

- Pugsley, A. T. 1964. Semi-dwarf wheats for Australia. *C.F. Field crop abst.*, 18 (1): 13.
- Raheja, P. C, and K. P. Mishra. 1965. Development studies on crop plants I. Influence of nitrogen, phosphate and potash and calcium alone and in combination on wheat. *Ind. J. Agri. Sci.*, 25 (2): 87-104.
- . 1958. Development studies on crop plant II. Investigation on character differences induced by fertilization in relation to lodging susceptibility in wheat crops. *Ind J. Agri. Sci.*, 28 (4): 499-510.
- Rai, S. N. 1961. Effect of urea on yield and quality of wheat. M.Sc. (Agronomy) thesis, Bhag. Univ., Bihar.
- Woodward, R. W. 1964. Response of some semi-dwarf spring wheats to N and P fertiliser. *Crops & Soils.*, 16 (1): 28-9.

<https://doi.org/10.29321/MAJ.10.A03525>

A Critical Approach to Rice Production in Tamil Nadu*

by

T. SIVASUBRAMANIAN¹

Introduction: Rice, being a primary food, occupies a pre-eminent position in crop production. In India and particularly in Tamil Nadu, a steady increase both in area and output of rice has been recorded. This increase has been phenomenal in recent times reaching an area of 6.8 million acres and an output of 4.2 million tons with an average acre yield of 1,385 lb. Many factors have contributed towards this end, the chief among them being the use of fertilisers and high fertiliser-responsive strains. A point of saturation is likely to be reached in the area under rice and in the use of inputs. An attempt has been made in this paper to examine critically the various limitations and plan for a better approach towards maximising rice production in the State.

Materials and Methods: The total area, total output and yield per acre of rice and the annual rainfall as published in the Season and Crop Reports of Tamil Nadu Government from the Fasli year 1905-06 to 1965-66 formed the basic material for the study. Quinquennial means were worked out from the year-wise data and presented district-wise. The year 1950-51 was treated as the base year and the subsequent quinquennia were fitted into the plan periods. Madras, a non-agricultural district and Kanyakumari, for want of data, were omitted in the study. The remaining districts of the State (excluding Nilgiris, a hilly district) were found to lend themselves for grouping into four zones based on the area and output of rice, rainfall and soil conditions. Correlations were then worked out for (i) output and area, (ii) yield per acre and area and (iii) yield per acre and rainfall. The soil fertility status of each district was also examined.

