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REGIONAL DISPARITIES IN THE AGRICULTURAL DEVELOPMENT OF BANGLADESH

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ABSTRACT

Knowledge about the regional disparities in the development of different sectors is an issue of considerable importance for administrators, planners and policy makers of any country. In this study an attempt has been made to evaluate the regional disparities in the development of the agricultural sector of Bangladesh through computing composite indices and relevant statistics for different districts based on secondary data. It is observed that out of 21 former districts of Bangladesh, the district of Chittagong ranked the first and the district Bandarban ranked the last in agricultural development during 1980-81 while Sylhet ranked first and Bandarban continued to occupy the last position during 1990-91. It is also observed that the level of development in 10 districts, out of 21 districts moved down during 1980-91. Significant change in development has also been observed over the two time periods.

1. INTRODUCTION

Bangladesh is primarily an agricultural country. Agriculture is the most important sector of the nation's economy. It accounts for nearly 35% of the Gross Domestic Product and provides employment to about 68.5% (BBS, 1994) of the labor force. About 80% of the population receive their subsistence directly or indirectly from agriculture.

Poverty and underdevelopment in Bangladesh are closely related to a very low level of productivity in agriculture. Agriculture is more or less traditional with primitive and little farm tools and implements. Per acre yield of agricultural product in Bangladesh is significantly lowers than most of the neighboring countries, which have similar geographical and human circumstances. Rice, Wheat, Jute, Sugarcane, Tobacco, Oilseeds, Pulses and Potatoes are the principal crops. Various kinds of vegetables and spices are produced. Among the fruits and nuts grown in Bangladesh Bananas, Pineapple, Mangoes, Jackfruits, Plums and Coconuts are important. Bangladesh is marginally deficient in food grains. All out efforts are being made by the government and the people to increase the production of food gains and diversity of agricultural output.

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Agriculture is recognized as a major source of employment generation, food supply export earnings and supplier of industrial raw materials of the country. Bangladesh agriculture is characterized by traditional technology, uneconomic input combination, lack of food marketing network for farm produce, absence of modern processing facilities,' non optional use of farm labor, lack of institutional credit resulting in low return to farm resources and low farm productivity.

The phenomenon of agricultural development has been approximately conceptualized as a process, which improves the quality of life. It would be of interest to measure the level of agricultural development in agricultural sector at district level. Knowledge of the relative level of development in agricultural sector of a district will help to identify appropriate strategies of development. Various works have been done on different aspects of development in Bangladesh related to agricultural sector. Boyce, J.K. (1986) examines the role of water control in Bangladeshis agricultural development from 1949 to 1981. Hossain, M (1986) examines the role of irrigation in agricultural development in Bangladesh by quantifying the relationship of fertilizer consumption and adoption of HYV's with irrigation and estimating the effect of irrigation on the intensity of land use and the growth of crop output and productivity than that of shown by Boycec and further confirm his conclusion that irrigation posses the key technological constraint to agricultural development in Bangladesh. In none of the aforementioned works overall development for the agricultural sector have been considered. Moreover regional disparities of development have not also been considered. Development being a multidimensional phenomenon, can hardly be captured by considering one, two or a group of few development indicators. Usable measure of development, can presumably be developed by combining all available factual features of development along with some normative judgements. The combined or composite indicator should have to be measurement scale invariant and should preferably lie between 0 and 1 so that it can be used effectively to compare the levels of development of different regions. The composite indicator developed by Narain, P. et al. (1992) used in this article possesses all the desirable features

In the present study, an attempt has been made to estimate the level of development in agricultural sector by considering the composite index of development at district level of Bangladesh. The relationships between levels of development in agricultural sectors have also been studied. On the basis of distance matrix, which depicts to what extent possible pairs of regions are close to or apart from each other, potential targets for the regions having failed to achieve desirable level of development, has been fixed which in turn help identify policies for least developed and developing regions. The evaluation of the change in development indices in this sector over two periods has further been made.

