STUDY REPORT

"COST-DISABILITIES OF HILL STATES IN INDIA"

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Executive Summary

Indian states are characterized by diverse ecosystems, arising from varied topography and other biophysical characteristics. States with mountainous and hilly terrain such as in the North Eastern region or the Western Himalayan region comprise of ecosystems that provide ecosystem services that are important for local, regional, national and international well being in the context of sustainability. Hill areas therefore face unique challenges in addressing their developmental needs in a manner that takes care of conservation concerns for sustainable development.

Disparities exist in developmental status, as evidenced by socio-economic indicators, across hill and plain area dominated states, and within hill states as well. The interplay of biophysical and economic factors has implications for sustainable economic development of these hill areas. Two important basic developmental requirements are the provision of physical infrastructure such as power and roads, and, the provision of social infrastructure that builds capacity, institutions and human skills, to ensure economic growth such as provision of health and education.

The aim of the study is to contribute to the understanding of these aspects for hill states in India by addressing the following objectives:

(a) Identification of the important parameters impacting cost disabilities of hill states arising from the biophysical terrain characteristics;
(b) Conducting a quantitative analysis of the parameters in terms of their implications for provision of infrastructure and basic services in achieving parity in sustainable development ; and
(c) Constructing a relative indicator of the implied cost disabilities for these states.

The empirical approach is to integrate economic indicators with biophysical ones in capturing disparities across states. Alternative criteria are used in constructing indices of relative disadvantage, which enables comparison across both economic parameters and biophysical ones. The indicators studied are on health, education, water and sanitation, infrastructure and economic conditions. Subsequent to deriving the indices, an attempt is made to monetize the disadvantage faced by states with hilly terrain. The study uses state-wise data on elevation to compute the costs. This is a major innovation as it moves away from the conventional administrative definition of hill districts. The elevation data was sourced from the National Remote Sensing Centre and the Surveyor General of India's office, and made available for the research purpose by the Fourteenth Finance Commission. Costs are estimated for three key public sector activities in this part of the exercise: health, education and, roads and bridges. Data on various parameters relevant for these sectors was quantitatively analysed and a cost function estimated for each sector, which explicitly allowed for costs to vary by the extent of elevated area in a state. A five years panel data model was estimated, and the estimates were used to derive cost mark-ups. These mark-ups indicate by how much costs change (increase) in hill areas relative to plain areas.

Chapter 1 contextualises the study, providing the scope, approach and objectives of the study. Considering hill states as per the conventional definition of hill districts, it builds a comparative picture of the key socio-economic indicators across states that have hill districts in India. Chapter 2 reviews the literature on economic disparities that arise from geographical factors, and the learnings from international experience in devising policies to specifically address these. The key economic and geographic variables relevant for mapping the relative disparity across states are discussed and identified.

Chapter 3 presents in detail the methodology for construction of indicators and disparity indices. The analysis is based on data for 16 states which have some percentage of their total geographical area classified as hills. The states are Mizoram, Nagaland, Arunachal Pradesh, Manipur, Meghalaya, Tripura, Sikkim, Uttarakhand, Jammu and Kashmir, Himachal Pradesh, Kerala, Assam, West Bengal, Maharashtra, Karnataka and Tamil Nadu. Indicators and Indices are also constructed and analysed for a subset of these states falling under the Special Category states. These states are – Assam, Manipur, Tripura, Meghalaya, Nagaland, Jammu and Kashmir, Arunachal Pradesh, Mizoram, Sikkim, Uttarakhand, and Himachal Pradesh. The indicators cover 5 categories: education, health, economic, infrastructure and water and sanitation. Four alternative indices are constructed using alternative weighting formulae. The findings from the exercise are presented in Chapter 4. Ranking of states based on the scores on individual indicators, and the four alternative measures of disparity are derived.

Chapter 5 presents the theoretical model for the cost function, its econometric estimation and the results leading to the derivation of the additional costs accruing to hill states due to the elevated terrain. The elevation data has been discussed comparing area measures in two dimension with those in three dimension. The chapter also contains a comparison of construction costs across hill and plain areas in different states of the country. It concludes the report with a discussion on the findings on the cost mark-ups that hill areas face relative to plain areas.

The empirical analysis indicates that there is substantial variation in the ranking of states when these are ranked according to the scores attained on various indicators for each of the sectors studied. The construction of indices to arrive at an overall picture which summarises information across sectors, is useful in providing insights on the relative disadvantages on various heads among states. The four indices constructed were an equal weights index, economic disability index, geographic disability index and a sample variance index. States with relatively less area under hilly terrain such as Karnataka, Tamil Nadu, Maharashtra, are found to be generally better performers on all counts. The empirical analysis shows that the states from the North Eastern region are the most disadvantaged, although individual rankings within the region change depending on the weights assigned. It is interesting to note that major changes occur in the ranking across the entire sample, when scores are scaled by weights based on the extent of hill and forest cover. There is far greater concordance when these biophysical factors are not given prominence. The approach is robust, and serves to establish the case for disparities that can be associated with hilly terrains.

The estimation of the cost function, and subsequent computation of the sector-wise costs for health, primary and secondary education, and the roads and bridges sector, reveals that costs are about 2 to 3 times higher for hill areas as compared to plain areas. However, these costs vary within this range depending on the sector. The cost mark-up for what can be termed as a representative of the social sector, including health and education, shows that costs are higher by 2.67 times or almost by 270% for hill areas as compared to plain areas. The cost escalation factor is lower for roads and bridges. Across all sectors, using a weighted average approach, the costs imputable to hilly terrain is 2.56 times higher than plain areas. A simple average of the cost mark-ups for the five hill states reveals that costs are higher by about 2.45 times. Based on this range of estimates, the costs in hill areas can be said to be approximately 2.5 times or 250% higher than in plain areas.

Acknowledgement

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Chapter 1: Hill States in India: The Context

I. Introduction: Scope of the Study

Indian states are characterized by diverse ecosystems, arising from varied topography and other biophysical characteristics. States with mountainous and hilly terrain such as in the North Eastern region or the Western Himalayan region comprise of ecosystems that provide ecosystem services that are important for local, regional, national and international well being in the context of sustainability. Hill areas therefore face unique challenges in addressing their developmental needs in a manner that takes care of conservation concerns for sustainable development. In addition, many hill areas in India are uniquely situated in terms of having large tracts of land designated as forest land with its attendant implications for governance in the hill states.

Disparities exist in developmental status, as evidenced by socio-economic indicators, across hill and plain area dominated states, and within hill states as well. The interplay of biophysical and economic factors has implications for sustainable economic development of these hill areas. Adequacy of resources to meet developmental targets, through reduction of vulnerability, improved economic productivity and delivery of basic amenities and services becomes a priority under the circumstances. Two important basic developmental requirements are the provision of physical infrastructure such as power and roads and, the provision of social infrastructure that builds capacity, institutions and human skills, to ensure economic growth such as provision of health and education.

The XII Five Year Plan emphasizes the objectives of faster economic growth, which is inclusive and sustainable. In understanding the sustainability of an inclusive development process, it is imperative to consider the complementarities and the trade-offs that characterize the interactions between natural and human systems in a particular context. If social and economic disparities exist between regions in the economy, consideration of the biophysical characteristics of a region in defining interventions to address those disparities may be of relevance. Vulnerability and resilience of both the ecosystem and the community dependent on it become important for addressing any existing disparities across regions. A recent study for the Planning Commission, (Pandey and Dasgupta, 2013) on estimating the relative disparity across states in India demonstrates how the interplay of biophysical and economic factors has implications for sustainable economic development for hill states in India.

The hill states in India seem to be at a disadvantage in terms of multiple social and economic indicators as compared to the rest of India. The states face the dual challenge of maintaining the natural resource base and simultaneously striving for development: a development process which requires creation of jobs and income generation, sustaining local resource based livelihoods, and ensuring a quality of life at par with other states in the economy. Infrastructure development, including communications and connectivity through road and air transport, is seen as a crucial input into the process of development, with its known multiplier effects, and as a means of improving productivity and encouraging investment into these states (NIPFP, 2012) (Government of India, 2010) (Rao, Govind; et al, 2007)

The current study takes forward the framework of the XIII Finance Commission, which recognized the need for compensation for states with forest cover, to a broader framework of inclusive and sustainable economic growth for hill states in India. This is also in accordance with the thinking evolving globally for setting new goals and targets for sustainable development in a post MDG 2015 world, in a manner that recognizes the developmental needs of specific sub groups and sub national territories within countries. Economic development is impacted by opportunity costs which can differ across states due to biophysical aspects, such as terrain, with implied implications for both environmental performance and economic development. The study specifically considers two interacting and yet distinct aspects of inclusive and sustainable economic growth. One is the vulnerability arising out of current circumstances which maybe beyond the control of the state, while the other, is the presence of factors that improve the coping capacity, expanding capabilities and the choice set through opportunities for economic growth.

Approach and Objectives of the Study

The approach of the study is to firstly, map the disadvantages faced by hill areas as compared to non hill areas due to the peculiarities of the terrain, which in turn translate into economic disadvantages. Secondly, to indicate the extent to which these disadvantages in hill areas translate into cost disabilities, ie additional costs for achieving desired performance levels in key public sectors.

There is a dearth of measures available of the extent to which specific cost disadvantages accrue to hill states. This study aims to contribute to the understanding of this aspect for hill states in India by addressing the following objectives:

(d) Identification of the important parameters impacting cost disabilities of hill states arising from the biophysical terrain characteristics;
(e) Conducting a quantitative analysis of the parameters in terms of their implications for provision of infrastructure and basic services in achieving parity in sustainable development ; and
(f) Constructing a relative indicator of the implied cost disabilities for these states.

The empirical approach is to integrate economic indicators with biophysical ones to capture disparity and to thereby define deviations from threshold values. Alternative criteria are used to capture the opportunity costs arising from biophysical characteristics in constructing indices of relative disadvantage, which enables comparison across both economic parameters and biophysical ones. The indicators studied are health, education, water and sanitation, infrastructure and economic conditions.

Subsequent to deriving the indices, an attempt is made to monetize the disadvantage faced by states with hilly terrain. The study uses state-wise data on elevation to compute the costs. This is a major innovation as it moves away from the conventional administrative definition of hill districts. The elevation data was provided to the researchers by the Fourteenth Finance Commission. Costs are estimated for three key public sector activities in this part of the exercise: health, education and roads and bridges. Data on various parameters relevant for these sectors was quantitatively analysed and a cost function estimated for each sector, which explicitly allowed for costs to vary by the extent of elevated area in a state. A panel data model was estimated, and the estimates were used to derive cost mark-ups. These mark-ups indicate by how much costs change (increase) in hill areas relative to plain areas.

Structure of the Report

Chapter 1 contextualises the study, providing the scope, approach and objectives of the study. Considering hill states as per the conventional definition of hill districts, it builds a comparative picture of the key socio-economic indicators across states that have hill districts in India. Chapter 2 reviews the literature on economic disparities that arise from geographical factors, and the learnings from international experience in devising policies to specifically address these. The key economic and geographic variables relevant for mapping the relative disparity across states are discussed and identified. Chapter 3 presents in detail the methodology for construction of indicators and disparity indices. 16 states that have hill districts have been included in the analysis. A subset of 11 states which fall under Special Category states has been analysed separately. The indicators cover 5 categories: education, health, economic, infrastructure and water and sanitation. Four alternative indices are constructed using alternative weighting formulae. The findings from the exercise are presented in Chapter 4. Ranking of states based on the scores on individual indicators, and the four alternative measures of disparity are derived. Chapter 5 presents the theoretical model for the cost function, its econometric estimation and the results leading to the derivation of the additional costs accruing to hill states due to the elevated terrain. The elevation data has been discussed comparing area measures in two dimension with those in three dimension. The chapter also contains a comparison of construction costs across hill and plain areas in different states of the country. It concludes the report with a discussion on the findings on the cost mark-ups that hill areas face relative to plain areas.

II. Economic Rationale for special measures

Hill states provide a range of mountain ecosystem services, which accrue at different scales, including local, regional, national and international levels (Ring, I, et al, 2010). However, these services remain largely unaccounted for, as these lack markets, and are in the nature of externalities which exhibit the features of public goods. Thus, although the ecosystem services provided maybe recognized, the lack of adequate monetization to reflect their worth, implies that although legal, administrative and local community linkages provide reason to preserve and maintain the ecological balance; their specific disadvantages remain neglected or at best low priority concerns in resource allocation and budgetary decision-making processes.

The hill states are also forest rich states, providing valuable mountain and forest ecosystem services many of which are non-instrumental and intangible, leading to a situation of externalities that remain largely unaccounted for in standard economic decision-making processes as the values are not monetized (Dasgupta, Morton et. al 2014).

An *economic rationale* for special provisions and incentives is thus derived from the fact that there are opportunity costs of (forgone) alternative paths of primary, secondary or tertiary sector development (e.g. more extensive agriculture, development of special economic zones, industrial development) which yields near term benefits in the form of greater income generation and employment creation. From the individual states' point of view, global benefits such as carbon sequestration, and even benefits such as biodiversity which accrue at various levels, are not accounted for in the system of national accounts nor are they backed by incentive mechanisms that would make it profitable to preserve these services. Rather, the compulsion to maintain terrestrial ecosystem diversity, translates into a situation of loss of revenue from these natural resources (as compared to returns from alternative land use) and instead, call for extra budgetary expenses for maintaining and enhancing these (Pandey & Dasgupta, 2013).

The principle of justification of higher allocations to states with specific disadvantages is already in vogue with certain programmes of the GOI. For instance, under NRHM, states in the north east, (Special category states) get a higher weightage in fund allocation under certain schemes. Special Category States, were in fact categorized as such because of their hilly terrain, high costs of delivery of public services and their low tax base. In his speech to the 56th National Development Council, the Chief Minister of Himachal Pradesh called for "Enhancement of norms for cost of infrastructure development and social sector projects/schemes in hill States on account of topographical considerations" (National Development Council, 2011) Similar requests were made by states on account of construction costs of irrigation projects where it was stated that the per hectare cost norm of Rs. 1.5 lakhs is exceeded by upto Rs. 3 to 4 lakhs per hectare while the cost of construction of roads is also stated to be higher by 3 to 4 times in hill areas. The claim that the ratio of wage cost to material cost should be changed from the current 60:40 (present scheme of MNREGA) to 40:60 as the cost of material and transportation in the hills is very high, is also predicated on the same rationale.[1]

III. Past Initiatives in Recognition of Regional disparity in the Indian economy

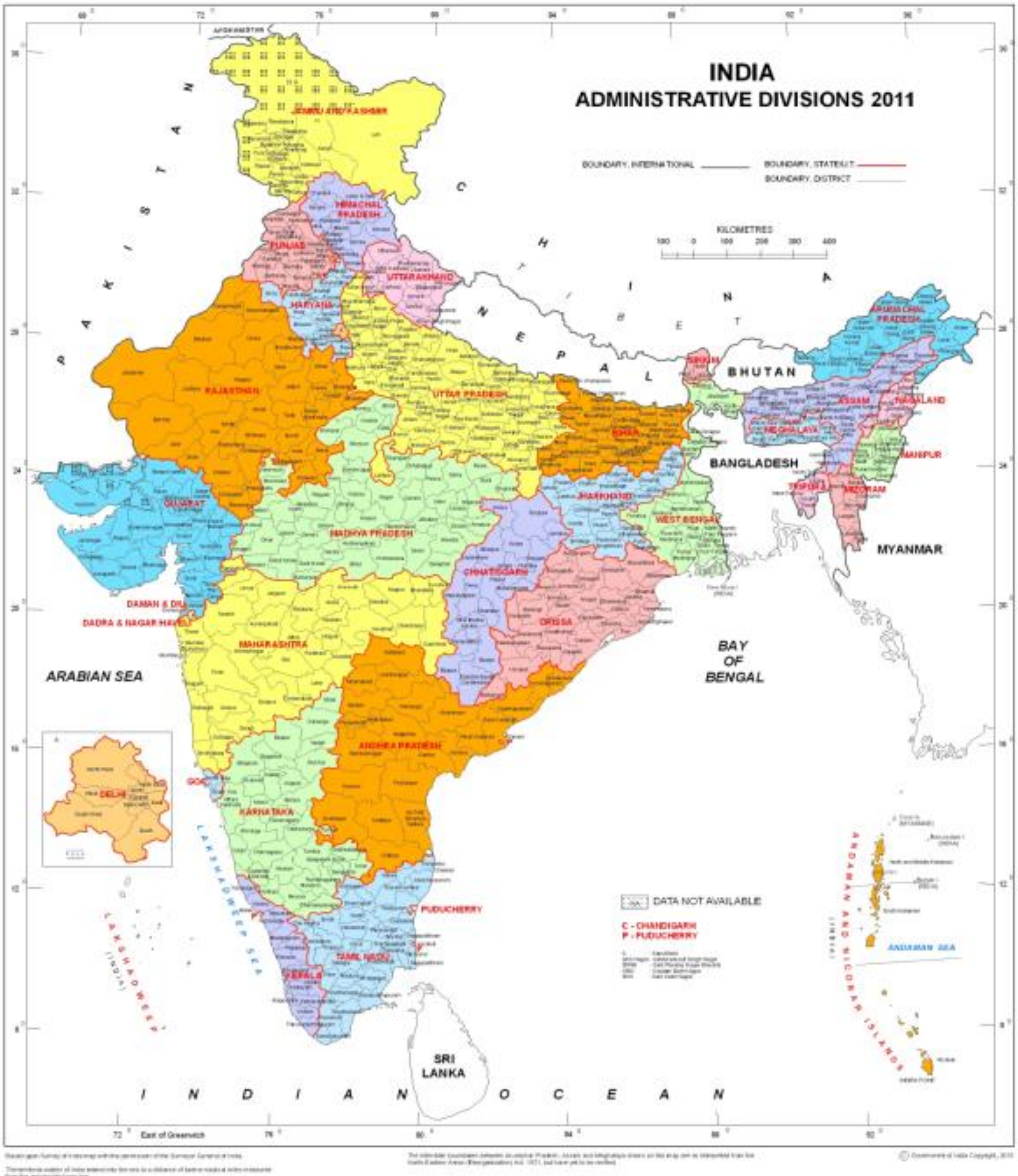
In the past, several committees that have been set up to look into issues of regional imbalance in India (Planing Commissiom, Government of India, 2005) have been primarily driven by considerations of disparity in industrialization, and criteria for identifying industrially backward districts. These include the Committee on Dispersal of Industries. (Government of India, 1960), the Pande Committee and the Wanchoo Committee set up by the National Development Committee in 1968. The first major initiative to link backwardness of an area

[1] Source: (The Himachal News, 2011) http://www.thenewshimachal.com/2011/10/chief-minister-demanded-for-uniform-funds-for-special-category-states/

with spatial or economic geography considerations, came with the setting up of a study group by the Planning Commission, which was followed up through the recommendations of the National Committee on Development of Backward Areas (1978). This in fact has significant implications for the current context, since the identification of six categories of backward areas by this Committee, was in close correspondence to what is recognized today as ecosystems that require special attention, and had specifically included hill areas as backward areas. The areas identified as backward included chronically drought prone, desert, tribal, hill, chronically flood affected and coastal areas affected by salinity. Apart from these, committees to identify and suggest criteria for backwardness for specific states have also been set up in the past such as the Patel committee (Uttar Pradesh), Hyderabad, Karnataka Development Committee, Fact Finding Committee on Regional Imbalance (Maharashtra), Committee for the Development of Backward Areas (Gujarat, 1984). It may also be noted that while most of these committees put forth criteria which were a mix of economic and social criteria for defining backwardness, the Committee for the development of Backward Areas in Gujarat, placed major emphasis on infrastructure among other criteria. The importance of infrastructure development found prominence in the report of the Committee to Identify 100 Most Backward and Poorest Districts in the Country in 1997, where social and economic infrastructure based criteria were used for identification of backward districts. In the context of the current study, it is to be noted that the Inter-Ministry Task Group on Redressing Growing Regional Imbalance (2005) also identified a set of physical infrastructure and human development based criteria for determining backwardness of regions.

IV. India's Hill States & Special Category States

Figure 1.1: Map of India[2]



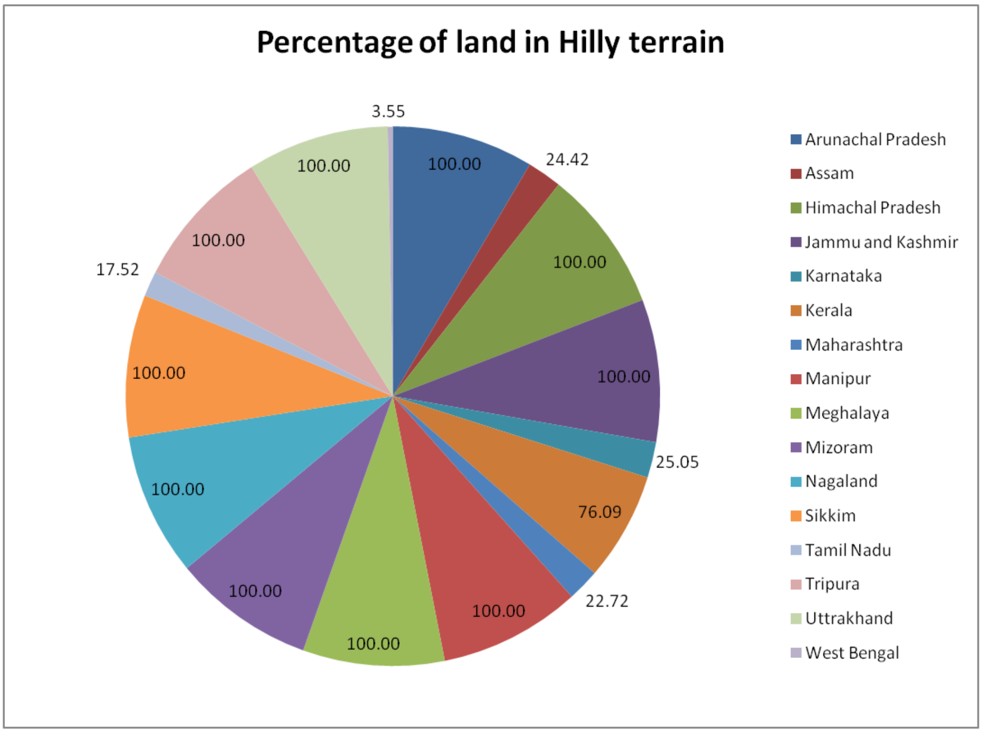
The hill states are Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, Sikkim, Himachal Pradesh, Jammu and Kashmir, Uttarakhand, Karnataka, Kerala, Maharashtra, Tamil Nadu and West Bengal. This classification is based on what percentage of their land is under hilly terrain using data from the India State of Forests Report 2011. The share of hilly terrain varies from 100% to 3.55%. Figure 1.2 shows this dristribution. It maybe noted that this classification of hill states follows from the definition of a hill district as a district with more than 50% of its area under 'hill talukas'

[2] Source: (Geological Survey of India, 2011)

based on critieria adopted by the Planning Commission for Hill Area and Western Ghats Development Programme (SFR 2011, Glossary).

The Special Category States include Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, Sikkim, Himachal Pradesh, Jammu and Kashmir, Uttarakhand. The classification was introduced in 1969 when the V Finance Commission identified certain disadvantaged states and sought to provide them with prefererential treatment in terms of central assistance and tax breaks. Jammu and Kashmir, Assam and Nagaland were initailly granted special status and eight more states were added eventually. These states have a low resource base and cannot mobilize resources for development due to which they are also economically and infrastructurally backward, they have a hilly and difficult terrain with a low population density or a sizable tribal population , are strategically located along borders with neighbouring countries and their state finances are non-viable[3]

Figure 1.2 Percentage of Land under Hilly Terrain



Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, Sikkim, Jammu and Kashmir Uttarakhand, Himachal Pradesh have 100% of their geographical area under a hilly terrain. The second highest at just over 76% is Kerala. West Bengal has the least hilly terrain at 3.55%, followed by Karnataka, Assam, Maharashtra and Tamil Nadu. The special category states alone constitute more than 75% of the total hilly terrain in the country with Jammu and Kashmir comprising of over 31%, followed by Arunachal Pradesh at 11.83%. The distribution of the all India hilly terrain among the special category states is listed in Table 1.1

[3] PRS Legistlative Research Blog http://www.prsindia.org/theprsblog/?p=2593

Table 1.1: Distribution of Hilly Terrain: Special Category States

States	Area under Hilly Terrain	Percentage to all India
Arunachal Pradesh	83743	11.83
Assam	19153	2.71
Himachal Pradesh	55673	7.87
Jammu and Kashmir	222236	31.40
Manipur	22327	3.15
Meghalaya	22429	3.17
Mizoram	21081	2.98
Nagaland	16579	2.34
Sikkim	7096	1.00
Tripura	10486	1.48
Uttarakhand	53483	7.56
All India	707747	75.49

Source: (Ministry of Environment and Forests, 2011)

In terms of the distribution of geographical area and population (Table 1.2) among the states, Maharashtra is the largest state amongst the sixteen states studied here. Its total geographic area is over 9% of all India geographical area. Maharashtra also has the highest proportion of population, compared to the All India levels. The smallest state is Sikkim with 0.22% of all India area and only 0.05% of all India population. Tripura, Nagaland, Mizoram, Meghalaya, and Manipur are other small states with less than 1% of all India geographical area. After Sikkim, the least populated state is Mizoram with 0.09% population and 0.64% of geographical area. Nagaland and Tripura follow with 0.16% and 0.30% of all India population, respectively.

Table 1.2: Distribution of Geographical Area and Population: All India

States	Geographical Area	Percentage to all India	Population	Percentage to all India
Arunachal Pradesh	83,743	2.55	1382611	0.11
Assam	78,438	2.39	31169272	2.58
Himachal Pradesh	55,673	1.69	6856509	0.57
Jammu and Kashmir	2,22,236	6.76	12548926	1.04
Karnataka	1,91,791	5.83	61130704	5.05
Kerala	38,863	1.18	33387677	2.76
Maharashtra	3,07,713	9.36	112372972	9.29
Manipur	22,327	0.68	2721756	0.22
Meghalaya	22,429	0.68	2964007	0.24
Mizoram	21,081	0.64	1091014	0.09
Nagaland	16,579	0.50	1980602	0.16
Sikkim	7,096	0.22	607688	0.05
Tamil Nadu	1,30,058	3.96	72138958	5.96
Tripura	10,486	0.32	3671032	0.30
Uttarakhand	53,483	1.63	10116752	0.84
West Bengal	88,752	2.70	91347736	7.55
All India	32,87,263		1210193422.00	

Source: (Ministry of Environment and Forests, 2011), (Census of India, 2011)

V. State of the Economy: Some Important Indicators

The North East presents a contrasting picture of the distribution of per capita income as measured by the per capita state domestic product (Table 1.3). While at one end of the spectrum, Sikkim has the highest per capita income at Rs. 124791, the lowest is Manipur at Rs. 32865 followed by Assam. Maharashtra, Tamil Nadu and Kerala are the other states with high per capita incomes.

