Status Paper on Rice in Tamil Nadu

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I. Name of the state: Tamil Nadu

II. Introduction

The food production required to be enhanced to provide food and nutritional security to the growing population. In order to retain the farmers especially the younger generation to take up agriculture as a profession, the income from the farm holdings required to be increased considerably. In Tamil Nadu, 90% of the farmers belong to small and marginal category and their operational holdings account 56% of the total areas. So the small and marginal farmers play a key role in overall development in Agriculture and the adoption of scientific technologies by these farmers needs focused attention. The Gross Cropped Area in Tamil Nadu is around 58.43 lakh hectares of which the Gross Irrigated Area is 33.09 lakh hectares which is 57% and the balance 43% of the area are under rainfed cultivation. Major efforts are required to increase the productivity of rainfed crops by overcoming the various challenges such as; erratic monsoon rains, soil with low nutrient and organic contents / poor water holding capacity, soil and water erosion, etc. The labour scarcity especially during the peak cropping season is also causing difficulty to the farmers to take-up timely field operations. In respect of agricultural crops, the crop cultivation is taken up in two to three seasons annually. Hence to achieve sustainable development and break-through in agricultural production, continuous concentration on technical advancement, input supply, credit and market supports are required. The Government is implementing various programmes to address the issues and constraints faced by the farmers to achieve the targeted growth in agriculture. The Government also primarily shoulders the major task of disseminating advanced technologies to 78.59 lakhs farm holdings through the departmental functionaries.

Tamil Nadu one of the leading rice growing states in India, has been cultivating rice from time immemorial as this State is endowed with all favourable climatic conditions suitable for rice growing. For enhancing rice production and productivity rice research was initiated in (composite) Madras State as early as 1902 at Samalkota of East Godavari district. Subsequently, it was extended to another 12 places of the composite State to develop new high yielding rice varieties and technologies to solve problems in rice cultivation of their respective regions. These 13 Rice Research stations released many high yielding rice varieties. In the beginning, release of high yielding varieties was mostly through selection from the ecotypes or local cultivars or by introduction. Hybridization was started in 1917 to improve the yield as well as to incorporate tolerance/resistance to biotic and abiotic stresses. The Paddy Breeding Station of

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Coimbatore which was established in 1913 has released CO 1 to CO 7 varieties up to 1929. The pure line CO 4 is highly resistant to blast and has been utilized as donor for the evolution of blast resistant strains. GEB 24 (Government Economic Botanist 24) a quality rice evolved through selection from konamani, a slender grained variety was released in 1921. A total of 50 varieties and 3 rice hybrids were released from Paddy Breeding Station, Coimbatore. After re-organisation of this state during 1956, with its present geographical limits, research has been further strengthened to produce more rice to meet the demand of ever-growing population in the State. The status of rice production and improvement in Tamil Nadu is discussed in this paper.

III. Zonal information

a. Climate

The climate of Tamil Nadu is basically tropical. Due to its proximity to the sea the summer is less hot and winter is less cold. The maximum daily temperature rarely exceeds 43°C and the minimum daily temperature seldom falls below 18°C. The State is exposed to both South West and North East monsoons.

b. Soil type/ Nutrient management

Rice is a semi aquatic plant and grows best under low land condition. In India, it grows in almost all types of soils- alluvial, red, lateritic, laterite, black, saline and alkali, peaty and marshy soils and in acid soils. But the soils having good water retention capacity with good amount of clay and organic matter are ideal for rice cultivation. Clay and clay loam soils are most suited. It tolerates a wide range of soil reaction from 4.5 to 8.0. It grows well in soils having pH range of 5.5 to 6.5. It can be grown on alkali soil after treating them with gypsum or pyrites.

Application of required quantity of organic manures and inorganic fertilizers in a balanced way based on the need of the crops is essential to get maximum productivity. Most of the soils in Tamil Nadu are found to be highly deficit in organic matter and micro nutrients content. The decline in organic matter content reduces the biological activity of soil, water holding capacity, nutritional availability which affects productivity of crops. In order to improve soil health and soil fertility, the application of Bio-fertilizer, cultivation of Green Manure crops, Vermi compost, composting of farm wastes through Pleurotus are recommended. The available N, P, K status of Tamil Nadu soils are as follows: low nitrogen, phosphorous low to medium, potassium medium to high. In addition, Tamil nadu soils are deficient in

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micronutrients viz., Zinc (52%), Iron (28%), Copper (7%) and Manganese(6%) (Source: Technical Bulletin on AICRP - STCR 2007, Department of Soil Science and Agricultural Chemistry, TNAU, Coimbatore). It is well known that Zn deficiency is predominant in low land ecosystems. Sodic and upland soils and calcareous coarse textured soils with low organic matter content suffer from Fe deficiency, besides Zn and Cu deficiencies (Savithri *et al.,* 1999).

c. Rainfall and its distribution pattern

The average annual rainfall of Tamil Nadu is 925.0 mm. The Western Ghats acting as a barrier deprive the State of the full blast South West Monsoon winds in this state. However, South West Monsoon has a precipitation of about 1/3rd of the normal rainfall received in Tamil Nadu. It helps in taking up the rainfed cultivation including dry rice in this State. The State depends mainly on the North East Monsoon rains which are brought by the troughs of low pressure establishing in southern Bay of Bengal between October and December. The following are the normal rainfall during the major seasons of State.

Season	Normal Rainfall (in mm)
South West Monsoon	307.6 (33.25%)
North East Monsoon	438.7 (47.42%)
Winter	42.2 (4.56%)
Summer	136.5 (14.75%)
Total	**925.0**

High rainfall Regions: The Nilgiris, the coastal belt of the Cuddalore, Kancheepuram districts, Kanyakumari and Palani Hills.

Medium Rainfall Region: Western parts of the Cuddalore, Tiruvallur districts, whole of Vellore, Thiruvannamalai, eastern parts of the Salem, Western part of Thanjavur, Nagapattinam, eastern and northern parts of Trichy, eastern part of Madurai, Dindigul, northern part of Ramanathapuram, Sivaganga, Virudhunagar, Coimbatore and Salem.

Low Rainfall Regions: Central and southern parts of Ramanathapuram, Sivaganga, Virudhunagar, Thoothukudi and Tirunelveli districts and central part of Coimbatore, central and western parts of Madurai, Dindigul and the southern half of Tiruchirapalli.

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Number of Rainy Days: An average of 50 rainy days per year was recorded in this state, the highest of 106.2 rainy days was recorded in Nilgiris, while the lowest of 45.8 days was observed in Ramanathapuram.

d. Agro-climatic zones

Based on rainfall distribution, irrigation pattern, soil characteristics, cropping pattern and other physical, ecological and social characteristics, Tamil Nadu State is classified into seven distinct agro-climatic zones delineated as indicated below.

(i) North Eastern Zone: This zone covers the districts of Kancheepuram, Tiruvallur, Vellore, Thiruvannamalai, Cuddalore (excluding Chidambaram and Kattumammar koil taluks) and Ariyalur and Perambalur taluks in Perambalur district.

(ii) North Western Zone: This zone comprises of Dharmapuri district (excluding hilly areas), Salem and Namakkal districts (excluding Tiruchengode taluk) and Perambalur taluk of Perambalur district.

(iii) Western Zone: It is comprising, Erode and Coimbatore districts, Tiruchengode taluk of Namakkal, Karur taluk of Karur district and northern parts of Madurai district.

(iv) Cauvery Delta Zone: This zone covers the Cauvery Delta area in Thanjavur, Nagapattinam, Thiruvarur districts and Musiri, Tiruchirappalli, Lalgudi, Thuraiyur and Kulithalai taluks of Tiruchirappali districts, Aranthangi taluk of Puddukottai and Chidambram and Kattumannar koil taluks of Cuddalore District.

(v) Southern Zone: This zone includes Ramanathapuram, Virudhunagar, Sivaganga, Thoothukudi and Tirunelveli districts, Dindigul and Natham taluks of Dindigul district, Melur, Tirumangalam, Madurai South and Madurai North taluks of Madurai district and Pudukottai district (excluding Aranthangi taluk).

(vi) High Rainfall Zone: This zone consists of Kanyakumari district.

(vii) Hilly Zone: This zone covers the hilly regions the Nilgiris, Shevroys, Elagiri-Javadhi, Kollimalai, Pachaimalai, Anamalais, Palanis and Podhigai malai.

e. Rice and cultural heritage in the state

Pongal is an ancient and undoubtedly the most popular and fervently celebrated festival of Tamils. It is the harvest festival of Tamil Nadu celebrated on the 1st day of Tamil month, *Thai*, that is 14th January of every year. "**Pongal**" is actually the name of a rice and lentil dish cooked commonly in Tamil Nadu, and specifically on the festive day of Pongal.

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IV Rice production scenario

a. Area

Paddy is the principal crop extensively cultivated in all the districts of the state having a unique three-season pattern viz., Kar/Kuruvai /Sornavari (April to July), Samba/ Thaladi/Pishanam (August to November) and Navarai/ Kodai (December to March). The total area under Paddy is about 1789170 ha during 2007-08. Paddy accounted for 30.77% of the total cropped area in the state during

2007-08. (Source: Season and Crop reports 2007-08, Department of Economics and statistics, Chennai-600 006). Nagapattinam district is at the top with an area of 154040 ha followed by Thiruvarur district 151629 ha and Thanjavur district 150228 ha. (Source: Department of Economics and statistics, Chennai-600 006).

b. Production

Total rice production in Tamil Nadu during the year 2007-08 is 5039954 tonnes. Production of rice has reduced to 5040 tonnes during 07-08 from 6611 tonnes in 06-07. Villupuram district is at the top with production of 480329 tonnes followed by Thanjavur district 479643tonnes. (Source: Department of Economics and Statistics, Chennai-600 006).

c. **Productivity; District wise /season wise**

The yield rate of Rice, on the contrary, has reduced to 2817kg/ha in 07-08 from 3423kg/ha in 06-07 (Source: Season and crop report 2007-08, Department of Economics and Statistics, Chennai-600 006). The productivity of rice has reduced to 2817 kg/ ha from 3423 kg/ ha in 06-07. Productivity in season wise and district wise during the year 2005-06 indicated that the total productivity was 2541 kg/ha (Source; Season and crop report 2005-06. Department of Economics and Statistics, Chennai -600 006). The yield rate was recorded on three seasons 1. kar/kuruvai/Sornavar 2. Samab/Thaladi/pishanam 3. Navarai/kodai. Among the three season, during the year 2005-06 the average yield rate was high in kar /kurauvai/sornavari (3298kg/ha) followed by navarai /kodai (2978kg/ha) and samba/thaladi/pishanam (2325 kg/ha). Highest yield rate of 4563kg/ha was recorded in Erode district during kar/kuruvai/sornavari season followed by Theni district(4525 kg/ha), Thoothukud district(4101kg/ha) and Kanyakumari district (4077 kg/ha). In samba/thaladi/Pishanam season, highest yield rate was recorded in Thoothukudi district (4068 kg/ha) followed by Theni

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district (3980 kg/ha) and Erode District (3933 kg/ha). In navarai/kodai season 2005-06, highest yield rate was recorded in Thoothukudi district (4324 kg/ha) followed Erode District (4154 kg/ha) and Virudhunagr district (3824 kg/ha) (Source; Season and crop report 2005-06. Department of Economics and Statistics, Chennai -600 006).

d. Yield gap and its reasons

There is an existence of sizable yield gaps between attainable and farm level yields across the ecologies, regions within ecologies, and crop seasons in all rice growing region. The practical yield gap that can be addressed is the difference between the maximum attainable yield and the farm level yield as defined below:

a. **Maximum Attainable Yield**: is the rice yields of experimental/ on-farm plots with no physical, biological and economic constraints and with the best- known management practices at a given time and ecology.

b. **Farm Level Yield:** is the average farmers yield in a given target area at given time and ecology.

e. Major contributing factors in different ecologies

i. Irrigated ecology

State-wise yield gap analysis reveals vast scope for yield consolidation in all the zones(Siddiq, 2000). In the south zone, except Tamil Nadu where the gap is the least (15.6 percent) all are in the range of 34 (Karnataka) to 49.8 percent (Kerala), while in the north zone, Punjab is the only exception, where 78 percent of the potential has already been realized with others remaining with yield gaps of 50 to 57 percent. Comparison of the present analysis with that of the one done 10 years ago reveals hardly any difference in yield gap. But this no-change trend should not mean failure or lack of efforts in the last 10 years to narrow the gap. Rather, the rapid and steady productivity advance made since 1987 appears to have contributed to the

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persistently wide yield gap warranting much more effort to narrow the gap appreciably (Siddiq, 2000).

Yield Gap in Major Rice Growing States 1990/91 - 1997/98

State	Paddy yield (kg/ha)		Yield Difference (kg/ha)	Gap of St. Av. over Exptl. Av.
	State Av.	Exptl. trial Av.*		
South Zone				
Tamil Nadu	4460	5286	826	15.6

(Siddiq, 2000)

ii. Rainfed ecologies

The estimation of achievable yield through adoption of currently popularized improved varieties reveals similar wide yield gaps in the major rainfed ecologies as well. The factors responsible are;

- Low soil fertility and fertilizer use
- Problem soils (salinity, alkalinity, iron toxicity)
- Drought / flood problems
- Poor weed management
- Timely availability and quality of inputs
- Post harvest losses
- Low profit
- Inadequate extension support to farmers and slow adoption of recommended technologies

iii. Upland condition

- Drought
- Very soil fertility and fertilizer use
- Weed infestation
- Low profit

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- Inadequate research and extension support service
- Lack of location specific varieties and production technologies

f. Contribution to GDP

Tamil Nadu's gross state domestic product for 2007 is estimated at 275,000 crores (70 billion USD) in current prices.GDP from TN Govt. website). The state experienced a GDP growth rate of 12.1% for this period. It was the third largest economy (2007-2008) among all states in India, and also the most industrialised state in India. The per capita income in 2007 - 2008 for the state was Rs.43,000 ranking second among the South Indian states and steadily been above the national average(Tamil Nadu Wikipedia website).

