CHAPTER 4

e-Readiness Index of the States/UTs

4.1 Introduction

Composite indicators (CIs) are used to compare performances in a given field between countries or states because of the practicality they present in measuring complex concepts through a single figure. They also lend themselves to interpretation by the general public, as it is easier to track the progression of a single composite indicator than study the trends of multiple variables. Caution should be practised while constructing these indicators however, else they can lead to erroneous conclusions. According to the *OECD working paper Handbook on Constructing Composite Indicators: Methodology and User Guide*, "composite indicators must be seen as a starting point for initiating discussion and attracting public interest. Their relevance should be gauged with respect to constituencies affected by the composite index." The following box from the same paper summarises well the advantages and disadvantages of using composite indicators.

Pros and Cons of Composite Indicators

Pros	Cons
• Can summarise complex or multi-dimensional issues in view of supporting decision-makers. • Easier to interpret than trying to find a trend in many separate indicators. • Facilitate the task of ranking countries on complex issues in a benchmarking exercise. • Can assess progress of countries over time on complex issues. • Reduce the size of a set of indicators or include more information within the existing size limit. • Place issues of country performance and progress at the centre of the policy arena. • Facilitate communication with general public (i.e. citizens, media, etc.) and promote accountability.	• May send misleading policy messages if they are poorly constructed or misinterpreted. • May invite simplistic policy conclusions. • May be misused, e.g., to support a desired policy, if the construction process is not transparent and lacks sound statistical or conceptual principles. • The selection of indicators and weights could be the target of political challenge. • May disguise serious failings in some dimensions and increase the difficulty of identifying proper remedial action. • May lead to inappropriate policies if dimensions of performance that are difficult to measure are ignored.

Source: Handbook on Constructing Composite Indicators: Methodology and User Guide, OECD Working Paper, page 8

There are several elements that need to be considered while constructing a composite indicator. To start with, the concept being measured needs to be clearly defined. The variables that constitute the composite indicator then need to be selected with respect to their relevance to the concept and the availability of their data. An analysis of the single indicators with respect to each other (i.e. a multivariate analysis) then needs to be conducted so that the final composite indicator remains relevant. Several methods exist to conduct this analysis such as the Principal Component Analysis (PCA), the Factor Analysis (FA), the Cronbach Coefficient Alpha (c-alpha) and the Cluster Analysis (CA).

In this report, the concept being measured is the e-Readiness of the Indian States, i.e. their ability to participate in the increasingly networked world. To measure this we have used 3 main sub-indicators: the environment that promotes the spread and usage of ICT; the readiness of different stake holders of the economy (the government - both the initiatives of the Central Government and the response of the State Governments, businesses and the individual) to use ICT; and the degree of usage of ICT by the three stakeholders. In continuation to the last three years' work and newly available data, the states have been ranked using a similar methodology and framework of analysis. This time the questionnaire has been designed more comprehensively and included some more relevant variables along with appropriate consistency checks. We have also sophisticated our data analysis with suitable additions of new variables and transformation of old variables. For the multivariate analysis, we used the Principal Component analysis to arrive at the final e-Readiness Index. The advantages of this method with respect to our study are detailed in section 4.4.2.

4.2 Objectives

e-Readiness can be considered as the ability to pursue value creation opportunities facilitated by information and communication technology (ICT). Therefore, it is not simply a matter of the number of computers, websites, Internet service providers, internet connections, telephones and mobiles in the state but also the ability or readiness to use technology skillfully at the level of the individual, business and the Government. We have become accustomed to ever-increasing application of ICT. In our measurement strategy we have tried to integrate the multidimensionality of e-Readiness through our conceptual framework and analogous design of the data model. Thus, our e-Readiness ranking is basically a weighted average of a large number of quantitative and qualitative indicators organised into three basic categories viz. environment, readiness and usage.

Environment relates to the conditions prevailing in the state like infrastructure and policies external to the players involved in making e-Governance effective. Readiness deals with those characteristics of the players that enable them to respond to an environment that in enabling. Qualification or training of individuals in IT is an example of readiness. Usage, on the other hand, is the actual utilisation of information technology given a conducive environment and positive state of readiness. In this sense, a certain level of environment and readiness is a precondition to usage of a certain level. However, our methodology does not allow us make absolute comparisons of the three sub-components of e-Readiness, and only provides relative positions of states as the indices indicate relative positioning of the states.

4.3 Data Sources

As mentioned earlier, our model considers three broad categories to construct the e-Readiness Index at the state level. The variables representing these categories are both quantitative and qualitative. The qualitative data was transformed into a quantitative form by codification of the information for the purpose of the model.

Data from both secondary sources and primary collection was collated for the analysis. Secondary sources included the Department of Telecommunication Annual Statistics, Statistical Abstracts of India, Economic Survey, Census publications and various Government of India websites. Primary data collection was through a survey of the various departments of the state Governments using a well-structured questionnaire. The raw data was then transformed into variables representing indicators and sub-indicators wherever required using appropriate normalisation factors. This transformation of the raw data into relevant variables is essential to maintain the comparability of the indicators across the states.

Some of the indicators considered initially for the model were dropped due to non-availability and/or inaccuracy

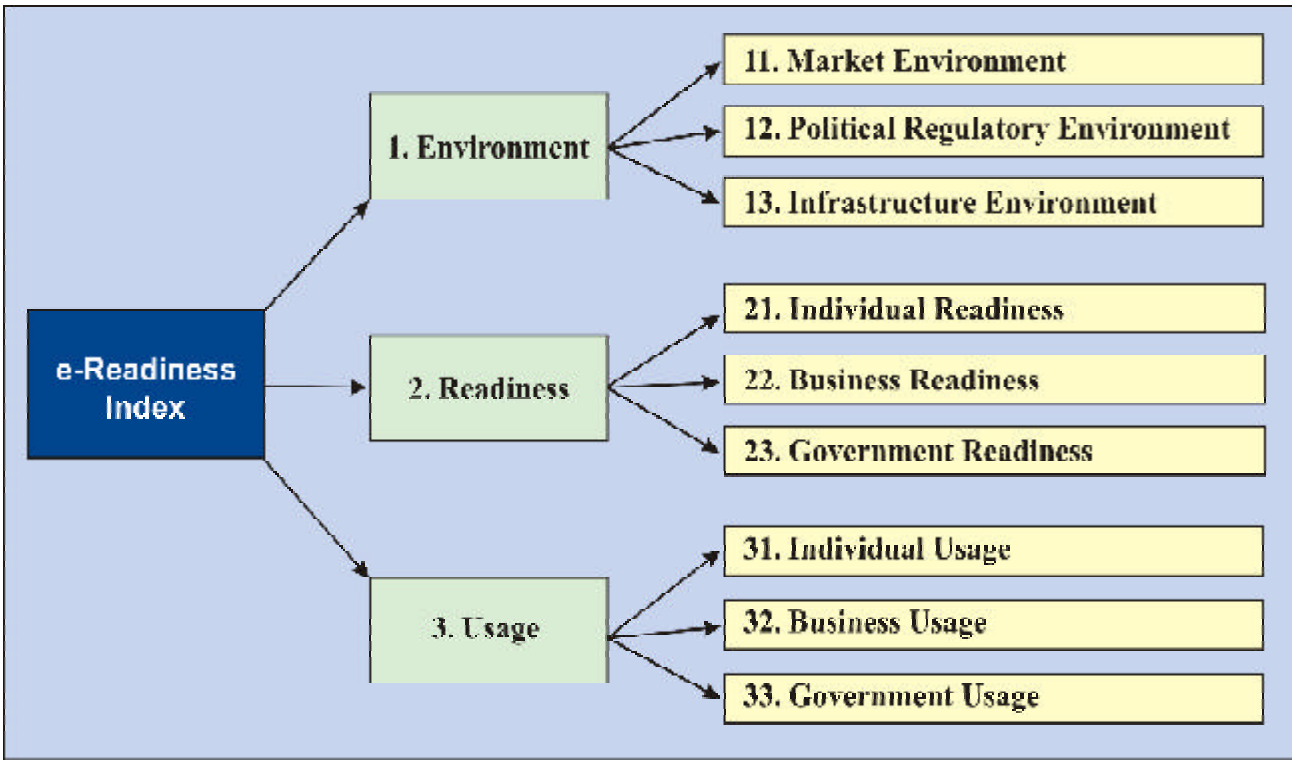
of data. Apart from that, the data has been adjusted through appropriate interpolation and extrapolation norms in case of missing data. Extrapolation norms are identified either through correlation with relevant explanatory variables or based on an income criterion which is considered as the most effective means for this purpose.

There are two objectives of ranking the states in terms of e-Readiness, a task that the National Council of Applied Research has been undertaking for the past three years. Firstly, this ranking enables us to understand the state responses to the policy thrust of emphasizing the use of IT as a tool for governance. Secondly, since this task is being carried out every year, since four years, the ranking of subsequent years enables us to capture the change in a states' relative position over the years. This year, the sub-indices were improved by the inclusion/exclusion/ modification of variables that went into the computation (the details of the change of variables are mentioned in Section 4.4.4). While this serves the purpose of the first objective better, the second objective is compromised somewhat by adopting this method as two indices over years are not strictly speaking comparable. However, since we have not changed our conceptual understanding about the basic components of e-Governance, the comparison of state rankings is still a valid exercise. The list of variables used in 2006 and 2005 is given in Tables 4.1, 4.2 and 4.3.

4.4 Framework of Analysis and Methodology

The framework used in the study is based on the Network Readiness Index (NRI), published by the World Economic Forum (WEF), that measures "the degree of preparedness of nation or community to participate in and benefit from ICT developments". We have modified the NRI to serve our purpose of ranking Indian states and Union Territories according to their e-Readiness.

Figure 4.1: The Networked Readiness Index Framework



4.4.1 Rationale of the components of e-Readiness

The following premises are the foundation of our analysis:

- There are three important stakeholders to consider in the development and use of ICT: individuals, business and Governments
- The degree of usage of ICT by (and hence the impact of ICT on) the three stakeholders is linked to their degrees of readiness (or capability) to use and benefit from ICT
- There is a general macroeconomic and regulatory environment for ICT in which the stakeholders play out their respective roles.

The logical underpinning being the environment for ICT offered by the concerned State Governments, the readiness of the key stakeholders to use ICT and finally the usage of ICT by these various stakeholders (Figure 4.1)

4.4.2 Methodology

In order to quantify the levels of achievement of each state in terms of e-Readiness and rank them accordingly; we have used a specific Factor–Analytic model - Principal Component Analysis (PCA)(Annex-I, for more details). PCA is a multivariate method of analysis that has been used widely with large multidimensional data sets. Other procedures for this analysis exist such as the data envelopment analysis or the benefit of the doubt approach. The data envelopment analysis (DEA) method estimates an "efficiency frontier" which acts as a benchmark against which all States/Countries are measured. The performance indicator is a ratio of the distance of the state from the origin and from the ideal position along the frontier. The weights of the variables will depend on the positions of the States. The Benefit of the doubt approach consists of the DEA applied to composite indicators. The PCA proved to be best suited to our study for the following reasons:

- The PCA has the advantage of using normalised data, which allows us to compare otherwise incomparable States due to their size differences or varying population densities for example.
- The PCA summarises the set of sub-indicators (in our case environment, readiness and usage) while at the same time preserving the maximum possible proportion of the total variation in the original data.
- It is the most appropriate method for our study because we are comparing the performance of States with regard to e-Readiness and the PCA attributes the largest factor loadings to the sub-indicators that have the largest variation across States. This is pertinent because the sub-indicators that are similar across States are of little utility in explaining the differences in their performance.
- The PCA attributes weights automatically in an objective manner

Weights are given to the variables to reflect their contribution to the overall composite indicator. The weights can have a significant impact on the value of the final composite indicator. The manner in which they are derived therefore becomes of importance and needs to be chosen appropriately. Most composite indicators rely on equal weights by which each variable has the same importance. When considering indicators that reflect a more complex concept however, weights often need to be altered so that those variables that have a greater influence, are given more importance in the measurements. In the DEA method, the weights of the variables depend on the positions of the States. With the BOD approach, the weights are designed to assure the best possible position of the State vis-à-vis the other States. This means that the variable pulling the State closer to the ideal frontier will be given a higher weight than the one in which the State has performed badly. The PCA computes the weights automatically but with this method, they do not reflect the importance of the variable. In PCA, the weights are utilised to minimise the impact of very strongly correlated variables in an attempt to correct for overlapping information. This ensures that when comparing the States, the data that explains the differences i.e. the most varied data, is given more importance.

The use of PCA, allows the number of variables in a multivariate data set to be transformed into a set of orthogonal variables, such that the first transformed variable, known as the first principal component, explains the maximum per centage of variation of the original data-set. The likelihood that the first PC explains a greater per centage of variation of the original data-set increases if the number of variables are small in number. This is

the reason for using multistage PCA, where smaller number of variables for sub-indices are integrated to construct a higher order index.

Using the method mentioned above, we have quantified e-Readiness status of different states of India which allows us to rank the states with regard to their relative positions. Higher the value of the composite index, higher the ranking of the state. The status of states with higher ranking would be taken to be more e-Ready compared to the states with a ranking lower than it in terms of its relative status.

4.4.3 Model

Measuring the levels of e-Readiness at the state level requires a three-step procedure:

(I) Identification of the most important characteristics that represent e-Readiness.

(II) Identification of appropriate indicators (both quantitative and qualitative) of those characteristics.

(III) A rating of states based on a composite index, which reflects the position of a particular state, developed on the basis of the indicators identified in step (II).