Table 1.3: Per Capita Net State Domestic Product (NSDP): All States

States	Per Capita NSDP (Rupee in Crores)
Arunachal Pradesh	72,091
Assam	37,250
Himachal Pradesh	74,694
Jammu and Kashmir	45,380
Karnataka	68,423
Kerala	80,924
Maharashtra	95,339
Manipur	32,865
Meghalaya	53,542
Mizoram	54,689
Nagaland	56,461
Sikkim	1,24,791
Tamil Nadu	88,697
Tripura	50,175
Uttarakhand	81,595
West Bengal	54,125

Source: (Planning Commission, 2013)

The state of the economy can be assessed by looking at the distribution of its Gross Domestic Product (Table 1.4, GSDP). A more advanced economy would have a relatively smaller share of GSDP in agriculture and allied services and a larger proportion in the Industries and Services sector. In the case of the present study, Arunachal Pradesh has the highest percentage of Agriculture and Allied Sector in its GSDP, followed by Nagaland and Assam. Sikkim is the only state from the North East with less than 9% share of agriculture and allied services in GSDP. Sikkim also has the highest percentage of industrial sector in its GSDP at slightly above 59%, followed by Himachal Pradesh and Uttarakhand. Nagaland on the other hand, has the lowest proportion followed by West Bengal and Mizoram. Kerala has the highest proportion of the services sector in its GSDP, followed by West Bengal and Tamil Nadu. The services sector is the lowest in Nagaland at about 32%, followed by Arunachal Pradesh and Himachal Pradesh.

Table 1.4: Sectoral shares in GSDP: All States

States	Percentage of Agriculture & Allied Services in GSDP	Percentage of Industries in GSDP	Percentage of Services in GSDP
Arunachal Pradesh	29.73	31.41	38.85
Assam	26.34	23.28	50.38
Himachal Pradesh	19.02	41.04	39.94
Jammu and Kashmir	22.85	25.24	51.91
Karnataka	16.97	29.53	53.50
Kerala	10.11	21.04	68.84
Maharashtra	8.71	29.62	61.67
Manipur	25.16	31.03	43.81
Meghalaya	16.66	29.42	53.92
Mizoram	20.17	20.10	59.73
Nagaland	27.69	16.25	56.08
Sikkim	8.34	59.22	32.44
Tamil Nadu	8.27	31.54	60.19
Tripura	24.05	25.42	50.54
Uttarakhand	11.30	36.25	52.44
West Bengal	18.54	19.97	61.50

Source: (Planning Commission, 2013)

Provision of Basic Services

Status of Water and Sanitation Facilities

In terms of the provision of basic services (Table 1.5), the supply of improved source of drinking water in slum areas has achieved full coverage in Arunachal Pradesh, Assam, Himachal Pradesh, Jammu and Kashmir, Sikkim, Tripura and Uttarakhand at 100%. It was 100% in non slum areas in Himachal Pradesh as well. Tripura and Uttarakhand have also done phenomenally well with 999 out of 1000 households in non slum areas receiving improved sources of drinking water. Kerala presents a very different scenario, while there is 100% provision in slum areas, only 568 out of 1000 households in the non slum areas have access to improved sources of drinking water. Manipur is another poor performer, although still at a better position than Kerala with about 70% provision in non slum areas.

Data on households getting good quality drinking water in rural areas reveals that Mizoram is the best performer. There is 100% supply of good quality drinking water to its urban population and 999 out of 1000 households in the rural areas are also covered. Assam on the other hand fares poorly, 638 out of 1000 households in urban areas get good quality drinking water, and only 580 out of 1000 households have access to these facilities in rural areas.

With respect to household access to improved source of latrine, Kerala, Mizoram and Sikkim had 100% coverage in slum areas while Himachal Pradesh and Sikkim did so in rural areas. On the other hand Jammu and Kashmir had improved access for 273 out of 1000 households in slum areas while doing reasonably well for non slum households at 867 out of 1000. Kerala, Mizoram and Meghalaya were the other top performers in non slum areas while Maharashtra, Arunachal Pradesh and Tripura were the other states doing well in slum areas.

The number of households (per 1000) getting sufficient water for all household activities is another indicator to measure the performance of states in the provision of basic services. In this regard, in rural areas, Tamil Nadu is the best performer, followed by Assam and Manipur. On the other hand, Nagaland fares worst, followed by Mizoram and Sikkim. In terms of urban areas, Tripura has the best performance, followed by Assam and Tamil Nadu. Nagaland fares worst in urban areas too, followed by slightly better coverage in Mizoram and Meghalaya.

In terms of access to safe drinking water, only 28.30% of households in rural Kerala have access to these facilities while in urban areas, the situation is marginally better at 39.40%. Himachal Pradesh on the other hand has the best record with over 93% households in rural areas and nearly 98% in urban areas with access to safe drinking water from taps, hand pumps and tube wells. Tripura presents a contrasting image with about 92% access in urban areas and just over 58% in rural areas.

In provision of bathroom facilities[4], Sikkim is the best performer with only 63 out of 1000 households in rural areas lacking access to bathroom facilities, followed by Kerala and Mizoram. In urban areas, Mizoram is the best performer with near 100% coverage (only 9 out of 1000 households without bathroom facilities), followed by Nagaland and Sikkim. The lowest coverage is in Tripura in both rural and urban areas.

[4] Note that this variable focuses on availability of bathing facilities, as distinct from another variable covered in the same survey for access to toilet facilities (NSS 69th round, 2013)

Table1.5: Status of Water and Sanitation: All States

States	Rural household/1000 getting sufficient water for all household activities	Percentage of rural household access to safe drinking water	Rural household/1000 without bathroom facilities
Arunachal Pradesh	891	74.30	525
Assam	944	68.30	456
Himachal Pradesh	833	93.20	317
Jammu and Kashmir	758	70.10	405
Karnataka	717	84.40	481
Kerala	846	28.30	97
Maharashtra	729	73.20	542
Manipur	895	37.50	502
Meghalaya	785	35.10	449
Mizoram	643	43.40	128
Nagaland	368	54.60	130
Sikkim	649	82.70	63
Tamil Nadu	949	92.20	577
Tripura	879	58.10	897
Uttarakhand	875	89.50	205
West Bengal	849	91.40	730

Source: (NSSO 69th Round, 2013)

Provision of Public services: Education, Health

In terms of the provision of public services such as education (Table 1.6), the following trends were observed: Literacy rate was observed to be the highest in Kerala, followed by Mizoram and Himachal Pradesh. Arunachal Pradesh has the lowest literacy rate of 65.39, closely followed by Jammu and Kashmir and Meghalaya.

In terms of primary education, Meghalaya has the highest ratio of primary schools per thousand population, followed by Mizoram and Himachal Pradesh. The lowest ratio is in Kerala, followed by Tamil Nadu and Karnataka. On the other hand, the ratio of teachers to students in primary school (per thousand population) were found to have wide variation amongst states, while the highest in Sikkim is 96.65, the next highest is 55.18 in Mizoram and 47.54 in Himachal Pradesh. The lowest ratio is 11.27 which is observed in Karnataka, followed by Tamil Nadu at 13.98 and Maharashtra at 14.

The gross enrolment ratio (GER) for classes I to XII is highest in Arunachal Pradesh, followed by Manipur and Mizoram. Nagaland has the lowest GER, followed by Assam and West Bengal. Meghalaya has the highest dropout rates, both for classes I to VIII and I to V. Assam and Manipur are the other states with high dropout rates at 53.97 and 52.79 respectively. The lowest dropout rates in these classes were seen in Jammu and Kashmir, followed by Tamil Nadu and Karnataka. Himachal Pradesh had the lowest dropout rate for classes I to V. It was followed by Jammu and Kashmir and Karnataka.

In terms of higher education, Karnataka has the highest number of colleges per lakh population. Tripura and West Bengal perform dismally, both with only 8 colleges per lakh population, followed by Arunachal Pradesh and Assam.

Table 1.6: Status of Education: All States

State	Primary Schools/1000 Population	Teachers/ Students in Primary Schools/ 1000 population	GER I-XII	No. of Colleges/ Lakh Population	Total Literacy Rate	Drop Out Rates (I-VIII)	Drop Out Rates (I-X)	Drop Out Rates (I-V)
Arunachal Pradesh	1.40	22.02	121.34	11	65.39	50.46	61.71	43.03
Assam	1.00	29.66	66.37	13	72.19	53.97	77.40	29.85
Himachal Pradesh	1.66	47.54	103.50	38	82.80	-	16.05	3.76
Jammu and Kashmir	1.23	46.57	86.18	14	67.16	6.06	43.60	8.38
Karnataka	0.43	11.27	84.72	44	75.37	20.79	43.34	8.86
Kerala	0.20	16.84	92.20	29	94.00	-	-	-
Maharashtra	0.44	14.00	87.97	35	82.34	25.90	38.18	20.32
Manipur	0.89	21.49	118.41	23	79.22	52.79	45.28	45.69
Meghalaya	2.24	27.28	111.89	16	74.43	70.43	77.38	58.42
Mizoram	1.67	55.18	115.78	21	91.33	36.67	53.70	37.90
Nagaland	0.84	36.20	61.10	20	79.56	45.41	75.13	39.95
Sikkim	1.23	96.65	91.31	14	81.42	42.82	69.86	18.35
Tamil Nadu	0.39	13.98	96.10	27	80.09	7.99	25.94	-
Tripura	0.63	21.70	91.47	8	80.09	48.21	58.38	31.13
Uttarakhand	1.55	41.84	95.74	28	78.82	31.56	36.57	32.87
West Bengal	0.55	21.18	74.41	8	76.26	49.06	64.22	28.44

Source: (Ministry of Human Resource Development, 2010-11) (Ministry of Human Resource Development, 2010-11)

The status of health and the provision of healthcare facilities is an important indicator for assessing vulnerability (Table 1.7). Assam is the worst performer with a very high IMR at 58, followed by Meghalaya and Jammu and Kashmir. Kerala has the lowest IMR at 13 and Manipur closely follows with 14.

In terms of nutritional status, Kerala has the highest number of moderately malnourished population while West Bengal has the highest share of population with severe malnourishment. Arunachal Pradesh is the best performer with only 2% of population moderately malnourished and zero reporting of severe malnourishment. In terms of the under five mortality rate, Arunachal Pradesh has the worst record, followed by Assam and Meghalaya. Kerala has the best record with a rate of 16.30. It is followed by Tamil Nadu and Sikkim.

Examining the status of healthcare infrastructure, the shortfalls in Sub Centers (SC), Primary Health Centers (PHC) and Community Health Centers (CHC) were studied. Meghalaya has the highest shortfall in SC coverage at over 46%. Himachal Pradesh, Karnataka, Kerala, Sikkim, Tamil Nadu and Uttarakhand are the best performers with no reported shortfalls. West Bengal has the highest shortfall in PHC, followed by Tripura and Maharashtra. Arunachal Pradesh, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Manipur, Mizoram, Nagaland, Sikkim and Uttarakhand meet their requirements for PHC and CHC and have zero shortfalls. However, Tripura has the maximum shortfall in the provision of CHCs, followed by Assam and Sikkim. The other states with shortfall include Karnataka, Manipur, Mizoram, Nagaland and Tamil Nadu.

Table 1.7: Status of Health: All States

State	IMR	% Rural Pop. Covered by SC	% Rural Pop. Covered by PHC	% Rural Pop. Covered by CHC	% Shortfall in SC	% Shortfall in PHC	% Shortfall in CHC	Under 5 Mortality Rate	% Moderately malnourished	% Severely Malnourished
Arunachal Pradesh	31	0.35	1.03	2.08	8.63	0.00	0.00	87.70	2.00	0.00
Assam	58	0.02	0.11	0.93	21.18	1.57	54.62	85.00	30.86	0.46
Himachal Pradesh	40	0.05	0.22	1.32	0.00	0.00	0.00	41.50	34.18	0.06
Jammu and Kashmir	43	0.05	0.25	1.20	4.41	0.00	0.00	51.20	31.06	0.06
Karnataka	38	0.01	0.04	0.56	0.00	0.00	44.79	54.70	36.66	2.84
Kerala	13	0.02	0.12	0.45	0.00	0.00	0.00	16.30	36.83	0.08
Maharashtra	28	0.01	0.06	0.27	21.10	17.36	33.27	46.70	20.71	2.61
Manipur	14	0.24	1.25	6.25	14.63	0.00	15.79	41.90	13.59	0.24
Meghalaya	55	0.25	0.92	3.45	46.57	4.39	0.00	70.50	28.95	0.18
Mizoram	37	0.27	1.75	11.11	0.00	0.00	0.00	52.90	23.06	0.20
Nagaland	23	0.25	0.79	4.76	13.35	0.00	0.00	64.70	8.29	0.07
Sikkim	30	0.68	4.17	50.00	0.00	0.00	50.00	40.10	9.86	0.86
Tamil Nadu	24	0.01	0.08	0.26	0.00	3.60	0.00	35.50	35.20	0.02
Tripura	27	0.16	1.27	9.09	6.09	25.47	57.69	59.20	36.54	0.35
Uttarakhand	38	0.06	0.42	1.82	0.00	0.00	6.78	56.80	23.74	1.19
West Bengal	31	0.01	0.11	0.29	20.56	57.68	35.20	59.60	32.93	3.99

Source: (Ministry of Health and Family Welfare, 2010-11)

Chapter 2: Disparities and their Costs: Learning from experience

I. Introduction

The existence of disparities imposes specific costs which have economic and social ramifications. While some of these are tangible and easily quantifiable as well, substantial negative externalities accrue in a society that comprises of regions / states experiencing differential developmental experiences, based on economic criteria. While there may be several causes to which the existence of differential economic and social well being can be attributed, there has been substantial learnings on the disparities that arise from geographical factors. Evidence based literature supports the cause for interventions that can help overcome the constraints imposed by geographical factors including biophysical ones. Specific policy based interventions can bring about greater parity and equality across regions (states), sub-national populations and territories.

In the specific context of the present study, two aspects are to be noted here. Firstly, the need for such interventions is today accepted world-wide, not just from a humanitarian angle, but from the holistic perspective of achieving sustainable development (UN post 2015 Development Agenda, 2012). The other important factor of relevance is that hill areas are today recognized as unique ecosystems, with distinct provisioning, regulating, supporting and cultural services. Hence, the need for preserving these is important from a national perspective, as well as for ensuring a certain quality of life for those residing in these areas.

The disadvantages accruing from geographical and biophysical factors, in particular, lead to various kinds of opportunity costs, described in the literature with different terminology, depending on the context. For instance, increased institutional costs faced by states that require environmental clearance in India for undertaking development projects such as construction of highways or hydel power projects, could be in the form of transaction costs. Cost inflation may also occur due to project delays arising from such institutional requirements. These are distinct from incremental costs that arise due to the technological requirements of building infrastructure in hilly and remote terrain. This increases the costs attributable or accruing to various factors of production including enhanced labour and material costs, apart from capital costs. The operation and maintenance costs of established and ongoing projects are also higher in regions that are subject to natural calamities such as landslides. There is also evidence that specific livelihoods such as pastoralism and mountain farming systems are vulnerable to high risks of adverse climate change impacts, often owing to neglect and a lack of appropriate government policies (Dasgupta, Morton, et al 2014).

II. Relationship between Geographical factors and disparity: International experience

There is a strong correlation between geography and development, characterized by high levels of welfare disparities and a large concentration of poor people along the most adverse regions (Kanbur & Venables, 2005). These spatial welfare disparities have two specific attributes that include; location specific attributes or immobile attributes such as access to infrastructure, availability of basic services such as water and sanitation, health and education facilities which impact household welfare indirectly through their impact on household returns, and non geographic or portable attributes such as demographic composition, level of education and age (Skoufias & Olivieri, 2009)

In terms of immobile endowments, areas better equipped with public goods generate positive externalities and help in the exit of households from poverty. But the access itself to public goods is restricted by hilly and difficult terrain and persons residing in such areas lack opportunities to improve their mobile endowments which push them further into poverty. Therefore, the disparities in household mobile endowments arise because of the lack of access to immobile endowments such as education, health and infrastructure services and complimentary investments in both areas are needed to improve welfare disparities in hill regions.

Furthermore, Federal countries such as Brazil, India, Mexico, Pakistan and Russia have been found to do better in controlling regional disparities as compared to unitary countries such as China, Chile, Indonesia, Sri Lanka and others (Shankar & Shah, 2003) In this system, regional disparities are a source of political risk and national political parties have to focus on more equitable development of their regions. They have been considered as having a greater compulsion to follow development policies and this competition among regional governments may actually lead to more regional equality.

Economic activity, Public infrastructure and Regional Disparity

Researchers have found that spatial inequality arises from the variation in availability of public and private assets (Kanbur & Venables, 2005). That the availability of infrastructure itself is limited by geography, where regions displaying more adverse geographical conditions are those that lack access to public infrastructure has been noted by several studies (Escobal & Terero, 2005) Further, this limits the spread of economic activity through the region. Examining the role of geography in regional inequality, welfare and development in the mountainous regions in Peru, Kanbur and Venables (2005) find a strong correlation between geography and development in these regions. Huge welfare disparities and a high concentration of very poor people exist along the most geographically adverse regions. Kanbur and Venables (2005b) summarizing findings from studies in 26 countries, find that rather than the endowment or physical factors, it is the economic interactions between agents that determine spatial disparities and inequality in development. In particular, they find that public infrastructure is a key explanatory factor in the level and trend of spatial inequality in a country. Further, their findings suggest that the efficiency gains from agglomeration economies and openness can be achieved by removing barriers for de-concentration of economic activity, by developing economic and social infrastructure that would help interior and poorer regions to benefit from integration.

Location specific or immobile attributes such as access to infrastructure, health and education facilities and basic services like clean water, sanitation etc influence household welfare indirectly through their impact on the returns to households. Evidence has been seen in China where investment in public infrastructure has been one of the major factors influencing regional imbalances (Shenggen Fan, 2011) Although infrastructure investment has tended to focus in urban areas and plains, returns to infrastructure investment in lagging regions is high because of its multiplier effect and positive externalities in all aspects of development.

Heltberg and Bonch-Osmolovskiy (2010) find that vulnerability varies according to socio-economic and institutional development which does not follow directly from exposure or elevation i.e. geography is not destiny. In their study on Tajikistan, a mountainous country, highly vulnerable to climate change, the authors find that urban areas are the least vulnerable while the mountain regions are most vulnerable. They find that vulnerability to climate change varies across regions and agro ecological zones in ways that may not be theoretically obvious. Instead, it varies according to socio-economic and institutional development of these regions rather than the extent of their exposure and elevation, which exercise smaller influences. In the case of Tajikistan, relatively vulnerable geographic areas are found to overlap areas concentrated with population and economic activity. In terms of directing funding, and planning for public policy, it is advocated that the focus should be on areas with the highest vulnerability.

In has been observed in Indonesia and China that "poor areas" arise from the concentration of individuals with personal attributes that inhibit growth in living standards (Skoufias & Olivieri, 2009) (Shenggen Fan, 2011). Since these qualities are inherent to an individual, they move with them and hence if they were to seek a better life by migrating, they would be taking their shortcomings with them and the new region will also be subject to their poor endowments. Therefore, it is not geography alone that answers why some regions are rich and some poor but the personal attributes of its inhabitants. In addressing these, resource allocation would need to be done in a manner that can build capability and increase income earning opportunities among the population.

Policies and schemes targeted towards improving household mobile disparities also have the potential of reducing welfare inequalities across regions. The various dimensions of regional development therefore need to be identified. The economic cohesion and access to goods in the area, and the future opportunities of the region vis-à-vis its abilities to create goods and services in the future such that living conditions are constantly improved needs to be analysed (Goletsis & Chletsos, 2011). Poverty maps (Hentschel et al., 2000) which indicate the geographic profile of the states, indicating areas of concentration of poverty and where policies must be focused to alleviate the problem can be a useful tool in designing interventions.

III. Contextualizing for India

The Ministry of Finance Committee for Evolving a Composite Development Index for States (September 2013) noted that geographic impediments, lack of natural resources or adverse climates may not form the basis for continuing with underdevelopment. To address this, the Government of India, within its federal framework has mechanisms to facilitate equitable development, in particular aimed at improving human capital development through fiscal transfers to states. Despite these provisions, regional economic disparities have been constantly rising across states and it is conjectured that these trends are emerging mainly due to the lack of appropriate and efficient institutions at the state level (M. Govind Rao, 2009) While implicit transfers have been heavily concentrated towards richer states, explicit transfers have been unsuccessful in providing impetus to development in poor states. Also, most states, in their attempt to reduce their fiscal deficit burden, have compressed their developmental expenditure which has further widened the gap between developed and backward states. Furthermore, with increasing globalization, investments have continued to flow towards states geared with good infrastructure and away from those with poor quality economic and social overheads. In light of this, there is a pressing need to reform intergovernmental transfers to correct the regional imbalances in development (Chakraborty, 2009). It must be also noted that while fiscal transfers may partially offset regional inequalities, their efficacy depends on the state's ability to use these resources. This success factor of fiscal management by states is dependent on the volume of transfers and the state's capabilities in managing their finances. This is also pointed out by Rao and Chowdhury (Rao & Chowdhury, 2012) in discussing health sector reforms. They note that low levels of public spending results in poor quality of preventive health and poor health status of the population.

In examining the important aspects for spatial parity across hill states in India, the following sectors were examined:

Infrastructure

Specific to hilly states, it has been observed that access to roads is significant for expanding economic opportunities (Sarkar, 2010). The construction of roads would enable access to economic activities through various means such as the expansion of markets, agricultural transformation, and generate non-farm employment opportunities. It would also lead to the introduction of other ancillary industries such as retail, trade and transport and provide the development of other physical and social infrastructure. Furthermore, the study finds that the school dropout rates and the number of children not attending schools increases with remoteness. With greater connectivity, proximity to schools would improve which would be imperative in affecting decisions regarding school education, especially for female students. Indeed, it observes that only those households that have road connectivity or have the means to rent homes closer to road networks have enabled their children to go to school. Lall and Chakravorty (Lall & Chakravorty, 2005) showed that in India, private firms tend to locate away from lagging and inland regions, which have poor infrastructure and poor connectivity.

In view of the importance of infrastructure development, there have been some special programs of the Government which have focused on building road and power infrastructure. One of the major programmes is the Prime Minister's Gram Sadak Yojana (PMGSY) which was launched in 2000. It seeks to provide connectivity through all weather roads to unconnected habitations with population of 1000 and above by 2003 and those with population 500 and above by 2007 in rural areas. In terms of hilly areas, the PMGSY attempts to line habitations with population of 250 and above. The scheme has completed 5884 out of 8893 roads sanctioned in the North East region as of June 2012 (Ministry of Development of the North East Regions, 2012)

Some other programmes have also been initiated in the North East regionwhich are highlighted below:

Roads

1. 670 km of East-West Corridor in Assam by the National Highway Authority of India (NHAI) in 2005-06
2. Special Accelerated Road Development Programme for the North-Eastern Region (SARDP-NE) connecting state capitals, district headquarters and border roads through 2 and 4 lane roads was approved in 2005-06 and will be implemented in two phases, A and B, covering 10,141 km comprising of 4,798 km of National Highway and 343 Km of state roads
3. Trans-Arunachal Highway, covering a distance of 2,319 km was subsequently added to the SARDP to connect districts. connecting Districts

Power

1. Major Hydro power projects of 2000 MW in Arunachal Pradesh
2. Thermal power plans, gas based and coal based in Tripura and Assam

Given the large positive externalities that infrastructure in the form of roads and power create, and the importance of these as a determinant of regional development, the study uses two indicators, road index and power index. The road index is seen to vary across the states with the highest at 100 in Tamil Nadu and the lowest is in Jammu and Kashmir at 28. The power index is found to be highest in Himachal Pradesh, followed by Tamil Nadu at 84 and Kerala and Maharashtra at 73 (Table 2.1).

The current study attempts to capture geographic vulnerabilities as a function of land under hilly terrain (thereby reducing access) and percentage of forest cover in total geographical area (limiting use of land for other purposes) as these impact both the creation of infrastructure and its maintenance by creating significant negative externalities that translate into additional costs for the hill states.

Table 2.1: Infrastructure Indicators

States	Road Index	Power Index
Arunachal Pradesh	31	68
Assam	64	58
Himachal Pradesh	65	85
Jammu and Kashmir	28	72
Karnataka	74	76
Kerala	83	73
Maharashtra	60	73
Manipur	70	53
Meghalaya	60	65
Mizoram	56	52
Nagaland	71	56
Sikkim	49	71
Tamil Nadu	100	84
Tripura	75	58
Uttarakhand	60	72
West Bengal	72	61

Source: (IDFC, 2011)

Education

It is observed that diverse geographic conditions are an incentive to migration (Escobal & Terero, 2005). Investment in mobile endowments such as education would help migrants improve their welfare through employability or engagement in other economic activities, and break away from inequality.

In this direction, the XI Plan (Planning Commission, 2010) had undertaken several measures to improving higher education in the country by supporting the establishment of universities and colleges located in remote, border and hilly areas. In addition, the Rashtriya Madhyamik Shikhsha Abhiyan (RMSA) was launched in 2009-10 to make provisions for residential schools and hostels for boys and girls in existing schools in a measure to improve access and encourage enrolment of children from hilly and sparsely populated areas (XII Plan document). The RMSA is a centrally sponsored scheme with funding pattern of 90:10 for special category and North East states and 75:10 funding pattern between the centre and other states. So far it has been successful in meeting 75% of its target and enrolled 2.4 million students in secondary school.

In terms of the overall education status in the country, although there was an increase in public spending on education during the XI Plan, the XII Plan has identified several challenges that still need to be addressed such as low attendance rates, increasing dropout rates and low secondary school enrolment. In the case of the North East, some progressive results have emerged and it has been found that the enrollment of girl students is higher than the national average in these states (Singh & Ahmad, 2012)

The XII Plan (Planning Commission, 2012) has identified certain critical areas to focus in Education for the North Eastern Regions which include the following:

1. Investment in teacher's training and evaluation
2. Capacity building and skill development to address the social, gender and regional gaps in education. In terms of employability, the states themselves may create opportunities for employment generation while the vocation education sector should be reformed to ensure employability in the dynamic market
3. Public Private Partnership models to be developed and operationalised in schools and higher education

Based on this identified priority on education, the current study attempts to map vulnerabilities arising from the existing educational infrastructure and incorporates data on dropout rates (Class I-X) as a proxy for access to school education and the number of colleges per lakh of population as a proxy for higher education to build an index for measuring the status of education in the hill states in India.

Data (Table 2.2) shows that Karnataka has the best infrastructure provision for higher education with 44 colleges per lakh of its population. It is closely followed by Himachal Pradesh at 38 and Maharashtra at 35. West Bengal and Tripura are the worst performers with only 8 colleges, followed by Sikkim and Jammu and Kashmir at 14 and Meghalaya at 16. In terms of school dropouts, Assam has the highest drop-out rate, followed by Meghalaya and Nagaland. Kerala has been the most successful in retaining students in school and has a very low dropout rate at 0.51. The next lowest is Himachal Pradesh at 16.05 and Tamil Nadu at 25.94.