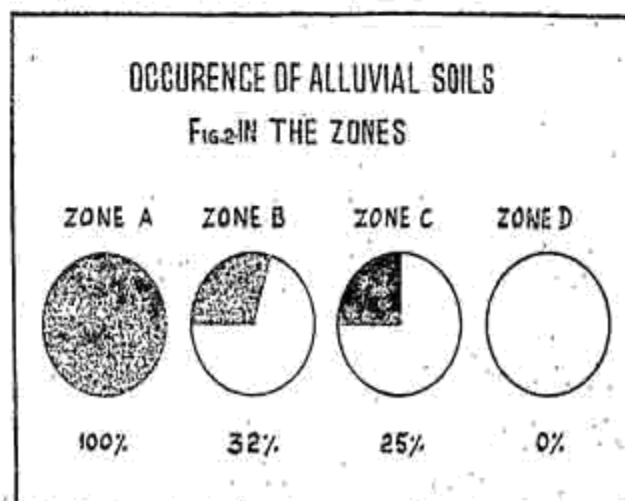
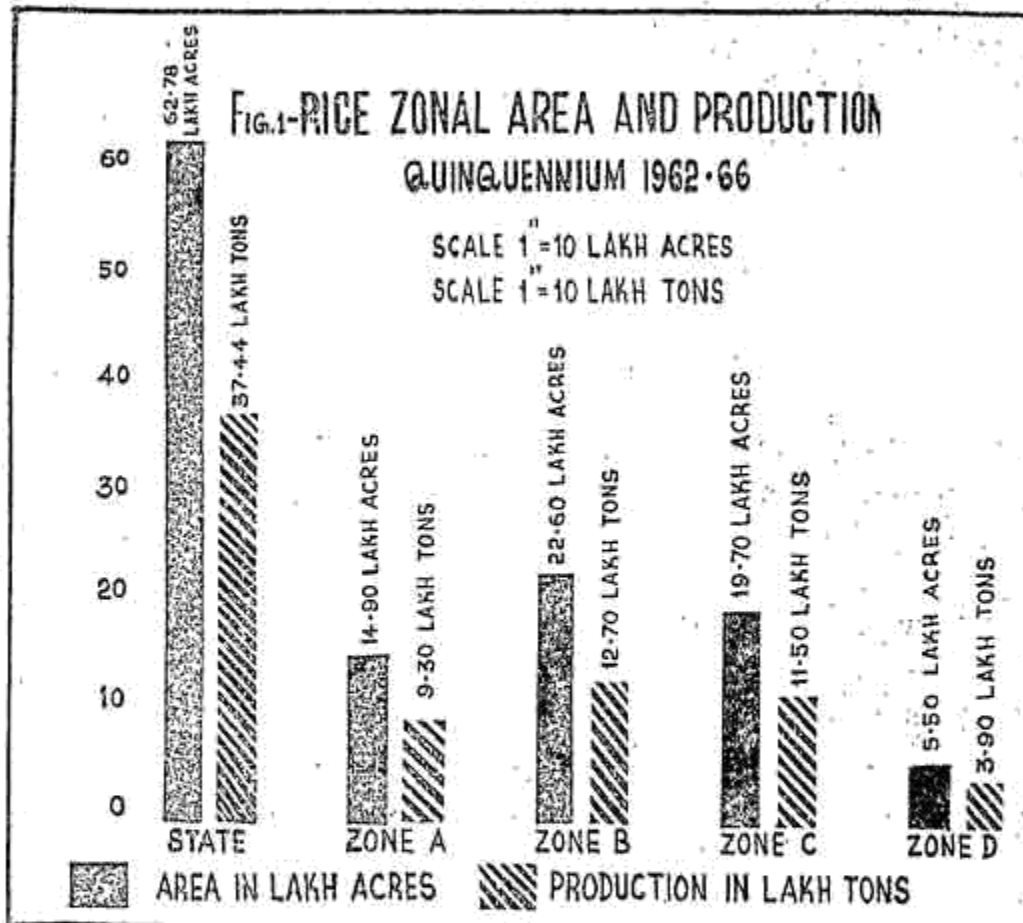
Results and Discussion: *Acreage:* The total area under rice in Tamil Nadu is 68 lakh acres as reported for the year, 1967-68. The district-wise

*Awarded A. H. S. Sharma Rolling Shield for 1969

¹ Joint Director of Agriculture (Inspection & General) Chepauk, Madras-5.

quinquennial average from 1906-10 to 1962-66 is furnished (Fig. 3). The area obtained for the first and last quinquennia with the maximum and the minimum recorded during the particular quinquennium is furnished (Table I).

As seen from the table, there has been a general increase in the area under rice in all the districts of the State, the increase being nearly four times in Ramanathapuram, three times in Coimbatore, two and a half times in Tiruchirapalli, nearly twice in Salem and one and a half times in North Arcot,



Chingleput and Nilgiris districts. The area increase is only about one-third in the districts of Thanjavur, Tirunelveli and South Arcot with a negligible increase of three percent in Madurai district. Yet, the districts of Thanjavur and Nilgiris continued to maintain the first and last ranks respectively during the last 60 years in regard to the area under rice while the ranks held by other districts changed.

