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Development of Livelihood Index for Different Agro-Climatic Zones of India

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Abstract

A livelihood index has been developed for different agro-climatic zones of India, based on the secondary data for TE 2003. Six different sub-indices obtained are indicators of Infrastructure Status, Agricultural Status, Nutritional Status, Economic Status, Health and Sanitation Status and Food Availability Status in respective zones. A total of 57 variables have been considered for this study. Finally, a composite integrated livelihood index has been developed which indicates the livelihood status of different agro-climatic zones in the country. Also, 103 districts of low agricultural productivity have been identified within low livelihood regions. The results of this study have been compared with those of backward districts identified under Wage Employment Program by the Task Force of Planning Commission of India. It is found that about 60 per cent districts identified in this study are the same as identified by the Task Force. Further, the spatial distributions of the identified districts under the study have been mapped using GIS maps and it has been observed that almost same region of the country has been found to be most backward in both the studies. The study has revealed regional disparity in the development process and has suggested to formulate appropriate policies to bridge this disparity gap.

Introduction

Indices for economic and social status are composite indicators of the economic and social well-being at the community, state, national and international levels. These social indicators are used to monitor the social system and help in the identification of problem-areas that need policy planning and require intervention to alter the course of social change. The term 'social indicator' was coined by the American Academy of Arts and Science in 1960. The main objective of this study was to detect and anticipate the nature and magnitude of second–order consequences of space programme for the US society (Land, 1999). In the absence of conceptual framework and lack of sufficient data, an attempt was made to develop a system of social indicators. The efforts made under this study were compiled in the form of a publication "Social Indicators", which was edited by Raymond Baller and was published in 1966.

In the survey of social indicators, Land (1999) has identified three main uses of social indicators: (i) monitoring, (ii) social reporting, and (iii) public enlightenment and social forecasting. The best-known composite index of social and economic well-being is Human Development Index (HDI), developed by United Nations Development Program (UNDP) (1989). The basic aim of this index was a cross-national comparison. UNDP has also developed sever other indices like Gender-related Development Index (GDI), which indicates the average achievement of each country in life-expectancy, and educational attainments of men and women, Gender Empowerment Measure (GEM) to evaluate the relative empowerment of women and men in political and economic spheres of activity, and

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Human Poverty Index (HPI). A comprehensive survey of different indicators of economic and social well-being has been provided by Sharpe (1999). The Quality of Life Index (QOL) developed by Diener (1995) is based on universal set of values. Estes (1997) has developed an Index of Social Progress (ISP) for identifying significant changes in "adequacy of social provision" and to assess the progress in providing more adequately the basic social and material needs of the world's population. Klein and Ozmucur (2002/2003) have estimated the economic growth of China using social indicators. Haberman (1978) has provided statistical methods for analyzing qualitative data. Apart from these, several international and cross-national indices have been developed based on time series data and data related to particular community/province/ administrative boundaries, etc. The development of livelihood security index is one of the most important social indicators for assessing the quality of life, coupled with meeting the basic needs of human beings.

Livelihood security, a*ccording to Food and Agriculture Organization (FAO)* is 'adequate and sustainable access to income and resources to meet basic needs (including adequate access to food, potable water, health facilities, educational opportunities, housing, time for community participation and social integration)'. Livelihoods can be derived from a range of on-farm and off-farm activities, which together provide a variety of procurement strategies for food and cash. Thus, each household can have several possible sources of entitlement, which constitute its livelihood. These entitlements are based on the household's endowments and its position in the legal, political and social fabric of society. The risk of livelihood failure determines the level of vulnerability of a household to income, food, health and nutritional insecurity. Therefore, livelihoods are secure when households have secure ownership of, or access to, resources and income-earning activities, including reserves and assets, to offset risks, ease shocks and meet contingencies (Chambers, 1989).