Table2.2: Education Indicators

States	Number of Colleges/Lakh Population (18-23 Yrs)	Drop Out Rates (I-X)
Arunachal Pradesh	11	61.71
Assam	13	77.40
Himachal Pradesh	38	16.05
Jammu and Kashmir	14	43.60
Karnataka	44	43.34
Kerala	29	0.51
Maharashtra	35	38.18
Manipur	23	45.28
Meghalaya	16	77.38
Mizoram	21	53.70
Nagaland	20	75.13
Sikkim	14	69.86
Tamil Nadu	27	25.94
Tripura	8	58.38
Uttarakhand	28	36.57
West Bengal	8	64.22

Source: (Ministry of Human Resource Development, 2010-11)

Health

A good indicator to assess the overall health status of the population is the Infant Mortality Rate. This is a measure of the deaths of children before the age of one year per 1000 live births. The IMR fell by 5% per year from 2006 to 2011 in India, better than the 3% decline per year in the preceding five years. At this rate of decline, India is projected to have an IMR of 36 by 2015 while the MDG target is 27. A further acceleration in reducing IMR is needed to achieve this goal. (Planning Commission, 2012)

In terms of healthcare infrastructure, the XII Plan finds both private and public provision of healthcare services to be inadequate. The situation is further exacerbated by the wide geographical variation in the country. The Report of the “Task Force to look into the problems of hill states and hill areas and to suggest ways to ensure these states and areas do not suffer in any way because of their peculiarities” (Planning Commission, 2010) find that there is a shortfall in the number of Sub-centres, PHCs and Community Health Centers (CHC) required in the north east states, namely Meghalaya, Tripura and Nagaland for sub-centre and others in Tripura. In terms of human resources, the shortfall in nurses has been found to be most common in the north and north eastern states.

To address these deficiencies, the XI plan envisaged the establishment of 132 auxiliary nursing midwifery schools in the high focus states of Himachal Pradesh, Jammu and Kashmir, Uttarakhand and the North Eastern states (mid term appraisal XI Plan). Another program, the Pradhan Mantri Swasthya Suraksha Yojana (PMSSY) was launched in 2006 to expand central and state government medical institutions. Phase I of this programme targeted the establishment of 6 new AIIMS like institutions in Rishikesh and Uttarakhand (among others) and the upgradation of current facilities at medical institutions in Jammu and Kashmir, West Bengal, Kerala, Tamil Nadu, Karnataka, and Maharashtra and Himachal Pradesh in Phase II. Phase III of this programme aims for the upgradation of medical institutions in Assam and additional institutions in Himachal Pradesh, Kerala, Karnataka, Maharashtra, West Bengal and Tamil Nadu. In the area of medical research, there are currently 98 extramural projects in the country which are funded by the Department of Health Research and 24 new ones have been initiated or are under progress in the North East (Planning Commission, 2010).

The XII Plan has also identified certain areas requiring special attention, as listed below:

1. Focus on increasing seats in medical colleges, nursing colleges and for other licensed health professionals.
2. Improvement in the quality of the National Rural Health Mission services including the rationalization of manpower requirement and involving communities to improve health care services.
3. Special emphasis is needed in the development of infrastructure and the availability of doctors, paramedics and nurses need special attention.
4. Encourage Public Private Partnership in secondary and tertiary health care

The status of hill states with regard to coverage by health facilities is examined in the current study using data from the Ministry of Health and Family Welfare on the average rural population covered by Sub Centres (SC) and Primary Health Centres (PHC). In terms of rural population covered by Sub Centre, Mizoram is at the lowest at 1430, followed by Himachal Pradesh and Sikkim. West Bengal’s resources are spread thin and each SC has to serve an average of 6008 patients while the PHCs have to cater to 68442 persons. Once again Mizoram has the lowest load at only 9281 (Table 2.3).

Table 2.3: Health Indicators

States	Avg. Rural Pop covered by SC	Avg. Rural Pop covered by PHC
Arunachal Pradesh	3,738	11,022
Assam	5,817	28,551
Himachal Pradesh	2,984	13,615
Jammu and Kashmir	4,790	23,010
Karnataka	4,234	16,257
Kerala	3,815	21,577
Maharashtra	5,817	34,022
Manipur	4,523	23,745
Meghalaya	5,849	21,734
Mizoram	1,430	9,281
Nagaland	3,553	11,166
Sikkim	3,123	18,998
Tamil Nadu	4,272	30,888
Tripura	4,288	34,304
Uttarakhand	3,981	29,396
West Bengal	6,008	68,442

Source: (Ministry of Health and Family Welfare, 2010-11)

Water and Sanitation

The Jawaharlal Nehru National Urban Renewal Mission (JNNURM) which was launched in 2005 has been an important contributor to the water and sanitation infrastructure in the country. So far, the bulk of its projects, comprising of 70% of the sanctioned cost of Rs. 60,000 crore has been utilized to build and refurbish water and sanitation facilities.

While the JNNURM has been addressing the concerns in water and sanitation provision in urban areas, the rural situation has been relatively less focused upon. The XII plan has now called for a regional planning approach for the provision of these services as a necessity to meet the needs of both rural and urban areas. Furthermore, it emphasizes the importance of clean drinking water and sanitation for improved health and reduction in disease burden.

The current study examines the status of Water and Sanitation in rural areas using data on the average number of rural households (per 1000) with access to sufficient water for all household activities, access to safe drinking water and households without bathroom facilities. The percentage access to safe drinking water has been less than 50% in four out of sixteen states examined and includes Kerala, Manipur, Meghalaya, and Mizoram. None of the states have 100% access while Himachal Pradesh, Tamil Nadu and West Bengal are states with over 90% access to safe drinking water; Uttarakhand comes close at 89.50%, followed by Karnataka at 84.40%. In terms of access to sufficient water for all household activities, Nagaland fares the worst with just 368 out of 1000 households with access to these facilities. Tamil Nadu has the best record and provides access to 949 households, followed by Assam at

944. Manipur, Arunachal Pradesh, Tripura, Uttarakhand, West Bengal, Kerala and Himachal Pradesh are the other states which provide access to over 80% households. In terms of sanitation infrastructure, Sikkim has been the most successful and only 63 rural households out of 1000 are without bathroom facilities. The next highest performer is Kerala at 97, followed by Mizoram at 128 and Nagaland at 130. Tripura has been the least successful and as much as 89.7% rural households in the state are without bathrooms, followed by West Bengal, Tamil Nadu and Maharashtra (Table 2.4).

Table 2.4: Water and Sanitation Indicators

States	Rural household/1000 getting sufficient water for all household activities	Percentage rural household access to safe drinking water	Rural household/1000 without bathroom facilities
Arunachal Pradesh	891	74.30	525
Assam	944	68.30	456
Himachal Pradesh	833	93.20	317
Jammu and Kashmir	758	70.10	405
Karnataka	717	84.40	481
Kerala	846	28.30	97
Maharashtra	729	73.20	542
Manipur	895	37.50	502
Meghalaya	785	35.10	449
Mizoram	643	43.40	128
Nagaland	368	54.60	130
Sikkim	649	82.70	63
Tamil Nadu	949	92.20	577
Tripura	879	58.10	897
Uttarakhand	875	89.50	205
West Bengal	849	91.40	730

Source: (NSSO 69th Round, 2013)

Economic Conditions

The Gross State Domestic Product (GSDP) comprises of the Agriculture and Allied sector, Industry, Mining and Quarrying, Manufacturing and Services sectors. The expectation is usually that with economic growth, the importance of the secondary and tertiary sectors would increase.

The North Eastern states had a substantial improvement in their growth rates during the XI Plan and the average GSDP in these states improved to 9.8% as against 8% at the national level. The XII Plan reports that Manipur, Tripura, Mizoram, Maharashtra and Karnataka registered over 5% growth in the proportion of agriculture in the GSDP (Table 2.5). Tripura, West Bengal, Kerala, Himachal Pradesh, and Jammu and Kashmir are the high productivity states whose ratio of GSDP to arable land exceeds 70,000/hectare at 2004–05 prices while low productivity (GSDP/arable land > 35,000/hectare at 2004–05 prices) states include Meghalaya, Maharashtra and Karnataka (Planning Commission, 2012).

Another indicator of economic maturity is the proportion of employed persons to total population. States that have a higher proportion of employed persons are generally considered to be better-off in terms of employment, skills and diversification possibilities. The Work Force Participation Rate has declined from 76.3% in 2004-05 to 74% in 2009-10 among males and from 22.7% in 2004-05 to 18.3% in 2009-10 for females. In terms of labour force participation rate, there has been a decline in the second half of the last decade. It fell from 43% in 2004-05 to 40% in 2009-10.

Data on the Worker Population Ratio from the National Sample Survey Report, and, the percentage share of agriculture and allied sector in the GSDP from the Planning Commission data repository, are used to examine the economic conditions in hill states. Himachal Pradesh has the highest worker population ratio, at almost 50% of its population, followed by Mizoram, Karnataka and Meghalaya. Manipur has the lowest at 349, followed by Assam and Kerala. The percentage of agriculture and allied sector in GSDP is lowest in Tamil Nadu, followed by Sikkim and Maharashtra. The highest share is observed in Arunachal Pradesh, followed by Nagaland and Assam.

Table 2.5: Economic Conditions Indicators

States	Worker Population Ratio (per 1000 population)	% of Agriculture & Allied in GSDP
Arunachal Pradesh	383	29.73
Assam	363	26.34
Himachal Pradesh	499	19.02
Jammu and Kashmir	411	22.85
Karnataka	456	16.97
Kerala	377	10.11
Maharashtra	443	8.71
Manipur	349	25.16
Meghalaya	454	16.66
Mizoram	460	20.17
Nagaland	380	27.69
Sikkim	437	8.34
Tamil Nadu	448	8.27
Tripura	379	24.05
Uttarakhand	407	11.30
West Bengal	386	18.54

Source: (NSS 66th Round, 2012)

Table 2.6: BPL Population and Gini Coefficients

States	BPL population (%)	Gini Coefficient (Rural)
Arunachal Pradesh	25.90	0.293
Assam	37.90	0.220
Himachal Pradesh	9.50	0.283
Jammu and Kashmir	9.40	0.221
Karnataka	23.60	0.231
Kerala	12.00	0.350
Maharashtra	24.50	0.244
Manipur	47.10	0.159
Meghalaya	17.10	0.170
Mizoram	21.10	0.194
Nagaland	20.90	0.181
Sikkim	13.10	0.259
Tamil Nadu	17.10	0.257
Tripura	17.40	0.197
Uttarakhand	18.00	0.231
West Bengal	26.70	0.220

Source: Compendium of Environment Statistics, 2012, MOSPI ; Planning Commission Data Tables, 2009-10

Two important variables for measuring the socio-economic vulnerability of a state are the GINI coefficient which is a measure of income inequality based on per capita Net State

Domestic Product (Nayak et al., 2010), and, the extent of poverty as measured by the Below Poverty Line (BPL) population (Table 2.6).

The range of percentage of BPL population is between 9.40 to 47.10, with Jammu and Kashmir having the lowest percentage at 9.40, followed by Himachal Pradesh and Kerala with 9.50% and 12% respectively. The highest proportion of poverty stricken population resided in the states of Manipur (47.10%), followed by Assam (37.90) and West Bengal (26.70).

The extent of inequality as indicated by the Gini coefficient varied between a low of 0.159 points in Manipur to a high of 0.350 points in Kerala. As implied by the figures, high inequality was recorded for the states of Kerala, followed by the states of Arunachal Pradesh and Himachal Pradesh recording inequality to the magnitude of 0.293 and 0.283 points respectively. Low inequality was observed in the states of Manipur (0.159), Meghalaya (0.170) and Nagaland (0.181).

The correlation between proportion of BPL population and Gini coefficient is negative for the study states at 0.44. Conceptually, higher the Gini, higher the induced negative impact on capabilities and economic opportunities created, implying an erosion of positive impacts from the other developmental activities and its associated costs on departing from the path of inclusivity. Hence, the Gini coefficient is taken with a positive dimension, for ensuring consistency with this notion of sustainable development. A negative dimension on the Gini would provide perverse signaling in rewarding states which promote inequality. In a multi dimensional framework this is antithetical since it would pull in the opposite direction to the other indicators for development, creating mutual incompatibility in the formula.

Forests and Hilly Terrain

Forests are a valuable resource and provide a number of services such as the following (Pandey & Dasgupta, 2013):

- Provisioning: Goods produced or provided by the forest ecosystem such as food, fuel, water, fibre, genetic resources and bio-chemical resources
- Regulating: Regulation of eco system services provide benefits such as climate regulation, flood control, disease control, and detoxification
- Cultural: non material benefits such as spiritual, aesthetic, recreational, educational, inspirational, symbolic and communal
- Supporting: forests support biodiversity by contributing to soil formation, primary production and nutrient recycling.

The economic value of forests can also be classified as use and non use values (Pandey & Dasgupta, 2013). These include the following:

Use Values:

1. Direct Use Values comprising of output that can be consumed directly such as:

- Consumptive and productive sustainable use of timber, firewood, medicines and others
- Non consumptive such as human habitat, eco tourism, education and others.

2. Indirect use values such as:

- Functional benefits: Comprising of watershed benefits which include agricultural productivity, soil conservation, regulation of stream flows and recharging of ground water
- Ecosystem services such as nitrogen fixing, waste assimilation, carbon store and microclimatic functions

3. Option Value which includes the future direct and indirect use values

Non use values:

1. Bequest value which include the value of leaving use and non use values for future generations or others
2. Existence value arising from the knowledge of continued existence

Given the multiple uses of forests and their contribution to preserving the environment, it is imperative to conserve and maintain forest cover. In particular, the forests in North Eastern Regions are one of the richest biodiversity areas in the world and in order to maintain these natural resources, these states need to make efforts in preserving their forest cover.

The percentage of forest cover in total geographical area and the percentage of land under hilly terrain are positively correlated at 5% level of significance. For the current study, data was taken from the India State of Forests Report 2011 (Ministry of Environment and Forests, 2011). All the North East states (barring Assam), Himachal Pradesh, Jammu and Kashmir and Uttarakhand have 100% land under hilly terrain. Kerala at just over 76% and Karnataka at 25.05% follow in the listing. West Bengal has the least area under hilly terrain at 3.55%, with higher proportions in Tamil Nadu at 17.52% and Maharashtra at 22.72%. In terms of forest cover in total geographical area, Mizoram has the highest at over 90%, followed by Arunachal Pradesh at 80.50%, and Nagaland at 80.33%. Jammu and Kashmir has the least share of area under forests at just over 10%, followed by West Bengal and Maharashtra at 14.64% and 16.46%, respectively. Table 2.7 presents data on these indicators for the 16 hill states.

Some central government schemes have been launched to address the geographical vulnerabilities in hill states such as (Planning Commission, 2012). These include the following:

1. Hill Areas Development Programme/Western Ghats Development Programme (HADP/WGDP)

This scheme was introduced in the V Five Year Plan to ensure ecologically sustainable development in hill areas. It focuses on eco-preservation and eco-restoration and the sustainable use of biodiversity. The scheme also takes into account the needs and aspirations of local communities and their participation in the design and implementation on conservation strategies for bio-diversity and livelihoods. The HADP covers two hill districts of Assam, major part of Darjeeling in West Bengal and the Nilgiris in Tamil Nadu. The WGDP was launched in 1974-75 in talukas/blocks along the western ghats. It currently covers 175 talukas across Maharashtra, Karnataka, Kerala, Tamil Nadu and Goa.

These schemes are mainly in the areas of agriculture and soil conservation, forestry, horticulture, sericulture, animal husbandry, livelihood generation, small scale industries, watershed development and others.

2. Border Area Development Programme (BADP)

The BADP was introduced during the VII Plan and is a 100% centrally funded scheme to ensure balanced development in infrastructure and promotion of security along border areas in the western regions. It covers 358 border blocks of 94 border districts in 17 states along the international border including Arunachal Pradesh, Assam, Himachal Pradesh, Jammu and Kashmir, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, Uttarakhand and West Bengal.

These states have leveraged the BADP in programmes to strengthen their social and economic infrastructure, closing gaps in road networks, schemes for employment, education, health, agriculture and allied sector and others. However, the programme allocation has been too small to draw the attention of state governments. The XII Plan proposes to increase the outlay in this scheme and calls for a relook at its structure.

Table 2.7: Forests and Hilly Terrain Indicators

States	Percentage of Forest Cover in Total Geographical Area	Percentage of Land under Hilly Terrain
Arunachal Pradesh	80.50	100.00
Assam	35.28	24.42
Himachal Pradesh	26.37	100.00
Jammu and Kashmir	10.14	100.00
Karnataka	18.87	25.05
Kerala	44.52	76.09
Maharashtra	16.46	22.72
Manipur	76.54	100.00
Meghalaya	77.02	100.00
Mizoram	90.68	100.00
Nagaland	80.33	100.00
Sikkim	47.34	100.00
Tamil Nadu	18.16	17.52
Tripura	76.07	100.00
Uttarakhand	45.80	100.00
West Bengal	14.64	3.55

Source: (Ministry of Environment and Forests, 2011)

Chapter 3: Methodology for Indicators and Index Construction

I. Introduction: Indicators and Indices for Economic Development

It is well accepted that indices which seek to capture disparity, in a development context, should incorporate the multidimensional aspects of human well-being, so that the index can accurately measure the quality of life, and also capture the multiple ways in which economic opportunities can expand and improve people's capabilities to use these opportunities. The use of non monetary, quantitative indicators for examining disparities across regions is well established in the literature. Such approaches have been used for measuring spatial differences across international and national boundaries. A number of studies have also been done which seek to measure vulnerability for a region, or measure the extent of disparity within and across regions within an economy.

In understanding disparity across regions and communities, quantitative statistical measures have usually adopted the approach of constructing composite indices to reflect disparity, such as in terms of vulnerability or backwardness of regions, impacts, adaptive capacity, governance, coping ability and so on, depending on the outcome of interest. Construction of a composite index would therefore include a range of economic and social indicators, while taking into account data availability and data quality at the regional level. Researchers typically construct these indices by weighting individual indicators (of say vulnerability) and combining these together by different methods. The main strength of such an index lies in its multi dimensionality, while providing a means of quantitative representation of a diverse range of indicators. While composite indices have been criticized for their lack of comparability across time, in terms of spatial comparisons they tend to perform well, and the construction of the index itself is rigorous in terms of technique. These are also relatively flexible, allowing for changes in selection, scaling, weighting and aggregation (Booysen, 2002). The composite indices are also much easier to interpret than locating trends in many separate indicators or making forced choices among a set of indicators, as well as for purposes of ranking among regions in a benchmarking exercise with a clear policy focus (Nardo et al., 2005). Particularly in the context of complex measurement constructs, such as the developmental disparity phenomena which the current study seeks to analyse, where hierarchical patterns cannot be assigned among different dimensions of development, the composite index approach is appropriate, and can overcome the limitations of using single indicator approaches, such as income based ones, in identifying regional disparities (Booysen, 2002) (Goletsis & Chletsos, 2011) and specifically in the Indian context, capture non income dimensions of disparity across and within states (Chakraborty, 2009)

Various techniques have been used to construct composite indices. While the use of factor analysis (FA) in weighting indicators for arriving at a composite indicator is common to most studies, such analysis is based on several assumptions such as the linearity of the relationship between indicators and the difficulties in interpreting the orthogonally transformed indicators after a Principal Component Analysis (PCA). PCA/ FA also do not provide weights when there is no correlation between the indicators. In the construction of an environmental sustainability index in particular, PCA/FA was not use due to concerns with the correlations obtained among the indicators, assigning negative weights to some indicators (World Economic Forum, 2002). Estimation of a linear multiple regression model, with indicators as explanatory variables, with their estimated coefficients serving as weights has also been used in some cases, where several data points are available to ensure that unbiased and reliable estimates with known statistical properties are obtained. Among the various alternative statistical and econometric (e.g. Data Envelopment Analysis for measuring environmental performance, (Zhou et al., 2007)) approaches that have been used, one useful statistical approach has been to use the coefficient of variation among indicators as a basis for weighting individual indicators, and subsequently combining these to arrive at the composite index. An early contribution was Hellwig's use of weights that were inversely proportional to the coefficient of variation for comparing countries development while Sudarshan and Iyengar adapted this further to classify district-wise data from Andhra Pradesh and Karnataka in India (Iyengar & Sudarshan, 1982)

In the Indian context, approaches used have included principal component analysis (Mundle et al., 2012), equal weighting which amounts to a simple average scoring process across variables for a particular region (Patnaik & Narayanan, 2009), unequal weights based on expert judgment (Ravindranath et al., 2011) (Pandey & Dasgupta, 2013), and weighting based on intra and inter-variable standard deviations (Iyengar & Sudarshan, 1982). Among international comparisons, an early study was on differences in consumption across countries (Bennett, 1951) and more recent attempts include a cross country study of role of regional policies in reducing regional income inequality (Shankar & Shah, 2003). Specifically for the North East, one study which attempted to construct a vulnerability indicator for the districts in the region, (Ravindranath et al., 2011) used a mix of methods, assigning weights to indicator variables in some instances through expert consultations, taking equal weights for forests and agriculture and using principal component analysis for the water sector. There are several methodological concerns of comparability, consistency and data issues that arise with the use of mixed methods when trying to arrive at an overall indicator.

A composite index approach is used in this study to capture the disparity in socio-economic development which exists among hill states in India, and translates due to specific biophysical features into cost disadvantages. In terms of economics, these represent opportunity costs arising from legal and institutional constraints on allocating land resources purely on principles of highest marginal returns. These constraints can further translate into non-marginal changes in costs that are incurred, even when allocations can be made subject to meeting legal obligations as discussed earlier (Chapter 1, Section I)[5].

[5] Consider for instance the claim by the Uttarakhand government that any developmental project to be started in the forest area gets delayed by 2-3 years becauseof clearing the forest area, which increases the total project cost by 20-25% (unplanned expenditure) which in turn has direct repercussions on the state's financial position. Source: (NDC)

II. Selecting States and Indicators

All the states which have officially been declared as having area under hills, have been included for the analysis. This list includes 16 states namely – Mizoram, Nagaland, Arunachal Pradesh, Manipur, Meghalaya, Tripura, Sikkim, Uttarakhand, Jammu and Kashmir, Himachal Pradesh, Kerala, Assam, West Bengal, Maharashtra, Karnataka and Tamil Nadu. These states have some percentage of their total geographical area classified as hills (Ministry of Environment and Forests, 2011). In addition, a sub-set of these states falling under the Special Category states is separately analysed. These 11 states are – Assam, Manipur, Tripura, Meghalaya, Nagaland, Jammu and Kashmir, Arunachal Pradesh, Mizoram, Sikkim, Uttarakhand, and Himachal Pradesh.

In the current study three distinct types of costs have been considered as having a bearing on the socio-economic development of hill states in India. While some of these costs are direct and tangible to some extent, the others impose negative externalities and thereby constitute indirect costs that constrain economic growth and individual opportunities. The costs can be grouped into three categories conceptually:

a) Biophysical constraints that impact costs directly and adversely are hilly terrain and area covered by forests.
b) Negative externalities arise from the lack of access to basic services such as health and education that do not get fully captured in direct measures of access. A good indicator is the Infant mortality rate.
c) Indirect costs which constrains economic opportunities and individual capabilities for enhanced income generation. A good example of this is the extent of inequality in a society. Quite apart from the extent of poverty, this is another factor that is increasingly being recognized as an obstacle to societal well-being.

In computing the indices for the study, states have been grouped into two alternative categories: firstly, all states that have hilly terrain, and secondly, the special category states with hilly terrain. For both groups, four alternative indices have been proposed.

Simple checks for data consistency were done. The pair-wise correlation matrix for the data set, and tested for these at 5% level of significance. A few of these correlations are significant, although the directionality is as expected for all the variables. These are discussed along with the other results in Chapter 4.

Indicators for the Analysis

The methodology adopted for constructing indicators that would adequately capture the disparity across hill states, in the specific context of the disadvantages that these states have and the costs that they thereby incur, reflects the importance of various criteria in pursuing sustainable and inclusive development.

The approach adopted towards constructing an indicator is a formative model of measurement, where all relevant indicators contribute to the construct. Relevant indicators include those which measure multiple dimensions of vulnerability or its obverse, i.e. the potential to reduce vulnerability. The purpose is to be able to construct a numerical value, that encompasses multiple dimensions of the disadvantages (or the potential to overcome these) within specific geographic or biophysical boundaries, and attributes a comparative value to each state. Usually the numeric values are normalized from a reference or threshold point, and lie on a scale of 0-1.

The list of variables and weights that are used in alternative formulations for the indices are presented in Table 3.1. Since many of the criteria chosen to reflect vulnerability to economic disadvantages (or the coping capacity to overcome these) changes with time, it is important to construct the numerical scale using indicators that are comparable in terms of time scale or for the same year. The data used in this study are for the years 2010 -2011 since for these years data was available for the selected indicators.

The indicators cover five categories: education, health, economic, infrastructural and basic amenities. These are briefly described below.

Basic Amenities, Education and Health

The status of basic services such as education, healthcare, and water and sanitation is examined in this study. It uses data on the dropout rates for classes I-X and the number of colleges per lakh of population to measure education, the coverage of health infrastructure is measured using Ministry of Health and Family Welfare data on the average rural population covered by Sub Centres (SC) and Primary Health Centres (PHC). The status of Water and Sanitation is studied using data on the average number of rural households (per thousand) with access to sufficient water for all household activities, percentage access to safe drinking water and rural households (per thousand) without bathroom facilities.

Infrastructure

The level of infrastructure development was measured using Road and Power Indices. The Power Index comprises of per capita energy index (1/3 weight), percentage of villages electrified (1/6 weight), percentage of BPL households electrified (1/6 weight), peak deficit (1/6 weight) and energy deficit (1/6 weight)

The Road Index comprises of lane length of National Highways per unit of geographical area (1/3 weight), length of rural roads per unit of geographical area (1/3 weight) and percentage of habitation coverage (1/3 weight).

Economic

Economic variables used in this study reflect the status of employment and state level income opportunities. These are measured by the worker population ratio (per 1000 workers) and the percentage share of agriculture and allied sector in the Gross state domestic product (GSDP) respectively.

Table 3.1: Variables and Weights

S. No	Indicator Category	Indicator Variable / Weight	Source
1	Education	Number of Colleges per Lakh Population (in 18-23 YEARS)	Report on All India Survey of Higher Education, Min. of HRD
		Dropout Rates (Classes I-X): defined as the percentage of dropouts in a given year out of the total number of those enrolled in a programme in the year	Statistics of School Education, Min. of HRD
2	Health	Average rural population covered by SC Average rural population covered by PHC	Rural Health Statistics in India: Detailed Statistics, MoHFW
		Infant Mortality Rate	Rural Health Statistics in India: Detailed Statistics, MoHFW
3	Basic Amenities	Rural households/1000 getting sufficient water for all household activities	Key Indicators of Drinking water, Sanitation, Hygiene & Housing Conditions in India, NSS 69th Round
		Rural households/1000 without bathroom facility	
		Percentage households with access to Safe Drinking Water (Tap/Handpump & Tubewell)	Planning Commission Data
4	Infrastructure	Power Index Road Index	Compendium of Proceedings Infrastructure Development Finance Company Ltd., 12th & 13th Finance Commission (2005-2010, 2010-2015).
		Percentage of forest cover in total geographical area	India State of Forests Report
		Percentage of land under hilly terrain	India State of Forests Report
5	Economic	Worker Population Ratio (per 1000 of persons): defined according to usual status (the usual principal category and usual subsidiary economic activity of a person taken together)	NSS 66th Round Report No. 539
		Percentage of Agriculture & Allied Sectors in the GSDP	Planning Commission Data
		Gini Coefficient	Planning Commission Data
		Percentage of Population Below Poverty Line	Compendium of Environmental Statistics, MoSPI

Construction of Indices

Normalization and Dimensionality of Indicators

In constructing the index, the indicators (X) are normalized following the methodology developed for the UNDP's Human Development Index approach (Anand and Sen 1994, HDR

If there are N regions (denoted i=1, 2,…..N) and V indicators (denoted j=1,2,…..V):

For each indicator Xij, the maximum and minimum value of a particular indicator is noted and Xij is normalized using the formula:

Xij = (Xij – Mini (Xij)) / (Maxi (Xij) – Mini(Xij)) ……………… ………………………..(1)

This leads to a value of 1 for the state with the highest score, 0 for the state with the lowest score, and the rest of the states get a score lying between 0 and 1.