II. DATA AND VARIABLES

For this study, the former twenty-one major districts in Bangladesh have been considered as the unit of analysis. The study utilizes data over two period of time (in 1980-1981 and 1990-1991) on 21 agricultural development indicators. The data are mainly collected from the Bangladesh Bureau of Statistics (BBS, 1981 & 1991). The development indicators taken from agricultural sector are as follows:

1. Percentage of forest area to total geographic area (PFA).
2. Percentage of net area shown to total geographic area (PNAS).
3. Percentage of total cropped area to total geographic area (PCA).
4. Productivity of Paddy [PADA] (m.ton/ac.).
5. Productivity of Wheat [PDWH] (m.ton/ac.).
6. Productivity of Tobacco [PDTO] (m.ton/ac.).
7. Number of veterinary hospital (NVH).
8. Productivity of Potato [PDPO] (m.ton/ac.).
9. Productivity of Oilseeds [POMO] (m.ton/ac.).
10. Consumption of fertilizer per acre [CONFR] (m.ton).
11. Percentage of area under high yielding varieties of paddy [PAUHYPA] (m.ton/ac.).
12. Productivity of Banana [PDBA] (m.ton/ac.).
13. Productivity of Vegetables [PDVGL] (m.ton/ac.).
14. Productivity of Sugarcane without mills area [PDSUG] (m.ton/ac.).
15. Yield rate of Mosur [YRMOS] (m.ton/ac.).
16. Yield rate of Khasari [YRKHARI] (m.ton/ac.).
17. Yield rate of Maskoli [YRMAS] (m.ton/ac.).
18. Productivity of Mango [PDMAN] (m.ton/ac.).
19. Productivity of Jackfruit [PDJACK] (m.ton/ac.).
20. Cropping intensity (CRO INTY).
21. Average area per holding (AAPH).

III. METHODOLOGY

3.1 : Composite Index of Development : Let a set of n points represents districts 1,2,.........,n for a group of k indicators 1,2,........,k. This can be represented by matrix $[X_{ij}]$; i=1,2,...,n and j=1,2,...,k. As the development indicators included in the analysis are in different units of measurement and since our object is to arrive at a single composite index relating to the dimension in question. There is a need for standardization of the indicators.

Therefore $Z_{ij} = \frac{X_{ij} - \overline{X}_j}{S_j}$, where $S_j^2 = \sum_{i=1}^{n} \frac{(X_{ij} - \overline{X}_j)^2}{n}$ and $\overline{X}_j = \sum_{i=1}^{n} \frac{X_{ij}}{n}$; i=1,2,...n , j=1,2,....,n.

$[Z_{ij}]$ denotes the matrix of standardized indicators. The best district for each indicator (with maximum/minimum standardized value depending upon the direction of the indicator) is identified and from this, the deviations of the value for each district are taken for all indicators in the following manner:

$$C_i = \left\{ \sum_{j=1}^{k} (Z_{ij} - Z_{0j})^2 \right\}^{\frac{1}{2}}$$

Where Z_{0j} is the standardized value of the j-th indicator of the best district and C_i denotes the pattern of development of i-th district. C_i is useful to identify the model districts and to fix up potential target of each indicator for a given district. The composite index of development is $D_i = \frac{C_i}{C}$, where $C = \overline{C} + 2S, \overline{C} = \sum_{i=1}^{n} \frac{C_i}{n}$ and

$$S = \left\{ \sum_{i=1}^{n} \frac{(C_i - \overline{C})^2}{n} \right\}$$

The value of composite index is non-negative and lies between 0 and 1. The value of index closer to zero indicates the higher level of development while the value of index closer to 1 indicates the lower level of development.

A more meaningful characterization of the different stages of development would be in terms of fractile classification from an assumed distribution of the mean of composite indices. It appears appropriate to assume that the mean has a Beta distribution in the range (0,1). It is generally skewed and perhaps relevant to characterized positive value random variables. Let $(0,Z_1)$, (Z_1, Z_2), $(Z_2, 1)$ be linear interval such that each interval has the same probability weight of 0.33. So we get $f(x) = \frac{1}{B(\alpha,\beta)}\int_0^{Z_1} x^{\alpha-1}(1-x)^{\beta-1}dx = 0.33$. The computational procedure of Z_1 and Z_2 are shown in the appendix.

