

field is liable at times to get spoilt by inopportune rains and subsequent sprouting.

4. Some extra vigour is seen in the growth of the treated seed. The vigour is most when the seed is treated once and declines with the number of times the seed is re-treated.

5. Certain degree of drought resistance is induced by this treatment; this effect is more pronounced with seeds treated a larger number of times and tends to increase with the number of times the seed is re-treated.

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References

Parija, P. (1942) *Curr. Sci.* 12, 88.

Rangaswamy Ayyangar, G. N. *Bull. No. 17, Imp. Bureau of Plant Genetics, P. 134.*

Accuracy of Estimates of Yields of Indian Cotton Forecasts with Special Reference to the Madras Cotton Crop

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Under the standing orders of the Government of India, the Director General of Commercial Intelligence and Statistics, Calcutta, issues for all India forecasts for cotton at intervals of two months—in August, October, December, February and April. The exact day and hour of the release of the forecast is announced in a Press Note about one week in advance and arrangements have been made for the publication of the information in Calcutta and Bombay simultaneously and then subsequently throughout the country in the quickest possible time.

Area The forecast is prepared on the basis of the formula — Estimates of yield = area × standard or normal outturn per acre × seasonal or condition factor. Though the acreage figures are considered to be accurate it may be noted that reliable data are lacking in the case of permanently settled areas, lands held on privileged tenure and unsurveyed tracts, though steps are being taken to make good the deficiencies.

Standard outturn Standard outturn per acre, the second element, has been defined as "the crop which past experience has shown to be the most generally recurring crop in a series of years". It is therefore the "mode" and not the average of a series of years' figures which is an arithmetical average or mean. It may be noted that the present standard outturn figures have not been worked out scientifically after a proper classification of soils and a statistical analysis of the various factors that influence yields on a series of years but are based more or less on empirical estimates prepared by the Agricultural and Revenue Departments of the normal or average yield per acre of land of average quality under the two major heads of irrigated and unirrigated land in each district. Crop-cutting experiments

are indeed made every year both by the Agricultural and Revenue Departments for revising the standard yield figure, but recent statistical analyses¹ have shown that these data of crop-cutting experiments are of doubtful value as they are too few in number and are not carried out on modern statistical lines.

Seasonal Factor The third element, known as the Seasonal Factor, is the condition of the crop expressed as a percentage of the "normal" crop². Under the present system, the village accountant reports the condition of the crop as so many "annas" of the rupee, the rupee or 16 annas being taken to represent the normal crop in certain provinces while 12 annas is taken to be the normal in certain other provinces, like Madras. This "anna estimate" is then converted into a percentage estimate³. For example, in Provinces like Madras where 12 annas are taken to represent the 'normal', a nine anna crop would give a seasonal factor of 75; and a 14 anna crop a seasonal factor of 116. The chief defect of the "anna estimate" is the unavoidable element of error due to personal bias on the part of the primary reporting agency.

Post-mortem Examination (which cannot be detected⁴) of the Cotton Forecasts

The above review of the methods of forecasting the yields of crops shows that there are elements of error in all the three factors forming the basis of estimates. The Indian Central Cotton Committee has therefore been subjecting the Cotton Forecasts of the Director General of Commercial Intelligence and Statistics to a post-mortem examination in order to trace the sources of error with a view to improve the accuracy of future forecasts. This is done on the basis of the two following formulae:—

1. A study of Forecasting of Cotton Crops in the Punjab, I, J. A. S. Vol. IX, Part III, June 1941.

2. In the U. S. A., the primary agency itself reports the condition of the crop as a percentage of the "normal". In England, the Crop Reporters are instructed to relate their estimates of yield of the current crop to the "estimated" ordinary average of their district which is the average of the ten previous years (Economic Journal, Vol. XXX., p. 406)

3. "These estimates being generally in the form of an integral number of annas per rupee when they are first prepared are likely to be in excess or defect of the true value to the extent of half an anna owing to this cause alone. The error may not be a serious one in the case of a nearly normal crop but for a crop below normal, it will be large....." (Ibid., p. 3.)

