Conclusion: Before concluding the account on the developments in the insecticidal methods of pest control, it has to be mentioned that notwithstanding the synthesis of some of the more potent insecticides, the problem of the control of tissue borers still remains unsolved. There is a need for an effective insecticide which will get into the texture of the plants and cause the death of these internal feeders without in any way proving detrimental to the human beings or domestic animals consuming the produce of the treated plants.

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The Condition Factor for Paddy and the Irrigation Facilities available in certain Districts of Madras State during the last Fifty Years

by

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Introduction: The estimate of output of any crop for each district in a given year is the product of three factors, namely (1) the area under the crop in that year, (2) the normal yield per acre and (3) the condition factor for that year. The area under the crop is compiled every year by village officers based on the actual area sown to that crop in each holding. So far as the normal yield per acre for paddy is concerned, this was worked out by the Director of Agriculture, Madras in the year 1919 for each district. This figure is continued to be adopted since then and upto 1949 – '50. The condition factor (or the seasonal factor as it is also called) is the percentage of the normal yield estimated to be obtained each year. If the season is normal in any year, the normal yield can be expected and therefore the condition factor for that year is expressed as 100. Conditions of drought, floods, incidence of pests etc., affect the yields. The village officers furnish every year their estimates of what percentage of the normal yield is expected from their villages. Based on these estimates and the area under the crop in each village, the average condition factor is calculated for each district. According to the Season and Crop Report for Madras State for the year 1951 – '52, the total

normal area under paddy in the thirteen districts comprising the Madras (Residuary) State is 5,951,130 acres and the normal output of paddy is 3,604,140 tons. Six districts have been chosen for the present study and they differ widely in soils, paddy seasons and the available irrigation facilities. These districts account for 64·4 percent of the total normal area and 66·1 percent of the total normal output of paddy in the Madras State.

Soils and paddy seasons: In Table I, the main features of the districts from the point of view of soils and paddy-growing seasons are given:

TABLE I

Soils and Paddy-Growing Seasons in the Selected Districts

District selected	Nature of soils in which paddy is grown	Main sowing and harvest seasons for paddy
South Arcot	Black clay and black loam	In 65% of the paddy areas, sowings are done between September and November. Harvests come off in January to March.
North Arcot	Black loam and red loam	Under wells, sowing is done in July—August (15·7% of the paddy area). In 51·5% of the area sowings are done in September to November. These receive water from tanks. Harvests are done in the above areas in November—December and February to April respectively.
Tiru-chirapalli	Alluvial and regar	In 70·7% of the areas sowings come off in September to November. Harvests come off in January to March.
Tanjore	Alluvial and regar	Over 90% of the sowings come off in August to November. The harvests are done in January to March.
Tirunel-veli	Black loam	In lands which receive water from freshes in the river (20%) sowings are done in June—July and harvests in September—October. In lands commanded by tanks (63%) sowings are done in November to January and harvests in February to April.
Malabar	Red ferrugin-ous	In 58% of the lands sowings are done during the south-west monsoon in May to July and harvested in September—October. Another 19% of the lands are sown in October and harvested in January—February.

It is seen that the paddy soils in Tanjore and Tiruchirapally are more nearly alike while those in other districts differ from one another. Sowings and harvest seasons are roughly alike in South Arcot, Tanjore and Tiruchirapalli. In the remaining districts these seasons differ.