As mentioned before, to evolve the e-Readiness index, we have used multistage Principal Component Analysis. Here we have organized the identified indicators into three main categories – environment, readiness and usage, which in turn consist of well-defined sub-groups depending on the nature of the indicators, as shown in Figure 4.1. Within a sub-group, they have a high degree of inter-correlation, while the canonical correlation between pairs of sub-groups is low average. The Principal Component Analysis has then been applied to each of these sub-groups of variables. The first Principal Component obtained from each of the different sub-groups has been treated as a set of new variables and combined at a second stage to obtain the Final Composite Index i.e. e-Readiness index. It has been argued that this method overcomes the necessity of taking more than one principal component in the analysis, since the correlation among the variables in a subgroup are generally high and consequently, the first principal component explains an adequate proportion of the variation in the data matrix.

In our case we have an unobservable dependent variable case. The States' e-Readiness is an unobserved variable, which cannot be concretely measured through a single available indicator. There are several indicators, which indicate e-Readiness collectively. To compare the States in terms of e-Readiness, we have to reduce the relevant factors or variables into one single measure or a Composite Index. A Composite Index can be defined as a linear combination of variables assigning equal or different weights to the variables. These weights can be determined subjectively or based on some statistical or econometric technique. In many cases, equal weights are used to form the Composite Index where it is assumed that each and every variable is equally important in explaining the phenomenon. Sometimes, subjective weights are used when the importance of the variables is known a priori and imposed externally.

We have used a multi-stage PCA to construct the e-Readiness Index of the States. Annexure1 contains the details of this model. In case of multi-stage PCA, the Composite Index formed at a lower level is used as a variable in the next step for computing the Composite Index and so on. Therefore, in this approach, important variables are identified at various stages. We have used the first principal component to form the Composite Index that is characterised by the property of having the largest sum of squared correlations. This process is applied to each sub-group of the identified components of e-Readiness. The first principal factors obtained from the different sub-groups were treated as a set of new variables and combined at the second stage to obtain the index of the components. Similarly, the first principal component of the broad indicators of e-Readiness was used to obtain the Composite e-Readiness Index (Figure 4.1).

4.4.4 Variables selected

The robustness of an index depends to a very large extent on the variables that have been included to construct it. Here in this section, at first we look at the categorization of the indicators of e-Readiness Index we have selected for our modeling purpose (Table 4.4). Then we briefly discuss the steps involved in the construction of final composite index i.e. e-Readiness Index.

Table 4.1: Categorisation of the Indicators of e-Readiness Index

Major category	Sub-major category	Minor category
1. Environment	11 Market Environment	111 Competition in the cellular market
		112 Competition in the Telecom market
		113 Competition in the ISP market
		114 Proportion of software and services export to total export from the state
	12 Political and Regulatory Environment	121 Duration of implementation of ICT Policy in the State
		122 Range of policies taken for e-Governance
		123 Range of policies taken for ICT companies
		124 Range of security policies
	13 Infrastructure Environment	131 Proportion of villages with Village Public telephones (VPTs)
		132 Teledensity
		133 Rural/Urban teledensity
		134 Cellular Teledensity
		135 Per centage of schools with computer labs
		136 Per centage of schools with Internet access
		137 Number of community information centre per lakh population
2 Readiness	21 Individual Readiness	211 Per centage of IT qualified teacher to total teachers
		212 Per centage of computer Engineers to total engineers
		213 Per centage of MCA to total technical students (Masters)
		214 Per centage households with PCs
		215 Per centage of household with internet connection
		216 Per centage of household with mobile
		217 Per centage of household with telephone

Major category	Sub-major category	Minor category
	22 Business Readiness	221 IT Park density
		222 Per centage IT companies to total companies
		223 RCA[1] of ICT export
	23 Government Readiness	231 Per centage of expenditure on technical education to total expenditure
		232 Per centage of policies taken by the Government for IT readiness
3 Usage	31 Individual usage	312 Current year-to-year growth rate in the number of internet users
		313 Average monthly household expenditure on telephone, mobile and internet
	32 Business Usage	321 Share of companies using Lease Lines , ISDN and VSAT
	33 Government Usage	331 Proportion of policies taken for ICT usage
		332 Have government employee records been computerised?
		333 Status of accessibility of the information and services by the citizen
		334 Government expenditure on ICT/NSDP
		335 Proportion of e-Governance workshops to total undertaken e-Governance projects
		336 Proportion of implemented e-Governance projects to the total initiated, ongoing and implemented e-Governance projects
		337 Proportion of workshops to duration of IT policy

The following steps have been used in constructing the e-Readiness Index:

1. First we have used PCA to compress the minor category indicators under each sub–major categories like Market Environment, Political and Regulatory Environment, Infrastructure Environment, Individual Readiness, Business Readiness, Government Readiness, Individual Usage, Business Usage and Government Usage (For indicators under these heads refer to Figures 4.2, 4.3 and 4.4)

2. In the second step we have used PCA to combine the sub–major categories and construct indices for the indictors of major categories (Environment Index, Readiness Index and Usage Index).

3. Finally, again applying PCA we constructed the aggregate e-Readiness Index by combining the Environment, Readiness and Usage indices.

This method alleviates the necessity of taking more than one principal factor, since the correlations among the variables in a sub-group are generally high. Consequently, the first principal component explains an adequate proportion of variation in the data matrix.

As mentioned earlier, we have improved the variables used to measure the various components of e-Readiness in 2006. The comparative list of variables is given in Tables 4.2 to 4.4.

Table 4.2: Comparison of Variables Indicating Environmental Component for e-Readiness in years 2005 and 2006

Environment	Variables in the year 2006	Variables in the year 2005
11 Market Environment	• Competition* in Cellular Market • Competition* in Telecom Market • Competition* in ISP Market • Proportion of software and services export to total export from the state	• Number of players in the Telecom Market. • Number of players in the ISP Market. • Number of players in the Cellular Market.
12 Political and Regulatory Environment	• Duration of implementation of ICT Policy in the State • Range of policies taken for e-Governance • Range of policies taken for ICT companies • Range of security policies	• Proportion of policies taken for e-Governance • Proportion of policies taken for ICT companies • Proportion of Security Policies
13 Infrastructure Environment	• Proportion of villages with VPTs • Teledensity • Rural/urban teledensity • Cellular teledensity • Per centage of schools with computer labs • Per centage of schools with internet access	• Average distance in kilometers from the nearest - Primary School - Post Office - Public Telephone booth - Computer Training Center - College - Internet Kiosk - Medical Store

Note: *The indicators included in the Competition are:
Number of players in the concerned market
Market share other than the top player's share
Growth of the number of players in the market relative to the last year

Table 4.3: Comparison of Variables Indicating Readiness Component for e-Readiness in years 2005 and 2006

Readiness	Variables in the year 2006	Variables in the year 2005
21 Individual Readiness	• Per centage of IT qualified teacher to total teachers • Per centage of MCA to total technical students Masters • Per centage households with PCs • Per centage of household with internet connection • Per centage of household with mobile • Per centage of household with telephone	• Total BSc (Computer Science) students/ total technical students. • Total number of engineering students / total technical students • Total MCA students/ total technical students • Per centage households with PCs • Per centage of household with mobile • Per centage of household with telephone
22 Business Readiness	• IT Park density • Per centage IT companies to total companies • RCA of ICT export	• Total no of employment in IT companies/total number of IT parks. • ICT exports to total Exports
23 Government Readiness	• Per centage of expenditure on technical education to total expenditure • Per centage of policies taken by the Government for IT readiness	• Proportion of policies taken for ICT Readiness • Per centage of top officials with on-line training programmes • Per centage of government expenditure on secondary education • How many ministries use ICT in governance process/functioning process?

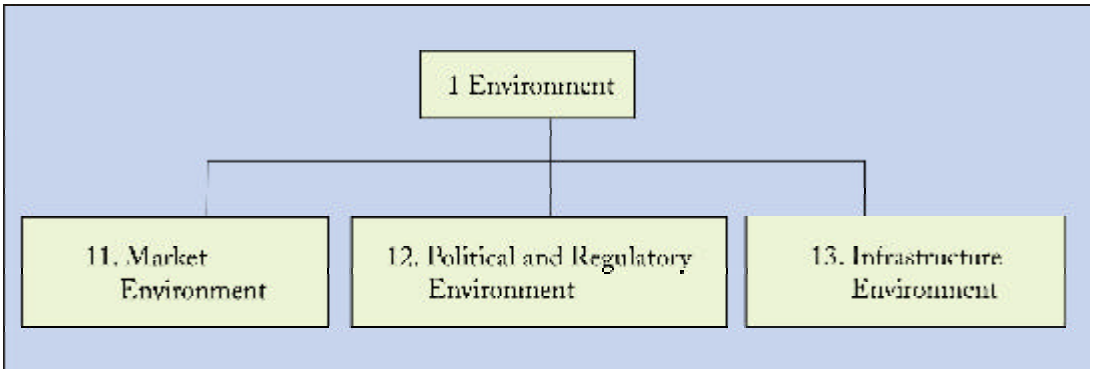
Table 4. 4: Comparison of Variables Indicating Usage Component for e-Readiness in years 2005 and 2006

Usage	Variables in the year 2006	Variables in the year 2005
31 Individual Usage	• Current year-to-year growth rate in the number of internet users • Average monthly household expenditure on telephone, mobile and internet	• Per Capita Net State Domestic Product • Average monthly household expenditure on telephone, mobile and internet
32 Business Usage	• Share of companies using Lease Lines , ISDN and VSAT	• Share of companies using VSAT and ISDN
33 Government Usage	• Proportion of policies taken for ICT usage • Have government employee records been computerised? • Status of accessibility of the information and services by the citizen • Proportion of implemented e-Governance projects to the total initiated, ongoing and implemented e-Governance projects • Proportion of workshops to duration of IT policy	• Proportion of policies taken for ICT Usage • Status of accessibility of the information and services to the citizen • Total number of e-Governance projects undertaken

4.5 State level Position of 2006 e-Readiness Status

As specified above, the three major components considered for measurement of the e-Readiness index are environment, readiness and usage. Figure 4.2 lists the three sub-components of environment which are market environment, political and regulatory environment and infrastructure environment. Market environment captures the competition and size of the IT market with respect to cellular, telecom, internet service providers as well as relative size of software exports. The second sub-component, i.e. political and regulatory environment, attempts to capture the responsiveness of the respective state governments in promoting the IT sector. The areas that this sub-index captures are policies in the IT sector, policies related to specifically promote e-Governance, incentives given to IT companies and policies to address the security concerns in e-Governance. The third sub-component relates to state-level infrastructure that is basic for implementation of e-Governance.

Figure: 4.2: Environmental Sub-indices for Measurement of e-Readiness



Next we discuss the PCA result of Environment sub-index.

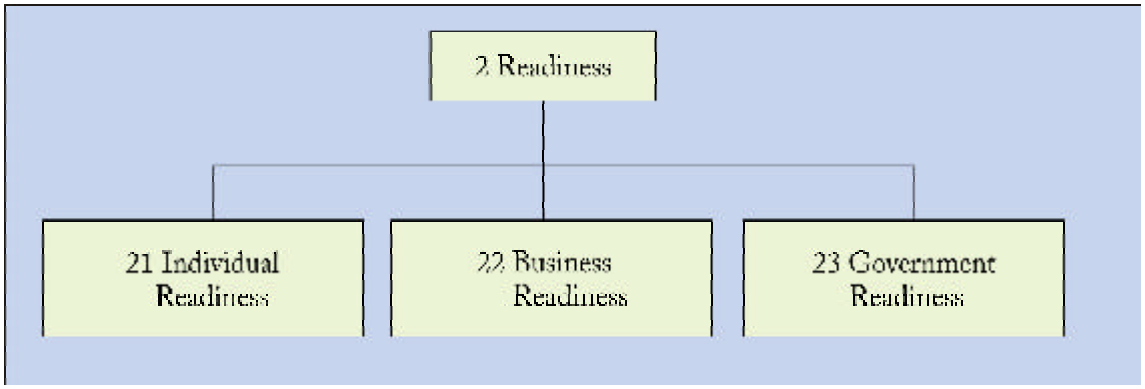
Table 4.5: PCA result of Environment Index

Environment	Variables**	Factor loadings / weights#	Per centage of variation explained by the composite sub-index
14 Market Environment	111 Competition* in Cellular Market	0.774	55.36
	112 Competition* in Telecom Market	0.866	
	113 Competition* in ISP Market	0.820	
	114 Proportion of software and services export to total export from the state	0.440	
15 Political and Regulatory Environment	121 Duration of implementation of ICT Policy in the State	0.841	69.93
	122 Range of policies taken for e-Governance	0.926	
	123 Range of policies taken for ICT companies	0.671	
	124 Range of security policies	0.884	
16 Infrastructure Environment	131 Proportion of villages with VPTs	0.431	
	132 Teledensity	0.836	
	133 Rural/urban teledensity	0.323	
	134 Cellular teledensity	0.771	
	135 Per centage of schools with computer labs	0.684	
	136 Per centage of schools with internet access	0.756	

Notes:
**Significant at 5 per cent level of significance. Some variables have been dropped, inclusion would reduce the percentage of variation explained by the variables included in the model.
#Significant at 1 per cent level of significance
*The indicators included in the Competition are:
Number of players in the concerned market
Market share other than the top player's share
Growth of the number of players in the market relative to the last year

Table 4.5 presents the factor loadings i.e. the weightages that have been given to construct the various sub-indices. As mentioned before, we have followed the method of a step-wise construction of indices at various levels to arrive at the final e-Readiness index. In the market environment sub-index, competition within the market is more important than the share of export in the relevant sector to the total exports from the states. Within competition, telecom competition has got a higher weightage compared to competition in the cellular or internet service sector. In the construction of the sub-index of political and regulatory environment, understandably, the direct state responsiveness towards e-Governance is a more significant variable compared to duration for which the policies were undertaken or promotion of ICT companies. Within the infrastructure sub- index, the variable of maximum importance is basic teledensity. Per centage of cellular density and per centage of schools with internet access comes second in importance. What emerges from the above analysis is that basic telephones are more important in explaining the environment suitable for e-Readiness compared to either cellular connectivity or internet services in general, though these are also important. Secondly, the direct initiative of state governments in promoting e-Governance policies is more important compared to the state's promotion of ICT industries or even the security policies of streamline e-Governance at the moment. What this implies is that the direct role of the Government is still more crucial that the role of the private sector in terms of market environment, provision of infrastructure and political and regulatory environment in promoting a conducive environment for e-Governance.

