LEVELS OF INPUT-OUTPUT RELATIONSHIP IN THE AGRICULTURE OF UTTAR RRADESH

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Introduction :

The agricultural fabric of Uttar Pradesh is perhaps the best expression of the infra-structural elements of its environmental frame. The region is agriculturally advanced, endowed with favourable conditions for crop cultivation and therefore, it carries 75.9 p. c. (22360 thousand hactares) land under cultivation out of which 28.4 p. c. area had crops sown more than once during 1868-69. These figures are considerably higher than the national percentages 48.7 and 16 0 respectively. The crop intensity has further increased by the extension of irrigation and technological innovations. The canals and tubewells dominate the irrigation landscape accounting for 2/3rd (65 p. c.) of the net irrigated area of Uttar Pradesh. As much as 75.3 p. c. of the total working force is actively engaged in agricultural activities. It has already been discussed by author that the cropping patterns, crop associations and their importance, crop concentration and diversification are well-balanced in Uttar Pradesh.[1] Despite all these facts the per hactare/acre agricultural production, specially of food grains, and its average rate of increase has been low (65.3 p. c.) as compared to that of India (112.1 p. c.) during the last 20 years (1950-51 to 1970-71). This is largely because of the improper and inadequate technology and institution leading to such an anomalous situation.

On the other hand, optimization of agricultural land-use is highly related with the agricultural production techniques, *viz.*, irrigation, modern technology, markets, transport and the natural factors particularly fertility of soils and rainfall. The production growth is also influenced by such production techniques For example, Bhatia concluded and statistically proved that the changes in technological factors in which extension of irrigation particularly in Uttar Pradesh, seems to be the most important factor in accounting for growth in crop productivity.[2] Therefore, it is obvious that the planning oriented study of agricultural productivity must be related with infra-structural elements and production techniques.

Viewing all the problems and agricultural imbalances in Uttar Pradesh, the study considers the emerging relations in agricultural production with input factors and therefore, attention is focussed first, to on aggregate agricultural production and its input elements for forming their composite indices; secondly to find out the

degree of relationship among them with their spatial patterns; and lastly, to examine the nature of agricultural development identifying its various levels. The forty eight out of fifty four districts have been considered as areal units for the purpose. The study is based on average of three years i. e. from 1969-70 to 1971-72.

Aggregation Of Agricultural Production And Input Factors :

The problem of aggregation or the formulation of composite index of agricultural production have earlier been discussed by considering the importance of crops at the local, provincial and national levels in relation with yields; crop-equivalents by determing the coefficients of crop rates income and their caloric-significance; and cropping intensity, that all have been composed by applying the multiplication formulation.[3,4] The elements of agricultural production are highly influenced by the physical, techno economic and sociocultural factors within the framework of geographical setup.

Moreover, the composite index of agricultural production as well as input factors, is modified with the help of 'Geometric Mean Method' in the present study which leads to the following procedure. "First of all, the elements of raw data of agricultural input and output (a_{ij}) are converted into their coefficients (X_{ij}) by dividing the element values (a_{ij}) to its regional average ($\bar{a}_{ij}$) for each areal unit (n) and then the geometric means of all coefficients ($\bar{X}_{ij}$) of each and every areal unit are calculated. Such geometric means indicate the composite ratio of each element of that particular areal unit, *i. e.*, denoted as Composite Index (Ici)."

The procedure can statistically be expressed as—

$$X_{ij} = \left(a_{ij} / \left(\sum_{i=1}^{n} a_{ij} / n \right) \right) \quad \ldots\ldots (I)$$

then

$$Ici = \left(\prod_{j=1}^{m} X_{ij} \right)^{1/m} \quad \ldots\ldots (II)$$

or

$$Ici = \left(X_{i1} \cdot X_{i2} \cdot X_{i3} \ldots X_{ij} \right)^{1/m}$$

for $i = 1, 2, 3, \ldots, n$

$j = 1, 2, 3, \ldots, m$

(Where n & m denote the no. of areal units and no. of elements respectively)

Applying the above procedure, the composite index of agricultural production incorporating all crops sown above 10 p. c. area and two indices of input factors (natural as well as human) accounting for ten elements have been determined for recognition of various patterns of agricultural development in Uttar Pradesh (Appendix 1). The names and regional averages of input elements are given in the following table.