In this article, livelihood index has been developed for different agro-climatic zones of India, based on available secondary data of TE 2003. In the first step, six different sub-indices were obtained which were indicators of Infrastructure Status, Agricultural Status, Nutritional Status, Economic Status, Health and Sanitation Status and Food Availability Status in respective zones. A total of 57 variables were considered for this study. Finally, a composite integrated livelihood index was developed. The agro-climatic zone of the Island Region comprising Andaman & Nicobar Islands and Lakshadweep was not considered for this study due to non-availability of sufficient data. Also, 103 districts of low agricultural productivity were identified within low livelihood regions. The results of this study were compared with the results of backward districts identified under wage employment program by the Task Force of Planning Commission of India. It was found that about 60 per cent districts identified in this study were same as identified by the Task Force. Further, the spatial distributions of the identified districts were mapped using GIS maps and it was observed that backwardness and agricultural productivity had a strong association.

Conceptual Framework

The Planning Commission of India has divided the country into 15 agro-climatic zones based on agro-climatic diversity. Each zone generally has similar characteristics of agricultural production and sustainable development. These agro-climatic zones described in Appendix I, have significant impact on the livelihood status of the rural masses.

The livelihood security has multidimensional aspects. It includes economic security, nutritional security, health security, food security, educational security, habitat security, community participation, environmental security, etc. Therefore, it is important to select parameters, which are representative indicators of all these sectors of human-life. The availability of authenticated secondary data at various levels also plays an important role in the identification of these indicators. Broadly, these parameters can be grouped into six categories: (i) Infrastructure Status, (ii) Agricultural Status, (iii) Nutrition Status, (iv) Economic Status, (v) Health and Sanitation Status, (vi) Food Availability Status. This clearly indicates that there is a need to develop six sub-indices

based on these categories and then an integrated livelihood index may be developed at agro-climatic zone level. Appendix II provides information on the parameters included in the development of different sub-indices.

Development of Integrated Livelihood Status Index

The methodology for development of Integrated Livelihood Index was based on the statistical background suggested by Narain *et al.* (1991). Let a set of n points represents states 1, 2,…,n having information on K parameters. Let $[X_{(z)is}]$; where s = 1, 2,…,S_z, represent value of ith parameter of sth state falling in the zth agro-climatic zone. Since the parameters (indicators) included in the analysis were in different units of measurement such as percentage of villages, per thousand villages, per capita, per hectare, etc., these were converted at agro-climatic zone level by multiplying with suitable weights. Let there be S_z states in a zth agro-climatic zone, where z = 1, 2, …,15. The weights of different states falling in a zone were calculated based on district data on population of the district of sth state falling in zth agro-climatic zone, $[W_{(z)s}(P)]$, gross cultivated area of sth state falling in zth agro-climatic zone, $[W_{(z)s}(A)]$, and number of villages of sth state falling in zth agro-climatic zone, $[W_{(z)s}(V)]$. The state level parameters were converted to agro-climatic zone level by weighted average method with the help of Equation (1):

$$X^*_{(z)i} = \sum_{s=1}^{S_z} W_{(z)s}(T) X_{(z)is} \quad \ldots (1)$$

where, T= P, A or V, depending on type of parameters, viz population, area, or number of villages. These indicators were standardized as shown below:

$$Z_{(z)i} = \frac{X^*_{(z)i} - \overline{X}^*_{(.)i}}{s_{(.)i}} \quad \ldots(2)$$

where, $s_{(.)i}{}^2 = \sum_{z}^{14} (X^*_{(z)i} - \overline{X}^*_{(.)i})^2$

and

$$\overline{X}^*_{(.)i} = \sum_{z}^{14} \frac{X^*_{(z)i}}{14} \qquad (i = 1,2,\ldots,K)$$