Figure 4.3: Readiness Sub-indices for Measurement of e-Readiness



As can be observed from Figure 4.3, the three sub-components of readiness are individual, business and government readiness. Individual readiness has been captured by two sets of variables- educational qualification and access to individual infrastructure like internet connection and mobile. It is important to note that while state level infrastructure in this analysis has been considered to be a part of the environment, access to infrastructure by individuals have been considered as a part of readiness. In business readiness their developmental status has been taken into consideration like IT park density and their revealed comparative advantage vis-à-vis IT export has also been taken into account. Government readiness has to do with its expenditure on technical education as well as the set of policies that have been undertaken to promote readiness to e-Governance.

Table 4.6: PCA result of Readiness Index

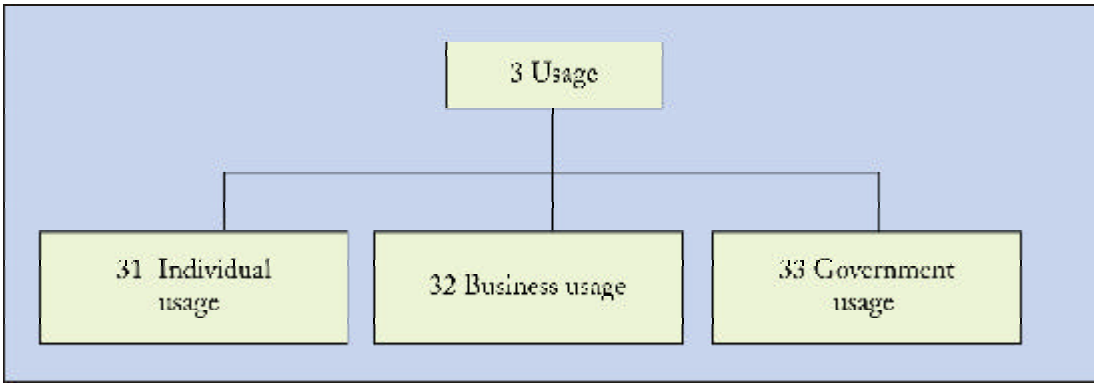
Readiness	Variables	Factor loadings / weights#	Per centage of variation explained by the composite sub-index
21 Individual Readiness	211 Per centage of IT qualified teacher to total teachers	0.346	51.304
	213 Per centage of MCA to total technical students (Masters)	0.312	
	214 Per centage households with PCs	0.789	
	215 Per centage of household with internet connection	0.730	
	216 Per centage of household with mobile	0.935	
	217 Per centage of household with telephone	0.911	
22 Business Readiness	221 IT Park density	0.524	47.97
	222 Per centage IT companies to total companies	0.782	
	223 RCA of ICT export	0.743	
23 Government Readiness	231 Per centage of expenditure on technical education to total expenditure	0.50	——ψ
	232 Per centage of policies taken by the Government for IT readiness	0.50	

Note ψ For only two variable cases, same weight has been given.

Table 4.6 reveals the factor loadings and per centage of variation of explained by the variables taken to measure sub-components of readiness. In determination of individual readiness, telephone and mobile connections for individuals seem to be more significant. Overall, it is observed that individual access to IT infrastructure is more important in determining individual readiness compared to their level of technical qualification or education. For the business readiness sub-index, the share of IT companies to total companies and their comparative advantage in exports is almost equally important in terms of their weighs.

Even with favourable environment and readiness, the actual usage of IT for promoting e-Governance may not be done optimally. In essence, the element of usage captures efficiency of available environment and readiness. Again usage can be separately defined for the individual, business and the government (Figure 4.4).

Figure 4.4: Usage Sub-indices for Measurement of e-Readiness



Since individual usage is captured by only two variables, instead of using factor analysis, the standardized values for these have simply been added. In other words, they have been given the same weights. Similarly, for business readiness, only one variable has been considered. For Government readiness, however, a number of variables such as policies promoting usage, using IT for citizen service, computerization of government employee record, ratio of implemented e-government projects to initiated projects and duration of training workshops, were considered. Among these policies, citizen services and training workshops were the most important in construction of the index of government usage (Table 4.7).

Table 4.7: PCA Result of Usage Index

Usage	Accepted Variables**	Factor loadings / weights#	Per centage of variation explained by the composite sub-index
34 Individual Usage	311 Current year-to-year growth rate in the number of internet users	0.50	——ψ
	312 Average monthly household expenditure on telephone, mobile and internet	0.50	
35 Business Usage	321 Share of companies using Lease Lines , ISDN and VSAT	1.0	———
36 Government Usage	331 Proportion of policies taken for ICT usage	0.747	39.39
	332 Computerisation of government employee records	0.664	
	333 Status of accessibility of the information and services by the citizen	0.722	
	336 Proportion of implemented e-Governance projects to the total initiated, ongoing and implemented e-Governance projects	0.517	
	337 Proportion of workshops to duration of IT policy	0.758	

Note: ψFor only two variable cases, same weight has been given.

Using the above stated variables the sub-components of the environment, readiness and usage indices were constructed. These sub-components have a similarity in the sense that all three of them have the market/business and Government components in it. The indices of readiness and usage also have the responsiveness of individuals. The environment index, however, has the important infrastructure subcomponent in it. Table 4.8 provides the results of the aggregation of these components into the three basic indices of environment, readiness and usage into it.

Table 4.8: PCA Results for Construction of Environment, Readiness and Usage Index

Environment Index	Factor Loadings	% of Variation Explained
Market Environment	0.595	59.8
Political and Regulatory Environment	0.835	
Infrastructure Environment	0.843	
Readiness Index		
Government Readiness	0.761	57.3
Individual Readiness	0.752	
Business Readiness	0.675	
Usage Index		
Individual Usage	0.923	57.5
Government Usage	0.878	
Business Usage	0.196	

One observation that emerges from Table 4.8 is that the responsiveness of the government and individuals is more important in the construction of the sub-indices of e-Readiness compared to the role of the market or the business. e-Readiness of states is focused at the purpose of e-Governance. Our results clearly show that the market on its own cannot take care of efficiency of governance, even in a situation where privatization has a substantive and clearly identifiable role in promoting the technology of e-Governance. Even the access to individual infrastructure and usage capabilities are indirectly affected by government policies (investment in education, network of basic telephones, pricing policies, incentives given to individuals for promotion of IT).

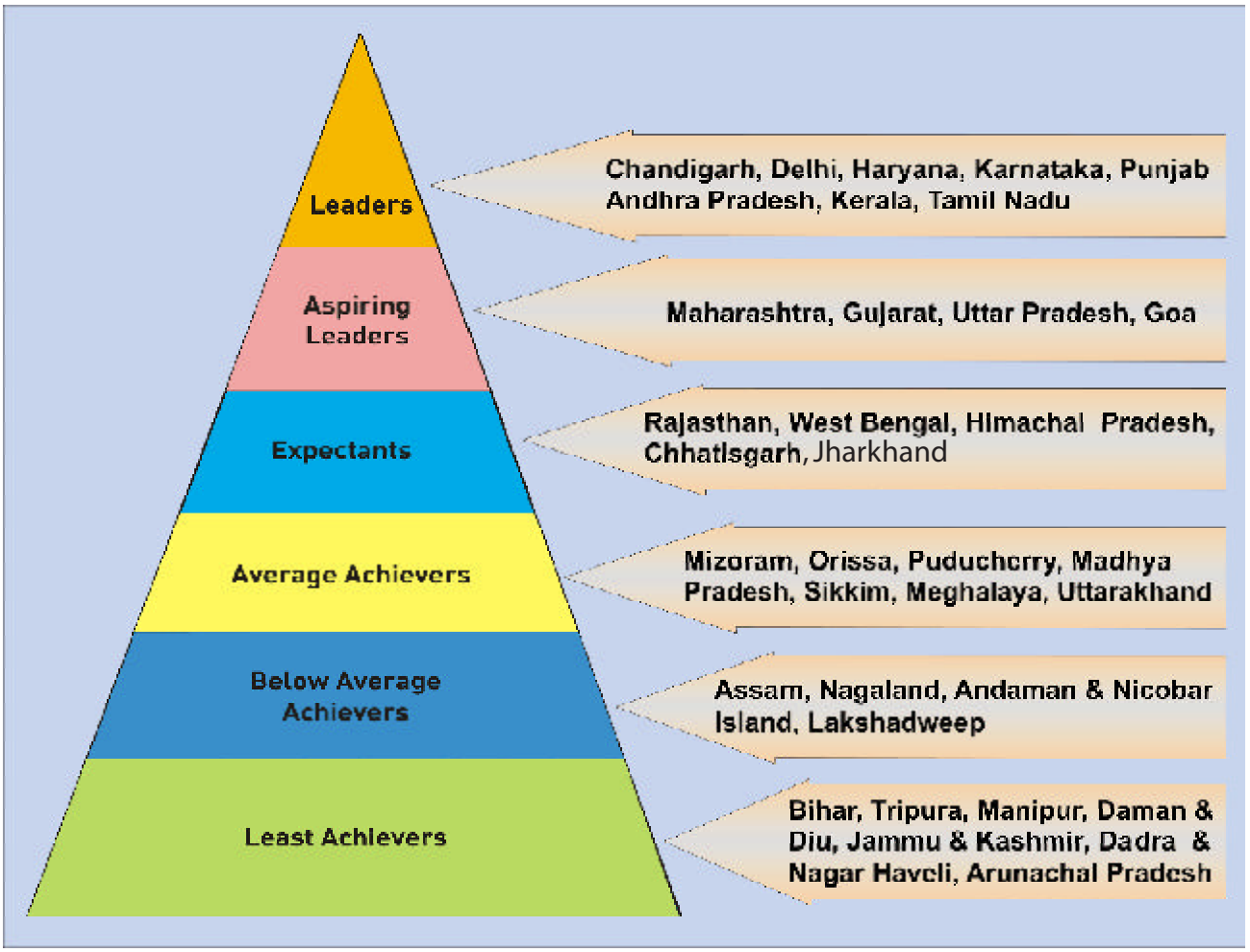
Table 4.9: PCA Results for Construction of e-Readiness Index

Final Composite index	Major Group Indicators	Factor Loadings / Weights[#]	Per centage of Variation Explained by the Composite Sub-index
e-Readiness	Environment	0.932	83.39
	Readiness	0.903	
	Usage	0.905	

Note: [#]Significant at 1% level of significance.

Table 4.9 reveals that the three sub-components of environment, readiness and usage are almost equally important in construction of the e-Readiness index, as the weightages of all three are nearly equal and high. The three sub-indices together explain as much as 83.39 per cent of the variability in e-Readiness.

Figure 4.5: Ranking of States in Terms of Different Levels



The north-western states and the southern states occupy the rank of leaders in terms of the overall e-Readiness index (Figure 4.5). States like Haryana and Chandigarh are leaders in terms of the Environment and Readiness indices as well. In terms of usage, the spread of the data is low and none of the states occupy the leaders rank. Karnataka is the best performing state out of southern Indian states and occupies the position of aspiring leaders in terms of environment, readiness and usage indices and that of leaders in terms of the final e-Readiness indices. Thus while the southern region had a leading position even in the last years' e-Readiness ranking, the north-western states have emerged this year in the same position. Developed western states like Maharashtra, Gujarat and Goa, along with Uttar Pradesh occupy the aspiring leaders' position. While Maharashtra and Gujarat occupy the leaders' rank in terms of the environment index, they are much lower down in the rank of expectants in terms of the readiness and usage indices. Among the eastern states, only West Bengal is in the rank of expectants, while the others have a negative e-Readiness value. In Table: 4.10 we have distributed the states according to their performance in composite index i.e e-Readiness as well as sub-indices viz. Environment, readiness and usage. The states have been classified in terms of their e-Readiness on the basis of index value as follows:

- Leaders (L1): Index value above 1.0
- Aspiring Leaders (L2): 0.5 to 1.0
- Expectants (L3): 0 to 0.5
- Average Achievers (L4): -0.5 to 0
- Below Average Achievers (L5): -1.0 to –0.5
- Least Achievers (L6): below –1.0

Table 4.10: Distribution of States for Environment, Readiness, Usage and e-Readiness

Levels	Environment	Readiness	Usage	e Readiness
L1	Punjab Haryana, Delhi Chandigarh Gujarat Maharashtra	Haryana Chandigarh, Kerala		Chandigarh, Delhi Haryana Karnataka, Punjab Andhra Pradesh Kerala Tamil Nadu
L2	Karnataka Tamil Nadu Kerala Goa West Bengal Uttar Pradesh Andhra Pradesh	Karnataka, Andhra Pradesh, Delhi Tamil Nadu	Chandigarh Delhi Karnataka Chhatisgarh	Maharashtra Gujarat Uttar Pradesh Goa
L3	Puducherry Rajasthan Himachal Pradesh Mizoram	Uttar Pradesh, Goa, Punjab, Maharashtra, Puducherry, West Bengal	Andhra Pradesh Tamil Nadu Rajasthan Maharashtra Punjab Mizoram Haryana Kerala Himachal Pradesh Jharkhand West Bengal Gujarat Goa Uttar Pradesh	Rajasthan West Bengal Himachal Pradesh Chhatisgarh Jharkhand
L4	Jharkhand Orissa Madhya Pradesh Nagaland Assam Chhatisgarh	Orissa, Lakshadweep, Jharkhand, Uttarakhand, Madhya Pradesh, Gujarat, Chhatisgarh, Sikkim, Himachal Pradesh, Rajasthan, Meghalaya, Andaman & Nicobar Island, Assam	Sikkim Meghalaya Orissa Uttarakhand Assam Madhya Pradesh Andaman & Nicobar	Mizoram Orissa Puducherry Madhya Pradesh Sikkim Meghalaya Uttarakhand

Levels	Environment	Readiness	Usage	e Readiness
L5	Sikkim Uttarakhand Meghalaya Tripura Bihar Manipur Andaman & Nicobar	Nagaland, Jammu & Kashmir, Mizoram, Dadra & Nagar Havelli, Manipur, Arunachal Pradesh, Daman & Diu, Bihar	Bihar Tripura Nagaland Daman & Diu Puducherry Manipur Arunachal Pradesh Lakshadweep	Assam Nagaland Andaman & Nicobar Lakshadweep
L6	Lakshadweep Dadra & Nagar Haveli Jammu & Kashmir Daman & Diu Arunachal Pradesh	Tripura	Jammu & Kashmir Dadra & Nagar Haveli	Bihar Tripura Manipur Daman & Diu Jammu & Kashmir Dadra & Nagar Haveli Arunachal Pradesh

Most of the hilly and island states with physical constraints have ranks of under-achievers and Least Achievers.

