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LOCATION OF PLANTS PROCESSING FOODGRAINS IN INDIA— SOME EMPIRICAL EVIDENCE

M. T. R. SARMA*

Senior Economist
National Council of Applied Economic Research
New Delhi

INTRODUCTION

The object of this paper is to find out, on the basis of the available data, answers to the two following questions :

(1) Is a certain geographical dispersion inherent in the location of processing units?

(2) What is the relative importance of various factors in determining the location of processing units?

In this paper, the analysis of the data is restricted to the processing units dealing with the selected foodgrains, namely, rice, wheat and gram. The main reason for choosing to deal, in this paper, with only the rice mills, flour mills and *dal* mills is that, although there are detailed studies on the location of processing units such as sugar mills, jute mills and cotton mills, very little research work has been done to examine the location pattern of the processing units for foodgrains. In the next section, the method of analysis of the data is presented. The available data and their limitations are briefly described in Section III. Some empirical analysis of the data is discussed in Section IV, and a summary is given in Section V.

II

METHOD OF ANALYSIS

For a study on location of plants or units two types of analysis (inductive analysis and deductive analysis) of the data are available. In both types of analysis, economists traditionally emphasize the cost and demand factors to explain the location pattern of units in an industry. The inductive analysis is useful in understanding the nature of the location pattern of the units. In other words, the inductive analysis will show whether a particular location pattern is "market-oriented" or "raw material controlled," nature of the regional dispersion of plants, etc. However, a mere inductive survey of changes in the location pattern among different regions in different years will not throw much useful light on the nature of the factors causing a particular location pattern. For understanding the relative importance of various factors in determining the location of processing units

the deductive approach developed by Thunen, Weber, Predhol and more recently by Isard and others is very useful.[1] In this paper both types of analysis will be presented and an attempt will be made to infer a few important criteria for the location of plants processing foodgrains in India.

For an inductive analysis of the geographical pattern of distribution of plants the pioneering work of Prof. P. Sargant Florence will be useful.[2] This approach involves the calculation of measures such as (1) "Location Quotient" or what is also known as "location factor" and (2) "Coefficient of Localization." The 'Location Quotient' is computed by dividing (a) the percentage share of the region in the total workers employed in the industry by (b) the percentage share of the region in the total working population.[3] This "quotient" gives the degree of concentration of a particular industry in a particular region. As R. Balakrishna points out : "For all practical purposes the regions chosen would be the political divisions of a country since a division into industrial zones is not feasible even though it might be more scientific. The available data regarding the distribution of the total industrial workers and the concentration of workers in a particular industry are all with reference to the existing political divisions of the country. In other words, the underlying idea of such an index is that location should be construed as the degree of dissimilarity between the geographical distribution of the industry and the population of the country. Wherever the industry is evenly distributed over the whole country the location factor for each region would be unity, because the proportion of the total industrial workers of the region would be equal to the proportion of workers in a particular industry. Otherwise, it will be either above or below unity. It is above unity if the region is supposed to have a higher share of the industry than what is legitimately due to it. On the other hand, it is below unity if the region is not supposed to have a sufficient share of the industry.[4]

The second concept, "coefficient of localization" indicates the propensity of each industry for local concentration. The 'coefficient of localization' is calculated by dividing the workers, region by region, as percentages of the total in all regions, and obtaining the sum (divided by 100) of the plus deviations of the regional percentages of workers in the particular industry from the corresponding regional percentages of workers in all industry. This coefficient, by definition, will have a value ranging from 0 to 1. From the calculated value of the coefficient, one might deduce that if the value is low then the industry under study has a high propensity of dispersal and if the value, on the other hand, is relatively high, we can infer that industry is, in a sense, "raw material controlled" rather than "market-controlled," and thus the choice of location is restricted. Industries whose coefficient lies in between the extreme values (generally such industries are cotton textiles, paper and cement) have usually a wide choice of location. In these industries, the relative pull of different location factors such as transport costs