Table- I Regional averages of inputs in Uttar Pradesh (1969-70 to 1971-72)

S. No.	Name of the Inputs	Unit of values	Average
[A]	**Natural Inputs**		
1)	Inputs of soil fertility	Rating Index (1965-66)•	62.60
2)	Inputs of climate (Rainfall)	Mean Annual Rainfall (in mm., 1901-50)	979.00
[B]	**Human Inputs**		
3)	Extention of irrigation	p. c. of G. I. A. to G. C. A.	35.51
4)	Inputs of Chemical fertilizer	NPK Kg /ha. of N. A. S.	18.10
5)	Inputs of mechanical aids -	No. of tractors (per 100 ha. of N. A. S)	.18
6)	Inputs of electricity	Electric consumption in ag. (KW/hours, per ha. of N. A. S.)	349.69
7)	Inputs of improved seeds	p. c. area under HYVs to G. C. A.	35.21
8)	Inputs of animal power	No. of working cattles in ag. (per 100 ha. of N. A. S.)	86.67
9)	Inputs of manual power	Ag. workers per 100 ha. of N.A S.	118.88
10)	Transportation index	Roads in Kms., per 100 ha. of N A.S.	17.00

N. B.: 1) G. I. A. = Gross Irrigated Area; G. C. A. = Gross Cultivated Area; N. A. S = Net Area sown; H Y Vs = High Yield Varieties.

2) Rating Index of soils is prepared on the basis of certain natural factors, *viz*., character of soil fertility, topography, texture & structure, degree of climatic suitability, salinity, stoniness & tendency to erode.

Sources: (1) The values of index rating of soils have been taken from; Shome, K. B. & S P. Raychaudhri : 'Rating of soils of India', *Proceedinngs of the National Institute of Sciences of India*, Vol 26 A (Supplement 1) 1960. (2) The rainfall data are obtained from Dy Director General of Observatories (Climatology & Geophysics), Pune. (3) The data of human inputs are compiled from; State Planning Institute Eco. & Statistics Division, U. P., Lucknow.

Relations Among Agricultural Input And Productivity Indices :

The comprehensive relationship among the indices of agricultural inputs, natural (X) as well as human (Y), and

productivity, (Z) is determined to dist - inguish the homogeneous divisions of each index. A preliminary analysis has revealed that the natural input index has the lower variability as compared to human input in Uttar Pradesh and, therefore, the division of natural input index (X) forms a few categories (six only) with the agricultural productivity index (Z) in the bivariate frequency distribution (Table – II), while human input index (Y) has the significant spatial variations and is, therefore, distinguished into twelve categories by considering the same class-intervals (Table – III).

The areal percentages and the number of districts that fall into each and every cell of bivariate frequency tables have been calculated and then broadly grouped into three classes, *viz.*,high medium and low.

Table– II Bi-Variate frequency distribution of agricultural production (Z) and natural input index (X) in Uttar Pradesh.

X/Z	AGRICULTURAL PRODUCTION							
	.60- .69	.70 .79	.80-.89	.90-.99	1.00-1.09	1.10-1.19	1.20-1.29	Total
.700-.799					1.4583 (1)	1.7234 (1)	1.9190 (1)	5.10078 (3)
.800-.899	4.6440 (2)			1.8961 (1)		6.4165 (3)	1.9656 (1)	14.92413 (7)
.900-.999	3.1078 (1)	4.5722 (2)	7.1991 (3)	3.0113 (2)	6.1268 (3)	10.7096 (6)		34.72532 (17)
1.000-1.099		2.7072 (1)	4.9722 (1)	8.3327 (5)	13.4204 (7)	3.9316 (2)		33.36422 (16)
1.100-1.199			2.4351 (1)	5.9848 (2)				8.41988 (3)
1.200 ≤						3.4662 (2)		3 46617 (2)
Total	7 75278 [3]	7.27937 [3]	14.60639 [5]	19.22495 [10]	21.00554 [11]	26.24736 [14]	3.88461 [2]	100.00 [48]

N. B. 1) The figures indicate the area in p. c.

2) The figures in brackets show the number of districts.

Table- II Bi-Variate frequency distribution of agricultural production (Z) and natural input index (X) in Uttar Pradesh.