Here, $[Z_{(z)i}]$ denotes the matrix of standardized indicators. The best zone for each indicator (with maximum or minimum standardized value depending upon the direction of the indicator) was identified and from this, deviations in the value of each zone were considered for all the indicators using Equation (3):

$$C_{(z)} = \left\{ \sum_{i=1}^{k} (Z_{(z)i} - Z_{(0)i})^2 \right\}^{1/2} \quad \ldots (3)$$

where, $Z_{(0)i}$ is the standardized value of the ith indicator of the best zone and $C_{(z)}$ denotes the pattern of development of zth zone. The pattern of development is useful in identifying the zones that serve as 'models' and it also helps in fixing the potential target of each indicator for a given zone. The status index of the zth zone was obtained through formula (4) :

$$D_{(z)} = \frac{C_{(z)}}{C} \quad \ldots (4)$$

where, $C = \overline{C} + 2s$, $\overline{C} = \sum_{z=1}^{14} \frac{C_{(z)}}{14}$

and $s = \left\{ \sum_{z=1}^{14} \frac{(C_{(z)} - \overline{C})^2}{14} \right\}^{1/2}$

The final value of the index was obtained as per Equation (5):

$$D^*_{(z)} = 1.0 - D_{(z)} \quad \ldots. (5)$$

The value of status index is non-negative and lies between 0 and 1. The value of index closer to one indicates the higher level of development, while that closer to 0 indicates the lower level of development. Following status indices were obtained with the help of above method:

1. Infrastructure Status Index $[D^*_{(z)}(I)]$
2. Agricultural Status Index $[D^*_{(z)}(A)]$
3. Nutritional Status Index $[D^*_{(z)}(N)]$
4. Economic Status Index $[D^*_{(z)}(E)]$

5. Health and Sanitation Status Index [$D^*_{(z)}(H)$]

6. Food Availability Status Index [$D^*_{(z)}(F)$]

The Livelihood Status Index of the zones was obtained by combining the above indices using optimum weights as shown below:

$$D^*(z)(L) = \frac{\sum_T \sigma^*_{Dz}(T) D^*(z)(T)}{\sum_T \sigma^*_{Dz}(T)}$$

T= {I, A, N, E, H, F}

Its value will lie between 0 and 1. If the value is close to zero, the livelihood status of the people in the zone is poor, and if it is close to 1, livelihood status is good.

Results and Discussion

The development of Livelihood Status Index was based on the average of secondary data from 2000-01 to 2001-03, i.e. TE 2003, collected by different organizations on the factors indicated in Appendix II. Data related to all the parameters were considered for development of these indices and the calculated values of indices were populated in Relational Database Management (RDBMS) tables using MS-Access and subsequently, these tables were attached to district map of the country (supplied by Survey of India) using ARC-GIS software for creation of various thematic maps The status of different agro-climatic zones of the country was represented through graphs for different indices and has been shown in Figures 1-6. Figure 1 depicting the Agricultural Status Index (ASI) revealed that zone 6 was highly developed and zone 2 was least developed. Figure 2 showing the Nutritional Status Index (NSI) revealed that zone 1, followed by zone 6, were highly developed, whereas zone 7 was least developed. Figure 3 showing the Economic Status Index revealed zone 12 to be highly developed and zone 4 as least developed. Figure 4 depicting the Health and Sanitation Status Index (HSSI) indicated zone 6 to be highly developed and zone 2 to be least developed. On the basis of Infrastructure Status Index (ISI), shown in Figure 5, zone 12 was found to be highly developed, whereas zone 1 was least developed. Figure 6 showing Food Availability Status Index (FASI) indicated zone 6 as highly developed and zone 1 as least developed. All these indices were integrated by giving optimum weights, i.e. inverse of their variances to develop the integrated Livelihood Status Index (LSI). Status of various agro-climatic zones with respect to different sub-indices and livelihood status index is provided in Table 1. The livelihood status of zone 6 was found to be highest and of zone 7, the least. The livelihood status of these zones was classified with the help of percentiles. The LSI values between 0 to 25th percentiles were classified as Low (L), values above 75th percentiles were classified as High (H), and the remaining zones were classified as Medium (M).

The distribution of zones with different livelihood status depicts that most of the tribal regions pertaining to Bihar, Madhya Pradesh, Orissa, North-Eastern states and J & K fall under the category of low livelihood status. The regions pertaining states in South India, Gujarat, Haryana and Punjab are in highly developed category and rest of the country falls in the middle livelihood status category.