TABLE 1. *Area under Rice (Lakh Acres)*

District	Area		Maximum		Minimum		Difference (cols. 4-6)
	1906-10	1962-66	Area	Quin. ended	Area	Quin. ended	
1	2	3	4	5	6	7	8
Chingleput	5.4	8.4	8.4	1966	5.4	1910	3.0
South Arcot	5.6	7.3	7.3	1966	5.2	1920	2.1
North Arcot	4.4	6.9	6.9	1966	4.2	1930	2.7
Salem	1.5	2.6	2.6	1966	1.0	1930	1.6
Coimbatore	1.1	2.9	2.9	1966	0.9	1915 & '40	2.0
Thanjavur	10.9	14.9	14.9	1966	10.9	1910	4.0
Tiruchirapalli	2.4	5.6	5.6	1966	2.4	1910	3.2
Madurai	3.8	3.9	3.9	1966	2.9	1915	1.0
Ramanathapuram	1.6	6.0	6.0	1966	1.6	1910	4.4
Tirunelveli	3.1	4.2	4.2	1966	3.1	1910	1.1
Nilgiris	0.05	0.08	0.08	1966	0.05	1910	0.03

Output: The total output of rice in Tamil Nadu for the year 1967-68 is estimated to be 42 lakh tons. The quinquennial average output of rice in each of the districts from 1906-10 to 1962-66 is furnished (Fig. 3). The output recorded at the starting quinquennium as also at the ending quinquennium during the period under study is furnished (Table 2).

TABLE 2. *Rice Output (Lakh Tons)*

District	Output		Maximum		Minimum		Difference (Cols. 4-6)
	1906-10	1962-66	Output	Quin. ended	Output	Quin. ended	
Chingleput	1.2	4.3	4.3	1966	1.2	1910	3.1
South Arcot	1.9	4.3	4.3	1966	1.9	1910	2.4
North Arcot	1.8	4.1	4.1	1966	1.8	1910	2.3
Salem	0.6	1.8	1.8	1966	0.5	1930	1.3
Coimbatore	0.5	2.1	2.1	1966	0.5	1910	1.6
Thanjavur	4.1	9.3	9.3	1966	4.1	1910	5.2
Tiruchirapalli	0.9	3.2	3.2	1966	0.9	1910	2.3
Madurai	0.9	2.8	2.8	1966	0.9	1910	1.9
Ramanathapuram	0.3	2.4	2.4	1966	0.3	1910	2.1
Tirunelveli	0.9	3.1	3.1	1966	0.9	1910	2.2
Nilgiris	0.02	0.04	0.04	1966	0.02	1910	0.02

The Table shows a general increase in the output of rice in all the districts of the State. The maximum output of rice was during the quinquennium

ended 1962-66 in all the districts of the State. The increase in the output has been of the order of eight times in Ramanathapuram, four and a quarter times in Coimbatore, three and a half times in Chingleput, Tirunelveli and Thiruchirapalli, three times in Madurai and Salem, two and a quarter times in North Arcot, South Arcot and Thanjavur and twice in the Nilgiris districts. Thanjavur district held the first rank and Nilgiris district the last rank, in the output of rice both at the beginning and at the close of the period under study, while the other districts differed in their ranks during the period of 60 years.

Yield: The average acre yield recorded for the different quinquennia under study is furnished (Fig. 3). The yield recorded at the beginning as well as closing quinquennia is furnished (Table 3).