V. Region-wise/ district-wise rice ecosystem

Rice ecosystems

The rice crop is cultivated both under irrigated and rainfed ecosystem. The upland rice are bunded rainfed or subsequently irrigated.

(a) Upland

Rainfed and semidry.

(b) Rainfed

The crop is raised with direct seeding either by broadcasting or sowing behind the country plough or *gorru.* The crop is depending entirely on the monsoon rain.

(c) Semidry

The dry seeds are sown either pre or post-monsoon depending on rainfall received or predicted. Later the crop is irrigated when the tanks get filled up with rains and water is received through canals.

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Low land

They are bunded and irrigated, either by river water or tank water. Transplanting is the common practice. However, direct seeding of wet sprouted seeds with the help of drum seeder is slowly getting popular.

VI. Rice production and economic analysis

Simple percentage analysis was used to analyze the structural changes in the cost of cultivation of paddy (Sitadevi and Ponnarasi,.2009),. Cost structure of the crop was analyzed by working out the share of each item in the total cost of cultivation. The cost of production was also worked out. The cost of cultivation was computed for the paddy crop separately for the two categories, viz. SRI and conventional methods and is presented in Table 1. It could be seen from the Table 1 that the total cost of cultivation per hectare was lower by about 10 per cent in SRI method (Rs 21655) than conventional method (Rs 25914). Among the components of the total cost, human labour occupied the highest share in both, viz. 43.61 per cent in SRI method and 41.87 per cent in conventional method. In the SRI method, the cost of seeds occupied a meager amount (0.63 per cent) as compared to the conventional method (6.99 per cent). Also, the share of irrigation cost was also very little in SRI method (9.84 per cent) as against 19.30 per cent in the conventional method. It is due to the fact that there is a drastic reduction in seed rate from about 30-60 kg/ha to 10 kg/ha in the SRI technology. Also, there is 40-50 per cent water saving from planting to harvesting. However, the cost of machine labour was higher (20.99 per cent) in SRI than conventional method (9.19 per cent) due to frequent weeding using a rotary weeder. It could also be noted that the lowest share of cost on plant protection chemicals was low in both the methods of cultivation, viz. 2.77 per cent and 4.41 per cent in SRI and conventional methods, respectively. The cost incurred on fertilizers was more or less the same in both the methods of cultivation.

Further, it could be seen that the net returns were higher in SRI (Rs 27009) than conventional (Rs 14499) method. It was mainly due to the higher productivity of paddy in the SRI method. The gross returns were also higher in SRI (Rs 48665) than conventional (Rs 40413) method. Also, the costs of production per tonne of paddy were lower in SRI (Rs 3937) than conventional method (Rs 7403) of rice cultivation. It could be inferred that the cost of production was almost double in the conventional method of paddy cultivation, as the productivity of rice was low in this method. It was also observed that the benefit-cost ratio was higher in SRI (2.25) than in conventional (1.56) method. The respondents in SRI method had realized increased productivity and thereby the returns in paddy crop were comparatively

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high. The increased grain yield under SRI was mainly attributed to more number of lengthy productive tillers with increased number of filled grains per panicle. Thus, the cumulative effect of SRI technology was higher returns compared to conventional method due to less seed rate, irrigation and labour requirement in weeding.

VII Rice and rice based cropping systems-zone-wise

The rice is cultivated for a very long time under wet, dry and garden land ecosystem. Under dry cultivation, the dry seed was sown either by broadcasting or dropped in lines after country plough or with the help of *Gorru.* It was also sown as mixed crop along with redgram. This practice is still being followed in Ramanthapuram district. In Chingleput, Thiruvallur, Kancheepuram, the seeds are sown in dry conditions but subsequently the crop is irrigated when the tanks get filled up with the on set of monsoon. It certain parts of North Arcot, South Arcot, Chingleput and Salem districts, rice is cultivated as a garden land crop under irrigation.

Some of the rice based cropping patterns being followed in the in Tamil Nadu are discussed below:-

Rice - Rice-Rice: This crop rotation is most suitable for areas having high rainfall and assured irrigation facilities in summer months, particularly, in soils which have high water holding capacity and low rate of infiltration. In some canal irrigated areas of Tamil Nadu, a cropping pattern of 300% intensity is followed. In such areas three crops of rice are grown in a year.

Rice-Groundnut: This cropping pattern is being followed by the farmers Tamil Nadu. After harvesting of rice crop, groundnut is grown in summer.

Rice fallow cultivation

Rice + Pigeon pea

Rice + green gram (moong bean)

Rice + Black gram, urd bean

Rice + Black gram

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VIII. Rice growing seasons of different regions

In Tamil Nadu rice is cultivated in varied agro-climatic, soil and stress conditions under eight different seasons with rice varieties of five different duration groups.

Rice growing seasons

(i) *Sornavari* (March-April to June-July)

(ii) *Kar* (April-May to July-August) (Ist crop)

(iii) *Kuruvai* (May-June to August)

(iv) Early *samba* (July-August to Jan-Feb)

(v) *Samba* (Sept-Oct to Jan-Feb) (Single crop)

(vi) Late *samba* (Sept.-Oct to Jan-Feb)

(vii) *Thaladi* / *Pishanam* (Sept-Oct to Feb-March) (II Crop)

(viii) *Navarai* (Nov-Dec to Feb-March)

Duration groups in rice

i. Very early	About 100 days
ii. Short	100-120 days
iii. Medium	121-140 days
iv. Long	141-160 days
v. Very long	Above 160 days

In general, rice varieties with durations of 110-115 days, 125-135 and 140-160 days are cultivated in larger area in this state.

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District/Season	Month	Varieties
1. Kanchipuram/Tiruvallur		
Sornavari	(April -May)	ADT 36, IR 36, IR 50, ADT 37, ASD 16, ASD 17, IR 64, ASD 18, ADT 42, MDU 5, ASD 20, ADT43, CO 47, TRY (R)2*, ADT (R) 45, ADTRH 1, ADT (R) 47
Samba	(Aug)	IR 20, White Ponni, CO 43, ADT 40, PY 4, ADT 39, TRY 1, ASD 19, ADT(R) 44, CORH 2
Late Samba	(Sep - Oct)	IR 20, White Ponni, ADT 39, CO 43, TRY 1, ADT (R)46, CORH 2
Navarai	(Dec -Jan)	ADT 36, ADT 37, ASD 16, IR 64, ASD 18, ADT 42, ADT 43 MDU 5, ASD 20
Dry	(July - Aug)	PMK 2, MDU 5, TKM 11, PMK (R) 3, TKM (R) 12
Semi-dry	(July - Aug)	IR 20, TKM 10, PMK 2, MDU 5, TKM 11, TKM (R) 12, PMK (R) 3
2. Vellore/Tiruvannamalai		
Sornavari	(April-May)	IR 64, ADT 36, IR 50, ADT 37, ASD 16, ASD 17, ASD 18, ADT 42, MDU 5, ASD 20, ADT 43, CO 47, ADT (R) 45, ADT RH1, ADT (R) 47
Samba	(Aug)	Ponmani, ADT 40, Bhavani, IR 20, White Ponni, CO 43, Paiyur 1, PY 4, CO 45, TRY 1, ASD 19, CORH 2
Navarai	(Dec -Jan)	ADT 36, IR 20, ADT 39, CO 43, IR 64, ASD 16, ASD 18, ADT 42, MDU 5, CO 47, ASD 20, TRY (R)2*
3. Cuddalore/ Villupuram		
Sornavari	(April -May)	ADT 36, IR 50, ASD 16, IR 64, ASD 18, ADT 42, MDU 5, ASD 20, ADT 43, CO 47, ADT (R) 45, TRY (R)2*, ADTRH 1, ADT (R) 47
Samba	(Aug)	IR 20, White Ponni, CO 43, Ponmani, PY 4, ADT 38, TRY 1, ASD 19, ADT (R) 44, CORH 2
Navarai	(Dec-Jan)	ADT 36, IR 20, IR 36, IR 64, ADT 39, ASD 16, ASD 18, ADT 42, MDU 5, ASD 20, TRY (R)2*
4. Tiruchirappalli/Karur/Perambalur		
Kuruvai	(Jun -Jul)	ADT 36, IR 50, IR 64, ASD 16, ADT 37, ASD 18, ADT 42, MDU 5, ADT 43, CO 47, ADT (R) 45 (except Karur), TRY (R)2*, ADTRH 1, ADT (R) 47
Samba	(Aug)	IR 20, White Ponni, CO 43, ADT 40, Ponmani, TRY 1, ASD 19, ADT (R) 44
Late Samba / Thaladi	(Sep -Oct)	IR20, WhitePonni, ADT39, CO43, TRY1, ASD19, ADT(R)46,
Navarai	(Dec -Jan)	ADT 36, IR 64, ASD 16, ASD 18, ADT 42, MDU 5, ASD 20, TRY (R)2*
5. Thanjavur/Nagapattinam/Tiruvarur		
Kuruvai	(Jun -Jul)	ADT 36, IR 50, IR 64, ADT 37, ASD 16, ASD 18, ADT 42, MDU 5, ADT 43, ADT (R) 45, TRY (R) 2*, ADTRH 1, ADT (R) 47, ,ADT (R) 48
Samba	(Aug)	IR 20, White Ponni, CO 43, Ponmani, ADT 38, TRY 1, ASD 19, ADT (R) 44, CORH 2
Late Samba / Thaladi	(Sep -Oct)	ADT 38, IR 20, CO 43, Ponmani, ADT 39, TRY 1, ASD 19, ADT (R)46,
Navarai (Kullankar)	(Dec -Jan)	ADT 36, ADT 37, IR 64, ASD 16, ASD 18, ADT 42, MDU 5, ASD 20, TRY (R)2*
6. Pudukottai		
Kuruvai	(Jun -Jul)	ADT 36, IR 50, IR 64, ASD 16, ADT 42, MDU 5, ASD 20, ADT 43, ADT (R) 45, TRY (R) 2*, ADTRH 1, ADT (R) 47
Samba	(Aug)	IR 20, White Ponni, CO 43, Ponmani, TRY 1, ASD 19,

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		ADT (R) 44, CORH 2
Late Samba/Thaladi	(Sep - Oct)	IR 20, ADT 38, ADT 39, TRY 1, ASD 19, CO 43, ADT (R)46
Dry	(Jul -Aug)	ADT 36, PMK 2, TKM 10, TKM (R) 12, PMK (R) 3
Semi-dry	(Jul -Aug)	ADT 36, PMK 2, TKM 10, TKM (R) 12, PMK (R) 3
7. Madurai/Dindigul/Theni_		
Kar	(May - Jun)	ADT 36, IR 50, IR 36, IR 64, ADT 37, ASD 16, ASD 18, ADT 42, MDU 5, ASD 20, ADT 43, CO 47, ADT (R) 45 (Dindigul only), TRY (R) 2*, ADTRH 1, ADT (R) 47
Samba	(Aug)	IR 20, White Ponni, CO 42, CO 43, ADT 38, ADT 40, MDU 4, TRY 1, ASD 19, ADT (R) 44, CORH 2
Late Samba/Thaladi	(Sep - Oct)	IR 20, White Ponni, MDU 3, ADT 39, MDU 4, CO 43, ASD 19, TRY 1, ADT (R)46
Navarai	(Dec -Jan)	IR 64, ADT 36, ADT 37, ASD 16, ASD 18, ADT 42, MDU 5, ASD 20, TRY (R) 2*
Semi-dry	(Jul -Aug)	PMK 2, TKM 10, MDU 5, TKM (R) 12, PMK (R) 3
8. Ramanathapuram		
Samba	(Aug)	IR 20, White Ponni, CO 43, MDU 3, ASD 19, TRY 1, ADT (R) 44, CORH 2
Rainfed & Semidry	(Jul -Aug)	ASD 17, ADT 36, PMK 2, MDU 5, TKM (R) 12, PMK (R) 3
9. Virudhunagar		
Samba	(Sep-Oct)	CO 43, TRY 1, IR 20, ADT (R)46, ADT 39, CORH 2
Dry	(Jul -Aug)	ADT 36, PMK 2, MDU 5, TKM (R) 12, PMK (R) 3
10. Sivaganga		
Semi-dry	(Jul –Aug)	ADT 36, IR 36, ADT 39, PMK 2, MDU 5, TKM (R) 12, PMK (R) 3
11. Tirunelveli, Thoothukudi		
Early Kar	(Apr - May)	IR 50, ADT 36, IR 64, ADT 42, ADT 43, ADT 45, CO 47, ADT (R) 47
Kar	(May -Jun)	ASD 16, ASD 17, ASD 18, ADT 42, ADT 43, CO 47, ADT (R) 45, TRY (R) 2*, ADTRH 1, ADT (R) 47
Late Samba/Thaladi	(Sep - Oct)	White Ponni, IR 20, ADT 39, ASD 19, TRY 1, ADT (R)46, CORH 2
Pishanam/Late Pishanam	(Sep-Oct.)	ASD 18, ASD 16, ASD 19, CO 43, TRY 1, ADT (R)46
Semi Dry	(July- Aug)	MDU 5, ADT 36, TKM (R) 12, PMK (R) 3
12. Kanyakumari		
Kar	(May –Jun)	ADT 36, IR 50, IR 64, ASD 16, ASD 17, ASD 18, ADT 42, MDU 5, ASD 20, ADT 43, ADT 45, CO 47, ADTRH 1, ADT (R) 47
Pishanam / Late Samba / Thaladi	(Sep – Oct)	White Ponni, IR 20, Ponmani, CO 43, TRY 1, TPS 2, TPS 3, ADT (R) 44, ADT 39, ASD 18, ASD 19, MDU 5, ADT (R) 46
Semi-dry	(Jul – Aug)	ADT 36, ASD 17, PMK 2, TKM (R) 12, PMK (R) 3
13. Salem, Namakkal		
Kar	(May - Jun)	IR 50, ADT 36,IR 64, ADT 37, ASD 16, ASD18, ADT 42, MDU 5, ASD 20, ADT 43, CO 47, ADT (R) 45, TRY (R)2*, ADTRH 1, ADT (R) 47
Samba	(Aug)	IR 20, White Ponni, Bhavani, CO 43, MDU 4, TRY 1, ASD 19, ADT (R) 44
Navarai	(Dec - Jan)	IR 20, ADT 36, IR 64, ASD 18, ASD 19, ADT 42, MDU 5, ASD 20, TRY (R)2*
14. Dharmapuri/ Krishnagiri		
Kar	(May -Jun)	IR 50, IR 64, ASD 16, Bhavani, IR 20, White Ponni, CO 43, ASD 18, MDU 4, ASD 19, PAIYUR 1, ADT 42, TRY 1, MDU 5, ASD 20, ADT 43, CO 47, ADTRH 1, TRY (R)2*, ADT (R) 47
Navarai	(Dec- Jan)	IR 64, ADT 37, ASD 16, ADT 36, ASD 18, ADT 42, MDU 5, ASD 20, TRY (R)2*
Samba/Late Samba	(Aug - Oct)	TRY 1, Bhavani, IR 20, White Ponni, CO 43, MDU 4, ASD 19,

