STATUS PAPER: NORTHEASTERN REGION

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INTRODUCTION

In race, language, culture, and social customs, the northeastern region of India may be said to be southeast Asia in miniature. In no other part of the country can such a large number of tribes be found living together, intermingled with an equally heterogenous group of non-tribal people; nowhere else do people speak such a vast range of languages and dialects and live such distinct and varied ways of life.

The region's 0.25 million km^2 make up about eight percent of the total geographical area of the country inhabited by a population of 26.6 million, which is 3.8 percent of the total population of the country. About 90 percent of the people, mostly tribals, live in rural areas.

Today, northeastern India is a political mosaic of five states and two union territories, bound together by economic interdependence. Recognizing this, the North-Eastern Council for the coordinated development of the region was formed in August, 1972. Its main function is to formulate and coordinate regional plans to supplement the Five Year Plans of the individual states and union territories. All the states of the region, except Assam and Tripura, are tribal states; even in these two states, the tribal populations constitute very sizeable proportions.

The region has the highest hydropower potential in India on account of the mighty Brahmaputra, the Barak, and their tributaries. This potential is estimated to be about 37,400 MW, which constitutes around 30 percent of the total hydro-reserves of India. Barely three percent of this has been harnessed so far. Efforts are being made to tap the hydel resources through the North-Eastern Power Corporation Limited (NEPCO), an organization set up in 1976 for this purpose by the government of India.

PHYSICAL SETTING

Topography

Physiographically, the region consists of three distinct divisions; the Assam or Brahmaputra Valley, the Meghalaya (Shillong) Plateau and the Northeastern Hills and basin, including the Arunachal Himalaya.

Climate

The great altitudinal differences in the region, together with the varied physiography, have made for great variations in the climate of the region.

The Himalaya ranges in Arunachal Pradesh have a typical temperate climate akin to the alpine zone. The

area is abundant in temperate pine forests. At lower elevations are the Naga Hills, Mikir Hills, and Shillong Plateau (1300 to 2500 meters). The climate in these areas is mild temperate to sub-tropical. The Imphal Valley is mainly sub-tropical, while the plains of Tripura, Assam, and the southern part of Mizoram are mainly tropical. In the plains of the Brahmaputra and the Barak Valley, as in Tripura and western Mizoram, the average daily temperature in January is generally above 15°C. In other parts of the region the January temperature is between 10° to 15°; Shillong, however, has much lower temperatures. In July, the average temperature in the region except in Shillong and southern parts of the Mizo Hills ranges from 25° to above 30° C. During October, the daily mean temperature in the hills ranges between 20 ° and 25° C. In the Brahmaputra and Barak Valleys, in Tripura, and Western Mizoram, it is above 25° C.

The annual rainfall received in the region comes mainly from the southwest monsoon, between early June and September. The pre- monsoon showers begin in mid-April. The intensity of rainfall varies from place to place. The average annual rainfall in the northeastern part of Arunachal Pradesh, northwest of Bomdila, is above 4000 mm. This is reduced to the southwest. The southern slopes of Khasi and Jaintia Hills of Meghalaya receive only 2000 mm. However, the Cherrapunjee Mawphlang-Pynunsala belt, which is close to the southern fall of these hills, records 12,000 mm per year. The intensity of precipitation decreases towards the south of the region; Aizawl, the capital of Mizoram receives only 2000 mm, and Imphal Valley gets 1400 mm. However, in the hills of Manipur, the rainfall ranges from 4000 mm in the west to 2200 mm in the north. Tripura has an average annual precipitation of 2000 mm. Owing to the extended rainy season, the atmospheric humidity remains high almost throughout the year (Singh 1971).

Population

The northeastern region accounted for 26.6 million people (3.8 percent) out of the total population of 683.8 million in India in 1981. During the first half of this century, the country's population increased by 51 percent, while the population of the northeastern region increased by 140 percent. It is seen that the population increase in the northeast over these years has always been higher than that of the country as a whole. The rates of population increase from 1951 to 1981 for the country and the northeastern region have been 89 percent and 159 percent respectively. Table 1 below gives the population trends in the northeastern region.

The main causes for the high rate of population increase in the region are heavy immigration, which has been a feature of the region from early times; high natural rate of increase in population since 1921; and relative absence of mobility of the indigenous people of the region.