For a fuller discussion vide Guide to Current Official Statistics, Government of India, Volume I, p. 3.

4. Experience has shown that there is a definite positive bias when yields are high, and a negative bias when yields are low. This could be eliminated however by a statistical examination of the data from time to time. It may be noted further that a uniform basis is necessary for the Anna Estimate in all the provinces so that the estimates of one province can be compared with those of another. For a fuller discussion, vide Official Statistics, Volume I (second edition), p. 4.

(a) Actual crop = net exports of cotton by all routes + mill consumption + extra-factory consumption + variations in stocks (stocks at the end of the season minus stocks at the beginning of the season.)

(b) Actual crop = cotton pressed + loose cotton consumed in spinning mills + net exports of loose cotton + village or extra factory consumption of loose cotton.

It may be pointed out at the outset that the two formulæ for arriving at the figures of actual crop are subject to certain limitations. Complete statistics of road-borne traffic in cotton are not available, though such traffic should be considerable particularly after the advent of motor lorries. Consumption of raw cotton in mills situated in the Indian States is not known accurately as the data relating to the same are collected on a voluntary basis instead of on a statutory basis as in the case of the mills in British India and cannot therefore be relied upon as complete. The data relating to stocks are admitted to be incomplete, being based upon voluntary returns. Stocks of ginned unpressed cotton and kapas are omitted in the calculation according to the second formula on the assumption that they are negligible, an assumption that may not be true in all cases. The method of making a constant allowance of $4\frac{1}{2}$ lakhs of bales for extra-factory consumption for the whole of India on the basis of the enquiry conducted by the Indian Central Cotton Committee in 1933—36 irrespective of the year to year changes in demand is also open to objection.

Even after making allowance for the defects in the two formulæ as noted above, it is clear that the approximate actual crop should be far greater and anyhow not less than the forecasted crop, since the errors noted above against the different items entering into the calculation of the actual crop are on the side of deficiency and not on the side of excess.

The Post-mortem Data of the Madras Cotton Crop from 1936 to 1942

A study of the post-mortem data of the Madras cotton crop as published annually by the Indian Central Cotton Committee in its Statistical Leaflet No. 5 (compiled and presented below in Table) would show that the "approximate actual crop" for all the years from 1936 to 1942 has been considerably higher than the "estimates of yield" as published in the Final Forecast Reports of the Indian Cotton Crop.

It may be noted in this connection that the post-mortem data for Madras have become somewhat complete only after 1938 when for the first time statistics of imports by road of raw cotton from Hyderabad were collected and included in the calculations of the "actual crop". These additional data necessitate corrections to the original data shown in Tables I and II of the Reports of the Indian Central Cotton Committee on the accuracy of the All-India Cotton Forecast. Columns 3 and 4 in our Table given below contain a summary of the original data as arrived at by the Indian Central Cotton Committee by the application of its two well-known formulæ and we have indicated within brackets the corrections we have made to the original

data in the light of the additional data noted above. Columns 5 and 7 give the simple differences between the "estimates" and the "actuals" as arrived at by the first and the second formulae respectively and columns 6 and 8 their percentages. Figures within brackets represent the corrections.

An examination of the data shows that the "actual crop" according to the second formula (column 4) is higher than that of the first formula (column 3) between 1938 and 1940 (the data of earlier years are not taken into consideration for the reason stated above) but lower than that of the first between 1941 and 1942. In fact, there has been this problem of "two conflicting actuals" in the case of the data of many cotton areas in India and, so far, there does not appear to have been any effort made to explain the causes for these conflicting actuals. As the method of arriving at the average of these two actuals as the "probable actual" is open to objection, it is proposed to examine here the causes for these discrepancies as far as Madras is concerned and then to indicate also the causes for underestimates in Government forecasts.