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		ADT (R) 44, ADT (R) 46
15. Coimbatore		
Kar	(May - Jun)	IR 50, ADT 36, ASD 16, IR 64, ASD 18, ADT 42, MDU 5, ASD 20, ADT 43, CO 47, ADT (R) 45, TRY (R)2*, ADTRH 1, ADT (R) 47
Samba	(Aug)	IR 20, CO 43, White Ponni, ADT 39, MDU 4, TRY 1, ASD 19, Bhavani, ADT(R) 44, CORH 2
Late Samba/Thaladi	(Sep - Oct)	IR 20, ADT 39, ADT(R) 46, CORH 2
Navarai	(Dec -Jan)	IR 20, ADT 36, IR 64, ASD 16, ASD 18, TRY1, MDU 5, ASD 20, TRY (R) 2*
16. Erode		
Kar	(May - Jun)	IR 50, ASD 16, IR 64, ADT 36, ASD 18, ADT 42, MDU 5, ASD 20, ADT 43, CO, 47, ADT (R) 45, TRY (R)2*, ADTRH 1, ADT (R) 47
Samba	(Aug)	IR 20, Bhavani, CO 43, White Ponni, ADT 39, TRY 1, CO 46, ADT (R) 44
Late Samba	(Sep - Oct)	IR 20, White Ponni, ADT 39, CO 43, TRY 1, CO 46, ADT (R) 46, CORH 2
Navarai	(Dec – Jan)	IR 20, ADT 36, IR 64, ASD 16, ASD 18, ADT 42, MDU 5, ASD 20
17. The Nilgiris		
Samba	(Jul -Aug)	IR 20, CO 43, TRY 1, ADT (R) 44

* suitable for salt affected soils

Month of sowing	Season	Duration (Days)	Districts
Dec - Jan	Navarai	< 120	Tiruvallur, Vellore, Tiruvannamalai, Cuddalore, Villupuram, Tiruchirapalli, Perambalur, Karur, Nagapattinam, Madurai, Theni, Salem, Namakkal, Dindigul, Dharmapuri, Coimbatore,Erode and Pudukkottai.
Apr - May	Sornavari	<120	Tiruvallur, Vellore, Tiruvannamalai, Cuddalore, Villupuram, Namakkal, Dharmapuri
Apr - May May - June	Early Kar Kar	<120	Tirunelveli, Kanyakumari, Thoothukudi, Erode, Coimbatore, Madurai, Theni, Dindigul, Salem, Namakkal, Dharmapuri.
June - July	Kuruvai	<120	Tiruchirapalli, Perambalur, Karur, Thanjavur, Nagapattinam, Tiruvarur, Pudukottai, Erode
July - Aug.	Early Samba	130 to 135	Tiruvallur, Vellore, Tiruvannamalai, Salem, Namakkal, Cuddalore, Villupuram, Madurai, Theni, Ramanathapuram, Dharmapuri, Coimbatore, Erode, Pudukkottai, The Nilgiris
August	Samba	130 - 135 and >150	All districts
Sep - Oct	Late Samba Thaladi/Pishanam	130 - 135	Tiruvallur, Madurai, Theni, Coimbatore, Erode
Sep -Oct	Late Pishanam	130 - 135	Madurai, Theni, Dindigul, Kanyakumari Tirunelveli , Thoothukudi
Oct - Nov	Late Thaladi	115 -120	Thanjavur, Nagapattinam, Tiruvarur, Tiruchirapalli, Perambalur, Karur,

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IX. Recommended package of practices

a. Varieties/hybrids

Recommended package of practices for varieties

Wet nursery

Nursery area

Select 20 cents (800 m^2) of land area near to water source for raising seedlings for one hectare.

Seed rate

30 kg for long duration

40 kg for medium duration

60 kg for short duration varieties and

20 kg for hybrids

Seed treatment

a. Treat the seeds in Carbendazim or Pyroquilon or Tricyclozole solution at 2 g/l of water for 1 kg of seeds. Soak the seeds in water for 10 hrs and drain excess water.

b. This wet seed treatment gives protection to the seedlings up to 40 days from seedling disease such as blast and this method is better than dry seed treatment.

c. If the seeds are required for sowing immediately, keep the soaked seed in gunny in dark and cover with extra gunnies and leave for 24hrs for sprouting.

d. **Seed treatment with *Pseudomonas fluorescens***: Treat the seeds with talc based formulation of *Pseudomonas fluorescens* 10g/kg of seed and soak in 1lit of water overnight. Decant the excess water and allow the seeds to sprout for 24hrs and then sow.

e. Seed treatment with *Azospirillum*: Three packets (600 g/ha) of Azospirillum and 3 packets (600g/ha) of Phosphobacteria or 6 packets (1200g/ha)of Azophos. In bioinoculants mixed with sufficient water wherein the seeds are soaked overnight before sowing in the nursery bed (The bacterial suspension after decanting may be poured over

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the nursery area itself).

- Biocontrol agents are compatible with biofertilizers
- Biofertilizers and biocontrol agents can be mixed together for seed soaking
- Fungicides and biocontrol agents are incompatible

Forming Seedbeds

- Mark plots of 2.5m breadth with channels 30cm wide all around the seedbeds.
- Length of the seed bed may vary from 8 to 10m according to soil and slope of the land.
- Collect the puddled soil from the channel and spread on the seedbeds or drag a heavy stone along the channel to lower it, so that the seed bed is at a higher level.
- Level the surface of the seedbed, so that the water drains into the channel.

Sowing

Sow the sprouted seeds uniformly on the seedbed, having thin film of water in the nursery.

Water Management

- Drain the water 18 to 24hrs after sowing
- Care must be taken to avoid stagnation of water in any part of the seedbed.
- Allow enough water to saturate the soil from 3rd to 5th day. From 5th day onwards, increase the water depth to 1.5cm depending on the height of the seedlings.
- Thereafter maintain 2.5cm depth of water.

Weed Management

- Apply any one of the pre-emergence herbicides viz., Pretilachlor + safener 0.3kg/ha, on 3rd or 4th day after sowing to control weeds in the lowland nursery. Keep a thin film of water and allow it to disappear. Avoid drainage of water. This will control germinating weeds.

Nutrient management

- Apply 1tonne of fully decomposed FYM or compost to 20cents nursery and spread the manure uniformly on dry soil.
- Basal application of DAP is recommended when the seedlings are to be pulled out in 20-

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25 days after sowing in less fertile nursery soils.

- For that situation, before the last puddling, apply 40kg of DAP and if not readily available, apply straight fertilizers 16kg of urea and 120kg of super phosphate.
- If seedlings are to be pulled out after 25 days, application of DAP is to be done 10 days prior to pulling out.
- For clayey soils where root snapping is a problem, 4kg of gypsum and 1kg of DAP/cent can be applied at 10 days after sowing.

Dry nursery

- Dry ploughed field with fine tilth is required.
- Nursery area with sand and loamy soil status is more suitable for this type of nursery.
- Area 20cents.
- Plots of 1 to 1.5 m width of beds and channels may be formed. Length may be according to the slope and soil. Raised beds are more ideal if the soil is clayey in nature.
- Seed rate and seed treatment as that of wet nursery.
- Sowing may be dry seeding. Seeds may be covered with sand and finely powdered well decomposed farm yard manure.
- Irrigation may be done to wet the soil to saturation.
- Optimum age for transplanting – 4^{th} leaf stage
- This type of nursery is handy in times of delayed receipt of canal water.

Main Field Management

Land preparation

- Plough the land during summer to economize the water requirement for initial preparation of land.
- Flood the field 1 or 2days before ploughing and allow water to soak in. Keep the surface of the field covered with water.
- Keep water to a depth of 2.5cm at the time of puddling.
- Special technologies for problem soils:

  a) For fluffy paddy soils: compact the soil by passing 400kg stone roller or oil-drum with

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stones inside, eight times at proper moisture level (moisture level at friable condition of soil which is approximately 13 to18%) once in three years, to prevent the sinking of draught animals and workers during puddling.

b) For sodic soils with pH values of more than 8.5, plough at optimum moisture regime, apply gypsum at 50% gypsum requirement uniformly, impound water, provide drainage for leaching out soluble salts and apply green leaf manure at 5 t/ha, 10 to 15 days before transplanting. Mix 37.5kg of Zinc sulphate per ha with sand to make a total quantity of 75kg and spread the mixture uniformly on the leveled field. Do not incorporate the mixture in the soil. Rice under sodic soil responds well to these practices.

c) For saline soils with EC values of more than 4 dS/m, provide lateral and main drainage channels (60cm deep and 45cm wide), apply green leaf manure at 5 t/ha at 10 to 15 days before transplanting and 25% extra dose of nitrogen in addition to recommended P and K and $ZnSo_4$ at 37.5 kg/ha at planting

d) For acid soils apply lime based on the soil analysis for obtaining normal rice yields. Lime is applied 2.5t/ha before last ploughing. Apply lime at this rate to each crop up to the 5^{th} crop.

Stand Establishment

Optimum age of seedlings for quick establishment

- Optimum age of the seedlings is 18-22 days for short, 25-30 days for medium and 35-40 days for long duration varieties.

Pulling out the seedlings

- Pull out the seedlings at the appropriate time (4^{th} leaf stage).
- Pulling at 3^{rd} leaf stage is also possible. These seedlings can produce more tillers, provided enough care taken during the establishment phase through thin film of water management and perfect leveling of main field.
- Transplanting after 5^{th} and higher order leaf numbers will affect the performance of the crop and grain yield. Then they are called as 'aged seedlings'. Special package is needed

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to minimize the grain yield loss while planting those aged seedlings.

Root dipping

- Prepare the slurry with 5 packets (1000 g)/ha of Azospirillum and 5 packets (1000g/ha) of Phosphobacteria or 10 packets of (2000g/ha) of Azophos inoculant in 40 lit. of water and dip the root portion of the seedlings for 15 - 30 minutes in bacterial suspension and transplant.

Planting seedlings in the main field

Soil	Medium and low fertility			High fertility		
Duration	Short	Medium	Long	Short	Medium	Long
Spacing (cm)	15x10	20x10	20x15	20x10	20x15	20x20
Hills / m^2	66	50	33	50	33	25

- Transplant 2-3 seedlings/hill for short duration and 2 seedlings/hill for medium and long duration varieties
- Shallow planting (3 cm) ensures quick establishment and more tillers.
- Deeper planting (> 5cm) leads to delayed establishment and reduced tillers.
- Line planting permits rotary weeding and its associated benefits.
- Allow a minimum row spacing of 20 cm to use rotary weeder.
- Fill up the gaps between 7^{th} and 10^{th} DAT.

Gap filling

- Fill the gaps if any within 7 - 10 days after planting.

Nutrient management

Application of organic manures

- Apply 12.5 t of FYM or compost or green leaf manure @ 6.25 t/ha.
- If green manure is raised @ 20 kg /ha *in situ,* incorporate it to a depth of 15 cm using a green manure trampler or tractor.
- In the place of green manure, press-mud / composted coir-pith can also be used.

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Stubble incorporation

- Apply 22 kg urea / ha at the time of first puddling while incorporating the stubbles of previous crop to compensate immobilization of N by the stubbles.
- This may be done at least 10 days prior to planting of subsequent crop. This recommendation is more suitable for double crop wetlands, wherein, the second crop is transplanted in succession with short turn around period.

Biofertilizer application

- Broadcast 10 kg of soil based powdered BGA flakes at 10 DAT for the dry season crop. Maintain a thin film of water for multiplication.
- Raise azolla as a dual crop by inoculating 250 kg/ha 3 to 5 DAT and then incorporate during weeding for the wet season crop.
- Mix 10 packets (2000 g)/ha of Azospirillum and 10 packets (2000g/ha)of Phosphobacteria or 20 packets (4000g/ha) of Azophos inoculants with 25 kg FYM and 25 kg of soil and broadcast the mixture uniformly in the main field before transplanting and
- *Pseudomonas fluorescens* (Pf 1) at 2.5 kg/ha mixed with 50 kg FYM and 25 kg of soil and broadcast the mixture uniformly before transplanting.

Application of inorganic fertilizers

- Apply fertilizer nutrients as per soil test recommendations
- N dose may be through Leaf Color Chart (**LCC**)
- P & K may be through Site Specific Nutrition Management by Omission plot technique (Ref. Appendix II)
- If the above recommendation are not able to be followed, adopt blanket recommendation as follows:

Nutrients	N (kg/ha)	P_2O_5	K_2O
Short duration varieties (**dry season**)			
a) Cauvery delta & Coimbatore tract	150	50	50
b) For other tracts	120	40	40

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Medium and long duration varieties (**wet season**)	150	50	50
Hybrid rice	175	60	60
Low N responsive cultivars (like Improved White Ponni)	75*	50	50

*For Ponni, N should be applied in three splits at AT, PI and H stages** in addition to GLM or FYM application.

