plantation crops like betel vine and flower crops like jasmine, marigold, crossandra and rose. The total area under banana cultivation is 11000 ha and the total production is 32.34 lakh tonnes. More than 10

different varieties esp., Nendran, Karpuravalli, PachaNadan, Poovan, Ney poovan, Monthan, Rasthali etc are being grown in different parts of the district. Among these, the varieties like Ney Poovan, Karpuravalli, Nendran can be exploited for the distant and export market. However, the problems are enormous which are identified asi) widening the scope of the crop insurance project to more than 30,000 acres of banana cultivation which is found in Thottiyam, Musiri, Mannachanallur, Lalgudi, Srirangam, and Thiruverumbur blocks of Trichy district ii) Water resource availability iii) non availability of disease free suckers/quality TC plants iv) high input cost especially fertilizers and pesticides vi) no awareness on the advanced techniques of cultivation of banana and crop diversification v) problem of lodging of banana plants due to wind damage vi) small holdings of the farm

Tirunelveli district is predominantly an agricultural district is situated in the Southern Agro climatic zone.Minimum temperature prevailing is 18°C and maximum temperature is 40°C. The major soil types in this district are Loamy and clayey. Tirunelveli has fertile soils only in scattered regions. Less fertile red soils are found distributed in most of the region. Most of the blocks in Tirunelveli district are having red loamy and black soils. Tirunelveli district is provided with varied agro climatic conditions ranging from extreme tropical to subtropical. Areas adjacent to Western Ghats like Tenkasi and Shenkottai taluks are enjoying subtropical climate which is conducive for cultivation of most of the spices, sub tropical fruits, plantation crops. Thamiraparani River fed areas and adjoining plains are provided with assured irrigation facilities where banana cultivation is predominant. Major horticulture crops cultivated in this district are fruits crops like mango, banana, lime and *aonla*, vegetables like bhendi, tomato, brinjal, onion, spices and condiments like chillies and tamarind and flower crops like jasmine and rose.

The district has huge potential for exploiting export banana market through therapeutic bananas like Matti, Peyan and Nendran for chips etc. The problem identified are i) fragmented land holdings ii) non availability of good quality planting materials iii) availability of labour for agriculture due to migration to industries and iv) high cost of the labour and increase in input cost v) poor mechanizationvi) increased input costvii) poor credit availability viii) non -remunerative returns while disposing the harvested produce ix) scarcity of water for irrigation x) crop destruction by rampaging wildlife and gale-force winds xi) very low application of technical know-how at field level xii) 15-20% loss of produce and value due to poor handling of horticulture produce starting from harvest to

consumers xiii) total damage to soil health and environment due to indiscriminate use of chemical fertilizers and plant protection chemicals

### 6.2.2. Mango

Mango is an important fruit crop grown in 18 districts of the State.The average area and production of mango were 13.12 lakh ha and 7.27 lakh tonnes respectively with average productivity of 5,523 kg/ha. Perusal of the Table 6.18 indicates that Coimbatore, Dharmapuri, Kanyakumari, Krishnagiri and Thanjavur districts witnessed negative growth in area and in the remaining 13 districts, the growth rate of area under mango was positive. Similarly, Coimbatore, Dharmapuri, Theni, Thiruvallur and Virudhunagar district had negative growth in production. The productivity trend was negative in six districts namely Coimbatore, Madurai, Sivagangai, Theni, Tirunelveli, Thiruvallur and Virudhunagar. In all the other districts, positive trend could be observed. In all these districts, Coimbatore showed the negative growth in area, production and productivity. In sum, the development of mango crop in Tamil Nadu requires planning to increase area, production and productivity as this crop has got export market as well.

**Table 6.18. Compound Growth Rate of Area, Production and Productivity of Mango**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Coimbatore | -3.77 | -7.52 | -4.57 |
| 2 | Dharmapuri | -9.23 | -7.93 | 1.43 |
| 3 | Dindigul | 2.18 | 17.24 | 14.74 |
| 4 | Kancheepuram | 3.75 | 5.05 | 1.25 |
| 5 | Kanyakumari | -2.03 | 3.66 | 5.81 |
| 6 | Krishnagiri | -0.59 | 2.11 | 2.71 |
| 7 | Madurai | 2.78 | 0.61 | -2.11 |
| 8 | Nagapattinam | 11.93 | 13.44 | 1.35 |
| 9 | Namakkal | 6.07 | 7.50 | 1.35 |
| 10 | Salem | 4.65 | 5.18 | 0.51 |
| 11 | Sivagangai | 5.99 | 3.76 | -2.10 |
| 12 | Thanjavur | -0.13 | 1.22 | 1.35 |
| 13 | Theni | 1.91 | -3.09 | -4.91 |

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 14 | Tirunelveli | 4.84 | 1.42 | -3.20 |
| 15 | Thiruvallur | 4.11 | -6.53 | -10.22 |
| 16 | Vellore | 0.22 | 2.23 | 2.01 |
| 17 | Villupuram | 8.06 | 9.13 | 0.99 |
| 18 | Virudhunagar | 7.56 | -4.69 | -11.39 |

### 6.2.3. Grapes

Grapes is yet another important horticulture crop, grow only inTheni district in the State. In Tamil Nadu, average area under grapes was 2,545 ha with average production of 56,428 tonnes and average productivity of 22,069 kg/ha in the year 2006-07 to 2010-11. The area and production performance had shown positive growth and productivity of grapes had shown negative trend. Therefore, strategy planning must aim at increasing growth trend in productivity of grapes through research and development and capacity building of grape growers. The compound growth rate of grapes crop in Theni district of Tamil Nadu during 2000-01 to 2014-15 is presented in Table 6.19.

**Table 6.19. Compound Growth Rate of Area, Production and Productivity of Grapes**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Theni | 3.60 | 0.75 | -2.76 |

### 6.2.4. Chillies

Chillies is an important spice crop in horticulture sector grown in five districts in the State. The average area and average production of chillies was 61,268 ha and 32,529 tonnes respectively. The average productivity of chilli was about 528 kg/ha. The rainfed chillies grown in Pudur / Vilathikulam areas of Thoothukudi district is very popular. The Sattur samba of Virudhunagar district and Paramakudi gundu Chilli of Ramanathapuram district are also popular in southern districts. Perusal of Table 6.20 exhibits the fact that Sivagangai district alone witnessed positive growth in area, production and productivity whereas Thoothukudi district had negative growth in area, production and productivity. Hence Thoothukudi district requires special attention of chill crop. The growth trend in area was positive in Sivagangai and Ramanathapuram districts,

negative in Ariyalur, Thoothukudi and Virudhunagar districts. The negative trend in production was found in Ariyalur, Ramanathapuram, Thoothukudi and Virudhunagar districts. In the case of productivity, the positive growth was seen in Ariyalur, Sivagangai and Virudhunagar districts and negative growth in Ramanathapuram and Thoothukudi districts. The development of chilli crop in Tamil Nadu requires appropriate interventions to increase productivity. The compound growth rate of chilli crop in major districts of Tamil Nadu during 2000-01 to 2014-15 is presented in Table 6.20.

**Table 6.20. Compound Growth Rate of Area, Production and Productivity of Chilli Crop**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Ariyalur | -25.66 | -8.50 | 38.17 |
| 2 | Ramanathapuram | 1.87 | -11.65 | -13.27 |
| 3 | Sivagangai | 2.14 | 12.78 | 10.41 |
| 4 | Thoothukudi | -6.85 | -11.15 | -4.61 |
| 5 | Virudhunagar | -7.38 | -3.33 | 4.37 |

### 6.2.5. Tomato

In Tamil Nadu, the average area under tomato crop was 22,794 ha with an average production of 2.97 lakh tonnes and average productivity was 13,054 kg/ha and mostly cultivated in five districts of the State. With reference to area, Krishnagiri district experienced positive growth, while Coimbatore, Dindigul, Salem and Theni districts have shown negative trend. The production witnessed uptrend in Dindigul and Krishnagiri districts and downtrend in Coimbatore, Salem and Theni districts. Similarly, in productivity, Coimbatore, Dindigul, Krishnagiri and Salem districts witnessed positive growth and Theni had negative trend. Theni district experienced negative growth rates in area, production and productivity. Hence, Theni district requires special efforts to boost production of tomato. The compound growth rate of tomato crop in major districts of Tamil Nadu during 2000-01 to 2014-15 is presented in Table 6.21.

**Table. 6.21. Compound Growth Rate of Area, Production and Productivity of tomato Crop**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Coimbatore | -6.96 | -4.74 | 1.86 |
| 2 | Dindigul | -2.58 | 4.92 | 7.70 |
| 3 | Krishnagiri | 8.51 | 7.57 | 1.99 |
| 4 | Salem | -4.05 | -3.91 | 0.15 |
| 5 | Theni | -2.66 | -4.90 | -2.30 |

### 6.2.6. Tapioca

During the 11th five year plan period, the average area under Tapioca crop in the State was 1.28 lakh ha with production of 48.10 lakh tonnes and productivity of 37,190 kg/ha grown in 14 districts in the State. The performance of the crop with respect to growth rates (Table 6.22) shows that the growth rate of area was positive in eight districts. Similarly, the production and productivity was positive in seven districts. Negative trend in area was found in Cuddalore, Kanyakumari, Perambalur, Salem, Tirunelveli, and Thiruvallur districts. In the same way, the growth rate in production was negative in Cuddalore, Kanyakumari, Perambalur, Salem, Nilgiris, Tirunelveli and Thiruvallur districts. The area, production and productivity of tapioca were found to be negative in Cuddalore, Perambalur, Tirunelveli and Thiruvallur districts. This indicates that measures have to be taken as development strategy for tapioca to increase the productivity in these districts. The compound growth rate of tapioca crop in major districts of Tamil Nadu during 2000-01 to 2014-15 is presented in Table 6.22.

**Table 6.22. Compound Growth Rate of Area, Production and Productivity of Tapioca Crop**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Cuddalore | -4.38 | -5.79 | -1.48 |
| 2 | Dharmapuri | 5.69 | 6.55 | 0.81 |
| 3 | Erode | 5.59 | 8.03 | 2.31 |
| 4 | Kanyakumari | -7.24 | -4.28 | 3.19 |
| 5 | Karur | 18.71 | 19.36 | 0.55 |
| 6 | Namakkal | 4.88 | 0.63 | -4.05 |
| 7 | Perambalur | -6.71 | -8.70 | -2.14 |
| 8 | Salem | -1.21 | -0.05 | 1.17 |
| 9 | The Nilgiris | 4.30 | -3.33 | -0.46 |
| 10 | Thiruvannamalai | 23.32 | 24.39 | 0.87 |
| 11 | Tirunelveli | -0.04 | -0.51 | -0.46 |
| 12 | Thiruvallur | -3.49 | -3.94 | -0.46 |
| 13 | Trichy | 1.45 | 2.99 | 1.52 |
| 14 | Villupuram | 4.72 | 2.70 | -1.93 |

### 6.2.7. Cashew Nut

The average area under Cashew nut was one lakh ha with a production of 50,034 tonnes and productivity of 500 kg/ha covering five districts in Tamil Nadu. The growth trend of area was positive in Cuddalore and Tirunelveli districts and negative trend was seen in Kanyakumari, Sivagangai and Vellore districts. The production was positive only in Kanyakumari district and negative trend was found in the remaining four districts. In the same way, positive growth of productivity was noticed in Kanyakumari and Vellore districts and negative trend was seen in Cuddalore, Sivagangai and Tirunelveli districts. In Sivagangai district, area, production and productivity of cashew nut was negative. Therefore, the development strategy must focus on increasing the area and productivity of the crop so as to keep increasing production in Sivagangai district. The compound growth rate of cashew nut crop in major districts of Tamil Nadu during 2000-01 to 2014-15 is presented in Table 6.23.

**Table 6.23. Compound Growth Rate of Area, Production and Productivity of Cashew nut**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Cuddalore | 1.23 | -3.36 | -4.54 |
| 2 | Kanyakumari | -2.79 | 1.40 | 4.31 |
| 3 | Sivagangai | -1.72 | -4.91 | -3.25 |
| 4 | Tirunelveli | 1.48 | -5.08 | -6.45 |
| 5 | Vellore | -6.07 | -4.53 | 1.47 |

### 6.2.8. Onion

Onion is the important vegetable crop, grown in six districts namely Dindigul, Erode, Namakkal, Perambalur, Salem and Tiruppur districts. In Tamil Nadu, the average area under onion was 31,592 ha with production of 3.02 lakh tonnes and productivity was 9,834 kg/ha. The growth rates presented in Table 6.24 depict that an uptrend in area was noticed in Perambalur and Tiruppur districts and downtrend was seen in Dindigul, Erode, Namakkal and Salem districts. The positive trend of production and productivity was found in Dindigul, Erode, Perambalur and Tiruppur districts. The negative trend of production was found in Namakkal and Salem districts. Likewise, a negative growth of productivity was seen in Perambalur district. Hence, Tamil Nadu State needs development strategy to boost production of onion.

**Table 6.24. Compound Growth Rate of Area, Production and Productivity of Onion Crop**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Dindigul | -1.22 | 0.24 | 1.47 |
| 2 | Erode | -2.63 | 0.08 | 2.79 |
| 3 | Namakkal | -3.67 | -0.73 | 3.05 |
| 4 | Perambalur | 6.63 | 5.10 | -1.43 |
| 5 | Salem | -5.29 | -1.50 | 4.00 |
| 6 | Tiruppur | 7.08 | 56.36 | 44.48 |

### 6.2.9. Turmeric

The average area under Turmeric in Tamil Nadu was 34,500 ha with a production of 18.81 lakh tonnes and the productivity achieved was 5,466 kg/ha. It was grown in six districts during the study period. In Turmeric, a positive trend in area, production and productivity was observed in Dharmapuri, Erode, Namakkal, Perambalur and Thiruvannamalai districts. A decline in growth rate of area under turmeric was noticed in Coimbatore district only. The compound growth rate of turmeric crop in major districts of Tamil Nadu is presented in Table 6.25.

**Table 6.25. Compound Growth Rate of Area, Production and Productivity of Turmeric**

**(Per cent per annum)**

| S.No. | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|
| | | Area | Production | Productivity |
| 1 | Coimbatore | -4.61 | 1.62 | 5.26 |
| 2 | Dharmapuri | 17.39 | 23.56 | 5.25 |
| 3 | Erode | 2.61 | 3.58 | 0.95 |
| 4 | Namakkal | 6.67 | 9.30 | 2.47 |
| 5 | Perambalur | 17.05 | 19.71 | 2.27 |
| 6 | Thiruvannamalai | 11.28 | 13.71 | 2.18 |

### 6.2.10. Other Horticultural Crops

The growth performance of other minor horticultural crops like guava, bhendi, brinjal, cabbage, potato, beetroot, carrot, etc. is outlined in this section.

With respect to guava, in Dindigul and Sivagangai districts, an upward trend of production and productivity and downward trend of area was observed. In Salem district, with regard to bhendi crop, a positive growth of area, production and productivity was found but in case of brinjal, it was reversible, as negative growth was seen in area, production and productivity. In the Nilgiris district, a positive trend of area was seen in cabbage, tuber crops (potato, beetroot, carrot), spices and condiments (ginger, cardamom, pepper) and plantation crops (coffee, tea). The negative growth of production as well as productivity was observed in cabbage, ginger and pepper crops in the Nilgiris district. In Kanyakumari district, an upward positive trend in area was observed for rubber crop. In Dindigul district, a major tobacco growing area in the State, a negative growth of area and production but a positive growth of productivity was seen.

The compound growth rate of these horticultural crops in major growing districts of Tamil Nadu during 2000-01 to 2014-15 is presented in Table 6.26.

**Table 6.26. Compound Growth Rate of Area, Production and Productivity of other Horticultural Crops**

**(Per cent per annum)**

| S.No. | Crop | District | CGR (2000-01 to 2014-15) | | |
|---|---|---|---|---|---|
| | | | Area | Production | Productivity |
| **Fruit Crops** | | | | | |
| 1 | Guava | Dindigul | -3.64 | 4.88 | 8.85 |
| | | Sivagangai | -3.90 | 1.23 | 5.34 |
| **Vegetable Crops** | | | | | |
| 2 | Bhendi | Salem | 0.42 | 1.21 | 0.79 |
| | | Vellore | 6.23 | 6.47 | 0.23 |
| | | Dharmapuri | 7.69 | 2.45 | 2.56 |
| 3 | Brinjal | Salem | -0.92 | -3.79 | -2.90 |
| | | Krishnagiri | 7.39 | 1.70 | -5.30 |
| | | **Vellore** | **-0.89** | **-3.92** | **4.23** |
| | | Dindigul | -1.73 | 5.23 | 6.59 |
| | | **Dharmapuri** | **-0.33** | **1.22** | **-2.72** |
| 4 | Cabbage | The Nilgiris | 3.36 | -0.70 | -3.93 |
| **Tuber Crops** | | | | | |
| 5 | Potato | Dindigul | -0.07 | 2.23 | 2.43 |
| | | The Nilgiris | **8.34** | **-3.35** | **1.91** |
| 6 | Beet root | The Nilgiris | 10.91 | NA | NA |
| 7 | Carrot | The Nilgiris | 22.10 | NA | NA |
| **Spices & Condiments** | | | | | |
| 8 | Ginger | The Nilgiris | 3.61 | -1.04 | -3.77 |
| 9 | Cardamom | The Nilgiris | 7.58 | -4.74 | 0.00 |
| 10 | Pepper | The Nilgiris | 7.01 | -7.57 | -0.99 |
| **Plantation Crops** | | | | | |
| 11 | Coffee | The Nilgiris | 15.35 | NA | NA |
| 12 | Tea | The Nilgiris | 21.24 | NA | NA |
| 13 | Rubber | Kanyakumari | 2.80 | NA | NA |
| **Narcotics** | | | | | |
| 14 | Tobacco | Dindigul | -3.46 | -1.64 | 0.13 |

Therefore, in the context of increasing population, urbanization and a favorable shift in the consumption of fruits and vegetables, there in a need to cover larger area under horticultural crops. Horticulture crops are grown in 14.50 lakh hectares, of which vegetables, spices, plantation crops, flowers and medicinal plants are the major crops cultivated in the State. Totally, 86 horticultural crops are grown in the State which clearly indicate wider crop choice and its diversity and also the possibility of augmenting the income of farmers. The action plans suggested are as follows:

To increase the income of the farmers, more support for establishment of pandals, trellies, staking and propping, poly green houses, (tubular structure) is proposed. Vegetables like bitter gourd, snake gourd, ribbed gourd, *pandal avarai*, pole beans, tomato, gherkin, cucumber, squash and in fruits, grapes, musk melons and in spices, pepper could be cultivated under pandal cultivation. Similarly, crops like peas, musk melon, pole beans, tomatoes, ivy gourd could be raised in trellies. High value vegetables like capsicum, beans and flowers like carnation, roses could be raised in poly houses.

With regard to fruit trees, the existing fruit trees have to be maintained properly until they attain fruit bearing stage and thereafter up to economically profitable bearing stage. This calls for proper maintenance of fruit trees with appropriate intercultural operations periodically. In general, 40-45 years old mango trees exhibit decline in fruit yield because of dense and overcrowded canopy. The trees do not get proper sunlight resulting in decreased production of shoots. New emerging shoots are weak and are unsuitable for flowering and fruiting. The population of insects and pests builds up and the incidence of diseases increases in such orchards. These unproductive trees can be converted into productive ones by pruning with the recent techniques developed. Similarly, a procedure to rejuvenate and restore the production potential of old unproductive and wilt affected guava orchards has been developed, which employs pruning of branches at different periodicity and at different severities.

Crowding and encroachment of guava trees, for instance, with subsequent inefficient light utilization is an obvious problem with many of the older orchards. The internal bearing capacity of guava trees also decreases with time, due to overshadowing of internal bearing wood.

Moreover, by providing inputs like water soluble fertilizers, hybrid / high yielding vegetable seeds and plant protection chemicals, the area under vegetables, flowers,

spices, medicinal plants, banana, tapioca, annual moringa and turmeric could be raised under precision farming technology. By adopting high density planting in mango, guava and sapota, the area under fruit trees could be also increased. This is possible through supply of pedigree planting materials, integrated nutrient management and integrated pest management. Besides precision farming and high density planting, the area could be increased by normal planting as well by using pedigree planting materials in fruits, spices, flowers and plantation crops. Similarly, by extending support for the planting materials of high value vegetables, the protected cultivation of vegetable area could also be increased. Likewise, cultivation of cut flowers and filler foliage also need to be encouraged.

It is proposed to increase the production of crops by adopting advanced technology like high tech cultivation practices which includes high density planting, use of quality planting materials, tissue culture planting materials, canopy management, micro irrigation fertigation, mulching, use of bunch sleeves for banana, protected cultivation, shade net nursery and mechanization in horticulture crop cultivation by popularizing the same among the growers to enhance productivity. It is also proposed to recommend high density planting in mango, guava and sapota in select districts of the State by providing subsidy.

Vegetable portray seedlings established under shade nursery show uniformity in growth, free from pest and disease attack. These attributes lead to 100 per cent crop stand in the main field and increase the productivity.

In agriculture, post-harvest handling namely cleaning, sorting and packing, post harvest treatment largely determines final quality, whether a crop is sold for fresh consumption, or used as an ingredient in a processed food product. The most important goals of post-harvest handling is to avoid moisture loss and slow down undesirable chemical changes, and avoiding physical damage such as bruising and spoilage. Sanitation is also an important factor, to reduce the possibility of pathogens that could be carried by fresh produce, for example, as residue from contaminated washing water.

After the field, post-harvest processing is usually continued in a packing house. This can be a simple shed, providing shade and running water, or a large-scale, sophisticated, mechanized facility, with conveyor belts, automated sorting and packing stations, walk-in coolers and the like. In mechanized harvesting, processing may also begin as part of the actual harvest process, with initial cleaning and sorting performed by

the harvesting machinery. Initial post-harvest storage conditions are critical to maintaining quality. Each crop has an optimum range of storage temperature and humidity. Also, certain crops cannot be effectively stored together, as unwanted chemical interactions can result. Various methods of high-speed cooling, and sophisticated refrigerated and atmosphere-controlled environments, are employed to prolong freshness, particularly in large-scale operations.

Regardless of the scale of harvest, from the domestic garden to industrialized farm, the basic principles of post-harvest handling for most crops are the same: handle with care to avoid damage (cutting, crushing, and bruising), cool immediately and maintain in cool conditions, and cull (remove damaged items). Once harvested, vegetables and fruits are subject to the active process of senescence. Numerous biochemical processes continuously change the original composition of the crop until it becomes unmarketable. The period during which consumption is considered acceptable is defined as the time of "postharvest shelf life". Postharvest shelf life is typically determined by objective methods that determine the overall appearance, taste, flavour, and texture of the commodity. These methods usually include a combination of sensorial, biochemical, mechanical, and colorimetric (optical) measurements.

An example of the importance of the field to post-harvest handling is the discovery that ripening of fruit can be delayed, and thus, their storage prolonged, by preventing fruit tissue respiration. This insight allowed scientists to bring to bear their knowledge of the fundamental principles and mechanisms of respiration, leading to post-harvest storage techniques such as cold storage, gaseous storage, and waxy skin coatings. Another well-known example is the finding that ripening may be brought on by treatment with ethylene. Considering the above knowledge on post-harvest handling, the action plans are suggested to establish farm gate, intermediate and final stage post-harvest facilities.

### 6.2.11. Bee Keeping

Another promising avenue in increasing the farm income is bee keeping. The Government also provides financial support by way of providing grant for supply of bee-hives to the tribal farmers in hill areas, Scheduled Castes /Scheduled Tribes under Western Ghats Development Programs, Hill Area Development Program and Integrated Tribal Development Programs. Honey industry in the country can well become a major

foreign exchange earner if international standards are met. Beekeeping is an age-old tradition in India but it is considered a no-investment profit giving venture in most areas. Of late, it has been recognized that it has the potential to develop as a prime agri-horticultural and forest-based industry. Honey production is a lucrative business and it generates employment.

Apiary honey is produced in bee hives and is harvested by extraction in honey extractors. Other types of beekeeping equipment like queen excluder, smoker, hive tool, pollen trap and honey processing plant are also used. Indian honey has a good export market. With the use of modern collection, storage, beekeeping equipment, honey processing plants and bottling technologies, the potential export market can be tapped with action plans.

With increasing demand on water from various sectors, the availability of water is under severe stress. Agriculture sector is the largest use of water. While irrigation projects (Major and medium) have contributed to the development of water resources, conventional methods of irrigation are inefficient and lead to wastage of water. It has been recognized that the use of modern irrigation methods like drip and sprinkler irrigation are the ways for the efficient use of surface as well as ground water resources.

Majority of fruit trees / orchards are under rainfed cultivation. It is proposed to bring at least 10 per cent of the area under irrigation by providing and strengthening the water harvesting system. The action plan includes extend of drip irrigation facilities, recharge of defunct bore wells, provision of pipes and protected distribution system, provision of water lifting devices, in-situ water conservation and the like.

### 6.2.12. Agro Eco System Analysis (AESA) based IPM

The IPM has been evolving over the decades to address the deleterious impacts of synthetic chemical pesticides on environment ultimately affecting the interests of the farmers. The economic threshold level (ETL) was the basis for several decades but in modern IPM (FAO 2002) emphasis is given to AESA where farmers take decisions based on larger range of field observations. The health of a plant is determined by its environment which includes physical factors (i.e. soil, rain, sunshine hours, wind etc.) and biological factors (i.e. pests, diseases and weeds). All these factors can play a role in the balancing the survival between herbivore insects and their natural enemies. Understanding the intricate interactions in an ecosystem can play a critical role in pest

management. Decision making in pest management requires a thorough analysis of the agro-ecosystem. Farmer has to learn how to observe the crop, how to analyze the field situation and how to make proper decisions for their crop management. This process is called the AESA.