3.2 : The Development Distance: Using $\lfloor Z_{ij} \rfloor$, the development distance between different districts can be obtained as follows:

$$D_{ip} = \left\{\sum_{j=1}^{k}(Z_{ij} - Z_{pj})^2\right\}^{\frac{1}{2}}, \text{ Here } D_{ii} = 0 \text{ and } D_{ip} = D_{pi}.$$

The form of distance matrix is

$$\begin{bmatrix} 0 & d_{12} & d_{13} \ldots\ldots\ldots & d_{1n} \\ d_{21} & 0 & d_{23} \ldots\ldots\ldots & d_{2n} \\ . & . & . & . \\ . & . & . & . \\ d_{n1} & d_{n2} & d_{n3} \ldots\ldots\ldots & 0 \end{bmatrix}$$

The minimum distance for each row (d_i, i=1,2,.....,n) can be obtained from the distance matrix for computation of upper and lower limits (C.D.) as indicated below:

$$\text{C.D.} = \bar{d} \pm 2\sigma_d, \text{ Where } \bar{d} = \sum_{i=1}^{n}\frac{d_i}{n} \text{ and } \sigma_d = \left\{\sum_{i=1}^{n}\frac{(d_i - \bar{d})^2}{n}\right\}$$

The distance matrix can also be used for fixing targets for different districts on each indicator. Model districts have been identified on the basis of composite index of development and critical distances between different districts. For example, let A and B are two districts and if A is having better level of development compared to B and if its distances from B is within limit of critical distance (C.D.), then A will be identified as model district for B. The best values of different indicators among the model districts will be fixed as potential target for poorly developed districts. This procedure will be repeated for a given district for all indicators considered.

3.3 : Change in development levels: To examine the statistical significance of change in development indices over time, The Slippage test Proposed by Rai (1987) is used. The test procedure is as follows:

Districts (1,2,.....,n) are arranged in ascending order of their development indices for each time periods (1,2,.....,t). The development indices for different time periods will now be ranked for their 1st order statistic, 2nd order statistic and so on, the n-th order statistic. Allot rank 1 to the smallest, 2 to the next higher and so on. The test statistic is

$$M = \frac{12}{nt(t+1)} \sum_{i=1}^{t} R_i^2 - 3n(t+1)$$, Where R_i is the sum of ranks of the i-th period for all districts.

Here M is distributed as χ^2 with (t-1) d.f. For this analysis t=2 and n=21.

This test statistic is used to test the null hypothesis that there is no change in the development indices of districts over time.

To examine the regional imbalances in development during different periods, coefficient of variation (C.V.) of development indices are computed and compared.

In this study, factor analysis has been used to condense the inter districts diversities observed in terms of 21 variables into a fewer factors. The method utilizes the correlation matrix based on the set of observations and condenses the matrix into smallest number of orthogonal factors. For estimating the communalities of the correlation matrix and the proper number of factors, the technique of principal component is used.

IV. RESULTS AND DISCUSSION

4.1: Development Indices: The composite indices of development have been worked out for different districts for agricultural sectors. The development indices based on 21 indicators regarding agricultural development have been computed for the period 1980-81 and 1990-91 for each district and presented in Table 1 bellow. The table represents the value of composite index for each district along with the rank allotted on the basis of these indices.

Table 1. Composite Index of Development and their Corresponding Ranks for Agricultural Sector.