****Phenological stages of rice (days after sowing)**

Stages	Short (105)	Medium (135)	Long (150)
Active Tillering (AT)	35-40	50-55	55-60
Panicle Initiation (PI)	45-50	70-75	85-90
Heading (H)	70-75	100-105	115-120

Split application of N and K

- Apply N and K in four equal splits viz., basal, tillering, panicle initiation and heading stages.
- Tillering and Panicle initiation periods are crucial and should not be reduced with the recommended quantity.
- N management through **LCC** may be adopted wherever chart is available as given below

N management through LCC

- Time of application is decided by LCC score
- Take observations from 14 DAT in transplanted rice or 21 DAS in direct seeded rice.
- Repeat the observations at weekly intervals up to heading
- Observe the leaf colour in the fully opened third leaf from the top as index leaf.
- Match the leaf color with the colours in the chart during morning hours (8-10 am).
- Take observation in 10 places.
- LCC critical value is 3.0 in low N response cultures like White Ponni and 4.0 in other

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cultivars and hybrids

- When 6/10 observations show less than the critical colour value, N can be applied @ 35kg N/ha in dry season and 30kg N/ha in wet season per application per ha.

Application of P fertilizer

- P may be applied as basal and incorporated.
- When the green manure is applied, rock phosphate can be used as a cheap source of P fertilizer. If rock phosphate is applied, the succeeding rice crop need not be supplied with P. Application of rock phosphate + single super phosphate or DAP mixed in different proportions (75:25 or 50:50) is equally effective as SSP or DAP alone.

Application of zinc sulphate

- Apply 25 kg of zinc sulphate mixed with 50 kg dry sand just before transplanting.
- It is enough to apply 12.5 kg zinc sulphate /ha, if green manure (6.25 t/ha) or enriched FYM, is applied.
- If deficiency symptom appears, foliar application of 0.5% Zinc sulphate + 1.0% urea can be given at 15 days interval until the Zn deficiency symptoms disappear.

Application of gypsum

- Apply 500 kg of gypsum/ha (as source of Ca and S nutrients) at last ploughing.

Foliar nutrition

- Foliar spray of 1% urea + 2% DAP + 1% KCl at PI and 10 days later for all varieties.

Weed management

- Use of rotary weeder from 15 DAT at 10 days interval. It saves labour for weeding, aerates the soil and root zone, prolongs the root activity, and improves the grain filling though efficient translocation and ultimately the grain yield.
- Cultural practices like dual cropping of rice-azolla, and rice-green manure (described in wet seeded rice section 2.5 & 2.6 of this chapter) reduces the weed infestation to a greater extent.
- Summer ploughing and cultivation of irrigated dry crops during post-rainy periods reduces the weed infestation.

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Pre-emergence herbicides

- Use Butachlor 1.25kg/ha or Anilophos 0.4kg/ha as pre-emergence application. Alternatively, pre-emergence application of herbicide mixture viz., Butachlor 0.6kg + 2,4 DEE 0.75kg/ha, or Anilophos + 2, 4 DEE 'ready-mix' at 0.4kg/ha followed by one hand weeding on 30 - 35 DAT will have a broad spectrum of weed control.
- Any herbicide has to be mixed with 50kg of dry sand on the day of application (3 - 4 DAT) and applied uniformly to the field with thin film water on the 3rd DAT. Water should not be drained for next 2 days from the field (or) fresh irrigation should not be given.

Post - emergence herbicides

- If pre-emergence herbicide application is not done, hand weeding has to be done on 15th DAT.
- 2,4-D sodium salt (Fernoxone 80% WP) 1.25 kg/ha dissolved in 625 litres with a high volume sprayer, three weeks after transplanting or when the weeds are in 3 - 4 leaf stage.

Water management

- Puddling and leveling minimizes the water requirement
- Plough with tractor drawn cage wheel to reduce percolation losses and to save water requirement up to 20%.
- Maintain 2.5cm of water over the puddle and allow the green manure to decompose for a minimum of 7 days in the case of less fibrous plants like sunnhemp and 15 days for more fibrous green manure plants like Kolinchi (*Tephrosia purpurea*).
- At the time of transplanting, a shallow depth of 2cm of water is adequate since high depth of water will lead to deep planting resulting in reduction of tillering.
- Maintain 2 cm of water up to seven days of transplanting.
- After the establishment stage, cyclic submergence of water (as in table) is the best practice for rice crop. This cyclic 5cm submergence has to be continued throughout the crop period.

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Days after disappearance of ponded water at which irrigation is to be given

Soil type	Summer	Winter
Loamy	1 day	3 days
Clay	Just before/immediately after disappearance	1 - 2 days

- Moisture stress due to inadequate water at rooting and tillering stage causes poor root growth leading to reduction in tillering, poor stand and low yield.
- Critical stages of water requirement in rice are a) panicle initiation, b) booting, c) heading and d) flowering. During these stages, the irrigation interval should not exceed the stipulated time so as to cause the depletion of moisture below the saturation level.
- During booting and maturity stages continuous inundation of 5cm and above leads to advancement in root decay and leaf senescence, delay in heading and reduction in the number of filled grains per panicle and poor harvest index.
- Provide adequate drainage facilities to drain excess water or strictly follow irrigation schedule of one day after disappearance of ponded water. Last irrigation may be 15 days ahead of harvest.

Harvesting

- Taking the average duration of the crop as an indication, drain the water from the field 7 to 10 days before the expected harvest date as draining hastens maturity and improves harvesting conditions.
- When 80% of the panicles turn straw colour, the crop is ready for harvest. Even at this stage, the leaves of some of the varieties may remain green.
- Confirm maturity by selecting the most mature tiller and dehusk a few grains. If the rice is clear and firm, it is in hard dough stage.
- When most of the grains at the base of the panicle in the selected tiller are in a hard dough stage, the crop is ready for harvest. At this stage harvest the crop, thresh and winnow the grains.
- Dry the grains to 12% moisture level for storage. Grain yield in rice is estimated only at

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14% moisture for any comparison.

- Maturity may be hastened by 3-4 days by spraying 20% NaCl a week before harvest to escape monsoon rains.

TRANSPLANTED HYBRID RICE

Seed rate	20 kg per hectare

SRI method

Seed rate : 5 Kg/ha

Nursery : 2.5 cents (Mat nursery)

Age of seedlings : 15 days

Seed treatment : : Pseudomonas 10g/kg of seed

Spacing 25 x 25 cm

Weed management : Use of rotary weeder / cono weeder (After transplanting 3-4 times at 10-15 days interval)

Irrigation management : Thin film of water during transplanting. Irrigating to 2-3 cm height after appearance of hair line crack till panicle initiation stage. After panicle initiation 2-3 cm of standing water.

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Nursery	Basal application of DAP at 2 kg/cent of nursery area. Sparse sowing of seeds at one kg/cent of nursery area will give robust seedlings with 1-2 tillers per seedling at the time of planting. If the soil is heavy, apply 4 kg gypsum/cent of nursery area, 10 days before pulling of seedlings.
Age of seedling	20 to 25 days
Spacing (cm)	20 x 10 (50 hills/m^2) or 25 x 10 (40 hills/m^2) according to soil fertility
Seedlings/ hill	One (along with tillers if already produced)
Fertilizer	175:60:60 kg N, P_2O_5 and K_2O/ha

Other package of practices: same as in transplanted rice varieties.

AGRONOMIC PRACTICES FOR TAMIL NADU RICE HYBRIDS

Hybrids

CORH 1 : (110 to 115 days),

CORH 2 : (125 days and 6.1 t/ha)

ADTRH1 : (115 days and 6.4 t/ha)

CORH 3(110 to 115 days and 7.5 t/ha)

Season :

CORH1 & ADTRH 1 : Kar, Kuruvai, Sornavari

CORH 2 : Samba, Late Samba, Navarai

CORH 3 : Kar, Kuruvai, Sornavari, Navarai

Nursery :

Seed rate : For hybrids CORH1, ADTRH 1 & CORH 2: 20 kg/ha (1 kg/cent)

Seed treatment : Carbendazin 2 g/kg of seed

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Manure to Nursery : FYM /compost 1t/20 cents or green manure 500 kg, DAP 2 kg/cent at last ploughing.

Bio fertilizer : Seed treatment with *Azospirillum* and *Phosphobacteria* each 3 pockets (600 g/ha).

Weed control : Butachlor/Thiobencarb at 200 ml/20 cent or Anilophos 100 ml/20 cent 8 DAS as sand mix

Seedling age : CORH 1 and ADTRH 1 : 25 days CORH 2 : 25 to 30 days

Main field : Preparation similar to that of wet rice (transplanted rice)

Fertilizer schedule N: P_2O_5: K_2O kg/ha

CORH 1 and ADTRH 1 - 150 :50: 50

Apply 50% N and 100% P and 50% of K as basal. Remaining 50% N in 3 splits viz. 15 DAT, 30 DAT and 45 DAT. Remaining 50% of K should be applied at 30 DAT

N : P_2O_5 : K_2O kg/ha

CORH2 : *150: 60 : 60*

50% N, 100% P and 50% K as basal, Remaining 50% N in 3 splits viz, 15 DAT, 40 DAT and 60 DAT. Remaining 50% of K at 40 DAT.

ZnSo4 : For both hybrids, at 25 kg/ha as basal

Weed control : Similar to that of transplanted rice

Irrigation : 5 cm depth of irrigation. Stop irrigation 10 days before harvest.

Critical stages : Panicle initiation (50 days) and heading (75 to 80 days)

Planting

i) No of seedlings /hill : One

ii) Spacing : 20 x 10 cm

iii) Population / m2 : 50 hills

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iv) Planting depth : 2 to 3 cm

Harvest : When 80% of panicles turn yellow

Yield : ADTRH 1 : 6.4 t/ha

: CORH 2 : 6.1 t/ha

Stop irrigation 10 days before harvest.

Recommended package of practices for Hybrid CORH3

FERTILIZER SCHEDULE

Fertilizer dosage	Urea (Nitrogen) (kg)	Phosphorus (Super phosphate) (kg)	Potassium (Murate of potash) (kg)	Zinc sulphate
Basal application	-	50	-	25
10 days after transplanting	50	-	20	-
35 days after transplanting	50	-	20	-
55 days after transplanting	25	-	10	-
Initial flowering	25	-	10	-

Fertilizer application (per ha)

FYM or : 12,500 Kg

Green manure : 6,250 Kg

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Plant protection

Nursery and main field : Integrated pest & Disease management based on ETL

Harvesting : 30-35 days after flowering

b. **Management inclusive of mechanization:**

Apart from developing suitable varieties with high yield potential, evolving proper management practices such as tillage, seeding, fertilizer application, plant protection, irrigation, drainage, harvesting, threshing, cleaning, drying, storage and post-harvest processing of grains and by-products is very essential for increasing production and productivity in large areas. Application of engineering principles for reducing energy requirement in the form of human, animal, mechanical and electrical power is necessary to reduce cost of production. Efficient tools and implements are to be designed to reduce drudgery of human and animals and to reduce time and cost. Better water management practices are to be adopted for economic use of available water. Appropriate post-harvest practices for cleaning, grading, drying, processing and storage are needed to improve the quality of food grain and by-products.

Development of improved farm implements and machinery

Paddy Transplanter

For transplanting mat type paddy seedlings in six rows in puddled and leveled soil

Cono Weeder

For weeding in Paddy crop cultivated in rows.

Paddy Harvester

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For harvesting and winnowing non-lodging paddy varieties.

Paddy Thresher

For threshing work.

X. Indigenous technical knowledge (ITKs) specific to the state

There were many indigenous practices based on farmers own perceptions with regard to managing diseases and pests, indigenous farm operations and the effectiveness and benefits of each practice. There were certain special methods of sowing rice adopted to suit certain local conditions. Very important practices are briefly described below.

Udu cultivation: This was followed in certain parts of Thanjavur district to save the crop from flood received during North East Monsoon in October–November. Seeds of a short duration (*Kuruvai*) variety were mixed with a long duration (220 days) (ADT 6 and ADT 7) Ottadan variety in proportion of 3:1 and were sown in nursery. Six to 10 day old seedlings were planted per hill ensuring that long duration varieties are also included. The *Kuruvai* crop was harvested during September leaving 6–10 inches of stubbles when the long duration crop was still in vegetative stage. Then the fields were irrigated, *Kuruvai* stubbles were removed and incorporated in the soil. The plants of Ottadan crop started growing by this time. Then the water was drained out and fertilizer was applied. The Ottadan crop grows and ready for harvest at the end of February or early in March. However, this method is not followed at present.