Immigration during the last five decades is often termed a 'prime cause' for the high population increase in the region. Between 1871 and 1901, the main and perhaps the only factor contributing to population increase in the region was immigration; natural increase in

Table 1: Population Trends in North Eastern Region

Census year	Arunachal Pradesh	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Tripura	Total for the Region	All India
		(Thousand Persons)							
1901	-	3,290	284	341	82	102	173	4,272	2,38,396
1911	-	3,849	346	394	91	149	230	5,059	2,52,093
1921	-	4,537	384	422	98	159	304	6,006	2,51,321
1931	-	5,561	446	481	124	179	382	7,173	2,78,977
1941	-	6,694	512	556	155	190	513	8,618	3,18,661
1951	-	8,029	578	606	196	213	646	10,268	3,61,088
1961	337	10,837	780	769	266	369	1,142	14,500	4,39,235
1971	467	14,625	1,073	1,012	332	516	1,556	19,581	5,48,160
1981	628	19,903	1,411	1,328	488	773	2,047	26,578	6,83,800

Provisional - Projected figures for 1981.

Sources - 1. Statistical Handbook, State Governments/Union Territory Administration
2. Series - 1. Paper 1 & 2 of 1981; Provisional Population Totals, registrar General and Census Commissioner for India

population was negative owing to widespread epidemics of ague, kalaazar and malaria.

A high natural rate of population growth began to be evident only after 1921. During the next 20 years, the natural growth rate in the region registered an average higher than the all-India figure. Even between 1951 and 1971, when there was a heavy influx of both refugees and others from East Bengal, the region registered a very high natural rate of growth in population.

Migration from rural to urban areas has been very pronounced during the decade 1971 - 81, especially in the tribal states of the northeast, showing a range of increase between 225 percent (over 1971) in Mizoram, and 39 percent in Tripura. There has also been a decrease in the percentage of rural population during this decade, except in Tripura, where it has remained around 89 percent over the decade. However, when compared to the all-India averages, the percentage of rural population in the northeast in 1981 (excluding Assam) is high, being 83 compared to 76 for India.

The northeastern region is land-abundant and population-scarce; the density of population is the lowest in the country. However, 'abundant' is misleading, for given the mountain terrain and the difficulties of settled cultivation in a large part of the region, the carrying capacity of the land is very small. Figures pertaining to population density and decennial poopulation growth rate are given in Table 2.

The distribution of population in terms of

Table 2: Density, Decennial Growth Rate, and Sex Ratio 1981 Population

State/Union Territory	Area	Population	Density (Persons)	Decennial Growth rate 1971 - 81 (%)		Sex Ratio Females per '000 males
	x 1000 ha	1000 persons	persons/ha	Observed	Adjusted	
Arunachal Pradesh	84	628	7	34.34	34.62	870
Assam	79	19,903*	253	36.09+	-	900
Manipur	22	1,411	63	32.57	31.83	972
Meghalaya	21	1,328	59	31.30	31.56	955
Mizoram	21	487	23	46.75	47.14	936
Nagaland	17	773	47	49.73	50.15	847
Tripura	10	2,047	195	31.55	31.81	948
Total	255	26,579	104	85.73++	..	909
All India	3,280	658,141	201	24.43	24.64	936

Source: Office of the Registrar General of India
*Projected: + Worked out from projected population
++ Estimated

economic classification is given in Table 3. The percentage of female workers does not lag far behind that of male workers in the tribal states of Arunachal Pradesh, Nagaland, Mizoram, and Meghalaya. In both Arunachal Pradesh and Nagaland, in fact, the female workers in the categories of cultivators and agricultural laborers show a higher percentage than the male workers in these categories.

ASPECTS OF CHANGE IN THE REGION

The natural resource to be exploited first by the British was the rich forest of the Brahmaputra Valley. This was done by the process of reserving forests as government property and the establishment of the Forest Department to manage them. Oil and natural gas were discovered in Upper Assam in 1926. These were developed, and they supplied a major portion of the oil requirements in India until independence in 1947.

Agriculture

Of the regions' total population , 90 percent is dependent on agriculture. The agricultural practices in the region are broadly of two distinct types: one practiced in the plains and valleys, and to a smaller extent on foothills and terraced slopes, known as 'settled cultivation'; and the other usually practiced on slopes of all possible gradients called 'shifting cultivation' or *jhuming* by the tribals of hill areas.

Settled cultivation accounts for about 14 percent (3.8 million hectares) of total geographical area, while shifting cultivation is practiced over 2.76 million hectares (Kaul 1981). The main foodgrain crops grown are paddy, maize, wheat, arhar, gram, and lentils, and among the