Thus, AESA is an approach, which can be gainfully employed by extension functionaries and farmers to analyze field situations with regard to pests, defenders, soil conditions, plant health, the influence of climatic factors and their inter-relationship for growing healthy crop. Such a critical analysis of the field situations will help in taking appropriate decision on management practices.

It is proposed to cover 48,000 ha of fruits and vegetable grown area with pheromone trap, 50,000 ha with yellow sticky trap and 40,000 ha with light crop

### 6.2.13. Promotion of Roof Top Garden / Potager Garden

The traditional kitchen garden, also now known as a potager (in French, *jardin potager*) is a separate space available from the rest of the residential garden i.e. the ornamental plants and lawn areas. Most vegetable gardens are still miniature versions of old family farm plots, but the kitchen garden is different not only in its history, but also its design. The kitchen garden may serve as the central feature of an ornamental, all-season landscape, or it may be little more than a humble vegetable plot. It is a source of herbs, vegetables and fruits, but it is often also a structured garden space with a design based on repetitive geometric patterns. The kitchen garden has year-round visual appeal and can incorporate permanent perennials or woody shrub plantings around (or among) the annuals.

A vegetable garden (also known as a vegetable patch or vegetable plot) is a garden that exists to grow vegetables and other plants useful for human consumption, in contrast to a flower garden that exists for aesthetic purposes. It is a small-scale form of vegetable growing. A vegetable garden typically includes a compost heap, and several plots or divided areas of land, intended to grow one or two types of plant in each plot. Plots may also be divided into rows with an assortment of vegetables grown in the different rows. It is usually located to the rear of a property in the back garden or back yard. With worsening economic conditions and increased interest in organic and sustainable living, many people are turning to vegetable gardening as a supplement to

their family's diet. Organic horticulture, or organic gardening, has become increasingly popular for the modern home gardener.

The herb garden is a separate space in the garden, devoted to growing a specific group of plants known as herbs. These gardens may be informal patches of plants, or they may be carefully designed, even to the point of arranging and clipping the plants to form specific patterns, as in a knot garden. Herb gardens may be purely functional or they may include a blend of functional and ornamental plants. The action plans involve supply of garden kit and establishment of shade net in 16,000 roof top gardens and supply of garden kit to 3,40,000 gardeners.

### 6.2.14. Perimetro Vegetable Cluster Development Programme

Since production of vegetables is not in accordance with the market demand and the productivity of many vegetables is less than the potential yield, farmers need to be motivated to plan for cultivation of vegetables based on market demand. Market led production of vegetables ensure continuous supply of vegetables to the market and for the grower to get an increased return by productivity enhancement through advanced technologies. The program involves vegetable cultivation under protected condition, post-harvest management, collection centres, retail outlets and training to the growers. The vegetable produced in the project area will be immediately transported to the pack house where grading, sorting and standard packing will be done. Further to narrow down the supply chain, open retail outlets and mobile stores are proposed.

### 6.2.15. Establishing Centre of Excellence for Different Crops

Centre of Excellence for Horticulture crops like fruits, vegetables and flowers are aimed at designing, manufacturing and installation of state-of-the-art facilities like greenhouse technology, environmental control systems, tissue culture labs, crop production modules etc. The major components are

- Hi-Tech greenhouse (fitted with cooling, misting, heating system along with humidity and temperature control system and raised platforms)
- Naturally ventilated green house (with inside net system)
- Net house
- Low tunnel poly house

- Support system (GI wire) for kiwi, passion fruit, grapes etc
- Creation of irrigation facilities-Water storage tank/water pond
- Overhead drip irrigation system
- Mini-sprinklers for irrigation nursery plants
- Automation fertigation/irrigation unit
- Vermi compost/FYM unit
- Soil sterilization system
- Shade house for filling of rooting media and for grafting & budding operations
- Tissue culture unit
- Establishment of Root Stock and Mother Plant Block
- Establishment of recommended rootstock block of citrus & apple (Under open field conditions)
- Establishment of mother block of citrus in greenhouse (under insect proof net house having virus indexing facility) as well as in open field conditions.

### 6.2.16. Establishment of Processing Units

Tamil Nadu produces nearly 110 lakh tonnes of vegetables and fruits but it has only 136 cold storage locations with a capacity of 2.3 lakh tonnes, which is shared amongst marine, milk and agro produce. The combined capacity is small as compared to required capacity. Further it is reported that nearly 30 per cent of the horticultural produce are wasted due to rotting and in the post-harvest supply chain of storage and handling. Reducing this wastage calls for conversion of value added horticultural crops. Hence, the action plans include establishing horticultural processing unit and essential oil extraction units. The action plan also proposed for establishment of integrated pack house, low-cost onion storage structure, cold storage units and banana ripening chambers.

## 6.17. Transformational Module

### 6.17.1. Promotion of Location-Based and Promising Fruit Crop (Mango)

In Tamil Nadu, mango is grown predominantly in Dharmapuri, Krishnagiri, Salem, Dindigul and Kanyakumari districts. Annually, about 6.26 lakh tonnes of mango is

harvested. Considering the value addition and export potential of this fruit crop, action plan is suggested to supply grafted plants, effective fruit fly control, nut weevil screening, hexonol based quality improvement in keeping quality and extended storage life, establishment of ripening facilities with cold chain and marketing network.

### 6.17.2. Promotion of Short Duration Horticultural Crops

In location like Theni (Periyakulam), Oddanchatram, Panruti and Tindivanam, vegetables are grown mostly by utilizing ground water. Farmers will be able to increase their income through supply of elite seedlings (protray), practicing protected cultivation and distribution of seedlings of assorted vegetables in staggered manner to ensure supply of vegetables throughout the year besides facilitating easy marketing. The retail outlets like "*Pusumai Kaikari*" (Green Vegetables) will be networked with these production centres. The Co-op "Green Stores" will be also covered through the supply chain.

## 6.3. Agricultural Engineering

To cultivate a crop, the power requirement includes human labor, draft animal and machine. Currently the farm power availability in Tamil Nadu State (kW/ha) is 1.42 kW/ha. This will be increased by implementing the scheme of "Agricultural Mechanization Program in Tamil Nadu". The major focus of the Agricultural Engineering Department (AED) is presently agricultural mechanization, harnessing solar energy, soil conservation in river valley project, increasing the conveyance efficiency of irrigation water and ground water recharge. The specific action plans are as follows

### 6.3.1. Demonstration of Agricultural Machinery

In Tamil Nadu, agricultural mechanization is the need of the hour to meet out the growing shortage of labor workforce in agriculture. It has been identified as one of the critical inputs for increasing production in time. Cost of cultivation data shows that labor accounts for more than 40 % of the variable cost in many of the crops. The labor-intensive crops need high man power requirement, which is becoming scarce and thus poses a big challenge to crop productivity. Agricultural labor wages are increasing at an alarming rate in some parts of Tamil Nadu resulting in shifting from labor intensive to mechanization intensive techniques.

The farm operations like hoeing, irrigation, harvesting, threshing and marketing which needs to be performed at appropriate time and any delay would reduce the yield

and farm income considerably. The quality and precision of the farming operations are equally significant for realizing higher yields. Farming operations like land levelling, irrigation, sowing/planting, fertilizer application, plant protection, harvesting, threshing and post-harvest operations require precision to increase the efficiency of the inputs and reduce the losses. For example, sowing of the required quantity of seed at proper depth and uniform application of given dose of fertilizer can only be possible with the use of proper mechanical devices. When such operations are performed through traditional methods, their efficiency is reduced. Higher productivity of land and labor is another factor, highlighting the need of farm mechanization. Not only the output per hour is more, the total labor requirement is also reduced by means of agricultural mechanization.

As the improved agricultural implements and machinery, compared to the traditional ones, results in increased agricultural production and at the same time reduce drudgery, different size and shapes of machineries and equipment are being popularized for efficient and expeditious operations under varying conditions. The machinery for land preparations, land development, seeding, planting, transplanting, weeding and intercultural operations, harvesting and threshing which are predominantly used in other parts of the country/other countries are proposed for introduction in the farmers' field in Tamil Nadu. Distribution of farm machinery / implements to farmers with subsidy pattern assistance will increase the farm power. The benefit of agricultural mechanization is to be extended to all categories of farmers with due consideration to small, marginal, scheduled caste, scheduled tribes and women farmers.

The farm Implements/equipment and machinery need to be distributed according to demand of the farmers as prescribed by the Government in the Sub Mission on Agricultural Mechanization guidelines to cater to scheduled caste, scheduled tribes, small, marginal and women farmers cultivating crops like paddy, pulses, oil seeds, cotton, sugarcane and horticultural crops.

Though long time effort has been taking place for demonstration of viable machinery, in different regions according to the need of the farmer, more intensive efforts need to be undertaken to demonstrate these equipment in all pockets especially rainfed areas. There is less awareness among farmers about the use of machines in the rainfed farm. Even conventional tools such as cultivator are not used effectively by most of these farmers. The demonstrations thus should include methods of how crop should be laid out and sown with row crop machines, so that all possible operations can be done up to harvesting.

Newer machines for every crop is now being introduced slowly both by commercial firms as well by government institutions / SAUs. There are to be selected and demonstrated extensively. Seed to harvest operations are to be demonstrated as a complete package. The engineers in the line department should be trained accordingly in the use of machines so that knowledge can be disseminated to farmers. There should be continuous feedback from AED to ICAR / SAUs, so that needed interventions can be planned in implementation of mechanization. Just in the same line as that of the agricultural department, extension engineers should be placed at block level so that this can be implemented effectively.

### 6.3.2. Training of Farmers and Rural Youths

In-service training of officials would help them to update the knowledge on modern machines and their operations. Similarly, exposure visits to farmers would help them aware of new and innovative technologies in production, post-harvest management and value addition of farm produce. Besides, skilled man power engaged in the repair and maintenance of the commonly used agricultural machinery / implements is shrinking day by day on one side and another side, advanced hi-tech, hi-value and hi-productive agricultural machinery / implements are getting popularization among the farmers. To engage the rural youth in skill development, training programs on the repair and maintenance of tractors / agricultural machinery / implements are to be introduced. Skill oriented training programs to rural youth on operation and maintenance of the newly developed agricultural machinery / implements are to be conducted across the districts in the State.

Skill training is being offered now to rural youth in AEC&RI, TNAU, Kumulur's skill training facility. Apart from it, more and more such units need be created strategically in the state, so that adequate rural manpower is generated for this work.

### 6.3.3 Establishment of Farm Machinery Banks

To develop efficient custom hiring and custom servicing in farming operations and to reduce the burden of ownership of equipment on the farmers, agricultural machinery/implements custom hiring centres are to be created at block level in Tamil Nadu.

This involves implementation of the schemes for Promoting Rural Youth group in Farm Mechanization in different districts for the supply and distribution of agricultural machinery and implements to the groups. Under this action plan, the capacity building

component would be included. The rural youth group will in turn hire out their agricultural machinery to the needy farmers on nominal hire charge basis.

A different strategy needs to be created for farm machinery banks in rainfed areas. The dryland farmers may not be able to afford the hire cost of these machinery. Hence a system of subsidizing the machinery hire charges should be evolved to enthuse the rainfed farmers to take up mechanization.

Tractor operated machines can help speedup row crop sowing, so that timely sowing after rains can be successfully done. Similarly, use of other machines are to be let hired at low / no cost for a predefined period to double the rainfed farmers' income.

### 6.3.4. Energizing Pump Sets with Solar Power

Renewable energy is gaining importance in India's energy planning process. The policy thrust, through specific schemes, needs to be proposed to accelerate the use of such renewable energy. Among the various sources of renewable energy, the use of solar energy is gaining momentum. Solar energy is available for more than 300 days a year in India with about 6-8 hours of effective day light hours. Most parts of India receive very high solar radiation intensities about 5 KWh/ Sq. m/day. In the present scenario, when the demand for electricity is very high and fuel prices are increasing exponentially, a solar water pump provides a viable solution for irrigation. Moreover, Government is heavily subsidizing electric tariff for agriculture, thus putting additional burden on State exchequer. Providing solar pumping system to the farmers is the right choice. A5 HP solar water pump set saves approximately 25 units of electricity every day.

It is proposed to provide a comprehensive package of solar PV pumping system with subsidy, linked with suitable micro irrigation system as per the existing norms along with forward linkage of precision farming / front-end technologies, crop specific improved cultivation methods etc. to the progressive farmers of the State on a pilot basis. It is proposed to provide solar driers (4 lakh driers of 400 sq. feet and 6 lakh driers of above 400 sq. feet) for drying various agricultural produce in a phased manner with the financial assistance under various programs.

Biomass gasifier can be introduced at a large scale to deal with farm waste at farm level. These can be used as heat source for farm operations such as drying as well for value addition processing in the farm. Running of small boilers, using the farm waste, need to be encouraged to incorporate the element of fruit processing at the farm level.

### 6.3.5. Water Conservation Measures

Water conservation measures are to be undertaken to improve the soil moisture regime, to recharge the ground water aquifer and thereby increasing the availability of water for cultivation. Rain water harvesting in paved and unpaved areas and water bodies, are some of the measures of water conservation. Construction of recharge pits, trenches, dug wells, recharge wells and recharge shafts are some the water conservation measures proposed as action plans. Proper maintenance of *Kanmois* and *Ooranis* in villages is also essential to conserve the water.

### 6.3.6. Minor Irrigation Scheme

Minor irrigation schemes are implemented by the State to locate suitable sites through Geo-physical survey for sinking open wells and tube wells. The scheme also aims at bringing new areas under irrigation by creation of additional irrigation facilities and promotes conjunctive use of surface and ground water.

### 6.3.7. Transformational Modules

#### 6.3.7.1. Ensuring Assured Irrigation for Small and Marginal Holders

In Tamil Nadu, small and marginal farmers constitute 91 per cent of the total operational holdings cultivating 60 per cent of the total area. The average size of the marginal and small farmer is 0.37 ha and 1.39 ha. These farmers are resource poor farmers and ensuring assured irrigation at least for 50 cents (0.2 ha) could improve their income. With this assured irrigation, the farmers would take up cultivation of high value crops especially vegetables with all technology and extension support. The farmers would be able to use the remaining available land for cultivation of regular crops.

#### 6.3.7.2. Assuring Stable Income in Dry Land

The rain fed and dry land cultivating areas are predominant in the State. Millets and pulses are the major crops grown in these tracts which need further support. It is observed that through proper crop planning, the farmers would be able to raise two crops in a year, which is a real boost to double the income of the farmers in these locations. Assurance of quality seeds, technology support to adopt various dry land techniques, proper market networking would offer greater potentials to raise the income levels.

#### 6.3.7.3. Piped Network Irrigation System

Being a water deficit state, improving water use efficiency of available water is of prime importance. Due to declining trend in surface water availability, the farmers are now dependent on tanks and wells to meet the irrigation requirement. In the above circumstances, the adoption of drip and sprinkler irrigation technique is now wide spread in the State. However, in such Micro irrigation system, there a wide gap between potential (9 lakh ha.) and coverage (3 lakh ha) due to the need for more private investment (farmers). Since public investment on irrigation projects are slowing down, as an alternative, installing Under Ground Pipe Irrigation System offers scope in the State to manage the water scarcity situation. The major benefits by laying UG Pipe irrigation are,

a. Water saving up to 20 to 25 per cent

b. Control and regulation of water delivered from head to tail end farmers

c. Faster adoption micro irrigation practices and increase in water use efficiency

It is found that about 15.94 lakh ha (1,69,588 ha in canal command area, 3,65,031 ha in tank command areas, 10,59,989 ha in well command area) spread across 15 districts can be covered through UG Pipe Irrigation system at an estimated cost of Rs. 11,840 crores.

#### 6.3.7.4. Water Harvesting and Recycling through Farm Pond and its Multiple Use in the High Rainfall Hilly Areas

**Background**

Potato based vegetable cropping system is the predominant *rainfed* cropping system in the Nilgiri hills, wherein potato is grown during *rainfed* I season (May to August) followed by different vegetables like carrot, cabbage, beetroot, broccoli and garlic during *rainfed* II season (August to November). Cropping intensity before the introduction of this technology was 200 per cent. Extreme weather events like high intensity rainfall and runoff, dryspell during the monsoon period and unseasonable rainfall are becoming common phenomenon in this region.

**The Technology**

There is a scope for harvesting runoff water during high intensity rains and unseasonable rainfall for increasing productivity through supplementary irrigation and

increasing the cropping intensity through taking up one additional crop during summer (January to April). The ICRC-IISWC, RC, Udhagamandalam centre has taken up participatory research project in Thiruchigadi village, the Nilgiris, Tamil Nadu to evaluate the production potential of recommended land use system. Considering the average runoff (15%) in this region and the catchment area (3.2 ha) a farm pond with a size of 1232 $m^3$ has been created to harvest the runoff water. Fish (mirror carp) in the pond and fodder grass (Hybrid Napier) on the riser portion of bench terrace was also introduced as a part of Integrated Farming System. In this system, an additional potato equivalent yield of 24.1 t/ha (50.5%) and additional farm income of Rs. 2,56,200/ha (131%)

**Table 6.27 Water Harvesting and Recycling – Before and After intervention**

| **Before Intervention** | | | | |
|---|---|---|---|---|
| **Particulars** | **Yield (t/ha)** | **Potato equivalent yield (t/ha)** | **Net income (Rs.)** | **Total Farm income (Rs.)** |
| *I season Crop* | | | | |
| Potato | 22 | 22 | 104000 | 194900 |
| *II Season crop* | | | | |
| Carrot | 29 | 26 | | |
| Total Potato Equivalent yield | | 48 | 90900 | |
| **After Intervention** | | | | |
| *I season Crop* | | | | 4,51,100 |
| Potato | 26.5 | 26.50 | 155500 | (231%) increase in income |
| *II Season crop* | | | | |
| Carrot | 33 | 29.70 | 138600 | |
| *Additional crop* | | | | |
| French Beans | 14 | 14.00 | | |
| Fodder grass (hybrid Napier) | 20 | 1.50 | 130000 | |
| Fish (mirror carp) | 0.2 | 0.40 | 20000 | |
| Total Potato Equivalent yield | | 72.10 | 7000 | |

THE NEW INDIAN EXPRESS

COIMBATORE SATURDAY 12 SEPTEMBER 2015

## Doubling of Crop Yield Through Farm Pond and Intergated Farming Method

by Prasath Selvaraj

**Udhagamandalam:** Farm pond and the integrated farming system play a major role in water conservation in the Nilgiris district, said K Kannan, principal scientist, Indian Institute of Soil and Water Conservation (IISWC).

He informed that Ooty received 75 and 45 per cent deficit rainfall in July and August respectively which is considered to be the main crop season in the district. He said that a pilot project was launched on the role of farm ponds and the integrated farming system at Thiruchigadi village by the ICAR Research Centre three years back. It was launched under the Centre's Tribal sub-plan on the agricultural lands of one K Kanna Kambattan of the Kota tribal community.

A farm pond, measuring 24x16 metres with a depth of about two metres, was dug in the land. It helped the farmers harvest rain water during the surplus period and irrigate the land during the dry spell.

Before this, farmers used to irrigate their lands by hiring water tankers. It used to cost ₹2,000 per trip and only one-third of an acre could be irrigated.

Using the farm pond method, seven acres of farm land belonging to five farmers could be irrigated. Thus, farmers can raise three crops a year due to the presence of water throughout the year.

He further said that to further increase the productivity of water, fish cultivation (mirror carp) was introduced in the pond. Nearly 150-200 kgs of fish is produced every year which, in turn, increases the revenue for the farmers. This results in doubling of crop yield and tripling of farm income for the farmers.

"Many hesitate to adapt to the bench terrace method due to space constraints. But, after planting the hi-breed Napier from TNAU in the bench terrace method, the increased yield is sufficient to feed 4-5 cattle. It also helps prevent landslides. Now, the farmers are keen to adapt to the method," added Kannan.

R Moharraj, Senior Technical Officer, ICAR, said that this method is economical compared to the other methods. For digging a well, the farmers have to spend up to ₹1 lakh whereas, a farm pond would cost only around ₹30,000.

He added that after witnessing the success of the method, the centre has planned to set up farm ponds at other parts of the district -- four in Kil Kotagiri and one in Gudalur.

This method was developed by scientists K Kannan, Dev Singh, V Selvi and technical officers R Mohan Raj and A Murugan under the guidance of OPS Khola, head of IISWC.

DECCAN Chronicle

## New hill area project to harvest rainwater

### Fishes and grass augment farm pond system

### 6.3.7.5. Watershed Management

**Alternate Land Use System - Melia Tree for Industrial Farm Forestry**

The technology developed as participatory mode under dryland development project was undertaken at Ayalur watershed, Gobichettipalayam Tehsil, District Erode, Tamil Nadu during 2008-09 to 2013-14. In the watershed, out of the total area (782.0 ha) about 90 per cent area (708.38 ha) is under agriculture, of which 60.1 per cent (430.47 ha) is under rainfed agriculture and 18 percent was under agriculture with supplementary irrigation through bore-wells. Groundnut – Tobacco, Maize –Tobacco, Groundnut – Fallow are the crop sequences followed in this areas. The yield level is not up to the irrigated crop as only supplementary irrigation is practiced and the input use is also less compared to irrigated agriculture. Average yield of groundnut, maize and tobacco is 1650, 4500 and 3200 kg $ha^{-1}$ respectively.

One of the main problems that farmers face today is decreasing income from an acre per year against sudden increase in the value of agricultural lands. Planting certain tree varieties such *Melia dubia* which fetch a handsome price in the market, assured buyback, and require low maintenance expenditure may help in this regard. Melia tree grows on a variety of soils; however, it grows well in deep, fertile and sandy loam soils. It does well in moist regions, with a mean annual rainfall exceeding 1000 mm. However, it can be successfully grown in dry region also with supplemental irrigation. In Ayalur watershed where the soil poor in texture and nutrient, block plantation of *Melia dubia* was successfully established with micro site improvement technique. In this technique, pits of 0.45 x 0.45 x 0.45 m were dug at the spacing of 3 x 3 meter to accommodate 1100 seedlings per hectare in the farmer's field. After removing gravels and stones the pits were filled with top soil and farm yard manure (10kg $pit^{-1}$).

To induce early and better growth of seedlings, bio-fertilizers (*Azopirillum, phosphobacteria* and VAM @ 50gm each $pit^{-1}$) was applied during the planting. *Neem* cake @ 200gm $pit^{-1}$ was applied to control root pests. Seedlings were planted during the onset of south west monsoon. Initially, irrigation was given through drip @ 8-10 litres once in two days during summer. Branches were pruned periodically to get straight poles. In this technique, 92 percent survival was achieved.

**Table 6.28. Melia Tree for Industrial Farm Forestry – Before and After**

| **Pre project** | | | | | |
|---|---|---|---|---|---|
| **Crop** | **Yield ( kg/ha)** | **Groundnut equivalent yield (kg/ha)** | **Net income Rs/ ha/year** | **Total income Per year (Rs.)** | **For five years (Rs.)** |
| Groundnut *(kharif)* | 1650 | 1650<br>3714 | 33113<br>65315 | 98428 | 492140 |
| Post project | | | | | |
| Melia dubea block plantation | 5500 cu.ft<br>After 5 years | | 15,00,000 | 15,00,000 | 15,00,000 |

### 6.3.7.6. Agri-Horticultural System for Higher Productivity in the Semi-Arid Region

Dryland or rainfed horticulture has assumed greater attention now a days due to better economic returns. In drylands, fruit trees provide a better substitute and offer alternative opportunity in areas where cropping may not be possible due to non-availability of irrigation. Considering frequent crop failure due to erratic monsoon in the region, dry land horticulture was introduced in Ayalur and Saliyur watersheds, Tamil Nadu in an area of 40 ha involving mango, sapota, lime and amla.

Micro-site improvement technique was adopted for proper establishment of tree species in the degraded areas. Under this technique, taking pits of proper size (1x1x1 m),

removal of gravels from soil in the pits and application of FYM (30 kg/pit), bio-agent (Neem cake @ 200 g/pit) and bio-fertilizers (VAM, *Phosphobacteria* and *Azospirillium* @ 50 g each/pit)) were demonstrated in the watershed. Observation on survival of different fruit saplings for developing agri-horticulture, coconut in 14.0 ha and sapota in 0.5 ha have been established in areas where earlier only annual crops were cultivated in the watershed.

**Table 6.29 Agri-Horticultural System in Semi-Arid Region**

| **Before** | | | |
|---|---|---|---|
| **Crop** | **Yield (kg/ha)** | **Groundnut equivalent yield (kg/ha)** | **Net income (Rs/ha/year)** |
| **Groundnut (kharif)** | 900 | 900 | 21000 |
| **After** | | | |
| **Mango +Groundnut inter cropping system** | | | |
| (i)Groundnut (up to 4 years) | 750 | 750 | 16000 |
| **(**ii)Mango | 6000 | 4250 | 83000* |
| (5-10 years) | 8000 | 5700 | 113000* |
| (10-20 years) | | | |
| **Tamarind +Groundnut inter cropping system** | | | |
| (i)Groundnut (upto 4 years) | 750 | 750 | 16000 |
| Tamarind after 6 years | 15000 | 10700 | 250000* |

*Including annual maintenance cost and capital investment distributed and interest on capital

### 6.4. Agricultural Marketing and Agri-Business

The agricultural marketing system of Tamil Nadu is confronted with the following problems / issues.