For ensuring consistency across indicators, directionality should be same and hence, for those values which are in an opposite direction the score attributable for the specific Xij is computed as:

(1 – Xij) ……………………………………………………………………………………. (2)

Thus, for instance, in constructing the overall index for ranking the states, we have adopted the positive dimensionality with development so, scores for indicators such as availability of water supply and per capita NSDP are calculated using (1) above. For all indicators that indicate negative directionality such as poverty and inequality, a further calculation is done as in (2) above for calculating the score attributable to the individual state.

Computation of Overall Index

The above exercise allows us to formulate the basic scores for each indicator, across states. This allows a comparison across states on each individual indicator, on the scale of 0-1. The states can be subsequently ranked on the basis of the index value obtained.

This in itself is useful in providing insights on which states lag in particular aspects that define disparity or create vulnerability to continuing disparity.

To create an overall index of disparity, the individual indicators are combined to construct an index. Four alternative indices are computed for this study. These are discussed below.

<u>Index 1: Equal weights index</u>

This index is based on a process of averaging across the individual scores on each indicator, state-wise. This method is one of the most commonly used ones in the literature and has the advantage of simplicity, and does not require imputation of any further expert judgement or other criteria for judging relative importance across indicators. However, it has been argued that even this method embodies an implicit judgement on the part of the researcher that all the indicators have equal importance in influencing the desired index outcome (Nardo et al., 2005). It may be noted that the biophysical constraints, as captured through the extent of hilly terrain and the extent of forest cover are taken as a given for the current exercise. Following convention, we therefore do not include these directly as indicators of development. Neither of these reflects a direct quantitative measure of either a means or an end indicator for development. This index is called the Equal Weights index.

Index 2: Weighting by economic externality costs

In this method, the score for each sub-group is first computed, weights are then applied to the sub-group score, and a linear summation of the weighted scores is subsequently done to obtain a composite score.

The economic variables directly reflect the economic growth of the state and the drivers for these can come from individual capabilities. The primary role of the state would be to create opportunities for encouraging private enterprise, skills and potentials. However, these are dependent on the provision of two kinds of facilitation: one which may be considered to be the direct responsibility of the state for provision of basic services for ensuring a threshold quality of life in relatively deprived areas. The other lies in the realm of public private partnerships to foster creation of multiplier effects for development namely, the provision of infrastructure.

However, the economic growth and development potential gets constrained by two factors that become relevant in addressing disparities: namely, poverty and inequality, neither of which may get reflected in measures of per capita average well –being such as income, employment status and so on. Hence, we weight the economic variables by an average of the Gini coefficient for the state and the proportion of below poverty line households in the state. The basic services provision variables are weighted by the infant mortality ratio, which as studies reveal is determined among other factors, by education and provision of health facilities. Since the focus of the study is on state policy to address disparity, the variables on provision of facilities for health and education, are weighted by the IMR.

The provision of infrastructure is often argued to be relatively more resource intensive, with substantially increased institutional, legal and financial costs as discussed earlier. There are two primary factors which have been highlighted as responsible for this situation – these are biophysical in nature, namely, the hilly terrain and the extent of forest cover in the state concerned. Applying the economic rationale of "opportunity costs", these translate into higher costs of provision for infrastructure. Accordingly the scores on the infrastructure variables are summed and weighted by a combination of the extent of hilly area and the extent of forest cover in the state.

It is to be noted that all the weights used, namely, BPL, Gini co-efficient, IMR, Proportion of forest and proportion of hill area, impose constraints on economic growth and the sustainability of the development process. To maintain directionality, the weighting is done by inverse weighting.

Subsequently these weighted sub-groups of indices are added together to obtain the weighted score, based upon which the states are ranked as per the extent of disability that currently characterizes these states. This index is called the Economic Disability Index.

Index 3: Weighting by disabilities from bio-physical factors alone

To exclusively capture the extent of constraints imposed due to biophysical factors, an independent index is generated, where all the indicators used for index 1 (apart from hilly terrain and forest cover) are weighted by the share of hilly terrain and the share of forest cover in the state. Such an index allows us to compare how the scores and hence rankings of economic disadvantages faced by different states, changes as one takes into account these two specific biophysical constraints, which are a given for all practical purposes for planning exercises.[6] This index allows full weightage to the biophysical related cost disabilities, as compared to the other indices where this weightage is reduced due to distribution across other concerns for weighting. This index is called the Geographic Disability Index.

Index 4: Weights by sample variance

Here, the development score for each state (inverse of indicator for cost disability), is computed as a linear sum of the individual indicators for the state, with weights determined by the extent of variation in the indicators across states. The weights for each indicator, varies inversely with the variation across indicators. This method controls for undue distortion in the arising from large variations which may occur in a particular indicator/s, if any.

Mathematically this is represented as follows:

If Xij is the indicator as derived in (1) above, (normalized value), then the Index (I) score for region i, is computed as a linear sum of the Xij, with weights Wj capturing the contribution of the individual indicator to the variation observed in the data set.

$$I_i = W_1 X_{1j} + W_2 X_{2j} + \ldots\ldots + W_n X_{nj} \qquad \ldots\ldots (3)$$

Where, the W's are such that : $(0<Wj<1 \ \& \ \Sigma \ Wj = 1)$.

The weights are calculated as varying inversely with the variation in the indicators used as follows:

$$W_j = \left[\frac{c}{\sqrt{Var_i(x_{ij})}} \right] \qquad \ldots\ldots (4)$$

Where c is a constant, such that:

[6] Specific policy on forestry, which has primarily focused on increasing forest cover within designated forest land or compensatory afforestation, are considered to be given for practical short term planning purposes.

$$C = \left[\sum_{j=1}^{V} \frac{1}{\sqrt{Var_i(x_{ij})}} \right]^{-1} \qquad \text{........ (5)}$$

This index is called the Variance index.

Summary of the Four Indices

A point to be noted is that at this stage, we have not imputed weights on basis of area share or population share to the scores generated. Typically, for making decisions on resource allocation, (or transfers), it is a common practice to allocate shares depending on population or geographical area of the state concerned. For instance, an 80% weight to population share and a 20% share to geographical area was considered to determine the need of a state by a committee on composite development index for states (Ministry of Finance, Government of India, 2013).Further criteria on performance are also developed in order to not create disincentives for performance alongside thresholds for transfer to meet costs of individual states. We also do not distinguish among states needs using any a priori criteria and instead opt for linear aggregation for computing the index, since the idea is to be inclusive in terms of all the hill states concerned without prioritization of a particular aspect of well-being. Rather, we account for specific economic disabilities arising out of economic criteria such as transaction costs(terrain, forest cover) and negative externality costs (IMR, Inequality, poverty) that do not get directly reflected in conventional indicators (or partially so at best), in terms of their implications for societal well being.

The methodology adopted here provides scores for four alternative sets of rankings, in order to trace the robustness of the results obtained. This is important since composite indices involve some amount of expert judgement on the part of the researcher, in terms of choice of indicators and in particular the weighting adopted. Therefore to reduce the uncertainty and improve the sensitivity of the results, the analysis uses alternative weighting schemes (Nardo et al., 2005).

The alternative formulations used are summarized in Table 3.2

Table 3.2: Weights for Alternative Indices

S. No	Index	Weighting
1	Equal Weights	Variables listed in Table 3.1 with equal weights
2	Economic Disability Index	Weighting Basic Services and Education with IMR. Weighting Infrastructure with Percentage of Forest Cover in total geographic area (0.1) and Percentage of land under hilly terrain (0.9)
3	Geographic Disability Index	Weighting of composite scores by Percentage of Forest Cover in Total Geographic Area (0.1) and Percentage of Land under Hilly Terrain (0.9)
4	Variance Index	Weights derived from the standard deviation across each indicator, across the sampled states

Chapter 4: Disparity Indices

I. Introduction

The findings from the exercise on construction of indicators and indices, as described in Chapter 3, are presented in this chapter. Indices have been constructed and analysed for all the states which have hilly terrain as per the GOI administrative definition under the HADP. Special category states being a particular focus area for policy purposes, the study also provides an analysis for these states separately. The results for all states with hilly terrain are presented first, followed by the results for special category states only. The states have been ranked in all the tables in terms of the most disadvantaged to the least disadvantaged. This can alternatively be interpreted in terms of the development status as per the selected indicators, namely, the state with the lowest score in terms of development, ranks the highest and the one with the highest score ranks the lowest. Table 4.1 presents descriptive statistics of all the variables used in the study.

Table 4.1: Descriptive Statistics

Variables/Indicator	Mean	Maximum	Minimum	Standard Deviation
Number of College per Lakh Population(18-23 Yrs)	22	44	8	10.95
Drop Out Rates (I-X)	49.20	77.40	0.51	22.43
Average rural population covered by SC	4263.88	6008.00	1430.00	1231.76
Average rural population covered by PHC	24750.50	68442.00	9281.00	14200.06
Infant Mortality Rate	33.13	58.00	13.00	12.50
Rural households/1000 getting sufficient water for all household activities	788.13	949	368	146.84
Rural households/1000 without bathroom facilities	406.50	897	63	236.93
Percentage households access to safe drinking water (rural)	67.27	93.20	28.30	21.98
Power Index	67.31	85	52	10.25
Road Index	63.63	100	28	17.79
Percentage of forest cover total GA	47.42	90.68	10.14	28.62
Percentage of land under hilly terrain	73.08	100.00	3.55	38.63
Worker Population Ratio (per 1000 population)	414.50	499.00	349.00	42.90
Percentage of Agriculture & Allied in GSDP	18.37	29.73	8.27	7.31
BPL Population percentage in 2009	21.33	47.10	9.40	10.01
Gini Coefficient Rural	0.232	0.350	0.159	0.05

II. Ranking as per scores of sub-groups of indicators

Table 4.2 presents the rankings as per scores attained by each state by components i.e. indicator groups. In terms of education, Assam is the least developed with the highest dropout rates amongst the states studied. Himachal ranks the highest in terms of educational development since it scores in terms of both a low drop-out rate and high provision of colleges relative to other states. While Kerala, Karnataka and Maharashtra, also have relatively higher number of colleges provided per lakh population, the drop-out rate is lowest across the sample in Kerala, ranking it just above Himachal in terms of educational attainment for the state. To reiterate, for the education sector, given the focus on creation of economic capabilities, two indicators were used: the drop-out rate at the school level capturing inherent concerns with lifelong ramifications on both social and economic impacts and the number of colleges available for higher education as a proxy for capturing the income generation and employment creation impacts.

For the health sector, two indicators used are the provision of sub centres and primary health centres. These are indicators that capture the provision of basic health services, of particular importance to rural, remote and inaccessible areas. The norms for population coverage differ for sub centres and primary health centres, and for hilly, difficult and tribal areas[7], however what comes across clearly from the data is the reality of wide variation in the population that is covered (on average) across states even after controlling for the variation in norms. In West Bengal which has the less than 4% of its area under hilly terrain, for instance, the average population coverage is over 68,442 for a PHC and 6,008 for a SC. Meghalaya, inspite of 100% hilly terrain, on the other hand ranks a close second in SC coverage at 5, 849, although its population coverage by a PHC is close to the norm for hill states at 21, 734. Himachal and Mizoram are the only two states which meet the norms (given that they have 100% hilly terrain), for both coverage by sub centre and PHC and therefore are the best performing states as per these indicators. Meghalaya and Tripura perform poorly in terms of SC and PHC coverage respectively, inspite of the lower norms that have been set due to their hilly terrain.

With regard to provision of water supplies, it is well established that both quality and quantity are important in defining adequacy of household access to safe water. Access to basic amenities in rural areas is an appropriate indicator to map the deficits, given that almost uniformly across India rural coverage in water and sanitation is lower than the corresponding coverage in urban areas for most states. Nagaland has the largest deficit in sufficiency of water supplies in rural areas, with only 368 households per 1000 getting sufficient water for all household activities. The implications become clearer if we note that Mizoram, which is the second last in terms of adequacy of coverage reports 75% higher coverage than Nagaland at 643 households per 1000 reporting sufficiency of water supplies. Meghalaya, with 35% households having access to safe drinking water, has the lowest coverage among hilly states in terms of access to safe drinking water. This is an important indicator of access since it is the most important one which has ramifications for health and well-being of the individuals in the household. Although Tripura's performance in the water sector is relatively better, Tripura has the poorest coverage in terms of access to sanitation, with 897 households per 1000 rural households reporting having no bathroom facilities. Sikkim is the best performer in the sanitation indicator, although does not do as well in terms of adequacy of coverage in rural areas. Uttarakhand, Himachal Pradesh and Tamil Nadu report coverage of 90% and

[7] Norms are: 1 PHC per 30,000 population in normal circumstances and 1 PHC per 20,000 population for hilly, difficult and tribal areas; the corresponding norms are 5,000 and 3,000 for a SC.

above in terms of access to safe drinking water, high coverage in terms of adequacy (highest in Tamil Nadu across the sample), while Uttarakhand does well in sanitation with only 20% households in rural areas without facilities.

While there is expectedly a highly significant and positive correlation between percentage area under forest cover and percentage area under hilly terrain, there is a significant negative association between the percentage of hilly areas and the percentage of households having access to drinking water, the latter being a basic quality of life indicator.

Among states lacking adequate infrastructure, the 9 most disadvantaged states are states with substantial area under hilly terrain and includes the entire North East region. The only exception among hill states is Himachal Pradesh, which has the highest score on the power index across the entire sample while the road index is average at 65, with the range of scores lying between 56 for Mizoram to 75 for Tripura. Jammu and Kashmir is worst off in road connectivity while Mizoram lacks most in terms of availability of power. Among hill states, Uttarakhand has relatively good access to power although its road index is below the average for the entire sample. Most of the better performers in terms of these two infrastructure indices have substantial area in non-hilly terrain.

The power index is found to be significantly correlated, positively with the Gini coefficient and negatively with the proportion of population below the poverty line in the state. The power index is also significantly and negatively correlated with the percentage share of agriculture and allied activities in gross state domestic product. This underlines further the importance of the provision of infrastructure, such as power, for creating the economic opportunities that are associated with poverty alleviation and inequality reduction.

The indicators on economic conditions are interpreted to imply that an improvement in these indicates enhanced income and employment opportunities for the state's population. Thus, we do not consider per capita NSDP but rather look at two indicators which represent trends for sustainability, reflecting diversification of earning choices and capabilities. These are the worker population ratios and the share of agriculture and allied activities in GSDP. It is of interest to look at these two indicators separately since the disparity in the worker population ratio is much higher than the distribution of the percentage share of agriculture and allied activities in GSDP among these states. The correlation between the two is also not significant at the 5% level. Rather, the worker population ratio is significant and positively correlated with the power index and the number of colleges per lakh population, indicating the close association between building capabilities to improve economic condition, and bringing in a more diversified occupational structure, which is less dependent on self employment. Expectedly, it is also significant and negatively correlated with the proportion of BPL population.

The share of agriculture and allied activities in the GSDP is much higher in six hill states, than the all India and the sample average values for16 study states. These six states are, five from the North East region and Jammu and Kashmir. It is highest in Arunachal Pradesh (29.7%) followed by Nagaland (27.7%), Assam (26.3%), Manipur (25.2%) and Tripura

(24%). The implication for this lies in the lack of diversification or alternative opportunities in other economic sectors. Manipur's disadvantage gets heightened in having the lowest workers per 1000 population ratio at 349. Sikkim scores with a very low share of agriculture in its GSDP, along with a high worker population ratio while Himachal has the highest worker population ratio in the sample. Figures 4.1 to 4.6 present the scores attained by states on the five indicator categories.

Figure 4.1: Education Scores

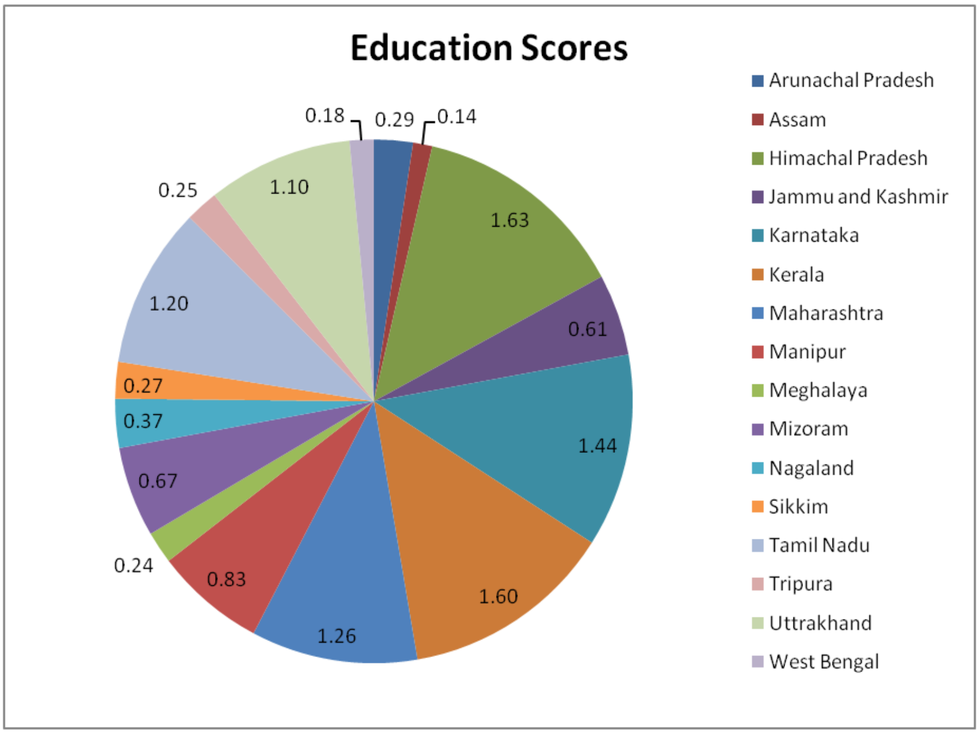


Figure 4.2: Health Scores

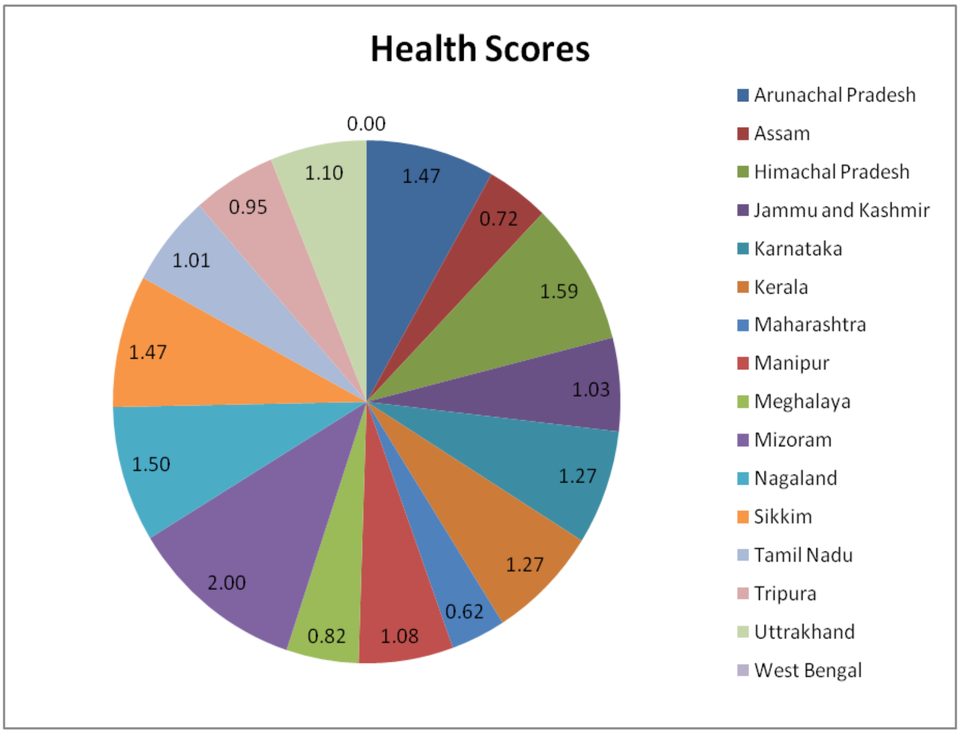


Figure 4.3: Water and Sanitation Scores

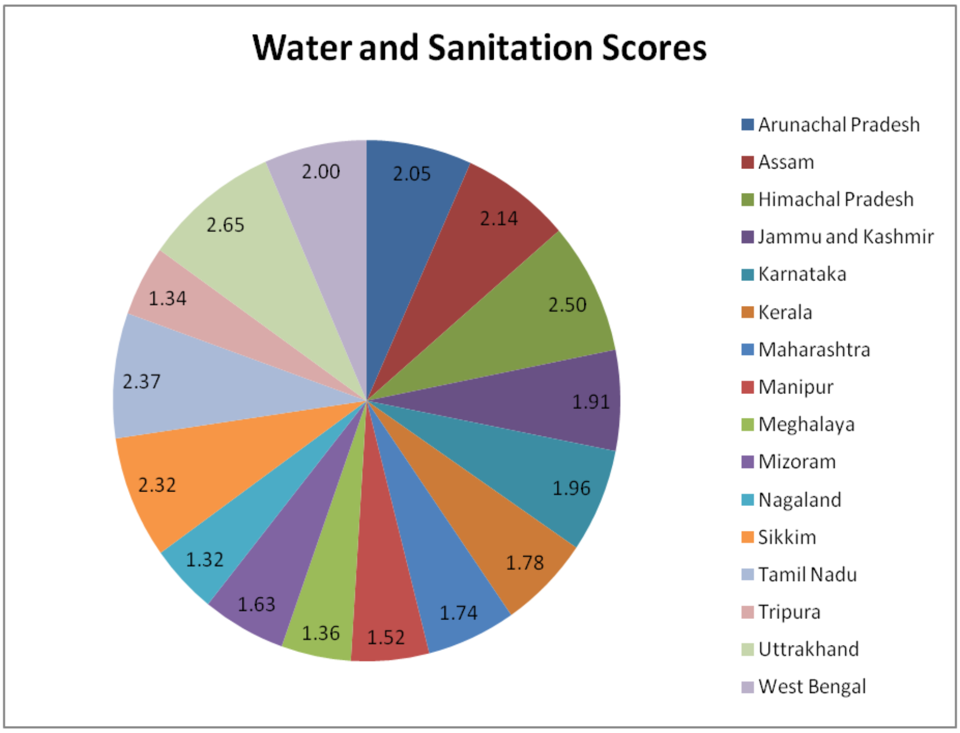


Figure 4.4: Infrastructure Scores

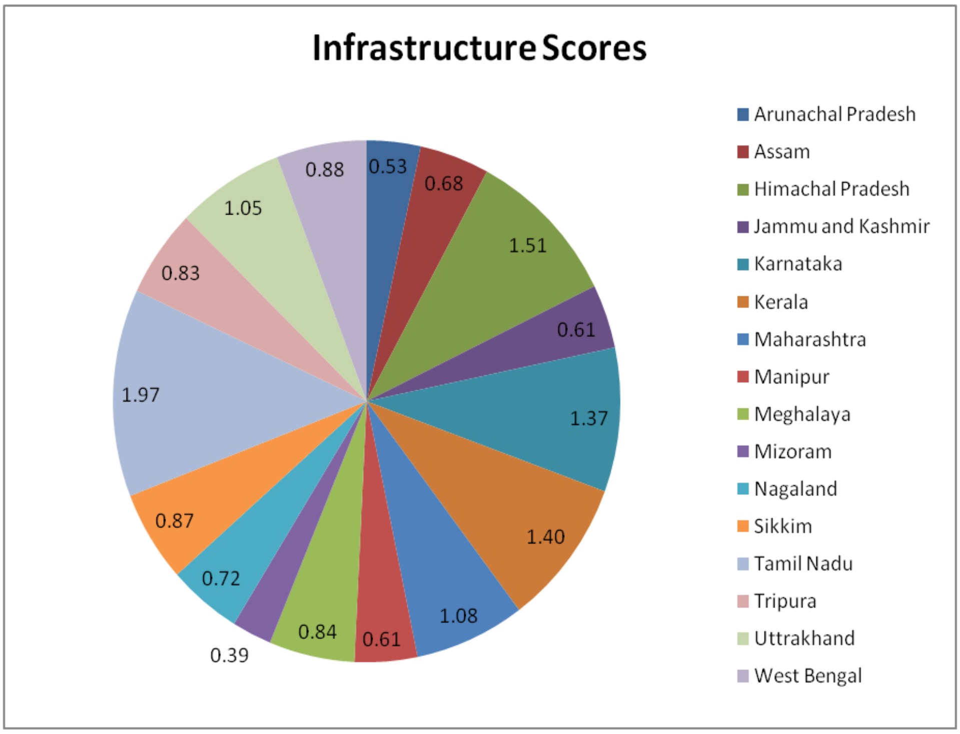


Figure 4.5: Economic Conditions Scores

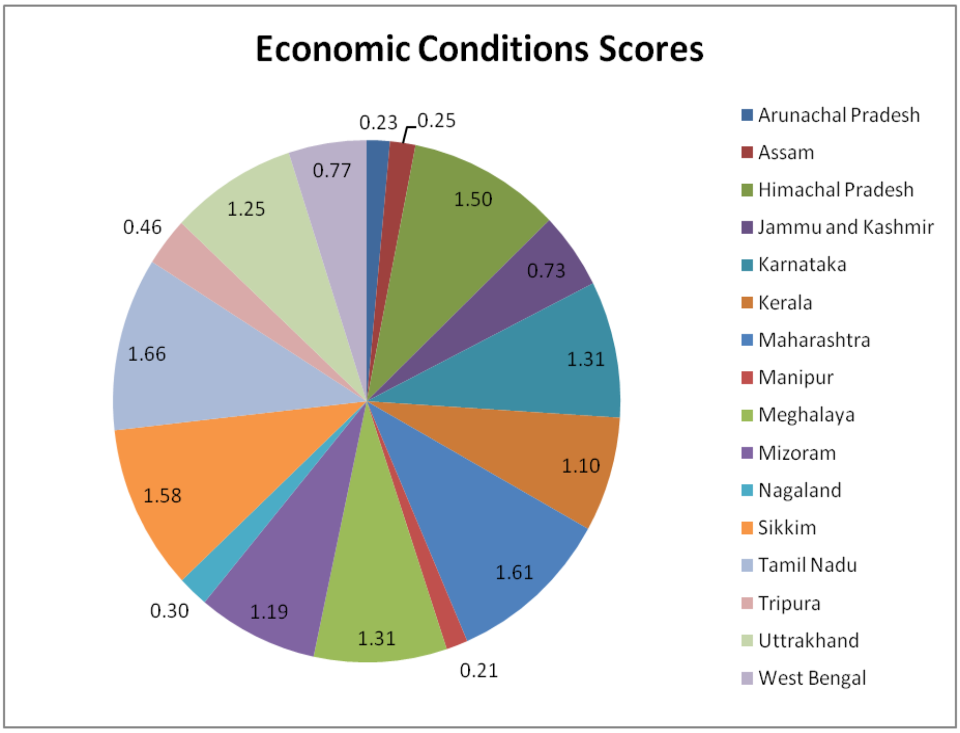


Table 4.2 Indicator Ranking: All States

Rank	Education	Health	Basic Services	Infrastructure	Economic Conditions
1	Assam	West Bengal	Nagaland	Mizoram	Manipur
2	West Bengal	Maharashtra	Tripura	Arunachal Pradesh	Arunachal Pradesh
3	Meghalaya	Assam	Meghalaya	Jammu and Kashmir	Assam
4	Tripura	Meghalaya	Manipur	Manipur	Nagaland
5	Sikkim	Tripura	Mizoram	Assam	Tripura
6	Arunachal Pradesh	Tamil Nadu	Maharashtra	Nagaland	Jammu and Kashmir
7	Nagaland	Jammu and Kashmir	Kerala	Tripura	West Bengal
8	Jammu and Kashmir	Manipur	Jammu and Kashmir	Sikkim	Kerala
9	Mizoram	Uttarakhand	Karnataka	Meghalaya	Mizoram
10	Manipur	Karnataka	West Bengal	West Bengal	Uttarakhand
11	Uttarakhand	Kerala	Arunachal Pradesh	Uttarakhand	Karnataka
12	Tamil Nadu	Sikkim	Assam	Maharashtra	Meghalaya
13	Maharashtra	Arunachal Pradesh	Sikkim	Karnataka	Himachal Pradesh
14	Karnataka	Nagaland	Tamil Nadu	Kerala	Sikkim
15	Kerala	Himachal Pradesh	Himachal Pradesh	Himachal Pradesh	Maharashtra
16	Himachal Pradesh	Mizoram	Uttarakhand	Tamil Nadu	Tamil Nadu