The second item in the second formula—loose cotton consumed in spinning mills—may be considered quite accurate as the relevant statistics are collected by an amendment to the Indian Cotton Cess Act of 1923. With regard to the third item—net exports of loose cotton—it may be noted that there is very little chance of exports of loose cotton by road, rail or sea from any of the southern districts for the simple reason that the cost would be prohibitive. In fact, the Western Ghats, the Indian Ocean, and the Bay of Bengal provide such natural frontiers that there are no land connections with any adjoining cotton areas as there are, for example, between the Punjab and Sind or between Berar and Bombay. The only part of the Madras Presidency from where exports of loose cotton by road to adjoining cotton areas are possible is the Bellary area. At present complete data of road-borne traffic are not available. It is possible that during years of low prices there may be much export of loose cotton by road and the absence of data on this point will therefore affect the data of "net exports" of the first formula. If this conclusion should be correct, it explains satisfactorily why the actual crop of the first formula shows a higher figure than that of the second formula during the years 1938 to 1940. Similarly, in years of higher prices and brisk local demand, much loose cotton might be imported by road into the Madras Presidency from the adjoining cotton areas and pressed here. As the pressing returns are statutory and therefore very accurate, and as any error in the second formula is likely to arise only from this first item—"cotton pressed"—we may conclude that the main source of discrepancy between the first and the second formulae lies in the data of import and exports by road of loose cotton.

Source of error in the Madras Forecasts

Having explained the probable reasons for the discrepancies between the two actuals as determined by the post-mortem examination, we may now

proceed to trace the source of error in the Government Forecasts of the Madras Cotton Crop.

The Madras figures of cotton acreage are said to be accurate. The necessary corrections are also said to have been introduced to some extent to the "anna estimates" of the condition factor as reported by the village accountants. Hence it is obvious that the main source of error in the Madras Cotton Forecast should be with regard to "standard of normal outturn" per acre. (Estimated yield, as is well known, is determined by the formula, Yield = Acreage \times standard yield per acre \times condition factor). This prima facie conclusion is confirmed by the fact that the same standard outturn of 250 lbs. lint per acre for irrigated cotton in the Madura area given in 1930 is repeated also for the year 1941-42 in spite of the fact that there has been a large increase in acreage under Cambodia during the last decade and that in certain parts there has also been the introduction of the higher-yielding varieties of Co. 3 and Co. 4. Obviously the crop-culting experiments conducted by the Revenue and the Agricultural Departments for the revision of the standard yield figure have not been satisfactory or their results have been misleading owing to the obvious defects in the technique adopted at present. The normal discrepancy between the estimates and the actuals according to the first formula is about 15 per cent, and if this is due to an underestimation of the standard yield figure only (the matter requires further examination), there is a possibility of avoiding the error in future forecasts.

Discrepancies between Estimates and Actuals as revealed by the post-mortem examinations of the Madras Cotton Crop by the I. C. C. C. as published in the Statistical Leaflet No. 5 of the Committee (in 1000 bales of 400 lbs. lint)

Years	Fore- casted yields	Actual crop as per		Differences between Estimates and Actuals			
		1st formula	2nd formula	Simple difference		Percentage difference	
				As per 1st formula	As per 2nd formula	As per 1st formula	As per 2nd formula
1	2	3	4	5	6	7	8
1936	455	522	480	-67	-14.7	-25	-5.5
1937	541	743	639	-202	-37.3	-88	-16.3
1938	535	594	533	-59	-11.0	-2	-0.4
1939	505	562	†(550) 543	-57	-11.3	(-15)	(-2.8)
1940	389	477	522	-88	-22.9	-38	-7.5
1941	421	505	†(463) 529	-84	-19.9	-133	-34.2
1942	504	†(489) 593	†(549) 611	(-68)	(16.1)	(-74)	(-18.9)
		*(578)	†(642)	-89	-17.6	-108	-25.6
				(-74)	(14.7)	(-128)	(-30.4)
						-107	-21.2
						(-138)	(-27.3)

Figures within brackets indicate corrections made by us on the basis of the data noted by the I. C. C. C. as shown below:

* After taking into account imports by road of loose cotton from Hyderabad.

† After taking into account exports by road of loose cotton from Hyderabad and variations in stocks of loose cotton by mills and trade.