Table A 4.1 to A 4.4 provide the distribution of states at different levels for the four indices. The distribution of environmental index is more or less even in each category (L1 to L6). For the readiness index, 13 states are skewed in L4 level, which is a category below average. Only seven states belonging to the north-western and southern India occupy the first two categories. For the usage index, there is no state in the L1 stage. 14 states are concentrated in the L3 category, which is just above average. The e-Readiness index distribution more or less follows the environment index and is distributed across all categories.

Figure 4.6: e-Readiness and its components: Regional Pattern

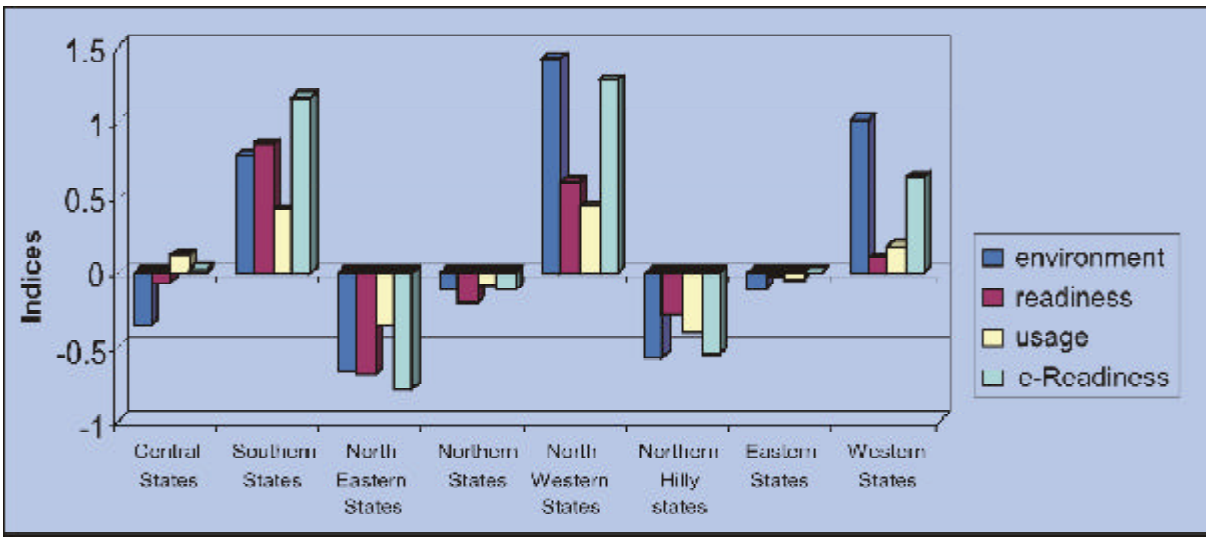


Table 4.11: Regional Construction for Analysis

Region	States
North	Uttar Pradesh, Jharkhand, Bihar
North-West	Chandigarh, Haryana, Delhi, Rajasthan, Punjab
North- East	Tripura, Manipur, Mizoram, Meghalaya, Assam, Nagaland, Arunachal Pradesh, Sikkim
Central	Chhatisgarh, Madhya Pradesh
East	Orissa, West Bengal, Andaman & Nicobar Island
West	Maharashtra, Gujarat, Dadra & Nagar Haveli, Daman & Diu, Goa
South	Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Puducherry, Lakshadweep
Northern Hilly	Himachal Pradesh, Jammu & Kashmir, Uttarakhand

Figure 4.6 reveals the different indices at the regional level (as given in Table 4.11). It is clear from the figure that the north western states have come up more than the southern states in terms of the final e-Readiness index and the driver of this trend is the environment index where these states rank much higher compared to the southern states. The southern states rank higher than north-western states in terms of readiness, however. The usage component is comparable for both the regions. The western group of states is third in terms of relative ranks and has done particularly badly in terms of readiness, though they are higher in terms of environment compared to even the southern states. The Hilly states, both the north-eastern ones as well as the northern hilly states like Jammu and Kashmir, Himachal and Uttarakhand are in the category of under-achievers and Least Achievers. This probably means that IT technology has been unable to overcome the physical constraints like remoteness of these areas. Table 4.12 reveals the region-wise distribution of states by e-Readiness index.

Table 4.12: Region-wise Distribution of States by e-Readiness Index

Region	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Total
North	0	1	1	0	0	1	3
North-West	4	0	1	0	0	0	5
North- East	0	0	0	3	2	3	8
Central	0	0	1	1	0	0	2
East	0	0	1	1	1	0	3
West	0	3	0	0	0	2	5
South	4	0	0	1	1	0	6
Northern Hilly	0	0	1	1	0	1	3
Total	8	4	5	7	4	7	35

Table 4.12 brings out a similar kind of picture as Figure 4.6. It also brings out the distribution of individual states at different levels of e-Readiness. The north-western region leads with 4 states in L1, and has only Rajasthan at level 3, which is also a level which has an above average position. The southern region has two states (island states) in below average ranks, while the main four states of Kerala, Tamil Nadu, Andhra Pradesh and Karnataka are in the top ranks. The central and eastern states are distributed in the middle ranks. Among the northern states, Uttar Pradesh and even Jharkhand are doing much better not being in the lowest ranks. Both categories of hilly states are not positioned well, but the north eastern states are worst off compared to all other regions, as all the eight states are concentrated in the three bottom levels.

Taking into consideration the fact that the size of the state, both in terms of area and population matters in

governance, we have given 10 per cent weight to area and 10 per cent to population while retaining 80 per cent weight for our e-Readiness index. This really means that in this modified index, the larger, more populous states have been pushed up, while the smaller ones have been pushed down. Table 4.13 compares the original e-Readiness and modified e-Readiness indices. It is observed that while states like Maharastra, Uttar Pradesh, Rajasthan, Assam, Madhya Pradesh and Bihar have gained by around one level, smaller states like Punjab, Kerala, Goa have lost out.

Table 4.13: Comparison of e-Readiness Index and e-Readiness Modified Index with Size Friction Element

e-Readiness	e-Readiness_mod (with size friction points)	Levels
Chandigarh Delhi Haryana Karnataka Punjab Andhra Pradesh Kerala Tamil Nadu	Karnataka Andhra Pradesh Chandigarh Haryana Delhi Maharashtra Tamil Nadu Uttar Pradesh	L1
Maharashtra Gujarat Uttar Pradesh Goa	Punjab Kerala Rajasthan Gujarat	L2
Rajasthan West Bengal Himachal Pradesh Chhatisgarh Jharkhand	West Bengal Goa Chhatisgarh Himachal Pradesh Madhya Pradesh Jharkhand	L3
Mizoram Orissa Puducherry Madhya Pradesh Sikkim Meghalaya Uttarakhand	Orissa Mizoram Puducherry Sikkim Uttarakhand Meghalaya Assam	L4
Assam Nagaland Andaman & Nicobar Lakshadweep	Nagaland Bihar Andaman & Nicobar Lakshadweep	L5
Bihar Tripura Manipur Daman & Diu Jammu & Kashmir Dadra & Nagar Haveli Arunachal Pradesh	Jammu & Kashmir Tripura Manipur Daman & Diu Arunachal Pradesh Dadra & Nagar Haveli	L6

The following maps (Figure 4.7.1 through 4.7.3) give a clear picture of the state performance in the major components of e-Readiness. These maps are generated using Geographic Information System (GIS) technique.