Table 1. Status of various agro-climatic zones with respect to different indices

Index	Status of agro-climatic zones		
	Low	Medium	High
Infrastructure Status Index (ISI)	1, 4, 7, 14	2, 3, 5, 8, 9, 13	6, 10, 11, 12
Agricultural Status Index (ASI)	1, 2, 7, 14	3, 4, 8, 9, 10, 12	5, 6, 11, 13
Nutrition Status Index (NSI)	3, 4, 7, 13	2, 5, 10, 11, 12, 14	1, 6, 8, 9
Economic Status Index (ESI)	3, 4, 5, 7, 9	1, 2, 8, 11, 14	6, 10, 12, 13
Health and Sanitation Status Index (HSSI)	2, 3, 4, 7	5, 8, 9, 10, 11, 14	1, 6, 12, 13
Food Availability Status Index (FASI)	1, 2, 4, 12	5, 7, 8, 9, 10, 14	3, 6, 11, 13
Livelihood Status Index (LSI)	1, 2, 4, 7	3, 5, 8, 9, 11, 14	6, 10, 12, 13

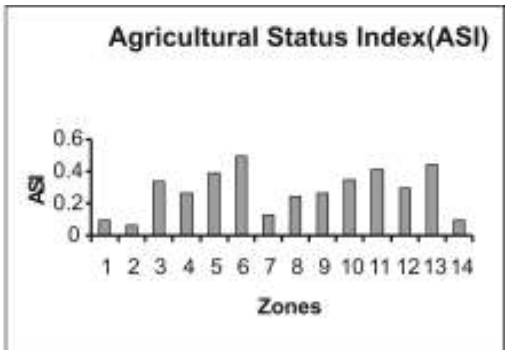

Figure 1. Zone-wise Agricultural Status Index

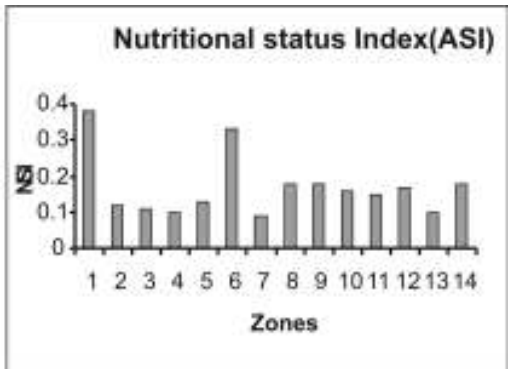

Figure 2. Zone-wise Nutritional Status Index

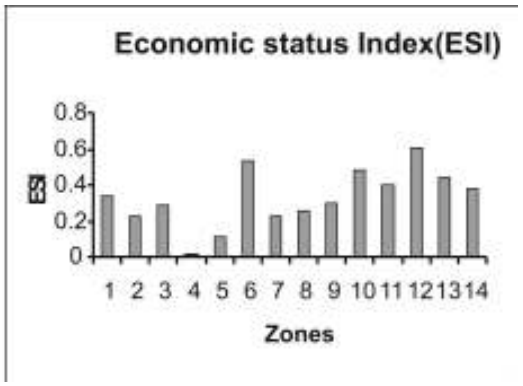

Figure 3. Zone-wise Economic Status Index

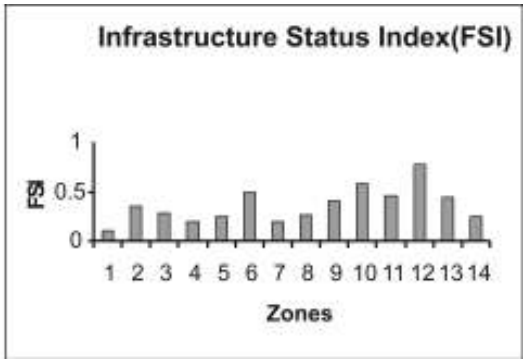

Figure 4. Zone-wise Infrastructure Status Index

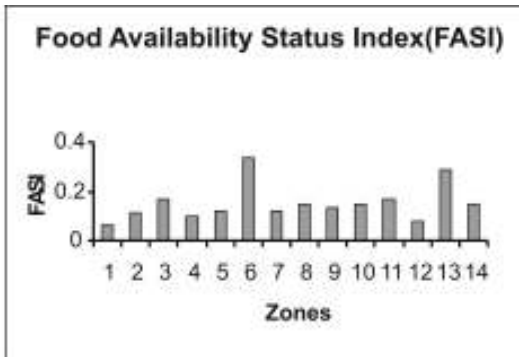

Figure 5. Zone-wise Food Availability Index

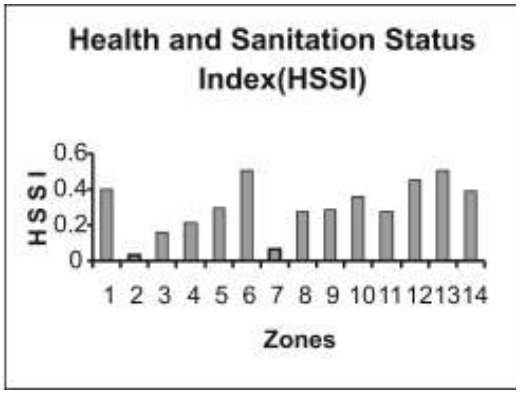

Figure 6. Zone-wise Health and Sanitation Index

Identification of Low Productive Districts from Disadvantageous Regions

In the second step, low agricultural productive districts were identified on the basis of their agricultural productivity calculated for cereals, coarse grains, pulses, oilseeds and commercial crops, etc. The categorization of low productivity districts was also based on percentiles. The districts having values less than 25th percentiles were put in the category of low productive districts with reference to all-India. Total 127 districts were classified as low agricultural productive. Out of these districts, 103 districts fall under the low livelihood status region also. State-wise distribution of low agricultural productive districts is provided in Table 2. It can be seen that maximum number of low productive districts, i.e. 25 are in Madhya Pradesh, followed by Rajasthan, Orissa, and Chhatisgarh.

There is a need to reduce this regional disparity through proper policy planning for a balanced development. Further, a Task Force of Planning Commission of India had identified 150 backward