TABLE II

Area Irrigated and the Acreage and Output of Paddy in Certain Districts

District and Year	Total Area Irrigated	Percentage of area irrigated to the Total area irrigated by				Normal Area under paddy 1951—52**	Normal output 1951—52**	Normal yield per Acre
		Government Canals	Tanks	Wells	Others			
South Arcot								
1911—12	514,446	30·8	53·1	13·0	3·2			
1931—32	511,427	28·7	52·8	13·5	5·1			
1951—52	545,355	38·5	34·4	25·7	1·4	537,250 (9·0)	299,930 (8·3)	1,752
North Arcot								
1911—12	412,059	7·7	60·1	14·5	8·7			
1931—32	408,657	7·1	64·9	23·3	4·6			
1951—52	367,349	5·9	42·4	51·1	0·5	390,960 (6·6)	243,570 (6·8)	1,832
Tiruchirapalli								
1911—12	328,404	41·4	23·3	32·4	2·9			
1931—32	281,815	43·6	21·8	31·4	3·1			
1951—52	435,353	35·8	37·0	23·6	3·5	426,160 (7·2)	261,350 (7·3)	1,819
Tanjore								
1911—12	999,795	84·1	14·0	1·6	0·2			
1931—32	953,631	88·0	10·7	1·1	0·2			
1951—52	1,213,293	95·1	4·1	0·8	0·2	1,338,560 (22·4)	872,190 (24·2)	1,711
Tirunelveli								
1911—12	326,911	15·3	54·3	29·0	1·4			
1931—32	284,716	17·3	55·0	25·6	2·0			
1951—52	345,189	14·5	61·3	23·4	0·7	320,120 (5·4)	238,070 (6·6)	1,997
Malabar	..	..	..	..	..	823,250 (13·8)	466,000 (12·9)	1,400

** Figures in brackets are the percentages of the total for Madras State.

Irrigation facilities : In table II a picture of the irrigation facilities available in the six districts is also given. The salient features are : (1) Malabar : The paddy areas of this district are exclusively rainfed. (2) Tanjore : In Tanjore a substantial portion of the irrigated area receives water supply through innumerable canals. In 1951-52, over 95% of the irrigated area received canal irrigation and this is 11% more than what it was 40 years ago. The area commanded by tanks is now only 4%. During the last 40 years an additional area of over 2 lakhs of acres has been brought under irrigation. (3) North Arcot : Only 6 to 7% of the irrigated areas receive canal irrigation. Wells which supplied water for 14% of the irrigated area 40 years ago now supply 51% but the ayacuts coming under tanks have decreased from 69% to 42%. The total area irrigated has been declining from 4·13 lakhs acres in 1911-12, to 4·09 lakhs in 1931-32 and to 3·67 lakhs in 1951-52. This seems to indicate that monsoon rains have been decreasing and underground water supplies are failing in that district. (4) South Arcot : Like North Arcot, South Arcot too, has recorded a decline in the ayacut under tanks. The increase in the area under well irrigation in South Arcot is also far less than North Arcot. Portions of South Arcot lying near the Cauvery delta command canal irrigation which accounted for 31% of the irrigated area in 1911-12 and 38% in 1951-52. The total area irrigated in South Arcot has increased by nearly 31,000 areas during the last 40 years. (5) Tiruchirapalli : More substantial is the increase in the area irrigated in this district. During the last 40 years an additional area of over a lakh of acres has received the benefits of irrigation. In 1951-52, 20,000 acres more have received canal irrigation as compared with the area irrigated by canals in 1911-12. The actual ayacut under tanks too has doubled itself in this district but the area receiving irrigation from wells has remained stationery during the last 40 years. (6) Tirunelveli : Over 60% of the irrigated area is commanded by tanks. Government canals supply water only to 15% of the irrigated area and wells to less than 25%.

Putting it briefly, the paddy lands of Malabar depend entirely on monsoon rains and those in Tanjore on canal irrigation. Water supply in North Arcot has been dwindling and about one half of the irrigated area of that district gets water from wells and the rest from tanks. South Arcot and Tiruchirapalli are now almost alike and 1/4th of the irrigated areas of these districts are commanded by wells and one-half of the balance is under the ayacuts of tanks and the other half receives canal irrigation. In Tirunelveli more than half the irrigated area is under the ayacuts of tanks and the balance gets irrigation from wells and from Government canals. The six districts selected for the present study therefore present a wide variety of conditions in soils, in seasons and in irrigation facilities.

Normal acre yields : Since the condition factor is a percentage of the normal yield per acre expected to be actually obtained in any year, it is necessary to take into account the normal yields adopted during the last

50 years covered by the present study. If the normal yields are pitched high, the condition factor will be low since the actual yield will be a smaller percentage than what it will be when a lower figure for normal yield is adopted. The normal yield of paddy as given in the Season and Crop Reports of Madras State of the respective years are given in table III.