X/Z	AGRICULTURAL PRODUCTION							
	.60- 69	.70-.79	.80- 89	.90-.99	1.00-1.09	1.10-1.19	1.20-1.29	Total
> .49	5.9511 (2)	2.7072 (1)	2.4351 (1)					11.09344 (4)
.50- .59	1.8016 (1)	1.6709 (1)	3.9720 (1)		1.8326 (1)	2.3597 (1)		11.63688 (5)
.60- .69				3 0420 (2)				3.04200 (2)
.70- .79			3.7270 (2)	3.1264 (1)	4.2942 (2)			10 64764 (5)
.80- .89				3 0644 (2)	2.9186 (1)	4.1710 (2)		10.15400 (5)
.90- .99				4.2798 (2)	3.7200 (2)	5 5523 (3)		13.55211 (7)
1.00-1.09		2.9013 (1)			1.4483 (1)	3 4098 (2)		7.76937 (4)
1.10-1.19				4.0031 (2)	1.5912 (1)	2 3286 (1)	1.9656 (1)	9.88886 (5)
1.20-1.29				1.7092 (1)		.9269 (1)		2.63611 (2)
1.30-1.39			4 9722 (1)		4.1909 (2)		1.9190 (1)	11.08211 (4)
1.40-1.49					.9993 (1)			.99929 (1)
1.50 >						7.0992 (4)		7.49919 (4)
Total	7.75278 [3]	7.27937 [3]	14.60639 [5]	19.22495 [10]	21.00554 [11]	26.24736 [14]	3.88461 [2]	100.00 [48]

N. B. 1) The figures indicate the area in p. c.

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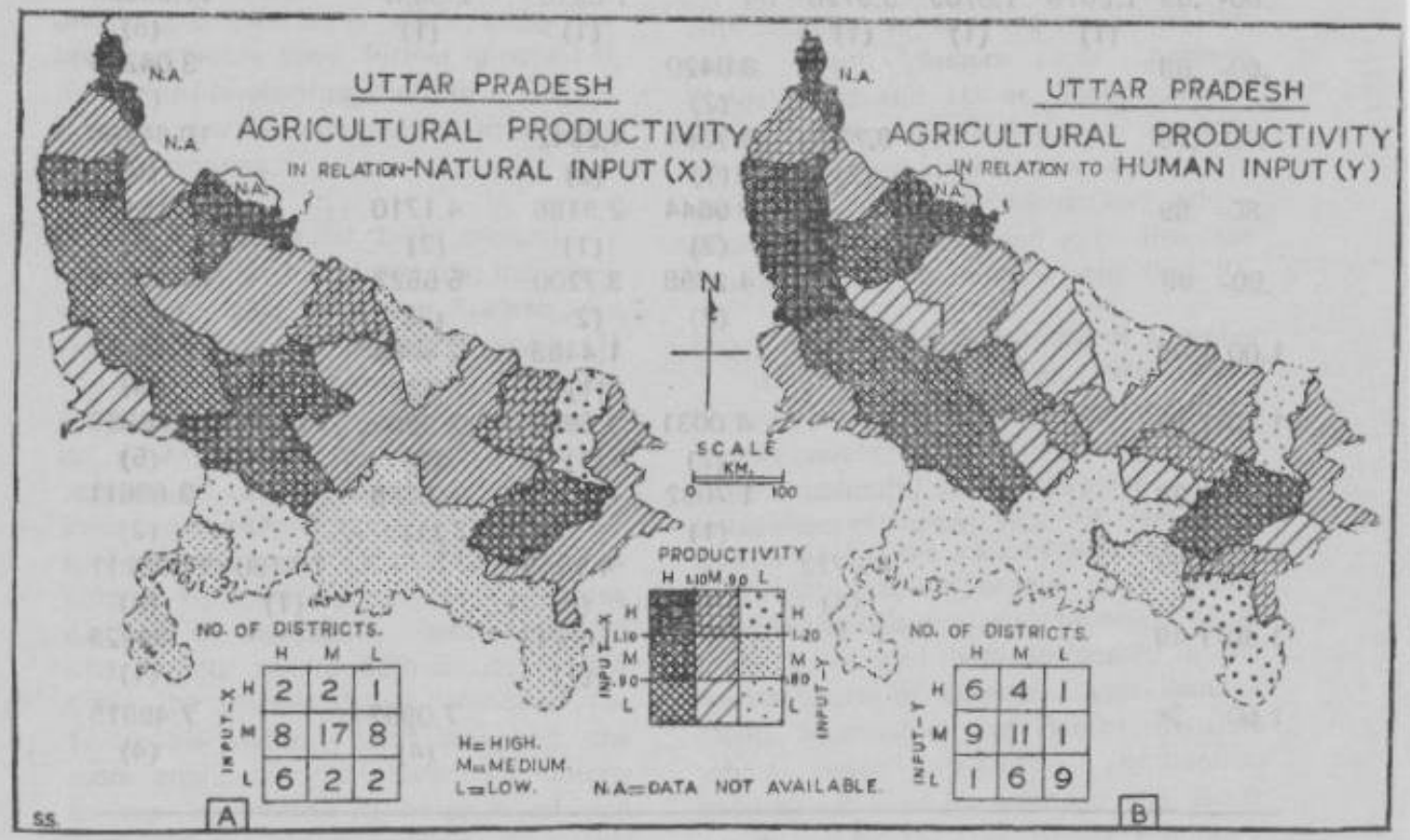
of each distribution. The classes of agricultural productivity form over-all nine combinations [3x3] with the classes of each input index [Fig. 1].