III. Ranking by Indices: All States

Equal Weights Index

In arriving at an index that integrates the normalized scores attained by states on each indicator, three more variables are added to the scores to maintain consistency with the alternative indices developed in this study. These are the measures on proportion of below poverty line population (BPL), Gini coefficient on distribution of consumption (Gini), and the infant mortality rate (IMR). The IMR is added to the health component, the BPL and Gini to the economic indicators component. The data is normalized, checked for dimensionality and added to the respective sub-group to maintain consistency with the other variables. Table 4.3 ranks states as per these variables. It also presents data on the percentage of geographical area under forest cover and the extent of hilly terrain in the states considered for the study.[8]

Table 4.3 State rankings on IMR, Gini, BPL, Forest cover and Hilly Terrain

Rank	IMR	% of BPL population	GINI Coefficient	% Area under Forest Cover	% land under hilly terrain
1	Assam	Manipur	Kerala	Mizoram	Arunachal Pradesh
2	Meghalaya	Assam	Arunachal Pradesh	Arunachal Pradesh	Himachal Pradesh
3	Jammu and Kashmir	West Bengal	Himachal Pradesh	Nagaland	Jammu and Kashmir
4	Himachal Pradesh	Arunachal Pradesh	Sikkim	Meghalaya	Manipur
5	Karnataka	Maharashtra	Tamil Nadu	Manipur	Meghalaya
6	Uttarakhand	Karnataka	Maharashtra	Tripura	Mizoram
7	Mizoram	Mizoram	Karnataka	Sikkim	Nagaland
8	Arunachal Pradesh	Nagaland	Uttarakhand	Uttarakhand	Sikkim
9	West Bengal	Uttarakhand	Jammu and Kashmir	Kerala	Tripura
10	Sikkim	Tripura	Assam	Assam	Uttarakhand
11	Maharashtra	Meghalaya	West Bengal	Himachal Pradesh	Kerala
12	Tripura	Tamil Nadu	Tripura	Karnataka	Karnataka
13	Tamil Nadu	Sikkim	Mizoram	Tamil Nadu	Assam
14	Nagaland	Kerala	Nagaland	Maharashtra	Maharashtra
15	Manipur	Himachal Pradesh	Meghalaya	West Bengal	Tamil Nadu
16	Kerala	Jammu and Kashmir	Manipur	Jammu and Kashmir	West Bengal

[8] Note that the biophysical factors, extent of hilly terrain and forest cover, are not at this stage added directly to the indicator variables in the equal weights index, since they constitute neither means nor processes for development by themselves. These factors are used later for weighting purposes, to capture the increased cost disabilities that states face due to these two factors.

Note: The states are listed in this table according to their status in terms of the original data on each indicator. The states highlighted in yellow have the same ranks

In Kerala and Manipur, the IMR values are substantially lower than for other states at 13 and 14 respectively. Himachal Pradesh and Jammu and Kashmir have the lowest percentage of population below poverty line, followed by Kerala and Sikkim. The Gini coefficient is highest in Kerala, indicating maximum inequality among the states considered here, followed by Arunachal, Himachal and Sikkim.

A linear aggregation of the scores for each sub-group of indicators is subsequently done. The equal weights index does not differentiate amongst the indicators in terms of relative importance. The normalized scores achieved under each head are simply averaged to obtain the overall score for the state concerned.

Assam is found to be the least developed with this index, followed by Manipur, West Bengal, Meghalaya and Tripura. Himachal Pradesh was the most developed state, while expectedly Tamil Nadu, Kerala and Karnataka are also relatively better-off states. Table 4.4 lists the state rankings.

Table 4.4: Equal Weights Ranking: All States

Rank	States
1	Assam
2	Manipur
3	West Bengal
4	Meghalaya
5	Tripura
6	Nagaland
7	Arunachal Pradesh
8	Jammu and Kashmir
9	Mizoram
10	Maharashtra
11	Sikkim
12	Uttarakhand
13	Karnataka
14	Kerala
15	Tamil Nadu
16	Himachal Pradesh

Economic Disability Index

It may be noted that in lieu of the opportunity costs on economic development imposed by forests alone, the XIII Finance Commission has already recognized the need to compensate states and made allocations accordingly. The definition of economic disability used here, seeks to capture both tangible and intangible costs, i.e. it seeks to be inclusive of the externalities that impact economic development through multiple channels, calling for a focus on specific sub-national territories. Hence the economic disability index was constructed to weight education, health and water and sanitation by the IMR, infrastructure with percentage of land under hilly terrain (90% weightage) and percentage of forest cover in total geographical area (10% weightage) and economic conditions with the share of BPL population (50% weightage) and the Gini coefficient (50% weightage). Table 4.5 presents the ranking of states component-wise for the economic disability index.

Table 4.5: Ranking of states by (Weighted) Components for Economic Disability Index

	Indicator Components		
Rank	*Health, Education, Water & Sanitation (IMR)*	*Power Index, Road Index (Hilly Terrain, Forest cover)*	*Economic Indicators (BPL,GINI)*
1	Assam	Mizoram	Manipur
2	Meghalaya	Arunachal Pradesh	Assam
3	Jammu and Kashmir	Nagaland	Nagaland
4	West Bengal	Manipur	Arunachal Pradesh
5	Tripura	Meghalaya	Tripura
6	Mizoram	Tripura	West Bengal
7	Karnataka	Sikkim	Jammu and Kashmir
8	Uttarakhand	Uttarakhand	Mizoram
9	Himachal Pradesh	Jammu and Kashmir	Meghalaya
10	Arunachal Pradesh	Himachal Pradesh	Karnataka
11	Maharashtra	Kerala	Uttarakhand
12	Nagaland	Assam	Maharashtra
13	Sikkim	West Bengal	Kerala
14	Manipur	Maharashtra	Tamil Nadu
15	Tamil Nadu	Karnataka	Sikkim
16	Kerala	Tamil Nadu	Himachal Pradesh

Education, Health, Water and Sanitation indicators: IMR weight

The status of education, health, and water and sanitation is captured through their impact on reducing the Infant Mortality Rates. More progressive states such as Kerala and Manipur have the lowest IMR. Rankings reveal that Assam is the most vulnerable, followed by Meghalaya and Jammu and Kashmir. In the case of Assam, the state has a good record in basic services provision but it has the highest IMR (IMR 58) which pulls its ranking down and makes it the most vulnerable. Meghalaya has the second highest IMR (IMR 55). In the case of Jammu and Kashmir too, the state ranked low on vulnerability in terms of individual indicators such as education, health and provision of basic services but because of its high IMR (IMR 43), it is the third most vulnerable state. Manipur and Nagaland have performed poorly in the provision of basic services, but these states have some of the lowest IMRs which is why their scores change drastically on weighting and Manipur turns out to be one of the better performers. Nagaland too is a better performer in terms of development by this component. Changes in the rankings are observed for Himachal Pradesh and Uttarakhand. While Himachal Pradesh has consistently been one of the two most developed states in the provision of education, health and water and sanitation services and Uttarakhand has been one of the medium performers in health and education and the best in the provision of basic services, both states have relatively high IMRs which is why they move lower on the performance scale, ranking now as medium performers as compared to the other states. Both states have IMRs well over the sample mean.

Infrastructure Indicators: Percentage of land under hilly terrain and Percentage of forest cover in total geographical area weights

The infrastructure variables comprising of the power index and the road index were weighted by the extent of forest cover and the extent of hill cover in the state concerned.

In this scenario Mizoram is found to be the most vulnerable state. Infact its rank does not change, with or without the weights. This can be explained by the fact that the state has the lowest power index, and has nearly 91% of geographical area under forests and 100% land under hilly terrain. Similarly, in the case of Arunachal Pradesh which ranks second in terms of vulnerability, the state has one of the lowest road indices, the second highest percentage of land under forests at nearly 81% and 100% of its area under hilly terrain. For Jammu and Kashmir on the other hand, the weighting actually improves its performance ranking. This can be explained by the small percentage (10.14%) of forest cover in the state, despite it having 100 % of its area under hilly terrain. The ranking of Uttarakhand and Himachal Pradesh, become more vulnerable on the infrastructure component, after the weighting. Assam's vulnerability on this count reduces as compared to a non-weighted index. This can be explained by the fact that it has a relatively smaller percentage of land under hilly terrain (just over 24%) as well as percentage of forest cover (just over 35%)

Economic Indicators: Percentage of population below poverty line and Gini coefficient weights

Two commonly used measures of the economic status of a state in India is the extent of its poverty and inequality. Weighting the economic indicators by the share of BPL population and the Gini coefficient of consumption, provides a comprehensive measure of the economic status.

Regardless of the weighting used, Manipur is found to be the most vulnerable state as far as the economic indicators component of development is concerned. It has the highest percentage of BPL population, apart from the lowest worker-population ratio among the study states and a relatively high percentage share of agriculture and allied services in its GSDP. Kerala presents an unique scenario. The Gini coefficient of the state is highest while the BPL population is among the lowest, at about 12%. Himachal Pradesh and Sikkim are the least vulnerable states by this component since these states have a low percentage of BPL population (Himachal Pradesh at 9.5% and Sikkim at 13.10%) although their Gini coefficient measure is relatively high (Himachal Pradesh 0.283 and Sikkim 0.259).

Table 4.6 presents the rankings based on scores obtained by this method.

Table 4.6 Economic Disability Index: All States

Rank	States
1	Assam
2	Meghalaya
3	Jammu and Kashmir
4	Tripura
5	Arunachal Pradesh
6	West Bengal
7	Mizoram
8	Nagaland
9	Uttarakhand
10	Manipur
11	Himachal Pradesh
12	Sikkim
13	Karnataka
14	Maharashtra
15	Kerala
16	Tamil Nadu

Geographical Disability Index

This index seeks to highlight the cost disabilities arising primarily from two biophysical constraints, namely extent of area under hilly terrain and extent of area under forest cover. Greater weightage is given to hilly terrain in the formula, in view of the focus of the study. The scores attained by various sub-groups of indicators (as derived for table 4.3), are weighted by the percentage of forest cover in total geographical area (10% weightage) and percentage of land under hilly terrain (90% weightage). The resultant rankings are presented in Table 4.7. The rationale being that these weights are indicative of the overall economic impact, which plays out through several indicators.

It is clearly observed that the rankings change substantially between the unweighted and geographic disability weighted indices. In understanding the economic challenges in furthering development, and the resources required to overcome the cost disabilities that biophysical factors impose, the rankings as in Table 4.7 seem more relevant to the analysis. The presence of additional opportunity costs associated with terrain issues, even when the share of forest cover has been given very low weightage, is apparent. The states of the North East region fare worst as a group, while the states with less hilly terrain fare much better. Of special interest is the fact that the middle ranking states of Sikkim, Himachal Pradesh, Jammu and Kashmir and Uttarakhand, do so, inspite of having 100% of their land in hill districts, lending credence to the notion that it is not to be taken for granted in designing interventions or allocating resources, that having hilly terrain is necessarily a drawback, with an inevitability to it. Nor is this a mere artifact of the weighting process. The weighted index accommodates the fact that incremental costs are higher for hill areas by design (such as higher transaction costs for forest cover and incremental costs for construction activity), but also takes note of the achievements on various indicators. Both Himachal Pradesh and Jammu and Kashmir have the lowest percentage of BPL population, yet due to the weightage to hill and forest cover, their vulnerability is higher than otherwise. It provides a confirmation of the hypothesis that geography is indeed not destiny and that resources can be effectively used to develop the states that are currently performing poorly.

Table 4.7 Geographic Disability Index: All States

Rank	States
1	Mizoram
2	Nagaland
3	Arunachal Pradesh
4	Manipur
5	Meghalaya
6	Tripura
7	Sikkim
8	Uttarakhand
9	Jammu and Kashmir
10	Himachal Pradesh
11	Kerala
12	Assam
13	West Bengal
14	Maharashtra
15	Karnataka
16	Tamil Nadu

Variance Index

The final analysis is a sample variance based approach which weights indices by a constant derived from their standard deviation. This seeks to control for the underlying (and statistically unknown) nature of individual characteristics of a state and present a relative ranking taking note of the variation across the entire dataset. The rankings based on scores from this index are presented in Table 4.8. There appears to be a fair amount of correspondence in these rankings with the rankings as per the equal weights index, except for a couple of exceptions.

Table 4.8 Sample variance index: All States

Rank	States
1	Manipur
2	Assam
3	Meghalaya
4	Tripura
5	Nagaland
6	West Bengal
7	Arunachal Pradesh
8	Jammu and Kashmir
9	Mizoram
10	Sikkim
11	Uttarakhand
12	Maharashtra
13	Karnataka
14	Kerala
15	Himachal Pradesh
16	Tamil Nadu

Comparative View of Alternative Indices

Table 4.9 summarises the rankings obtained from the 4 alternative methods to calculate indices. States with relatively less area under hilly terrain such as Karnataka, Tamil Nadu, Maharshtra, are generally better performers by all counts. On the other hand, it is obvious that the states from the North Eastern region are the most disadvantaged, although individual rankings within the region change depending on the weights assigned. It is interesting to note that major changes occur in the ranking across the entire sample, when scores are scaled by weights based on the extent of hill and forest cover which is the focus of the study. There is far greater concordance when these biophysical factors are not given prominence. The approach is robust, and manages to isolate a ranking of states reflecting the economic disabilities that are uniquely associated with the biophysical factors.

Table 4.9: Summarizing Rankings: All States

Rank/Index	Equal Weights	Economic Disabilities	Geographic Disabilities	Sample Variation
1	Assam	Assam	Mizoram	Manipur
2	Manipur	Meghalaya	Nagaland	Assam
3	West Bengal	Jammu and Kashmir	Arunachal Pradesh	Meghalaya
4	Meghalaya	Tripura	Manipur	Tripura
5	Tripura	Arunachal Pradesh	Meghalaya	Nagaland
6	Nagaland	West Bengal	Tripura	West Bengal
7	Arunachal Pradesh	Mizoram	Sikkim	Arunachal Pradesh
8	Jammu and Kashmir	Nagaland	Uttarakhand	Jammu and Kashmir
9	Mizoram	Uttarakhand	Jammu and Kashmir	Mizoram
10	Maharashtra	Manipur	Himachal Pradesh	Sikkim
11	Sikkim	Himachal Pradesh	Kerala	Uttarakhand
12	Uttarakhand	Sikkim	Assam	Maharashtra
13	Karnataka	Karnataka	West Bengal	Karnataka
14	Kerala	Maharashtra	Maharashtra	Kerala
15	Tamil Nadu	Kerala	Karnataka	Himachal Pradesh
16	Himachal Pradesh	Tamil Nadu	Tamil Nadu	Tamil Nadu

IV. Rankings: Special Category States

The special category states comprise of Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, Arunachal Pradesh, Sikkim, Jammu and Kashmir, Himachal Pradesh, and Uttarakhand. Assam has the highest drop-out rates and is ranked one in terms of education vulnerability. It also fares worst in health. Nagaland continues to have the worst provision of basic services while Arunachal Pradesh has the maximum disadvantage in infrastructure. Manipur continues to be the least developed state in economic conditions. The best performers in education and infrastructure facilities are Himachal Pradesh, followed by Uttarakhand. Mizoram and Sikkim on the other hand have been the most successful in providing health facilities and creating good economic conditions for their residents. Himachal Pradesh follows as the second best performer. The rankings are presented in Table 4.10.

Table 4.10: Indicator Ranking: Special Category States

Rank	Education	Health	Basic Services	Infrastructure	Economic Conditions
1	Assam	Assam	Nagaland	Arunachal Pradesh	Manipur
2	Meghalaya	Tripura	Meghalaya	Mizoram	Arunachal Pradesh
3	Tripura	Meghalaya	Tripura	Jammu and Kashmir	Assam
4	Sikkim	Uttarakhand	Manipur	Manipur	Nagaland
5	Arunachal Pradesh	Jammu and Kashmir	Mizoram	Assam	Tripura
6	Nagaland	Manipur	Jammu and Kashmir	Sikkim	Jammu and Kashmir
7	Jammu and Kashmir	Sikkim	Arunachal Pradesh	Nagaland	Mizoram
8	Mizoram	Arunachal Pradesh	Assam	Meghalaya	Uttarakhand
9	Manipur	Nagaland	Sikkim	Tripura	Meghalaya
10	Uttarakhand	Himachal Pradesh	Himachal Pradesh	Uttarakhand	Himachal Pradesh
11	Himachal Pradesh	Mizoram	Uttarakhand	Himachal Pradesh	Sikkim

Equal Weights Index

Rankings of states as per indicators is provided in Table 4.11. Assam has the highest IMR, followed by Meghalaya and Jammu and Kashmir. Manipur is the best performer in terms of IMR and has the least inequality as measured by the Gini coefficient. It however has the highest BPL population amongst special category states, followed by Assam and Arunachal Pradesh. Jammu and Kashmir has the lowest BPL population, followed by Himachal Pradesh and Sikkim. Mizoram ranks one in terms of forest cover and Arunachal Pradesh and Nagaland rank second and third. Jammu and Kashmir has the least forest cover and is followed by Himachal Pradesh and Assam. Arunachal Pradesh, Himachal Pradesh, Jammu and Kashmir, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura and Uttarakhand are completely hilly and they all rank equally in terms of percentage of hilly terrain in geographical area. Assam has the lowest percentage of land under hilly terrain.

Table 4.11: State rankings on IMR, Gini, BPL, Forest cover and Hilly Terrain

Rank	IMR	BPL	GINI	Percentage Forest Cover	Percentage of land under hilly terrain
1	Assam	Manipur	Arunachal Pradesh	Mizoram	Arunachal Pradesh
2	Meghalaya	Assam	Himachal Pradesh	Arunachal Pradesh	Himachal Pradesh
3	Jammu and Kashmir	Arunachal Pradesh	Sikkim	Nagaland	Jammu and Kashmir
4	Himachal Pradesh	Mizoram	Uttarakhand	Meghalaya	Manipur
5	Uttarakhand	Nagaland	Jammu and Kashmir	Manipur	Meghalaya
6	Mizoram	Uttarakhand	Assam	Tripura	Mizoram
7	Arunachal Pradesh	Tripura	Tripura	Sikkim	Nagaland
8	Sikkim	Meghalaya	Mizoram	Uttarakhand	Sikkim
9	Tripura	Sikkim	Nagaland	Assam	Tripura
10	Nagaland	Himachal Pradesh	Meghalaya	Himachal Pradesh	Uttarakhand
11	Manipur	Jammu and Kashmir	Manipur	Jammu and Kashmir	Assam

Note: The states are listed in this table according to their status in terms of the original data on each indicator. The states highlighted in yellow have the same ranks.

Equal weight ranking has Assam at the top of the list as the most disadvantaged, followed by Manipur and Tripura. The three least disadvantaged states are Himachal Pradesh, Uttarakhand and Sikkim.

Table 4.12: Equal Weights Ranking: Special Category States

Rank	States
1	Assam
2	Manipur
3	Tripura
4	Meghalaya
5	Nagaland
6	Jammu and Kashmir
7	Arunachal Pradesh
8	Mizoram
9	Sikkim
10	Uttarakhand
11	Himachal Pradesh

Economic Disability Index

Education, Health, Water and Sanitation indicators: IMR weight

With a high IMR, Assam continues to have the worst status in education, health and water and sanitation. It is followed by Meghalaya and Jammu and Kashmir. From being one of the most vulnerable states in the Equal weights index (Table 4.12), Manipur is less vulnerable the Economic disability index, amongst the special category states.

Infrastructure Indicators: Percentage of land under hilly terrain and Percentage of forest cover in total geographical area weights

Mizoram continues to be the most vulnerable in terms of infrastructure, followed by Arunachal Pradesh and Nagaland. With the lowest percentage of hilly terrain, Assam is the least vulnerable state, followed by Himachal Pradesh and Uttarakhand

Economic Indicators: Percentage of population below poverty line and Gini coefficient weights

In terms of Economic indicators, as weighted by BPL and Gini, Himachal Pradesh is the least vulnerable, followed by Sikkim and Uttarakhand. Manipur is the most vulnerable, followed by Assam and Nagaland (Table 4.13).

Table 4.13: Ranking of states by (Weighted) Components for Economic Disability Index

	Indicator Components		
Rank	*Education, Health, Water & Sanitation (IMR)*	*Power Index, Road Index (Hillly Terrain, Forest Cover)*	*Economic Indicators (BPL, GINI)*
1	Assam	Mizoram	Manipur
2	Meghalaya	Arunachal Pradesh	Assam
3	Jammu and Kashmir	Nagaland	Nagaland
4	Tripura	Manipur	Arunachal Pradesh
5	Mizoram	Meghalaya	Tripura
6	Uttarakhand	Tripura	Jammu and Kashmir
7	Arunachal Pradesh	Sikkim	Mizoram
8	Himachal Pradesh	Jammu and Kashmir	Meghalaya
9	Sikkim	Uttarakhand	Uttarakhand
10	Nagaland	Himachal Pradesh	Sikkim
11	Manipur	Assam	Himachal Pradesh

Note: The weights used for the corresponding indicators is provided in parentheses

In terms of overall Economic Disability, Meghalaya is the most vulnerable, with Assam as the next most vulnerable, while the least vulnerable state is Himachal Pradesh (Table 4.14).

Table 4.14: Economic Disability Index: Special Category States

Rank	States
1	Meghalaya
2	Assam
3	Tripura
4	Jammu and Kashmir
5	Arunachal Pradesh
6	Nagaland
7	Mizoram
8	Uttarakhand
9	Manipur
10	Sikkim
11	Himachal Pradesh

Geographic Disability Index

Geographic vulnerability is observed to be the highest for Mizoram, given that 90% of its area is forest area and 100% land is under hilly terrain. Nagaland and Arunachal Pradesh are the next most vulnerable states. The least vulnerable state is Assam, with Himachal Pradesh and Jammu and Kashmir being less better-off than Assam. The rankings are given in Table 4.15.

Table 4.15: Geographic Disability Index: Special Category States

Rank	States
1	Mizoram
2	Nagaland
3	Arunachal Pradesh
4	Meghalaya
5	Manipur
6	Tripura
7	Sikkim
8	Uttarakhand
9	Jammu and Kashmir
10	Himachal Pradesh
11	Assam

Variance Index

The sample variance index shows Tripura as the most vulnerable, followed by Meghalaya and Manipur. Himachal Pradesh is the least disadvantaged (Table 4.16). Table 4.17 summarizes rankings for the Special Category States based on the four indices.

Table 4.16 Variance Index: Special Category States

Rank	States
1	Tripura
2	Meghalaya
3	Manipur
4	Assam
5	Nagaland
6	Arunachal Pradesh
7	Jammu and Kashmir
8	Mizoram
9	Sikkim
10	Uttarakhand
11	Himachal Pradesh

Comparative View of Alternative Indices

Table 4.17: Summarizing Rankings: Special Category States

Rank / Index	Equal Weights	Economic Disabilities	Geographic Disabilities	Sample variance
1	Assam	Meghalaya	Mizoram	Tripura
2	Manipur	Assam	Nagaland	Meghalaya
3	Tripura	Tripura	Arunachal Pradesh	Manipur
4	Meghalaya	Jammu and Kashmir	Meghalaya	Assam
5	Nagaland	Arunachal Pradesh	Manipur	Nagaland
6	Jammu and Kashmir	Nagaland	Tripura	Arunachal Pradesh
7	Arunachal Pradesh	Mizoram	Sikkim	Jammu and Kashmir
8	Mizoram	Uttarakhand	Uttarakhand	Mizoram
9	Sikkim	Manipur	Jammu and Kashmir	Sikkim
10	Uttarakhand	Sikkim	Himachal Pradesh	Uttarakhand
11	Himachal Pradesh	Himachal Pradesh	Assam	Himachal Pradesh

Chapter 5: Costing Disabilities for Hill Areas

I. Introduction: Why use a Cost function?

In the current exercise, a cost function approach is adopted in empirically investigating the cost disabilities for hill areas. The purpose is to isolate additional costs incurred in providing services that can be attributed to hill areas as compared to plain areas. The cost function approach is based on the premise that outcomes in different sectors, measured in terms of both quantity and quality, are due to a combination of inputs which maybe exogenous or endogenous; purchased (availability of facilities such as schools or health centres) or non purchased (such as drop-out rates of girls for educational outcomes). So costs are a function of the outcomes, the prices, and other factors that influence the outcome process.

A cost function can be thought of as specifying the minimum amount of money a state must spend in order to achieve a given level of education, health care or infrastructure as the case maybe. Increasingly it is recognised that such costs vary across states for reasons that may be exogenous to the sector itself, as well as those that are beyond the control of the state concerned. These could include higher implicit input prices (such as higher costs of supplying materials), and socio economic characteristics such as population demographics. In such a situation, the cost function helps to understand by how much and due to what factors do costs vary across states.

For instance, the estimation of educational cost functions and using the subsequent results to guide the distribution of resources to ensure that administrative areas with higher costs receive additional resources is fairly standard practise (Duncombe and Yinger, 1997, 1999; Imazeki and Reschovsky 1998). In an exercise for the Ninth Finance Commissions, the cost function approach has been adopted for estimating the sectoral resource allocations and projections of need for resources by experts (Ninth FC 1990). Other scholars have also used expenditure data to analyse the resource needs of states and the cost disabilities of poorer states for the education sector in India (Roy et al 2000).

The econometric model is estimated using a panel data regression technique, with the Hausman Taylor estimation technique. The dependent variable is actual spending per capita annually, by states. the independent variables are the cost factors. The model is estimated over slightly varying time periods for 3 different sectors: education, health and roads and bridges. Education and health can broadly be described as the social sector while roads and bridges represent infrastructure provision. Within education, we estimate costs separately for primary and secondary education. The sectors have been selected keeping in view their relevance for improving the quality of life and tackling the disparity observed across states as discussed in the previous chapter. The choice of sectors and variables is also dictated by the availability of consistent and comprehensive time series data that can be used for a quantitative analysis. Among the key sectors analysed earlier, the exercise on costing considers all except Water and Sanitation. Data available for the sector does not lend itself to a rigorous analysis compatible with those for the other sectors for the time period selected for the study.