Other indigenous methods are

- Treatment of paddy seeds in diluted bio gas slurry for 12 hours increases resistance of seedlings to pests and diseases.
- During panicle formation in paddy, the flowers of *Cycas circinalis* are placed on sticks in paddy fields @ 4/ac. Its unpleasant odor repels ear head bugs.
- About 30 kg. of tamarind seeds are applied for an acre of paddy field 1 day after transplanting to boost up the crop growth and yield.
- Soaking the paddy seeds in diluted cow's urine before sowing, considerably reduces the incidence of leaf spot and rice blast

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- Presoaking of paddy seeds in milk increases its resistance against 'tungro' virus and 'stunt' virus
- For control of red leaf spot disease in paddy, the seeds are soaked in 'Pudina' leaf extract (*Mentha sativa*) for 24 hours
- 'T' shaped bamboo stands are placed in many places in the paddy fields so that birds can sit on them and feed on the larvae and adults of rice pests.
- Sowing on eighteenth day (Aadipperukku) of Tamil month Aadi (Jul-Aug.) ensures good harvest.
- Daincha (Sesbania spp.) seeds are sown on paddy main fields when paddy nursery is raised and the grow up daincha is ploughed in-situ during field preparation.
- Plough the main field for four to six times for better yield.
- Good harvest can be obtained from the crop transplanted during Aavani i.e. Aug. - Sep.
- The crop transplanted during October-November will give reduced yield.
- The rice crop will establish better if it is transplanted along the wind direction.
- Planting the 'samba (Aug), crop thickly and 'navarai' (Feb.) thinly.
- Practice sheep penning during summer to get more yield.
- Practice sheep penning for the first season and green leaf manure for the second season for better yield.
- Apply 100 kg. of pig manure for one acre of rice at 10 days after planting to get higher yield.
- Apply the neem seeds @ 40 kg / ac as basal to get more yield as compared to the equal quantity of neem cake.
- Irrigate the fields, allow the weed seeds to germinate and then ploughthe fields to incorporate the weeds into the soil before sowing or transplanting of rice crop to control weed growth.
- Cultivation of sunhemp or daincha helps to control the nut grass (*Cyperus rotundus*) weed.
- Application of Calotropis gigantean as green leaf manure will prevent thrips attack in the nursery.
- Neem (Azadirachta indica) oil cake extract is sprayed to control thrips in rice.
- Dragging the branches of country ber or Aloe sp. on the affected field to control the leaf roller.
- Neem oil is mixed with water @ 30ml./lit. and sprayed to control stem borer in rice.
- Dusting chulah ash in the early morning to control stem borer and ear head bug.
- To control the ear head bugs, 10 kg. of cow dung ash is mixed with 2 kg. of lime powder and 1 kg. of powdered tobacco waste and dusted on the rice crop during morning hours.
- Hundred ml. of leaf extract of "Karuvel" (Acacia nilotica) and 10 kg of cow dung are dissolved in 10 lit. of water and sprayed on the rice crop to control ear head bug.

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- Growing or planting calotropis at 12 feet interval on all sides of paddy fields to control the hoppers.
- Applying neem cake before last plough to control root rot and nematode problem.
- A mixture of 5 kg. of common salt and 15 kg. of sand is applied for 1 acre to control brown spot disease.
- Soaking the paddy seeds in 20% mint leaves solution before sowing will control the brown leaf spot.
- Spraying the leaf extract of *Adaathoda vasica* to control rice tungro.
- Palmyra (Borassus flabellifer) fronds are tied on to poles and kept on the corners of rice fields so that the noise produced by them scare away the birds like ducks, sparrows etc. and save the grains being damaged.
- When one ear head contains about 100 grains, the yield will be20-22 quintals/ac.
- One hundred and twenty grains found in a rice ear head indicates the full yield.
- Use large mud pots called 'Kudhir' as high as six feet for storing paddy grains for longer periods.
- Putting the leaves of notchi (Vitex negundo) and pungam (*Pongampinnata)* inside the Kulumai to ward off storage pests.
- Mixing the paddy grains with the leaves of pungam (P.pinnata) or notchi (V. negundo) or neem (Azadirachta indica) before storage to avoid storage pest attack.

Pest and Disease management

Traditional pest management practices have been developed for major pests in rice. The farmers mostly used plant products and materials of natural origin like cow dung, cow's urine, etc. Similarly the tribal people who live in isolated localities in hills practise numerous age-old technologies. The tribal people in Kalrayan hills of the Villupuram District in Tamil Nadu followed certain indigenous methods to control the rice pests as described below.

Spraying tobacco leaf extract, dusting ash, spraying neem oil, beating drums to scare away the birds, pelting stones to drive the birds, displaying crow carcasses to scare away the crows, digging out the rat burrows and killing the rats, fumigating the rat burrows with cow dung cake keeping the cowdung balls, soaked in kerosin all over the field erecting bird perches in the fields and ploughing the land during summer etc.

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Leaves of neem and nochi (*Vitex negundo*) were found to be equally effective biocides against normal hatching of larvae from eggs besides establishing high larval mortality in paddy.

A traditional method to control BPH was to pour 30-40 litres of kerosene per ha into a flooded field. The kerosene oil which forms a thin float on the paddy water is highly toxic to many predators also.

Sweeping rice plants with nets, bags or baskets coated with sticky materials (such as Jack fruit latex, castor oil, grease) has been used to remove BPH in olden days. Light traps were used to control planthoppers. Greater number of hoppers and blackbugs were collected during a full moon as further proof of the value of light traps. Pest outbreaks have been reported to occur in our country after power blackouts, because many insects are normally killed at street lights.

XI. Byproducts/extended use of rice specific to the state

a. Usage and consumption

Rice has potential in a wide range of food categories. Besides having nutritional and medicinal benefits, the by-products of rice are equally important and beneficial. By-products from growing rice create many valuable and worthwhile products. The unedible parts that are discarded through the milling process and the edible part could be transformed into some of the following suggested products.

Rice By-Products

- Rice Husks
- Rice Bran
- Broken Rice
- Rice Flour
- Rice Milk
- Rice Pudding
- Rice Starch
- Rice Straw
- Rice used in Beverage Making
- Rice Paper

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- Rice Glue
- Rice Cakes (mochi)
- Rice Vinegar
- Rice Soy Milk
- Red Yeast Rice
- Rice based food products

b. Market value

Prices of Rice: To Increase Marginally (June 2008)

The monthly Average Wholesale Price of Rice Common reveals an increasing trend upto January 2008 and a slight decrease in February 2008 and then increasing trend upto June 2008. The maximum price was Rs.1508.62 in January 2008 and minimum price was Rs.1175.80 in July 2007. Its annual average price registered an increase of 27.68% in the current year when compared to the previous year (Source: Season and Crop Reports

2007-08, Department of Economics and Statistics, Chennai -600 006).

With an inflation rate rising to 8.24 per cent, the price of staple food – rice is escalating to newer heights. Both the governments at central and state levels are taking measures to reduce the same. At the same time there is a fear that price of rice may increase shortly due to off season. Hence the Domestic and Export Market Intelligence Cell (DEMIC) of Tamil Nadu Agricultural University studied the price behavior of paddy and rice in Tamil Nadu to bring out the price forecasts for the next four months.

The price of paddy is fixed on four major criteria namely moisture content (11-12%), outturn of rice, percentage of broken rice and percentage of black grains. At Thanjavur and Kumbakonam in the last Samba and Thaladi (January- March, 2008) harvest period the paddy price of CR-1009 and BPT (Andhra Ponni) were Rs.730- Rs.1000 and Rs.1030-Rs.1050 per quintal respectively. The prevailing wholesale prices of rice at Red hills market are Rs.1460, Rs.1130-1200, Rs.1600 and Rs.1860 per quintal of ADT-37, TKM 9, (both of lower quality) ADT-43 (deluxe), and BPT (fine) varieties respectively. The introduction of Rs.2/kg of rice scheme in Andhra Pradesh has a direct impact on the price of paddy and rice in Tamil Nadu. The scheme has restricted the inflow of paddy into Tamil Nadu from Andhra Pradesh as a larger

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portion of the production is procured by its government. Traders are of the opinion that there will be increase in the price of rice by Rs.100 for low, Rs.150 for medium and Rs.200 for fine quality of rice of 75 kg bag in November-December. Farmers are expecting an increase in the price of paddy in another three to four months to an extent of Rs.150-Rs.200 per quintal in all the varieties.

Coimbatore and Erode districts are endowed with natural consent and there would not be any shortage or shortfall for rice in the forthcoming months as reported by the millers. The restriction by Andhra Pradesh government won't affect the demand for paddy directly in Erode and Coimbatore but indirectly it will reflect in the price of paddy and rice. The millers are expecting a price increase of Rs.50-100 per bag of paddy because of increased consumption and demand. It is to be noted that rice prices are expected to be firm at world level at least until the third quarter of 2008 inspite of a higher production.

Under the above situation the price analysis done by Dr.N.Raveendaran, Professor and Project Coordinator of Domestic and Export Market Intelligence Cell and his team confirmed an increase in price of paddy by Rs.100-200 per quintal and price of rice by Rs.150 to 300 per quintal up to September, 2008. A marginal decline in rice price is expected from October, 2008 onwards due to Kuruvai harvest. Much reduction in prices of paddy and rice is not expected in spite of anticipated larger area under ensuing Kuruvai and Samba/Thaladi paddy.

To minimize the rise in prices of paddy and rice it is suggested that godown facilities may be offered to wholesalers and millers whether they go for pledge loans or not in the godowns owned by Regulated Markets and Marketing Societies including rural godowns.

One of the reasons for increasing paddy price is the increase in cost of cultivation of the same. Adoption of System of Rice Intensification (SRI) method of cultivation would lead to reduction in cost of production of paddy. Hence efforts are to be made for larger scale adoption of the same.

Direct procurement of rice from millers by organized retailers would also lead to reduction in rice prices at consumer level since there is an increase of Rs2-3 /kg of rice from miller to consumer through wholesaler and unorganized retailer of rice.

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Farmers and Farmer's groups might be encouraged to convert the paddy produced by them into rice and direct sale of the same to the consumer through Farmer's Shandies, which will reduce the rice prices at consumer level and increase the price realized by farmers.

c. Milling products

Rice milling involves the removal of husks and bran from rough rice to produce polished rice. Time of harvest and season affect the milling yield of rice.

Utilization Of By-Products Of Rice Milling Industries

The economics of rice milling industries is largely dependent on the useful commercial utilization of its by-products. **Husk**, **Bran** and **Broken Rice** are the by-products of the rice milling industries. These by-products can be used in better and profitable manner both for industrial and feed purposes. The methods for the effective utilization of these-by-products are discussed below:

Rice-Husk

Rice husk constitutes the largest by-product of rice milling and one fifth of the paddy by weight consists of rice husk. Rice husk has a considerable fuel value for a variety of possible industrial uses. Hence, the major use of husk at the moment is as boiler fuel, wherever parboiling is practiced. Rice husk is tough because of its silica-cellulose content. The silica content in husk is the highest among plant offal. It contains 15 to 18 percent silica, therefore, it is a potent source of silica for the manufacture of silicates or in glass manufacture. Also pulverized husk is available wherever paddy is parboiled and it is mixed with other mill fractions as cattle feed. Pulverized husk has a low feed value and it has a low protein content. It contains more than 30% crude fibre. If nitrogen content in pulverized husk is increased by blending with other nitrogen rich feeds and fibre content is brought down to around 10 per cent, pulverized husk can be used as cattle feed on large scale.

Rice Bran

Rice bran is the most valuable by-product of the rice milling industry.

Rice bran can be utilized in various ways. It is a potential source of vegetable oil. Refined oil can be a supplementary source of edible oil. Raw rice bran contains 12-18% oil, whereas parboiled bran contains 20-28% oil. The de-oiled bran contains about 1 to 3 percent oil only. Rice bran also contains high fat and

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protein. It also contains vitamins, minerals and many other useful chemicals. Because of its nutritional value, it is being used as feed for poultry and livestock. Defatted/de-oiled bran contains higher percentage of protein (17-20%) vitamins (A and E) and minerals than full fatted bran obtained from raw and parboiled paddy. In fact, full fatted bran is an excellent ingredient for both food and feed.

Various uses of rice bran, bran oil and its different constituents are discussed below :-

Edible Oil Grade

Bran oil contains low linolenic acid and high tocoferol, hence, it has distinct advantage over other vegetable oils. Edible oil can be produced by refining and suitable hydrogenation of bran oil.

Rice bran oil is more economical than the other traditional cooking oils because while cooking it absorbs 20-25% less oil as compared to other traditional cooking oils. Besides, at the time of frying there is no much degradation of oil. The rice bran oil possesses the same frying properties as ground nut oil. Rice bran oil fries the food faster and after frying it becomes more golden brown colour resulting in lighter testing food. Food cooked in rice bran oil increases it flavour and palatability.

Industrial Grade Crude-Oil

(a) Soap Manufacture

Rice bran oil contains high free fatty acid (FFA) hence, highly suitable for manufacture of soft soap and liquid soap. Other kinds of metallic soap such as aluminium, barium and calcium soaps are also manufactured from rice bran oil and they find market as components of lubricants.

(b) Free Fatty Acid Manufacture

By hydrolysis technique of the triglycerides of fatty acids into fatty acids and glycerol, fatty acids and glycerol are obtained. The use of hydrogenation in combination with fractional distillation pure stearic and oleic acids is obtained.

Protective Coatings

From rice bran oil resin based paints, enamels, varnishes etc. are prepared.

Plasticisers

Fatty acids and fatty oil based plasticisers are used in the plastic and rubber industries.

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Tocoferol

Crude rice bran oil contains 2% - 4% tocoferol and it has nutritional and antacid effect. Edible oil contains about 1% - 2% tocoferol rest is lost during deodorizing process.

Rice Bran Wax

Rice bran wax is used for coatings of candy, fruits and vegetables as it prevents moisture loss and shrinkage. It is also used as component for manufacture of carbon paper base, stencils, candles etc.

Feed

De-oiled/ defatted rice bran, which is a rich source of protein (17 to 20 per cent) and vitamins (vitamins A & E) is used as a cattle and poultry feed. De-oiled bran is more suitable for feed than raw bran due to higher nutritional value, higher digestibility and better keeping quality.

Food

In preparation of bakery products such as bread, cake, biscuits etc. de-oiled/defatted bran can be used as an ingredient. In baking flour, fine powder of de-oiled bran can be added up to 20%.

Fertilizer

De-oiled/ defatted bran contains plant nutrition i.e., N.P.K., and it can be used as fertilizer. Raw bran is not suitable for use of fertilizer because it contains high fat and wax, which are harmful for plants and roots.

Medicinal Use

Rice bran contains valuable Vitamin-B complexes, amino acids, phosphoric acid compound etc. and can be used in pharmaceutical industry. Protein can also be easily extracted from rice bran.