Districts	Period 1980-81		Period 1990-91	
	Composite Index	Rank	Composite Index	Rank
Bandarban	0.99	21	0.99	21
Chittagong	0.65	1	0.69	2
Chittagong H.T.	0.89	19	0.87	17
Comilla	0.75	4	0.82	13
Noakhali	0.90	20	0.89	18
Sylhet	0.87	17	0.63	1
Dhaka	0.69	2	0.73	3
Faridpur	0.86	16	0.84	15
Jamalpur	0.78	7	0.77	7
Mymensing	0.84	14	0.81	12
Tangail	0.84	15	0.83	14
Barisal	0.81	12	0.90	19
Jessore	0.82	13	0.81	11
Khulna	0.79	9	0.79	9
Kustia	0.74	3	0.80	10
Patuakhali	0.89	18	0.94	20
Bogra	0.76	5	0.86	16
Dinajpur	0.80	11	0.78	8
Pabna	0.78	8	0.77	6
Rajshahi	0.77	6	0.75	4
Rangpur	0.88	10	0.76	5

It may be observed from the table that out of 21 former districts of Bangladesh, Chittagong district ranked the first and Bandarban district ranked the last in agricultural development during 1980-81. The values of the composite indices varied from 0.65 to 0.99. For classificatory purposes we get three intervals (0, 0.78), (0.78, 0.85) and (0.85, 1). These intervals can be used to characterize the various stages of development. For relative comparison, the districts with composite indices up to 0.78 may be put in category I as developed districts. The districts with composite indices between 0.78 and 0.85 may be taken in category II as developing districts and with the composite indices greater than 0.85 as poorly developed districts. We observe that according to this classification in agricultural development, the districts of Chittagong, Dhaka, Kustia, Comilla, Bogra, Rajshahi, Jamalpur and Pabna fall in category I and these may be taken as developed districts. The districts of Khulna, Rangpur, Dinajpur, Barisal, Jessore, Mymensing and Tangail are put in category II and may be classified as developing districts. The remaining districts of Faridpur, Sylhet, Patuakhali, Chittagong H.T., Noakhali and Bandarban are in category III and these are taken as poorly developed districts during the period 1980-81.

Table 2. Model Districts for Agricultural Sector.

Low Developed Districts	Model Districts
Bogra	Chittagong, Comilla, Dhaka, Faridpur, Jamalpur, Mymensing, Tangail, Jessore, Khulna, Kustia, Rajshahi, Rangpur, Dinajpur, Pabna.
Chittagong H.T.	Chittagong, Pabna.
Noakhali	Chittagong, Comilla, Dhaka, Faridpur, Jamalpur, Mymensing, Tangail, Jessore, Khulna, Kustia, Rajshahi, Rangpur, Dinajpur, Pabna.
Barisal	Chittagong, Comilla, Dhaka, Faridpur, Jamalpur, Mymensing, Tangail, Jessore, Khulna, Kustia, Rajshahi, Rangpur, Dinajpur, Pabna.
Patuakhali	Chittagong, Comilla, Faridpur, Jamalpur, Mymensing, Tangail, Jessore, Khulna, Kustia, Rajshahi, Rangpur, Dinajpur, Pabna.
Bandarban	Chittagong

The analysis of relative level 'of development in the districts during the period 1990-91 indicated that the district of Sylhet ranked the first and the district of Bandarban continued to occupy the last position in respect of agricultural development. The value of composite indices varied from 0.63 to 0.99 during this period. Also we get the same classificatory intervals for 1980-81. The classification of districts into three groups of development indicated that Sylhet, Chittagong, Dhaka, Rajshahi, Rangpur, Pabna, Dinajpur and Jamalpur are in category of highly developed districts. The districts of Khulna, Kustia, Jessore, Mymensing, Comilla, Tangail and Faridpur are in the category of middle level of development and the district of Bogra, Cgittagong H.T., Noakhali, Barisal, Patuakhali and Bandarban are in the low developed category. It is also observed that the level of development in 10 districts, out of 21 considered moved down during 1980-91. The districts of Kustia and Comilla which occupied position under high category of development during 1980-81 moved down to the medium category during 1980-91 and the district Bogra shifted from the high category to the low category during the same period. The districts of Pabna and Rangpur improved their position from medium to highly developed category and Barisal is shifted from medium category to low category. The development of district Sylhet from low category to high category is also observed. Again from Slippage test, it is observed that the test statistic M is very high compared to the tabulated value of χ^2 at 5% level of significance. This indicates the rejection of null hypothesis of no change of development indices in districts over time. From this, it can thus, be concluded that the level of development is significantly different between the two periods of time. On the other hand, we can conclude on the basis of coefficient of variation (C.V.) of development indices that the period 1990-91 has greater variability.