- Heavy post-harvest losses and Inadequate infrastructure
- Uncertainty in supply of quality agricultural produce.
- Insufficient handling and transportation of farm produce
- Small marketable surplus
- Low utilization in processing sector
- Lack of direct linkages with buyers or consumers resulting predominance of middle men
- Inadequate market information and
- Insufficient market research and analysis

These issues call for various action plans/interventions as follows

- Promotion of commodity interest groups and formation of Farmer Producers Organization and market linkages.
- Strengthening post-harvest infrastructure facilities to handle marketable surplus.
- Encouraging of private players in infrastructure facilities, value addition, food processing and marketing under public private partnership
- Sensitizing the farmers towards market-led agriculture through capacity building.
- Crop advisory and market information.
- Provision of market accessories.

Thus, paving the way forward towards market-led agriculture and to help the farmers to realize a better price for their produce through market information are the major thrusts in the marketing sector. Moreover, priority is to be given for establishment of need based storage and drying facilities at key villages, establishment of the drying yard in major crop growing areas, provision of covered storage facilities to the farmers, providing solar driers and plastic crates and construction of cold storages. Training to

farmers on value addition of horticultural and agricultural crops for augmenting their income are the other suggested interventions for strengthening the activities of marketing sector.

### 6.4.1. Market led Agriculture through Capacity Building

Government adopted several programs of providing market supported services since independence through planned approach. However, it has not attracted many. The main reason could be that agricultural marketing on business related aspects of training, education and research was not focused much. In this regard, training on grading and storing the produce, market intelligence, post-harvest management, value addition of the produce, exposure visits would facilitate the capacity building of the farmer-producers. Further this would also facilitate the stakeholders in the supply chain to augment their income through remunerative prices and meet their requirement adequately.

## 6.5. Livestock

Livestock industry continues to demonstrate a beneficial impact on rural people by improving their income, employment and consumption and thereby becoming as a potential alternative in alleviating rural poverty. The livestock population is expected to grow at the rate of 0.55 per cent in the coming years and the population is likely to be around 781 million by 2050. However, the productivity of animals is 20-60 per cent lower than the global average due to improper nutrition, inadequate health care and management.

Fodder scarcity and poor quality of available fodder are the major constraints in increasing livestock productivity. Livestock are also affected by many ailments. Delay in diagnosis will lead to increase in loss of productive days, increase in the recovery period and consequent loss of production. Further, due to difficulties in transporting the ailing animals, cost and time involved, farmers generally do not take their animals to the referral centres which are few and far apart. Hence, it is necessary to enable select veterinary institutions function as referral centres by providing them culturing technologies. Similarly, in order to achieve the projected demand for fodder, it is necessary to bring more area under high yielding fodder crops for which quality seeds of improved variety is the pre-requisite. Similarly, strengthening of veterinary institutions, livestock farms, modernization of dairy units and conduct of health camps are suggested for enhancing the activities of animal husbandry sector.

Goat farming is an extremely demanding activity. In recent years, the overall appreciation of this long under-estimated species has grown and thus enhancing its importance in the livestock industry. Hence rearing of goats should be examined in a new light and from new perspectives. Moreover, the demand for animal protein is increasing at a very faster rate. Human population growth, increasing urbanization vis-a vis income are predicted to double the demand for livestock and livestock production by 2020. The trends reveal that the role of small ruminants in meat supply is growing and meat from these animals is most preferred. The small ruminants sector will therefore play a significant role in the coming decade in impacting on the livelihoods of small and marginal farmers who rear them.

Therefore enhancing the production of livestock is absolutely essential. The production cost of cattle feed coupled with erratic supply of green fodder due to frequent drought condition aggravate the situation. Hence, improving fodder production by promoting high yielding fodder varieties is needed. Besides, emphasis has to be laid on optimum utilization of wasteland to grow fodder. Providing proper infrastructure and equipment to the veterinary health care institutions is necessary for the timely diagnosis and treatment of animal diseases. Further, a strong program for the supply of sufficient veterinary vaccine is imperative. Each veterinary health care institution is to be provided with cold storage facilities to store vaccine. Sensitization of the general public and livestock farmers on various livestock diseases through information, education and communication campaign would help in education the people about animal diseases. Training on value addition of milk and milk products and capacity building of livestock farmers, besides strengthening activities of veterinary hospitals, dispensaries and clinics, would go long way in improving this sector. The details of specific action plans are discussed below

### 6.5.1. Provision of Modern Veterinary Diagnostic aids to Veterinary Institutions

Animal health care services and prevention of animal diseases is a priority for maintenance of a healthy livestock for optimum production. Protective and therapeutic activities of the Animal Husbandry Department are being conducted through various institutions such as Veterinary Polyclinics, Veterinary Hospitals, Veterinary Dispensaries, Mobile Veterinary Units and sub-centres.

Modern diagnostic aids will enable the Veterinary Institutions function as “Referral centres” by providing them with cutting edge technologies, reduce loss of productivity due to delay in diagnosis and will significantly reduce infertility among dairy cattle and prevent loss of germplasm.

Veterinary services need to be delivered following "Good Veterinary practices" and “Good Animal Husbandry Practices” for which, minimum infrastructure like proper building, necessary equipment, furniture, etc., should be available. In the absence of any of the components of this system, the GVP and GAP shall be severely compromised. The advances in the field of Veterinary profession can be disseminated more effectively in an efficient, user friendly environment for the ultimate benefit of the farmers. Improved infrastructure facilities will provide improved veterinary services contributing to reduction in the incidences of animal diseases thereby increasing the overall productivity of animal wealth. The Rural Veterinary Dispensaries are either functioning from rented premises or in dilapidated buildings. Further, functioning of Veterinary Institutions in the rental buildings do not satisfy the requirement of a typical Veterinary Institution and with a restricted scope for further expansion, these are not ideal infrastructure.

This necessitates strengthening the infrastructure of the veterinary institutions to offer better delivery of services and to reshape it into knowledge resource centers where best practices are being disseminated to the farmers. By this, the State’s impressive cross bred cattle gene pool can be favorably exploited for increased egg, meat and milk production. It is proposed to improve the infrastructure facility of 200 veterinary institutions.

With around 2600 institutions, it is imperative that such facilities are provided in block headquarters and district headquarters so that the benefits of such cutting-edge diagnostic facilities are accessible to vast majority of livestock owners. With this objective, it is proposed to provide diagnostic facilities such as Ultrasound, Computerized X rays, diathermy units, Haemocytometers, Laparoscopy etc and surgical theatres to 400 institutions over a period of five years.

### 6.5.2. Enhancement of Livestock Productivity Adopting Recent Concepts in Breeding Management

Artificial insemination (AI) has proven to be very effective for the improvement of the genetic potential of animals for higher production and there is no surprise why today AI is the back bone of all breeding programs in India. In commercial dairy production,

over 80 per cent of all the cattle are now bred artificially. A large proportion of the success is due to improvement of the genetic potential of dairy cattle through use of outstanding sires by artificial insemination.

The economic wellbeing of a dairy farmer depends on the productive and reproductive ability of the herd that he maintains. The replacement of unproductive and ageing animals in the herd and its expansion are very important to maintain the scale of economy of the farm. Oestrus synchronization with CIDR, sex-sorted semen and MOET (Multiple Ovulation and Embryo Transfer) are some of the modern scientific techniques which are proposed for effective breeding management to enhance the livestock fertility and productivity. The entire gamut of activities and processes involved in semen production, processing, storage and distribution will be modernized to improve the efficiency of the AI program. It is proposed that 10,000 animals will be synchronized in a planned manner through the veterinary institutions of the State. About 10,000 doses of sex-sorted semen will be imported and distributed to institutions. Embryo Transfer will be conducted across the State, utilizing the elite cows of farmers as donors and other healthy animals as recipients. Departmental Farms will also be strengthened to act as ET hubs to revamp the frozen semen production, processing, storage and distribution.

### 6.5.3. Improving the Animal Protein Availability by Establishing Small Holder Dairy, Sheep/Goat and Piggery Units

Milk, meat and egg play a crucial role in fulfilling the protein requirements of human beings. In recent times, increasing urbanization has led to shrinkage of pasture land and related natural resources putting enormous strain on animal husbandry. This necessitates facilitating farmers to take up dairy, goat and sheep farming, piggery and poultry as an avocation to embolden not only the rural economy but also to enhance the animal protein availability.

It is proposed to establish 300 dairy units (both cows and buffaloes), 1000 piggery units and 5000 sheep/goat units over the next five years.

### 6.5.4. Livestock Health Management

Livestock productivity is dependent on effective health management. An all-encompassing approach covering vaccine production, sero-surveillance, vaccination, biosecurity, disease diagnosis and appropriate interventions will ensure better livestock health leading to sustained productivity will be the action plan suggested.

#### 6.5.4.1. Up gradation of Vaccine Production Facilities at IVPM, Ranipet, Vellore to GMP Standards

The Institute of Veterinary Preventive Medicine, Ranipet, a unit of the Department of Animal Husbandry and Veterinary Services, Government of Tamil Nadu, is engaged in the production of Veterinary Biological and Pharmaceuticals for use by the field Veterinary Institutions in the State. The WHO has mandated that any institution involved in vaccine production must have facilities compliant with GMP norms to be eligible for licensing. As most of the production facilities at IVPM, Ranipet were established several decades back, the following facilities have to be provided to make the institute GMP compliant.

- Establishment of Animal testing facility
- Establishment of QC lab
- Upgradation of FMD regional centre to GMP standards
- Establishing PPR vaccine production unit of GMP standards
- Construction of Warehouse
- Strengthening of *Brucella* vaccine production unit
- Upgradation of pharmaceutical division
- Establishment of Tissue Culture facility for Sheep pox Vaccine Production
- Upgradation of Diagnostic section to GLP standards
- Improving the infrastructure facilities
- Establishment of feed milling plant.

#### 6.5.4.2. Vaccination and Sero-Surveillance

Strengthening the sero-surveillance mechanism by improving the infrastructure facilities of Animal Disease Intelligence Units, Poultry Disease Diagnostic Labs, Central Referral Lab and the field units assumes greater significance. Establishment of more number of mobile veterinary units, mobile disease diagnostic laboratories and facilities for cold-chain management also will strengthen the disease monitoring and management capabilities of the Department.

### 6.6. Strengthening the Departmental Farms for Enhancing Livestock Productivity

The Department of Animal Husbandry has under its control 11 Livestock Farms, one poultry Farm and one Fodder Farm. These farms were established with a mandate to demonstrate latest technologies in the field of Animal Husbandry and to supply quality genetic material to the farmers. Modern amenities will be provided taking into account animal physiology, behaviour, climatic conditions of the area and scientific designing**.**

Such modern infrastructure will provide health sustaining and comfortable environment to different categories of livestock for health, longevity and ideal productivity, desirable working conditions for labor and supervisory staff of the farm, harmonized integration of housing with feeding, watering, milking and manure handling systems for efficient production.

It is hence proposed to provide modern shelters taking into consideration of factors such as heat, humidity, over-crowding, light, ventilation, sanitation etc, at departmental farms at Abishegapatti (Tirunelveli District), Sattur (Virudhunagar), Chettinad (Sivagangai), Pudukottai, Naduvoor and Eachenkottai (Thanjavur), Korukkai (Thiruvarur), Chinnasalem (Villupuram), Mukundarayapuram (Vellore), Hosur (Krishnagiri), Kattupakkam and Padappai (Kancheepuram) and Ooty.

#### 6.6.1. Induction of New Genetic Pool

Department livestock farms serve not only as demonstration units but also provide livestock of good genetic merit for breeding purposes to the farmers. Scientific principle advocates continuous replacement of genetic pool in the breedable age group to avoid undesirable effects of inbreeding. In addition, ageing animals with declining production and reproductive potential also need to be continuously replaced. Taking the above factors into consideration, approximately 25 per cent of the breedable population in the livestock farms is proposed to be replaced every year by purchasing quality livestock from various sources. This will increase the number of quality off - springs of high genetic merit, so that more number of such animals can be distributed to the farmers for breeding purpose. This will facilitate increase in livestock production and productivity with a direct bearing on socio economic condition of the farmers.

### 6.7. Augmentation of Fodder Availability in the State

The health and productivity of livestock are closely linked with the quantum and quality of forage production. Forage-based economical feeding strategies are required to reduce cost of quality livestock products; as feed alone constitutes 60-70 per cent of milk-production cost.

Both quantitatively and qualitatively, there exist a huge gap between the demand and supply of green fodder in the State. It is estimated that the average cultivated area devoted to fodder production is only 1.3 per cent of the total area and the pasture and grazing land comprises only 0.8 per cent of the total area to cater the need of the Livestock population in the State. At present, the State faces a net deficit of around 30-40% of green fodder (Table 6.30)

**Table 6.30. Grazing Resources Available for Production of Fodder / Pasture in Tamil Nadu and India**

**(in Million Hectares)**

| Category | India | Tamil Nadu |
|---|---|---|
| Total geographical area | 328.7 | 13.00 |
| Forest | 69.7 | 2.12 |
| Cultivable waste land | 13.12 | 0.32 |
| Pasture and grazing land | 10.4 | 0.11 |
| Fodder crops | 8.3 | 0.17 |
| Tree crops and groves | 3.5 | 0.23 |

Future development and growth of livestock sector are highly associated with the scope of availability of fodder from cultivable lands, grazing lands and efficient utilization of available fodder. Focused strategies and concerted efforts are the need of the hour to face this challenge

The action plan is to augment green fodder production and thereby enhancing the livestock productivity are detailed below

#### 6.7.1. Increasing Fodder Biomass by bringing More Area under Fodder

A cost-effective feeding practice for productive crossbred animal can be achieved by decreasing the dependence on external input i.e., concentrates and increasing the internal input system through fodder production at farmer’s level. Thus, cultivated fodder

has an important role in meeting the requirement of various nutrients and roughage to produce milk most economically as compared to concentrates. Hence, it is proposed to encourage farmers to take up cultivation of green fodder in their own holdings to ensure year-round availability of fodder to the livestock maintained by them. At present, State faces deficit of around117.85 lakh tonnes of green fodder annually. To meet out the deficit annually around 1.83 lakh hectares need to be brought under green fodder production. Hence, it is proposed to address the issue by encouraging farmers to take up cultivation of fodder crops for green fodder production by distribution of required seed material, fertilizer, agricultural machineries, etc. It is proposed to bring 2.50 lakh acres under green fodder production over a period of five years.

### 6.7.2. Efficient Utilization of Available Fodder

#### *a. Provision of Chaff Cutters*

Animals tend to eat only the succulent leaves of the plant and generally waste the stem part. By chopping the green/dry fodder, effective utilization of fodder is obtained thus reducing the wastage of fodder. Thus, to economize the use of available fodder, the farmers across the State are to be distributed with power operated chaff cutters at subsidized price to chop the fodder and feed their animals. It is proposed to provide Chaff cutter to 25,000 farmers over a period of five years.

#### b. Preservation of Surplus Fodder Available during Flush Season

It is customary that forages are consumed by domestic animals either in grazing land or stall seasonally. However, it is possible to serve the animals round the year conserving the forage properly. The availability of green grass is mostly seasonal, only in monsoon, when plant growth is high. The green grass is highly deficient in dry season and during flood. The seasonal deficiency can considerably be reduced by conserving the surplus forage during high fodder availability period. Hence farmers are encouraged to ensile the excess fodder available during flush season for utilization during lean months by a technique called "Ensiling ".It is proposed to establish 10,000 units across the State.

### 6.7.3. Efficient Utilization of Water thereby Optimizing the Fodder Yield

Water is the vital input in crop production. It is essential to maximize both yield and quality. Hence, to utilize the available water efficiently and enhance the yield of the

fodder crop, it is proposed to provide financial assistance to farmers for installation of rain guns to cover 10,000 acres of farmers' land with rain gun system of irrigation.

### 6.7.4. Reducing Drudgery and Timely Operation by Distribution of Grass Cutters

The harvesting of crops is traditionally is done by using sickle. This traditional method involves drudgery and consumes long time. Timeliness of harvest is of prime importance. The use of machines can help to harvest at proper stage of crop maturity and reduce drudgery and operation time. Considering these, grass cutter/brush cutters are to be distributed to farmers. It is proposed to provide grass cutter/brush cutter to 10,000 farmers over a period of five years.

### 6.7.5. Promotion of Alternate Feed Substitute – *Azolla*

The demand for milk and meat is creating new potential in the profitability of animal husbandry as an occupation. Yet, at the same time, fodder availability is a great concern. The shortage of fodder is therefore compensated with commercial feed, resulting in increased costs in meat and milk production. The search for alternatives to concentrates led to a wonderful plant *Azolla*, which holds the promise of providing a sustainable feed for livestock.*Azolla* is very rich in proteins, essential amino acids, vitamins (vitamin A, vitamin B12 and Beta- Carotene), growth promoter intermediaries and minerals like calcium, phosphorous, potassium, ferrous, copper, magnesium etc. Livestock could digest the plant easily. Due to its high protein and low lignin content, the livestock could become accustom to it. Moreover, it is easy and economical to grow. Hence, to familiarize the method of propagation of *Azolla* among the farmers and to meet out the requirement of fodder, 50,000 *Azolla* units will be established across the State.

### 6.7.6. Production of Quality Seeds to Expand Area under Fodder Cultivation

In order to achieve the projected demand of fodder, it is necessary to bring more area under cultivated fodder crops. Sowing a new fodder area requires a reliable source of seed as quality seeds are very crucial and essential for fodder production and productivity. Therefore, an assured supply of fodder seeds at the appropriate time to farmers is crucial for enhancing fodder production.

To bring requisite area under green fodder production, annually around 7000 MT of fodder seeds of cereals and leguminous fodder crops are essential. Since, most the fodder crops are shy seed bearer; it requires adoption of better technology in seed

production to enhance quality seed production. Hence, to ensure assured supply of fodder seeds at the appropriate time to farmers, fodder seed production will be taken up in Departmental Farms by adopting better technology and by providing adequate infrastructure like borewells/open wells, farm ponds, percolation ponds, pipelines, ground level reservoirs, overhead tanks, fencing, farm roads, erection of transformers, godowns, drying yards, store rooms, procurement of agricultural machineries etc. Besides, Vermicomposting units will also be established in all the farms to enhance the fodder/fodder seed production.

### 6.7.7. Distribution of Tree Fodder Seedlings to Farmers

During dry periods, feed shortage is often experienced and therefore feed of low quality is used. The animals are not able to obtain enough energy and protein to grow or to produce milk. Sometimes animals are even fed less than the daily 'maintenance requirements' as the green fodder is scarce. During these periods, fodder trees become important source of energy and protein to maintain the animal, improve growth rates and even increase milk production. Hence, to enlighten the farmers on the importance of raising and feeding tree fodder, tree seedlings of various fodder tree varieties according to the regional adaptation will be raised in departmental farms and distributed to farmers across the State for raising them in their fields. It is proposed to distribute 50 lakhs seedlings to the farmers.

### 6.7.8. Water Conserving Hydroponic Green Forage Production to Augment Livestock Productivity

A major concern in developing sustainable dairy farming is inadequate availability of green fodder. The major constraints in production of green fodder by dairy farmers are decreasing land holdings size, high cost of land, scarcity of water, more labor requirement for cultivation (sowing, earthing up, weeding, harvesting etc.), requirement of manure and fertilizer, long growth time, non-availability of same quality green fodder round the year, influence of natural calamities etc. As an alternative to conventional method of fodder cultivation is the emergence of hydroponics technology to grow fodder for farm animals without soil and minimum water. Green fodders produced by growing seeds without soil but in water or nutrients rich solutions are known as hydroponics green fodder. Hence, it is proposed to establish Hydroponic units in the Departmental farms and popularize the method among the farmers across the State by establishing mini units in their premises.

A sum of Rs 100 crores will be required to establish Hydroponic units at Departmental farms.

### 6.7.9. Establishment of Fodder Production Units in Meikkal Lands across the State

A large majority of the farming community in our State are small and marginal farmers with limited land holdings. These farmers traditionally rely on common lands and other common resources to meet out a significant portion of green fodder requirements for their livestock. There are 1.10 lakhs ha of common grazing lands in the State that are under various stages of degradation and are not producing optimum quantities of fodder due to various reasons. The deficit in green fodder production can be addressed efficiently by adopting a community centric approach by undertaking fodder production in the common property lands which are in various stages of degradation. These lands need to be converted into an area suitable for fodder cultivation so that green fodder can be made available at the village level throughout the year. It is proposed to establish Fodder Production unit in meikkal poromboke lands in all districts of the State by providing infrastructure facilities such as borewell, open wells, farm ponds, percolation ponds, pipelines, ground level reservoir, overhead tanks, fencing, farm roads, silage pits, etc.

### 6.7.10. Strengthening of Infrastructure for Milk Processing and Dairy Development

In Tamil Nadu, milk contributes more than 43 per cent share in the value of output from livestock sector (Policy note on Diary development, Govt. of Tamil Nadu). There are 17 milk processing units run by Milk Producer's Unions and 12,105 Primary Milk Producer's Co-operative Societies in the State. Out of 23.01 lakh members in the Milk Producer's Co-operative Societies, about 4.60 lakhs members are regularly supplying milk to the Milk Producer's Co-operative Societies. The Milk Producer's Unions have milk processing capacity of 24.07 lakhs litre/day. Besides, there are 35 chilling centres and 299 Bulk Milk Coolers (BMC) run by the Societies. On an average about 9.78 lakhs litre/day of milk has been sold by the Co-operative Societies. There are also 42 private diaries functioning in the State.

Some of the action plans suggested to achieve higher and quality milk production are:

- Strengthening of milk testing at village level for clean milk production.
- Strengthening of dairy plants functioning under Co-operative sector through capacity expansion.

- Enabling supply of clean, hygienic milk and milk products.
- Providing veterinary health cover, implementation of AI program, supply of cattle feed, fodder and insurance cover to animals.
- Computerization of dairy activities at various levels to improve the efficiency and ensure more transparency in milk handling.
- Training to farmers, provision of antiseptic chemicals and utensils, strengthening of lab at Union dairies and chilling centres and installation of Bulk Milk Coolers (BMC) at societies.

### 6.7.11. Animal Husbandry Research

Specific focus on bovine infertility diagnostic centre, monitoring, surveillance and controlling poultry diseases, establishment of frozen semen banks, food processing centre, establishment of nucleus jersey cross breed bull, mother farm, capacity building program to field veterinarians, centre for poultry products certification, dairy entrepreneurs training facility, hydroponic green forage production, increasing animal production and health through nanotechnology, animal mobile medical ambulance and strengthening of veterinary institutions are necessary.

Action plan on increasing fodder production through quality fodder seed production and distribution, enhancing the productivity of livestock through of superior crossbred bulls for sustainable milk production, increasing availability of green fodder, harnessing the production potential to maximize the returns from dairy farming by improved feeding, breeding and management techniques, reducing the cost of production of milk through proper care to the animals, enhancing the accessibility to veterinary services to the farmers at the door step by providing animals mobile medical ambulances for rural veterinary care, capacity building to field veterinarians and entrepreneurship training for dairy and poultry farmers, developing training models for training beneficiaries would help in modernizing this sector. Tamil Nadu Veterinary and Animal Science University will also establish Centres with special reference to buffaloes and poultry, products certification, bovine infertility diagnostic centre and for freedom from microbes for export respectively.

- Establishment of Bovine Infertility Diagnostic and Training Centre with special reference to Buffaloes
- Monitoring, surveillance and control of emerging and reemerging diseases of poultry at field level
- Establishment of Frozen Semen Bank at Veterinary College and Research Institute, Namakkal
- Establishment of “State Level Food Processing Training Centre (FPTC)” at College of Food and Dairy Technology, Koduvalli
- Establishing Nucleus Jersey Crossbred Bull-Mother Farm: Production of Superior Crossbred Bulls for Sustainable Milk Production under Rural Conditions
- Augmenting Animal Productivity and Advanced Veterinary Care Delivery through Continuing Education to Field Veterinarians
- Strengthening of University peripheral centers and developing training modules for training beneficiaries towards distribution of milch animal and sheep and Goat Schemes
- Establishment of a “Centre for Poultry Products Certification for freedom from microbes for Export”
- Animal Mobile Medical Ambulance for Rural Veterinary Care in Tamil Nadu
- Establishment of "Regional Dairy Entrepreneurs Training facility (RDEF)" at Veterinary College and Research Institute, Orathanadu, Thanjavur
- Establishing Regional Feed Processing and demonstration unit
- Water Conserving Hydroponic Green Forage Production for Livestock Farming
- Nanotechnology facility to Augment Farm Animal Production and Health
- Strengthening of Diagnostic Modalities in Teaching Veterinary Hospitals of Tamil Nadu
- Establishment of Innovation and Instrumentation Centre to fabricate farm equipments/ devices for sustainable livestock farming
- Establishment of Veterinary Forensic Sciences Laboratory
- Climate resilient fodder production through Hydroponic mode to augment livestock productivity in Tamil Nadu

### 6.8. Fisheries

India ranks second in aquaculture production in the world and its fertile aquatic bodies offer vast scope for cultivation of commercially important finfish and shellfish. Fisheries is recognized as a powerful income and employment generation enterprise as it stimulates growth of a number of subsidiary industries and is also a source of cheap and nutritious food for the people besides a foreign exchange earner. Fishery resources of Tamil Nadu are categorized as Marine, Inland, Reservoir and Brackish water.

