

# The Interactions of Productive Factors in Rice

By

MULUKUTLA SATYANARAYANA, B. A., B. SC., (Ag.)  
Deputy Director of Agriculture, Madras

1. The Bowley-Robertson Committee's Crop Census: The practicability and scope of a census of production was one of the important subjects considered by Dr. A. L. Bowley and Mr. D.H. Robertson, when they were invited by the Government of India in 1933 for a Reorganisation of Statistics and report on the further study of the economic problems of India. They pointed out that excepting in the branches of vital statistics and foreign trade "the Statistics of India have largely originated as a by-product of administrative activities", relating to land revenue, famines and so forth. It was this Bowley-Robertson Committee that first fixed the minimum of villages for each province in India to be selected by random sampling, for the investigation of rural income, almost synonymous with agricultural production or crop census in this country.

2. Precise estimates for State assistance and drive: Primary estimates of agricultural statistics emanating from the village accountants except in the ryotward areas and in areas that have a levy in water rate are very wide of the truth. With numerous other administrative and revenue duties in hand, they compile agricultural statistics mainly through their informants, the '*chokidar*' in Northern India and the '*talayari*' in Southern India. In aiming at self-sufficiency in food production, not merely precise estimates of the crops, but the individual contribution by the several factors of production is essential.

3. The Productive factors: In tackling rice production, water, manure and improved seed come in as the *direct* factors, and the control of pests and diseases as the *indirect* contributory factors. In the survey of the census of the paddy crop, there is indication of contribution independently by the three factors of water, manure and improved seed, in combinations in pairs and in a very marked way, when all the three acted collectively.

4. To bring out the interactions of the productive factors in the rice crop of 1948-49, three appendices are provided to this paper. The first is a telescopic table indicating the per cent excess in yield of one or more productive factors over one or more other productive factors, under all practicable permutations and combinations. The second is a pictogram showing the distribution and the acre-yields of the productive factors in the province. The third is a belt strata chart showing the distribution of the productive factors in the main rice-growing areas in the province.

5. The 'O' factor: Marginal land under the plough, land under shifting cultivation, land under peasantry in penury and land in extensive estates under neglected conditions, do not obtain the facility for irrigation, or manuring and have crops only from non-descript seed. The yields in such are at the lowest ebb. State aid is raising production in the first three kinds of lands and is correcting the moribund state in the fourth by enacting legislation under the Agricultural Bill. Lands under the 'O' factor are estimated at 3% and this is an appreciable figure in a province with land hunger unsatiated. Such areas are confined to the zamindaries in Visakhapatnam, Godavari, Kistna, Madura and Ramnad and to the hillslopes of Visakhapatnam, Godavari and Malabar.

6. The 'S' factor: This pertains to land wherein improved seed evolved by the department was made use of to raise the crop. This factor by itself does not draw the particular attention of the cultivator as indicated by the poor dispersion of less than 1% in the sample. With water, it is a helpful adjunct. as proved lower down.

7. The 'M' factor: There is 17% of rainfed local paddy that had manuring in the province. Most of it pertains to the districts of Malabar and South Kanara where paddy land is classed as unirrigated. Visakhapatnam and Guntur which are also prominent for this factor, are cattle-rearing tracts and cattle and sheep-penning are common practices in them. With the heavy rainfall in the West Coast and in Visakhapatnam manuring on the 'O' factor and on 'S' have recorded 55% extra yield.

8. The 'W' factor: All the figures above the top zig-zag line in the telescopic table, with the exception of the three underlined that have no direct bearing on this factor, speak eloquently of irrigation to the the paddy crop and illustrate the common knowledge that paddy is an aquatic plant. Irrigation by itself and in combination with manuring and with good quality seed, recorded increased yields ranging from 24.5% to 156.2%. It thus takes the first rank amongst the productive factors and is a pointer to the State for taking up irrigation projects on an extensive scale. That the paddy crop has only 4% under this factor indicates that with irrigation water available, no cultivator would grudge to manure or to seek good seed to enhance rice production. The time factor for early planting needing reservoirs and regulators and the labour factor for planting in the central districts are subsidiary factors under this.