4.2: Potential target for low developed districts: The list of model districts identified for low developed districts is given in Table 2. The districts of Chittagong, Comilla, Dhaka, Faridpur, Jamalpur, Maymensing, Tangail, Jessore, Khulna, Kustia, Dinajpur, Pabna, Rajshahi and Rangpur have been identified as model districts for most of the low developed districts. It would be quite interesting and useful to examine the extent of improvement required in different indicators of the low developed districts. It will also provide avenues to bring about uniform regional development in the districts. The potential target of each indicator have been estimated and presented in Table 3. Such information may help the planners and administrators to readjust the resources to reduce inequalities in the level of development among different districts of the country. It may be seen from the Table 3, that the low developed districts require improvements of various dimensions in almost all the indicators for enhancing their level of agricultural development. However actual achievements of some of the low developed districts are found to be better than that of their potential targets in some of the indicators. There is great difference between potential target and actual achievement for the first indicator like forest area to total geographical area of all the poor developed districts except Bandarban district. It is further observed that the indicators like cropped area, productivity of paddy, productivity of wheat, productivity of tobacco, number of veterinary hospital, productivity of oilseeds, consumption of fertilizer, area under HYV, productivity of fruits, productivity of vegetables and yield rate of various crops in agricultural sector require improvements of varying magnitude in all the low developed districts.

Table 3. Estimates of Potential Targets and Actual Achievements for Agricultural Sector.

SL	Development Indicators	Bogra	Chit. H.T.	Noakhali	Barisal	Patuakhali	Bandarban
1	PFA	27.96 (0.101)	27.96 (80.45)*	8.49 (1.95)	80.49 (1.95)	80.49 (4.49)	27.96 (27.55)
2	PNAS	78.67 (69.06)	54.04 (6.93)	78.67 (65.85)	78.67 (65.85)	78.67 (59.36)	32.53 (5.64)
3	PCA	134.51 (139.47)*	101.08 (9.64)	134.5 (99.21)	134.5 (98.19)	134.5 (95.5)	58.96 (8.13)
4	PADA	0.78 (0.89)*	0.76 (0.75)	0.78 (0.77)	0.78 (0.56)	0.78 (0.43)	0.76 (0.76)
5	PDWH	0.75 (0.79)*	0.67 (0.12)	0.75 (0.46)	0.75 (0.49)	0.75 (0.44)	0.10 (0.01)
6	PDTO	0.40 (0.20)	0.30 (0.25)	0.40 (0.16)	040 (0.13)	0.40 (0.16)	0.30 (0.30)
7	NVH	7.48 (3.26)	4.60 (3.64)	7.29 (3.07)	7.29 (5.37)	7.29 (2.30)	4.6 (5.37)*
8	PDPO	4.05 (4.05)*	4.05 (4.05)	4.05 (4.05)	4.05 (4.05)	4.05 (4.05)	4.05 (4.05)
9	POMO	0.42 (0.40)	0.37 (0.38)*	0.44 (0.39)	0.44 (0.24)	0.44 (0.42)	0.28 (0.38)
10	CONFR	17.14 (9.03)	90.89 (6.94)	12.44 (4.45)	12.44 (2.49	12.44 (2.04)	90.89 (10.9)
11	PAUHYPA	109.92 (102.05)	109.31 (83.58)	109.91 (89.13)	109.91 (90.23)	109.91 (67.69)	93.42 (100.00)*
12	PDBA	7.59 (5.68)	7.4 (11.11)*	7.59 (4.53)	7.59 (5.68)	7.59 (6.33)	7.40 (8.04)*
13	PDVGL	26.75 (6.26)	6.42 (3.82)	26.75 (5.59)	26.75 (3.99)	26.75 (3.85)	6.42 (3.85)
14	PFSUG	20 (19.99)	19.99 (20)*	20 (19.99)	20 (19.99)	20.00 (19.99)	19.99 (15.09)
15	YRMOS	0.7 (0.05)	0.30 (0.31)*	0.70 (0.30)	0.70 (0.30)	0.70 (0.30)	0.30 (0.29)
16	YRKHARI	0.41 (0.32)	0.31 (0.22)	0.31 (0.31)	0.31 (0.25)	0.31 (0.31)	0.21 (0.13)
17	YRMAS	0.29 (0.29)	0.29 (0.29)	0.29 (0.29)	0.29 (0.29)	0.29 (0.29)	0.29 (0.21)
18	PDMAN	2.76 (1.54)	1.87 (0.88)	2.76 (0.78)	2.76 (1.81)	2.76 (1.07)	1.87 (0.75)
19	PDJACK	6.72 93.04)	3.84 (3.19)	6.74 (3.33)	6.72 (1.51)	6.74 (1.30)	3.84 (3.95)*
20	CRO INTY	201.96 (160.89)	181.27 (162.87)	201.96 (133.44)	201.96 (170.63)	201.96 (191.26)	181.27 (142.86)
21	AAPH	0.00793 (0.00081)	0.0079 (0.0009)	0.00793 (0.0009)	0.00793 (0.00109)	0.00793 (0.00176)	0.00793 (0.0138)*