1. For a good review of the literature on the theory of location, see J. S. Schumpeter: The History of Economic Analysis, Oxford University Press, London, 1954 and Louis Lefeber: Allocation in Space-Production, Transport and Industrial Location, North Holland Publishing Company, 1958.
2. P. Sargant Florence : Investment, Location and Size of Plant, Cambridge University Press, 1948, pp. 34-37, 41 and 77.
3. M. M. Mehta : Structure of Indian Industries, Popular Book Depot, 1955, p. 150.
4. R. Balakrishna : Regional Planning in India, Bangalore Publishing Co., 1948, p. 17.

and labour costs plays a relatively major role in the choice of a suitable location of plants.

It may be noted here that these two measures defined by Prof. Sargant Florence will be used in the present paper to reveal the nature of the existing pattern of the location of plants processing foodgrains in India. However, one should bear in mind that these measures are incapable of assigning reasons for a particular form of concentration and much less to throw any useful light on the question of a correct allocation of industries among different regions.[5]

The deductive analysis attempts to discover certain general factors of location. Weber, for instance, attempts to classify on the basis of costs of production in an industry, the influences which distribute industries regionally and those that do not. Thus, Weber arrives, on the basis of costs of production, at three general regional factors of location, namely, price range of deposits of materials, costs of labour and cost of transportation.[6]

III

DATA AND THEIR LIMITATIONS

Secondary data on the location of plants processing foodgrains in India are very meagre. The main source for the data on the processing plants of foodgrains in India for recent years is the Annual Survey of Industries (ASI), published by the Government of India. The latest publication of the Annual Survey of Industries is for the year 1961. The ASI gives the data on rice mills, flour mills and *dal* mills separately. The source of data on processing plants for 1951 to 1958 is the annual publication called 'Census of Manufacturers in India' (CMI). The CMI gives data only for rice mills and wheat flour mills. The data given in 1951 relate to the States existing in that year. Since there has been reorganization of States, the data given for 1961, by States, are not strictly comparable with the data for 1951. Another important limitation of the data published in ASI or CMI is that if the returns from processing plants in a particular State are less than 3, the data are not reported for that State separately but are aggregated for all such States in one group.

IV

SOME EMPIRICAL ANALYSIS

In this section, the analysis of the data is attempted separately for (a) rice mills, (b) wheat flour mills, and (c) *dal* mills.

Rice Mills

Table I gives the location pattern of the plants processing rice in 1961. It may be seen that the largest number of rice mills existed in West Bengal, whereas

5. R. Balakrishna : *Op. cit.*, p. 18.
6. *Ibid.*, pp. 4-5.

the number of such mills existing in Kerala, Punjab, Uttar Pradesh, Assam, Maharashtra and Mysore seemed to be relatively small in relation to the output of rice crop in these States (see the data on output given in Table IX.)

TABLE I—LOCATION PATTERN OF RICE MILLS (1961)

States	No. of mills	Mills from which returns were received (No.)	Average number of working days	No. of persons employed	Value added by manufacture (Rs.)
1. Andhra Pradesh	72	72	203	4,051	1,00,22,773
2. Bihar	16	16	151	709	6,02,626
3. Kerala	4	4	257	229	2,13,688
4. Madhya Pradesh.. ..	68	68	217	3,168	57,19,328
5. Madras	29	29	261	1,386	21,21,229
6. Orissa	50	48	256	2,961	39,38,684
7. Punjab	3	3	235	106	1,09,637
8. Uttar Pradesh	4	4	254	158	61,866
9. West Bengal	166	164	258	12,845	1,30,42,401
10. Assam, Maharashtra, Mysore	4	4	256	185	1,57,939
Total	416	412	235	25,798	3,59,90,171

Source : Annual Survey of Industries, 1961, Central Statistical Organisation, Government of India.