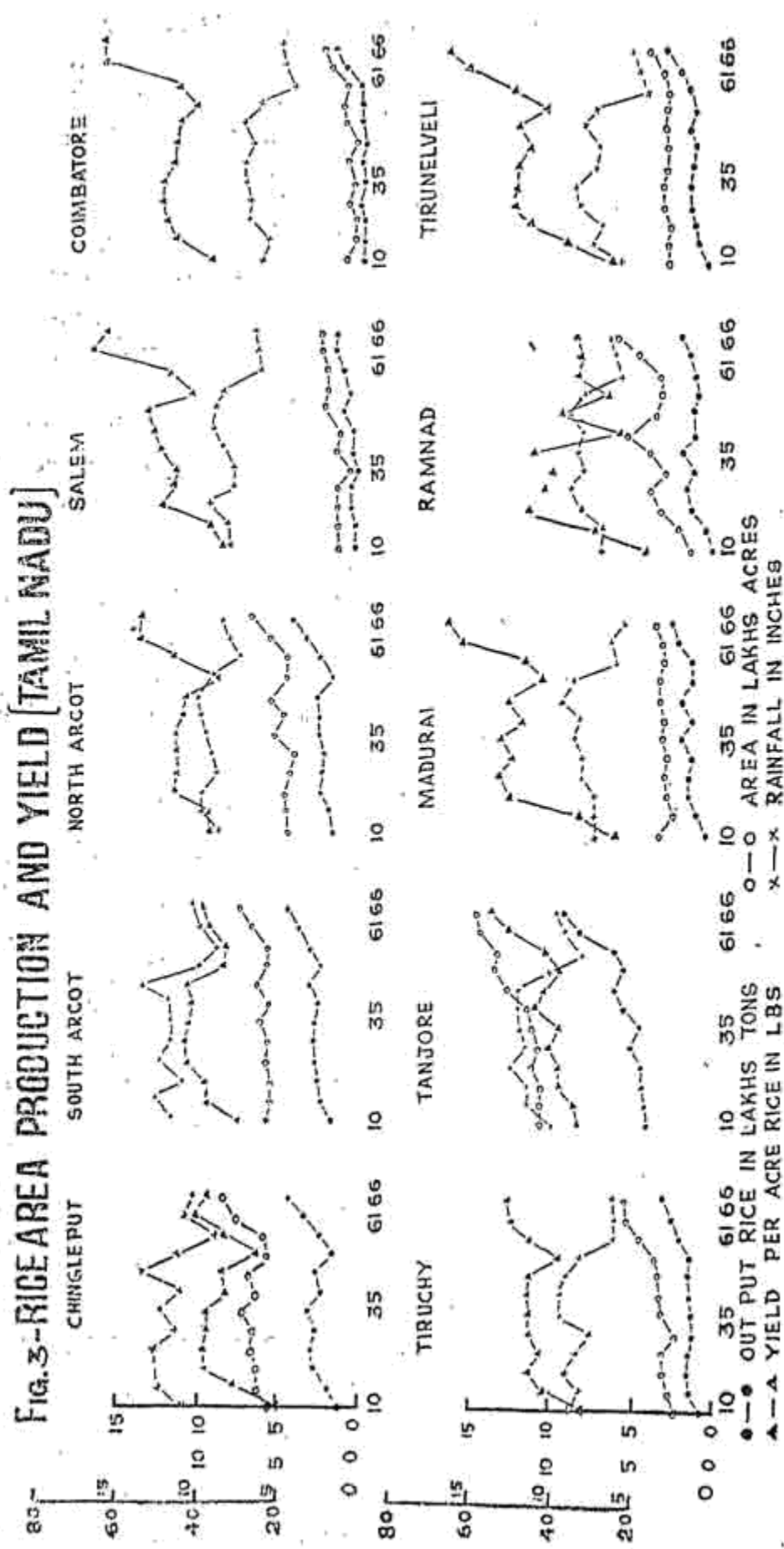
TABLE 3. *Rice Yield (Lb/Acre)*

District	Yield		Maximum		Minimum		Difference (Cols. 4-6)
	1906-10	1962-66	Yield	Quin. ended	Yield	Quin. ended	
1	2	3	4	5	6	7	8.
Chingleput	504	977	1002	1961	504	1910	498
South Arcot	767	981	1083	1945	767	1910	316
North Arcot	901	1322	1340	1961	880	1950	460
Salem	854	1595	1655	1961	854	1910	801
Coimbatore	949	1603	1617	1961	949	1910	668
Thanjavur	810	1397	1397	1966	840	1910	557
Tiruchirapalli	836	1267	1267	1966	836	1910	431
Madurai	538	1621	1621	1966	538	1910	1083
Ramanathapuram	449	884	1176	1920	449	1910	727
Tirunelveli	675	1645	1645	1966	675	1910	970
Nilgiris	696	1076	1277	1940	696	1910	581