#### 6.8.1. Marine Fisheries

Tamil Nadu State with the second longest coastline in the country covers an area of 1,076 km. The marine fisher population in Tamil Nadu is 9.85 lakh, living in 608 fishing villages. The inshore waters of 1,016 km length of the coast on the eastern side and 60 km length of the coast on the western side are found to be over-exploited, whereas the offshore and deep sea resources are yet to be exploited to its optimum levels. The marine fish production of the State presently is estimated to be 4.77 lakh tons against the estimated potential of 7 lakh.

**Table 6.31. Marine Fishery Resource**

| | |
|---|---|
| Coastal length (km) | 1,076 |
| Exclusive Economic Zone (EEZ) sq.km | 1,90,000 |
| Continental shelf (sq.km) | 41,412 |
| Number of Coastal Districts | 13 |
| Number of Fishing Villages | 608 |
| Marine Fisher folk population | 9,85,000 |
| **Fishing Crafts Registered(online)**: as on 28.02.2017 | |
| 1. Mechanised Fishing boats | 5,944 |
| 2. Traditional Crafts (Motorised and Non-motorised) | 34,920 (29,587+ 5,333) |
| Major Fishing Harbours | 5 |
| Major Fishing Harbours under construction | 2 |
| Medium Fishing Harbours | 4 |
| Fish landing centres / Jetties | 36 |
| Fish Landing Points | 254 |

### 6.8.2. Inland Fisheries

Tamil Nadu possesses 3.83 lakh ha of effective inland water resources comprising of reservoirs, major irrigation tanks, minor irrigation tanks and short seasonal tanks and ponds, rivers, backwaters and derelict water bodies. The inland fisher population is about 2.29 lakh. There are 61 reservoirs under the control of the Fisheries Department comprising of major, medium and small reservoirs. Among these, 53 reservoirs are directly under the control of the Fisheries Department and 8 reservoirs are under the control of Tamil Nadu Fisheries Development Corporation Limited (TNFDC) The short water retention period in ponds and tanks due to erratic and scanty rain fall necessitates promoting and stocking of fast growing fish species in short duration such as Amur Carp, Genetically Improved Farmed Tilapia (GIFT), Jayanthi Rohu, Pangassius sp. etc.

**Table 6.32. Inland Fishery Resource**

| | |
|---|---|
| Inland Fishery Resources (lakh ha) | 3.83 |
| Reservoirs (78 Nos) – Ha. | 62,015 |
| Large irrigation and short seasonal tanks (ha) | 2,65,819 |
| Brackish water spread area (ha) | 56,000 |
| Population of Inland Fishers (lakh) | 2.29 |
| ***Fish seed production centres*** | |
| i) Government Fish farm | 8 |
| ii) Private Fish farm | 49 |
| ***Fish seed rearing centres*** | |
| i) Government Fish farm | 34 |
| ii) Private Fish farm | 180 |

### 6.8.3. Brackishwater

Brackishwater aquaculture has been identified as one among the high potential areas for increasing shrimp, finfish and shell fish production and for deriving maximum economic and social benefits. This sector has vast potential of creating employment generation and acts as a vital source of food supply for meeting the food security and nutritional requirements of growing India’s population. Tamil Nadu is one among the

states, which has good scope for promoting brackish water aquaculture for increasing farmer's income by multi-fold times within short period of four to six months. White Leg Shrimp *P.Vannamei* yields about 5.5 t/ha and the realized profitability is about 3.3 lakh/ha by 120 days.

Tamil Nadu with a coastal area of 1076 km has an estimated brackishwater area of about 56,000 ha in Thiruvarur, Thiruvallur, Villupuram, Ramanathapuram, Tuticorin, Tirunelveli, Chennai districts. In addition, there are about 14880 ha of potential area in these districts, which are suitable for brackish water aquaculture. Unlike the freshwater resources using for fish culture, brackish water aquaculture resource is not converging its use with that of freshwater, for the purpose of drinking or irrigation. Hence the resource can be developed and used for aquaculture for the production food, employment and income generation.

In Tamil Nadu, the total extent of brackish water area can be used for capture fisheries. Apart from this, about 7,100 ha area is under coastal aquaculture production mainly shrimp aquaculture. In Tamil Nadu, shrimp farming has grown considerably and has emerged as a major commercial activity owing to the introduction of Specific Pathogen Free (SPF) Shrimp, *Litopenaeus vannamei.* So far, 1,734 shrimp farms (3,514.65 ha) and 51 shrimp hatcheries have been registered under the Coastal Aquaculture Act (CAA), 2005

Conservation and management of fisheries resources are done by adopting measures namely imposing seasonal fishing ban, stock enhancement, habitat development like sea ranching programme, installation of artificial reefs and introduction of diversified fishing methods.

Artificial reefs act as habitats to marine aquatic organisms, help in enhancing the fish production through increased breeding activity and survival of young ones. It also acts as a barrier for bottom trawling operations. The Government has taken steps for development of fish habitats, by setting up of artificial reefs in the inshore waters as a conservation/stock enhancement measure. So far, 37 artificial reefs have been setup along the Tamil Nadu coast.

The Indian Squid is available throughout the coast and is predominant in the catch in the west coast of Kanyakumari district. To take up diversified fishing, this State have

introduced a scheme of extending financial assistance to fishermen for procurement of squid jigging materials with 50% subsidy assistance.

#### 6.8.3.1. Strategies

a. Identification of suitable areas for aquaculture development through effective utilization of potential brackishwater areas

Out of the 56,000 ha total potential area available for brackishwater in Tamil Nadu, hardly 10% has been developed into shrimp farming and at present about 6% area is under culture. Hence there is ample scope for further development of shrimp, finfish, crab and bivalve (edible oysters) farming that can create new farming enterprise and also to improve the livelihoods of the coastal population living in the remote areas, by creating alternate livelihood options. To address this, a policy for utilizing public brackishwater resource, such as leasing policy, under the Government of Tamil Nadu, need to be framed involving research and development agencies, stake holders and farmers.

CIBA has developed a methodology for identifying suitable land area for brackish water aquaculture development based on multi-disciplinary decision support system using Geographical Information System (GIS) and Remote Sensing data. The technology includes delineation of suitable coastal land areas and inland saline areas incorporating CAA guidelines, source water characteristics, distance from the water source, drainage and carrying capacity of source water bodies for the sustainable expansion of brackish water aquaculture.

Further, geo-spatial techniques like 3-D mapping can be adopted for assessment of resources in the potential areas considering parameters such as water depth, pH, seasonal and water depth effect on sea water temperature etc. ICAR-CIBA has initiated a programme in partnership with the Tamil Nadu Government in this direction for identification and mapping of potential brackish water resources in Ramanathapuram district. This can be emulated for other coastal districts of the state. Once the mapping is done the same can be made available for the decision makers, at the State and Central Government levels, for the developmental purposes.

b. District level planning for promotion of brackish water aquaculture

ICAR-CIBA has developed a methodology for district level planning for brackish water aquaculture development evaluated in Nagapattinam district of Tamil Nadu. This planning tool integrated the site selection criteria, the resource map of the district, the agro-climatic conditions, selection of suitable culture practice and evolves an overall District/State level planning tool for future integration in Integrated Coastal Zone Management Plans of the coastal states and union territories. The stake holders meeting was organized to discuss the issues identified in the field and possible solutions for them. Similar attempts can be envisaged for other potential districts of the state.

c. Horizontal expansion of successful brackish water aquaculture technologies through Public Private Partnership Mode

ICAR-CIBA has developed aquaculture technologies for candidate species such as shrimps (tiger shrimp, Indian white shrimp, Exotic shrimp Vannamei), crab (mudcrab), finfishes (seabass, milkfish and etroplus) and brackish water ornamentals (etroplus, scatophagus, moon angels). These include hatchery production of seed, nursery rearing, formulated feeds and health management. These technologies can be spread on a larger scale through Public Private Partnership (PPP) mode in the potential coastal districts of Tamil Nadu. ICAR-CIBA, State Department of Fisheries and Private farmers / entrepreneurs can jointly promote these technologies. These include:

1. Production technology for selectively bred SPF *Penaeus vannamei* which tripled increased the country’s shrimp production and increased the export earnings from Rs. 4000 Cr in 2010 to Rs. 20,000 Cr in 2014-15. Here the individual farmers income from shrimp farming has been tripled from the year 2010 to 2015, by adopting the vannamei farming, made possible by the timely intervention of institutions such as ICAR-CIBA, MPEDA and Ministry of Agriculture.
2. Year round breeding techniques of seabass through seed production, nursery rearing and faming technology.
3. Indigenous shrimp feed manufacturing by compressed pelleting technology
4. Shrimp hatchery and farming technology for five potential shrimp species.
5. Production of cost effective desi feed, Vannami Plusby using the indigenous feed resources.

6. Production technology of selected microbial based shrimp growth promoter “CIBASTIM”
7. A sensitive, cost-effective and users friendly nested PCR detection kit for White Spot Syndrome Virus (WSSV) in shrimp
8. Modular hatchery and technology for fish pearlspot for homestead, SHGs and farming families
9. Production technology for crab farming in three tier or Zero stocking model
10. Cost-effective water quality kits for estimation of pH, ammonia, calcium, magnesium and hardness critical water parameters.
11. Promotion of functional feeds for larvae and broodstock as alternates for imported expensive hatchery feeds.

### 6.8.3.2. Proposed Action Plan

The proposed action plan is furnished below.

| S.No | Technical Activities | From | To | Total Duration (in months) | Institutions / Departments involved |
|---|---|---|---|---|---|
| 01 | Identification of suitable area for aquaculture development through Utilization of potential brackish water areas | May 2017 | March 2019 | 23 | ICAR CIBA, State Department of Fisheries Government of Tamil Nadu and State Revenue Department, Government of Tamil Nadu |
| 02 | District level planning for promotion of brackish water aquaculture | April 2019 | March 2020 | 12 | ICAR CIBA and State Department of Fisheries Government of Tamil Nadu |
| 03 | Horizontal expansion of successful brackish water aquaculture technologies through Public Private Partnership Mode | April 2020 | March 2022 | 24 | ICAR CIBA, State Department of Fisheries Government of Tamil Nadu and NFDB Hyderabad |

The specific action plans suggested for enhancement of the farmers' (stake holders) income in fisheries are

1. Approaches like "production and productivity enhancement, price enhancement, value addition / rich, and market strengthening".
2. Enlargement of culture area and efficient water usage
3. Technology intervention and to effect the migration from conventional farming to input based farming so as to produce high value fishes
4. Reduction of post-harvest loss and quality assurance for high price command
5. Integrated use of resources for holistic production approach involving all sectors and both genders without any discrimination
6. Promotion measures by the government for the wide scale adoption and assured income through creation of aquaculture park in coastal regions and specially designated areas. Marketing support through supply of transport carriers and live fish market facilities
7. Technical support from research (University and ICAR and Central Institutes)

In order to overcome the limitations, the Government is taking the following measures:

- Adopting Eco friendly and sustainable fish / shrimp aquaculture
- Introduction of fish seed rearing in floating cages in water bodies
- Adopting intensive cage farming in reservoirs
- Creation of fish seed banks to ensure the availability of fish seeds throughout the year
- Undertaking intensive fish culture in irrigation tanks
- Integrating fish culture in farm ponds / multipurpose farm ponds with agriculture to provide additional income for Farmers.
- Introduction of culture technology for fast growing fishes viz., Amur Carp, Jayanthi Rohu, Genetically Improved Farmed Tilapia (GIFT) and Pangassius, dissemination of knowledge for its propagation and establishing hatcheries for these species.

- Encouraging farmers by providing subsidy for setting up of infrastructural facilities for fish/prawn hatchery, fish culture in grow out ponds, feed mill and hygienic marketing infrastructure.
- To enhance the fishing efficiency of Inland fishermen.
- Creating job opportunities by promoting ornamental fish culture to rural women and youngsters.

Government is taking efforts on all spheres, to effectively boost the Inland fish production of the State by implementing various schemes under NADP. During 2016-17, fish culture with fast growing fish species has been taken up in 383 irrigation tanks covering an area of 9,000 hectares and this will be extended to 500 more irrigation tanks covering an area of 15,000 ha. during 2017-18.

The Government has mooted initiatives to double the income of agriculture farmers of the state by providing subsidy assistance to the tune of Rs.3.50 lakh per hectare for the integration of agriculture and aquaculture activities besides providing input subsidy assistance. The major thrust exerted by the Government during the past five years has commendably reduced the demand and supply gap of fish seed production in the State. This supply gap was reduced from 8.7 Crores last year to 6 Crores during the current year.

### 6.8.4. Capacity Building

Farm advisory services, answer to farmers' queries, organizing mass awareness programs, fish farmers' meets, stakeholders linkage through mass media, Industry-Institute meets and Exhibitions. The University and the State Fisheries Department are conducting various training program. With the objective of planning and execution of all outreach program in close coordination with other line departments / agencies such as the Dept. of Fisheries, Tamil Nadu Fisheries Development Corporation and other Government organizations, the University is taking a coordinating role. Besides, the Fisheries University established Centre for Sustainable Aquaculture (CESA) to enhance aquaculture production in the State, at Nagapattinam with the following mandates:

1. To develop and run the production centres at outstations of the University
2. To propose and establish new stations with focus on economically important species for the development of culture technology for adoption.

3. To establish and run the farms in the strategic locations and forming platforms for the research
4. To transfer the viable technologies through demonstration and training to the stakeholders

The marine fishermen will be taken to neighboring states for an exposure visit to the major fishing harbors, landing centres, processing plants and fish markets and training imparted to them on the best practices being followed in those places, type of crafts and gear used, fishing methods etc. Capacity building programs conducted for 1273 fisheries officials across the country to train farmers, fishers, master trainers, officers of the public-sector units concerned with fisheries development in the State

To initiate Knowledge Management (KM) activities in Fisheries and Aquaculture, the Centre for Fisheries Management, Planning and Policy (CEFIMAPP), as a constituent unit of TNFU at Chennai was established. This centre carries out the role of a knowledge aggregator, and become a clearinghouse of all data/information on existing and planned research projects and initiatives relating to Fisheries and aquaculture in the Tamil Nadu. The specific action plans are

- Hosting of geo-portal on Fisheries and Aquaculture
- Host-hub for knowledge/information sharing related to Fisheries and Aquaculture;
- Fisheries and Aquaculture Knowledge repository;
- Identification of potential research and development domains concerned with Fisheries and Aquaculture issues in the state; and
- Technical demonstration, research and development, extension and transfer of technology protocols, relating to Fisheries and Aquaculture.

The Fisheries Staff Training Institute (FSTI) under Tamil Nadu Fisheries University provides regular in-service training, refresher and orientation courses on Specialized Fisheries topics to the State Fisheries Department Officials. The University is also involved in certification of the seafood products through the Fish Quality Monitoring and Certification Centre at Thoothukudi. The State Referral Laboratory for aquatic animal diseases surveillance at Madhavaram, Chennai provides fish disease certification services

Fisheries Institute of Technology and Training (FITT) is a constituent unit of State Government funded Tamil Nadu Fisheries University (TNFU) functioning as a society, registered under Tamil Nadu Societies Registration Act, 1975 since 18.07.2008, with a vision to promote livelihood opportunities for the economic development of fishers and people involved in fisheries and aquaculture. FITT has been allotted with 1.16 ha land in Muttukadu, East Coast Road for which a master plan has been prepared to establish a state of art Skill development centre for fisheries and aquaculture. Memorandum of Understanding (MOU) between Tamil Nadu Government and TATA Sons as a technical partner was signed on 02.09.2008 for five years with a major objective to provide technical assistance to implement various marine fisheries schemes during the period of collaboration.

The Fisheries University is focusing its research and extension activities in the following issues with specific action plans like “production and productivity enhancement, price enhancement, value addition / rich, and market strengthening”, enlargement of culture area and efficient water usage, technology intervention and to effect the migration from conventional farming to input based farming so as to produce high value fishes, reduction of post-harvest loss and quality assurance for high price command, integrated use of resources for holistic production approach involving all sectors and both genders without any discrimination, promotion measures by the government for the wide scale adoption and assured income through creation of aquaculture park in coastal regions and specially designated areas and marketing support through supply of transport carriers and live fish market facilities

### 6.8.5. Enhancement of Production / Productivity, Price and Income:

The Inland fish productivity of the State was 626 kg from 3.83 lakh hectares with a total production of 2.4 lakh tonnes during 2014. This productivity can be enhanced with minimum possible technological and policy intervention to 1500 kg /ha. Similarly, the per capita production potential in the marine fisheries sector can also be increased by suitable interventions like increase in CPUE, Cold chain maintenance improved fish handling methods, post-harvest loss reduction strategies and by effective value addition.

**a. For inland Fish Farmers:**

1. Reclamation of water bodies and designating new water bodies for aquaculture work in order to increase the production area.

2. Establishing Fish seed Estate /Park with a cluster of fish read production units at a suitable location preferably in a reservoir area with necessary infrastructure. This can be operated by the Government or cooperative societies. Alternatively, farmer production organizations can also be entrusted with the responsibility of managing the Park funded by the government.
3. Establishment of "Fish Farmers Markets" at Taluk /District Headquarters, cities, rural markets, etc with facilities for sales of live fish including provision of live fish transport units. Farmers cluster groups (units) can be encouraged to take up this activity.
4. Introduction of diverse fish species for aquaculture like Air breathing fish (*Pangassius* spp., Murrel) GIFT Tilapia, *Etroplussuratensis*, *L. vannamei* (in low saline waters).
5. Encouraging Agriculture farmers to have fish culture in their farm ponds to serve as income – buffering unit. Integrating with livestock and poultry to be promoted.
6. Fresh Fish Market to be tied up with TNFDC and to get Fish price intelligence from their network.
7. To maximize income in Ornamental Fish culture practices, existing facilities are to be linked for sizing and marketing fishes.
8. Introduce Trench farming in areas where ever it is suitable to facilitate additional income (eg. 'Ayirai' fish)

**b. Marine Fisheries Sector**

1. Fish Business Incubator / Hand Holding facilities to be created in all TNFU Centres.
2. All Fish handling Centre, to be provided with fish dressing centers to facilitate primary value addition and thereby increasing the income. It also helps in easy collection of fish waste, which can be further used for Organic Fish manure production a key ingredient for Agriculture sector input cost reduction process.
3. Migration of fishermen from their core fishing activity to fish farming activity through coastal aquaculture park and supporting fish breeding facilities.
4. Supporting the fishermen with the fish marketing and value added fish production and marketing.

### 6.8.6. Research Support from TNFU for Doubling the Farmers' Income:

Further research will be taken up in the following areas

1. Technology development for mass – scale seed production and rearing of Carps (*Labeo calbasu* and *Labeo fimbriatus*), Catifishes (Magur and Singhi) Murrels (*Channa striatus*) and Pangas (*Pangasianodon hypophthalmus*).
2. Development of technology for seed production and farming of India Spiny Loaches, *Lepidocephalus thermalis* (Ayiraimeen) along India Major Carps.
3. Intercropping of Carps and Barbs in conventional major carp culture systems.
4. Development of aqua feeds by formulating feed with locally available feed in ingredients/ unconventional feed ingredients.

Tamil Nadu State Apex Fisheries Co-operative Federation Ltd., (TAFCOFED), has been registered under Tamil Nadu Co-operative Societies Act, 1983 and functioning since 19.10.1992 with its headquarters at Chennai, under State Department of Fisheries. At present, 477 Marine Fishermen Co-operative Societies, 141 Inland Fishermen Co-operative Societies, 158 Fisherwomen Co-operative Societies and 9 District Fishermen Co-operative Federations have been enrolled as members in TAFCOFED. TAFCOFED is conducting various need based training programs for fisher folk with the funding support of National Fisheries Development Board (NFDB), National Agriculture Development Program (NADP) and Government of India for effective transfer of technology and propagation of welfare schemes of the Government.

As a measure of offering alternative livelihood to marine fisherwomen, TAFCOFED had conducted training program on 'Solar Lantern fabrication and servicing' to fisherwomen belongs to 13 maritime districts of Tamil Nadu, with NFDB financial assistance of Rs.5.42 lakh for 260 coastal fisherwomen. This will help the fisher women to become a self-entrepreneur in production and servicing of Solar Lanterns.

TAFCOFED is also conducting Training program on "Basics of Seamanship and Navigation, Electronic equipment and Maintenance of Marine Engine" to deep sea going fishermen of Tamil Nadu with technical assistance from Central Fisheries Nautical Engineering Technology (CIFNET) and with financial assistance from NFDB. 1,000 fishermen in 40 batches will be trained under this program. 373 deep sea going fishermen were already trained in eight batches at Fishermen Training Centre, Colachel, Kanniyakumari district.

TAFCOFED is conducting training program on “Value added fish products” for members of fisherwomen co-operative societies in coastal districts of Tamil Nadu. In the first phase, 2,500 fisherwomen will be trained in 125 batches at a cost of Rs.31.87 lakh under NFDB assistance. About 1,150 beneficiaries were already trained in 36 batches in coastal District

### 6.9. Other Initiatives for Doubling the Farmer’s Income

#### 6.9.1. Bio-Control Production

Bio-control agents like parasitoids, predators and microbial pathogens become invaluable components in agricultural IPM system in view of high level of specificity, safety and sustainability. In addition to the natural bio control operating in many crop habitats, applied bio control can bring about a successful suppression of crop pests, disease and nematodes without disruption of the ecosystem and help us to have residue free marketable commodities. The high level of human safety, stability of control and renewable nature, make them very attractive candidates for pest management in organic farming.

Organic agriculture has experienced rapid worldwide growth during the last decade. According to recent surveys, more than 31 million hectares are currently under organic management in approximately 120 Countries. In Tamil Nadu, around 28,114 acres were registered under organic farming which necessitates the need for the availability of quality bio-control agents for pest management. Under natural condition, the biological control agents available are in quantities not adequate to bring down the pest damage. Hence the practical methods of mass multiplying them and using under field conditions have been investigated and exploited on a large scale in India during the last four decades. Recently a spectacular success has achieved in the state for the management of papaya mealy bug. *Paracoccus marginatus* using the parasitoid *A.papayee*. However, availability of Bio-control agents is often realized as a tough task at farmer’s level.

In this connection, Mass Production of potential parasitoids, predators and pathogens can be taken up at village level using farmers, self help groups and unemployed youth. The farmers showing interest can be trained on the mass production of bio control agents by the Scientists of Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore. The trained farmer/self help group/un employed

youth can initiate a Mass Production unit at village level as a small-scale cottage unit. The farmers of the village can have their own bio control agents for their crop husbandry which orient towards the bio village concept.

As a pilot project the interested farmers /unemployed youth in village / self help groups shall be provided with essential facilities for establishing mass production unit with funding. The farmers who have the training on the Mass Production of bio control agents can focus initially on the production egg parasitoid *Trichogramma spp.,* larval parasitoid *Bracon brevicornis* and coccinellid predator *Cryptolaemus montrouzieri* which will be easier and have good demand for sale. After gaining experience, they can scale up the production with addition of the bio control agents.

**Revenue Expected**

If an operating farmer employs his family labor for 3 to 4 hrs/day and spends Rs.10,000/month (by charging 10 trays /day and for 20 days per month) on food material for *Corcyra cephalonica* production, the host insect of egg parasitoid and larval parasitoid, he can earn Rs.20,000/month from six weeks after the initiation of Corcyra culture. Hence, a farmer can definitely expect a profit of Rs.10,000/month on this bio control mass production activity ensuring with sustainable and profitable to the farmer.

### 6.9.2. Community Entrepreneurship and Business Process Integration of Oyster and Milky Mushroom Production

Mushroom cultivation is the best rural biotechnology process to enhance the farmers income through crop residue recycling. By integrating the bioprocesses involved in mushroom growing, protein rich food, value added feed and organic biomanure can be made available at every farm holding. Oyster mushroom is an easy to cultivate tropical to subtropical climate loving mushroom, which can be cultivated by utilizing the agricultural residues like paddy straw, sorghum and maize stalks, maize cobs, saw dust. Milky mushroom (*Calocybe indica* var. APK 2) is a tropical edible mushroom and is relatively new to the world mushroom lovers. It is of Indian origin. The technology for commercial cultivation and the new variety has been introduced for the first time from Tamil Nadu Agricultural University, Coimbatore.

**The Process Involves**

- Centralized mushroom spawn production
- Indoor cultivation of oyster and milky mushroom
- Environmentally safe packing
- Enrichment of spent mushroom compost with beneficial bioinoculants / silage additives for value added feed and biomanure

**The Focus**

Community Entrepreneurship - Creation of centralized facility for

- Supply of quality Spawn, Spawned beds and Casing soil
- Pilot plant for packing, post harvest processing and food quality analysis
- Buy back, common brand equity and marketing linkages
- Technical consultancy, capacity building and quality control by TNAU Scientists
- Business planning Integration through ABI platform, Directorate of Agribusiness Development, TNAU, Coimbatore
- Creation of a Mushroom Food Court
- Linkage with financial institutes for future expansion

**Work Plan – Production**

- 25 individuals (5 from 5 villages at 5 KM radius) / cluster
- 250 kg of mushrooms per day(@ 10 kg by an individual).