9. The 'MS' factor: In rainfed paddy, the association of improved seed with manuring is only upto 4%. As indicated under the 'M' factor, this area is confined again to Visakhapatnam and the

West Coast. From the heavier rainfall in these districts, the 'W' factor is indirectly there. But with acute drought in two successive years in the Central districts, specially in Chingleput, manuring acted as an inhibitive factor, as indicated by the negative figures over the bottom zig-zag line, in the telescopic table. The acre-yield of the 'MS' factor (968 Lb) is less than that of the 'M' factor (1026 Lb). This shows that the inhibitive character of 'M' is further augmented by association with 'S' in 'MS'.

10. In years of drought strains struggle to assert their superiority over locals. The following exemplifies this feature.

Percentage increase in yield of 'Biyahunda' strains  
over local 'Biyahunda' in Visakhapatnam district.

1945-46	...	42%	} Years of tidal wave cyclones and floods.
1946-47	...	42%	
1947-48	...	6%	} Years of fewness of freshes.
1948-49	...	7%	

11. The 'WS' factor: The wetland crop raised with improved seed is estimated at 6% of the total paddy area. The scope for improved seed to give extra yield on wetlands to the extent of 52.8% is revealed by this 'WS' factor. This zone without the association of manure is confined to the highly fertile mid-region of the Godavari deltas and to some extent to the Krishna and Tanjore deltas. Topping of rank growth and grazing by cattle are practices in vogue in unmanured, silty soils of the middle portion of the Godavari delta, where many fields may be found with the planting of the new 1st crop seedling on the stubble of the previous paddy crop.

12. The 'WM' factor: Notwithstanding the depressing effect of manure when associated with inadequate water supply, the popular practice is to apply manure to paddy land, with the full hope of receiving the optimum supply of water. In spite of the lower yield (180 lb.) under this factor, when compared to WS (1584 lb.) and (WMS 1694), still the irrigated manured paddy land has the greatest spread 40%, when compared to WS (6%) and WMS (25%). Thus the manuring of paddy land in all non-deltaic districts is a regular feature as also in the deltaic districts. Manure can pull up yields of paddy on irrigated land by 22.9%, as revealed in the telescopic table, by the interaction of manure in the 'WM' factor on the 'W' factor.

13. The 'WMS' factor: 25% or one-fourth of the paddy crop of the State is served by all the three direct productive factors collectively (and has a yield of 1694 lb.) based on 2319 plots.

sampled for all paddy in the State. There is thus scope for augmenting production in 7% of the existing paddy ayacut itself, in the drive toward self-sufficiency.

14. Cumulative effect of the interactions: The productive capacity of the factors under interactions are worked out to indicate their cumulative effect and expressed as mean percentages.

Factors	Interactions	Per cent excess from the telescopic table	Productive extra capacity of the factors expressed as algebraic mean in %
W	WMS—MS	63.3	67.1
	WM —M	93.8	
	WS —S	53.9	
	W —O	57.4	
M	WMS—WS	7.0	33.0
	MS —WM	46.6	
	WM —W	22.9	
	M —O	55.4	
S	WMS—WM	32.1	19.7
	WS —W	52.8	
	MS —M	5.8	
	S —O	0.0	
MS	WMS—W	63.0	54.9
	MS —O	46.4	
WS	WMS—M	65.5	102.3
	WS —O	139.2	
WM	WMS—S	156.2	156.0
	WM —O	155.9	
WMS	WMS—O	155.9	155.9

15. Trends of productive factors indicating the absence of correlations: The trends of production by the several factors in the rice districts of Madras are indicated by the curves drawn for

acre-yields of the factors, in the appended graph. By scanning carefully the multimodal curves, it may be seen that no correlation exists between the factors 'O' and 'S'. There is indication of a positive correlation between 'S' and 'M'. Ryots affording manure also think of improved seeds for further production. Indication also exists of a positive correlation between 'W' 'WS' and in a higher degree between the factors 'WM' and 'WMS'.

16. **Conclusions:** (a) The yield of paddy per acre, for all the crops raised in the State of Madras, during 1948-49, is estimated under the stratified random sample survey at 1326 Lb per acre.

(b) Three percent of the area under paddy, or 3,23,200 acres are raised without any irrigation, manuring or improved seed. This is mostly confined to the zamindari areas and the "podu" cultivation in the Circars and the "kumri" and "modan" on the West Coast.