The salient features of the frequency distribution tables and maps are shown as follows :

1] The natural input varies from .754 to 1.681 in which the medium classes of distribution [.900-1.100] include the larger parts [68.1 p. c] of Uttar Pradesh. Such areas are generally dispersed in the entire northern terai including the larger parts of Ganga-Ghaghra Doab [Fig. 1-A].



2] The general trend of distribution in natural inputs is uniformly distributed through out Uttar Pradesh while the tendency of human inputs distribution has the positive relationship with the distribution of agricultural production.

3] The degree of applicabilities of human inputs carries the significant changes in agricultural production.

4] The medium range [.800-1.200] of the applicability of human inputs accounts for the high agricultural

productivity [above 1.10] in the areas of Upper and Middle Ganga-Yamuna Doab including the two districts of Lower Ganga-Saryu Doab [Fig. 1-B].

Levels of Agricultural Development

Now, it is quite clear from the above discussion that the degree of agricultural development may be determined to classifying levels of balances inherent in the nature of relationship between agricultural input and production. Following the ideal agricultural development of Uttar Pradesh, all 48 areal units have broadly been grouped into three categories with the six sub-categories. The categorization and their importance are shown as follows (Table- IV).

Table—IV : Area and Number of districts in the various categories of agricultural development in Uttar Pradesh.

S. No.	Name of the categories	Area [in p. c.]	No. of districts
I	Regulated Agricultural Development :		
	a] Areas of high productivity with high or medium inputs	20.29823	11
	b] Areas of medium productivity with medium or low inputs	30.08508	17
	c] Areas of low productivity with medium or low inputs	22.35701	9
II	Unregulated Agricultural Development :		
	a] Areas of high productivity with medium or low inputs	10.15325	5
	b] Areas of low productivity with high or medium inputs	4 97224	1
III	Randomly - Regulated Agricultural Development :		
	a) Areas have no relations between productivity & inputs	12 13420	5