  (Each of the individual is expected to earn a minimum of Rs. 8,000 to 10,000 /month)
- Preference to unemployed rural women / youth / SHG
- Training and capacity building at Central Unit
- Quality spawn, spawned beds and casing soil will be supplied with

  buy-back arrangement for mushrooms.
- Cropping rooms at a cost of Rs.1 lakh is to be constructed by the individuals

Expected production (calculated based on 100% Bio-efficiency Giving allowance to risk of contamination and Quality of produce) is 250 Kg /Day/ cluster.

1. Expected income per person in the group per month: Rs. 16,000
2. Expected income per person in the group per year: Rs. 1,92,000

**Project Outcome and Sustainability**

- 250 kg of Oyster / Milky mushroom / day ready for market
- Spent mushroom waste for feed, vermicomosting and organic manure
- Finished product is a nutritious food with lot of health benefits
- Quick money flow to the members
- Addresses Human Resource Development
- Direct employment opportunity – 25 Farm families in and around the project site

**Future Scope**

- Multipartite linkage in the production and supply chain for different tropical mushrooms and value added mushroom products including nutriceuticals, probiotics and pharmaceuticals
- Production of vermi compost / biofertilizers / bioinoculants through organic recycling of straw and other farm wastes

**6.9.3. Sericulture as a Component for Bio-Village Concept**

Sericulture is a regular and sustainable income generation enterprise particularly for the small and marginal farmers of the state. At present, 30,000 farmers are practicing sericulture activities in Tamil Nadu, cultivating 41,624 acres of mulberry in 31 districts and providing employment opportunity to more than 1.5 lakhs people.

Tamil Nadu continues to occupy the fore-front position in the country in Bivoltine silk production. Tamil Nadu stands first in cocoon productivity with an average of 69.69 Kg per 100 dfls, whereas the National average is 58.20 Kg. Hence sericulture is a remunerative enterprise for Tami Nadu farmers.

Sericulture farmer should have a minimum of one acre of mulberry garden supported by 1560 sq. feet of silkworm rearing house for carrying out silkworm rearing.

Farmer can realize income only after one year of mulberry cultivation. An amount of Rs. 2.20 lakh need to be spent as initial investment, during the first year. The farmer can realize a net income ranging from Rs. 1-1.5 lakh per year from second year onwards.

**B. Potential Contribution to Farmers**

The following are the success stories which can be up scaled in the state.

## Increasing Pulse Productivity

| | |
|---|---|
| Place of Implementation | Sikkal, Nagapattinam District |
| Sector | Agriculture |
| Type of Intervention | Introduction of Black Gram VBN 6 variety against ADT 3 |
| Impact | Now the variety black gram VBN 6 is cultivated in large scale area more than 15000 hectares over 43030 hectares of Black gram. |
| Key takeaways | Seed treatment with bio fertilizers, Nutrient management and application of TNAU Pulse Wonder during peak flowering stage |

## Out come

| | ADT 3 | VBN 6 |
|---|---|---|
| Yield (q/ha) | 7.0 | 20.0 |
| Gross Return (Rs./ha) | 70,000 | 2,00,000 |
| Net Return (Rs./ha) | 50,000 | 1,37,500 |

## Popularization of Hybrid Tube rose

| Place of Implementation | Dharmapuri District |
|---|---|
| Sector | Horticulture |
| Type of Intervention | Introduction of Tube rose Prajwal Hybrid against local |

| Village | Pre-demonstration (kg/ha) | Demonstration (kg/ha) | Post-demonstration (kg/ha) | Average increase over pre-demonstration stage (kg/ha) | Additional monetary gain (Lakh Rs./ha) |
|---|---|---|---|---|---|
| Kariappanalli | 7.60 | 22.05 | 20.40 | 168.42 | 492800 |
| Palavadi | 8.00 | 22.50 | 23.75 | 196.87 | 496000 |
| Makkanur | 5.25 | 14.25 | 13.30 | 153.33 | 309000 |
| Paisuhalli | 5.00 | 14.60 | 16.50 | 230.00 | 327200 |
| Kanapatti | 7.50 | 19.20 | 22.50 | 200.00 | 404400 |

## Millet Cultivation and Value Addition

| Place of Implementation | Salem District |
|---|---|
| Sector | Agriculture and Food Processing |
| Type of Intervention | Cultivation of minor millets and value addition |

| Minor Millets | Before processing (Rs/kg) | Processed (Rs/kg) |
|---|---|---|
| Sorghum | 30 | 70 |
| Pearl millet | 15 | 40 |
| Finger millet | 15 | 60 |
| Little millet | 30 | 75 |
| Foxtail millet | 30 | 100 |
| Kodo millet | 35 | 100 |
| Barn yard millet | 35 | 100 |

## Cultivation of Mushroom

| | |
|---|---|
| Place of Implementation | Pudukottai District |
| Sector | Allied Sector |
| Type of Intervention | Milky and Oyster Mushroom production throughout the year |

- Oyster mushroom - 10 kg/day @ Rs. 110/kg for 30 days
- Milky mushroom - 10 kg/day @ Rs. 150/- per kg for 30 days
- Spawn production – 300 bed spawn sold per month @ Rs. 35/ per spawn= Rs. 10500/- month
- Net profit Rs. 5,31,000/ year.

## CHAPTER VII

# VALUE CHAIN DEVELOPMENT, MARKET LINKAGES AND TRADE POTENTIAL

### 7.1. Processing and Value Addition

Despite low level of processing, food processing industry is one of the largest industries in India – it ranks fifth in terms of production, consumption, export and expected growth. The extent of processing in fruits and vegetables is very low (1.8%). The dairy products have the highest rank in terms of percentage of processing. The demand for processed food is increasing rapidly due to rising urbanization, change in the dietary habits and income levels. Due to this, processed food market is likely to go up manifold in the near future. Food processing has, therefore, been declared as one of the priority sectors. However, availability of quality value-added products is a major concern in addition to low shelf life of the products.

#### 7.1.1. Production & Post-Harvest Scenario

- Agriculture contributes about 16% of GDP, employs 52 % workforce and sustains approx over 70 % of the population
- India produces about 230 million tons of food grains and 53.1 and 91.6 million tons of fruits and vegetables and ranks second in world
- Low level of processing of fruits and vegetables at only 2.2% and losses range from 6 - 18 %.
- Food processing is employment intensive, creates 1.8 jobs directly and 6.4 indirectly for every US$ 25000 investment

**Reasons for Losses**

- Handling of raw produce (without washing, cleaning, sorting) through many stages of middlemen.
- Non availability of adequate and efficient equipment and machinery to be used in catchment areas.
- Processing is mostly controlled by urban rather than rural entrepreneurs which leads to losses in valuable by-products.

- Non availability of cold chain infrastructure for post harvest management and modern value addition techniques in production catchment
- Non uniform agricultural produce due to fragmented land holdings hence not suitable for large capacity processing.

### 7.1.2. Present Level of Processing of Different Commodities

**Table. 7.1. Level of Processing Across Different Crops**

| Sr. No | Sector | Processing level (%) |
|---|---|---|
| 1 | Cereals | 50 |
| 2 | Pulses | 75 |
| 3 | Oilseeds | 90 |
| 4 | Sugarcane | 88 |
| 5 | Fruits & Vegetables | 2 |
| 6 | Spices | 90 |
| 7 | Tea | 100 |
| 8 | Coffee | 100 |
| 9 | Dairy | 33 |
| 10 | Meat & poultry products | 7.5 |
| 11 | Fisheries* | 10 |

- Mostly in un-organized sector with traditional methods and inefficient equipment leading to losses
- Negligible secondary and tertiary processing
- Negligible attention to quality, hygiene and packaging
- Higher the value addition better the PH management and lower will be losses

### 7.13. Approach Planned

Post harvest management, value addition, and utilization of residues and by-products in production catchments to:

- Reduce post harvest losses
- Ensure safety and quality of food products
- Enhance nutritional security through fortification
- Produce high value derivatives from agricultural produce and by-products
- Increase farmers' income and generate employment
- Value addition to primary agriculture
- Agro-commodity based high value industrial and chemical products.

Establishment of secondary processing industries in production catchments based process waste

### 7.1.4. Assessment of harvest & Post Harvest Losses for Major Crops and Livestock Produce

| CROP | % Loss, minimum | % Loss, maximum |
|---|---|---|
| Cereals | 3.9 (Sorghum) | 6.0 (Wheat) |
| Pulses | 4.3 (Chickpea) | 6.1 (Blackgram) |
| Oilseeds | 2.8 (Cottonseed) | 10.1 (Groundnut) |
| Fruits | 5.8 (Sapota) | 18.0 (Guava) |
| Vegetables | 6.8 (Cabbage) | 12.5 (Tomato) |

- Technologies for

  -Reduction of post harvest losses

  -Value addition to agricultural produce in production catchments

  -Utilization of residues and by products

  -Nutritionally enriched products

- Entrepreneurship development
- Demonstration of value addition technologies through agro-processing centres in production catchments
- HRD in the area of value addition technologies

### 7.1.5. Technologies (Equipment) Developed in the Area of Food Grains and Oilseeds

- Modern small scale machinery for processing pulses into dhal (Mini Dal Mills)
- Production technology for dairy analogues from Soybean and Groundnut
- Extrusion/Expelling technology for production of edible oil and medium fat soyflour at small industry level
- Development of cleaners and graders for food grains and oilseeds (pedal-cum-power operated cleaner grader, Single drum rotary grain pre-cleaner)
- Development of pod graders and decorticators for groundnut and castor, dehusker shellers for maize and sunflower
- Development of batch and continuous dryers for cereals and pulses
- Development of metallic bins and silos for safe storage of food grains
- Devices and techniques to detect and control insect infestation during storage of food grains
- Ready to eat extruded products from cereals, millets and legumes
- Plant based dairy analogues and health drinks
- Value added soy products such as fortified biscuits, nuts, full medium and defatted soy flours and multi grain biscuits.
- Products like maize rab, makhana kheer mix, mustard sauce and snacks from millets
- Confectionery products from sunflower

### 7.1.6. Technologies (Equipment) Developed in the Area of Fruit and Vegetables

- Hand tools and gadgets for safe harvesting and component separation (kinnow and strawberry clippers, banana comb/hand cutter, hand tool for aril extraction, harvesters for mango, sapota etc.)
- Extractors for chillies, tomato, tamarind seeds and pomegranate arils,
- Dryers for dehydration of vegetables using different energy sources
- Pilot plant for cleaning grading waxing of kinnow
- Fruit graders/sorters
- Dehumidified air dryer using heat pump system
- Fruit and vegetable washing machine
- Evaporative cooled storage structures
- Powders from beetroot, carrot, sarson saag, ginger, garlic, onion
- Preserves from ber, amla
- Fruit bars from guava, sapota, papaya, mango and
- RTS beverages from guava, aonla, bael, mango
- Osmo-dehydrated pineapple, ber, guava slices and rings
- Technology for minimally processed and modified atmosphere packaging for cut fruits, vegetables and pomegranate arils

### 7.1.7. Technologies (Equipment) Developed in the Area of Plantation Crops

- Pedal and power operated dehuskersfor coconut and arecanut
- Climbing devices for coconut and arecanut
- Dryer for coconut and other plantation crops using different sources of energy
- Tender coconut punch and cutter
- Machine for production of white pepper
- Equipment for production of virgin coconut oil and snow ball coconut
- Harvesting device for oil palm

- Mobile oil palm waste shredding machine
- Mini palm oil mill
- Fiber extracting unit for empty palm oil fruit bunches
- Process for production of coconut chips
- Production of snow ball tender nut
- Process for virgin coconut oil, sweetened coconut chips, ball copra
- Chipping and shrink wrapping of tender coconut for urban markets
- Cashew apple RTS, jam/jelly and squash
- Process for production of white pepper from dried black pepper.
- Technology for making window shades from oil palm rachis
- Arecanut leaf sheath cup and plates and boards

### 7.1.8. Technologies (Equipment) Developed in the Area of Tuber Crops

- Cassava harvesting tools
- Manual and motorized cassava chipping machine
- Cassava chips dryer
- Cassava Rasper for production of starch
- Mobile unit for production of cassava starch
- Feed granulator
- Integrated low cost effluent treatment for starch and sago factories
- Biodegradable plastics from cassava starch
- Cold water miscible cassava starch
- Cassava rava, cassava porridge, cassava fried chips, cassava fried snacks, snack foods, nutria gulab, pickles and squashes from sweet potato
- Passive evaporated cool structure for potatoes

### 7.1.9. Technologies (Equipment) Developed in the Area of Sugarcane

- Two Pan Furnace with forced draft system
- Improved triple pan furnace
- Four Roller Sugarcane Crusher
- Double grating Jaggery furnace for increased heat use efficiency
- Churner for de-frothing during Jaggery Making
- Modified Hardness Tester for Solid Jaggery
- Cane Juice Boiling Pan
- Drying-cum-Storage Bin for Jaggery
- Cane juice filter for Jaggery making
- Sugarcane Juice Filtration System
- Sugarcane Juice collection and settling tank
- Boiling Pan Tipping Mechanism
- Crystal Jaggery making unit
- Low cost double pan furnace for Jaggery making by small/ marginal farmers
- Jaggery cubes moulding frame
- Electronic alarm for striking point of Jaggery
- Process for improved quality Jaggery from immature, over aged, scale infested and drought affected cane juice
- Process for producing liquid Jaggery
- Bottling of Sugarcane Juice
- Process for preparation of cane Jaggery in crystal form
- Okra plant stalk powder for clarification
- Herbal clarificants for sugar-cane juice in jaggery making
- Jaggery chocolate
- Ready-to-use Juice Clarificant Powder prepared from Deola *Hibiscus ficulneus*) Stem for Making Jaggery (*Gur*)
- Bottled Sugarcane Juice Concentrate

### 7.1.10. Critical Gaps

- Modernization of grain storage (bag and bulk)
- Agro-processing waste and crop residues – Extraction of bio-active compounds and value addition
- Indigenous Supply/Cold chain system
- Appropriate/Eco-friendly packaging for distribution
- Protocols for minimally processed/Near Fresh horticultural, livestock and fisheries produce
- Grades and standards
- Non-destructive measurement of quality
- Food quality and safety, including residue monitoring
- Modernization of market infrastructure
- Modernization of handling and value addition of livestock and aquaculture products for better hygiene and food safety
- Development/adaptation of appropriate processing machinery and their multiplication
- Modeling and simulation

**Priorities**

- Shelf-life extension of perishable commodities
- Rural level storage technologies for agriculture produce
- Technologies for modernization of production-to-consumption value chains for nutritionally important commodities
- Production of functional foods and nutraceuticals from agricultural produce
- Production of bio-fuels and industrially important products from agro-residues and processing byproducts
- Non-destructive quality assessment of raw and processed products
- Cryogenic processing of food
- Extending supply/cold chains to farm gate
- Emerging processing technologies for nutri-rich foods

## 7.2. Livestock and Poultry

### 7.2.1. Availability of Quality Germplasm

- Massive development support for continued availability of quality semen, chicks, piglets etc. and production of improved breeds and an effective supply system for different regions befitting varying production system, is imperative to capitalize on the potential of breeds for substantially enhancing productivity and production.
- Policy-setting and effective plan of action for potential indigenous breed improvement in livestock viz. Cattle, buffalo, goat etc. are essential for which quality semen production, storage, transportation, cold-chain facility and effective insemination system are required for reaching the end-user.In this endeavor, sampling of existing genetic variability and utilizing the potential livestock using both conventional and molecular approaches are essential.
- For exploitation of crossbreeds, not only the policy but also its effective implementation is critical with proper breeding policies for different agro-climatic regions based on the resource availability.

- *The annual milk production needs to increase by 5 million tonnes/annum against the present average increase of 3.2 million tonnes to fulfill the growing demand and this essentially has to come by increasing productivity. Large numbers low productivity – local milch cows constitute 39% of the animals in milk and contribute 21% of total milk production while crossbreds contribute the same amount (21%) but milch crossbreds constitute only 13% of the total animals in milk. There is a need to improve the productivity of local cows leading to reduction in total numbers and reduction in the carbon foot prints and feed resources*
- *A steady increase in the productivity of cattle and buffaloes is achievable by improving their genetic potential in a scientific manner. Presently about 20% breedable bovines are bred artificially and 80% are bred naturally. To accelerate genetic progress the proportion of bovines bred through AI needs to be increased substantially.*
- *Conception rate through AI in the field is not more than 25% and there is an urgent need to improve the success rate as this results in delayed conception of loss of productive life.*
- *For producing bulls with high genetic merit, progeny testing, import of exotic bulls (semen/embryo) and pedigree selection for indigenous breeds need to be followed.*

**Feed and Fodder**

The National Commission on Agriculture (1976) estimated deficit in dry fodder, green fodder and concentrates to the extent of 49,53 and 43 per cent respectively for 1972- Feed deficit, however, declined subsequently due to significant increase in production of food-feed crops. In 2020, the estimated deficiency in dry fodder, concentrates and green fodder will be 31, 47 and 23 per cent, respectively.

In order to address the critical issue of feed shortage, there is a need for enhancing the bio-availability of poor quality feeds, identify newer unconventional feeds, developing resource-based region-specific feeding modules, and developing fodder warehouses in the form of enriched feed blocks to mitigate the impact of drought and other natural calamities.

*Animal nutrition –(quantitative and qualitative shortage)ration balancing, compounded cattle feed, bypass protein/fat, area specific mineral mixtures, Densification/enrichment of crop residues,Increase the area under fodder cultivation, Fodder seeds production/distribution,Better management of common property resources, Ban on export of feed resources, removal of VAT and excise duty on use of molasses*

### 7.2.2. Animal Health Care

Controlling incidence and propagation of animal-borne infectious diseases such as foot-and-mouth disease, *brucellosis*, PPR, Jhones' Disease, and avian influenza is important for agriculture, industry and public-health officials because of the devastating economic consequences and possibility of transmission to human-beings. Inadequate availability of vaccines, delay in vaccination, requiring repeated vaccination due to low immunity of the vaccines, inadequate cold-chain are some of the major concerns affecting livestock health and production. In addition, the lack of national Geographic Information Systems (GIS) vis-a-vis animal farm locations, disease surveillance and monitoring are hampering the efforts to develop control strategies.

**Approach**

- Milk cooperatives have made a remarkable dent in the procurement, processing and distribution of fluid milk. Hence, there is need for increased involvement of cooperatives with adequate support in terms of marketing, cold-chain, and remunerative price to the producer.

- With respect to Value-addition, it is mostly the small-scale industries that have been playing a major role. As there is potential in this sector, the involvement of large business houses would be essential to bring in quality and meet the demand.
- Feed, which is one of the most critical inputs in livestock production, has been handled by private industries but have not been able to address the issue adequately due to the increase in the prices of the raw-material and due to less demand as most of the livestock farmers use either home-made feed or rear their cattle on grazing. This activity needs to be strengthened through participation from private sectors and public institutions providing technology backstopping and ascertaining quality and safety of feeds.
- Fodder has always been a matter of contention and has not received adequate importance. The fodder development programmes have been in the hands of the Animal Husbandry Department and neither there is qualified manpower nor infrastructure for addressing this issue. Fodder programme should be addressed by Milk Cooperatives that have a wider network and deep percolation. Involvement of NGOs and self-help groups would be critical to address this issue. Development of enriched fodder blocks and establishment of fodder warehouses will be important for providing balanced nutrients throughout the year and this activity needs to be taken with the help of commercial enterprises.
- Beef and buffalo meat production in TN is not purposive, but merely an outcome of the milk production system. Surplus male and unproductive animals end up as meat animals. Meat production in TN, except in case of broiler industry and the meat from culled layers in organized farms, are all in the traditional production systems with little investment. Meat prices in TN and their NPC indicate fairly high international competitiveness. However, they lose out on Sanitary and phyto sanitary (SPS) standards and have only limited markets confined to West, South and South East Asia. Livestock extension education can play an important role in this context to make the livestock products quality specific and cost effective by training of farmers and entrepreneurs on export quality standards and phytosanitary requirements; Market intelligence through information technology-cyber extension; Sensitization training to middle level extension functionaries to improve their technical and professional knowledge in skills; Conducting Livestock Extension Education

programmes on Good Agricultural Practices (GAP), Good Laboratory Practices (GLP) Good Manufacturing Practices (GMP); Capacity building in the areas of understanding WTO, SPS, legal issues of SPS, food safety, risk analysis, disease risk analysis, diagnosis etc are the prime areas of importance for the livestock extension education system.

- Manufacturing of vaccines and disease diagnostics has predominantly been addressed by the private players. This needs to be further strengthened by providing technology backstopping in the area of DNA vaccines, combo-vaccines, thermo-stable vaccines and molecular diagnostics. The delivery mechanism in terms of timely vaccination, artificial insemination and other healthcare related issues has to be undertaken by Cooperative Sector, NGOs, and private entrepreneurs. There is a need for establishing large number of veterinary clinics for providing timely diagnosis and treatment for which a network of small-scale entrepreneurs should be encouraged.
- The Poultry sector has attained a proportion of an industry, as several commercial players have been involved in this activity. This could be one of the reasons that this Sector has grown rapidly over the recent past. The role of corporate houses could continue to be the mainstay for the growth of this sector. However, there is a need for both forward and backward linkage development for making this sector vibrant and economically viable to the farmers.

*In TN, poultry sector growth is being driven by rising incomes and a rapidly expanding middle class, together with the emergence of vertically integrated poultry producers that have reduced consumer prices by lowering production and marketing costs. Integrated production, market transition from live birds to chilled and frozen products, and policies that ensure supplies of competitively priced domestic or imported corn and soybeans are keys to future poultry industry growth in India.*

- *Poultry meat demand is highly price sensitive among low- and middle-income consumers. Policies that protect the domestic poultry market may also slow growth in consumption and production.*
- *Factors that discourage transport and distribution of poultry within India, including limited demand for frozen products, a poor and high-cost transport infrastructure, and limited and unreliable cold chain, or frozen storage, facilities, are also strong impediments to poultry imports and may be as important as tariffs in constraining trade.*
- *Vertical integration can promote industry growth by enhancing production and marketing efficiency and reducing consumer prices. In India, the gains in marketing efficiency appear more significant than in production efficiency.*
- *Competitive feed prices are key to competitive poultry and egg production. Policies that protect local feed producers are also likely to slow growth in poultry and egg output, imposing significant losses on producers and consumers.*
- *Availability of corn and soybean meal at competitive prices, either through local production or imports, is a key to growth and competitiveness.*

On the whole, the economic dictates seems to demand a re-moulding of the livestock economy and the involvement of various stakeholders and alternative players, who can support this sector to meet the demands of the market-led growth.

### 7.3. Fisheries

Fisheries and aquaculture is an important component for state development rendering livelihood security for millions of poor people, income and employment generation, rich nutrition at cheaper price and augmenting national income.

Fisheries and aquaculture extension services play a critical role in application and transfer of scientific information to the end users and facilitate the farmers, fishers and entrepreneurs to access quality inputs, credit, market and backward and forward linkages throughout the value chain. Fisheries and aquaculture could easily meet its estimated target

of 3 million tonnes by 2020 and contribute much more substantially in its associated fields provided the issues constraining the sector are adequately addressed.

Fisheries production comprises of inland capture and culture (freshwater aquaculture), marine capture and culture (mariculture and brackishwater aquaculture) and fishery technology (crafts, gears, post harvest and value addition) components. It has been proved in fisheries dominated countries investments made in fisheries extension research and extension services have contributed much more than expected not only in augmenting fisheries production but also in the quality of fish produced.

China is the current example and it attributed 15% to its extension service for the production increase in fisheries and aquaculture. Increasing the knowledge levels, improvement in skills, progressive changes in behaviour and attitude of the end users is the progressive path of extension services. In all the south east countries where fisheries is major player in their economy extension services are public funded, given its due share and proved to be effective. An attempt has been made in this note to identify the component specific issues and possible development approaches to deal with those aspects.