Broken rice

Broken rice is another by-product of rice milling industry. From the nutritional point of view, broken rice is as good as whole rice itself. Broken rice has low economic value as compared to whole rice. Generally, broken rice is of poor quality due to admixture with grit, stones and clay particles. Therefore, broken rice is used either as a part of animal feed or partially in the diet of poor people. If the quality of broken rice is improved by cleaning the paddy properly before milling, it can be utilized and marketed

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straightway for preparation of Idli, Dosa and other such preparation in which rice flour or wet-ground rice paste is needed.

d. Rice based food products

Rice recipes are plenty. As the world's most important food crop, rice occupies a particularly rich and varied place in the cuisine of many cultures.

Rice is one of the most consumed grains on the planet. With approximately 200 calories per cup serving, it is free of fat, cholesterol, and sodium. Rice is easily digestible, making it suitable for all ages and individuals with sensitive digestive systems, and its naturally mild flavour is a suitable complement to many dishes.

Rice Recipes: Bisibelabath, Carrot rice, Coconut rice, Coriander rice, Curd rice, Curry Leaves rice, Fried rice, Ghee rice, Lemon rice, Mango rice, Methi rice, Mint Leaves rice etc.

XII. Rice and commerce (exports and revenue generation)

In Tamil Nadu paddy is cultivated in three major seasons namely Kuruvai (May-June), Samba (Sep-Oct) and Thaladi (Nov-Dec). The major varieties preferred for Kuruvai are ADT 36, CO43, ADT 43 and TKM 9. For Samba and Thaladi BPT 5204, ADT 36, ADT 37, ADT 39, CR-1009 and CO 43 varieties are preferred. The average yield per acre is around 30-40 bags (1 bag=65 kg) with a cost of cultivation of about Rs.12000-Rs.15000/-per acre.

Red hills, Thiruvallur district is the major paddy market in Tamil Nadu and acts as a gateway for the entry of Andhra Pradesh paddy as Tada, the border town is just 25 km from Red hills. Normally the peak inflow of paddy will be from January-March during which period about 2000 tonnes/day of paddy arrival is reported. About 60 per cent of this comes from Andhra Pradesh and the remaining from Thiruvallur and Kancheepuram districts. During April-May the arrivals will be around 1000 tonnes/day and during lean season i.e., July-August 20-50 tonnes/day is reported which is from Andhra Pradesh only. The recent ban on export of rice from India pushed Andhra Pradesh paddy into Red hills to an extent of 2000 tonnes per day in April-May, 2008. Paddy accumulated here is distributed to Madurai, Erode and Tiruppur mills and rice milled at Red Hills alone is consumed by Chennai metropolitan. There are about

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150 mills in the Red hills area and each has a per day processing capacity of 12 tonnes of paddy. For processing paddy into rice, millers incur around Rs.1-1.25 per kg which includes labour, electricity and other charges. By processing one load (12 t) of paddy, miller can get 7500 kg rice (61-66%), 2500 kg husk (27-30%), 500 kg broken rice (4-5%) and about 1500 kg bran (10-12%), A storage loss of 8-10% is accounted in case of storing paddy for more than a year.

The rice millers in Erode, Karur and Coimbatore districts procure paddy from Karnataka. Peak arrivals will be in the months of December to April. Usually May-November is considered as lean season. Procurement is mainly from Gangavathi, Sindhanur and Karthagi districts. Sona, Deluxe, Emergency, BPT 5204 and ADT 43 are the major varieties procured from Karnataka. During April-May they procure paddy from Thanjavur (Athisaya ponni and Emergency), Kumbakonam and Thiruvarur regions. In Madurai district the rice mills procure from Ramnad and Thanjavur districts apart from local procurement.

The peak procurement of paddy in Thanjavur and Kumbakonam region is during January-March. At that time the arrivals will be about 12000 tonnes/ day (1000 lorry loads (1 lorry=12 tonnes). Arrivals during these months are from Thanjavur, Kumbakonam, Vellore, Ulundurpettai, Thiruvarur and Nagapattinam. During April-June arrivals are from Villupuram, Tiruvannamalai, Gingee and Tindivanam. During off season viz., from mid June to October arrivals from Andhra Pradesh are reported. Mostly paddy from these areas is distributed around the districts.

XIII. Special development programmes in rice sector of the state

In Tamil Nadu, scientific adoption of system of rice intensification techniques have proved to get 10 to 13.38 M.Tonnes of paddy per hectare during 2007-08, under Integrated Cereal Development Programme. SRI demonstrations were conducted over an area of 11,690 ha and 58,450 farmers were trained on SRI technologies. Intensive village level meetings were conducted by extension staff, massive Publicity and Press releases has extended to cover 4.2 lakh ha under SRI during 2007-08. Complete adoption of SRI techniques by the farmers led to achieve the highest productivity of 13.380 M.Tonnes in Villupuram District, 13.000 M.Tonnes in Tirunelveli district, 12.855 M.Tonnes in Trichy district, 11.400 M.Tonnes in Theni District, 11.000 M.Tonnes in Vellore District and 10.245 M.Tonnes in Cuddalore district. An announcement was made in the State Budget during 2008- 09, to bring 7.5 lakh ha under SRI cultivation in Tamil Nadu and necessary action has been initiated.

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XIV. Status of recent rice production/ technologies

a. SRI

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Promotion of System of Rice Intensification Technology

During 2008-09, effective steps have been taken to promote System of Rice Intensification technology to cover an extent of 7.50 lakh hectares and an area of 5.38 lakh hectares has been covered. The System of Rice Intensification technologies are promoted by conducting demonstrations covering 42,546 hectares through Cereal Development Programme, National Food Security Mission, IAMWARM and ATMA programme at a total cost of Rs.10.32 crores by providing inputs and Conoweeder / Marker with subsidy. Under National Food Security Mission 1,03,551 nos of conoweeder and markers were distributed to the farmers in the National Food Security Mission - Rice districts of Nagapattinam, Thiruvarur, Pudukottai, Ramanathapuram and Sivagangai at a cost of Rs.11.41 Cr. The TANWABE groups, Farmers' Interest Groups, Farmers' Training Centres Convener have been motivated to promote this technology. The district collectors have been sensitized through special workshops conducted at Coimbatore and Madurai on the importance of this programme and the Collectors are closely monitoring the performance. Greater awareness has been created among the farmers on the benefit of this technology.

Highest yield of 13.7 MT per hectare in Salem district, 12.5 MT per hectare in Trichy district and 11.24 MT per hectare in Tiruvarur district has been recorded by adoption of System of Rice Intensification. The Government will take steps to bring 7.5 L.Ha under System of Rice Intensification

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during 2009-10 and more attention will be given for perfect adoption of this technology to achieve higher production in paddy. In view of this, during 2009-2010, steps will be taken to conduct demonstrations on System of Rice Intensification, to cover around 50,000 hectares through various schemes. In order to help the paddy farmers who adopt System of Rice Intensification technology to visually assess the need for Nitrogen and apply fertilizers at right time at required quantity, 1.78 lakh Leaf Colour Chart (LCC) were distributed at a cost of Rs.45 lakhs.

Research and extension activities by TNAU

- TNAU has developed the location specific SRI practices to be adopted for promotion of SRI method of rice cultivation in Tamil Nadu.
- 94 on-farm demo trials were organized during 2003-04 for the dissemination of SRI practices in the Cauvery Delta through a State funded scheme.
- 100 on-farm demo trials were organized during 2003-04 for the dissemination of SRI practices in the Tamirabarani through a State funded scheme.
- TNAU has developed a modified rice mat nursery (MRMN) to produce young, robust, and healthy seedlings in 15 days. The rice seedlings reach a height of 18-20 cm with 4 leaves in 15 days. Seedling mats can be easily transported to the main field for transplanting. This innovative mat nursery requires 88% less land and 55% less water for seedling production to plant 1 ha of main field.
- Marked check rope planting, transplanting with marker tool method have been developed by TNAU for transplanting rice under square geometry in order to facilitate cono weeder operation in both the directions
- Efforts are initiated by TNAU for fabrication of motorized cono weeder to facilitate inter cultivation in larger areas and reduce the human drudgery involved in this operation with the ultimate objective of promoting SRI in Tamil Nadu.
- Efforts are already initiated by TNAU under TN-IAMWARM project for fabricating SRI transplanter machine.

b. Hybrid rice

About 30.77% cropped area in Tamil Nadu is being occupied by rice. During 2007-08 Tamil Nadu has achieved a total production of 5039954 tonnes from 1789170 hectares by

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adoption of many high yielding rice varieties released from TNAU. As the possibilities for area expansion are limited, it is inevitable to enhance the productivity levels. Among the various genetic approaches contemplated to break the yield barrier in varietal improvement, hybrid rice has proved to be one of the readily adoptable and practically feasible methods.

Hybrid rice research in Tamil Nadu and Release of hybrids

Hybrids rice research was strengthened in Tamil Nadu since 1989 utilizing UNDP/FAO/ICAR/State funds with technical collaboration of IRRI and China National Hybrid Rice Research and Development Centre, Changsha, China. The work was initiated at Paddy Breeding Station, Coimbatore, first then subsequently it was also started at TRRI, Aduthurai under Tamil Nadu State Plan Scheme. A number of new hybrid combinations were tested from 1989 and the following four hybrids were released for general cultivations in Tamil Nadu.

1. CORH 1 (PBS, TNAU, Coimbatore)

Parentage	:	IR 62829 A/IR 10198 –66-22
Duration of IR 62829 A	:	115 days
Duration of IR 10198-66-22	:	105 days
Duration of hybrid	:	110-115 days
Season	:	May-June and Dec-Jan.
Grain type	:	Medium slender white rice
Yield	:	6t/ha (1 ton increased yield over the check IR 50)

2. CORH 2 (PBS, TNAU, Coimbatore)

Parentage	:	IR 58025 A / C20R
Duration of IR 58025 A	:	125 days

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Duration of C20R : 125 days

Duration of hybrid : 125 days

Season : July- Oct.

Grain type : Medium slender white rice

Yield : 7 t/ha

3. ADTRH 1 (Tamil Nadu Rice Research Institute, Aduthurai)

Parentage : IR 58025 A/ IR 66 R

Duration of IR 58025 A : 125 days

Duration of IR 66 R : 110 days

Duration of hybrid : 115 days

Season : April - July

Grain type : Long slender white rice

Yield : 6.5 t/ha

1. CORH 3(PBS, TNAU, Coimbatore)

Parentage : TNAU CMS 2A / CB 87 R

Duration of TNAU CMS 2A : 125 days

Duration of CB 87 R : 125 days

Duration of hybrid : 110-115 days

Season : Sornavari/Kar/ Kuruvai/ Navarai

Grain type : Medium slender non-aromatic rice with good cooking qualities.

Yield : 7500kg/ha

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Pipeline hybrids

Simultaneously the efforts made to synthesize new hybrids with heterotic effect in PBS, Coimbatore resulted in the identification of many hybrids. Among them the medium duration hybrid TNRH 174 recorded the average grain yield (7020 kg/ha) which was 25.8 and 26.0 per cent increased yield over BPT 5204 and ADT (R) 46. It possesses medium slender grain. The hybrids viz., TNRH 193, TNRH 206, TNRH 243 TNRH 222, TNRH 241 and TNRH 244 are being evaluated in the advance trials.

Development of new CMS lines

The new CMS lines *viz*., COMS 14 A, COMS 15A, COMS 19A, COMS 20A, COMS 21A, COMS 22A, COMS 23A, COMS 24A, COMS 25A, COMS 29A, COMS 30 A and COMS 31A were identified as promising for desirable floral characters and quantitative traits. These CMS lines are being utilized for developing new hybrid combinations. Characterization of new CMS lines is under progress.

Development of two line hybrids

The widely used CMS system although stable has some problems such as cumbersome seed production procedures, restriction on choice of parents etc., The TGMS system in which sterility / fertility status of rice depends on temperature has several advantages. In this case no maintainer line is required. TGMS simplifies the hybrid rice seed production. Several sources of TGMS have been reported from China (Sun *et al.,* 1989; Wu *et al.,* 1991). A few mutants have been identified in Japan (Maruyama *et al.,* 1991) and at the IRRI (Virmani and VOC, 1991). Convinced by the potential of two line hybrid rice technology, the Tamil Nadu Agricultural University has initiated a project on two line hybrids during April 1995. Under this project a new sub centre at Gudalur in Nilgiris was started for multiplication of TGMS lines in addition to the main centre at Coimbatore.

Promising TGMS lines and hybrids

As a result of intensive research at Paddy Breeding Station (TNAU), Coimbatore and Hybrid Rice Evaluation Centre at Gudalur, TS 29 was identified as a promising TGMS line. In addition some of the promising TGMS line viz., TNAU 14S, TNAU 18S, TNAU19S, TNAU 21S, TNAU 27S were identified which are under testing and evaluation. Promising Two line rice hybrid cultures viz., TNTRH 8, TNTRH 12, TNTRH 15,

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TNTRH 25, TNTRH 17, TNTRH 18 and TNTRH 19 are in advance stage of evaluation. Among them TNTRH 19 is proposed for testing in multi location trial.

c. Aerobic rice/ conservation agriculture

One technology that enables rice to be grown in dry land without flooding, and help farmers cope with water scarcity is the aerobic rice system. Aerobic rice is a new way of growing rice that needs less water than lowland rice. Aerobic rice, reduce water inputs in rice field by cutting down the unproductive water losses caused due to seepage and percolation. Experiments on aerobic rice have shown that water inputs were more than 50 per cent lesser (only 470–650 mm) and water productivities were 64–88 per cent higher than the lowland rice, but require improved varieties bred specifically for aerobic condition.

The target environments for aerobic rice includes irrigated lowland rice areas where,

- Rainfall is insufficient to sustain lowland rice production (estimated to require about 1200-1500 mm) but sufficient for aerobic rice (about 800 mm).
- In pump irrigated areas where water has become so expensive that lowland rice production was abandoned.
- Water is scarce during the first part of the growing season (requiring irrigation) but floods occur in the second part. and favourable uplands with access to supplementary irrigation (Bouman, 2001).