The calculated values of the 'location quotients' and the 'coefficients of localization' for the years 1951, 1956 and 1961 are given in Table II. The 'coefficient of localization' has increased from 0.464 in 1951 to 0.488 in 1956 and to 0.584 in 1961. This trend suggests the location pattern of rice mills is increasingly determined by the availability of the important raw material, namely, rice. The calculated values of the "location quotients" in the year 1961 suggest that Kerala, Punjab, Uttar Pradesh, Bihar and Madras do not have their "legitimate" share of rice mills. This would suggest the desirability of locating more rice mills in these States, nearer to the larger production areas.

In order to examine the relative importance of various locational factors in different States in India with regard to location of rice mills, an examination of the data on the average cost of production per unit of output of rice mills in

TABLE II—LOCATION QUOTIENT AND COEFFICIENT OF LOCALIZATION OF RICE MILLS
FOR THE YEARS 1951, 1956 AND 1961

States	1951*		1956*		1961†	
	Location quotient	Deviations	Location quotient	Deviations	Location quotient	Deviations
Bombay ..	0.01	—33.69	0.01	—33.34	—	—
West Bengal ..	1.17	+ 4.86	1.29	+ 7.63	2.28	+27.92
Madras	3.14	+23.65	1.13	+ 1.17	0.70	— 2.30
Andhra Pradesh	—	—	7.50	+22.81	3.24	+10.86
Uttar Pradesh ..	0.14	— 8.26	0.25	— 7.33	0.07	— 7.64
Bihar	1.34	+ 2.04	1.28	+ 1.67	0.52	— 2.48
Mysore	—	—	0.13	— 2.90	—	—
Madhya Pradesh	3.06	+ 6.43	8.30	+ 7.25	3.63	+ 8.90
Punjab	0.71	— 0.43	0.20	— 1.62	0.16	— 2.07
Orissa	11.68	+ 7.37	6.93	+ 5.34	14.91	+10.71
Assam	6.36	+ 1.77	8.05	+ 2.96	—	—
Cochin	1.68	+ 0.24	—	—	—	—
Kerala	—	—	—	—	0.19	— 3.80
Rest of India ..	0.40	— 3.98	0.06	— 3.64	0.08	— 40.10
Plus deviations =		+ 46.36		+48.83		+58.39
Minus deviations =		—46.36		—48.83		—58.39
Coefficient of localization =		0.464		0.488		0.584

Source :   *Census of Indian Manufactures, Government of India, 1951 and 1956.
†Annual Survey of Industries, 1961, *Op. cit.*

1961, given in Table III, will be useful. The average cost of labour (total wages and salaries) per unit of output is relatively low in Madhya Pradesh and Andhra Pradesh, whereas it is the highest in Kerala. The average cost of fuel, lubricants, power, etc., per unit of output appears to be low in Bihar, Andhra Pradesh, Uttar Pradesh, Madhya Pradesh and West Bengal. Rice mills in Kerala seem to be at a disadvantage in terms of the labour cost and cost of fuel and power compared to the position of rice mills located in other States. Except in the case of Kerala and Punjab, all other States seem to be at no disadvantage with respect to the average cost of materials consumed. Thus, in the location pattern of rice mills in different States labour costs and costs of fuel and power seem to have been the major factors influencing the locational pattern.

TABLE III—REGIONAL VARIATION IN THE AVERAGE UNIT COST OF PRODUCTION IN RICE MILLS IN 1961

(in rupees per metric tonne)

Items	All-India	Andhra Pradesh	Bihar	Kerala	Madhya Pradesh	Madras	Orissa	Punjab	Uttar Pradesh	West Bengal
Total materials consumed ..	507.375	528.140	522.551	753.107	439.833	598.183	429.258	895.155	444.355	530.758
Wages and salaries	14.543	12.163	15.368	76.426	9.589	24.314	17.601	16.708	14.466	15.568
Fuel, electricity, lubricant, etc. ..	4.398	2.922	2.103	42.712	3.369	7.907	7.248	12.173	2.884	4.311
Repairs and maintenance	1.232	1.545	0.391	7.750	0.321	1.911	1.384	1.743	0.896	1.352
Gunny bags	4.890	12.776	3.635	8.029	2.540	5.233	5.919	0.961	1.652	2.201
Depreciation	2.085	0.283	2.480	21.085	1.651	3.129	4.063	6.642	5.558	2.223
Total Cost	534.523	557.829	546.528	909.109	457.303	640.677	465.473	933.382	469.811	556.413