The chapter is organized as follows. In section II the available data on elevated area across states from two alternative sources is analyzed. Based on a classification of states as per the elevation data, section III examines data on whether and to what extent elevation impacts construction costs across states in education and health sectors. Sections IV, V and VI provide details of the cost function, its econometric model and the data and variables used in the estimation, respectively. Section VII presents the results from the regressions. Section VIII gives the results on the cost mark-ups for sectors and for individual states, while section IX concludes the study with the derivation of the cost mark-ups for hill areas.

II. Elevation in States of India

The elevation data was made available by the Fourteenth Finance Commission, from two sources namely, the offices of the Surveyor General of India and the National Remote Sensing Centre. Currently, the former does not provide data for all states. Both datasets provide data as area measured on a three dimensional grid. There are some minor differences that emerge among these two measures, when compared for the states where data is available from both sources. However, the purpose of the current exercise being to do a comprehensive exercise for the estimation of the elevation impact, the complete dataset from the NRSE is used. This offers two advantages: firstly it allows us to include the full dataset for all states in the analysis without loss of information, and secondly, the NRSE dataset provides information on both the area as conventionally measured in two dimensions and in three dimensions, measured at the same level of sophistication and time point. It provides a ratio of the two dimensional to the three dimensional area, and allows us to construct a measure of the proportionate difference between the two. The impact in terms of the change in costs of provision, due to a change in the extent of elevation, can thereby be easily computed from the estimates obtained through the cost function regression[9]. Tables 5.1 and 5.2 present the elevation as per NRSE and a comparison of the elevated area between the two data sources.

Table 5.1 highlights in yellow states that have a significant proportion of their area elevated, as indicated by the ratio of three dimensional to two dimensional area. Table 5.2 shows that there are three states (Himachal, Sikkim and Arunachal) where the SGI estimate differs by a little more than 0.1 relative to the NRSE measure. In Uttarakhand the difference is 0.1. For the others, the difference is insignificant. Hereafter, the proportionate difference between the three dimensional and the two dimensional area, relative to the two dimensional area of the NRSE dataset, is referred to as the elevation factor. It is used in the regression analysis to generate the coefficient for evaluating the elevation impact on per capita expenditures.

[9] The analysis can be done on similar lines with the alternative SGI dataset, if the two dimensional and three dimensional area is available for all states.

Table 5.1 Elevation in Indian States

States	2-D area (Sq.km)	3-D area (Sq.km)	Difference (3D – 2D) (Sq.km)	Ratio of 3D-2D data
Andhra Pradesh	271990.41	276115.56	4125.16	1.02
Arunachal Pradesh	82067.96	95757.03	13689.07	1.17
Assam	78301.82	79457.42	1155.6	1.01
Bihar	94049.72	94237.76	188.03	1.002
Chattisgarh	135153.5	136352.27	1198.78	1.01
Goa	3363.56	3450.09	86.53	1.02
Gujarat	189723.09	190328.56	605.5	1.003
Haryana	44075.25	44130.71	55.46	1.001
Himachal Pradesh	55675.93	64216.87	8540.94	1.15
Jammu and Kashmir	222197.5	254155.22	31957.7	1.14
Jharkhand	79858.29	80616.22	757.93	1.01
Karnataka	191243.59	193692.98	2449.37	1.01
Kerala	36439.7	37700.76	1261.06	1.03
Madhya Pradesh	308019.09	309852.47	1833.41	1.01
Maharashtra	307243.31	310245.31	3001.98	1.01
Manipur	22294.11	24283.97	1989.86	1.09
Meghalaya	22385.27	23312.87	927.6	1.04
Mizoram	21086.91	23031.46	1944.55	1.09
Nagaland	16589.61	18170.93	1587.32	1.1
Odisha	155390.09	158532.67	3142.54	1.02
Punjab	50343.01	50416.88	73.87	1.001
Rajasthan	342383.97	343966.84	1582.88	1.004
Sikkim	7128.81	8398.95	1270.14	1.18
Tamil Nadu	127913.5	130033.95	2120.45	1.02
Tripura	10397.46	10548.56	151.1	1.01
Uttar Pradesh	240702.8	240857.69	154.88	1(approx)
Uttarakhand	53607.1	60969.47	7362.37	1.14
West Bengal	83357.49	84198.09	840.6	1.01

Source of Data:
National Remote Sensing Centre, Department of Space, Govt. of India (NRSE)
Courtesy: Fourteenth Finance Commission of India

Table 5.2: **Comparing Elevation in Indian States: NRSE and SGI Three Dimensional Measures of Area (sq.km)**

State	**Area (NRSE)**	**Area (SGI)**	**Difference in Area(SGI - NRSE)**	**Proportionate difference (relative to NRSE)**
Arunachal Pradesh	95757.03	109657.31	13900.28	0.15
Assam	79457.42	80496.3	1038.88	0.01
Bihar	94237.76	94700.4	462.64	0.005
Chattisgarh	136352.3	136443.06	90.79	0(approx)
Gujarat	190328.6	196821.09	6492.53	0.03
Haryana	44130.71	44560.58	429.87	0.01
Himachal Pradesh	64216.87	72267.68	8050.81	0.13
Jharkhand	80616.22	81438.52	822.3	0.01
Madhya Pradesh	309852.5	310145.22	292.75	0(approx)
Manipur	24283.97	25888.09	1604.12	0.07
Meghalaya	23312.87	24207.4	894.53	0.04
Mizoram	23031.46	24371.29	1339.83	0.06
Nagaland	18170.93	19141.35	970.42	0.05
Punjab	50416.88	50656.41	239.53	0.004
Rajasthan*	343966.8	343569.8	-397.04	-0.001
Sikkim	8398.95	10651.26	2252.31	0.27
Tripura	10548.56	10880.99	332.43	0.03
Uttar Pradesh	240857.7	241143.81	286.12	0.001
Uttarakhand	60969.47	67356.51	6387.04	0.1
West Bengal	84198.09	89231.24	5033.15	0.06

Notes: Absolute difference in area : Area NRSE – Area SGI ;
Proportionate difference = Absolute difference in area (NRSE – SGI) / Area NRSE
*Rajasthan is the only state having higher elevation as per NRSE data than SGI data.
Sources of Data:
National Remote Sensing Centre, Department of Space, Govt. of India (NRSE)
Office of the Surveyor General of India, Govt. of India (SGI)
Courtesy: Fourteenth Finance Commission of India

III. Capital Costs: Evidence from descriptive data on cost differentials across states

The regression exercise uses the consistently available time series data on revenue expenditure. For the capital expenditures, given the time constraints, we pursue an investigative route to check for some preliminary insights. While there has not been any systematic analysis of the costs imputable to elevation for any state in India, some indicative evidence on construction costs incurred across states for building facilities in the health and education sector can be gathered from some Government of India documents available in the public domain. We attempt to piece together some of this evidence, which of course is only a preliminary exercise to assist the understanding of the subject. In trying to gain insights from this data, as discussed below, it is to be noted that there are variations in specifications and technicalities across states, hence only states where data on items match (as per the reporting format) across states have been selected to enable comparison.

For ease of comparison of the available data on construction costs across states, the states have been grouped together in terms of the elevation criteria that is the main focus of this study. Three categories of states have been delineated, based on the proportion of elevation as per NRSE data as follows:

1. Primarily Plain Areas : (proportion of elevation ranging between 0.009-0.001) approx. less than 1% proportion relative to plains area
   - Bihar (0.001)
   - Chattisgarh (0.008)
   - Gujarat (0.003)
   - Punjab (0.001)
   - Maharashtra (0.009)
   - Uttar Pradesh (0.001)

2. Mixed : Hill and Plain Area (proportion of elevation ranging between 0.03 – 0.01) approx between 3% to 1% proportion relative to plains area
   - Karnataka (0.012)
   - Andhra Pradesh (0.015)
   - Kerala (0.034)
   - Odisha (0.02)
   - Tamil Nadu (0.016)
   - West Bengal (0.01)
   - Tripura (0.014)
3. Primarily Hill Areas (proportion of elevation ranging between 0.1 – 0.04) approx more than 3% proportion relative to plains area
   - Himachal Pradesh (0.15)
   - Jammu and Kashmir (0.14)
   - Meghalaya (0.04)
   - Nagaland (0.09)
   - Uttarakhand (0.14)
   - Manipur (0.089)

State names are highlighted in yellow, green and blue in the following tables, indicating the category namely plain areas, primarily hill areas, mixed (hill and plain areas) respectively.

Primary Education

For primary education, data on unit construction costs as presented in the project approval board minutes for Sarva Sikshya Abhiyan for some states has been pieced together. The results are presented in Table 5.3 and 5.4. Table 5.3 presents data for construction of primary and upper primary schools across states in India. Since standard reporting formats are used for preparation of these documents, we assume that the figures are comparable. It is fairly evident that on average, the hill states face higher costs as compared to the plains (with the exception of Punjab) as per this data for 2014-2015. The costs are for the most part higher in the hill states than the ones with mixed hill and plains as well.

Even if states differ among themselves in the specifics, it is of interest to note that in the matter of construction of civil works, i.e. for primary school and upper primary school, comparison of identical units within a state shows the differences between hill and plain areas. In case of all three states in table 5.4, costs are higher for hill areas as compared to plain areas. While for all types of construction, costs are lowest in UP which is almost entirely plains, it is higher in both TN and Uttarakhand, of which, the latter is among the most hilly states in the country. The difference in costs is significant for Tamil Nadu, whereas for both UP and Uttarakhand the difference appears to be quite low. It is difficult therefore to draw further insights without information on where in the state of Uttarakhand or at what level of elevation the schools are to be located.

Table 5.3 Unit Costs of Civil Works Construction in Rural Areas Across States (lakhs)

State	Unit Cost of Civil works construction Primary Schools in Rural Areas	Unit Cost of Civil works construction Upper Primary Schools in Rural Areas	Unit costs of Civil works construction for Additional Classroom in lieu of upgraded primary schools
Andhra Pradesh	20	20	6.5
Arunachal Pradesh	22.69		8.33*
Bihar	12.24		4.88
Chattisgarh	10.85	11.38	4.37
Himachal Pradesh	25	30	6.50
Maharashtra	18.60	5.10	
Manipur	22.32	27.23	8.67
Meghalaya	19.97	33.78	9.76
Mizoram	35.16	38.27	8.58
Punjab	21.92	32.37	8.16
Odisha	14	14.80	5
Tripura	14.16	14.16	3.70

Notes: *For Arunachal, the figure was slightly unclear, but seemed to imply this. For Bihar, the cost of primary school is also given without any category of rural or urban. Data for Classrooms in Bihar is also not specific in terms of whether in lieu of upgraded primary school.

Table 5.4 Unit Cost of Civil Works Construction within States (in lakhs)

State	Primary School		Upper primary school	
	Hill Areas	*Plain Areas*	*Hill Areas*	*Plain Areas*
Tamil Nadu Rural Urban	 24 19.63	 20 16.36	 31.20 25.75	 26.00 21.46
Uttar Pradesh	13.27	13.15	20.77	20.65
Uttarakhand	20.45	19.25	26.69	24.57

Source: Fresh Approvals for the year 2014-15, SSA PAB Minutes 2014-15.
Project Approval Board minutes of States for SSA 2014-15, Ministry of Human Resource Development, Department of School education and Literacy, Government of India.
(For most states data are available in Annexure 5, section 22; http://ssa.nic.in/pab-doc/pab-minutes/PAB%20Minutes%202014-15)

Secondary Education

However, if one considers state level norms for construction costs, costs in hill areas are clearly higher. This is borne out by data at the state level in the education sector. For instance, Data under the Rashtriya Madhyamik Shiksha Abhiyan reveals that there are differences in construction costs between hill and plain areas. Whereas data in the public domain was relatively more difficult to come by in this category of secondary education, an illustration of the range within which costs can vary can be gleaned from the case of Uttarakhand. The PWD norms for construction costs per square metre for hill and plain areas is 14100 and

12330 lakhs respectively. Table 5.5 presents the differences in costs for new one section schools, two section schools and strengthening of existing schools under different heads for hill and plain areas. Apart from construction of toilet blocks and laboratory equipment, costs are consistently higher for hill areas as compared to plains. For some of the items, the cost differences again do not emerge to be significantly higher.

Table 5.5 Construction Costs for the state of Uttarakhand: 2012-2013

Civil Works of New Schools

Facility	**Area**	**Unit Costs (In Lakhs)**
1-Section School	Hill Area	63.53
	Plain Area	60.29
2-Section School	Hill Area	79.23
	Plain Area	78.26

Strengthening of Existing Schools

Facility	**Area**	**Unit Costs (In Lakhs)**
Integrated Science Lab	Hill Area	11.78
	Plain Area	10.49
Computer Room	Hill Area	10.68
	Plain Area	9.39
Library	Hill Area	10.14
	Plain Area	8.99
Art and Craft Room	Hill Area	6.11
	Plain Area	5.39
Toilet Block	Hill Area	2.75
	Plain Area	2.75
Others/Lab equip	Hill Area	1.00
	Plain Area	1.00

Source: RMSA Annual Work Plan and Budget 2012-2013, Uttarakhand. (More figures available in minutes of PAB/PM and EG/GIAC meeting of states, Rashtriya Madhyamik Shiksha Abhiyan 2012-2013, 2013-14. Ministry of Human Resource Development. Department of School Education and Literacy; annexure 3 http://mhrd.gov.in/minutes)

Health

For the health sector, data on construction costs for three types of facilities is available from the State Programme Implementation Plans under the National Health Mission. A compilation of the costs for construction of Sub centres, Primary Health Centres and Community Health Centres is presented in Tables 5.6 – 5.8.

Here too, we only use data which is comparable in terms of specifics, the relevant indicator in this case being the number of beds. This is a standard indicator used for indicating size of the facility. Thus for instance, for Jammu and Kashmir, cost data is reported for 100 bedded CHCs, which is incomparable to most of the states which report cost data for 20 bedded

CHCs. For some states, specifics differ vastly from other states. In case of Gujarat for instance, the data reflects the new norms which have emerged recently and include facilities to be built specifically in tribal areas, with earth quake proofing for every new construction. The latter escalates costs.

Table 5.6 indicates that for PHCs, of size 6-10 beds, there seems to be a gradation in the unit construction costs. Costs in the hill states are higher than those in the states with mixed areas, and much steeper than those in the plains states. It is to be noted that the costs for Meghalaya and Nagaland will be higher than stated if inflation is factored in since the stated costs are for 2012-2013, whereas the costs for other states is for 2013-2014. The state of West Bengal is highlighted in green in this table since it was specified that the cost was for construction in the hill district of West Bengal. For Sub-Centres, (Table 5.7) with 1 bed, unit costs for the hill states of Meghalaya and Nagaland are once again higher than those for the plain states, with the exception of Gujarat. Once these costs are adjusted for the price escalation for Meghalaya and Nagaland, these are also likely to be higher than the costs for most of the states with mixed hill and plain areas. As in the case of education construction costs, further analysis is only possible at a more disaggregated level if data for costs is made available by location of the specific facility within the state especially for states with mix of plain and hill areas.

Although the picture is a little less clear for CHC construction costs for 20 bedded facilities, costs for hill states seem to be clearly much higher than for those which are primarily located in plains (Table 5.8).

Table 5.6 Project Unit Costs of New Construction for PHCs (6-10 beds)

State	**Cost (in rupees lakhs)**
Bihar	75.99
Chattisgarh	49.53
Gujarat	95
Jammu and Kashmir*	235
Karnataka	110
Kerala	100
Maharashtra	40
Meghalaya**	100
Nagaland**	99
Tamilnadu	38
West Bengal***	300

Notes: *For Jammu and Kashmir, data pertains to Jammu division 2013-14. The Unit/Project costs ranges between 140 to 319 lakhs with more than 50% of the PHC being constructed with a project cost greater than 175 lakhs. **indicates data for the year 2012-13 ***Hill District (Darjeeling)

Table 5.7 Project Unit Costs of New Construction for SCs (1 bed)

State	**Cost (in rupees lakhs)**
Bihar	15.57
Gujarat	25
Karnataka	24
Kerala	21
Maharashtra	11
Meghalaya*	26
Nagaland*	22
Punjab	12
Tamilnadu	15
West Bengal	17.63

*indicates data for the year 2012-13

Table 5.8: Project Unit Costs of New Construction for CHCs (20 beds)

State	Cost (in lakhs)
Bihar*	20
Gujarat*	308.21
Himachal Pradesh	200
Karnataka	125
Kerala*	75
Meghalaya*	118
Maharashtra	33.26
Nagaland*	166
Tamil Nadu	87
West Bengal	36.80

Notes:
*indicates data for the year 2012-13
Source: State Programme Implementation Plans, National Health Mission, Ministry of Health and Family Welfare, Government of India.(Infrastructure annexures, supplementary PIPS and executive summaries:
LInk : http://nrhm.gov.in/nrhm-in-state/state-program-implementation-plans-pips.html)

To sum, we find that the limited data available indicates that construction costs are definitely higher in hill areas than plain areas, but the extent of the differential is difficult to gauge since it varies substantially across states for even comparable items and for some items these differences are also relatively minor in certain states. Given the variability and limited data, we prefer to rely on an econometric model which has the dual advantage of using a larger time series dataset as well as being able to control for other factors influencing outcomes.

IV. Cost Function Model

The cost function approach to understanding the factors that influence variations in public spending across administrative and geographical units has been widely used (Gronberg et al 2011 for education). In particular, it has been used for inferring policy insights for future resource allocation and spending in social sectors such as education.

The model is a state level cost function. This implies that resource allocation decisions and costs incurred, are made at the state level.

Mathematically, the cost function concept is a simple one; that of producing at minimum cost, a specified quantity of products or providing desired level of services. Typically, therefore, the dependent variable (costs / spending) is a function of a set of independent variables that influence the outcomes (quality and quantity of the service) . This includes prices, state level inputs and characteristics, and unobserved characteristics. It offers the advantage of using actual data to estimate variations in spending and allows for easy interpretation of the results for policy analysis such as building alternative cost indices. A range of fairly sophisticated econometric approaches for statistical estimation build confidence in the derived estimates (Duncombe, 2002). So, to build an effective set of estimations, it is necessary to be cautious about using reliable and consistent data. (see data and Variables section for more details).

The cost function , captures the available technologies (Varian, 1992), and being specified with regard to output and a set of input functions, lends itself to a convenient characterisation in providing insights on the economics of a sector. This is considered to be particularly relevant for industries/sectors that are highly regulated and specialize in service provision such as education and health care (Rufino 2006). Some literature (Costrell et al 2008) argues that cost function regression based results cannot provide accurate estimates of the *minimum* cost of achieving current performance levels as these approaches are not adequately able to adjust spending for arriving at minimum efficient costs. However, the use of cost functions to understand the variation in average spending across units and by how much the spending varies due to a particular explanatory variable is a widely accepted.

To the extent that states make decisions about spending simultaneously with decisions about output levels, the coefficients resulting from the estimation of a cost function indicate the contribution of various explanatory variables to the costs of provision of a service, for achieving a certain level of performance. In the Indian context, the use of actual expenditures per student as a basis for deriving unit costs has been adopted by various earlier studies, and along with the enrolment data, these have been further used for deriving normative resource needs for education (Ninth Finance Commission, See also discussion in Tilak 1997). The use of expenditures along with gross enrolment figures serves well for estimating a cost function. It also has the advantage of avoiding a situation where a host of assumptions require to be made for directly estimating costs based on cost based norms (rather than expenditures), given the data constraints in the Indian context (Tilak 1997).

V. Estimation of econometric model

Apart from linear regressions, alternative specifications that have been tried in the literature for estimating cost functions include nonlinear specifications, generalized linear models, semiparametric approaches, such as finite mixture and discrete conditional density estimators.

Here a panel data model is used. The econometric model used for estimating the cost function in the present exercise can be described as an instrumental variables estimation of the Random Effects panel data model. (Green 2003, Baltagi 2005) . The dependent variable is the per capita expenditure of the state, while the explanatory variables comprise of both time invariant and time varying explanatory variables.

The panel is set up for a period of five years, based on data from 2005-06 to 2010-2011. The exact years vary slightly across sectors depending on data availability, but there is five years data for each sector. Data is used for 28 states in India, including the North Eastern Region and other hill states. The choice of five years is a rational one from the econometric viewpoint since the sample may be considered to be thin with lesser number of years, whereas it maybe argued that issues of structural change may arise for longer time periods. The cost function estimation uses historical data, and as such is constrained by the underlying structures and institutions. Hence it is important to choose a time duration during which the underlying policy changes can be assumed to have been modest or gradual; while a longer time period is more likely to have seen changes that could constitute a structural change.

The most common approaches to panel data estimation is to use either Fixed Effects or Random Effects models. Each has its own advantages and drawbacks. In the context of the current exercise, an issue that arises is that in a fixed effects estimation it is not possible to obtain estimates for time invariant characteristics which implies that the elevation impact cannot be estimated. The random effects estimation on the other hand is limited by the assumption that unobserved state specific effects are uncorrelated with the explanatory variables which are included in the regression. The Hausman Taylor estimator (1981) uses an instrumental variables technique which allows one to overcome these problems. The estimation technique has been used and recommended in empirical panel applications (Baltagi et al 2003).

The model is described below.

$y_{it} = x'_{1it}\beta_1 + x'_{2it}\beta_2 + z'_{1i}\alpha_1 + z'_{2i}\alpha_2 + \varepsilon_{it} + u_i$

where,

x_{1it} is a set of variables that are time varying and uncorrelated with $u_{i,}$

x_{2it} is a set of variables that are time varying and are correlated with u_i,

z_{1it} is a set of variables that are time invariant and uncorrelated with u_i,

z_{2it} is a set of variables that are time invariant and are correlated with $u_{i,}$

u_i is the unobserved, panel-level random effect that is assumed to have zero mean and finite variance $\sigma^2{}_u$ and to be independently and identically distributed (i.i.d.) over the panels;

ε_{it} is the idiosyncratic error that is assumed to have zero mean and finite variance $\sigma^2{}_\varepsilon$

and to be i.i.d. over all the observations in the data;

β_1, β_2, α_1, and α_2 are coefficient vectors, respectively; and i = 1, . . . , n, where n is the number of panels in the sample and, for each i, t = 1, . . . , Ti (t = years).

The steps for consistent and efficient estimation are as follows:

Step 1: The Fixed effects estimator (least squares dummy variable estimator or the within estimator) provides consistent estimates for β_1 and β_2.

Step 2: The within group residuals (e_{it}) are computed from the regression at step 1. The group means of these residuals are then used as dependent variables in an instrumental variable regression on z1 and z2, with instrumental variables x1 and z1. The identification requirement is that the number of variables in x1 be at least as large as the number of variables in z2. The instrumental variables are those which are time varying and uncorrelated with ui.

A simple instrumental variable estimation of the model is consistent but inefficient.

Step 3: The residual variances from the regressions in step 1 and step 2, are used to subsequently derive a weight for a GLS transformation on each of the variables.

Step 4: A weighted instrumental variable estimator is derived and the full model is estimated (FGLS).

The model has been estimated using STATA software.

As far as the functional form is concerned, it is noted that in order to obtain consistent parameter estimates for the cost function, it is assumed that output and factor prices are exogenous and factor markets are competitive and production is efficient (Kumbhakar, 1991). In the real world however, the latter requirement does not usually hold due to various types of technical and allocative inefficiency in production. The standard approach is to assume that this inefficiency will be captured through the vector of unobserved characteristics (namely the error term).

We therefore try out several alternative specifications before finally selecting the form which provides the best possible fit (using standard econometric tests for goodness of fit). Costs are usually transformed for purposes of econometric estimation to avoid certain statistical problems. Here we adopt the standard approach of taking a log transformation for the dependent variable which reduces skewness and making the distribution more symmetric and bringing it closer to normality (Jones 2010) . Since all the observations for the dependent variable are non zero, there are no concerns with making additional transformations for retaining zero observations. Further, since the main interest lies in estimating the extent to which costs change due to certain explanatory variables, rather than prediction of absolute cost values, the results are directly interpretable (Basu et al 2006 for instance highlights the distinction between the scale of interest and the scale of estimation).

VI. Data and Variables

The current study uses published data on standardised indicators available across states, taking care in particular to select indicators that cover the states in the North Eastern region and Jammu and Kashmir. In the absence of reliable data on individual components of direct costs (or prices) the standard approach is followed here ie to use per capita expenditures for the statistical estimation. Primary objective is to provide objectivity for creating confidence in the policy relevance of the numbers generated. The per capita expenditures, based on budget data, are compiled for states using identical methodology, leading to a consistent and comparable time series database.

The measure of per capita state revenue expenditures is used as a proxy measure of average costs per person. Table 5.9 presents data on both capital and revenue expenditures for states, as per state finance statements (RBI sources). As is evident, the per capita capital expenditures are very low, which is not surprising given the capital expenditures flow mostly outside the state finances. However, given that the stated purpose of the exercise is only to obtain the across state differentials imputable to elevation across states, it maybe considered that for present purposes the use of revenue expenditures[10] will suffice for estimation purposes. To control for the price effect, year dummies are introduced and in the format of the panel model, it is therefore no longer necessary to deflate individual observations.

[10] However, we note that there maybe a possibility for improvements in the estimation, if time series data on the entire set of capital expenditures is made available in an easily accessible form to researchers, at least for purposes of future estimation.

Table 5.9: Average Per Capita Revenue and Capital Expenditures as per State Finances

Category	Expenditure	Mean	Min	Max
Health	Revenue	531.64	83.77	2629.1
	Capital	99.11	.6802 (Andhra Pradesh)	1749 (Sikkim)
Education, Arts, Sports and Culture	Revenue	2071.93	437.7 (M.P.)	8767.6 (Sikkim)
	Capital	153.94	0.20 (Assam)	1420 (Sikkim)
Primary Education	Revenue	489.46	.21	2360.75
Secondary Education	Revenue	256.38	.55	1255
Roads and Bridges	Revenue	287.24	15.56	5305.8
	Capital	502.04	24 (West Bengal)	5520 (Arunachal)

Note: Data is for the years 2005-06 to 2012-13, except for capital expenditure on roads which is for 2004-05, 2005-06 and 2008-09 to 2010-11. For primary and secondary education only revenue expenditure data was available. The capital expenditure data is for the major head "Education, Arts, Sports and Culture."

The explanatory variables have been chosen in keeping with two considerations: availability of consistent datasets on the measured variable, and its relevance in the current policy context. Thus, for the health sector, given the importance of extending health services to achieve universal coverage, the availability of health facilities is a key variable, while for education in the spirit of implementation of the RTE Act, the emphasis also includes enrolment and drop out rates. For the infrastructure sector, sheer physical availability of roads are of special relevance, as is amply demonstrated in many of the programmes of the GOI. Thus, here the key variable chosen is the coverage achieved in terms of surfaced roads.

Among the exogenous factors, that may influence the per capita availability of resources and costs incurred, are demographic and developmental characteristics inherent to the state. The distribution of population between rural and urban areas is taken as a demographic indicator.