Table 2. State-wise low agricultural productive districts

Sl No.	State	No. of districts	Agro-climatic zones	Districts
1	Andhra Pradesh	3	10, 11	Guntoor, Prakasam, Srikakulam
2	Arunachal Pradesh	4	2	Lower Subansiri, Tirap, Upper Subansiri, West Kameng
3	Assam	5	2	Barpeta, Bongaigaon, Darrang, Kokrajhar, Lakhimpur
4	Bihar	2	4	Darbhanga, Supaul
5	Chhattisgarh	14	7	Bastar, Durg, Dantewada, Dhamtari, Janjgir, Jashpur, Kanker, Kawardha, Korba, Koriya, Mahasamund, Rajnandgaon, Rajgarh, Surguja
6	Gujrat	3	13	Amreli, Bhavnagar, Rajkot
7	Haryana	2	6	Bhiwani, Mahendragarh
8	Himachal Pradesh	2	1	Lahaul & Spiti, Hamirpur
9	Jammu & Kashmir	3	1	Doda, Jammu, Kupwara
10	Jharkhand	3	7	Gumla, Bokaro, Garhwa
11	Karnataka	4	10, 12	Gadag, Raichur, Gulbarga, Koppal
12	Kerala	2	12	Kozhikode, Malappuram
13	Madhya Pradesh	25	7, 8, 9	Balaghat, Badwani, Betul, Chhatarpur, Damoh, Dhar, Dindhori, Guna, Harda, Jabalpur, Jhabua, Khargaon, Mandla, Panna, Raisen, Rewa, Rajgarh, Khandua, Shahdol, Sagar, Satna, Seoni, Shivpuri, Sidhi, Umaria
14	Manipur	3	2	Chandel, Senapati, Tamenglong
15	Meghalaya	1	2	South Garo Hills
16	Mizoram	1	2	Aizwal
17	Maharashtra	5	7, 9, 12	Amravati, Chandrapur, Dhule, Gadchiroli, Nagpur
18	Nagaland	1	2	Zunhebato
19	Orissa	15	7, 11	Bhadrak, Debagarh, Dhenkanal, Gunjam, Jajapur, Jagatsinghpur, Kendujhar, Kendrapara, Khurdha, Mayur bhanj, Malkangiri, Phulbani, Puri, Rayagada, Sundergarh
20	Punjab	2	6	Hoshiarpur, Rupnagar
21	Rajasthan	18	6, 8, 14	Ajmer, Banswara, Barmer, Bhilwara, Bikaner, Churu, Dungarpur, Jodhpur, Jalor, Jhunjhunu, Nagaur, Pali, Rajasmand, Sawai Madhopur, Sirohi, Tonk, Udaipur
22	Sikkim	1	2	South Sikkim
23	Tamil Nadu	2	10, 11, 12	Ramnathpuram, Sivaganga
24	Tripura	1	2	North Tripura
25	Uttar Pradesh	2	4, 5, 8	Banda, Lalitpur
26	Uttarakhand	2	1	Almorah, Pithoragarh
27	West Bengal	2	2, 3, 7	Jalpaiguri, Midnapore (W)

districts for wage employment programme on the basis of variables such as incidence of poverty, unemployment rate, agricultural wage rate, per hectare agricultural productivity, productivity per agricultural worker, SC/ST population, drought-proneness, desert-proneness and rural connectivity. These districts were compared with the low agricultural productivity districts identified under this study. A state-wise comparison of these districts has been presented in Table 3, which shows that state-wise number of identified (matched) districts in both the studies. A perusal of Table 3 revealed that out of

Table 3. State-wise number of districts identified on the basis of low productivity and wage employment

State	No. districts (identified on the basis of wage employment)*	No. districts (identified on the basis of low productivity)**	No. of districts	
			Common (Matched)	Unmatched
Andhra Pradesh	6	-	-	6
Assam	7	6	2	5
Bihar	6	2	-	6
Madhya Pradesh +Chhatisgarh	35	39	28	11
Gujarat	8	-	-	8
Jharkhand	19	-	-	19
Karnataka	4	-	-	4
Maharashtra	15	5	4	11
Orissa	27	15	12	15
Rajasthan	7	18	5	13
Tamil Nadu	2	2	-	2
Uttar Pradesh	7	2	1	6
West Bengal	7	1	-	6
Jammu & Kashmir	-	3	-	3
Uttarakhand	-	2	-	2
North-Eastern states	-	8	-	8
Total	150	103	52	-

* As identified by Task Force of Planning Commission

** As identified by authors in this study

103 districts, 52 were common in both these studies. It may be noted that in the case of districts for wage employment, J&K and North-Eastern states were not considered, otherwise number of matched districts could have been more. This study has shown that there was a high association between backwardness and agricultural development.

Conclusions

The study has revealed the livelihood status of different agro-climatic zones through Infrastructure Status, Agricultural Status, Nutritional Status, Economic Status, Health and Sanitation Status, and Food Availability Status and has developed Livelihood Status Index for each zone. It has been found that in the developmental process of the country, some regions have been neglected and left far behind. Spatial distribution of backward regions with respect to livelihood status has clearly shown that the north-hill region, eastern parts of the country, except coastal area, and north-eastern regions need special attention of policy planners. Also, low livelihood, backwardness and low agricultural productivity have strong relationship with each other. It has been noted that around 25 per cent of the total backward districts of the country belong to states of M.P. and Chhattisgarh. Further, 40 per cent of the total low agricultural productivity districts in the country also pertain to these states. Major parts of these states are in the Eastern Plateau and Hills region, i.e. Agro-Climatic Zone 7, which has shown low value for most of the sub-indices, including integrated livelihood status index.. It clearly indicates regional disparity in the development process and livelihood status of the people in the country. There is an urgent need to reduce this regional disparity through appropriate policy planning for a balanced development of the country