TABLE III. Normal yields of paddy. *(In pounds per acre).*

District	1902–03 to 1904–05	1905–06 to 1909–10	1910–11	1911–12 to 1917–18	1918–13 to 1949–50	1950–51 onwards
South Arcot	..	1350	1700	1700	1850	1752
North Arcot	..	1650	1650	1800	1900	1832*
Tiruchirapalli	..	1450	1800	1800	1900	1819
Tanjore	..	1600	1600	1600	1750	1711
Tirunelveli	..	1350	1800	2000	2000	1997
Malabar	..	1350	1400	1400	1400	1400

* In the Season and Crop report for 1950–51 this is given as 1332 whereas in 1951–52 it is given as 1832.

TABLE IV. Frequency Distribution of the "Condition Factor" for Paddy in Certain Districts

District	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–99	100–104	Total	Mean	Standard deviation	Coefficient variation
South Arcot	—	1	2	—	3	5	6	5	15	13	—	50	87·0	11·4	13·1
North Arcot	1	2	—	—	3	7	11	6	8	10	2	50	85·1	10·8	12·7
Tiruchirapalli	—	—	—	—	2	4	4	10	15	14	1	50	89·8	7·7	8·6
Tanjore	—	—	—	3	—	4	11	6	16	8	2	50	87·7	8·5	9·7
Tirunelveli	—	1	—	3	2	8	9	3	16	8	—	50	85·3	8·8	10·4
Malabar	—	—	—	—	—	1	15	7	10	13	4	50	90·1	6·8	7·5
	1	4	2	6	10	29	56	37	80	66	9	300	87·2	10 8	12·4

Condition Factor: In table IV the frequency distribution of the condition factor during the last 50 years for the six selected districts is given. It will be seen from it that the distribution is not strictly normal.

The number of years having a condition factor of 70 and above increases gradually till the 'mode' is reached. The frequency then decreases steeply. The normal yield or anything above it (i. e. the condition factor of 100 and above) has not been met with in any year during the last 50 years in the districts of South Arcot and Tirunelveli. North Arcot and Tanjore each experienced this situaiion in only two out of the 50 years and Tiruchirapalli only in one year. Malabar has been fortunate in having had four years out of the fifty in which the condition factor was 100 and above. This district has not also experienced any year in which less than 75 percent of normal yields were obtained. Tiruchirapalli has not seen a condition factor less than 70 percent and Tanjore less than 65 percent. South Arcot, North Arcot and Tirunelveli have seen very bad seasons in which only 50 to 60 percent of the normal yields were obtained. The mean condition factor for all these districts is between 85 and 90 and the difference in the means for individual districts is not statistically significant. The Coefficient of variation for seasons is the least, namely 7·5 percent in Malabar showing that the conditions in this district are generally uniform. It is highest (13·1%) in South Arcot. For all the six districts together the mean condition factor is only 87·2. The trends of the condition factor for each district are represented in the graph attached. The existence of successive years of bad and good condition factors is revealed in these graphs and they can be grouped as shown below:

(1) About twelve successive years from 1904—'05 to 1915—'16 in which the condition factor was below the mean in all the six districts. (2) About thirty years of above-the-average condition factors from about 1916—'17 to 1945—'46 in all districts except Malabar. (3) Adverse condition factors in all districts except Malabar from 1945—'46 onwards. Till 1951—'52 there was practically no recovery. (4) In Malabar the favourable period was from 1916—'17 to 1933—'34 only i. e. for 18 years. This was followed by seven unfavourable years. This district had again a favourable period from 1941—'42 to 1951—'52 except in three years.