### 7.3.1. Inland Fisheries

| Stream | Problems/Issues | Development Needs/ Possible Solution (s) | Development approaches/strategies |
|---|---|---|---|
| **Inland Capture Fisheries**<br><br>Capture Fisheries (Reverine, reservoir, bheel, flood plain fisheries ) | ❖ Average annual fish yield in reservoirs is 20kg/ha. Fish yields from small, medium and large reservoirs are respectively 30, 40 and 50 kg/ha only. (China 800 kg/ha)<br><br>❖ Reservoir fisheries are a sleeping giant with proper stock enhancement and culture the production can be increased to 1.5 million tonnes easily from the present 93,000 tonnes. | ❖ Selective seed stocking, scientific management and errection of cage, pens in the peripheral waters.<br><br>❖ The DoFs need to manage the reservoirs either in partnership with local community and/or with private entrepreneur. | ❖ Co-management approach (govt. and local communities and private).<br><br>❖ Community based fisheries management. Community mobilization is critical. SHG approach could be a good option. |

| Stream | Problems/Issues | Development Needs/ Possible Solution (s) | Development approaches/strategies |
|---|---|---|---|
| | ❖ Substantial hike in reservoir fisheries is possible through culture based and stock enhancement interventions in reservoirs (enhanced capture fisheries). | ❖ Government can provide the seed and the management should be by either community or entrepreneur. Framework for sharing the output need to be worked out and an MOU can be made. | ❖ Capacity building on scientific stock enhancement fisheries & management. |
| | ❖ Large reservoirs stock enhancement and for small and medium reservoirs culture based management is shown to be an important tool for large scale seed raising from such water bodies. | ❖ Stocking of high value prawns scampi and river prawn (*Macrobrachium sp)* in reservoirs yielded good results (CIFRI study). | ❖ Demonstration of pen and cage culture with suitable fish species in reservoirs. |
| | ❖ Reservoir is sleeping giant even with a modest improvement through better management and governance it could make substantial improvement. | ❖ Pen and cage culture in running waters gives production as well as livelihood. | ❖ Demonstration of pen culture in running waters in rivers during the monsoon season with SHG mode.<br>❖ (Govt. subsidy for seed, pens and inputs make it wide adoptable).<br>❖ Policy advisories for capture fisheries development. |
| **Inland Culture Fisheries** | ❖ India is self sufficient in carp fry production with 21 million fry production. Average fish production from | ❖ Educating the aqua farmers on scientific production practices | ❖ Awareness creation and capacity building and Better Management Practices of inland |

| Stream | Problems/Issues | Development Needs/ Possible Solution (s) | Development approaches/strategies |
|---|---|---|---|
| | tanks and ponds is 2.5t/ha. However, the production is very low in seasonal waters. Inland aquaculture is mainly confined to Indian Major Carps as Polyculture or composite culture with exotic carps (Grass, silver and common carps). | | aquaculture. |
| | ❖ Non-availability of fingerlings of desired size and species is a major concern and issue. | ❖ Educating people to minimize the anthropogenic pollution of common water tanks. | ❖ Educating people to minimize the anthropogenic pollution of common water tanks. |
| | ❖ Stocking of ponds with fry/spawn and irrational quantity lead to low survival and low production. | ❖ Lack of technical skills in production management practices | ❖ Group approach to freshwater culture too and capacity building on nursery rearing of scampi. |
| | ❖ Irrational stocking of the fish fingerlings due to the availability of species (IMCs). | ❖ Species and system diversification - technology for indigenous fish seed production – especially for riverine cat fish *Pangacius pangacius* need to be standardized. | ❖ Demonstration of cage fish culture in running waters SHG model with a scheme. |
| | ❖ Poor technical knowledge – improper management of individual and community owned ponds. | ❖ Integration of rice farming and fish (2 million ha rice farming). | ❖ Entrepreneurship development in nursery rearing of Carps. |
| | ❖ Improper feed and feed management. | ❖ Adoption of BMPs in scampi, HACCP approach to scampi farming. | ❖ Capacity building on HACCP approach for Scampi farming. |

| Stream | Problems/Issues | Development Needs/ Possible Solution (s) | Development approaches/strategies |
|---|---|---|---|
| | ❖ Anthropogenic pollution of common water tanks.<br>❖ Need for horizontal expansion, bring unutilized area under culture – 50% of the area still unutilized.<br>❖ Ignorance of fish culture technology among the farmers one of the important major constraint.<br>❖ Lack of entrepreneurial attitude among the inland farmers to adopt fish farming on enterprise mode.<br>❖ Lack of institutional credit and insurance.<br>❖ Lack of infrastructure, machinery facilities, market facilities.<br>❖ Almost total quantity is domestically consumed. Lack of market intelligence and storage facilities.<br>❖ Lack of regulation and control of marketing channel by the government. | ❖ Fish nursery rearing – separate package of entrepreneurial activity.<br>❖ Ornamental fish culture – a livelihood activity – training SHGs on that.<br>❖ Integrated fish farming systems – models, demonstration and training.<br>❖ Cold water fisheries – Carp culture in the middle hilly region and integration of fish culture with other farm production systems.<br>❖ Development of an online data base for the inland culture sources based on GIS and remote sensing.<br>❖ Linking with farmers with domestic market | ❖ Demonstration of integrated fish farming systems.<br>❖ Community based management of common tanks with SHG approach.<br>❖ Development of e-learning modules on vernacular languages<br>❖ ICT aided market intelligence<br>❖ Establishment of VKCs for exclusively for freshwater aquaculture.<br>❖ Contract farming approach to address the credit, insurance and marketing issues. |

| Stream | Problems/Issues | Development Needs/ Possible Solution (s) | Development approaches/strategies |
|---|---|---|---|
| | ❖ Lack of data base on freshwater ponds, production techniques, production details is a constraint in planning and policy levels.<br>❖ *Salmonella* problem in harvested scampi and rejections in the international market. Scampi culture area has come down drastically. | | |
| **Marine Capture Fisheries**<br><br>**Mariculture** | ❖ Depletion of natural resources through irresponsible fishing<br>❖ Mariculture - constraints lack of knowledge on mussel farming, unpredictable seed availability, mortality of the seeds during transportation, mortality of seeds during transportation, reduced growth and marketing of mussels.<br>❖ Marine fin fish farming lack of seed is a major issue.<br>❖ Lack of awareness on marine ornamental culture | ❖ Marine Fisheries – self help groups – preparation of value added fish products in fisheries, preparation of dry fish products, ready to eat fish products, ready to cook fish products, ornamental fish culture, mussel culture, clam collection, edible oyster culture, pearl culture, mud crab fattening/culture.<br>❖ Open cage farming to improve the fisheries production – selective stocking seed production technologies available for fishes, crabs and bivalves.<br>❖ Responsible resource enhancement through sea ranching. Educate | ❖ Public private partnership for open sea farming.<br>❖ Awareness creation on responsible fishery resource enhancement.<br>❖ Large scale demonstration of artificial reefs through FADs<br>❖ Capacity building of SHGs on bivalve cultures. |

| Stream | Problems/Issues | Development Needs/ Possible Solution (s) | Development approaches/strategies |
|---|---|---|---|
| | | the fishers to use by catch reduction devices (BRD), square meshes and large size mesh nets. | |
| | ❖ Lack of awareness on sea weed culture | ❖ Fish Aggregating Devices (FADs) – artificial reefs for natural conservation. | ❖ Demonstration of open cage farming in the identified locations- needed policy initiatives- policy inputs required.<br>❖ Development of policy advisories required |
| **Brackishwater Aquaculture** | ❖ Sustained crop failures owing to diseases – vertical and horizontal entry of pathogens. | ❖ Adoption of bio-security and better management practices (BMPs). Educate and motivate the farmers on adoption of BMPs including bio-security. | ❖ Capacity building of farmers on BMPs. |
| | ❖ Ever increasing production cost | ❖ Promotion of Sea bass nursery rearing as a separate enterprise activity. | ❖ Entrepreneurship development in brackishwater aquaculture. |
| | ❖ Decreasing market prices | ❖ Domestic marketing – market intelligence, branding and advertising on the nutritional benefits of seafood. | ❖ Sensitization farmers on sanitary and phytosanitary measures to ensure shrimp quality. |
| | ❖ Rejections at international markets due to food safety issues | ❖ Diversification of indigenous shrimp species banana shrimp *F.merguensis* and Kuruma shrimp | ❖ Sensitization of farmers on *L.vannamei* farming. |

| Stream | Problems/Issues | Development Needs/ Possible Solution (s) | Development approaches/strategies |
|---|---|---|---|
| | | *M.japonicus* standardization of seed production technology. | |
| | ❖ Single species centric nature of production | ❖ Traditional brackishwater farming – selective stocking and supplementary feeding. | ❖ ICT for market intelligence and technology transfer. |
| | ❖ Lack of domestic consumption. | | ❖ Demonstration of improved traditional farming with selective stocking and management. |
| | ❖ Diversification of brackishwater aquaculture through seabass and mud crabs. Seabass - criticality of nursery rearing. In case of mud crab – lack of seed. | | |
| | ❖ Introduction of exotic shrimp *Litopenaeus vannamei* – need for a complete farm bio-security and post-harvest handling. | | |
| | ❖ Traditional brackishwater farming – very low productivity | | |
| **Fish Processing and technology**<br>In India about 80% of the total fish production | ❖ Post – harvest loss (8-12% of total fish catch). Improper handling of fishes, storage loss, poor fish handling – lack of hygiene and sanitation. | ❖ Proper post harvest handling of fishes to prevent the quality deterioration, fish transportation, preprocessing.<br>❖ Inculcating business | ❖ Entrepreneurship development of SHGs (business skills, branding, packaging etc.). |

| Stream | Problems/Issues | Development Needs/ Possible Solution (s) | Development approaches/strategies |
|---|---|---|---|
| (capture and culture) is domestically consumed and only 9% is alone processed and exported. | ❖ Lack of awareness on the developmental schemes available for fishermen and women on fish handling and marketing.<br><br>❖ SHG value addition of low value fishes – lack of marketing linkage<br><br>❖ 80% marine catch is marketed in fresh from and remaining 30% is processed. | promotion skills<br><br>❖ Value addition of low cost fishes – training SHGs and linking SHGs with market<br><br>❖ Value addition through community based fish processing units<br><br>❖ Awareness creation on the nutritional benefits of sea food with data.<br><br>❖ Capacity building on quality control – HACCP protocols. | ❖ Awareness creation on the schemes for fisher folk and fisherwomen.<br><br>❖ Community approach for development of fish processing and value addition.<br><br>❖ Training to all farmers and fisher folk on fish handling, effective storage/ preservation. |

### 7.3.2. Institutions working for Fisheries and Aquaculture Development and Linkages

| | |
|---|---|
| Animal Husbandry, Dairying and Fisheries, MOA, GOI | Policy and guidelines |
| Department of Agricultural Research and Education - ICAR | Research, technology support and front line demonstration with extension service |
| Coastal Aquaculture Authority | Regulation and guidelines for sustainable coastal aquaculture |
| National Fisheries Development Board | Promotion of fisheries and aquaculture incl. domestic marketing with various schemes. |
| Marine Products Export Development Authority (MPEDA) of Ministry of Commerce, GOI | Promote fisheries and aquaculture to boost production for trade. |
| National Centre for Sustainable Aquaculture (NaCSA), MPEDA | Extension services for coastal aquaculture including mobilization of farmers, technical counseling and other services. |
| Fisheries Colleges of SAUs | Research, education and training with limited extension service. |
| Krishi Vigyan Kendras | 2 exclusively for fisheries one each with CMFRI and CIFA |
| Trainers Training Centres | 2 exclusively for fisheries one each with CMFRI and CIFA |
| Agricultural Technology Information Centres | 3 exclusively for fisheries one each with CMFRI , CIFT and CIFA |
| Department of Fisheries of States | Major responsibility for extension service with 422 FFDAs and 39 BFDAs, Fisheries Cooperatives, Fisheries Development Corporations etc. |
| NGOs | Mobilizing fisherwomen SHGs |
| Development Departments including banks | Fisheries and aquaculture promotional schemes |

### 7.3.3. Fisheries and Aquaculture Development and Extension Services

In India, fisheries and aquaculture being the State subject, though the fisheries development and extension services are planned both at Central and State levels, the maritime states have the major responsibility in providing this key support. Establishment of FFDAs and BFDAs respectively for the freshwater and brackish water aquaculture was the only measure undertaken so far on the fisheries extension front by the central government. FFDAs and BFDAs established to augment the income and employment generation of fish farmers by providing training and help in availing institutional credit. Studies indicated that FFDA trainings were not effective in terms content and lack of practical orientation. BFDAs were also not supported with technical backstopping and some of the states had even dismantled the BFDAs. The research centres of DoF and State Veterinary and Fisheries Universities play a very limited role in extension service. The DoF extension system has been pre-occupied with implementation of welfare schemes of central and state governments having input and subsidy delivery. In coastal aquaculture aqua business companies, aqua-consultants and progressive farmers have taken the lead.

- Fisheries sector is yet to start a dedicated and organized extension service. There is no formal well-established system for information delivery and to obtain feedback from the field.
- There is no uniform organizational structure exist in DoFs of maritime states
- There is no budget for fisheries extension as such
- Inadequate skilled manpower at various levels
- Lack of extension orientation in the DoFs and DoF officials are unaware of extension concepts, methods
- Lack of opportunity for knowledge and skill updation
- Mismatch of trained personnel with their work.
- Concentration mostly on welfare measures
- Lack of extension material and infrastructure at field.
- There is no focused linkage with SAUs other then membership in certain committees
- There is no linkage between central research institutions and SAUs.

Productivity enhancements in aquaculture ponds and tanks, effective management of reservoirs and riverine resources, diversification of aquaculture, scientific management of ponds and confinements, conservation and responsible fishing, post-harvest handling and value addition, strengthening domestic marketing and streamlining of institutional mechanisms are prominent areas need to be addressed for augmenting and sustaining the fisheries production. Fisheries extension would contribute significantly if proper attention and investments are made. Other than FFDA and BFDA in 4$^{th}$ and 6$^{th}$ plans respectively no support has been given for fisheries extension. To streamline the public extension services and to facilitate partnerships, evolution of a State Fisheries and Aquaculture Development Extension Service (NFAES) to strengthen the public extension system (DoFs) with structural and functional modifications is the need of the hour. A strong public funded extension service is essential to cater the diverse resource poor farmers and ensure sustainable natural resource management. Further, a strong DoFs alone could create an enabling environment for other extension service providers to contribute for sustainability. An institutional mechanism which facilitates the linkage between research and extension systems is to be established at the state level. This would ensure regular exchange of information between research and field extension, help in updating the fishery extension personnel and contribute for need-based technology development, transfer and communication of feedback.

## CHAPTER VIII

# POLICY AND INVESTMENT REQUIREMENTS AND ROLE OF THE GOVERNMENT

### 8.1. Policy

Lessons from recent developments: In the last 15 years, agriculture in Tamil Nadu has undergone a considerable change towards diversification and market orientation. With the limited scope for area expansion, three most effective instruments for reducing rural poverty, increasing income and improving livelihood security are: (i) increasing productivity, (ii) enhanced post harvest activity in production catchments, and (iii) reducing costs leading to greater share of consumer rupee being passed on to the grower. Thus, accessibility to relevant agriculture knowledge, technologies, materials, skills and services becomes a critical determining factor. There is vast scope for managing knowledge in agriculture and allied sectors with involvement of all possible stakeholders' viz. Govt. machinery, agriculture research ecosystem, and other agencies in the public and private sectors, including the non-Government organizations. All efforts must aim at the ultimate goal of realization of the empowerment of the socially and economically most disadvantaged sections of the Indian society.

Agriculture as the key to Food security: Agriculture, along with the allied sectors, only provides the principle means of livelihood to over 60% of state population. Despite a steady decline in its share of GDP, it remains the largest economic sector in the state. Thus, application of available knowledge in agriculture is essential to boost the agrarian economy and give the Indian farmer a competitive edge in the global market.

From knowledge creation to use' as the key to peace and happiness in villages: The scope of research and extension must be expanded beyond technology transfer to encompass a wide range of services relating to knowledge creation, exchange, access and use. There is need for massive investment towards: i) improving the organization of agricultural research, ii) reforming the agriculture education and extension, iii) directing R&D funds to neglected areas, iv) providing effective incentives for researchers, v) harnessing the synergies through involvement of private and NGO sectors, vi) promoting growth and development of both traditional and contemporary knowledge; and finally, as India lives in villages; vii) improving the overall quality of life in its villages.

The focus has to aim towards widening the scope and efficiency of extension, with stress on making knowledge applications in agriculture farmer-led and community-driven; therein ensuring integrated range of services with a holistic approach towards a committed sustainable program of development for ultimately bringing peace and happiness in the villages.

### 8.2. Reforms in Agriculture Education as the First Driver of Change

A clamoring society for meaningful knowledge of agriculture: The agrarian society wants the information to be: i) relevant, ii) practical, iii) communicated on their level, iv) near their home, and vii) available when needed, on the television or internet, via cell phone, or by society-ready extension personnel. Therefore, the information is required from the input, production, processing, public health and economic sectors. The general situation that harvested produce sits and spoils, and is not optimally utilized must end. The general situation of short-term surpluses and long-term shortages must end. Over the chain of events, value addition, and not value subtraction, has to be ensured. We need society-ready graduates with skills in: i) problem solving, ii) critical thinking, iii) oral communication, iv) leadership, and v) appreciation of life-long learning. Agriculture extension agents need to have ethical / moral character with awareness of social dimensions and eagerness to learn from international trends.

Increasing demand of agriculture education: The demand for agriculture education is growing with widening of the diversity in consumption patterns for the increasing variety of requirements. Today, agriculture graduates are in great demand; both for the agri-business related requirements in banking, finance, marketing, insurance and other related sectors; as well as for the much increased opportunities in public and private agriculture R&D and extension dimensions.

Effects of inadequacy of agriculture education infrastructure: The spurt in growth of agriculture education infrastructure remains severely affected with inadequacy of financial support and autonomy. The overall support is clearly presenting a dilution in quality of human resources engaged in agriculture research, education and extension. Salient problems affecting agriculture education in the country are: unplanned growth of institutions, poor quality of intake, lack of practical orientation, poor industry interaction, and much less exposure to recent advances in agriculture sciences.

Absence of a strong base in agriculture science erodes the strong agriculture base: The severity of the situation needs to be viewed in the face of changes that are happening worldwide. With agriculture becoming more and more globalized, we are more and more lagging behind. In terms of the future prospects of agriculture sciences in India, we are far behind in new areas of agriculture science e.g. biotechnology, nanotechnology, GPS/GIS, ICT applications to agriculture, climate change and adaptation, growing mechanization in agriculture in several developing countries, food safety, technology guided fishing, drought management, natural resource management, increasing demands for high quality food and non-food agriculture commodities, intellectual property management, and global agribusiness and international trade. The erosion of basic sciences in agricultural research ecosystem, and not addressing adequately the social sciences and gender issues, as well as the agriculture marketing and agriculture development policy dimensions will be found wanting in the long run, thus impacting negatively with respect to providing a strong base to state agriculture.

Reforms in course curriculum is a must: There is need for modernization of course curriculum in agriculture. Agriculture education designed mainly for green revolution era has not transformed much to meet the current needs. Efforts to develop agriculture education in the state will include revamping the course curriculum based on present and future needs, is imperative. In the present times, agriculture education has to also cater to the inter-relationship among the following agriculture sub-systems: i) agribusiness, ii) plant/crop, iii) animal, iv) biotechnology, v) environmental service, vi) food products and processing, vii) natural resource, viii) power, structural and technical; and ultimately the ix) socio-economic system.

Requirement of para-professionals in agriculture: Considering the dimensions of the country and diversity of agriculture situations, scientific strength alone cannot meet the gigantic requirement. The massive requirement of para-professionals calls for new degree, diploma and certificate courses in: i) agriculture mechanization and crop production, ii) soil and water management, iii) flowers, fruits and vegetables growing, iv) processing and value addition, v) food science, vi) applications of biotechnology and bioinformatics, vii) bioenergy, viii) organic farming, ix) GM crop production, x) computer/IT use, and xi) supply chain management. All this needs emphasis as grass root workers (bare foot technicians) are in great demand. This is specifically required besides the conventional emphasis in a general manner on agriculture, horticulture, animal husbandry, veterinary, dairy, poultry, fisheries, and agriculture engineering.

Accountable flexibility for demand-driven agriculture education: In the B.Sc/B.Tech degree programs in the final year, and in post-graduate degree programs, flexibility in the selection of courses will go a long way in directed prospects for individual student. Emphasis on both written and oral communication needs special emphasis in the degree programs to enable students face successfully the increasing standards of competition in the market. Equipping new graduates with subject competency, self-motivation and positive attitude is also necessary. Examples of new innovative methods for management of education are available in plenty; and provide the required leads for cost-cutting as well as a holistic education. Autonomy alongside accountability in operations of the universities and research institutes is equally critical to: i) attract and retain youth in agriculture, and ii) global recognition of Indian agriculture education. This alone will provide a new breed of students with knowledge, professionalism and entrepreneurial skills.

### 8.3. Conversion of Meaningful Agriculture Education into Effective Agriculture Extension

The existing agriculture extension system for the ultimate goal: Agriculture extension system in India is one of the largest systems in the world. Agriculture universities (TNAU/TANUVAS/TNFU), agriculture technology information centres and the *Krishi Vigyan Kendras* provides the advisory and technology backstopping frontline extension system. Massive support is provided from central Govt. to agriculture extension services and plans in all the States. The State Governments thus get support for rural development, technology transfer and field extension from various Govt. of India Ministries. Besides, there are several programs and schemes sponsored by Central Govt. for private and non-government sectors, and farmers' organizations. Central Govt. schemes also exist to benefit individual farmers and landless workers. Yet, the overall effort in capacity building falls far short of actual requirements to meet the ultimate goal. The ultimate goal is: improve food availability, nutrition and health by providing opportunities for diversification of income and consequent economic and social advancement of the rural poor and women; in particular by modernizing agriculture sciences and extension curriculum.

Harnessing from the available knowledge and technologies: To a reasonable extent, available knowledge and technologies can solve agricultural and environmental

problems, meet local food and nutrition needs, and create business opportunities in India and other developing regions. However, these are less or not delivered appropriately owing to the peculiarity of available systems. The existing knowledge is required to be given in the safe hands of entrepreneurs, businesses and agencies who can adapt them to local economic structures and markets.

Requirement of appropriate structures and processes: Despite the size of available systems, there are few structures and processes that: i) facilitate mapping emerging technology needs based on priority development needs, ii) select appropriate, adaptable technologies from technologies generated in India and in partner countries to meet these development needs, iii) prepare the necessary scientific, technical, legal and human components into an assessable, accessible and assimilate package, iv) identify and mentor suitable and receptive implementing parties, v) plan and manage the technology transfer and commercialization process between creators and implementers, and vi) provide on-going mentoring and support to assure that the technology transfer and assimilation takes “root”.

### 8.4. Effective Agriculture Extension to Nurture Entrepreneurship and Commerce in Agriculture

Effort in Extension Schemes: The schemes are *inter-alia stated to be* aimed to provide the necessary five broad dimensions: i) knowledge about relevant agriculture technologies, farming and production system, and about markets (inputs, demands and prices) and policies; ii) therein facilitating the critical technical resources viz. latest knowledge and technologies, capacity building, and minimum essential infrastructure support; iii) problem solving consultancy and critical technology products (e.g. seed, planting material, bio-agents, small tools / equipments / machinery, etc.), iv) organizing farmers - for exchange of information, facilitating from learning and experience, and support in decision making; and the ultimate but most critical, v) inculcating the very competence in individual farmer / entrepreneur to themselves evaluate technologies, appreciate the requirements of agri-logistics, develop from intelligence in the market, harness synergies from group dynamics, and be ready to capture opportunities and manage any possible threats in their business of farming and related sectors.

Effort in Agriculture Education Schemes: The schemes are *inter-alia* stated to be aimed at nurturing communication and knowledge sharing skills. These include

professional development requirements viz. experiential learning, e-learning and delivery, and entrepreneurship; and attempt to focus on both: i) hard skills viz. strong training in fundamentals, critical thinking, problem solving, and operation and management; and ii) soft skills viz. working in teams, listening and speaking, professionalism and leadership.

In partnership mode: The formal collaborations with agencies like ICAR include involving in All India Coordinated Research Projects (AICRPs), and *Krishi Vigyan Kendras* (KVKs). A more organized / planned effort fully realizing that collaboration with private sector / NGOs required.

Gains from the World Bank-aided projects: Experience and expertise of people with both intensive and extensive international exposure in agriculture research, education and development have been utilized in these projects given to the state. With fixed time duration and much more accountability in their administration, these World Bank-aided projects have to a great extent hastened the learning process on diverse and latest nuances of the overall subject, as understood in the developed world.

The learning so far: There is an evolution in the thinking that the transformation of agricultural R&D sector from primarily food self-sufficiency to market orientation requires partnerships with external agencies including seed producers, farm equipment manufacturers, grain wholesalers, agro-produce processors and so on. It is strongly felt that the potential in the new approaches (developing consortia, partnerships) is much higher than in the old approach (single standing research).

The way forward: More reforms in research, education, extension and entrepreneurship have been conceptualized on a much bigger scale fully realizing that it is the market-led forces which alone will determine the success in times to come. More and more game changing innovations are needed not only in developing and scaling up path breaking technologies, practices or products but also in creating smarter business practices / models that package and deliver existing / new products and services to rural people across all income groups, and even export in the most cost-efficient manner. Hundreds of thousands of innovative and knowledgeable entrepreneurs should get involved to launch thousands of possible solutions to address uncommon opportunities and complex challenges emerging every day. A mass movement / mission / initiative are needed to make it happen.

The new research challenge: The new challenge is that the potential of research has to be realized by extending it in a manner that leads to new products, services and systems that add value to bring about significant changes in income, employment and livelihood security of people; not only in rural India but also to fuel the entire economy. In other words, bringing knowledge to create value has to be at the centre of the new approach. This can be achieved if entrepreneurs are created in large number and nurtured through appropriate interventions / incentives / investments by generating new technologies, allowing access to latest technologies, arranging required services and supplies to optimally use the technologies, and providing the required entrepreneurship skills. This requires setting up of an effective innovation system that nurtures entrepreneurship through networking of institutions in the public and private sectors and also social / development agencies that would interact in the production, processing, diffusion and use of new and economically useful knowledge.

The translational research requirements: Generally, the technologies developed by academic and research institutions are at ‘proof of concept’ stage. Rendering them fit for commercialization requires catalytic support and facilities for demonstration of innovative product and process technologies so as to traverse the journey from ‘laboratory’ stage to ‘pilot’ stage and then commercial production. Compounding the dilemma are the regulatory aspects of research that have become increasingly burdensome, complex and difficult to understand and comply with. There is need to address specifically the issues of mid-level validation of research results that would require translational research engagement, invariably in partnership mode. It would include technology refinement, scaling up and provide for technology verification, process / technology scale-up assistance, pilot scale design / construction / operation services, as well as identification and solutions for process scale-up and regulatory issues.