Hill states face specific cost disabilities as has been demonstrated in this report. To capture this aspect, the proportion of elevated area is considered as an exogenous explanatory variable.

The extent of elevation reflects the impact of many hidden inputs which are largely non purchased: such as access to facilities; and variation in prices caused by factors impacting costs of materials, equipment and other logistics from transporting and constructing facilities and making available the required inputs in elevated areas. This applies for both capital and operating inputs. Most non purchased inputs related to terrain, are not costed for directly and represent transaction costs that would not get accounted for other-wise. In the case of roads and bridges, a non purchased input for instance can be the time costs involved in clearances required if one has to build through forested areas. In the case of the health and education sectors, negative externalities associated with terrain influence outcomes such as through drop-out rates. Most variables that directly capture physical availability of facilities represent purchased inputs.

The definitions and sources of data for the variables are listed in Annexure II. The summary statistics for variables used in the econometric estimation are presented in Annexure III.

VII. Results from the Estimation

The model allows for the computation of marginal effects and the proportionate increase in costs due to changes in the explanatory variables. The estimated effects are statistically significant and show the expected signs. The estimated results allow distinction between endogenous and exogenous variables, and the time varying and time invariant variables. The estimated coefficients of the *endogenous* variables for instance, show an inverse relationship between per capita expenditures and provision/service levels, as would be the expected interpretation, holding other things constant. This is a reflection of the fact that it is expenditure data that is measured in the dependant variable and these are influencing the measure. Exogenous variables on the other hand show a direct relationship with per capita expenditures, as can be expected as a reflection of the costs. The influence of the endogenous, time varying variables and the exogenous variables are in the expected direction, allowing for ease of interpretation even where the significance levels are not very high, since they create confidence in the overall validity of the estimation. The inclusion of some such variables is also relevant for the purpose of removing bias that may otherwise arise from non inclusion of these variables, lowering the overall explanatory power or fit of the equation.

Overall the models are significant as demonstrated by the Wald test for specification (Chi squared distribution). The fraction of variance explained by the unobserved panel level random effect that is assumed to be independently and identically distributed over the panels, with zero mean and finite variance (0, sigma 2 u) is acceptable. The detailed regression estimates and tests are reported in Annexure IV.

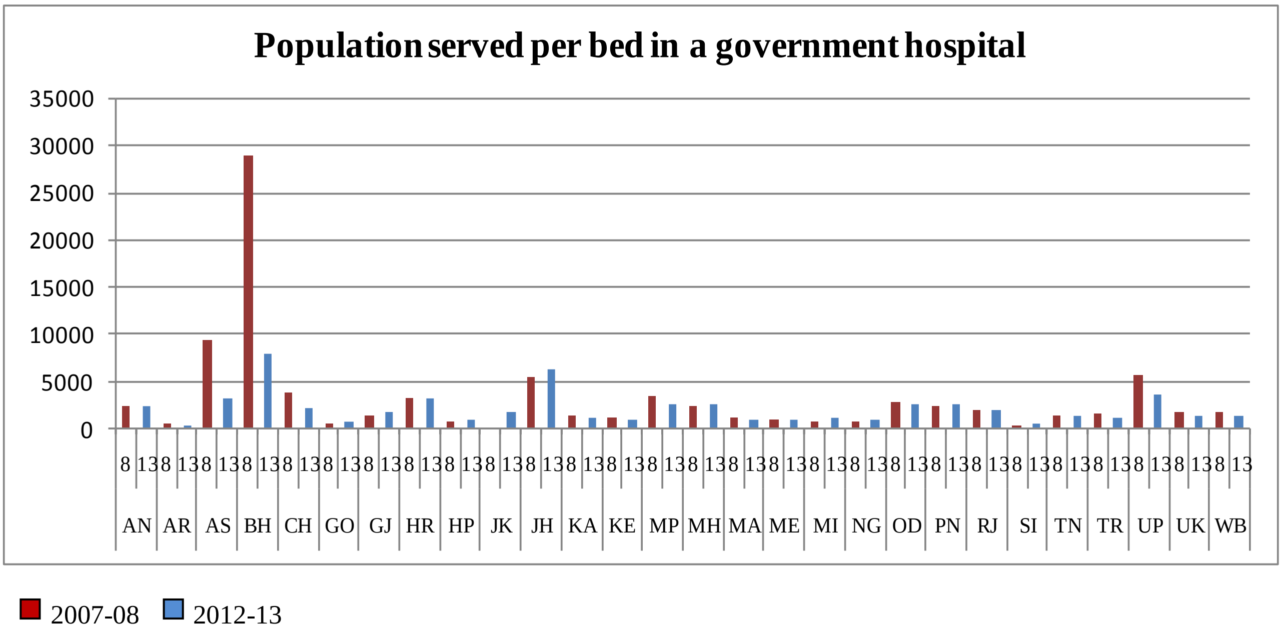
The exogenous variables for the estimation are the elevation factor and the proportion of urban population. While the former is the variable of interest for the analysis, the latter was found to be significantly correlated with the dependent variable for several states for the social sector. This is probably due to the increasing recognition of the need to provide services to the growing number of urban centres, particularly small towns and census towns, which have concentrations of poor and less well off, who require and utilize public services. Also many areas of the country are getting redefined as urban as urbanization is proceeding at a relatively fast pace in India. Each sector’s estimation includes other sector specific variables that impact the outcome in the respective sector. The key results are summarised below for each sector. Year dummies are included to control for the price effect as per standard practise.

Sector-wise Regression Results

Health

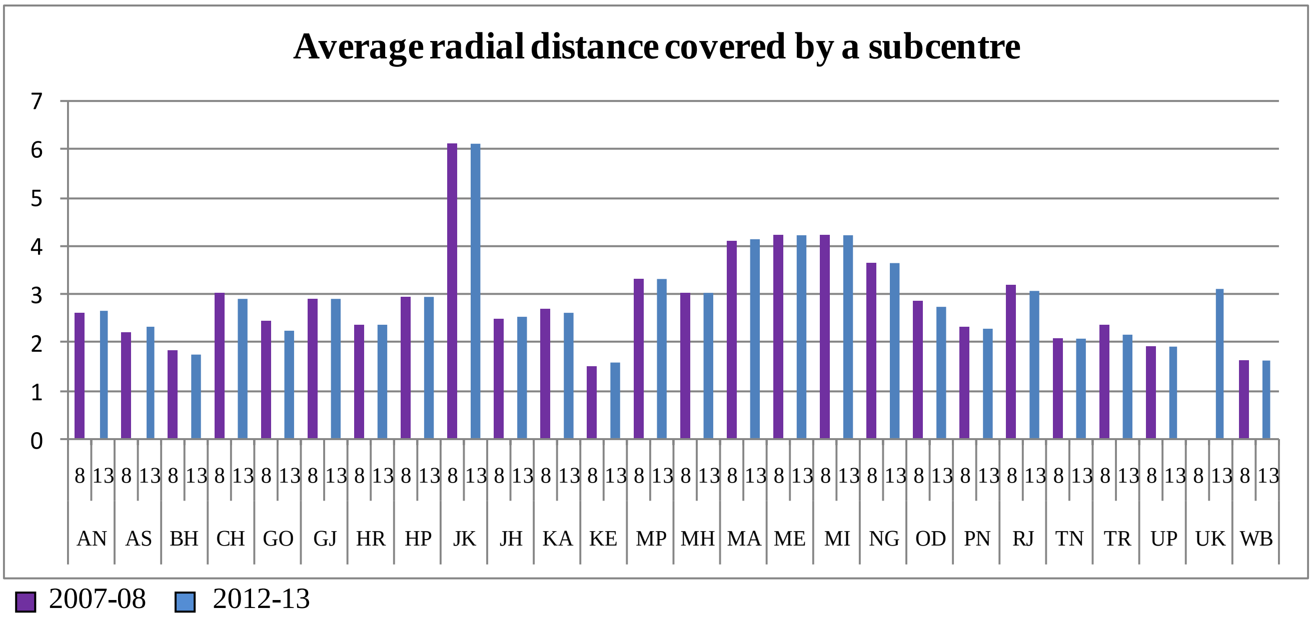
The regression estimates for the health sector have been obtained using panel data, covering 26 states for 6 years from 2007-08 to 2012-13. The dependent variable is (logarithm of) the per capita revenue expenditure on health. The two endogenous explanatory variables are the average radial distance covered by a sub centre and the average numbers served by a hospital bed in a government hospital.

Figure 5.1 Population served per bed in a government hospital



The population served per government hospital bed is derived as the ratio of the total number of beds in government hospitals of a state, and the total population of the corresponding year. While, there is a declining trend across states based on data for the two years 2007-08 and 2012-13 (Figure 5.1), the rise in availability of beds has been quite uneven across states. Bihar and Jharkhand show dramatic improvement over this time period although in absolute terms the availability remains low by this indicator in both states, In several states, the indicator is fairly stagnant, with slight reversals in Punjab and Rajasthan, and a relatively sharper reversal in Manipur. Arunachal, Sikkim and Goa are the best performers in terms of maximum availability, when scaled by population.

Figure 5.2 Average radial distance covered by a subcentre



The average radial distance covered by a sub-centre is highest in the state of Jammu and Kashmir in both years, 2007-08 and 2012-13, followed by Mizoram and Meghalaya. The radial distance covered in the hilly states is at a minimum of 3 kms, or and is much higher for Jammu and Kashmir and some of the north eastern states, being at above 4 kms (Figure 5.2). The state of Himachal Pradesh does better on this count among the hilly states. For most states, this indicator of health care provisioning has changed little over the study years.

Inclusion of both these variables is justified as it provides a robust set of results and is in keeping with the understanding of what are the determinants of health care expenditure. The sub centres are the frontline of health care provisioning of the health care facility set-up and are tasked with many outreach activities, including important services such as immunization and delivery of some maternity care. The availability of hospital beds is an important indicator since it carries major weightage in accounting for the variation in expenditures incurred by states. This is because it reflects the provisioning of in-patient services, across levels of health care – primary, secondary and tertiary. The share of urban population and the proportion of elevation are highly significant, while the average radial distance covered by a sub centre is also significant at the 10% level.

Primary Education

This is a regression based on a five year panel, of 23 states from 2006-07 to 2010-11. The endogenous explanatory variables used are the primary gross enrolment ratio and the drop out rate (combined for boys and girls) in keeping with the understanding of what constitutes measures of outcome and provisioning in education. The drop out rate and the elevation factor are both significant explanatory variables.

As shown in Figure 5.3, the drop out rate for primary schooling has increased in some states while in others it has decreased over the study period. The drop out rates are highest for Arunachal, Bihar, Manipur, Meghalaya, Nagaland, Mizoram, and Rajasthan, ranging between 35% to 48%. The primary gross enrolment ratio too shows variations across states over the study period (Figure 5.4). It is to be noted that except for Arunachal Pradesh and Manipur, and to a lesser extent Tamil Nadu and Madhya Pradesh, the gross enrolment ratio has shown only minor improvements in most states. In Arunachal and Manipur, the drop-out rate has in fact increased in the former and remained more or less constant in Manipur. Maharashtra, Meghalaya, Nagaland, Tamil Nadu, Tripura, Rajasthan and Uttarakhand have seen substantial increase in the drop out rate over this period of time. This could partly explain why the gross enrolment ratio is not picking up in some of these states.

Figure 5.3 Drop out rate for all (I-V)

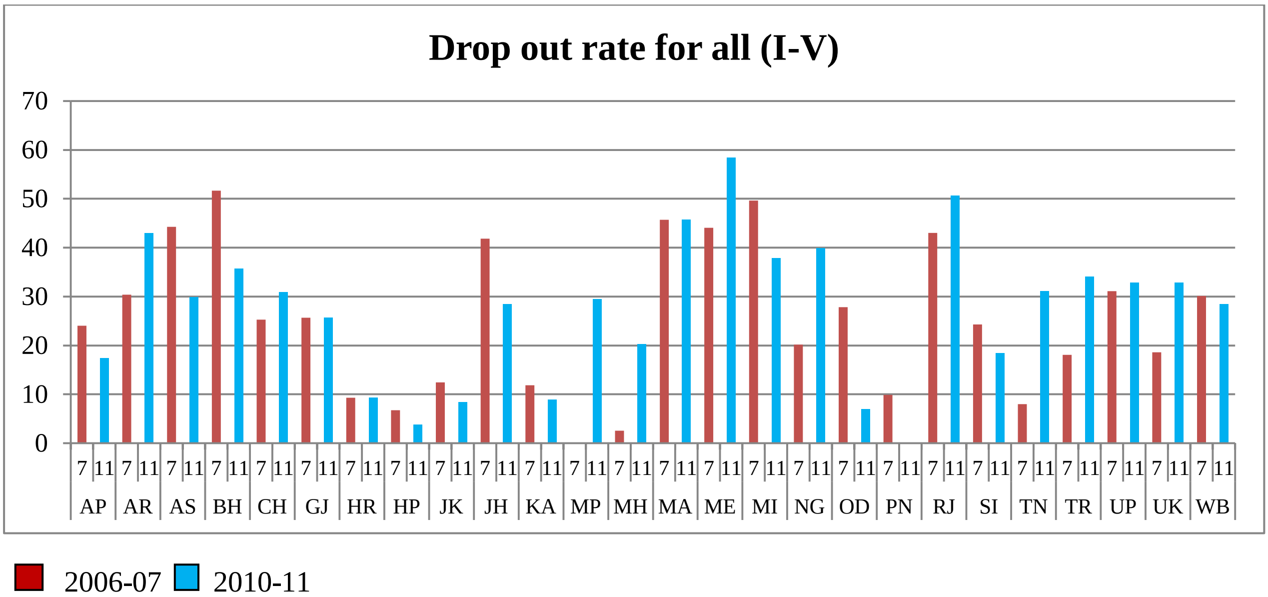
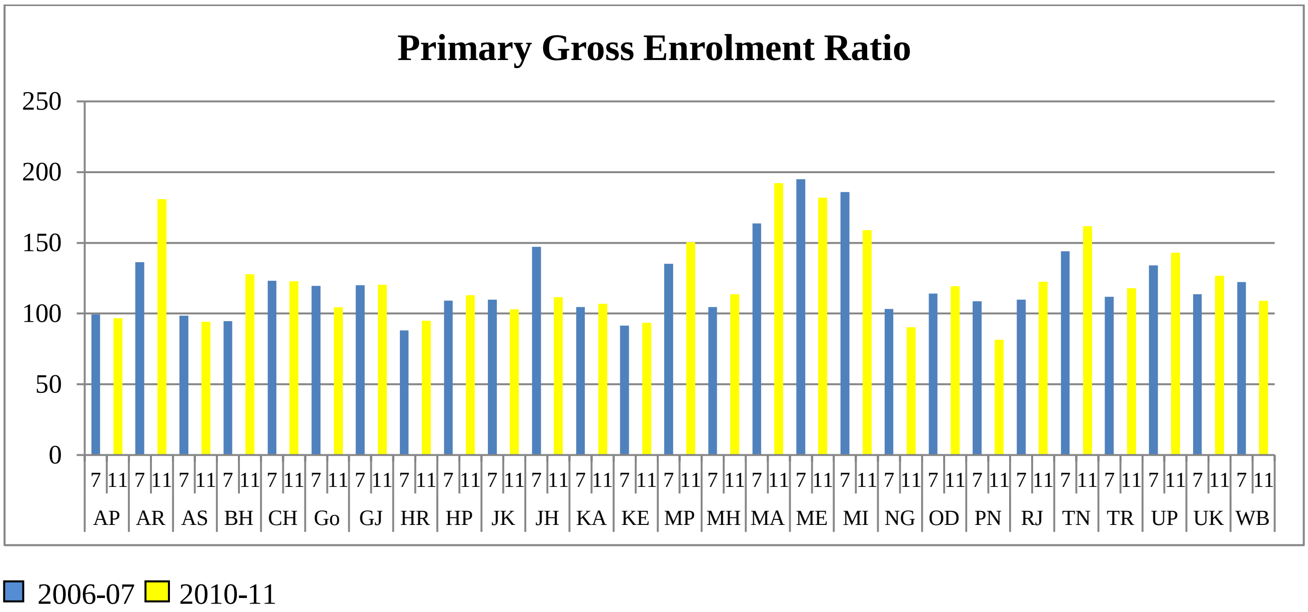


Figure 5.4 Primary Gross Enrolment Ratio



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Secondary Education

This is a regression based on a five year panel, of 26 states from 2006-07 to 2010-11. The endogenous explanatory variables are the drop out rate for girls and the secondary gross enrolment ratio. It is to be noted that in this case, the drop out rate for girls is an important explanatory variable for understanding the outcomes for secondary education. In the literature, this has been variously attributed, most prominently to the availability of facilities such as separate toilet facilities apart from cultural and social factors. The share of urban population and the drop out rate are both significant. The elevation factor and the secondary gross enrolment ratio are both highly significant.

We present below some data that helps to highlight the differences in drop-out rates between boys and girls, and only girls. Figure 5.5 presents the drop out rate for girls from class I till class X. There are wide variations in achievement levels over the study period going by this indicator, and it is difficult to discern any generalised trend in the data over the study period across all the states. However, what becomes clear from a comparison of the data for drop out rates for girls with overall drop out rates over the entire period of schooling from class 1 to X, is that across states, drop out rates for girls is much higher. This effect is more pronounced at the secondary level. Consider for instance that in two otherwise well performing states at the primary education level, ie Himachal Pradesh and Sikkim, the drop out rate for girls has actually gone up and the secondary gross enrolment ratio (Figure 5.6) has fallen quite sharply as well. A closer correspondence is observed between drop out rates for girls and gross enrolment ratios at the secondary level than at the primary level, as also borne out by the correlation coefficients between the two which are positive and significant at the 5% level for secondary education, but not so highly significant at the primary level. At the primary level, the correlation coefficient is positive and highly significant between drop out rates (for boys and girls) and primary enrolment ratios.

Figure 5.5 Drop out rate for girls (I-X)

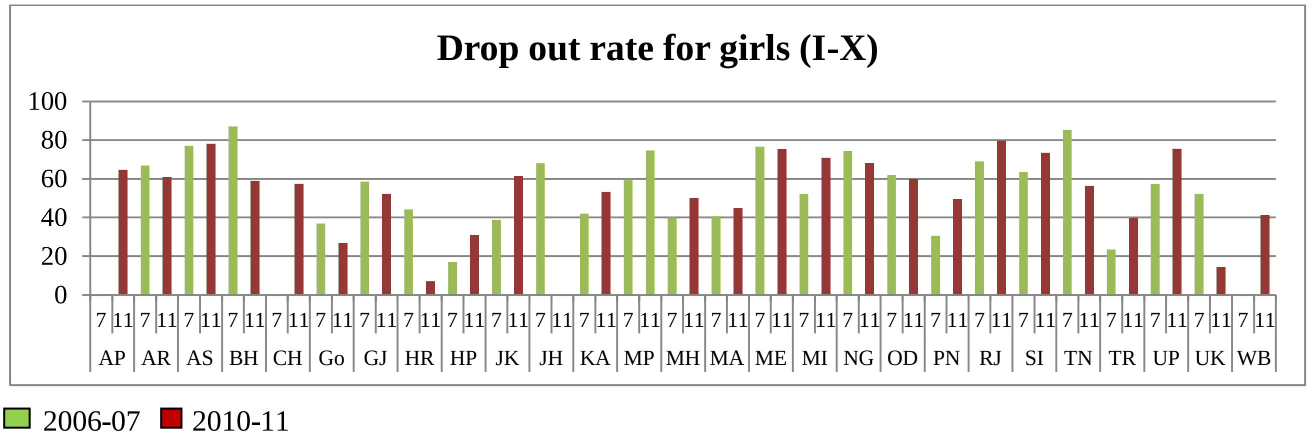
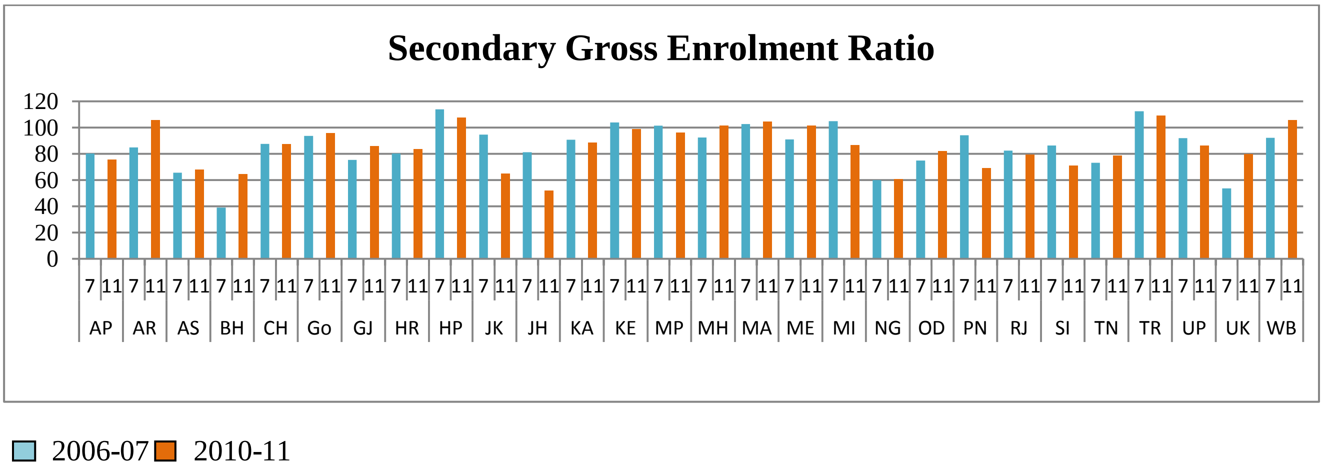


Figure 5.6 Secondary Gross Enrolment Ratio

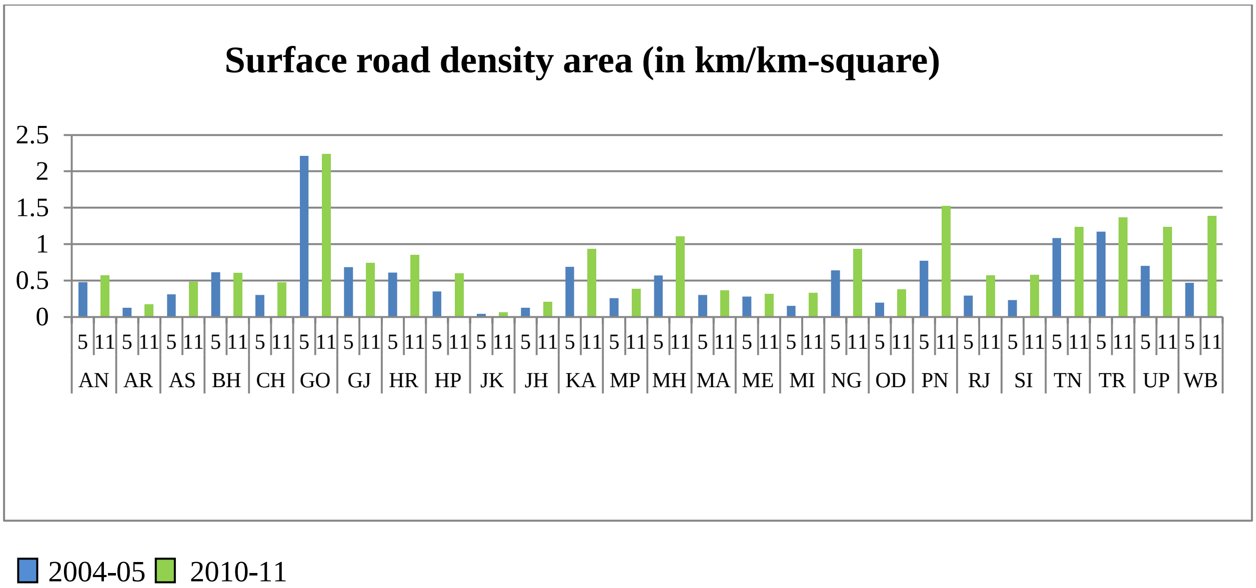


Roads and Bridges

The regression for the roads and bridges sector is based on a 5 year panel covering 26 states for the years 2004-05 to 2005-06 and 2008-09 to 2010-11. In the intervening years as mentioned earlier, there are data gaps. The endogenous explanatory variable is the density of surfaced roads available, measured as the total length of surfaced roads relative to the area of the state.

The surfaced road length (measured in kms) per unit area (measured in km square) provides an indicator for the density of surfaced roads in the state. This indicator for two years 2004-05 and 2010 – 11 is mapped in Figure 5.7.

Figure 5.7 Surface road density area (in km/km-square)



The road density is highest for the state of Goa, followed by Punjab and Tripura, while West Bengal shows marked improvement by 2010. The road density is lowest in Jammu and Kashmir, with a marginally higher density in Arunachal Pradesh and Jharkhand. Overall, the surfaced road density across states for the two year period displays an increasing trend across all states although the rate of increase varies over the period of time.

Expectedly in the regression, the share of urban population is not of significance as a determinant of expenditures in this case. The relative availability of surfaced roads is significant while as per expectations, the elevation factor is a highly significant explanatory variable.

VIII. Costs Imputable to Elevated Areas in States

The estimates can be used for calculating the extent to which a change in elevation leads to a change in costs. Thus, an indicator is obtained for by how much costs increase with a proportionate increase in elevated area as compared to non elevated area in the state.

The cost mark-ups are computed for each of the three sectors for each state. Average cost mark-ups for highly hilly states are also compared to the average mark-up for states with mixed hill and plain areas. Cost mark-ups are also computed across sectors using a weighted average of the expenditure shares across hilly states.

Computation of the Sectoral Cost Mark-up

The regression coefficients obtained can be interpreted in terms of by how much the costs increase due to an increase in the elevation. The manner in which the dependent variable (since it is in log) and the elevation factor (elevated area as a proportion measure) is defined, imply that the coefficient is an estimate of by how much the costs (proxied by expenditure) change, with a proportionate rise in elevated area. However, the estimated value is a measure of the change from 0 to 1 in the explanatory variable. However, the elevation factor does not range from 0 to 1. Hence it has to be scaled to the feasible maximum of the range for the states considered. The elevation factor ranges from 0.0006 (approx 0) for UP to 0,178 for Sikkim.

For this purpose, we compute the average of the elevation factor for the top 5 hilly states, as defined by the elevation factor used in the estimation. These are five states which have an elevation factor of more than 0.1 and are namely, Arunachal Pradesh, Himachal Pradesh, Jammu and Kashmir, Sikkim and Uttarakhand. An average of their elevation factors, provides a scaling factor of 0.15. Hence each co-efficient is scaled by this factor to arrive at a more representative figure of the actual proportion by which the cost changes. In contrast, the bottom 5 states in terms of having the lowest elevation factors are Bihar, Gujarat, Haryana, Punjab and UP.