Note: Figures within parenthesis indicates actual achievement.
*Actual achievement is better than potential target.
*Abbreviations shown in the section 2: data and methodology

Table 4. Percentage of Total Variance Explained by Each Factor.

Period (1980-81)				Period (1990-91)			
Factor	Eigen Value	Percent	Cum. Percent	Factor	Eigen Value	Percent	Cum. Percent
1	4.39	20.9	20.9	1	5.88	28.0	28.0
2	3.16	15.0	36.0	2	3.12	14.8	42.8
3	2.37	11.3	47.2	3	2.53	12.0	54.9
4	2.04	9.7	56.9	4	1.96	9.3	64.2
5	1.62	7.7	64.6	5	1.45	6.9	71.1
6	1.40	6.7	71.3	6	1.35	6.4	77.5
7	1.28	6.1	77.4	7	1.11	5.3	82.8
8	1.19	5.7	83.1	8	1.03	4.9	87.7

4.3: Factor analysis: The analysis has resulted (based on Kaiser's criteria of eigen value to be higher than 1) into eight components for period I (1980-81) and for period II (1990-91). The results are presented in the Table 4. The linear combination formed by factor 1 has the variance 4.39, which is 20.9% of the total 21 variables i.e., factor 1 explains 20.9% variation in the data set. Factor 2 explains 15% variation, factor 3 explains 11.3% and so on in 1980-81. Again in period II factor 1 explains 28% variation in the data set and so on. The table also shows that almost 83% and about 88% of total variation attributable to the first eight factors in Period I and period II respectively. The 1st factor has significantly high loading in percentage of net area shown to total geographical area, productivity of wheat during both the periods. The 1st factor has significantly high loading in productivity of fruits, cropping intensity during first period in positive direction and in average area per holding, percentage of forest area to total geographical area during 2nd period in negative direction. The second factor common to both the periods as it loads very heavy on variables like productivity of vegetables. The second factor has significantly high loading in 1st period for percentage of net area shown to total geographical area and percentage of cropped area to total geographical area, in negative direction whereas in 2nd period for yield rate of Khasari and yield rate of maskoli, production of Sugarcane in positive direction. The third factor loads very high during period I on average area per holding and yield rate of Maskoli in positive direction and production of Sugarcane in negative direction whereas during period II the factor has significantly high loading in consumption of fertilizer per acre in positive direction and production of Mosur in negative direction. The fifth factor has significantly high loading in number of veterinary hospitals and average area per holding during 1st period. The sixth factor loads very high during period I on productivity of potato, consumption of fertilizer and cropping intensity. The seventh factors loads very heavy on variables like productivity of potato and yield rate of Mosur in 1st period and only productivity of potato in second period. The 8th factor loads very high during period I on the productivity of banana, yield rate of Khasari in positive direction and productivity of oilseeds in negative direction during period II.