Source :   Annual Survey of Industries, 1961, *Op. cit.*

Wheat Flour Mills

The location pattern of wheat flour mills in 1961 is given in Table IV. The largest number of flour mills in 1961 is located in Punjab, Uttar Pradesh and West Bengal. The number of plants existing in Andhra Pradesh, Assam, Mysore and Orissa totals only four. When we take into account the data on the State-wise production of wheat (given in Table IX), this geographical pattern of location of processing plants in this category (wheat flour mills) is not surprising. The

TABLE IV—LOCATION PATTERN OF FLOUR MILLS (1961)

States	No. of mills in existence	Mills from which returns were received (No.)	Average No. of working days (No.)	No. of persons employed	Value added by manu-facture (Rs.)
1. Bihar	6	6	260	517	11,41,352
2. Gujarat	4	4	332	418	13,97,344
3. Madhya Pradesh ..	5	5	281	311	5,17,067
4. Madras	3	3	305	475	6,38,132
5. Maharashtra	6	6	307	1,461	1,15,32,103
6. Punjab	10	10	291	1,029	17,85,019
7. Uttar Pradesh	10	10	303	1,487	43,32,560
8. West Bengal	10	10	262	1,614	43,87,042
9. Delhi	5	5	258	628	18,38,222
10. Andhra Pradesh, Assam, Mysore, Orissa ..	4	4	270	306	12,98,629
Total	63	63	286	8,246	2,88,67,470

Source : Annual Survey of Industries, 1961, *Op. cit.*

calculated values of 'location quotients' and the 'coefficients of localization' for wheat flour mills in 1951 and 1961 are given in Table V. The low values of 'coefficients of localization' in 1951 and 1961 suggest that the location of wheat flour mills in different States in India seems to have been influenced by the market considerations more than the considerations of the availability of raw material, *viz.*, wheat. In other words, the location of wheat flour mills is "market-oriented." The calculated values of the 'location quotients' in 1961 indicate that Punjab has the highest concentration of wheat flour mills. Delhi has the next highest concentration of wheat flour mills. However, the 'location quotients' in 1961 indicate that the highest concentration of wheat flour mills is in Delhi, followed by Punjab.

Over the decade 1951 to 1961, Uttar Pradesh, Madhya Pradesh and Bihar seem to have gained relatively more in the number of flour mills located in these States.

TABLE V—LOCATION QUOTIENT AND COEFFICIENT OF LOCALIZATION OF WHEAT FLOUR MILLS FOR THE YEARS 1951 AND 1961

States	1951*		1961†	
	Location quotient	Deviations	Location quotient	Deviations
Bombay	0.70	—10.30	—	—
Gujarat	—	—	0.50	— 5.15
West Bengal	1.18	+ 5.38	0.89	— 2.30
Uttar Pradesh	0.41	— 5.71	2.18	+ 9.78
Bihar	0.46	— 3.19	1.20	+ 1.04
Punjab	13.63	—18.94	5.03	+10.00
Delhi	4.38	+ 4.97	5.77	+ 6.30
Madhya Pradesh	—	—	1.12	+ 0.39
Madras	—	—	0.75	— 1.91
Maharashtra	—	—	0.81	— 4.19
Rest of India	0.52	—10.09	1.32	—13.96
Plus deviations =		+29.29		+27.51
Minus deviations =		—29.29		—27.51
Coefficient of localization =		0.293		0.275

Source : * Census of Indian Manufactures, 1951, *Op cit.*
   † Annual Survey of Industries, 1961, *Op. cit.*

The data on the average cost of production by different factors in wheat flour mills for 1961 are given in Table VI.