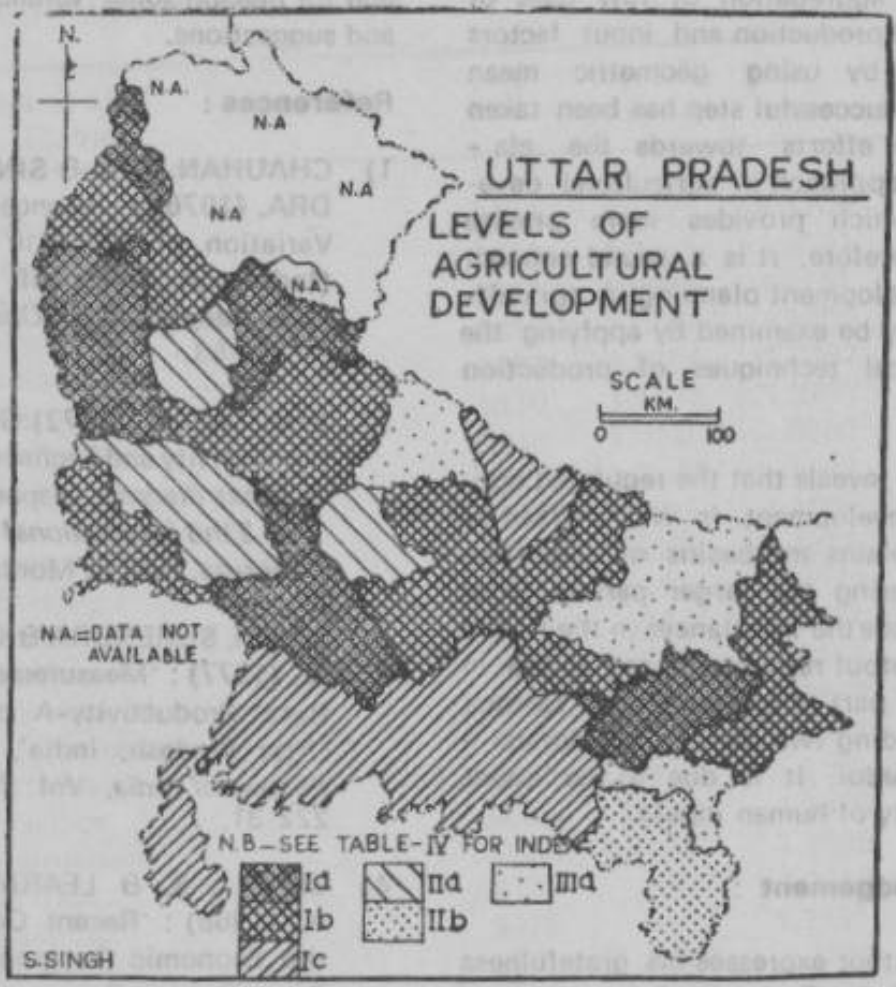
(I) **Regulated Agricultural Development** : The positive relations between agricultural production and input factors indicate the regulated agricultural development. It is obvious that such areas account for 3/4th (72.7 p. c.) part which extensively cover the plains of main rivers, running from North-West to South -East including Bundelkhand (Jhansi division). But the areas falling under this broad category have further grouped at the various levels of relationships. Therefore, it may be sub-divided into three sub - categories.

(a) The areas of high productivity with high or medium input that incorporate 1/5th part of Uttar Pradesh, are generally lying in three parts, *namely*, (1) the larger part of Middle Ganga- Yamuna Doab, It has the great significance owing, no doubt, to the fertile soils, stronger application of technological inputs and intensive use of irrigation in the agriculture with the higher urbanization (2) The Kumaun-Garhwal terai areas of three districts of Dehradun, Nainital (plain) and Rampur where both inputs indices score the highest values because of the favourable natural conditions and the more applicability of human technology in the larger size of holdings of rich business - community farmers who do not care and consider the profit maximization from the farm, and (3) the lower lands of Ganga —Saryu Doab which includes only two districts of eastern Uttar Pradesh where soils are fertile with sufficient rainfall. But the occupational structure of agriculture, specially cultivator - agricultural labourer ratio, is very poor.

(b) The areas of medium productivity with medium or low inputs are dispersed in the central linear belt including larger parts of Rohilkhand, Lucknow plains and Ganga - Gandak Doad of extremely eastern part of Uttar Pradesh.

(c) The areas of low productivity with medium or low inputs - cover the entire South - Western parts, namely, Bundelkhand and Lower Ganga-Yamuna Doab, including Bahraich district of central terai. In such areas of low productivity the technological input factors and irrigation facilities are poor with the less fertile soils of rugged topograpy (Fig 2).

(II) **Unregulated Agricultural Development** : The negative relationship between agricultural production and input factors denotes the imbalances and unregulated agricultural development. Such imbalances claim two types of areal distributions : (a) the areas of high productivity with medium or low inputs which include the five districts of western Uttar Pradesh Three of them are located in the central part of Middle Ganga-Yamuna Doab, Moradabad and Hardoi districts where better agricultural production is being achieved by applying the lesser inputs and (b) the areas of low product - ivity with high or medium inputs includes only one district of Uttar Pradesh, *viz.*, Mirzapur where the application of inputs seems greater due to higher range of rainfall and higher consumption of electricity, in the othes, rural activities (mining) than agriculture is significant.