Table 5. Percentage of Variance of Each Variable Accounted by the Crucial Components.

Variables	Period 1980-81	Period 1990-91
	Communality (hj^2)	Communality (hj^2)
PFA	51.6	91.9
PNAS	91.8	95.4
PCA	97.3	95.2
PADA	86.4	95.1
PDWH	83.6	85.3
PDTO	84.9	91.2
NVH	87.9	74.4
PDPO	83.9	86.9
POMO	64.9	92.2
CONFR	91.6	86.9
PAUHYPA	81.6	74.4
PDBA	89.4	92.6
PDVGL	89.4	91.1
PDSUG	86.4	96.7
YRMOS	86.4	90.2
YRKHARI	93.4	86.7
YRMAS	78.2	91.9
PDMAN	63.6	78.5
PDJACK	77.4	69.2
CRO INTY	83.5	90.3
AAPH	92.1	86.2

A perusal of the communalities values (given in Table 5) indicates for 18 variables for both periods, the communalities exceed 75%. Thus we find a fairly high degree of representation of all the 21 variables considered by the 8 factors identified crucial for the study.

V. CONCLUSION

Development is a multidimensional process and its impact can not be measured completely by single indicator. In the present analysis regional (districts) disparities of agricultural sector based on 21 indicators concerned with agricultural development, were studied and the disparities are found to be statistically significant. Again the change in the level of development of agricultural sector of Bangladesh is significantly different between periods of time (1980-81 and 1990-91). Model districts were identified and potential targets for various indicators were estimated for different low developed districts. The districts, which are low developed, require improvements of various dimensions of different indicators for enhancing their levels of development. So a sustainable policy is needed to balance the inter-districts inequalities in the level of development and to overall growth of agricultural sector of Bangladesh.

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Appendix-A

Calculation of fractiles of two parameter β-distribution for the period 1990-91:

We get from Composite Index, $\overline{x} = 0.81095, s^2 = 0.00676$.

Now, from Beta distribution of first kind we know,

$$\frac{\alpha}{\alpha+\beta} = \overline{x} \text{ or } (\alpha+\beta) = \frac{\alpha}{\overline{x}} \text{ and}$$

$$\frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)} = s^2 (\text{variance}).$$

$$\text{Now } (\alpha-\beta)^2 = (\alpha+\beta)^2 - 4\alpha\beta$$

$$= \frac{\alpha^2}{\overline{x}^3}(\overline{x} - 4s^2\overline{x} - 4s^2\alpha)$$

$$= \alpha^2(1.4794 - 0.0506\alpha)$$

$$\text{or, } (\alpha-\beta) = \alpha(1.4794 - 0.0506\alpha)^{\frac{1}{2}}$$

$$\text{or, } 2\alpha = (\alpha+\beta) + \alpha(1.4794 - 0.0506\alpha)^{\frac{1}{2}}$$

$$\text{or, } 2 - \frac{1}{\overline{x}} = (1.4794 - 0.0506\alpha)^{\frac{1}{2}}$$

$$\text{or, } \alpha = 17.5837$$

$$\text{Again, } \frac{\alpha}{\alpha+\beta} = \overline{x}$$

$$\text{or, } \beta = 4.098$$

$$\text{So, } \frac{\Gamma(\alpha+\beta)}{\Gamma\alpha\Gamma\beta} = 26902.45$$

Similarly, we found this value for 1980-81.

With these values we found the intervals mentioned in the methodology.