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Appendix-I

Agro-climatic zones and geographical distributions of states

Zone No.	Name of zone	States
1	Western Himalayan Region	Himachal Pradesh, Jammu & Kashmir and Uttarakhand
2	Eastern Himalayan region	Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, West Bengal
3	Lower-Gangetic Plain	West Bengal
4	Middle-Gangetic Plain	Uttar Pradesh, Bihar
5	Upper-Gangetic Plain	Uttar Pradesh
6	Trans-Gangetic Plain	Chandigarh, Delhi, Haryana, Punjab, Rajasthan
7	Eastern-Plateau and Hills	Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Orissa, West Bengal
8	Central-Plateau and Hills	Madhya Pradesh, Rajasthan, Uttar Pradesh
9	Western-Plateau and Hills	Madhya Pradesh, Maharashtra
10	Southern-Plateau and Hills	Andhra Pradesh, Karnataka ,Tamil Nadu
11	East-Coast Plains and Hills	Andhra Pradesh, Orissa, Pondicherry, Tamil Nadu
12	West-Coast Plains and Ghat	Goa, Karnataka, Kerela, Maharashtra, Tamil Nadu
13	Gujarat-Plains and Hills	Gujarat, Dadra & Nagar Haveli, Daman & Diu
14	Western Dry Region	Rajasthan
15	Island Region	Andaman & Nicobar Islands, Lakshadweep

Appendix-II

Different sub-indices and the parameters of their development

Sub-Indices	Parameters
Infrastructure Status Index (ISI)	Percentage of inhabited villages having 1. Different types of communication facilities 2. Pucca approach roads 3. Post and telegraph offices and telephone connections 4. Percentage of villages not linked with road 5. Per thousand villages having different government development programmes/schemes 6. Per thousand villages having irrigations facilities 7. Per thousand villages having facilities/existence of community TV centre/ Cable TV connections/ cooperative societies/self-help groups 8. Percentages of inhabited villages having electricity 9. Percentage of inhabited villages having educational institutions 10. Percentage of inhabited villages having sources of drinking water 11. Per thousand inhabited villages having drainage systems 12. Per thousand villages having number of national and rural banks
Agricultural Status Index (ASI)	Per hectare productivity of 1. Rice, 2. Wheat, 3. Pulses, 4. Oilseeds, 5. Cotton, 6. Sugarcane, 7. Fruits, and 8. Vegetables 9. Per animal productivity of meat 10. Per animal productivity of milk 11. Per bird productivity of eggs 12. Cropping intensity 13. Irrigation intensity 14. Fertilizer intensity
Nutrition Status Index (NSI)	Per capita consumption of 1. Rice, 2. Wheat, 3. Cereals, 4. Pulses, 5. Milk, 6. Eggs, 7. Fish, 8. Broad groups of other items, and 9. Milk and milk products
Economic Status Index (ESI)	1. Per capita income 2. Percentage of population below poverty line 3. Credit per capita from nationalized banks 4. Percentage literacy rate
Health and Sanitation Status Index (HSSI)	1. Per capita (public sector) expenditure on health (medical and public health), including water supply and sanitation and family welfare 2. Per thousand households having kuchcha and semi-pucca dwelling units 3. Per thousand households having pucca dwelling units. 4. Per thousand households having distance less than 0.5 km from hospital/health centre 5. Percentages of inhabited villages having medical institutions
Food Availability Status Index (FASI)	Per capita availability of 1.Rice, 2. Wheat, 3. Pulses, 4. Oilseeds, 5. Sugarcane, 6. Fruits, 7. Vegetables, 8. Meat, 9. Milk, 10. Eggs, and 11. Fish