(III) **Randomly-Regulated Agricultural Development :** This category is not maintaining any relationship between the agricultural production and inputs It carries only 12.1 p. c. area of Uttar Pradesh and includes five districts of North-Eastern terai and the lower parts of Ganga low lands where two problems disturb the whole relations in agriculture. These are (1) the problem of water logging due to heavy rains and larger floods and (2) the probiems of scientific and technological awakning in the farming systems. Therefore, the caste-based farming and the greater socio-economic differences within the agricultural population or between the cultivator and agricultural labour prevail the randomly-regulated relations in agricultural structure.

Conclusion : The study of nature of relations between agricultural production and various inputs is useful for understanding the levels of agricultural develop-

ment. The aggregation of raw data of agricultural production and input factors is derived by using geometric mean method. A successful step has been taken to justify efforts towards the classificatory approach in agricultural development which provides more precise results. Therefore, it is a sound concept for the development planning in agriculture and may be examined by applying the mathematical techniques of production function.

The study reveals that the regulated agricultural development is well-marked in the entire plains and basins of important rivers covering the larger part of Uttar Pradesh while the imbalances in the nature of input-output relationship are found in the smaller part of Middle Ganga-Yamuna Doab including two districts of Morada - bad and Hardoi. It is due to the lower applicability of human inputs.

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Appendix-I : Agricultural inputs, Natural (X) as well as Human (Y), and production (Z) indices in Uttar Pradesh.

Sl. No.	Name of Districts	X	Y	Z
1.	Dehradun	1.6805	2.1671	1.1208
2.	Saharanpur	1.0610	1.3245	1.0591
3.	Muzaffarnagar	.9213	1.8665	1.1961
4.	Meerut	.8912	2.0151	1.1790
5.	Bulandshahr	.7883	1.3184	1.2792
6.	Aligarh	.8110	1.1337	1.2487
7.	Mathura	.7910	1.0246	1.0880
8.	Agra	.8277	1.1 93	.9612
9.	Mainpuri	.7537	1.0011	1.1050
10.	Etah	.8553	.9339	1.1381
11.	Bareilly	1.0802	1.1914	1.0576
12.	Bijnore	1.0278	.9872	1.0051
13.	Badaun	.9586	.7987	1.0561
14.	Moradabad	.9920	1.1263	1.1869
15.	Thanjahanpur	1 0092	.8512	.9651
16.	Pilibhit	1.0383	.9989	.9501
17.	Rampur	.9888	1.2698	1.1650
18.	Farrukhabad	1.0338	1.0677	1.1595
19.	Etawah	.9134	.8407	1.1213
30	Kanpur	.9475	.8968	1.1195
21.	Fatehpur	.9762	.5506	.7524
22.	Allahabad	.9840	1.1087	.7895
23.	Jhansi	.9290	.5145	.8330
24.	Jalaun	.8768	.5596	.6455
25.	Hamirpur	.8356	.3296	.6882
26.	Banda	.9164	.3973	.6811
27.	Varanasi	1.0216	1.3748	1.0456
28.	Mirzapur	1.0324	1.3115	.8913
29.	Jaunpur	.9960	.9887	1.1495
30.	Ghazipur	.9897	.6188	.9892
31.	Ballia	1.0053	.8336	.9855
32.	Gorakhpur	1.1931	.2836	.8434
33.	Deoria	1.0665	1.1688	.9960

Appendix-I : Agricultural inputs, Natural (X) as well as Human (Y), and production (Z) indices in Uttar Pradesh.

Sl. No.	Name of Districts	X	Y	Z
34.	Basti	1.1543	.9274	.9701
35.	Azamgarh	1.0321	.9895	1.1147
36.	Lucknow	1.0001	1.4190	1.0452
37.	Unnao	.9395	.5788	1.0357
38.	Rae Bareilly	.9621	.7398	.8763
39.	Sitapur	.9567	.7286	1.0157
40.	Hardoi	.9332	.5939	1.1526
41.	Kheri	1.1551	.7405	.9953
42.	Faizabad	.9733	1.2317	.9648
43.	Gonda	1.0963	.8030	1.0597
44.	Bahraich	1.0902	.4872	.7958
45.	Sultanpur	1.0267	.6652	.9820
46.	Pratapgarh	.9801	.7799	.8462
47	Barabanki	1.0549	.9031	1.0151
48.	Nainital	1.4525	2.3757	1.1766