Research on aerobic rice in TNAU is under progress.

d. Biotechnological invention/ golden rice

BIOTECHNOLOGY RESEARCH IN TNAU

Activities of the Department Of Plant Molecular Biology and Biotechnology

The following major programmes, which were chosen based on the needs of the farming community, are being undertaken at this department.

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Genetic Transformation

- Engineering rice for resistance to major pests and diseases.
- Engineering rice cultivars with enhanced nutritional quality with special reference to pro-vitamin A (Golden rice) and iron
- Development of drought and salinity tolerant rice and groundnut.

Gene Isolation

- Isolation of *Bt* genes from native isolates of *Bacillus thuringiensis* and development novel Bt gene sequences to enhance insecticidal spectrum.
- Isolation of genes conferring resistance to insects, fungal and viral disease for use in developing transgenic crops
- Isolation of genes associated with stress tolerance in rice
- Identification of genes conferring seed quality traits

Molecular Markers

- Marker assisted selection for resistance against major insects of rice
- Marker assisted selection for abiotic stress tolerance in rice
- Evolving bacterial leaf blight resistance rice cultivars through molecular markers assisted selection

ACCOMPLISHMENTS

Gene Isolation

A collection of about 500 isolates of indigenous *Bacillus thuringiensis* were made and three *cry2A* genes were cloned. The proteins encoded by indigenous *cry* genes showed significant toxicity against rice leaf folder. Water stress induced genes in rice were identified.

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Genetic Transformation

Transgenic rice lines of locally adapted varieties expressing and disease resistance (fungal and bacterial diseases) were developed and evaluated under field conditions.

Molecular Markers

Molecular markers associated with resistance to yellow stem borer, leaf folder, brown plant hopper and white backed plant hopper were identified. Quantitative trait loci associated with yield and yield components under drought stress in field condition have been mapped both under managed stress and target rainfed environments. A drought tolerant rice culture, PM01011 has been submitted for approval for release for cultivation in Ramnad and Sivaganga districts. A recombinant inbred line CB (MAS) 26004 resistant to yellow stem borer developed and being tested under multi location trials (MLT).

e. IPM/ IDM

The loss of agricultural produce due to pest and diseases is estimated to be around 20% without affecting the productivity. The pest and disease have to be controlled effectively.

Tamil Nadu is the pioneer State in adoption of Integrated Pest Management technology through Farmers' Field Schools. Under Integrated Pest Management concept, conservation of farmers' friendly insects (defenders) which controls the crop pest, release of parasites and predators, use of bio-inputs are largely recommended. Because of the massive adoption of Integrated Pest Management technology, the major pests like paddy sterm borer, leaf folder, green jassids, redhairy caterpillar and prodenia in groundnut, pod borer in pulses and boll worm in cotton which caused severe damage in the 1990s brought under complete control. The application of pesticides is advocated when the occurrence of pest and diseases exceeds the tolerance limit. The required plant protection chemicals are made available to the farmers through 8,610 nos. of private outlets. The quality of pesticides is ensured by enforcing Insecticides Act 1968 and Rules 1971.

The major activities taken up to control the pest and diseases are as follows:-

10 Bio Control Labs, 59 Parasite Breeding Centres and 2 Integrated Pest

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Management Centres are functioning in Tamil Nadu to produce and distribute bio control agents to cover around one lakh hectare. The bio control agents for the control of Red hairy caterpillar and Prodenia in groundnut, Black headed caterpillar and rhinoceros beetle in coconut, Inter node borer in sugarcane, Pseudomonas and Trichoderma viridii for the control of diseases are produced and distributed to the farmers.

f) INM

Micro Nutrients plays an important role in sustaining the soil health and soil fertility. Most of the soils in Tamil Nadu are deficit in micro nutrient content and this deficiency has a direct impact on the productivity of crops and quality of the produce. A Micro Nutrient Production Centre belongs to the Department is functioning at Kudumiyanmalai to produce 14 types of notified micro nutrient mixture for different crops with an annual production capacity of 1400 MTs. During 2008-09, 1501 Mts of Micro Nutrient mixtures have been produced and 1309 Mts distributed. Besides, the private producers are also distributing around 6000 Mts of Micro Nutrient mixture through retail sale points and the Department ensures quality through FCO.

g) Any other

XV. Organizations (Government and Non- government)

A special additional central assistance scheme namely **National Agricultural Development Programme** - **(RKVY)** launched during 11th Five Year Plan to achieve 4% growth rate in agricultural sector. The objective of the scheme is to increase public investment in agriculture, reducing yield gap in key crops through focused interventions, maximize returns to the farmers and bringing quantifiable changes in the production and productivity of agriculture and allied sectors. Greater flexibility and autonomy is given to the States to develop and implement projects on the basis of their priorities by formulating District and State Agricultural Plan. The projects relating to Agriculture, Animal Husbandry, Dairy, Fisheries and also minor irrigation are focused under this programme. The Government of India provides 100% financial assistance for this programme. An amount of Rs.185.31 crores for 2007-08 and Rs.140.38 crores for 2008-09 was sanctioned for Tamil Nadu.

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XVI. Constraints in rice production

The problems/constraints in rice production vary from state to state and area to area. The major rice growing areas are concentrated in Eastern region and this region is generally experiences high rainfall and severe flood almost every year. The loss to the rice crop is considerably very high. Besides, in upland areas the crop gets setback either from high rainfall or drought condition. It has also been observed that certain category of soils do not give the desired yield response to the balanced application of N.P.K. fertilizers. The main reasons for this lack of response to the application of balanced fertilizers are associated with certain inherent characters of the soil. All these problems/constraints are affecting the productivity of the rice crops in different growing zones. In certain area, the availability of suitable high yielding varieties and quality seeds are also a problem. These problems/constraints are discussed below:-

1. About 78% of the farmers are small and marginal in the country and they are poor in resource. Therefore, they are not in a position to use optimum quantity of inputs in their crops which are essential for increasing the productivity.

2. Often rice crop suffers with soil moisture stress due to erratic and inadequate rainfall. In upland soils rain water flows down quickly and farmers are not able to conserve the soil moisture. There is also no facility for life saving irrigation particularly in upland and drought prone rainfed lowland areas.

3. Continuous use of traditional varieties due to the non-availability of seeds and farmers lack of awareness about high yielding varieties (Upland and rainfed lowland).

4. Low soil fertility due to soil erosion resulting in loss of plant nutrients and moisture.

5. Heavy infestation of weeds and insects/pests such as blast and brown spot and poor attention for their timely control (upland and rainfed lowland).

6. Poor plant population in case of broadcast sowing method resulting in uneven germination (upland and direct seeded lowlands) . Delay in monsoon onset often results in delayed and prolong transplanting and sub-optimum plant population (Mostly in rainfed lowlands).

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7. Poor adoption of improved crop production technology due to economic backwardness of the farmers (upland and lowlands).

8. Non-availability of bullock drawn or power drawn transplanter for timely transplanting of rice crop.

9. In upland rainfed rice crop is grown under rainfed conditions, the growth is mostly dependent on the vagaries of the monsoon. In the years of scanty or adverse distribution of rainfall, the crop fails owing to drought and in the years of heavy rainfall, particularly during blossoming, there is poor grain setting and also the matured grains germinate on the panicles.

10. In the high-rainfall region, the rain-water is lost rapidly through deep percolation, because of the upland location and loose texture of the soil. In these soils the plant nutrients applied through fertilizers are also lost rapidly and investment on fertilizers becomes risky. Further, low water retention capacity by the soil due to high permeability brings in moisture stress condition quickly after the cessation of rains.

11. In the low-rainfall regions, the crop suffers from iron and zinc deficiency in some soils, in the high-rainfall regions, diseases break out particularly Helminthosporium possibly due to unbalanced nutrient availability in the soils.

12. Generally, upland rice crop becomes ready for harvesting earlier in the season; there is much damage due to birds and rodents.

13. In acid, red laterite and lateritic soils, the following problems are encountered : -

- Moderate to high acidity
- Deficiency of nutrients, because of there soils are low in C, N and available nutrients.
- Toxicity due to iron and in some soils due to aluminum and manganese.
- P- deficiency and high P-fixing capacity which necessitate higher rates of application of P-fertilizers
- Impeded drainage in certain areas.

14. Saline and alkali soils mostly occur in the coastal districts .The problems of saline and alkali soils are given below :

- Osmotic effect due to high concentration of salts in the saline and saline-alkali soils.

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- Difficulty in removal of salts by flushing from these lands in the coastal region because of heavy texture of the soil, lack of freshwater source, recharge of the salt from sub-surface to the surface soil due to capillary rise and periodic inundation with sea water.
- Toxicity due to high pH and due to the presence of sodium either as carbonate or as bicarbonate in the alkali or saline-alkali soils.
- Highly dispersed soil under alkaline or saline-alkali situation, where drainage becomes a problem.

a. Biotic stress-Insects, Diseases, Nematodes, rodents and weeds

Pest and disease

The incidence of the following pests and diseases is very common on rice plants in Tamil Nadu.

Diseases

.	Blast	*Pyricularia oryzae* (Syn: *P. grisea*) (Sexual stage: *Magnaportha grisea*)
.	Neck blast	
.	Sheath rot	*Sarocladium oryzae (Syn: Acrocylindrium oryzae)*
.	Sheath blight	*Rhizoctonia solani* (Sexual Stage: *Thanetophorus cucumeris*)
.	Bacterial leaf blight	*Xanthomonas compestris pu.oryzae*
.	Bacterial leaf streak	*Xanthomonas campestris* p.v. *oryzicola*
.	Brown leaf spot	*Helminthosprium oryzae* (Syn: *Drechslera oryzae*) (Sexual stage : *Cochliobolus miyabeanus*)
.	Grain discolouration	Fungal complex (*Helminthosporium oryzae, Curvularia lunata, Sarocladium oryzae, Fusarium moniliforme, Cladosporium herbarum, Epicoccum purpurascens, Cephalosporium* sp., *Phoma*

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		sp. *Nigrospora* sp.
.	RTD	Rice tungro bacilliform virus (RTBV) Rice tungro spherical virus (RTSV) Vector *Nephotettix virescens, N. nigropictus*
0.	Grassy stunt	Virus : *Vector Nilaparvata lugens*
1.	Ragged stunt	Virus : *Vector Nilaparrata lugens*

Pests:

.	Leaf folder	*Cnaphalocrocis medinalis* Guln
.	Stem borer	*Scirpophaga incertulas* (Wlk)
.	BPH	*Nilaparvata lugens* Stal.
.	GLH	*Nephotettix virescens* Dist.
.	Thrips	*Stenchactothrips biformis* Bagn.
.	Caseworm	*Nymphula depunctalis* Guln.
.	Earhead bug	*Leptocorisa acuta* Thunb
.	Black bug	*Scotinophora lurida* Burm

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.	Mealy bug	*Brevennia rehi* Ldgr.

b. Abiotic stress-Temperature, cold, drought, water logging, sodic, saline problems

Major stresses

Physiological stress

Acid soils

Soils with 5.5 pH result in accumulation of higher amount of Fe and Al. The acid soils are generally not prevalent in Tamil Nadu.

Saline and alkaline soils

Saline soils

Soils with EC>4, pH <8.5 and ESP <15% mostly due to HCO_3, CO_3, Cl_2, SO_4 of Na followed by Ca and Mg are saline soils (USDA Handbook 60).

Sodic soils

Soils with EC <4, pH >8.5, ESP >15% predominated by CO_3 and HCO_3 salts of Na are sodic soils (USDA Handbook 60).

Micro nutrient deficiency

Micronutrient deficiency is considered as one of the major causes of declining productivity trends observed in rice growing countries. It is well known that Zn deficiency is predominant in lowland ecosystems. Sodic and upland soils and calcareous coarse textured soils with low organic matter content suffer from Fe deficiency besides Zn and Cu deficiencies (Savithri *et al.* 1999).

Zn deficiency

Zinc deficiency sinks profits in paddy cultivation especially in the late *kharif* season (October, November-March). In Tamil Nadu, cultivation of high yielding varieties with high levels of fertilizer application has been reported to cause zinc deficiency. The deficiency also occurs in saline and alkaline soils. In submerged and flooded soils, severe Zn deficiency has been observed. The zinc deficiency

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symptoms, which are observed particularly in the double cropped wetlands in Thanjavur delta and the late *kharif* paddy crop, are mistaken for the symptoms of BLB. In regions of intensive cultivation with high yielding varieties, zinc deficiency is quite marked. Loss of surface soil by erosion or removal of top soil during land levelling often makes soil low in total zinc.

Because lowland rice experiences wide spread Zn deficiency, substitution of Zn is common compared to other micro-nutrients (Bansal and Nayar 1989; Katyal 1985). Many sources of Zn can be applied by different methods. Well tested application methods for Zn include broadcast / band application, foliar spray, soaking the seed in Zn solution or dusting the seed with Zn dust, dipping the roots in Zn suspension / slurry etc.