Figure 4.7.1: Environment sub-index

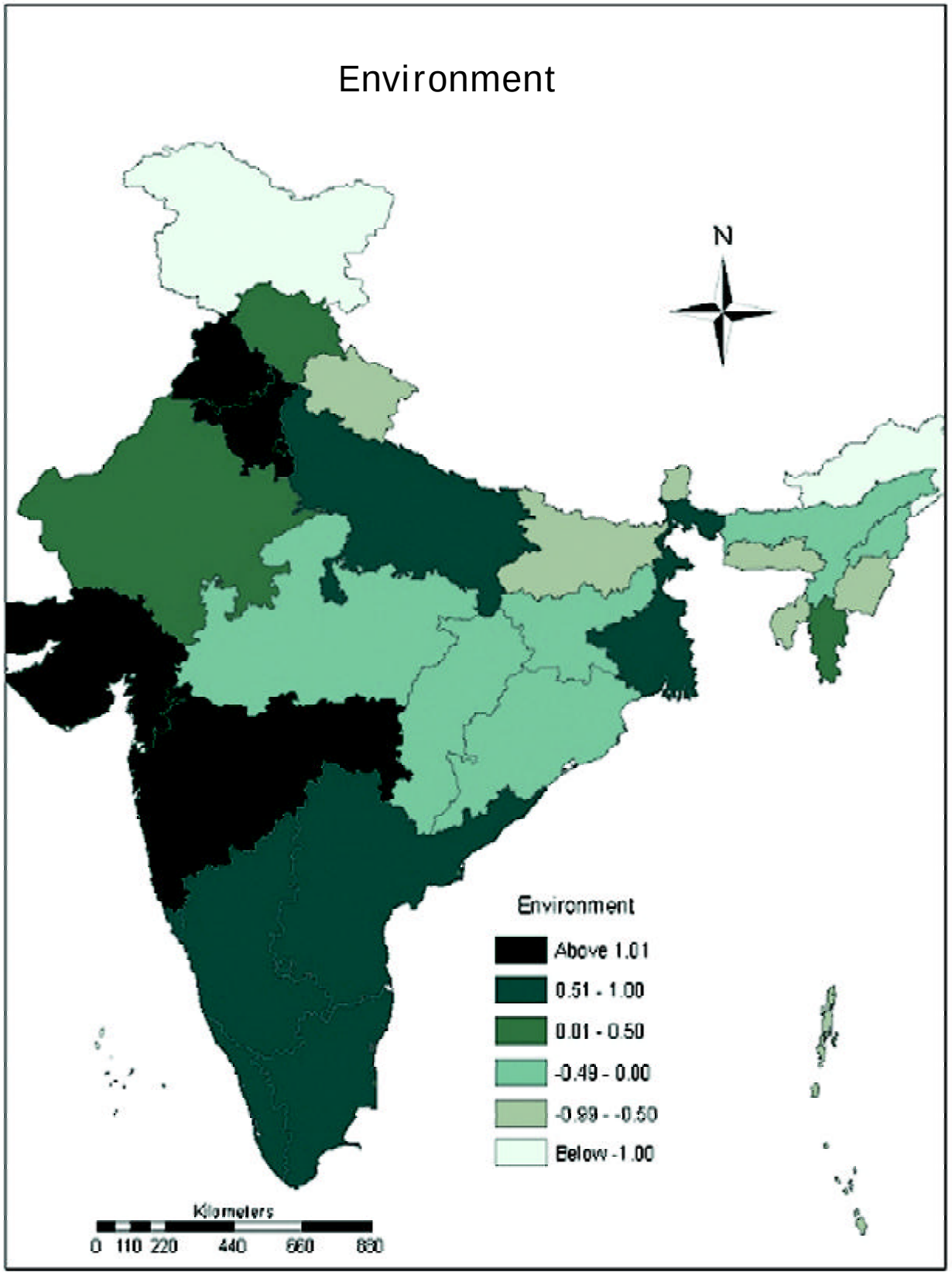


Figure 4.7.2: Readiness sub-index

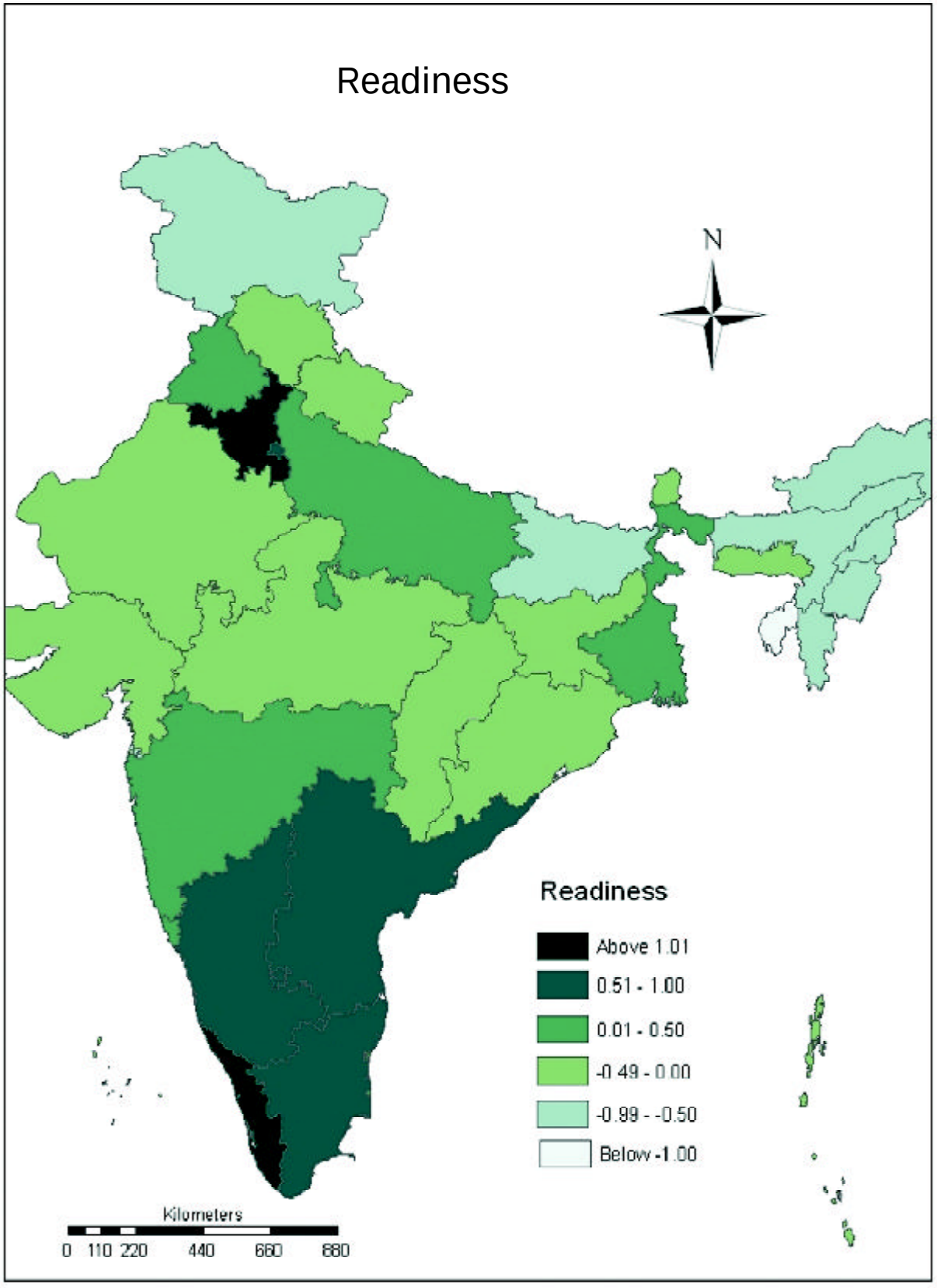


Figure 4.7.3: Usage sub-index

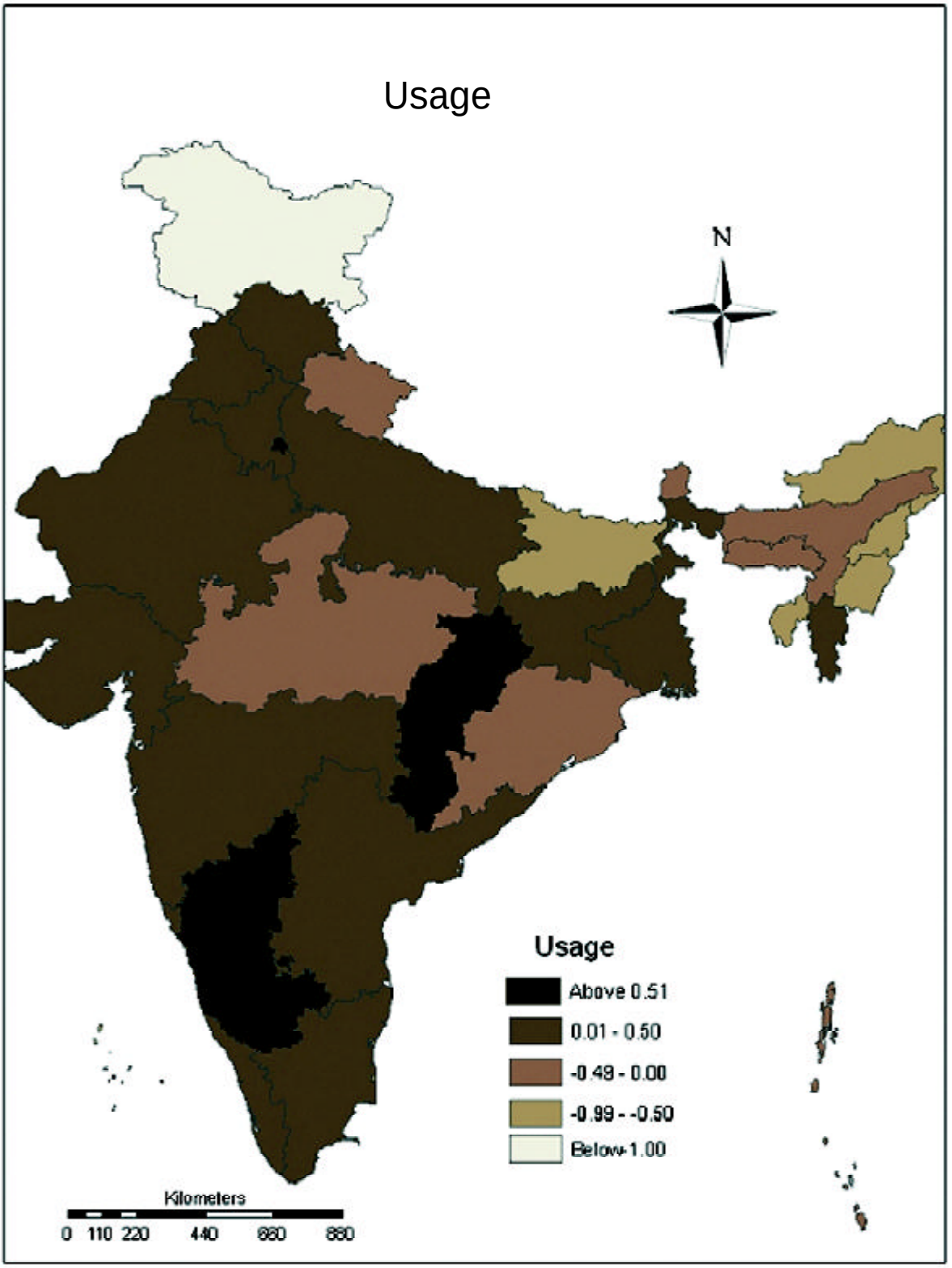


Figure 4.8 is the cartography presenting the State/UTs' performance in the composite index- e-Readiness.

Figure 4.8: e-Readiness

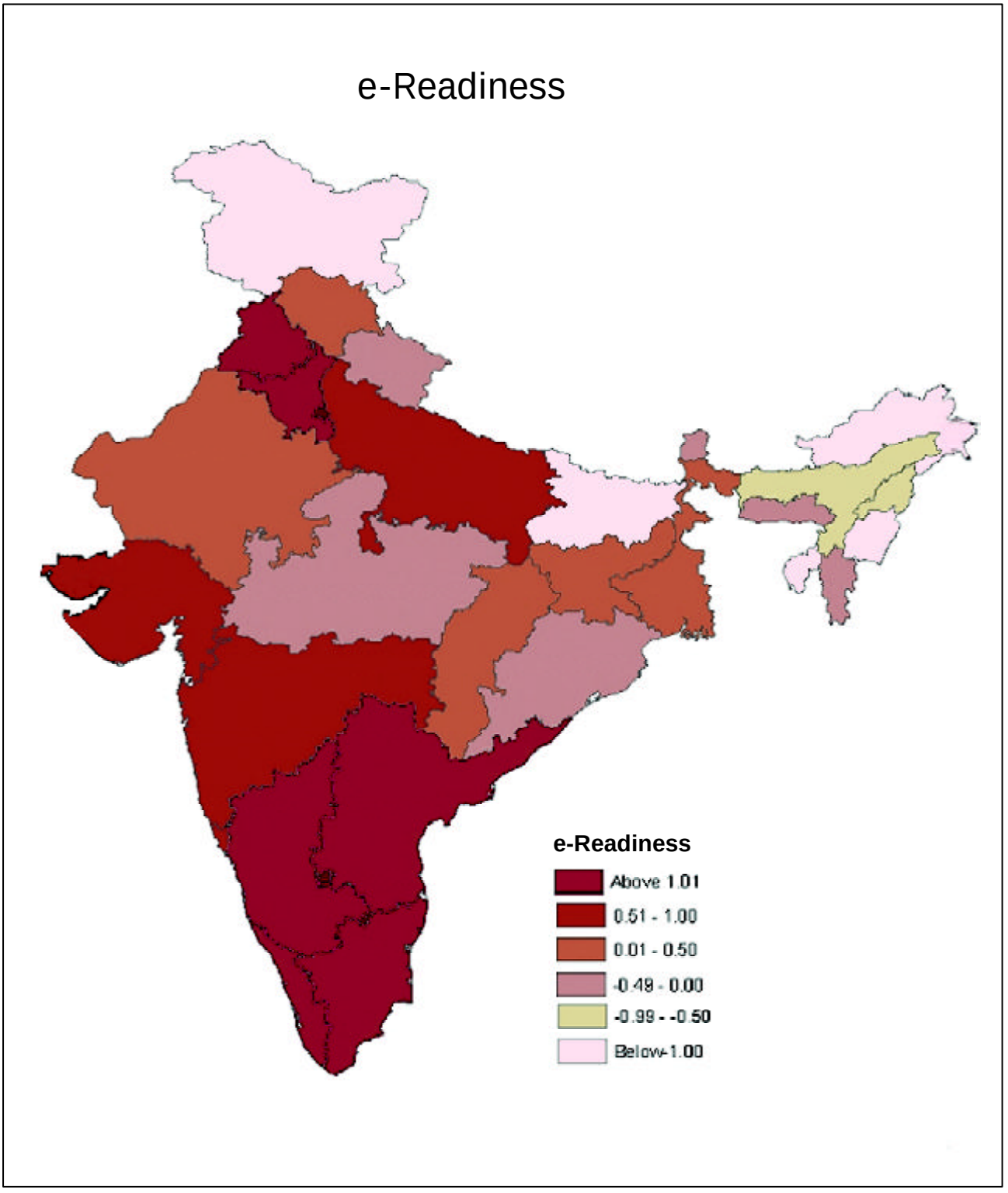


Figure 4.9.1 is presenting the State/UTs' performance in environment and readiness Indices together.

Figure 4.9.1: Environment and Readiness

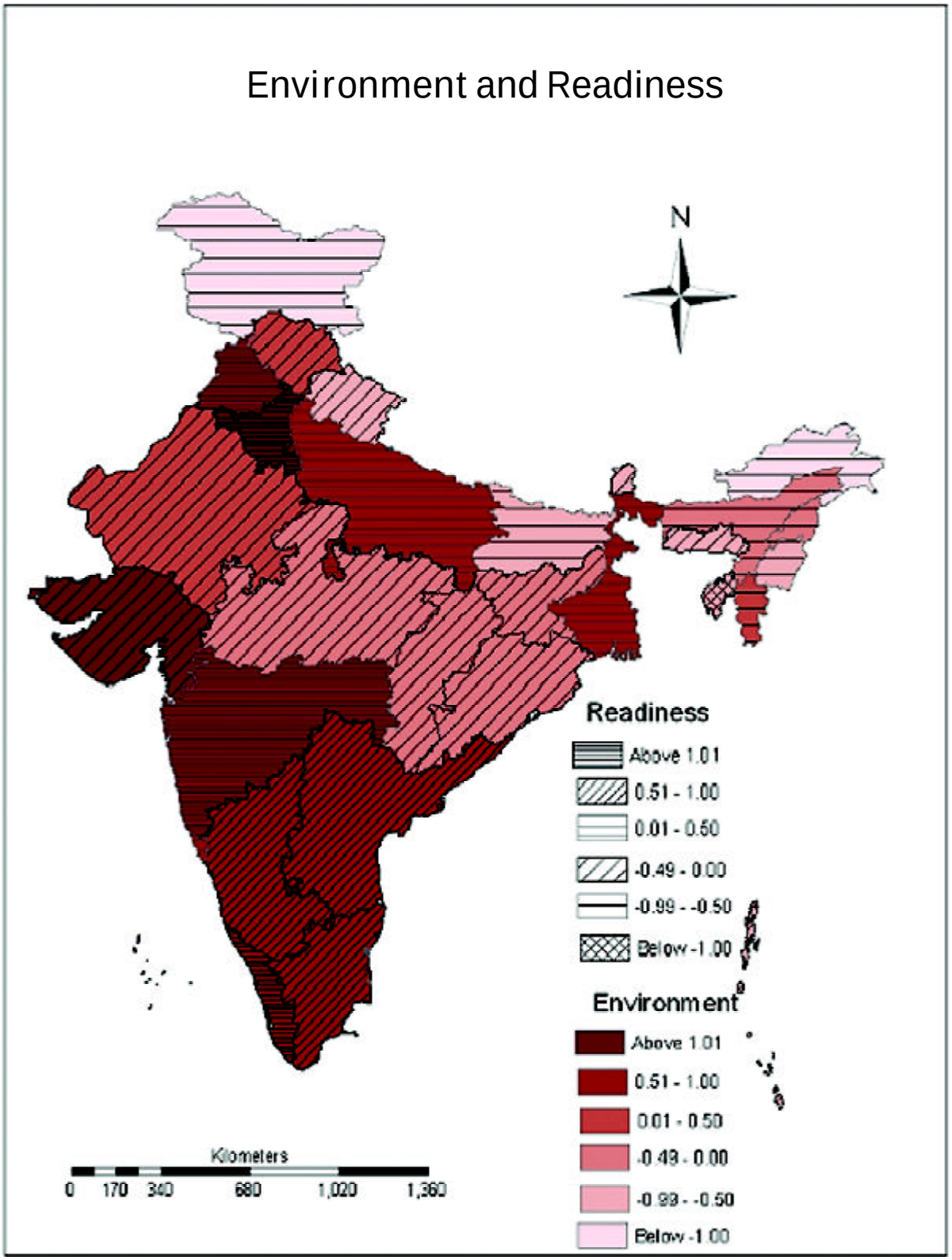


Figure 4.9.2 is the graphical presentation of the State/UTs' performance in environment and usage indices together.