Table 5.10 Cost mark-up by sector due to elevation

Sector	**Coefficients**	**Cost mark-up (top 5 hill states)**	**Average Cost mark-up (all states)**
Health	13.79	2.07	0.63
Primary Education	19.75	2.96	0.91
Secondary Education	18.54	2.78	0.85
Roads & Bridges	13.22	2.00	0.61

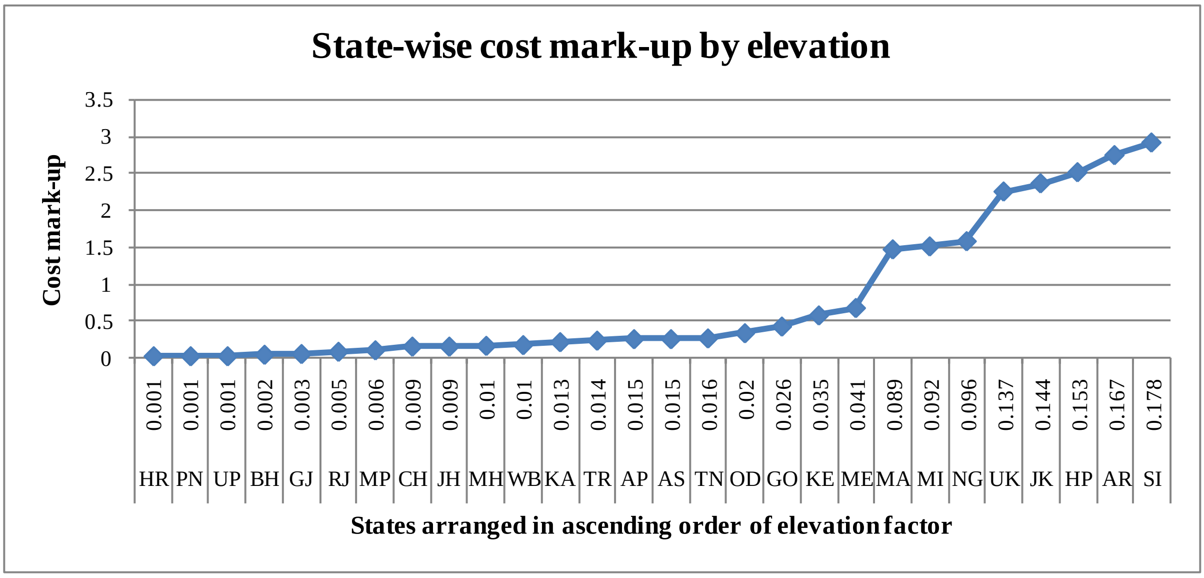
Note: Average elevation factor for top 5 hilly states = 0.15, average elevation factor all states = 0.046

The average of the elevation factor, when taken for the entire sample is also presented in table 5.10 for comparison purposes. However, since our primary interest is in finding out the impact on costs due to elevation alone, the coefficients for the top 5 hilly states is relevant for subsequent calculations. The cost mark-up is a measure of by how many times costs would go up in hill areas (due to the existence of elevated areas) as compared to non elevated areas.

As is evident from Table 5.10, cost mark-ups vary across sectors. The relevant figures for mark-ups for hilly areas over plain areas are presented in column 2 of the table. Cost mark-ups are highest for primary education and lower for health for instance. The emphasis for primary education is to provide last mile services, implying that all concerned expenditures (e.g. human resources and supplies are likely to be most significant in the revenue expenditures) would need to be incurred on site, at a far greater frequency. In the health sector, although the services are ideally projected to reach every individual, the norms for setting up facilities are driven by population norms, leading to greater flexibility in terms of compulsions as to where a facility is sited within a specific geographic area. To a small extent this is offset in the case of the health sector where in some states, provision is made for health personnel to get a "difficult area allowance," as an incentive or compensation to serve in difficult areas.[11,12]

Using the same method, the cost mark-ups can be calculated for individual states based on the state specific elevation factor. This is presented in table 5.11 (Figure 5.8). It is evident how the cost mark-up varies as the proportion of the area under elevation varies. To illustrate the implied differences in costs, the interpretation would be that if baseline costs (say for ensuring health services in plain areas) are Rs. 100 per capita, to accommodate the costs incurred for hilly areas in Andhra Pradesh a mark-up by 25% over the baseline would suffice (i.e. Rs. 125 per capita), whereas for Arunachal Pradesh a mark-up of 273% is required for its hilly areas (Rs. 373 per capita). However, if one is interested in deriving an overall cost escalation factor to be applied uniformly for all hilly areas as distinct from plain areas, irrespective of the extent of hilly versus plain areas, the practical approach taken is to consider the costs for states with primarily hill areas which is the approach followed in column 2, Table 5.10.

Figure 5.8 State wise cost mark-up by elevation



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[11] In Uttarakhand for instance, there is a three tier classification for allowances based on areas labeled as *sugam*, *durgam* and *ati-durgam*

[12] While supplies are an important component of revenue expenditures for the health sector, human resource costs are important for both. In future work, subject to availability of data, incorporation of time series data on these components may contribute further to the understanding.

Table 5.11: Cost mark-up for individual states

States	Elevation Proportion	Cost mark-up by sector				Average Cost Mark-up
		Health	*Primary Education*	*Secondary Education*	*Roads*	*All sectors*
Andhra Pradesh	0.015	0.21	0.3	0.28	0.2	0.25
Arunachal Pradesh	0.167	2.3	3.3	3.1	2.21	2.73
Assam	0.015	0.21	0.3	0.28	0.2	0.25
Bihar	0.002	0.03	0.04	0.04	0.03	0.04
Chhatisgarh	0.009	0.12	0.18	0.17	0.12	0.15
Goa	0.026	0.36	0.51	0.48	0.34	0.42
Gujarat	0.003	0.04	0.06	0.05	0.04	0.05
Haryana	0.001	0.01	0.02	0.02	0.01	0.02
Himachal Pradesh	0.153	2.11	3.02	2.84	2.02	2.5
Jammu and Kashmir	0.144	1.98	2.84	2.67	1.9	2.35
Jharkhand	0.009	0.12	0.18	0.17	0.12	0.15
Karnataka	0.013	0.18	0.26	0.24	0.17	0.21
Kerala	0.035	0.48	0.69	0.65	0.46	0.57
Madhya Pradesh	0.006	0.08	0.12	0.11	0.08	0.1
Maharashtra	0.01	0.14	0.2	0.18	0.13	0.16
Manipur	0.089	1.23	1.76	1.65	1.18	1.46
Meghalaya	0.041	0.56	0.81	0.76	0.54	0.67
Mizoram	0.092	1.27	1.82	1.7	1.22	1.5
Nagaland	0.096	1.32	1.9	1.78	1.27	1.57
Odisha	0.02	0.27	0.4	0.37	0.26	0.33
Punjab	0.001	0.01	0.02	0.02	0.01	0.02
Rajasthan	0.005	0.07	0.1	0.09	0.07	0.08
Sikkim	0.178	2.45	3.51	3.3	2.35	2.9
Tamil Nadu	0.016	0.22	0.32	0.3	0.21	0.26
Tripura	0.014	0.19	0.28	0.26	0.18	0.23
Uttar Pradesh	0.001	0.01	0.02	0.02	0.01	0.02
Uttarakhand	0.137	1.89	2.7	2.54	1.81	2.24
West Bengal	0.01	0.14	0.2	0.19	0.13	0.17

IX. Conclusion: Cost Mark-up for Hill Areas

Indian states are characterized by diverse ecosystems, arising from varied topography and other biophysical characteristics. States with mountainous and hilly terrain such as in the North Eastern region or the Western Himalayan region comprise of ecosystems that provide services that are important for local, regional, national and international welfare in the context of sustainability. Hill areas therefore face unique challenges in addressing their developmental needs in a manner that takes care of conservation concerns for sustainable development.

Disparities exist in developmental status, as evidenced by socio-economic indicators, across hill and plain area dominated states, and within hill states as well. The interplay of biophysical and economic factors has implications for sustainable economic development of these hill areas. Adequacy of resources to meet developmental targets, through reduction of vulnerability, improved economic productivity and delivery of basic amenities and services becomes a priority under the circumstances.

To successfully determine the effort required and design the interventions required, a pre-requisite is to understand (a) the extent of disparity, in terms of the relative position of the states concerned, (b) the underlying factors that are associated with this disparity and (c) to cost the differentials which can be imputed to hilly terrain. An exercise was undertaken in this study to address these concerns for the states in India.

Akerlof had modeled how an individual’s utility is dependent on the utility or actions of others, demonstrating the externalities in social interaction, where social distance among agents influence social decision-making (Akerlof, 1997). Other scholars have also provided evidence of the importance of the social origins of individual inequalities (Mills & Lubele, 1995), On similar lines, it is well accepted today that geography is not an obstacle to overcoming disparity, since efforts can be specifically designed to overcome these (Kanbur & Venables, 2005)

The findings from the study clearly establish that the extent of hilly terrain in a state is one of the most important biophysical factors that influence the economic development of a state. To borrow a term from international trade and paraphrase it in the present context; states with hilly terrain are at a comparative disadvantage, since these states face increased costs of producing or facilitating the production of goods and services (including those which lead to income generation and employment opportunities) as compared to some others.

Four alternative indices have been proposed in the study, for evaluating the extent of disparity and the underlying factors that are associated with the observed disparity across states. Acknowledging that development is multi-faceted, the study considers a range of factors that impact the state’s developmental status, using standardized and robust methodology to score states on their performances. The study rationale is that economic disparity is impacted by not only tangible costs, but a range of externalities, that are often invisible but impose real time costs in terms of opportunity costs (such as transaction costs from legal and institutional procedures) associated with biophysical factors such as the extent of hilly terrain.

The four indices constructed were an equal weights index, economic disability index, geographic disability index and a sample variance index. States with relatively less area under hilly terrain such as Karnataka, Tamil Nadu, Maharshtra, are found to be generally better performers on all counts. The empirical analysis shows that the states from the North Eastern region are the most disadvantaged, although individual rankings within the region change depending on the weights assigned. It is interesting to note that major changes occur in the ranking across the entire sample, when scores are scaled by weights based on the extent of hill and forest cover. There is far greater concordance when these biophysical factors are not given prominence. The approach is robust, and serves to establish the case for disparities that can be associated with biophysical factors such as hilly terrains.

Subsequent to deriving the indices, an exercise was done to monetize the disadvantage faced by states with hilly terrain. This exercise is conceptualized in terms of the (expected) higher costs in hill areas for providing public services, which are identified as most important for sustainable economic development. Three sectors are covered in the exercise: health, education and, roads and bridges. Data on various parameters relevant for these sectors was quantitatively analysed and a cost function estimated for each sector, which explicitly allowed for costs to vary by the extent of elevated area in a state. A panel data model was estimated, and the estimates were used to derive cost mark-ups. These mark-ups indicate by how much costs go up in hill areas, relative to plain areas.

The computation of the sectoral costs, as discussed in the above section and presented in table 5. 10, reveals that the costs are about 2 to 3 times higher for hill areas as compared to plain areas , but costs vary within this range depending on the sector. A weighted cost–mark-up may be more useful in arriving at a single cost escalation factor since there is some variation even within a sector like education. The average per capita expenditures of the top 5 hill states (table 5.12) is used for deriving the weights. These weights are then applied to the sectoral cost mark-ups to generate the cross sectoral cost escalation. Two alternative results are presented in tables 5.13 and 5.14. As shown in table 5.13, the cost mark-up for what can be termed as being representative of the social sector which includes health and education, is 2.67. This implies that costs are higher by 2.67 times or almost by 270% for hill areas as compared to plain areas. The cost escalation factor is lower, being twice or 200% higher for roads and bridges, which is a reflection of the additional costs of infrastructure provision. Across all the sectors, the costs imputable to hilly terrain is 2.56 times higher than plain areas. A simple average of the cost mark-ups for the five hill states reveals that costs are higher by about 2.45 times. Based on this range of estimates, the costs in hill areas can be said to be approximately 2.5 times or 250% higher than in plain areas.

Table 5.12 Average Per Capita Expenditure for top 5 hill states (in Rupees)

States	Health	Primary education	Secondary education	Roads
Arunachal Pradesh	1030.00	1516.00	536.00	816.00
Himachal Pradesh	634.00	1411.00	786.00	859.00
Jammu and Kashmir	609.00	513.00	448.00	36.00
Sikkim	1283.00	2032.00	1965.00	712.00
Uttarakhand	408.00	968.00	881.00	125.00

Table 5.13 Cost mark-ups for Social Sector (Top 5 hill states)

Sector	Cost mark-up	Average per capita expenditure (in rupees '00)	Weighted share	Weighted cost mark-up
Health	2.07	7.93	0.26	0.54
Primary education	2.96	12.88	0.43	1.27
Secondary education	2.78	9.23	0.31	0.86
Cost mark-up for social sector = 2.67 times ≈ 267% (weighted average) **Cost mark-up for social sector = 2.60 times ≈ 260% (simple average)**				

Table 5.14 Average cost mark-up for Hill States (All sectors)

Sector	Cost mark-up	Average per capita expenditure (in rupees '00)	Weighted Share	Weighted cost mark-up
Health	2.07	7.93	0.23	0.47
Primary education	2.96	12.88	0.37	1.09
Secondary education	2.78	9.23	0.26	0.73
Roads	2.00	5.10	0.14	0.28
Cost mark-up overall = 2.56 times ≈ 256% (weighted average) **Cost mark-up overall = 2.45 times ≈ 245% (simple average)**				

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Annex 1- Terms of Reference

THE AGREEMENT

BETWEEN

FOURTEENTH FINANCE COMMISSION

AND

Cost Disabilities of Hill States in India

Institute of Economic Growth
Delhi

<u>SCHEDULE-I</u>

TERMS OF REFERENCE (TOR)

FOR THE STUDY ON

“Cost Disabilities of Hill States in India”

The Second party to the Contract will conduct the above study in accordance with the proposal submitted by it to the First Party and would broadly cover the following:-

Framework of Study

1. Indian states are characterized by diverse ecosystems, arising from varied topography and other biophysical characteristics. States with mountainous and hilly terrain such as in the North Eastern region or the Western Himalayan region, comprise of ecosystems that provide ecosystem services that are important for local, regional, national and international welfare in the context of sustainability. Hill areas therefore face unique challenges in addressing their developmental needs in a manner that takes care of conservation concerns for sustainable development.
2. Many hill areas in India are uniquely situated in terms of having large tracts of land designated as forest land with its attendant implications for governance in the hill states. For ensuring ecological sustainability, legal and institutional constraints exist on diversion of forestlands for non-forestry purposes, leading to cost disabilities or opportunity costs of (forgone) alternative paths of economic growth.
3. Disparities exist in developmental status, as evidenced by socio-economic indicators, across hill and plain area dominated states, and within hill states as well. The interplay of biophysical and economic factors has implications for sustainable economic development of these hill areas. Adequacy of resources to meet developmental targets, through reduction of vulnerability, improved economic productivity and delivery of basic amenities and services becomes a priority under the circumstances.
4. Two important basic developmental requirements are the provision of physical infrastructure such as power and roads or connectivity; and the provision of social infrastructure that builds capacity, institutions and human skills, to ensure economic growth such as provision of health and education. Ensuring security and livelihood for local population who depend on the forests for their existence and involving them in sustainable livelihood systems is also important.

Objective

This study will (a) identify important parameters impacting cost disabilities of hill states arising from the biophysical terrain characteristics; (b) conduct a quantitative analysis of its implications for provision of infrastructure (roads, power etc.) and basic services (such as health, education, water supply and sanitation) in achieving parity in sustainable development for identified hill states; and (c) a relative indicator of the implied costs for states in India, with special reference to hill states.

Methodology

- Desk review of policy documents and literature on: hill states and forest governance in India, global best practices, infrastructure development and delivery of basic services in India with particular reference to hill states.
- Collection and analysis of secondary data and information from various sources including CSO, MoEF, Planning Commission, previous Finance Commission reports and papers, state agencies as available and applicable.
- Developing methodology for a relative indicator of cost disparity across states and construct the indicator with most recently available and consistent estimates.

2. The duration of the Study Report would be seven months (7 months) commencing from 10th October, 2013 and concluding on 10th May, 2014. The first draft of the study should be submitted to the commission on 1st April, 2014 and the Final Report shall be submitted by 10th May 2014 incorporating therein the suggestions/input, if any, made by the Referee appointed by the First party or by the First party.

3. The total amount for the study project would be Rs. 6,65,000/- (Rs. Six lakhs sixty five thousand only) as per following table:

Item*	**Revised Amount (Rs.)**
Faculty Time @ 50,000/month	3,50,000
Research Assistance / Inputs @ 30,000/month	2,10,000
Contingency (including local travel, data purchase, misc)	30,000
Office support	75,000
Total	**6,65,000**
Timeline	**7 months**

*Flexibility up to 20% in moving across the above budget heads, as necessitated by the study is permitted

The total study amount is inclusive of all expenses covering lead researchers, stipends for research assistants, books, contingency, printing, data collection, travel cost and institutional overheads. Any applicable tax will be paid additionally. The Second Party shall indicate separately the proportion of the Agreement Amount towards expenses and towards professional fees/charges etc. The payment shall be subject to all taxes/cess (including TDS), if any payable. It is made clear that the First party to the contract will not reimburse any other expenditure on Study Report over and above Agreement Amount plus applicable taxes

Annex II – Variable Definitions and Sources

1. **Common Variables**

- Share of Urban Population: 2004-05 – 2011-12.
  Percentage of projected urban population to total population.
  Source: Population Projections for India and States 2001 – 2026. Census of India, 2001.
- Elevation Factor
  - Area as per two dimension (in sq km)
  - Area as per three dimension (in sq km)

Source: National Remote Sensing Centre, Government of India.

Elevation factor (ie. Proportion of elevation) calculated as: (difference between area as per three dimension and area as per two dimension) / area as per two dimension

2. **Health**

- Average Radial Distance (in kms) covered by a Sub-Centre(2007-08 – 2012-13)
  Source: Rural Health Statistics in India, Ministry of Health and Family Welfare, Government of India.
- Population Served Per bed in a Government Hospital (2007-08 – 2012-13)
  Source: National Health Profile, Central Bureau of Health Intelligence, Government of India.

3. **Primary Education**

- Primary Gross Enrolment Ratio: 2006-07 - 2010-11
  Gross Enrollment Ratio of pupils (total) at education level 1 – 5.
  Source: Statistics of School Education, Ministry of Human Resource Development, Government of India.
- Dropout rate for all (I-V) (in percentage): 2006-07 – 2010-11.
  Calculated by subtracting the value obtained by, dividing the enrolment in Class V during the reference year by enrolment in Class I during base year, from one and multiplying it by 100.
  Source: Statistics of School Education, Ministry of Human Resource Development, Government of India.

4. **Secondary Education**

- Secondary Gross Enrolment Ratio: 2006-07 – 2010-11.
  Gross Enrollment Ratio of pupils (total) at education level 6 – 8.
  Source: Statistics of School Education, Ministry of Human Resource Development, Government of India.
- Dropout rate for girls (I-X) (in percentage): 2006-07 – 2010-11.
  Source: Statistics of School Education, Ministry of Human Resource Development, Government of India.

5. **Roads and Bridges**

- Surfaced Road density in terms of area (km/km^2) (2004-05 –2005- 06;2008-09 – 2010-11)
  Calculated as: Surface road length / Geographical area
  - Surface Road Length (in kms)

Source: Basic Road Statistics of India, Ministry of Road Transport and Highways, Government of India.

- Geographical Area (in sq kms)

Source: State of Forest Report, 2011, Government of India.

Other Variables

The following is a list of variables that were experimented with but not included in the final estimations either due to the panel dataset being incomplete or because of the poor overall fit of the resulting equations.

- Pupil-Teacher Ratio (PTR): Average number of pupils (students) per teacher at a specific level of education in a given school-year (for primary and secondary level of education).
  Source: Statistics of School Education, Ministry of Human Resource Development, Government of India.
- Pass Percentage in class X school exams
  Pass percentage of regular students (boys + girls) in annual class X school examinations.
  Source: Boards of Secondary and Higher Secondary/Intermediate Education in India. Results of high schools and higher secondary examinations. Ministry of Human Resource Development. Government of India.
- Road Index for 2006 and 2010. Source: 2010, Infrastructure Index:
  Source: Energy Advisory Board, IDFC Compendium of Proceedings, Vol. I
- Power Index for 2006 and 2010. Source: 2010, Infrastructure Index:
  Source: Energy Advisory Board, IDFC Compendium of Proceedings, Vol. I
- Percentage of villages electrified: 2008 and 2010-2012.
  Source: Ministry of Statistics and Programme Implementation, Government of India
- Shortfall of doctors, nurses and specialists at CHCs, PHCs and Sub-Centres.
  Source: Rural Health Statistics in India, Ministry of Health and Family Welfare, Government of India.
- Share of per capita private expenditure in total per capita public and private expenditure on health
  Source: Based on data reported in the National Health Accounts, India 2004 – 05, Ministry of Health and Family Welfare, Government of India.
- Elevation as per SGI data
  - Area as per two dimension (in sq km)
  - Area as per three dimension (in sq km)
    Source: Office of the Surveyor General of India, Government of India.

Annex - III

Summary Statistics for Sector Variables[13]

1. <u>Health Sector</u>

For the health sector data is for the years 2007-08 to 2012-13.

Name of Variable	Unit of Measurement	Number of Observations	Mean	Range		Standard Deviation
				Min	Max	
Per Capita Revenue Health Expenditure	Rupees	168	604.33	106.74	2629.1	5.13
Average Radial distance covered by a Sub Centre	Kms	155	2.87	1.49	6.11	.97
Population covered per government hospital bed	Absolute numbers	155	1880	236	6089	1268

[13] Note: These summary statistics relate to the years used in the regression analysis after correcting for outlier values.

2. Education

For the education sector, including both primary and secondary education, data is for the years 2006-07 to 2010-11.

Name of Variable	Unit of Measurement	Number of Observations	Mean	Range		Standard Deviation
				Min	Max	
Per Capita Revenue Expenditure on Education (total)	Rupees	140	1838.32	530	7859.8	1.23
Per Capita Revenue Expenditure on Primary Education	Rupees	111	482.05	.21	2360.75	4.53
Per Capita Revenue Expenditure on Secondary Educ.	Rupees	135	249.06	.69	1108.96	2.61
Primary Gross Enrolment Ratio		140	122.47	80	195	27.27
Secondary Gross Enrolment Ratio		140	85.83	39	114.31	15.93
Dropout rate (I-V) (all)	Percentage	128	25.43	0	58.4	15.86
Dropout rate girls (I -X)	Percentage	131	54.89	4.7	86.99	20.09

3. <u>General Indicators</u>

For the general indicators, the data presented here correspond to years 2006-07 to 2011-12. Note, for the roads sector, we also include data from 2004-05 onwards.

Name of Variable	Unit of Measurement	Number of Observations	Mean	Range		Standard Deviation
				Min	*Max*	
Share of Urban Population	Percentage	168	28.17	10.5	59.4	12.37
Proportion of Elevation (NRSE)		168	.047	.0006	.1781694	.06

4. <u>Roads and Bridges</u>

For Roads sector, the data corresponds to years 2004-05 to 2005-06 and 2008-09 to 2010-11. There are inconsistencies and several instances of missing data for the intervening years and so these are not used in the regression analysis.

Name of Variable	Unit of Measurement	Number of Observations	Mean	Range		Standard Deviation
				Min	*Max*	
Per capita revenue expenditure on roads and bridges	Rupees	127	287.24	15.56	5305.8	.53
Surface Road Density (area)	Km/Km^2	127	.645	.04	2.23	.48

Annex - IV

Regression Results

1. Health

The regression results for the health sector have been obtained for the years 2007-08 to 2012-13.

Dependant Variable	Log of Per Capita Revenue Expenditure on Health			
No. of Observations: 155; No. of groups : 26 Observations per group: Min: 5; Avg: 6.0; Max: 7 Fraction of variance: 0.710; Wald chi2(9): 68.64; Prob>chi2= 0.00				
Independent Variables	Variable Name	Coefficient	Z-value	significance
TV exogenous	Urbpop	.028	2.54	0.01
	Year_dum1	-.75	-5.94	0.00
	Year_dum2	-.65	-5.47	0.00
	Year_dum3	-.37	-3.14	0.00
	Year_dum4	-.30	-2.52	0.01
	Year_dum5	-.29	-2.41	0.02
TV endogenous	avgradsc	-.52	-1.89	0.06
	avpopgbed	-0.0004	0.02	0.98
TI exogenous	Pelenrse	13.79	2.98	0.00
	_cons	1.99	2.76	0.00

Where, urbpop = Proportion of urban population

Avgradsc = Average Radial Distance covered by a Sub-centre

Avpopgbed = Population served per government hospital bed

Pelenrse = Proportion of elevation as per NRSE data

2. Primary Education

Regression for 5 years panel: 2006-07 to 2010-11.

Dependant Variable	Log of Per Capita Expenditure on Primary Education			
No. of Observations: 101 ; No. of groups : 23 Observations per group: Min :1; Average:4.4 ; Max:5 Fraction of variance: 0.996; Wald chi2(8): 168.02 ; Prob>chi2=0.00				
Independent Variables	Variable Name	Coefficient	Z-value	significance
TV exogenous	Urbpop	.01	0.31	0.76
	Year_dum1	.12	2.14	0.03
	Year_dum2	.30	4.98	0.00
	Year_dum3	.50	8.03	0.00
	Year_dum4	.66	9.01	0.00
TV endogenous	Priger	-.003	-1.26	0.21
	droutall	.005	1.67	0.10
TI exogenous	Pelenrse	19.75	1.84	0.06
	_cons	-1.33	-0.97	0.33

Where, Urbpop = Proportion of urban population

Priger = Gross Enrolment Ratio in primary education

Droutall = Dropout rates for all (Class 1-V)

Pelenrse = Proportion of elevation as per NRSE data

3. Secondary Education

Regression for 5 years panel: 2006-07 to 2010-11.

Dependant Variable	Log of Per Capita Expenditure on Secondary Education			
No. of Observations: 121; No. of groups : 26 Observations per group: Min:2; Avg:4.7 ; Max:5 Fraction of variance: 0.993; Wald chi2(8): 373.87; Prob>chi2=0.00				
Independent Variables	Variable Name	Coefficient	Z-value	significance
TV exogenous	Urbpop	.03	1.65	0.10
	Year_dum1	.12	2.98	0.00
	Year_dum2	.29	6.52	0.00
	Year_dum3	.54	11.46	0.00
	Year_dum4	.70	13.01	0.00
TV endogenous	Secger	-.01	-2.30	0.02
	droutg	.004	1.76	0.08
TI exogenous	Pelenrse	18.54	2.99	0.00
	_cons	-1.71	-2.21	0.03

Where, Urbpop = Proportion of urban population

Secger = Gross Enrolment Ratio in secondary education

Droutg = Dropout rates for girls (Class I-X)

Pelenrse = Proportion of elevation as per NRSE data

4. <u>Roads and Bridges</u>

Regression for 5 years panel: 2004-05 to 2005-06; 2008-09 to 2010-11.

Dependant Variable	Log of Per Capita Revenue expenditure on roads and bridges			
No. of Observations : 130 ; No of groups: 26 Observations per group : Min: 5; Avg: 5 ; Max: 5 Fraction of variance: 0.679 ; Wald chi2(7): 111.71 ; Prob>chi2= 0.00				
Independent Variables	Variable Name	coefficient	Z-value	significance
TV exogenous	Urbpop	-0.002	-0.10	0.92
	Year_dum1	-0.99	-5.13	0.00
	Year_dum2	-.41	-2.13	0.03
	Year_dum3	0.05	0.30	0.76
	Year_dum4	.17	1.03	0.30
TV endogenous	surrddenar	0.92	1.88	0.06
TI exogenous	Pelenrse	13.22	3.93	0.00
	_cons	-2.86	-5.27	0.00

Where, urbpop = proportion of urban population

surrddenar= surface road density in terms of area

Pelenrse = Proportion of elevation as per NRSE data.