(c) There is 17%, or 1,831,700 acres of rainfed local paddy receiving manuring, confined mostly to Visakhapatnam, Guntur and the West Coast.

(d) Four percent, or 431,000 acres occur as rain-fed paddy under departmental strains receiving manuring.

(e) The rest of the crop comprising 76% is under irrigation. Of this, only 4% does not get associated with the other productive factors of manure and improved seed. This shows that the ryot is aware that wetland paddy yields can be increased by manuring and growing departmental strains.

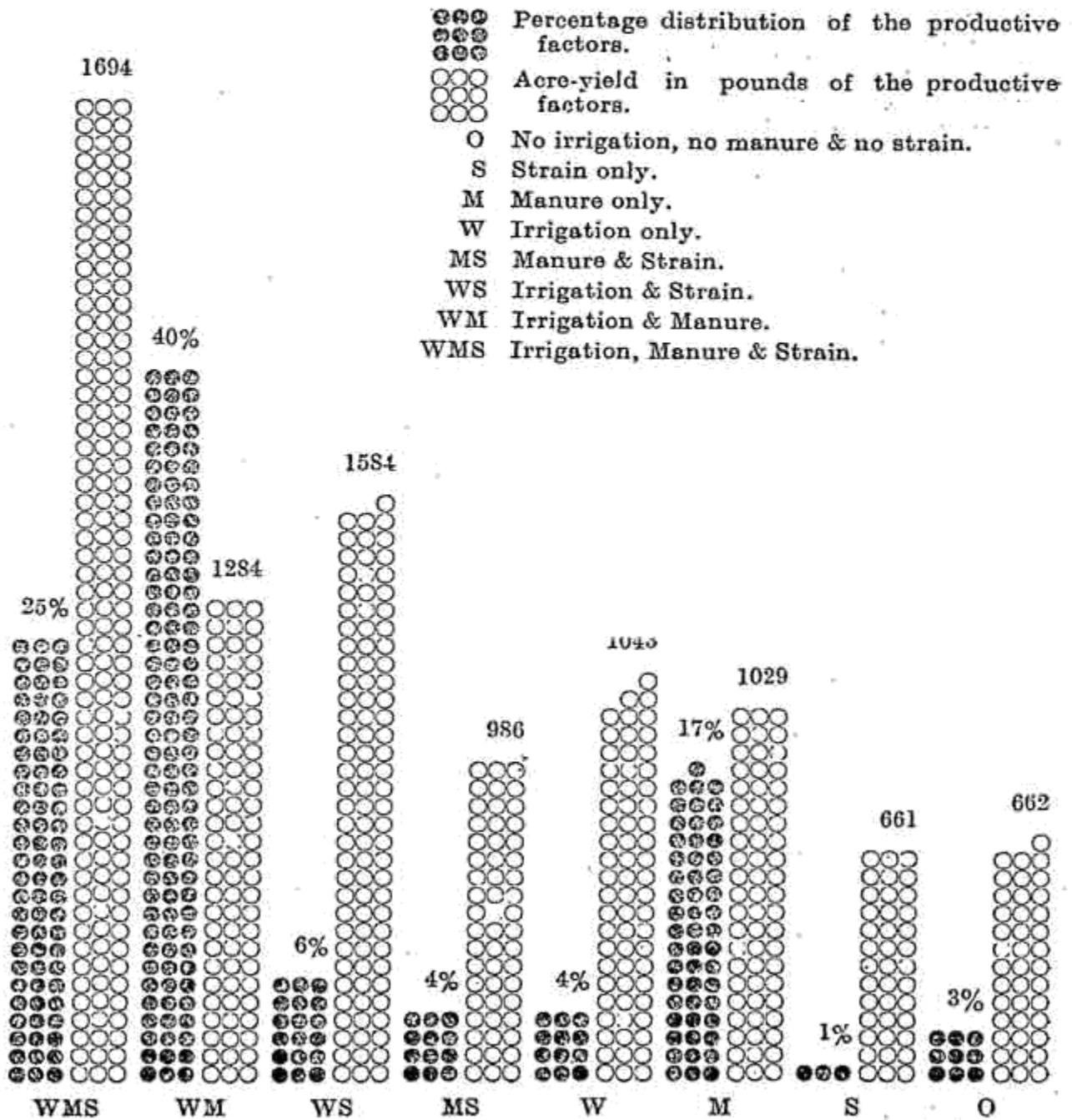
(f) The estimates from the random sample surveys on paddy set the extra productive capacity (i) by irrigation alone at 67%, (ii) by manuring alone at 33%, (iv) by manuring and using quality seed at 55%, (iii) by resort to improved seed only at 20%, (v) by growing departmental strains under irrigated conditions at 102% and (vi) by irrigation combined with manuring or with manuring or with manuring and good quality seed at 156%. Association of the factors in the phases (v) and (vi) increase the yield by 15% and 36% respectively than when built up from their individual attainments under the phases (i) to (iii).