Figure 4.9.2: Environment and Usage

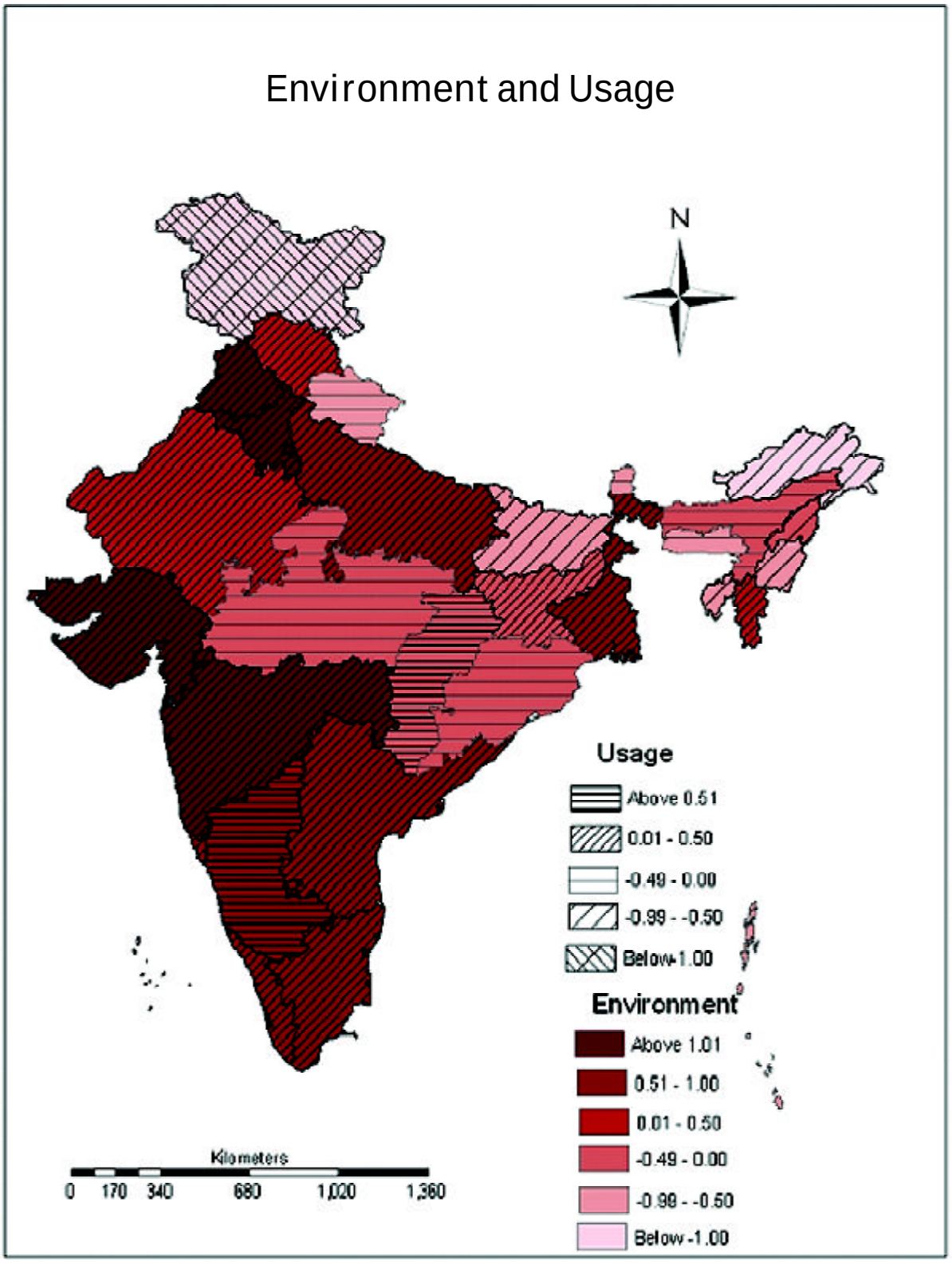


Figure 4.9.3 is the graphical presentation of the State/UTs' performance in readiness and usage indices together.

Figure 4.9.3: Readiness and Usage

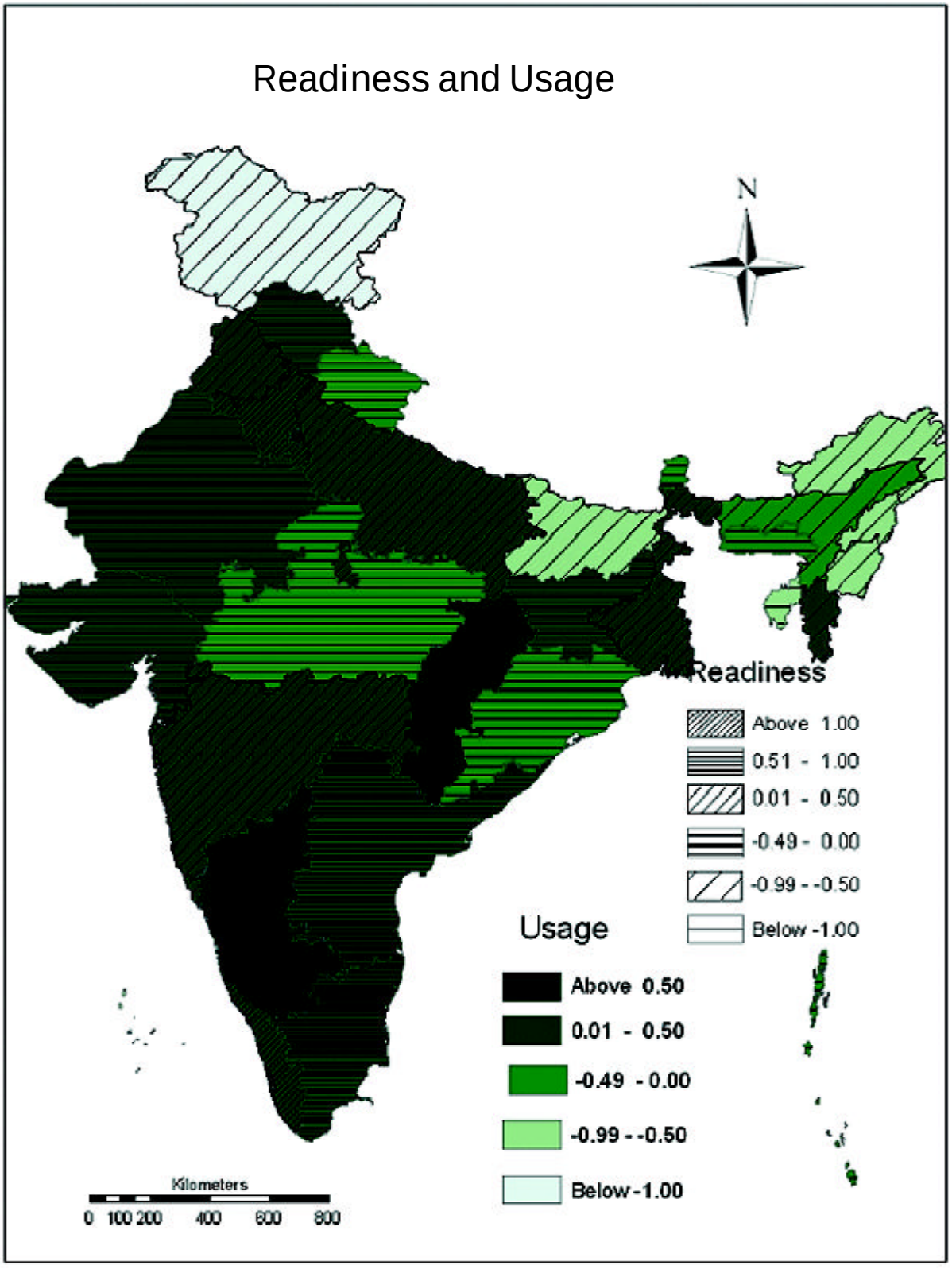


Figure 4.9.4 is the graphical presentation of the State/UTs' performance in environment and e-Readiness indices together.

Figure 4.9.4: Environment and e-Readiness

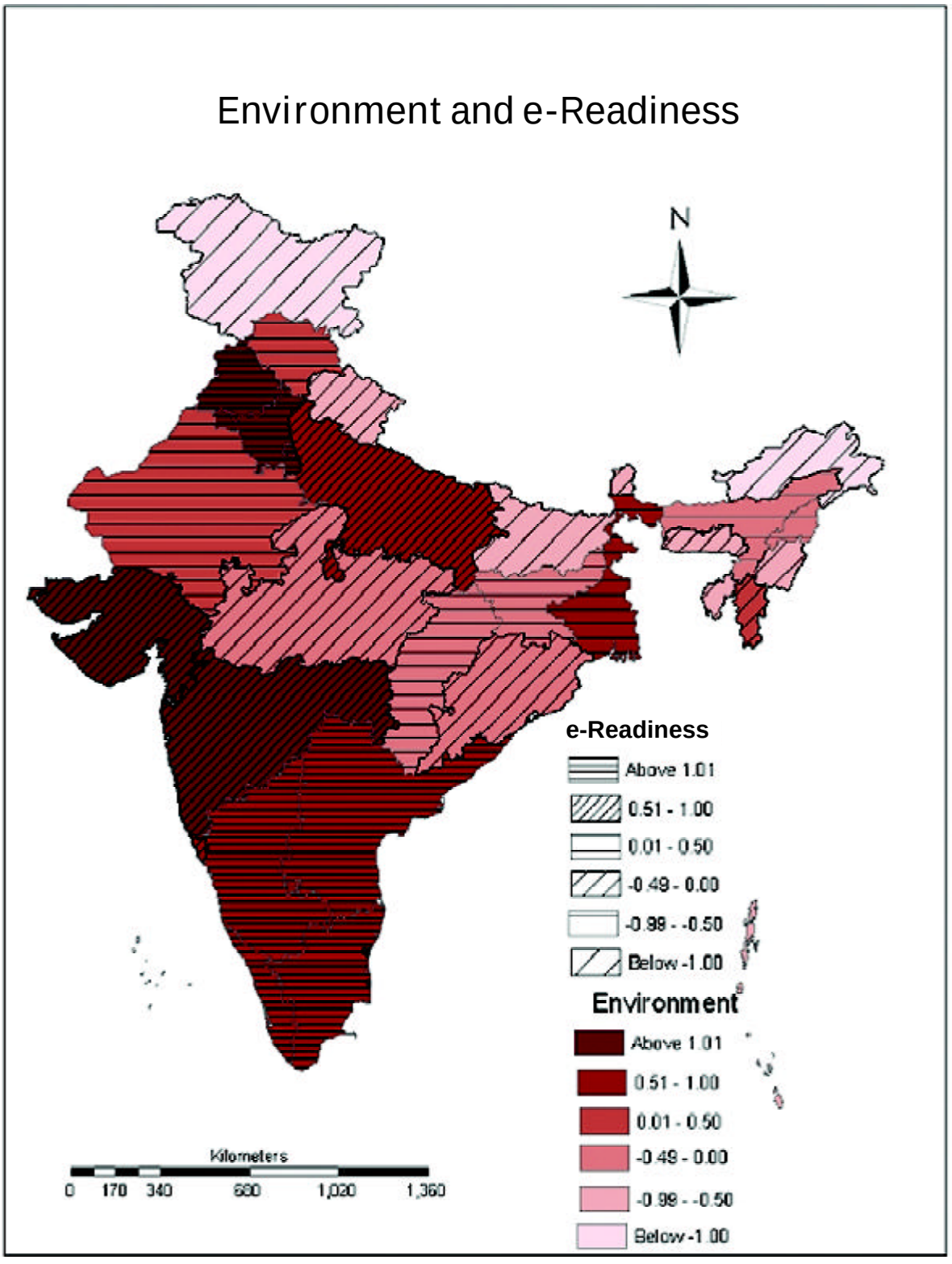


Figure 4.9.5 is the graphical presentation of the State/UTs' performance in readiness and e-Readiness indices together.