The table reveals a general increase in yield in all the districts. The increase was the maximum at three times in Madurai district. It was two and a half times in Tirunelveli, twice in Ramanathapuram, Salem and Chingleput, and two thirds in Thanjavur and Coimbatore districts. The increase was nearly half in Nilgiris, Tiruchirapalli and North Arcot and one-third in South Arcot districts. Again, the ranking of the districts as regards acre yields has also undergone changes between the first and last quinquennia except Ramanathapuram district which held the last rank.

It is also seen that the difference between the maximum and minimum yields recorded, has been widest (*i. e.* 1083 lb) in Madurai district and narrowest (*i. e.* 316 lb) in South Arcot district. A difference of more than 400 lb was recorded in Tiruchirapalli, North Arcot and Chingleput districts. The difference was more than 500 lb in Thanjavur and Nilgiris districts, about 600 lb in Coimbatore district, more than 700 lb in Salem and Ramanathapuram districts and more than 900 lb in Tirunelveli district.

FIG. 3--RICE AREA PRODUCTION AND YIELD [TAMIL NADU]



●—○ OUT PUT RICE IN LAKHS TONS
 x—x RAINFALL IN INCHES

It is of interest to recognise that the poor yield in Ramanathapuram district even when doubled could not alter its last rank. Another feature is the fluctuation between the maximum and minimum yields which has been the lowest (316 lb per acre) in South Arcot and the highest (1083 lb) in Madurai districts, indicating thereby the scope for intensive cultivation as minimum in South Arcot and maximum in Madurai districts. This is further supported by the fact that there had been 300% increased output for a mere three per cent area increase in Madurai district. Yield fluctuations which are lowest in Chingleput, North Arcot and South Arcot districts indicate the limited scope for intensive cultivation in these districts. Thanjavur district comes next which is only slightly better. Salem and Coimbatore districts seem to offer better scope for intensive cultivation with a range of 600 to 700 lb per acre. Considerable scope for intensive cultivation is indicated in the fluctuation range of 400 to 1083 lb in Tiruchirapalli, Madurai Ramanathapuram and Tirunelveli districts.

Rainfall: The quinquennial average for annual rainfall recorded district-wise during the period under study is furnished in Fig. 3. The average annual rainfall recorded during the first and the last quinquennium together with the maximum and minimum recorded against particular quinquennium are furnished (Table 4).

TABLE 4. *Quinquennial average for Annual Rainfall (Inches)*

District	1906-10	1962-63	Maximum		Minimum		Difference (Cols. 4-6)
			Rainfall Quin. ended	Quin. ended	Rainfall Quin. ended	Quin. ended	
1	2	3	4	5	6	7	9
Chingleput	43.0	40.1	53.5	1945	34.2	1956	19.3
South Arcot	46.5	40.6	53.4	1945	32.9	1956	20.5
North Arcot	35.7	34.5	40.2	1945	29.4	1956	10.8
Salem	32.8	26.8	38.1	1920	25.0	1956	13.1
Coimbatore	26.6	21.2	31.8	1935	18.8	1956	13.0
Thanjavur	40.2	38.3	50.1	1925	32.2	1956	17.9
Tiruchirapalli	32.7	25.2	38.0	1935	24.0	1961	14.0
Madurai	30.5	23.7	38.5	1945	23.7	1966	14.8
Ramanathapuram	28.7	24.4	37.7	1945	23.6	1956	14.1
Tirunelveli	25.5	20.9	35.8	1930	16.9	1956	18.9
Nilgiris	78.6	53.7	82.6	1925	50.8	1956	31.8

From the table, it is seen that for the period under study, there was a general decrease in the rainfall recorded during the last quinquennium as compared to the first. All the districts except Tiruchirapalli and Madurai, recorded the minimum rainfall during the quinquennium ended 1956; while the maximum rainfall was recorded at different periods in the districts. The

difference between the maximum and the minimum rainfall recorded during the period under study was highest in Nilgiris district with 32 inches and lowest in North Arcot district with eleven inches. The difference is about thirteen inches in Salem and Coimbatore, fourteen inches in Tiruchirapalli and Ramanathapuram, fifteen inches in Madurai, eighteen inches in Thanjavur, nineteen inches in Tirunelveli and Chingleput and twenty inches in South Arcot districts.