(g) Only two-thirds of the crop is under the last phase (vi). In the intensification drive under "Grow More Food", the other one-third, or 3,591,540 acres have potentialities to raise the crop to the limit of the 156% capacity, given the supply of the deficient productive factors.



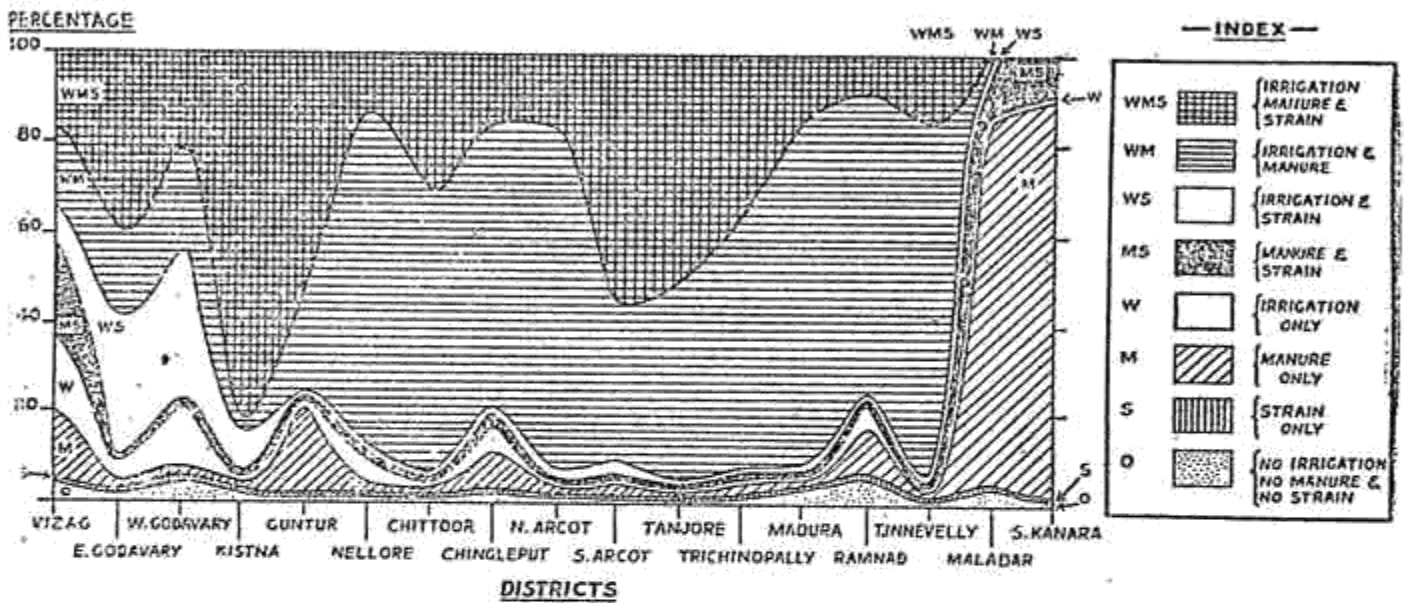
APPENDIX II.

Picto-Gram of Percentage Distribution and Acre-yields of Productive Factors in Paddy, in the Madras State, 1948-49.



APPENDIX III

BELT STRATA CHART FOR 1948-49 SHOWING THE DISTRIBUTION OF THE PRODUCTIVE FACTORS IN THE DISTRICTS IMPORTANT FOR RICE IN THE MADRAS PROVINCE



APPENDIX IV

CURVES OF ACRE YIELDS OF THE SEVERAL FACTORS IN THE DISTRICTS EXHIBITING COVARIANCE AND THE ABSENCE OF CORRELATION.