Figure 4.9.5: Readiness and e-Readiness

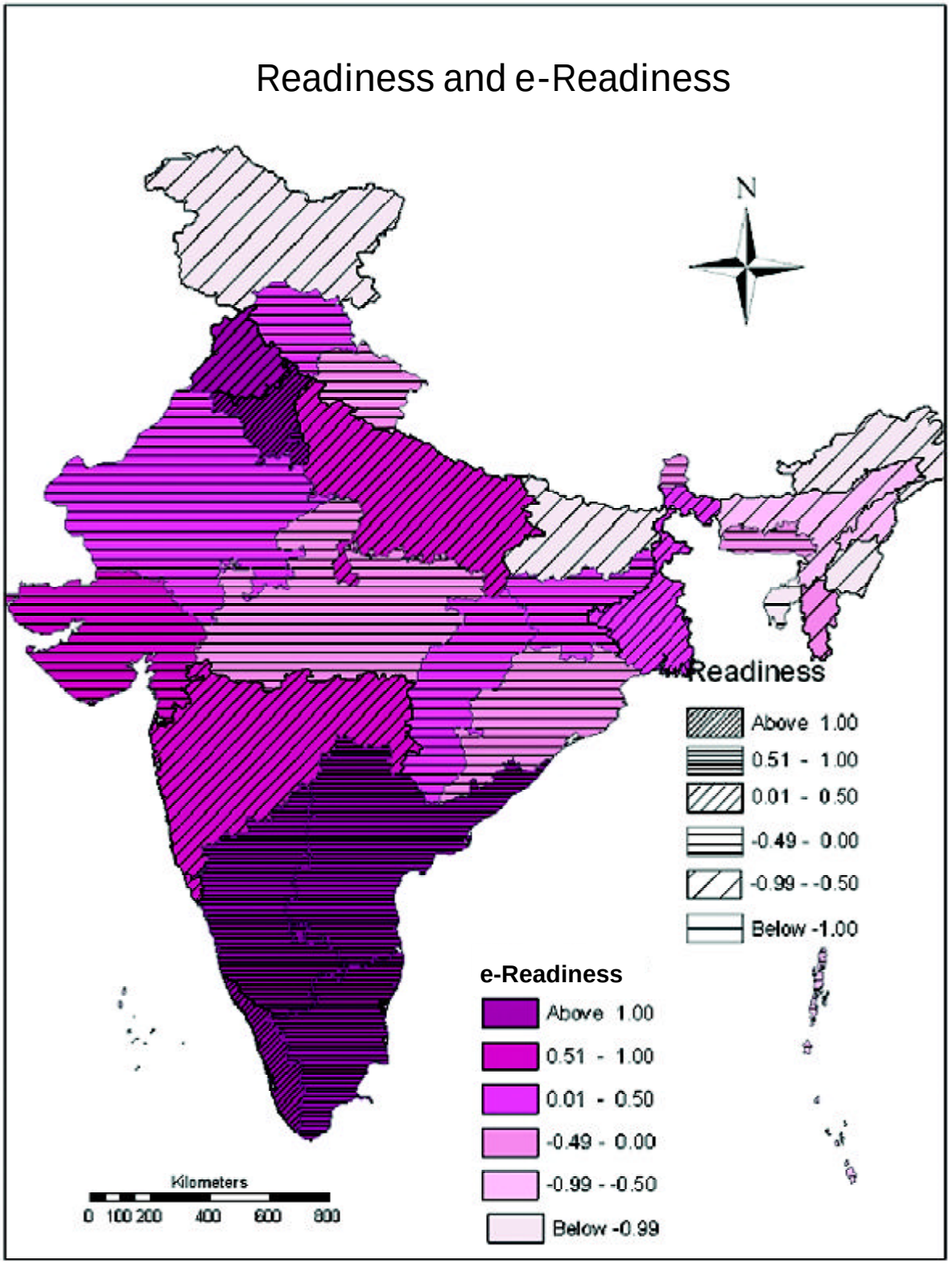
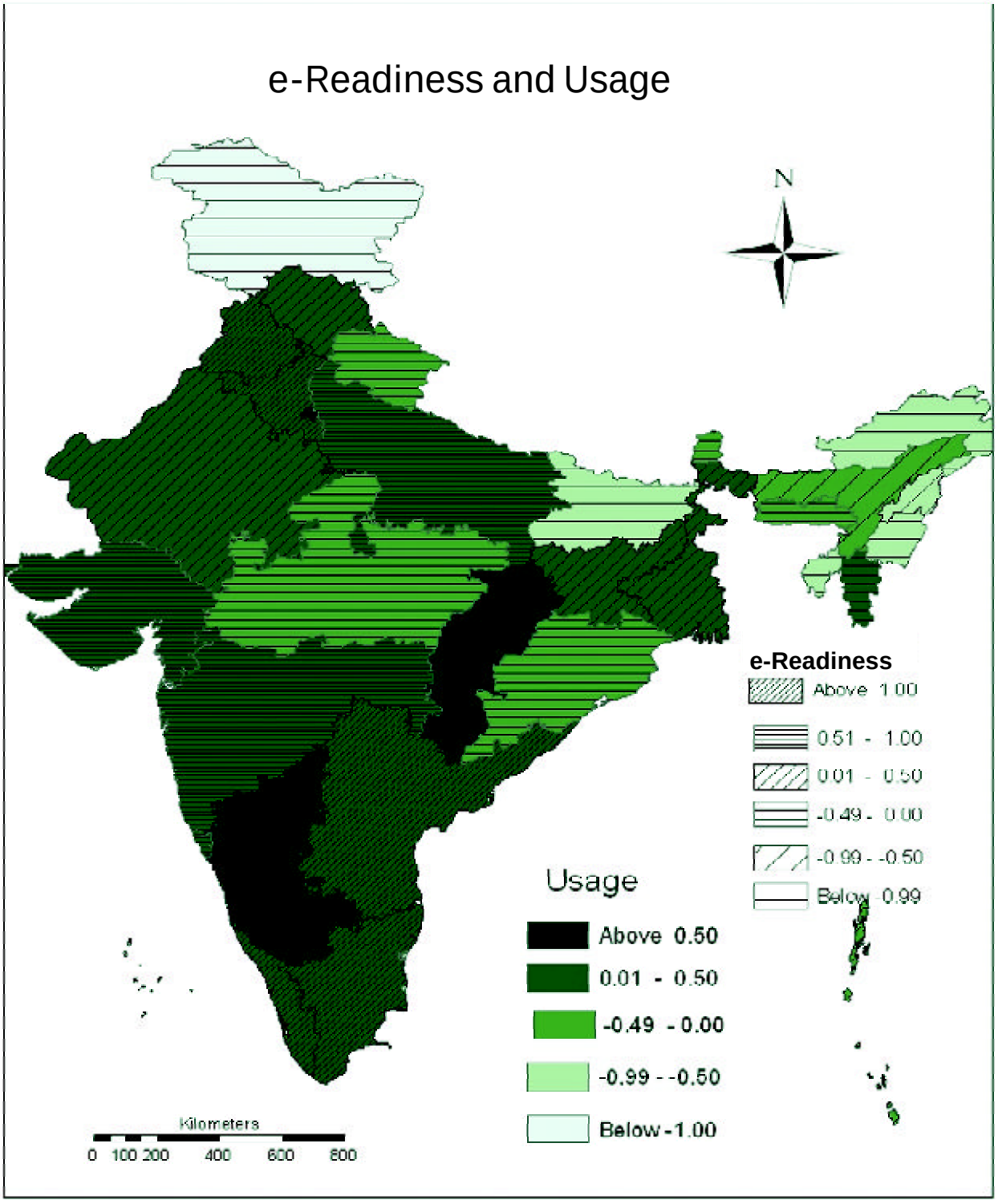


Figure 4.9.6 is the graphical presentation of the State/UTs' performance in usage and e-Readiness indices together.

Figure 4.9.6: e-Readiness and Usage



4.6 Trend Comparison of Ranking of States: 2004 to 2006

It needs to be noted that though the broad methodology of the e-Readiness index has not changed over the last four years, variables that have been used to construct indices have changed over a period of time. Particularly this year a lot of variables have changed with respect to the last year. In the infrastructure sub-index, for example, all the variables have been changed and improved for this year. Thus, a comparison of ranks for states over different years has to be seen along with its limitations.

The status of ranks across time has been given in Table A 4.5. The trends of relative positions of states in terms of the e-Readiness index, however, can be understood in terms of graphs showing trends over three years from 2004 to 2006 (Figures 4.10 to 4.16). The ranks, as mentioned at the heading of the graphs are reciprocal ranks, i.e., the leading state has been given the rank of 35 and the lowest state has been given the rank of 1. Within the southern states, only Karnataka has improved its position with respect to the last year (Figure 4.10). All the other states have lost out in this year's index value, while maintaining a stable position between 2004 and 2005. The northwestern states have, on the other have registered a rising trend with the sole exception of Punjab (Figure 4.11). Moreover, for most of these states, the rise has been registered consistently over the last three years.

The northeastern states show a mixed picture. The case of Nagaland needs a special mention as this state has improved its position for the past three years. The other states from this region those have shown an improvement are Mizoram and Tripura; the latter state though has not been able to improve its position with respect to 2004. All the other states in the region have lost out in terms of their ranks.

The central, eastern and northern states, most of which were in the below average level in last year's index (2005), have improved their positions. The improvement has been sustained for the last three years, however, only by the northern states of Uttar Pradesh, Jharkhand and Bihar. The other two states have registered an increase primarily over the last year.

The Western States and Northern Hilly states have primarily gone down in their ranking 2005.

In sum, out of the better off regions, only the north-western states have maintained an upward trend. The southern and western states, which were also among the better off regions have lost out. On the other hand, the below average regions such as central, northern and eastern India have somewhat improved their ranks. Most of the hilly states, whether they are located in the north or the north east, have been placed in a low e-Readiness status in the earlier years, have actually shown a relative decline over the years.