Dal Mills

The available data on *dal* mills in 1961 are very meagre. The ASI for 1961 gives data for only Madhya Pradesh separately. Out of the 11 *dal* mills existing in 1961, 7 mills are located in Madhya Pradesh and the remaining are located in Gujarat, Madras and Punjab. This location pattern again seems to reflect the pattern of production of gram in different States in India which may be seen from the data given in Table IX. The calculated values of the 'location quotient' and 'coefficient of localization' for *dal* mills in 1961 are given in Table VII. The low value of the 'coefficient of localization' implies that the location of *dal* mills in

TABLE VI—REGIONAL VARIATION IN THE AVERAGE UNIT COST OF PRODUCTION IN FLOUR MILLS IN 1961

(in rupees per metric tonne)

Items	All-India	Bihar	Gujarat	Madhya Pradesh	Madras	Maharashtra	Punjab	Uttar Pradesh	West Bengal	Delhi
Total materials consumed	400.462	418.725	430.725	382.499	402.674	397.184	400.570	413.366	395.923	376.957
Wages and salaries	9.943	8.405	7.470	16.554	10.758	14.184	12.059	5.627	11.988	6.142
Fuel, lubricant, electricity, etc.	5.671	9.017	7.947	14.507	8.564	3.236	7.158	6.306	4.010	5.219
Repairs and maintenance	1.554	0.432	0.998	2.503	2.114	4.314	0.627	0.692	0.999	0.637
Gunny bags	8.951	3.674	8.236	10.181	14.739	7.557	7.638	6.964	14.658	6.289
Depreciation	2.510	1.826	3.059	8.391	6.185	1.849	2.936	1.259	2.430	2.839
Total Cost	426.832	441.835	458.435	434.635	445.034	428.324	430.988	434.214	430.008	398.083

Source : Annual Survey of Industries, 1961, *Op. cit.*

TABLE VII—LOCATION QUOTIENT AND COEFFICIENT OF LOCALIZATION
OF DAL MILLS: 1961

States	Location quotient	Deviations
Madhya Pradesh	8.24	+24.47
Rest of India	6.25	—24.47
	Plus deviations = + 24.47	
	Minus deviations = — 24.47	
	Coefficient of localization = 0.245	

Source : Annual Survey of Industries, 1961, *Op. cit.*

India is generally "market-oriented." The data on the average cost of production by various factors in 1961 for *dal* mills are given in Table VIII. The average cost of production by different items for *dal* mills located in Madhya Pradesh seems to be the lowest, thus giving locational advantage for plants in this State. Owing to the paucity of available data, it is not possible to find out the relative importance of various locational factors in different States with regard to the *dal* mills.

TABLE VIII—REGIONAL VARIATION IN THE AVERAGE UNIT COST OF PRODUCTION
IN DAL MILLS IN 1961

(in rupees per metric tonne)

Item	All-India	Madhya Pradesh	Gujarat, Madras and Punjab
Total material consumed	678.215	453.481	802.448
Wages and salaries	23.096	16.737	26.612
Fuel, electricity, lubricant, etc.	11.876	11.165	12.268
Repairs and maintenance	4.760	2.560	5.977
Gunny bags	7.193	0.767	10.745
Depreciation	3.417	0.416	5.076
Total Cost	728.557	485.126	863.126

Source: Annual Survey of Industries, 1961, *Op. cit.*

TABLE IX—OUTPUT OF RICE, WHEAT AND GRAM IN 1960-61 BY STATES

('000 tons)