Seasonal conditions do not really seem to have been adverse over successive years during 1904—'05 to 1915—'16. It is therefore difficult to explain why poor condition factors have been recorded in successive years in all the districts upto 1915—'16. Since firm normal yields based on a number of factors such as actual yield at Research Stations, actual crop sampling experiments etc. have been worked out in 1919 and adopted since then it is desirable to ignore the figures prior to 1918—'19. An era of prosperity seems to have dawned from about 1915—'16 and has generally been sustained upto 1944—'45. During this period all districts except Malabar had generally experienced more-than-average seasonal factors. The reasons for adverse conditions in certain years were as below: (1) Submersion of low-lying areas in the Coastal districts such as Tanjore. (2) Inadequate rains in Malabar. (3) Late or inadequate rains in districts which depend on freshes in rivers or in areas commanded by tanks and wells. (4) Excesive rains when crop is advanced in growth.
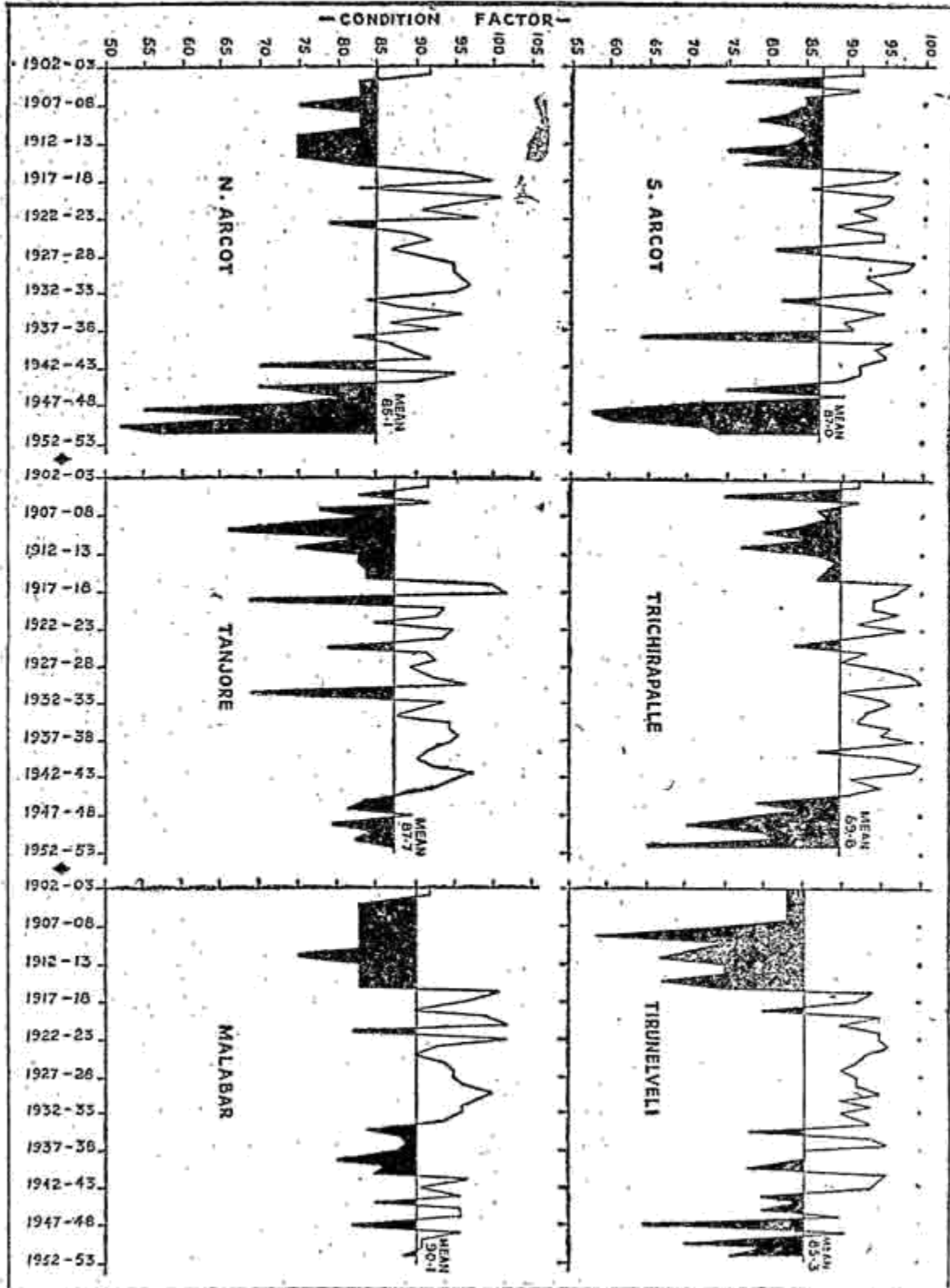
From the graphs it will be seen that during the 'twenties' and the 'thirties', Tirunelveli district has shown no depression in the condition factor. Malabar follows an independent trend. Acute adverse conditions have been experienced in North Arcot from 1945—'46 onwards. This is a district which depends on tanks and wells the water supply in which depend entirely on the receipt in adequate quantities of monsoon rains. It has therefore suffered most, consequent on the continued inadequacy of rains. In the prosperous period of the twenties and thirties the graphs for South Arcot and North Arcot are alike. So also the graphs for Tanjore and Tiruchirapalli. But during the adverse period of the 'forties the graphs for South Arcot and Tiruchirapalli which have similar irrigation facilities now are alike.