For a proper evaluation and realistic approach towards stepping up rice production in Tamil Nadu, due importance has to be given to the suitability of the soil, the soil groups and their fertility status. Considering the area and output of rice as also the mean annual rainfall for the quinquennium ended 1962-66 the districts seem to get themselves grouped into four contiguous geographical areas or zones (Table 5). The total area and production of rice in each zone during the quinquennium 1962-1966 are presented in Fig. 1.

TABLE 5. *Zonal classification of Districts*

Zone	Districts	Area under rice (as % to State area)	Rice output (as % to State area)	Mean Annual Rainfall (inches)
A	Thanjavur	24	25	38.3
B	Chingleput South Arcot North Arcot Tiruchirapalli Madurai	36	34	38.4
C	Ramanathapuram Tirunelveli	31	31	23.6
D	Salem Coimbatore	9	10	24.0

The grouping of the districts into four zones as above would seem to be justified by a perusal of soil groups expressed as percentage of occurrence in different districts - as calculated from the "Economic Atlas of Madras State" (Table 6).

As rice is best cultivated in alluvial soils, the grouping of the districts into four zones is further supported by the percentage area of occurrence of alluvial soils in each zone as follows :—

Zone A	...	100 per cent
Zone B	...	32 per cent
Zone C	...	25 per cent
Zone D	...	0 per cent

The occurrence of alluvial soils in each zone is represented in Fig. 2. Incidentally the zones show a graduation in their soil fertility status (Table 7).

TABLE 6. Soil classification

Zones	A		B		C			D		
District	Thanjavur	Chingleput	South Arcot	North Arcot	Tiruchirapalli	Madurai	Ramanathapuram	Tirunelveli	Salem	Coimbatore
Area in laksh acres	23.9	20.4	26.9	30.4	35.2	31.2	30.9	28.2	45.1	38.7
Soil group and percentage of occurrence										
<i>Red</i>										
Red soil	—	—	48	94	—	—	—	—	96	—
Deep red	—	—	—	—	—	35	12	23	—	5
Thin red	—	—	—	—	7	25	—	—	—	73
Red loam	—	28	—	—	10	—	—	—	—	—
Red Sandy	—	—	—	—	—	15	22	25	—	—
Red sterile	—	—	—	—	32	6	7	—	—	—
TOTAL	—	28	48	94	49	81	41	48	96	78
<i>Black soil</i>	—	—	14	6	20	9	14	28	4	18
<i>Alluvium</i>										
River alluvium	71	49	26	—	31	—	25	13	—	—
Saline coastal alluvium	29	23	12	—	—	—	20	11	—	—
TOTAL	100	72	38	—	31	—	45	24	—	—
<i>Laterite</i>	—	—	—	—	—	10	—	—	—	4
GRAND TOTAL	100	100	100	100	100	100	100	100	100	100

TABLE 7. Soil fertility status

Zone	District	N	P	K
A	Thanjavur	L	L	L
B	Chingleput	L	L	L
	South Arcot	L	M	—
	North Arcot	L	L	—
C	Tiruchirapalli	M	M	—
	Madurai	L	L	—
	Ramanathapuram	L	L	—
	Tirunelveli	L	M	—
D	Salem	L	M	L
	Coimbatore	L	M	M

NOTE:

	N	P	K
L=Low (lb/acre)	0-250	0-10	0-300
M=Medium (lb/acre)	251-400	10.1-30	300-500
H=High (lb/acre)	Over 400	Over 30	Over 500