Rice varieties released in Tamil Nadu for specific situations / purposes

Drought resistant	TKM 1, TKM 2, TKM 5, TKM 7, TKM 11, TKM 12, CO 31, TKM 10, PMK 1, IET 1444 (Rasi) and PMK 2
Semidry condition	ADT 22, ASD 4, TPS 1, MDU 1, TKM 9, ASD 17 and MDU 5
Saline / alkaline	PVR 1, IET 1444 (Rasi), CO 43, ASD 16, TRY 1 and AU 1
Late planted condition	ASD 5, ASD 11, ADT 39, CO 44 and ASD 19
Cold tolerant	MDU 2 and MDU 4
Water-logged condition	ADT 40, TPS 3
Deep water condition	TNR 1 and TNR 2
Gall-midge resistant	MDU 3 and PY 4
BPH resistant	PY3, CO 42, and CO 46
Blast resistant	CO 4, CO 25, CO 29, CO 30, CO 43, CO 45, CO 47, ADT 38, ADT 39 and ADT 40

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Quality Rice	GEB 24, CO 41 , ADT 16, ADT 43, IET 4786, Ponni, Imp.White Ponni, TKM 6
Scented Rice	ADT 41
Hybrid rice	CORH 1, CORH 2, CORH3 and ADTRH 1

c. Institutional constraints

d. Socio-economic constraints

XVII. Economic of rice production in state

Cost and Returns of Paddy

Simple percentage analysis was used to analyze the structural changes in the cost of cultivation of paddy (Sitadevi and Ponnarasi,.2009),. Cost structure of the crop was analyzed by working out the share of each item in the total cost of cultivation. The cost of production was also worked out. The cost of cultivation was computed for the paddy crop separately for the two categories, viz. SRI and conventional methods and is presented in Table 1. It could be seen from the Table 1 that the total cost of cultivation per hectare was lower by about 10 per cent in SRI method (Rs 21655) than conventional method (Rs 25914). Among the components of the total cost, human labour occupied the highest share in both, viz. 43.61 per cent in SRI method and 41.87 per cent in conventional method. In the SRI method, the cost of seeds occupied a meager amount (0.63 per cent) as compared to the conventional method (6.99 per cent). Also, the share of irrigation cost was also very little in SRI method (9.84 per cent) as against 19.30 per cent in the conventional method. It is due to the fact that there is a drastic reduction in seed rate from about 30-60 kg/ha to 10 kg/ha in the SRI technology. Also, there is 40-50 per cent water saving from planting to harvesting. However, the cost of machine labour was higher (20.99 per cent) in SRI than conventional method (9.19 per cent) due to frequent weeding using a rotary weeder. It could also be noted that the lowest share of cost on plant protection chemicals was low in both the methods of cultivation, viz. 2.77 per cent and 4.41 per cent in SRI and conventional methods, respectively. The cost incurred on fertilizers was more or less the same in both the methods of cultivation.

Further, it could be seen that the net returns were higher in SRI (Rs 27009) than conventional (Rs 14499) method. It was mainly due to the higher productivity of paddy in the SRI method. The gross

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returns were also higher in SRI (Rs 48665) than conventional (Rs 40413) method. Also, the costs of production per tonne of paddy were lower in SRI (Rs 3937) than conventional method (Rs 7403) of rice cultivation. It could be inferred that the cost of production was almost double in the conventional method of paddy cultivation, as the productivity of rice was low in this method. It was also observed that the benefit-cost ratio was higher in SRI (2.25) than in conventional (1.56) method. The respondents in SRI method had realized increased productivity and thereby the returns in paddy crop were comparatively high. The increased grain yield under SRI was mainly attributed to more number of lengthy productive tillers with increased number of filled grains per panicle. Thus, the cumulative effect of SRI technology was higher returns compared to conventional method due to less seed rate, irrigation and labour requirement in weeding.

XVIII. Strategies and modern techniques to enhance rice production

- Developing new rice plant types.
- Deploying inter-subspecies heterosis by using wide compatible genes (WCG).
- Exploitation of TGMS system for developing two line hybrids with quality grain.
- Developing hybrids for better cooking quality and resistance to major pests and diseases.

XIX. Status of seed production of major varieties/ agencies involved/ demand and supply

PRODUCTION AND DISTRIBUTION OF BREEDER SEEDS FROM TAMIL NADU AGRICULTURAL UNIVERSITY

Crop	Indent for 2008-09 (in Kgs)			Distribution upto March 2009(in Kgs)		
	Department (State + GOI)	Private	Total	Department (State + GOI)	Private	Total
Paddy	22721	70215	92936	22498	98911	121409

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Source: Commissioner of Agriculture, Chennai-5

DISTRIBUTION OF QUALITY SEEDS

(in tonnes)

Crop	2008-09			
	Dept.	**Private**	**Total**	**Seed Replacement rate (%)**
Paddy	**16262**	**53238**	**69500**	**67**

Source: Commissioner of Agriculture, Chennai-5

XX. Modern agricultural implements used in rice

Cono weeder for SRI techniques

Paddy harvester

Paddy thresher

Paddy Transplanter

XXI. Conclusion and way forward

For the next five years, well defined objectives and priorities have been set for popularizing hybrid rice technology covering both seed production and commercial cultivation. They include effective transfer of the technology already generated, developing hybrids with desirable grain quality, resistance to diseases and pests and adaptability to a specific ecosystems.

XXII. Future thrust in rice production technologies

- Developing new rice plant types.
- Deploying inter-subspecies heterosis by using wide compatible genes (WCG).

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- Exploitation of TGMS system for developing two line hybrids with quality grain.
- Developing hybrids for better cooking quality and resistance to major pests and diseases.
- Popularization of hybrid rice technology among the farming community.
- Development of export quality rice.
- Molecular mapping and scanning of genomics of wild species and other land races for useful genes.
- Developing a comprehensive package of practices for cultivation of hybrids in target areas in different seasons.

A strong network of hybrid rice research, seed production and technology transfer could be developed.

Table1. Area of production and productivity of rice in Tamil Nadu 2007-08

SEASON	In terms of Rice								
	Area in ha			Production in tonnes			Yield rate in Kg/ha.		
	07-08	06-07	% Var.	07-08	06-07	% Var.	07-08	06-07	% Var.
1.Kuruvai	295280	361075	-18.2	1140409	1155035	-1.3	3862	3199	20.7
2.Samba	1375510	1451982	-5.3	3498309	5010964	-30.2	2543	3451	-26.3
3.Navarai	118380	118340	0.0	401236	444608	-9.8	3389	3757	-9.8
All Seasons	1789170	1931397	-7.4	5039954	6610607	-23.8	2817	3423	-17.7

Source: Department of Economics and Statistics, Chennai-600 006

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Table 1a. District wise area and production of rice in Tamil Nadu

Sl.No.	Districts	Area (Hectares)	Production (in Tonnes)	Production % to State
1	Kancheepuram	91356	345129	6.85
2	Thiruvallur	78712	286007	5.67
3	Cuddalore	102798	335119	6.65
4	Villupuram	145403	480329	9.53
5	Vellore	44326	148367	2.94
6	Thiruvannamalai	112148	385914	7.66
7	Salem	21711	72083	1.43
8	Namakkal	12205	45300	0.90
9	Dharmapuri	18801	70395	1.40
10	Krishnagiri	14982	47672	0.95
11	Coimbatore	6479	24456	0.49
12	Erode	38360	166860	3.31
13	The Nilgiris	1110	4287	0.09
14	Tiruchirappalli	61289	227332	4.51
15	Karur	12433	40279	0.80
16	Perambalur	38121	95428	1.89
17	Pudukottai	88665	159552	3.17

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18	Thanjavur	150228	479643	9.52
19	Thiruvarur	151629	311306	6.18
20	Nagapattinam	154040	289317	5.74
21	Madurai	61864	214880	4.26
22	Theni	14400	61662	1.22
23	Dindigul	17276	67837	1.35
24	Ramanathapuram	123771	29879	0.59
25	Virudhunagar	28214	93093	1.85
26	Sivagangai	76733	78939	1.57
27	Tirunelveli	83711	323944	6.43
28	Thoothukudi	18056	64735	1.28
29	Kanyakumari	20349	90210	1.79
	State	**1789170**	**5039954**	**100**

Source: Department of Economics and Statistics, Chennai-600 006

Table 1b Season-wise/district wise area under rice cultivation in Tamil Nadu.

NORMAL AREA OF PRINCIPAL CROPS 05-06 (Average of five years ending 05-06) District	**PADDY**			
	Kar / Kuruvai / Sornavari (in Ha)	**Samba / Thaladi / Pishanam (in Ha)**	**Navarai / Kodai (in Ha)**	**TOTAL (in Ha)**

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1.	Chennai	0	0	0	0
2.	Kancheepuram	13151	63357	32710	109218
3.	Thiruvallur	23796	46779	13595	84170
4.	Cuddalore	19578	82960	6215	108753
5.	Villupuram	23736	90386	14597	128719
6.	Vellore	7238	17464	16272	40974
7.	Thiruvannamalai	17065	53794	28510	99369
8.	Salem	5774	16733	4594	27101
9.	Namakkal	2033	9231	1967	13231
10.	Dharmapuri	7565	14664	4153	26382
11.	Krishnagiri	5381	10179	1478	17038
12.	Coimbatore	1185	4486	1414	7085
13.	Erode	8462	23832	1305	33599
14.	Tiruchirapalli	6680	50292	4777	61749
15.	Karur	88	14079	699	14866
16.	Perambalur	2254	36515	3908	42677
17.	Pudukottai	1213	84361	371	85945
18.	Thanjavur	25848	123533	4649	154030

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19.	Thiruvarur	14100	130359	1926	146385
20.	Nagapattinam	23190	126024	1440	150654
21.	Madurai	6668	40683	6126	53477
22.	Theni	4529	10409	614	15552
23.	Dindigul	2644	11995	2897	17536
24.	Ramanathapuram	0	125140	0	125140
25.	Virudhunagar	0	27012	2112	29124
26.	Sivagangai	0	80783	24	80807
27.	Tirunelveli	17450	51050	4278	72778
28.	Thoothukudi	2757	8993	3212	14962
29.	The Nilgiris	1702	0	0	1702
30.	Kanyakumari	10683	12383	0	23066
State		**254770**	**1367476**	**163843**	**1786089**

Source :Department of Economics and Statistics, Chennai-600 006

Table 3 Popular and high yielding varieties grown

Popular high yielding varieties grown in Kuruvai season (May-June)	Popular high yielding varieties grown in Samba season (Sep-Oct)	Popular high yielding varieties grown in Thaladi season (Nov-Dec).

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ADT 36	BPT 5204	BPT 5204
CO43	ADT 36	ADT 36
ADT 43	ADT 37	ADT 37
TKM 9	ADT 39	ADT 39
	CR-1009	CR-1009
	CO 43	CO 43

(Source: Report by Domestic and Export Market Intelligence Cell (DEMIC) of Tamil Nadu Agricultural University, Coimbatore)

Ruling rice varieties/hybrids of Tamil Nadu (Duration wise)

Short duration varieties	Medium duration varieties(120 –145)	Long duration (>150)
ADT 48 (95-100 days)	IR 20	Ponmani (CR 1009) – Savithri
ADT 43 (110 days)	Bhavani	White Ponni
ADT 37 (105 days)	CO 43	PY 4 (Jawahar)
ADT 36 (115 days)	IR 36	
CO 47 (110-115 days)	MDU 3	
ASD 20 (110 days)	MDU 4	
ADS 17 (101 days)	ADT 38	
ADS 16 (110 days)	ADT 3	
IR 64 (115-120 days)	ADT 44	

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ADTRH 1 (115days) - Kuruvai	ADT 46	
CORH 3(110-115 days) – Kar/ kuruvai/navarai	TPS 2	
	TPS 3	
	ASD 19	
	TRY 1	
	CORH 2 (125 days) – Samba season	

Table 4. Area under high yielding variety (Combined) in Tamil Nadu

District		PADDY (Combined) (in Ha)								
		High Yielding variety			Local Variety			Total		
		Irrig.	Un irrig.	Total	Irrig.	Un irrig.	Total	Irrig.	Un irrig.	Total
1.	Chennai	0	0	0	0	0	0	0	0	0
2.	Kancheepuram	109954	4119	114073	647	0	647	110601	4119	114720
3.	Thiruvallur	86304	10690	96994	0	0	0	86304	10690	96994
4.	Cuddalore	113529	762	114291	0	0	0	113529	762	114291
5.	Villupuram	165591	2844	168435	0	0	0	165591	2844	168435
6.	Vellore	58152	11	58163	0	0	0	58152	11	58163
7.	Thiruvannamalai	140627	190	140817	1921	6	1927	142548	196	142744

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8.	Salem	36474	752	37226	0	102	102	36474	854	37328
9.	Namakkal	18832	1	18833	0	0	0	18832	1	18833
10.	Dharmapuri	28815	208	29023	0	0	0	28815	208	29023
11.	Krishnagiri	21934	35	21969	0	11	11	21934	46	21980
12.	Coimbatore	7405.7	0	7405.7	0	0	0	7405.7	0	7405.7
13.	Erode	43423	0	43423	0	116	116	43423	116	43539
14.	Tiruchirapalli	78956	620	79576	0	0	0	78956	620	79576
15.	Karur	18398	0	18398	0	0	0	18398	0	18398
16.	Perambalur	37423	8529	45952	0	0	0	37423	8529	45952
17.	Pudukottai	89221	6765	95986	0	0	0	89221	6765	95986
18.	Thanjavur	154901	0	154901	0	0	0	154901	0	154901
19.	Thiruvarur	145750	0	145750	10348	0	10348	156098	0	156098
20.	Nagapattinam	143271	14829	158100	0	0	0	143271	14829	158100
21.	Madurai	70996	0	70996	0	0	0	70996	0	70996
22.	Theni	15694	0	15694	0	0	0	15694	0	15694
23.	Dindigul	23735	0	23735	0	0	0	23735	0	23735
24.	Ramanathapuram	38999	21996	60995	14838	51562	66400	53837	73558	127395
25.	Virudhunagar	30433	343	30776	0	0	0	30433	343	30776

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26.	Sivagangai	71916	18008	89924	0	0	0	71916	18008	89924
27.	Tirunelveli	86397	0	86397	0	0	0	86397	0	86397
28.	Thoothukudi	19932	0	19932	0	0	0	19932	0	19932
29.	The Nilgiris	4	0	4	0	1426	1426	4	1426	1430
30.	Kanyakumari	21709	0	21709	0	0	0	21709	0	21709
State		**1878775.7**	**90702**	**1969477.7**	**27754**	**53223**	**80977**	**1906529.7**	**143925**	**2050454.7**

Source: Season and crop report-2005-06. Department of Economics and Statistics, Chennai -6

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