States					Rice	Wheat	Gram
Andhra Pradesh	..	..	..	..	3498 (10.52)	5 (0.05)	31 (0.50)
Assam	..	..	..	..	1640 (4.93)	3 (0.03)	1 (0.02)
Bihar	..	..	..	..	4472 (13.44)	436 (4.11)	319 (5.14)
Gujarat	..	..	..	..	262 (0.79)	291 (2.74)	36 (0.58)
Jammu & Kashmir	..	..	..	..	234 (0.70)	14 (0.14)	1 (0.02)
Kerala	..	..	..	..	1063 (3.20)	—	—
Madhya Pradesh	..	..	..	..	3402 (10.23)	1921 (18.10)	847 (13.65)
Madras	..	..	..	..	3550 (10.67)	1 (0.01)	1 (0.02)
Maharashtra	..	..	..	..	1279 (3.85)	367 (3.45)	139 (2.24)
Mysore	..	..	..	..	1237 (3.72)	72 (0.68)	58 (0.93)
Orissa	..	..	..	..	3670 (11.03)	4 (0.04)	6 (0.10)
Punjab	..	..	..	..	424 (1.27)	2596 (24.46)	1973 (31.80)
Rajasthan	..	..	..	..	64 (0.19)	996 (9.38)	905 (14.58)
Uttar Pradesh	..	..	..	..	3101 (9.32)	3882 (36.58)	1802 (29.04)
West Bengal	..	..	..	..	5386 (16.14)	25 (0.23)	86 (1.38)
Total					33264 (100.00)	10613 (100.00)	6205 (100.00)

Source: Estimates of Area and Production of Principal Crops in India.

SUMMARY

Based on the available secondary data on the plants processing foodgrains in India, both inductive and deductive methods of analysis are attempted to find out the nature of the geographical pattern of location of processing plants and the relative importance of various location factors. In the case of units processing rice, it appears that Kerala, Punjab, Uttar Pradesh, Bihar and Madras have not had their "legitimate" share of rice mills, compared to other States, in 1961. The number of rice mills existing in Kerala, Punjab and Uttar Pradesh seems to be rela-

tively small in relation to the output of rice crop in these States. Among the various factors influencing the location of rice mills, three factors generally stand out to be relatively more important : (1) availability of rice to be processed, (2) cost of labour, and (3) cost of fuel and power.

In the case of units processing wheat (flour mills), the largest number of mills in existence in 1961 is located in Punjab, Uttar Pradesh and West Bengal. The general location pattern of flour mills in India appear to be in conformity with the pattern of production of wheat in different States in India. The location of wheat flour mills in different States seems to be influenced by the market considerations more than the considerations of the availability of raw material to be processed, *viz.*, wheat.

With regard to the location pattern of units processing gram (*dal* mills), the available data in 1961 indicate that Madhya Pradesh had the highest concentration of these units. The location pattern of *dal* mills again seems to reflect the pattern of production of gram in different States.

Thus, in conclusion, there seems to be a particular geographical dispersion inherent in the location of processing units which is related to the geographical pattern of production of crops for which these processing units are required. With regard to the relative importance of various factors in determining the location of these processing units of foodgrains, generally three factors, *viz.*, availability of raw materials, the cost of labour and the cost of fuel and power, seem to be important.

Finally, a suggestion for further research work to be done, if adequate unitwise data are available, is that it would be useful to test the locational hypothesis formulated by Prof. T. W. Schultz. This hypothesis may be stated in three parts:

"(1) Economic development occurs in a specific locational matrix; there may be one or more such matrices in a particular economy. This means that the process of economic development does not necessarily occur in the same way, at the same time, or at the same rate in different locations.

(2) These locational matrices are primarily industrial—urban in composition; as centres in which economic development occurs, they are not mainly out in rural or farming areas although some farming areas are situated more favourably than are others in relation to such centres.

(3) The existing economic organization works best at or near the centre of a particular matrix of economic development and it also works best in those parts of agriculture which are situated favourably in relation to such a centre; and it works less satisfactorily in those parts of agriculture which are situated at the periphery of such a matrix."[7]

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7. T. W. Schultz : The Economic Organisation of Agriculture, McGraw Hill Book Co., Inc., 1953, p. 147.