The above table indicates that N is low in all the districts except in Tiruchirapalli while P is low only in half the number of districts. This emphasises the need for an appropriate approach based on the judicious evaluation for intensive or extensive cultivation, since the four districts in zone 'C' represent four different fertility status and potentialities. The lack of scope for intensive cultivation in Thanjavur district having been already brought out, the possibilities for extensive cultivation are to be explored. With lack of area under alluvial soil, zone 'D' does not offer much scope for extensive cultivation. In zone 'B', extensive cultivation may be attempted on account of favourable soil condition. Zone 'C' however, offers considerable scope for extensive cultivation as it is favoured by the occurrence of alluvial soil.

In as much as the districts of the State align themselves into four zones, it is felt meaningful that the data for sixty years be subjected to correlation tests zonal-wise rather than for the State as a whole. The pairs of factors—output and area, yield per acre and area, and yield per acre and rainfall—were examined. The corresponding regression equation was also computed (Table 8).

TABLE 8. *Correlation and regression for rice production for the zones*

Zones		Pairs compared		
		Output and area	Yield/acre and area	Yield/acre and rainfall
A	n=13	** r=0.916 y=-561007+930.07x	** r=0.762 y=90+0.78x	r=-0.267
B	n=39	** r=0.755 y=-62197+530.33x	r=0.092	r=0.031
C	n=52	** r=0.644 y=5817+466.65x	r=0.121	r=0.014
D	n=26	** r=0.989 y=-37366+808.07x	** r=0.677 y=819+2.48x	r=-0.134

Note: ** Significant at 1% level

A high degree of positive correlation significant at one per cent level between output and area is obtained. It is significant that zone D and A rank high. As regards yield per acre and area, zone A and D alone have shown significant positive correlation at one per cent level, while it was not significant in zones B and C indicating thereby limitations for intensive cultivation. This may be ascribed to the heterogenous nature of the soil groups prevailing in zones B and C. The effect of rainfall on yield per acre, curiously enough, has

no association in all the four zones. It would appear, therefore, that the factor of soil condition rather than rainfall requires proper recognition in rice production programmes.

This view is also supported by the studies made by the Programme Evaluation Organisation who contradict the general assumption that any area with assured rainfall or irrigation is good enough for implementing the high yielding varieties programme. According to them, the programme will be more suited to areas with controlled irrigation and better water management.

Suggestions and Recommendations: The programme for stepping up rice production needs reorientation by recognising the zones. For intensive cultivation, controlled irrigation, recognition of soil groups and their fertility status are the factors to be considered. So far as rice production is concerned, zone 'C' seems to lend itself for both intensive and extensive cultivation, while zone 'D' for intensive cultivation only. In zones 'A' and 'B' the potentialities for extensive cultivation are worth examining.

The fact that application of fertilisers has not given spectacular results even in soils of low fertility would suggest the need for the use of other nutrients including trace elements for the better utilisation of N. The photoperiodic sensitivity of the rice plant and its interactions with temperature have also to be recognised.

Summary and Conclusion: The data on area, total output and acre yield of rice and rainfall during the past six decades were examined to bring out the scope and potentialities for stepping up rice production in Tamil Nadu. The trend showed an appreciable increase in area and output caused by many factors.

The need for grouping the districts into zones was brought out. A high degree of correlation between output and area but not yield per acre and rainfall was obtained for the zones. Yield per acre and area could be correlated only in certain zones bringing out the heterogeneity of the area in other zones. The soil group with controlled irrigation rather than gross rainfall holds sway. Zone 'C' covering the districts of Madurai, Ramanathapuram, Tirunelveli and Tiruchirapalli offers scope for both intensive and extensive cultivation. Factors like efficient N utilisation and photothermal reaction of the rice plant are to be considered.

REFERENCES

- Anon. 1906-1966. Season and Crop reports of the Madras State.
———, 1962. The Economic Atlas of Madras State.