Necessary support to translational research: Providing funding support for translational research will require: (a) identification of priority research needs where partnerships are essential to aggregate technologies from partners based in India and outside India; (b) a mechanism to pool technologies within the NARS in a manner where access is facilitated by competent teams engaged in aggregation and access facilitation process; and (c) a system of funding externally or internally driven translational research for product commercialization. This could be in collaboration under public-private partnership mode.

Promoting and facilitating translational and regulatory research: It would also require creation of state-of-the-art laboratory infrastructure and skilled manpower in specialized centers of research and creation of product scale-up centers that can effectively scale up technologies for commercialization. These technology-specific hubs would integrate and streamline product / process development from the laboratory to the market place in identified high-end technology areas, including seed and planting material, post-harvest and value addition research, plant and animal health technologies, biotechnological products etc. These hubs would be coordinating and enhancing this focused activity to create commercial opportunities to develop and exploit partnerships between academic researcher and industry, therein integrating translational research and regulatory compliance processes so as to reduce both, the time to market and the costs associated with research and development of innovative technologies.

Hubs to meet international standards: These have to aim at meeting the requirements of international standards for quality, food safety and other regulatory obligations, and will require dedicated personnel / experts for providing the required technical back up to the industry. It would be essential to develop professional competency to engage in post technology commercialization process with mentoring support and hand holding to ensure that the technologies take the requisite root through market success.

Lateral flow of technology: The public sector research today is facing enormous challenges related to long-term sustainable productivity increase in agriculture, while maintaining and enhancing the natural resource base on which rural agriculture economy depends. Advances in other fields of science and engineering are catalyzing efforts in agriculture production and processing with a view to address the economic, human health and environmental sustainability issues. Next generation technologies harness the powers of information technology, biotechnology (genomics, phenomics, proteomics etc.), nanotechnology, emerging food processing technologies for high value products, mechatronics and environmental engineering to address the issues confronting the agriculture and agro-industries.

Public-private partnership for high-end science: There are some complex, long standing unresolved, intractable problems or completely new issues where India is unable to make advances and lead the world in agro-industrial development (e.g. cost

effective diagnostics, development of vaccines for emerging cross border diseases, detection of food adulterants, detection of infectious diseases using simple hand held techniques, developing biotic and abiotic stress tolerant sturdy crop varieties, control of insect pests through RNA interface, biosafety studies, use of proven modern processing facilities for our crop commodities etc.). This requires special focus in terms of investments and research partnerships for developing discovery-linked innovations. Identification of niche areas of partnership with potential / promising private and public partners for carrying out a joint collaborative strategic and industrial application research for development / adaption of technologies relevant to application / adoption for accelerated growth and higher economic impact thus needs to be carried out.

Global linkages for attaining frontier heights: Many global research organizations (public and private) have sensed the need for next generation technologies, and India is no exception to this. Due to lack of working platform and provisions for operational partnership linkages, it is getting increasingly difficult for the countries like India to reach frontier heights in innovation without global linkages. Therefore, it calls for a redefinition of partnership to actualize the vast untapped potential of Indian agriculture and industry and in this context the nation needs to prepare itself to engage globally in technology convergence with global technology generators, institutes of excellence and technology validation partners to provide a platform for development of next generation technologies and accelerate convergence of innovative inventions for further application for resolving complex problems of agri-/food industry in the country. There is thus need for more focused engagement in project-based, goal-driven research programs.

Next generation technologies: Focus is required in collaboration with national / international partners for the discovery and invention of next generation technologies. The target must be the frontier areas of technology generation (discovery-led research) that can bring regional relevance for enhancing productivity, quality and value through adoption of advanced processes and high throughput research methods.

### 8.5. Strengthening Extension Research and Technology Delivery System

Farmers require a wide range of support to address the challenges such as shrinking resource base, changes in farming systems, international developments, climate change etc. The extension system therefore must be empowered with adequate knowledge and skill to deliver (i) right technology and methodology, (ii) market

information and decisions, (iii) changes to be made in accordance with national and international developments/policies (iv) financial and investment decisions and (v) resource optimization, production plan and risk management. In this context extension research plays an important role for effective technology selection, optimization, application and delivery management.

### 8.6. Extension Research Policy

The policy is to promote research in extension and evolve different methodologies for effective technology application and delivery under different farming systems and locations across the country. The research policy for extension need to provide an opportunity for i) analyzing existing extension models in the country and designing new and appropriate models to suit farmers needs ii) conducting systematic socio economic impact studies on the ongoing extension programmes iii) identification of thrust areas for agricultural research based on farmers needs and problem magnitude iv) farmers preferences to different extension services and methodologies to energies the public sector delivery system and v) operational issues related to Public Private Partnership in the country.

Designing appropriate extension approaches relevant to different farming situations

a. Conduct action research on ways of promoting knowledge application
b. Conduct review of extension activities conducted by different agencies
c. Evaluate different kinds of extension tools and techniques promoted by different agencies
d. The policy is to strengthen the basic, strategic, applied, adaptive, policy and evaluative research programmes in extension. Assessment of technology consequences, technology dynamics and kinetics, impact analysis research are to be undertaken for providing feedback and forecasting.

### 8.7. Agricultural Extension Education

Strengthening the course content of Ag Extension Education through revision and incorporation of recent concepts and methods. Curriculum development as on today in the field of veterinary science VCI is entrusted with the development of the course curriculum along with the role to implement the minimum standards of education in the

country. The maintenance of the minimum standards of education must be wrested with the VCI. Similarly there should be regulatory authorities in agriculture and fisheries to enforce the minimum standards of education on par with VCI.

Extension system mainly functions as an agency for technology dissemination and most of the organizations including public sector departments continue to work in isolation. Therefore, policy approaches for strengthening the Extension system need to consider

- Assessment of existing extension system approaches and organizations against the back drop of changing scenario to come out with practical solutions for strengthening/ restructuring the system.
- Development of location specific, participatory gender sensitive and customized extension materials and methodologies.
- Emphasis on FSR/E and farmer participatory approach.
- Strengthening the operational linkages and partnership between research, extension, farmer, market and other key stake holders.
- Empowering farmers and organizing them into commodity groups/associations and federating them.
- Integrating ICT in the extension research, education and technology development system.
- Focus on issues like IPR, Farmers Rights and DUS guidelines.

Among other things, we need a uniform national standard for quality specifications with respect to agro products. Presently, so many standards like Agmark, FPO and BSI/ ISI standards need to be confirmed with by the producers. Similar to ICMR, ICAR may create its standards in the agricultural sector for recommendation and adoption across the country.

**8.8. Technology Application and Delivery System**

The technology delivery system needs to gear up their capacity in terms of manpower, expertise, finance, structure, institutional linkages and the kinds of methods, approaches and delivery system they employ. Dynamic agricultural situation is posing several challenges to agricultural extension system. Some of the challenges with which the extension system has to cope up with are;

- How to reach millions of farm families spread in every nook and corner of the country especially those who are thriving in Complex, Diverse and Risk prone (CDR) environment?
- How to improve the technology standards of the farmers through effective and optimal technology use, especially when the pressure on land is increasing and common property lands are slowly fading out.
- How to face the emerging agricultural development situation as a sequel to the technological and development interventions?
- How to take cognizance of the changes that are taking place in the society which include : Shift from farming to industry; Shift from rural to urban (migration ); Shift from grazing to stall feeding; Shift in focus from social to economic issues.

**8.9. Strengthening Institutional Arrangements for Capacity Building**

Lack of quality and dedicated man power in extension is a serious constraint and challenge encountered by the system. An extension system with business and professional approach is a must. This is possible only if the system recruits personnel who can bring in different kinds of expertise. For instance, expertise related to cutting edge technologies, organizational development, market development, legal issues related to farmer rights, IPR, ICT etc. are very much important. This would involve some de-learning of our conventional technology dissemination approach and learning new ways of doing things. Strengthening of natural and regional level training facilities for continuous skill up gradation is a must.

Assessment of quality of extension personnel and services, conceiving a national level mission mode approach is the need of this hour. ICAR needs to address this issue to improve the man power situation in the county both in terms of numbers and quality. NAARM is the only organization which is involved in capacity building of the agricultural and animal science scientists especially of ICAR institutes. It is not in a position to cater to the requirements of the faculty of agriculture and veterinary universities. Hence, it is the time to establish academic staff colleges in the four regions of the country under ICAR to reorient the faculty in the SAUs and State departments. ICAR must establish one institution each in agriculture and veterinary sciences in the country to set international standards in graduate agriculture and veterinary education on par with the IITs/IIMs.

### 8.10. Farmers' Empowerment and Farmer Organizational Development

Small holder production system often faces difficulties in capturing the economics of scale in marketing, input supply and services delivery. Agricultural extension education plays an important role in this context to make our agro products quality specific and cost effective.

**The Role of Agricultural Extension Policy in this Direction must be on:**

- Capacity building in the areas of related to WTO, SPS, legal issues of SPS, food safety, risk analysis, etc are the prime areas of importance for the livestock extension education system.
- Facilitating adoption of improved knowledge on production, value addition and marketing by farmers
- Farmer organizational development including leadership development and supporting farmer organizations to take up new initiatives (technology application, networking, financing and marketing through supporting producer companies)

### 8.11. Research-Extension-Farmer-Market

KVKs are established in the country with a mandate of technology application through OFTs, demonstrations and training. It is an institutional approach and is comprehensive in nature. It functions on farm based model with a built in research-extension-farmer linkage through a multi-disciplinary team. It ensures feedback and feed-forward through participatory management. It is the largest research based extension body in the country by the ICAR at the district level. However, the effective reach of these KVKs is marginal mainly due to inadequate linkages with other development agencies.

Linking the ATICS with KVKs, ATMA and farmers organizations will help to strengthen the research-extension-farmer-market continuum. ATICs need to be transformed into learning and training centres for trainers/SMS/extension staff from KVKs, ATMA and line Depts. Linking of farmers cooperatives, FIGs and CIGs with ATICs and KVKs for back stopping is a must. ATICS need to serve as the technology consultancy and forecasting centres. All the SAUs and ICAR institutes are to be provided with ATICs to speed up the technology delivery mechanism. There should be a coordinated attempt to synergies and converge these efforts at the district level and

below to improve the performance of various stake holders. One such frame work for Technology Development and Delivery System is given at. It illustrates the roles of different organizations and the functional linkages among them and is worth considering in this context.

The functioning of KVKs is mostly limited to the central grant only as there is no corresponding matching grant either from the state or the host organisation. This has led to lack of ownership of KVKs and lack of accountability resulting in improper manpower deployment, delay in sanction and utilization of the budget, and non-establishment of required infrastructure. These institutional issues currently constrains the integrated delivery of technology and services at the district and block levels.

Partnership**:** Suitable partnership among national and regional players involving commodity boards, research institutes, farmer organizations and business houses will certainly prove to be successful, provided such partnership arrangements are made on professional terms and conditions, centered around teams, free from conventional bureaucratic control with incorporation of inbuilt project planning, implementation and monitoring arrangements. For example, a viable partnership among NDRI (National Dairy Research Institute), NDDB (National Dairy Development Board), Dairy co-operatives and the state Department of Animal Husbandry in the field of dairying can potentially lead to a successful technology generation, support, transfer and application for dairy development.

Similar arrangement could be worked out in the area of production and marketing of agricultural commodities. Big corporate players like Reliance, ITC, Pepsico and Bharati, have entered the business of marketing agricultural commodities. Partnership arrangements with the public sector for technological support in the areas of production, value addition, cold chain management etc at the farmer end can ensure farmers from receiving holistic benefit from such partnerships. Lack of a common platform to broker such alliances has led to non-operationalisation of PPP in practice. Under present circumstances, a suitably conceived and operated PPP arrangement will certainly will help the country to promote client centered extension, and lessen the burden on government exchequer.

### 8.12. Establishment of State Extension Co-ordination Centre/Agency (SECA)

It can potentially bring about much needed integration for objective planning through convergence and partnership.

### 8.13. Technology backstopping, Application, integration, ICT and Management

The most important and neglected area of the present extension system is its limited ability to integrate different kinds of technologies. As a result, farmers adopt such technologies in isolation and blames extension and research system for its failures. This has resulted in confusion at the field level and erosion in extension's credibility on technological aspects. Creating technology and innovation repository at ATICs and KVKs ensure a continuous availability of technology packages to the delivery system. Establishing National and Regional Technology Parks helps to link the technology providers with the delivery system and users. The Technology Park is a state of art one stop arrangement for entrepreneurship promotion of selected technologies. Operational aspects of technologies, technology worthiness, viability, breakeven point, product quality etc. are demonstrated and the parks provide a firsthand learning opportunity to the entrepreneurs. The facilities in the park also provide a continuous opportunity for product testing, hands on experience and product improvement.

### 8.14. Institute Entrepreneur Linkage Programme (IELP) and Technology Application for Income Generation (TAIG)

An evolutionary growth and replacement of the Institute and Village Linkage Programme (IVLP) and technology Assessment and Refinement (TAR) programme of NATP is essential. The policy need to focus upon skill and entrepreneurship development and income generation aspects. The focus of such approach will essentially include suitable off farm income generation activities, which are becoming increasingly important for rural employment and income - generation.

### 8.15. Innovation Demonstration Programmes (IDP)

Innovations need to be the prime focus and programmes for demonstrating innovations in the farmers field are to be conceived and implemented under partnership mode.

### 8.16. ICT and Knowledge Dissemination

The most important role of ICT in Agricultural development is fostering a knowledge intensive sustainable livelihood security system in rural areas. ICT can enable us to reach

the unreached and include the excluded information, knowledge and skill empowerment. The issues of importance in the information led knowledge dissemination are: (i) access (ii) content and (iii) Capacity Building.

The access to information and knowledge is impeded for much of our population due to poverty and illiteracy. Linkages among professional partners are essential to reach those who are unreached and especially those who are under greatest risk of being left out of the knowledge societies.

Content: The farmers need locally relevant information, in the right language, to meet their immediate needs, and it may be more useful to promote more information sharing between local institutions than bringing in new information from outside. It is therefore important to promote information as a catalyst for community initiatives and encourage the adaptation of new technologies within decentralized and locally owned processes.

Capacity Building: It is needed at all levels to equip farmers and extension functionaries towards effective use of ICT in acquiring and dissemination of knowledge. Support is to be provided in terms of training for the use of ICT, establishment of rural knowledge centres, appropriate linkages with research institutes for continuous content updating. Training in information collection, storage and dissemination including the use of innovative formats based on the local culture is a must.

In the future, market determined production is likely to be basis of all agricultural operations. In such a scenario, real time and up to date information regarding market prices, insurance, logistics, warehousing, commodity trading, pesticide and other allied activities and resources, becomes indispensable to the farmers. The market led agriculture is possible through information based extension support system provided through information communication technologies at his door steps.

### 8.17. Virtual Extension and ODL Programmes

In order to ensure continuous out of class room learning and knowledge flow for reaching the un reached, National and state level Virtual Extension and ODL programmes may be started along with a dedicated channel for agriculture by the Government covering all the major languages.

Harnessing the synergies of science and business: We need to add and pool resources for harnessing the synergies. Both old and new sciences are required to be attended to, both intensively and extensively. Business in science has to be deeply ingrained in all our efforts from the research system. Agricultural research in India has to ultimately improve the quality of life in villages; and so has to have a human touch in all its professional endeavors. Lessons from XI Plan Scheme for Intellectual Property and Technology Management as well as World Bank-aided NAIP have amply indicated the requirement of mutually-reinforcing top-down and bottom-up approaches to make things happen in the manner desired in the changed times.

**8.2. Vision 2023**

In Vision 2023, the State Government has also proposed to undertake various infrastructure projects. Infrastructure developments in agriculture are targeted at the three initiatives of improving the productivity in agriculture, assurance of year-round irrigation, and marketing extension. An estimated investment of Rs 40,000 Crores (Table 8.1) is anticipated towards development of agricultural infrastructure across the State. The key projects are:

a) Irrigation projects involving connectivity of farms with canals and dams, and cleaning of water resources such as tanks, wells and dams.

b) Micro irrigation for 100% of crops under horticulture, vegetables and fruits and spices.

c) Horticultural parks for fruits, vegetables and spices would be developed across the state

d) Chain of storage facilities including cold storage and associated logistics facilities

e) Packing houses and gamma irradiation facilities are to be developed in each district

f) Grain storage facilities

g) Three terminal market complexes to serve the local and export market

h). Strengthening R&D capacity

The State Government has also identified various infrastructure projects to be implemented and the budget requirements are shown in Tables 8.1 and 8.2.

**Table 8.1 Infrastructure Investment**

**(Rs. in crore)**

| Sl. No. | Name of the Project | Amount |
|---|---|---|
| 1 | Cleaning of well, tanks and canals | 16,000 |
| 2 | Horticulture Parks | 6,600 |
| 3 | 100% Micro Irrigation for horticulture crops | 6,400 |
| 4 | Grain Storage Godowns | 2,700 |
| 5 | Strengthening of R&D Capacity of Agricultural Universities | 2,000 |
| 6 | Food Processing Centres | 1,500 |
| 7 | Cold Storage Projects, Terminal Market Complex | 2,000 |
| 8 | Support to Mechanization | 1,000 |
| 9 | Packing houses, Gamma Irradiation Facility, Agro Food Parks & Export Zones, Perishable air cargo complex, ICT tools for agriculture extension etc | 1,800 |
| | **Total** | **40,000** |

Source: Vision Tamil Nadu 2023, Strategic Plan for Infrastructure Development in Tamil Nadu Vision Volume 1, Government of Tamil Nadu.

**Table 8.2. Infrastructure projects identified by State Government**

**(Rs. in crore)**

| Sl. No. | Name of the Project | Amount |
|---|---|---|
| 1 | Infrastructure set-up for seed supply chain | 2,000 |
| 2 | Program for Soil Quality Improvement and Wasteland Rehabilitation | 2,000 |
| 3 | Strengthening of Seed Farms, Horticultural Farms and establishment as demonstration farms | 2,000 |
| 4 | Horticulture Development Program | 400 |
| 5 | Propagation of Micro Irrigation | 20,000 |

| Sl. No. | Name of the Project | Amount |
|---|---|---|
| 6 | Agricultural mechanization | 20,000 |
| 7 | Integrated Market Development and Post Harvest Supply Chain | 20,000 |
| 8 | Infrastructure support for Agro Food Processing Industry | 5,000 |
| 9 | Infrastructure for diary processing | 5,250 |
| 10 | Infrastructure for poultry processing | 2,000 |
| 11 | Integrated fish processing centres and fish landing stations / fishing harbors | 1,500 |
| | **Sub-total for Agriculture and Allied Sectors** | **80,150** |
| 12 | Rehabilitation of tanks and well | 22,500 |
| 13 | Infrastructure development to conserve North East Monsoon drainage water, Coastal zone and Cauvery Delta Irrigation Development Plan | 3,000 |
| 14 | Lining of major canals in Tamil Nadu | 5,000 |
| 15 | Dam Rehabilitation and Improvement Project | 750 |
| 16 | Interlinking of Rivers | 10,000 |
| | **Sub-total for Irrigation** | **41,250** |
| | **Total** | **1,21,400** |

Source: Vision Tamil Nadu 2023, Strategic Plan for Infrastructure Development in Tamil Nadu Vision Tamil Nadu Phase 2, Government of Tamil Nadu, page 248, 2014.

Considering the aforesaid scenario of developments, the overall infrastructure requirement was assessed in consultation with the line departments of the State Government at the district level and State level and also based on the feedback obtained from the farmers at various levels.

## CHAPTER IX

# IMPLEMENTATION PLAN AND INSTITUTIONAL RESPONSIBILITIES

The major focus of implementation plan is to reduce the yield gaps through better crop and livestock management strategies. The research and technology dissemination thereof plays a major role in such transformations. Besides, adequate infrastructure for post-harvest management and value addition has to be created and wherever needed, the support from the State and Central Government has to be enhanced. Such steps would further motivate the farmers/fishers to be an effective partner to achieve the state agenda and at the same time ensure these farmers the benefit that could emerge out of the changes anticipated through doubling the farmer's income before 2022.

The Government intends to build/strengthen the State infrastructure immediately, in parallel the existing production standards for seeds and nurseries will be streamlined into the system envisaged. Private participation in the project is expected to start and it would be an ongoing process. Standards for private participation would be laid down and the reaching out to farmers through the new system is expected. Private participation would be through both PPP and stand alone industry mode.

### 9.1. Soil Quality Improvement

Conservation of soil health is a long term process that needs concerted effort of the Government, farmers and private industries. The Government will spearhead the activities with active participation of private sector through PPP mode.

The Government has an ongoing budgeted scheme for strengthening of demonstration farms for different crop initiatives. This would be strengthened and private participation would be brought in through PPP methods. A feasibility study on the type of farms available with the Government and the methods of modernization that can be brought in relation with the local region and produce would be conducted. Based on this study interested and capable private partners would be invited for establishing the demonstration farms.

The programme will be implemented through multiple modes of financing including Government funding, PPP format and private investment. The Government shall promote horticultural parks and poly green houses through suitable financing modes to encourage public participation. Private and PPP investments will be welcome

by Government through enabling policies and regulatory mechanisms to establish horticultural farms and contract farms. The Government will start the process by strengthening the state horticultural farms and selected demonstration farms of public across the state. Participatory guidelines for private firms will be framed and investments would be welcomed following that.

The programme will be implemented through multiple modes of financing including Government funding, PPP mode and private investments. The Government shall provide direct funding/subsidy to small and marginal famers and would encourage private projects for large areas under irrigation. Private investment in micro irrigation will be encouraged through regulation of reliable organizations and technologies for micro irrigation. Action has been initiated to maintain the transparency and supply of quality materials for MI systems.

The programme will be implemented through multiple modes of financing including Government funding, PPP format and Private investments. The Government will continue its subsidy schemes for small and marginal farmers and will encourage PPP mechanism for supporting mechanization of large land holdings. Private entrepreneurs, organizations and farm equipment makers will be encouraged in partnering with the Government in providing farm equipments for farm preparation, cultivation, crop management, harvesting, and material handling.

The Government intends to strengthen the state’s post harvest infrastructure in participation with the industry.

The Government will encourage private investment and PPP investment in:

Establishment of cold chain/godowns:

1. Terminal Market Complexes

2. Air cargo complex for perishables

3. Establishment of logistics network for goods transportation

Farmers would have the flexibility and option to store their goods as per market availability. The farmers can store their goods availing the facilities, receive a challan towards its quantity and quality and can use the challan for trading of the goods stored. The storage facilities can also act as financing agents for farmers towards postharvest

goods. A State level governing body will be formed for framing the rules of operating the storage facilities and governing the trading of goods at the TMC and cluster godowns. Suitable policy initiatives would be established for trading of goods and to avoid profiteering based on information asymmetry. The State will establish the framework for this operation and shall start the establishment of infrastructure immediately.

The programme will be implemented through multiple modes of financing including Government funding, PPP format and private/entrepreneur.

1. The Government will continue its subsidy based schemes for primary processing by small and marginal farmers to support their subsistence.

2. The Government would encourage large and medium food processing industry by formulating supportive policies and enabling infrastructure.

3. The Government will encourage PPP by involving PACCS and farm co-operatives to work with industry in setting up primary and secondary processing industries in the districts mentioned above.

The Government will frame food processing industry promotion schemes and guidelines and will promote private participation immediately. The Government will also conduct a detailed feasibility study for PPP in food processing and shall implement feasible projects in this mode. The Government intends to create these dairy processing centres through private and Public Private Partnership mode. Private industry will be welcome to assist the State to augment its milk production and processing capacity. Farmers through unions will be encouraged on PPP in dairy processing plants thereby providing them assured economic returns

The Government would promote private industry and Public Private Partnerships in the poultry processing and egg processing industry. Favorable investment climate will be created for private investors who are willing to invest in the sector. The Government will also assist marginal famers and small and medium hatcheries in modernizing their production methods and quality requirements, thereby preparing them for Public Private Partnerships in the sector. The initial promotion efforts will be in the chicken and broiler districts belt of Tamil Nadu including Namakkal, Karur, Dharmapuri, Dindigul, Sivagangai, Tirunelveli, Villupuram, Virudhunagar, Coimbatore, Tiruppur, Erode, Salem and Krishnagiri, and then will be extended to other districts.

The Government has prepared a detailed project report for construction of fish processing parks at Cuddalore and Nagapattinam on PPP mode. The process will be replicated for the other eleven districts of the state in a phased manner. Detailed project report is under preparation for mid sea mother-ship processing centre.

The programme will be implemented by the Government through the PWD and Panchayat Raj institutions. The Government has prepared a detailed remote sensing map of the tanks in Tamil Nadu; this will be used in conjunction with the existing revenue record details to identify the areas for rehabilitation. The master plan for tank rehabilitation will be prepared. The programme will be implemented by the Government through the PWD department. A detailed remote sensing map of the watershed areas and water bodies has been prepared which will be used as base data for development of necessary irrigation mechanisms in the coastal areas. The master plan for the project will be prepared in conjunction with the NE monsoon drainage water project and the developmental work will be started.

The programme will be implemented by the Government through the PWD. The Government will identify the major canals where stone or HDPE lining is possible and shall decide on the technical specifications. The programme will be implemented by the Government through the combined effort of WRO of PWD and TANGEDCO An empowered committee has been constituted under the Chief Secretary and agreement has been signed with the World Bank towards funding of the project. The State project management unit is functional and the works are underway.