Figure 4.10: Comparison of Ranks (Reciprocal) across Years: North-Western States

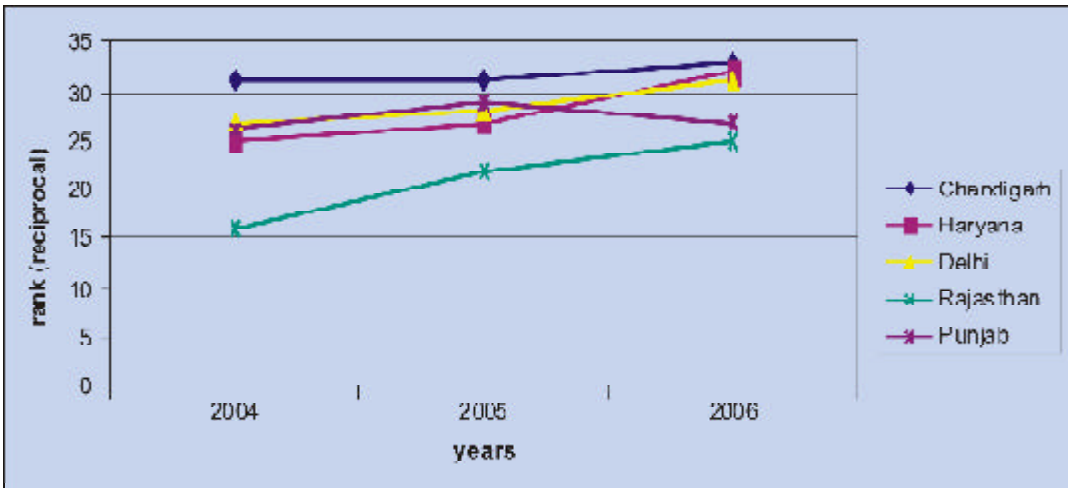


Figure 4.11: Comparison of Ranks (Reciprocal) across Years: North Eastern States

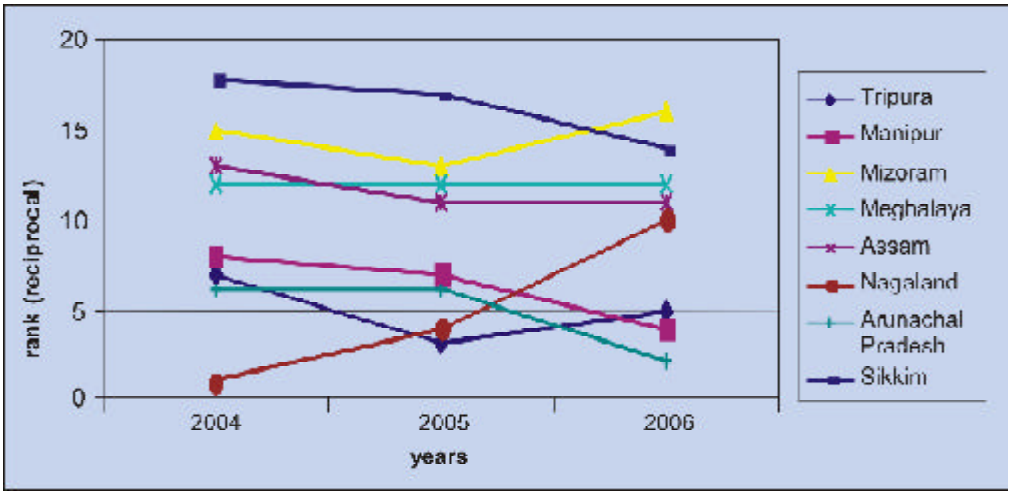


Figure 4.12: Comparison of Ranks (Reciprocal) across Years: Northern States

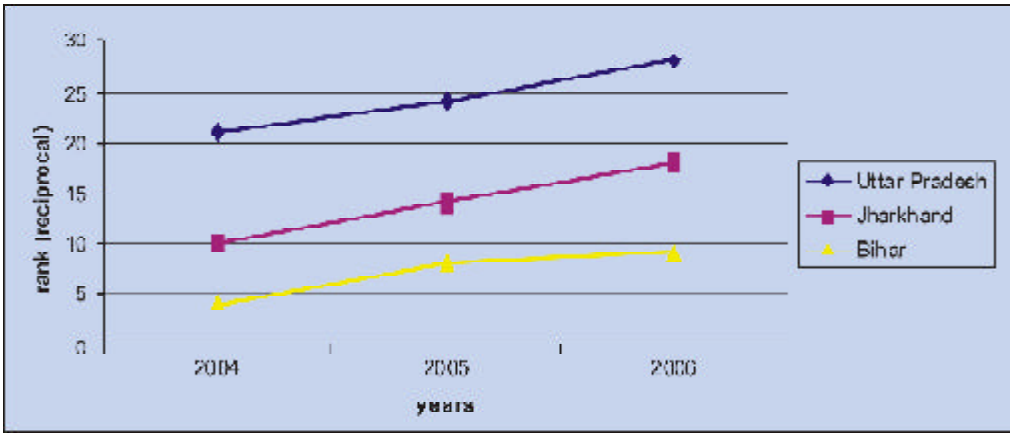


Figure 4.13: Comparison of Ranks (Reciprocal) across Years: Western States

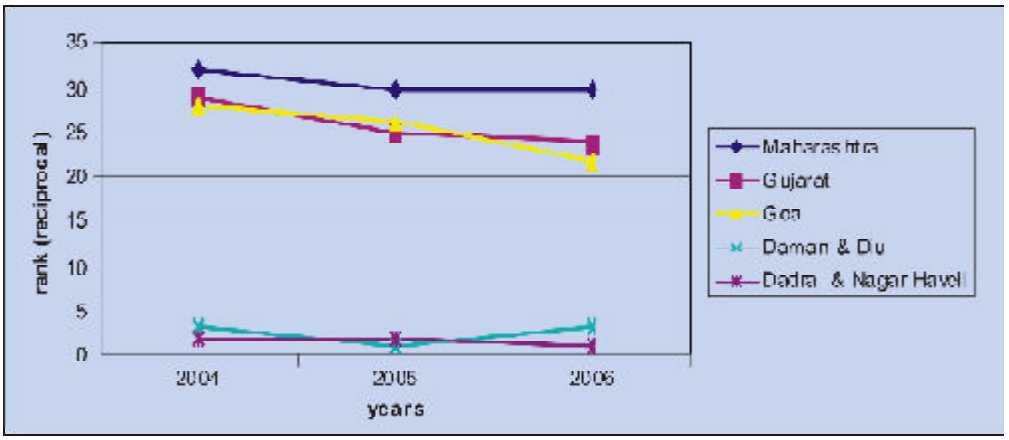


Figure 4.14: Comparison of Ranks (Reciprocal) across Years: Central States

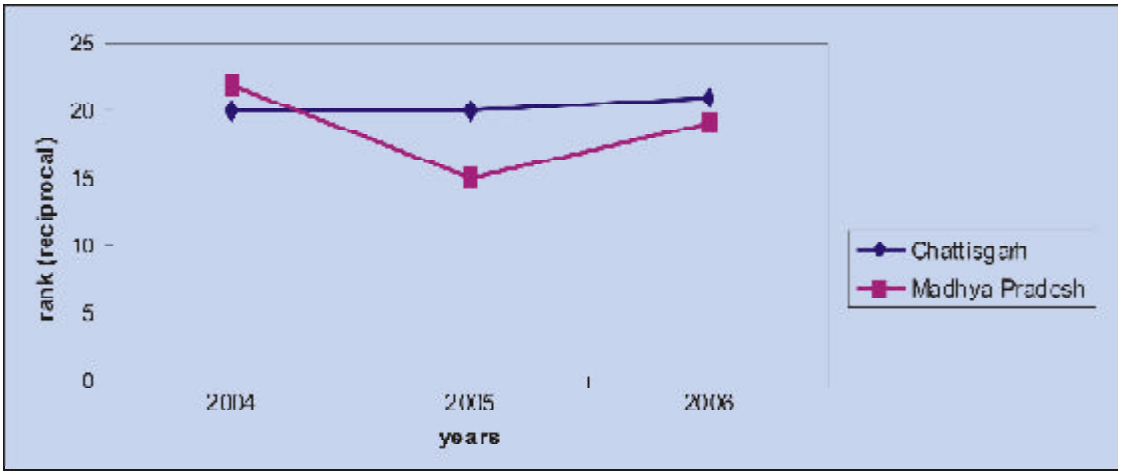


Figure 4.15: Comparison of Ranks (Reciprocal) across Years: Northern Hilly States

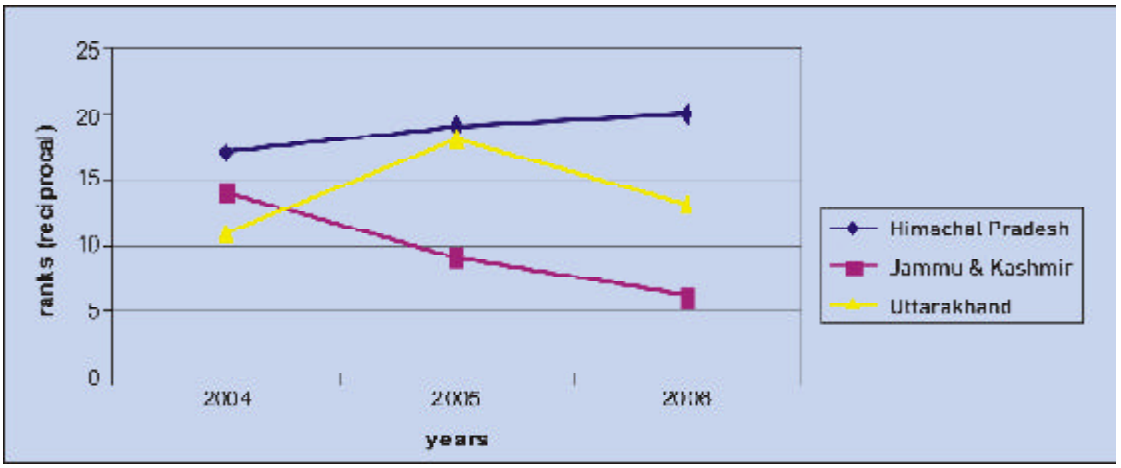


Figure 4.16: Comparison of Ranks (Reciprocal) across Years: Eastern States

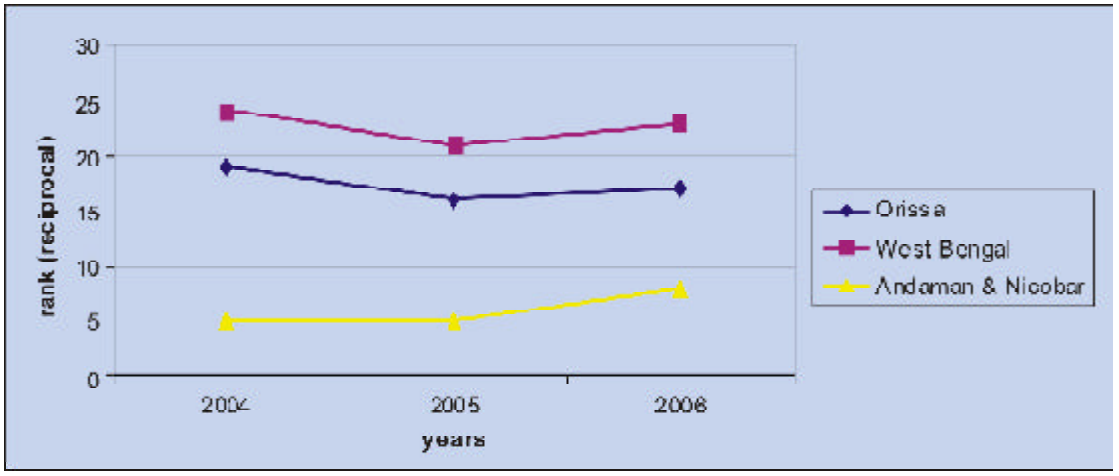


Figure 4.17: Comparison of Ranks (Reciprocal) across Years: Southern States

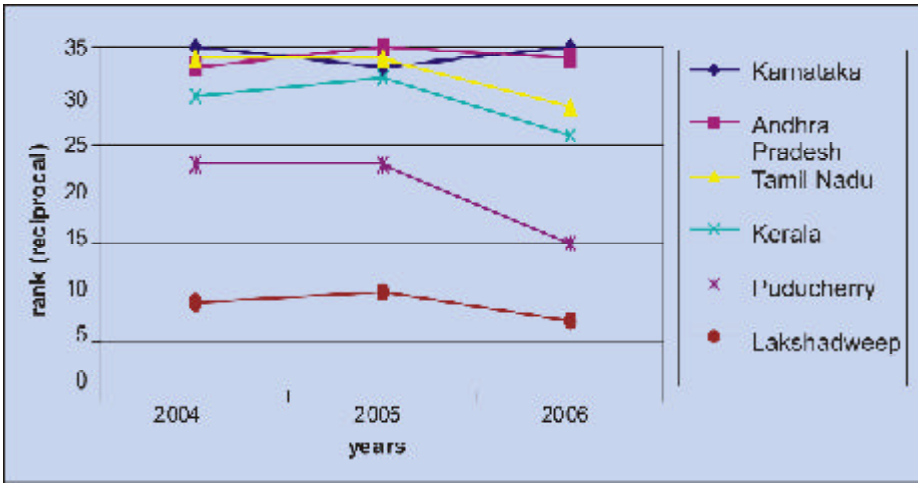


Table 4.14 reflects the degree of association of ranks in the various years. This shows a fairly high degree of association in all years. Among the consecutive years, the association is the maximum between 2004 and 2005. However, if the association between the current year and the last three years are taken into account, it is observed that over the years, the association of ranks have become stronger.

Table 4.14: Rank Correlation of e-Readiness Indices between Different Years

Years	2003-2004	2004-2005	2005-2006
Correlation coefficient	0.92	0.96	0.94
Years	2006-2003	2006-2004	2006-2005
Correlation coefficient	0.89	0.90	0.94

Though regional trends can be brought out through comparison of ranks, this method has an inherent limitation. The relative distance between the different states is not taken into account through this method. To overcome this problem, range equalization method has been used to compare the relative positions of the states (A 4.6 and A 4.7)[18]. Since this method brings the two years data between the same range, it becomes comparable while maintaining the relative distance between states. However, it needs to be noted that the thus modified series would still measure relative positions of the states and not the absolute changes[19]. Hence, the positive and negative deviations indicated in Table 4.15 do not in any way indicate absolute decline or absolute decline or improvement in the states position with respect to e-Readiness or its constituent components. It only shows relative decline or improvement of the states position with respect to a common maximum or minimum.

The states that have achieved relative positive deviation are not homogenous. On one hand, most of the north Western states except Punjab have achieved a positive deviation. On the other, less developed states as Chattisgarh, Jharkhand, and North Eastern states as Mizoram, Nagaland and Tripura also have improved their relative range equalized scores. Large less developed states as Uttar Pradesh and Rajasthan also fall in this category. This trend indicates that though the relative positions of the north eastern states, and new less developed states like Chattisgarh and Jharkhand are not very high in 2006, many of them have improved their relative scores over 2005. In other words, they have advanced faster than the developed southern and western states over the last year.

[18] The formula for range equalization is
REV= (x_i-min)/(max-min), REV= range equalized value, x_i is the untransformed value, min and max is the minimum and maximum value for all states for the respective variable. The maximum and minimum value of the transformed variable is 1 and 0 respectively.

[19] The composite index derived through Principal Component Analysis is an index which gives relative positions of states vis-à-vis a number of indicators.

Table 4.15: Deviation of Values of Comparable Indices of 2006 over 2005

	Environment Indices
Deviation (2006-2005)	States
Positive Deviation	Andaman and Nicobar, Dadra & Nagar Haveli, Daman & Diu, Delhi, Gujarat, Haryana, Manipur, Nagaland, Punjab, Tripura.
Negative Deviation	Meghalaya, Chattisgarh, Sikkim, Goa, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal, Rajasthan, Puducherry, Orissa, Mizoram, Maharastra, Madhya Pradesh, Lakhshadweep, Kerala, Karnataka, Jharkhand, Jammu & Kashmir, Himachal Pradesh, Chandigarh, Bihar, Assam, Arunachal Pradesh, Andhra Pradesh
	Readiness Indices
Deviation (2006-2005)	States
Positive Deviation	Chandigarh, Delhi, Haryana, Andaman &Nicobar, Chattisgarh, Dadra &Nagar Haveli, Goa, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala,, Meghalaya, Nagaland, Puducherry, Sikkim, Uttar Pradesh, West Bengal, Arunachal Pradesh, Assam, Bihar, Delhi, Lakshadweep, Madhya Pradesh, Manipur, Mizoram, Orissa, Rajasthan,, Tamil Nadu, Uttarakhand
Negative Deviation	Andhra Pradesh, Jammu and Kashmir, Maharastra, Punjab, Tripura
	Usage Indices
Deviation (2006-2005)	States
Positive Deviation	Chhatisgarh, Jharkhand, Nagaland, Rajasthan, Andhra Pradesh, Assam, Chandigarh, Bihar, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Mizoram, Orissa, Punjab, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, Andaman & Nicobar, Daman & Diu, Goa, Gujarat, Haryana, Uttarakhand, West Bengal
Negative Deviation	Arunachal Pradesh, Dadra & Nagar Haveli, Delhi, Jammu & Kashmir, Kerala, Lakshadweep, Puducherry, Manipur
	e-Readiness Indices
Deviation (2006-2005)	States
Positive Deviation	Haryana, Chandigarh, Daman & Diu, Delhi, Himachal Pradesh, Chhatisgarh, Jharkhand, Mizoram, Nagaland, Tripura, Rajasthan, Uttar Pradesh, Andaman &Nicobar, Dadra & Nagar Haveli, West Bengal
Negative Deviation	Andhra Pradesh, Arunachal Pradesh, Assam, Jammu &Kashmir, Lakshadweep, Madhya Pradesh, Manipur, Meghalaya, Orissa, Puducherry, Tamil Nadu, Uttarakhand, Bihar, Kerala, Karnataka, Goa, Gujarat, Maharashtra, Punjab, Sikkim

4.7 Summing up

1. The role of the Government emerges as more important than the role of the private sector in promoting e-Readiness at the state level. Though our indicators capture state level policy initiatives only, our observation also implies that the central Government's focus on promoting e-Readiness is well-placed and requires to be continued as this is likely to have a complementarity with the state government's efforts.
2. Out of the two leading regions, the Southern region has lost out its position somewhat to the northwestern region, which has emerged as the top region.
3. The remote states, i.e. the hilly states, have been in a very vulnerable position, though it is heartening to note that some of their relative status has improved (egs. **Nagaland, Mizoram, Andaman and Nicobar). This implies that one of the objectives of e-Readiness, i.e. providing better governance that reaches the marginalised regions has only been partially fulfilled.**

e-Readiness of Selected Central Ministries/Departments