TABLE V
Results of crop sampling survey in certain districts of the Madras State

Name of District (1)	Year (2)	Output of paddy in thousands of tons			Remarks (6)
		As per Crop Sampling Survey (3)	As per official estimate (4)	Difference expressed as %age of col. 3 (5)	
1. South Arcot	1949—50	350·8	245·9	—30	
	1950—51	311·9	253·0	—19	
	1951—52	346·2	273·8	—21	
	Average	336·3	257·6	—23	
2. North Arcot	1949—50	270·2	242·9	—10	
	1950—51	247·7	127·5	—49	
	1951—52	156·7	155·2	— 1	
	Average	224·9	175·2	—22	
3. Tiruchirapalli	1949—50	307·5	305·6	— 1	
	1950—51	350·8	288·2	—18	
	1951—52	271·6	266·2	— 2	
	Average	309·9	286·7	— 7	
4. Tanjore	1949—50	732·8	880·1	+20	
	1950—51	787·9	910·0	+15	
	1951—52	870·0	916·5	+ 4	
	Average	799·9	902·2	+13	
5. Tirunelveli	1949—50	188·0	182·1	— 3	
	1950—51	250·7	222·9	— 8	
	1951—52	222·4	251·1	+13	
	Average	220·4	221·0	—	
6. Malabar	1949—50	373·1	470·0	+26	
	1950—51	397·0	476·6	+20	
	1951—52	403·0	471·7	+17	
	Average	391·0	472·8	+21	

Note :— (1) The figures in Col. 3 have been worked out from the figures of output of rice given in the "Administration Report of the Agricultural Department" for the respective years.

(2) The figures in Col. 4 are from the Season and Crop Report of the respective years.

Discussion and conclusions: This study reveals that anything like the normal yield of paddy has not been obtained over a substantial period during the last half a century, the mean condition factor having been between 85 and 90% in the six districts under study. This shows that the normal acre yields have been pitched too high. In Table V are furnished the estimates of total output of paddy during the last three years in the six districts based on crop sampling surveys and on the condition factors. It will be seen that, the official estimates of output in Tanjore and Malabar based on the condition factors have been on the high side during all the three years. In the remaining districts it has been consistently on the low side except in Tirunelveli during 1951 – '52. The average of the three years shows that the output has been over-estimated by 13% and 21% in Tanjore and Malabar respectively and under-estimated by 7% in Tiruchirapalli, 23% in South Arcot and 22% in North Arcot. The average variation for the three years for Tirunelveli is 'Nil'. This seems to indicate that besides pitching the normal yield too high the estimates of condition factors too were put on the high side in the districts of Tanjore and Malabar. In other districts which have a less assured water supply the official estimates of output were more cautious indicating that the estimate of condition factor for each district should be as near as possible. This has not been realised during the last fifty years. This can be achieved only by revising the figures of normal yield to levels which can really be possible of attainment over many years and not something which can be reached in just less than 5 years out of fifty. The fixation of a more realistic figure for normal yields perhaps based on the crop-sampling surveys now in progress seems warranted.

This study has once again brought out the well-known fact that seasonal vagaries can more nearly be overcome in areas which enjoy the benefits of assured seasonal rains and those which enjoy supply of irrigation water from river systems. In a district like Tirunelveli where a substantial portion of the paddy crop matures in the warmer months of February to April the acre yields are the highest.