Interlinking of Cauver Manimuthar, Vaigai and Gundar is under progress through construction of a barrage across the Cauvery River 250 meter below from the existing Kattalai bed regulator in Karur district. Flood carrier canal from the Kannadian Channel to drought prone areas of Sathankulam and Thisaiyanvilai by interlinking Tamiraparani, Karumeniyar and Nambiyar Rivers in Tirunelveli and Thoothukudi Districts is under progress. Detailed project reports of other projects are under various stages of preparation and approval from the State and Central Governments. The State Government intends to complete the interlinking of rivers within the next ten years.

The agriculture department has six departments as follows:

1. Department of Agriculture
2. Department of Horticulture and Plantation Crops
3. Department of Agricultural Engineering
4. Department of Agriculture Marketing and Agri Business
5. Department of Seed Certification and Organic Certification, and
6. Department of Sugar
7. Tamil Nadu Agricultural University, Tamil Nadu Veterinary and Animal Sciences University, Tamil Nadu Fisheries University ICAR Institutes and KVKs
8. Tamil Nadu Horticulture Development Agency
9. Tamil Nadu Horticultural Producers Co-operative Enterprises Limited
10. Tamil Nadu Watershed Development Agency
11. Tamil Nadu State Agricultural Marketing Board
12. Tamil Nadu Coconut Farmers Welfare Board
13. Animal Husbandry, Dairy and Fisheries
14. WRO-PWD
15. Tamil Nadu Water Shed Development Agency

# CHAPTER X

## SUMMARY AND RECOMMENDATIONS

Innovations and human resources are the twin engines of agricultural growth and development. The way to double farmers' income is possible only through more productive agricultural sectors by supporting the technologies with synergizing policies and support from the government.

Agriculture is still the biggest employer and livelihood provider to the majority in the state. This sector therefore, offers considerable leverage over the growth of the economy as a whole and its development not only provides cheaper food for both urban and rural population, but it also generates employment, raises the income of poor people, creates a demand for other non government goods and services. Further, it also saves our foreign exchange and encourages our international trade.

The five related challenges of food production, malnutrition, poverty, population growth and environment are more acute now and through its cutting edge technologies and extension programmes, the nexus among these five elements that challenges the development can be addressed. Poverty limits the opportunities for protecting and enhancing the environment because we are left out with few options but to exploit the natural resources base in order to attain food security.

A more productive agriculture also means more food at lower prices. These lower prices facilitate the complex interaction's that promote an inclusive economic growth. Research generates agricultural technologies and innovations that increase productivity and incomes while conserving natural resources for sustainability as the nucleus of the whole development process. The complexity of the challenges requires greater resources for research and committed team of scientists and extension work force.

Climate resilient agriculture, GIS based soil fertility maps, using soil test data, to improve the soil and water productivity through location specific nutrient and resource management are key requirements. The innovative idea of using digital radiographs, computed tomography and magnetic resonance imaging to detect internal disorders like spongy tissues in mango samples have got bright field of application in the coming years.

Understanding of farming systems and the farmer's resources is very much important to design and develop technologies that are acceptable and appropriate for the resource poor farmers. Realizing the importance of farming system approach the plan has laid due emphasis on farming system mode development by developing a decision support system tool (DST) to facilitate farmers in deciding the profitable components for farming system. In addition, district wise extension and development strategies for the state based on the detailed analysis of prevailing farming system prevailing in all the agro climatic conditions have been formulated.

The rural backyard poultry production system need to be strengthened by the newly developed dual purpose poultry breed which achieved body weight closer to Vanaraja breed and egg production closer to Gramapriya in 72 weeks. Diagnostic kit "DIVA" developed for differentiating FMD infected and vaccinated animals is an important innovative technique which has got potential application in the field.

The technology enters the agricultural sectors from two major sources. As primary source, farmers themselves were the main suppliers. Through their efforts in selecting plants, perfecting their tools and designing their crop mixtures and rotations, the traditional wisdom based agricultural production system evolved. Farmers efforts need to be supported by scientists through their innovative research and development approaches. Yet in today's world of shrinking natural resources and rapidly raising human populations, traditional production systems are increasingly falling to meet the food and income needs of increasingly urbanized consumers, while some are in danger of breaking down altogether.

Empowerment of farm women through development of income generating technologies and gender friendly agricultural equipment is one of the key areas of focus toward empowerment of women with appropriate technologies.

| Driving Forces | Restraining Forces |
|---|---|
| • Good Varietal performance in terms of yield and recovery.<br>• Remunerative price for produce and timely payment.<br>• Adequate technology back stopping<br>• Capacity building and farmer-led extension.<br>• Strong linkage and partnership between research-extension-farmer and industry continuum<br>• Industry backing and support.<br>• Remunerative and stability compared to other agricultural crops. | • Fragmentation of land holdings<br>• Water and labour crisis<br>• Increasing cost of production<br>• Pest and Disease incidences<br>• Wild animal menace.<br>• Lack of mechanization and small tools and machinery<br>• Climate change effect – biotic and abiotic pressure<br>• Lack of Quality planting materials.<br>• Inadequate farmer field school and FIGs<br>• Non- availability of credit and inadequate crop insurance coverage |

Right technologies, methodologies, human resource development and knowledge management are the key players in doubling the farmer' income in the state in light of challenges due to globalization of agriculture and climate change.

# Annexure I

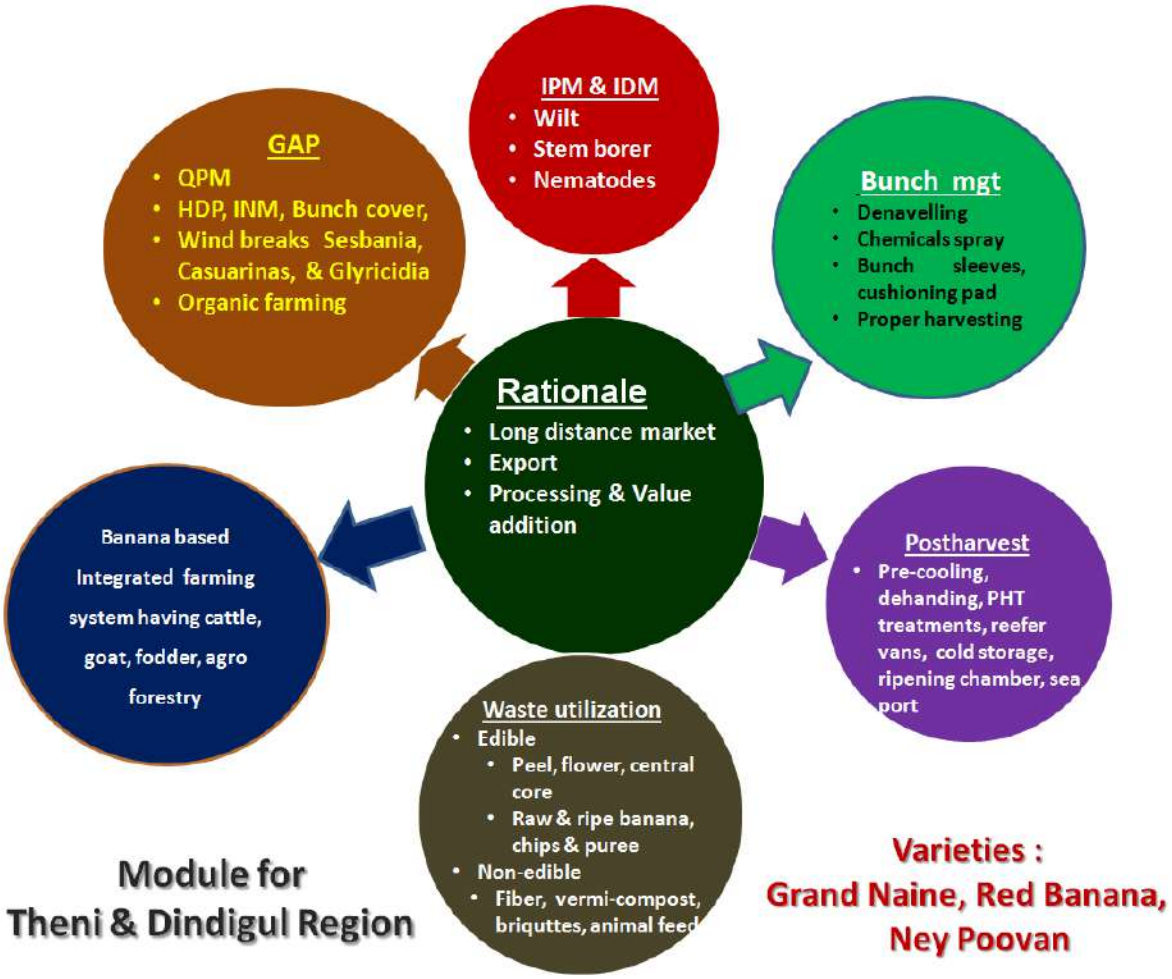



**Fig 3: Module for Theni District**

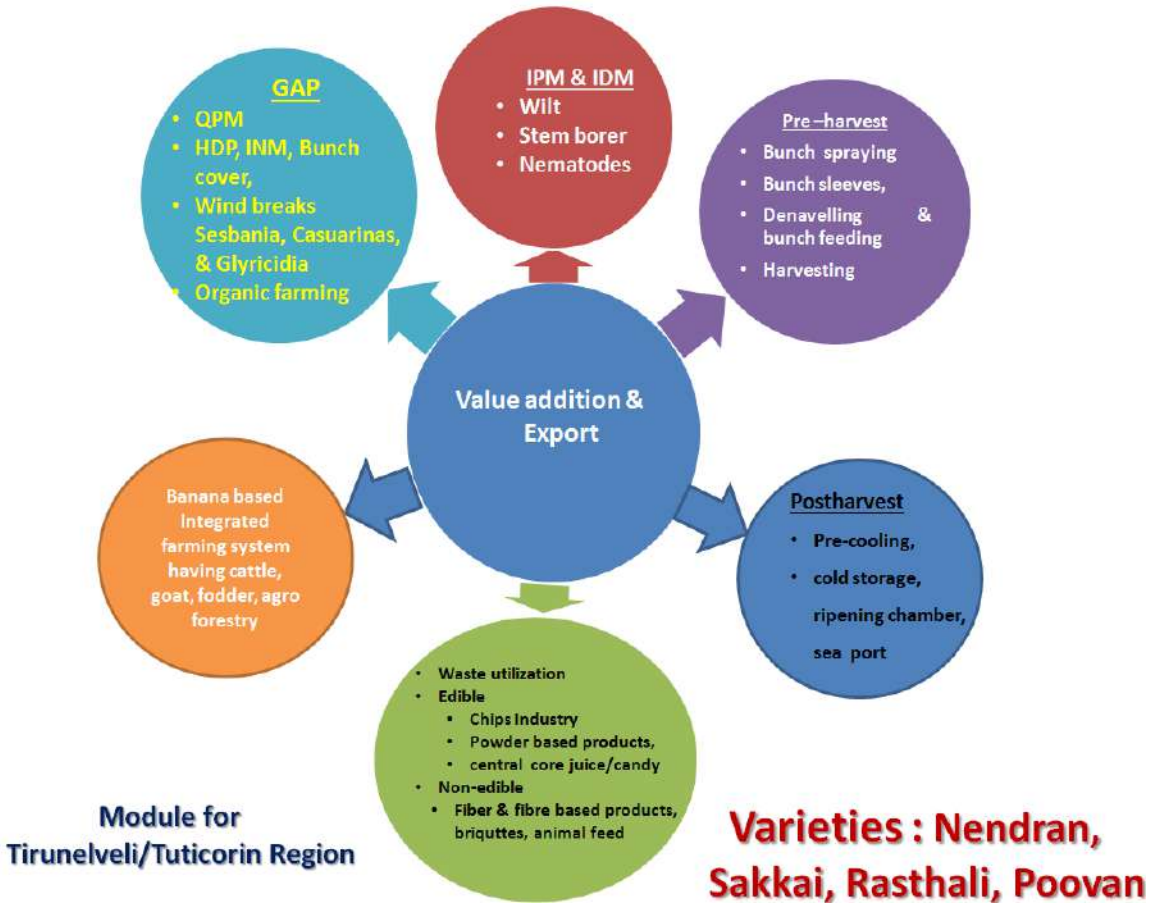



**Fig 4: Module for Tirunelveli District**


**Fig. 5. Module for Tiruchirappalli district**

# Annexure 2

## Cost of Cultivation of Principal Crops in Tamil Nadu

(Rs. / hectare)

| Sl.No | Particulars | Paddy | | Sorghum | | Maize | | Black gram | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2015-16 | 2016-17 | 2015-16 | 2016-17 | 2015-16 | 2016-17 | 2015-16 | 2016-17 |
| I | Operational cost | 62515 | 71917 | 24537 | 28220 | 56930 | 65470 | 31677 | 36430 |
| | Human labour | 26832 | 30880 | 17590 | 20229 | 31041 | 35697 | 15358 | 17662 |
| | Animal labour | 350 | 403 | - | - | - | - | - | - |
| | Machine Power | 11850 | 13628 | 3625 | 4169 | 7020 | 8073 | 5775 | 6641 |
| | Seed | 8680 | 9982 | 950 | 1093 | 3838 | 4414 | 2890 | 3324 |
| | Fertilizers and Manures | 11310 | 13007 | 1950 | 2243 | 12470 | 14341 | 5660 | 6509 |
| | Plant protection charges | 1900 | 2185 | - | - | 900 | 1035 | 1450 | 1668 |
| | Irrigation charges | 168 | 193 | - | - | 363 | 417 | - | - |
| | Interest on working capital | 1425 | 1639 | 422 | 486 | 1298 | 1493 | 544 | 626 |
| II | Fixed Cost | 9135 | 9135 | 3240 | 3240 | 4815 | 4815 | 1340 | 1340 |
| | Sub Total (I + II) | 71650 | 81052 | 27777 | 31460 | 61745 | 70285 | 33017 | 37770 |
| | Managerial Cost @10% | 7165 | 8105 | 2778 | 3146 | 6174 | 7029 | 3302 | 3777 |
| III | Total cost | 78815 | 89157 | 30555 | 34606 | 67919 | 77314 | 36319 | 41547 |
| | Yield (Qtl) | 52 | 52 | 24 | 24 | 57 | 57 | 7.8 | 7.8 |
| IV | Cost of Production (Rs./qtl) | 1516 | 1715 | 1273 | 1442 | 1191 | 1356 | 4656 | 5326 |
| V | MSP (Rs/qtl) | 1410 -1450 | 1470-1510 | 1570-1590 | 1625-1650 | 1325 | 1365 | 4625 | 5000 |

## Cost of Cultivation of Principal Crops in Tamil Nadu (Contd.)

(Rs /hectare)

| Sl. No | Particulars | Sugarcane | | Groundnut | | Gingelly | | Cotton | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2015-16 | 2016-17 | 2015-16 | 2016-17 | 2015-16 | 2016-17 | 2015-16 | 2016-17 |
| I | Operational cost | 177232 | 203818 | 65895 | 75778 | 33762 | 38825 | 74218 | 85349 |
| | Human labour | 94111 | 108228 | 28620 | 32913 | 24289 | 27932 | 44174 | 50797 |
| | Animal labour | 2275 | 2616 | 1500 | 1725 | - | - | - | - |
| | Machine Power | 20230 | 23265 | 6136 | 7056 | 3954 | 4547 | 6050 | 6958 |
| | Seed | 25034 | 28789 | 11543 | 13274 | 963 | 1107 | 2433 | 2798 |
| | Fertilizers and Manures | 26030 | 29935 | 15061 | 17320 | 2780 | 3197 | 17724 | 20383 |
| | Plant protection charges | 2935 | 3375 | 1500 | 1725 | 1196 | 1375 | 2145 | 2467 |
| | Irrigation charges | 624 | 718 | 33 | 38 | - | - | - | - |
| | Interest on working capital | 5993 | 6892 | 1502 | 1727 | 580 | 667 | 1692 | 1946 |
| II | Fixed Cost | 21348 | 21348 | 2785 | 2785 | 2785 | 2785 | 4200 | 4200 |
| | Sub Total ( I + II) | 198580 | 225166 | 68680 | 78563 | 36547 | 41610 | 78418 | 89549 |
| | Managerial Cost @10% | 19858 | 22516 | 6868 | 7856 | 3655 | 4161 | 7842 | 8955 |
| III | Total cost | 218438 | 247682 | 75548 | 86419 | 40202 | 45771 | 86260 | 98504 |
| | Yield (Qtl) | 998 | 998 | 21 | 21 | 7 | 7 | 21 | 21 |
| IV | Cost of Production (Rs./qtl) | 219 | 248 | 3597 | 4115 | 5743 | 6539 | 4107 | 4691 |
| V | MSP (Rs/qtl) | 235 | 285 | 4030 | 4220 | 4700 | 5000 | 3800-4100 | 3860-4160 |

Source: Cost of Cultivation Scheme, CARDS, TNAU (Provisional)

**State Level Coordination Committee Meeting held on 27.03.2017 at State Planning Commission, Chennai**

**State Level Coordination Committee Meeting held on 27.03.2017 at State Planning Commission, Chennai**

**State Level Coordination Committee Meeting held on 27.03.2017 at State Planning Commission, Chennai**


**State Level Coordination Committee Meeting held on 27.03.2017 at State Planning Commission, Chennai**

## References


Government of India (2015). Agricultural Statistics at a Glance 2015. *Ministry of Agriculture & Farmers Welfare, Department of Agriculture, Cooperation & Farmers Welfare, Directorate of Economics and Statistics.* pp.1-478.

Government of India (2015). *Raising Agricultural Productivity and Making Farming Remunerative for Farmers. NITI Aayog Report. December 16. 46.*

Government of India (2016). Annual Report 2015-16. .Ministry of Agriculture and Farmers' Welfare. pp.1-158.

Government of India (2017). Hand Book of State Statistics. *NITI Aayog. 30 August*. pp1-531.

Government of India (2017). National Workshop Doubling Farmers' Income through Scaling-up. *Conference Report. New Delhi.15-16 March.*

Government of India (2017). *Road map of Pradhan Mantri Krishi Sinchayee Yojana. NITI Aayog Report. January.*

Government of Tamil Nadu (2012). Crop Production Guide. *Department of Agriculture*. pp. 1-388.

Government of Tamil Nadu (2014). Strategic Plan for Infrastructure Development in Tamil Nadu. *Vision Document Phase 2. February*. pp 1-336.

Government of Tamil Nadu (2016). Animal husbandry, Dairying and Fisheries Department. *Policy Note 2016-17*.pp. 1-118.

Government of Tamil Nadu (2016). State Agriculture and Infrastructure Development Programme. *National Agriculture Development Programme (NADP / RKVY) Report.*

Government of Tamil Nadu (2017). Citizen Charter. *Department of Agriculture.* pp.1-138.

Government of Tamil Nadu (2017). Finance Department Demand No.16. *Policy Note (2017-2018)* pp. 1-77.

Government of Tamil Nadu (2017). State Irrigation Plan (SIP). *Pradhan Mantri Krishi Sinchayee Yojana 2016-2023.* pp.1-178.

ICAR-Sugarcane Breeding Institute (1997). *Vision 2020 document*. pp.1-51.

ICAR-Sugarcane Breeding Institute (2007). *Vision 2025 document*. pp.1-92.

ICAR-Sugarcane Breeding Institute (2011). *Vision 2030 document*. pp.1-29.

ICAR-Sugarcane Breeding Institute (2015). *Vision 2050 document*. pp.1-35.

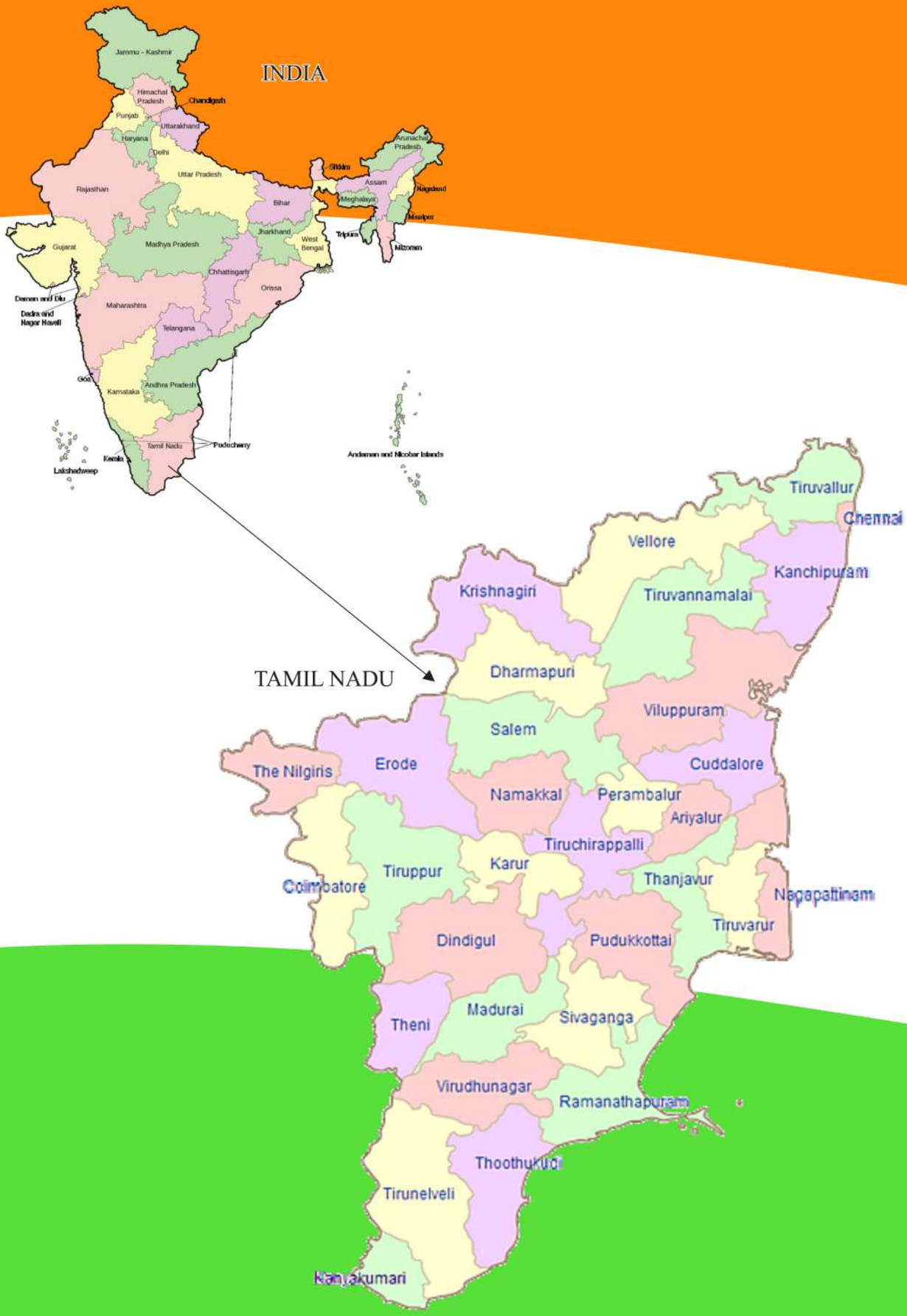
Jothi Sivagnanam, K. (2014). State Agriculture Profile of Tamil Nadu – 2011. *Agro-Economic Research Centre, Study No. 154. Ministry of Agriculture, Government of India University of Madras*. pp.1-87.

Kareemulla, K. R. Venkattakumar and M. P. Samuel (2017). An analysis on agricultural sustainability in India. *Current Science*, *Vol. 112, No. 2*. pp 258-266.

Ramesh Chand (2016). Doubling Farmers' Income: strategy and Prospects. *The Indian Society of Agricultural Economics. 66th Annual Conference 21-23 November.* pp.1-21.

Ranganathan, T. (2017). Farmers' Income in India: Evidence from Secondary Data. *Ministry Of Agriculture study Report*. pp.1-89.

Saxena,R., N P. Singh, S.J. Balaji, U.R. Ahuja and D. Joshi (2017). Strategy for Doubling Income of Farmers in India. *Policy Paper 31. ICAR – National Institute of Agricultural Economics and Policy Research New Delhi*. pp.1-96.


INDIA
Jammu - Kashmir
Himachal Pradesh
Chandigarh
Punjab
Uttarakhand
Haryana
Delhi
Uttar Pradesh
Rajasthan
Bihar
Sikkim
Arunachal Pradesh
Assam
Nagaland
Meghalaya
Manipur
Tripura
Mizoram
Jharkhand
West Bengal
Gujarat
Madhya Pradesh
Chhattisgarh
Orissa
Daman and Diu
Dadra and Nagar Haveli
Maharashtra
Telangana
Goa
Karnataka
Andhra Pradesh
Tamil Nadu
Puducherry
Kerala
Lakshadweep
Andaman and Nicobar Islands
TAMIL NADU
Tiruvallur
Chennai
Vellore
Kanchipuram
Krishnagiri
Tiruvannamalai
Dharmapuri
Viluppuram
Salem
The Nilgiris
Erode
Cuddalore
Namakkal
Perambalur
Ariyalur
Tiruchirappalli
Karur
Tiruppur
Thanjavur
Coimbatore
Nagapattinam
Tiruvarur
Dindigul
Pudukkottai
Madurai
Theni
Sivaganga
Virudhunagar
Ramanathapuram
Thoothukudi
Tirunelveli
Kanyakumari