Table 3: Economic Classification of Population 1981

	Arunachal Pradesh	Manipur	Meghalaya	Mizoram	Nagaland	Tripura
Total Population	628,050	1,411,375	1,328,343	487,774	773,281	2,047,351
Males	335,941	715,718	679,519	251,988	414,231	1,051,240
Females	292,109	695,657	648,824	235,786	359,050	996,111
Total Mainworkers	308,946	588,231	587,158	200,988	354,102	606,153
Males	190,238	334,178	360,260	123,815	207,495	515,746
Females	113,708	254,053	226,889	77,173	146,607	90,407
Cultivator	223,329	348,363	373,180	144,941	249,614	264,099
Males	113,378	203,301	212,839	79,422	116,390	229,585
Females	109,951	145,062	160,341	65,519	133,224	34,509
Agricultural Labourers	7,575	46,334	58,236	5,136	6,611	144,910
Males	5,240	22,396	33,154	3,023	4,578	116,045
Females	2,335	23,938	25,082	2,113	2,033	28,865
Household Industry Manufacturing Processing, Servicing and Repairs	1,267	64,071	6,403	2,580	5,079	9,836
Males	966	10,863	3,278	1,410	3,094	7,345
Females	301	53,208	3,125	1,170	1,985	2,491
Other Workers	76,775	129,463	149,339	48,331	92,798	187,313
Males	70,654	97,618	110,998	39,960	83,433	162,771
Females	6,121	31,845	38,341	8,371	9,365	24,542
Marginal Workers	21,336	61,305	19,912	16,830	64,573	53,898
Males	5,464	24,307	6,675	7,049	32,820	16,527
Females	15,872	36,998	13,237	9,781	31,753	37,371
Non-workers	297,768	761,839	721,273	269,956	354,606	1,387,300
Males	140,239	357,233	312,575	121,124	173,916	518,967
Females	157,529	404,606	408,698	148,832	180,690	868,333

Source - Directorates of Census Operations

oilseeds grown are rapeseed, mustard, and sesamum.

The total production of foodgrains in the region was around 35 million tons in 1977 - 78 which came down to 29 million tons in 1979 - 80, against an estimated demand of 46 million tons. Production per unit area is low despite the fertile soil, well - distributed rainfall, and sufficiency of surface and groundwater for irrigation needs. One reason for this may be the practice of mono-cropping, especially of paddy; other reasons cited are the smallness of the area brought under high-yielding varieties (only about 20 percent of the cultivated area), and the low average per hectare consumption of fertilizer (approximately 5 kg). Irrigation facilities are available to only about 20 percent of the cultivated area. In addition, the per capita cultivated area is only 0.15 hectare; the all - India average is 0.24 hectare.

Shifting Agriculture

The other type of cultivation--shifting cultivation--is practiced by the tribal people of the area. This type of cultivation covers about 2.7 million hectares of land, of which at any one point in time only about 15 to 16 percent of the area is cultivated. It has been estimated that more than 0.45 million tribal families are engaged in shifting cultivation, with an average of 1.20 hectares of land to cultivate in a season.

The main characteristics of shifting cultivation are:

- rotation of fields rather than crops
- use of fire for clearing and preparation of land
- human labor as the main input, and non- of draught animal, plough or machinery
- use of simple instruments like dibble sticks, chopping knives, etc.
- shifting of homestead if necessary when new area is opened in distant places

Land under shifting cultivation is owned communally and fields are demarcated for successive annual operations with no permanent boundary, right of possession or ownership over land. The plots to be cultivated are jointly cleared of forests and brush up to stump level by the community in December-January and after burning the debris the families divide the land among themselves. After this division, labor on the individual plots is usually done by the individual or family. The crops grown are mixed and a variety of crops are raised on the same plot - paddy, millet, beans, sweet potatoes, tapioca, chillies, cotton, and vegetables. Mixed cropping has the advantage of ripening at different periods, thereby providing the tribes with varied food, six to eight months a year. Thus, the choice of crop is consumption- oriented (Goswami 1980).

The same plot of land is cultivated for two or three years, then abandoned for regeneration of soil fertility, and another piece of land within the village boundary is cultivated. The number of years of fallow depends upon the availability of land and population in a village. With increasing population, the

cycle in most areas has shrunk from 30 or 40 years to an average of 5 to 8 years at present, which is hardly a sufficient period for rebuilding of soil fertility. The loss of soil due to erosion under this type of cultivation is also great, and has been estimated at 40 tons per hectare compared to 5 tons per hectare in terrace cultivation. It also causes reduction in organic carbon owing to burning. These losses have contributed to serious decline in the productivity of hill areas. They have also been cited as causes of heavy siltation in the lower reaches of the major river systems of the region, which has contributed to the heavy annual floods and inundation of large tracts of riverine land.

However, in some parts of the hill areas, and particularly in Nagaland, there are areas where improved and intensive methods of cultivation are in vogue. In the Angami area of Nagaland, irrigated terraced cultivation as early as 1841 was reported (Robinson 1841), described by Godwin-Austin in 1873 as "terrace cultivation of highest perfection seen in any part of the Himalayas". Similarly, improved methods of cultivation are found among the Apatanis in the Zero adjoining areas of Subansiri District, and Monpas (Tibetan race) in Kameng District of Arunachal Pradesh.

Forests constitute nearly 47 percent of the total area of the region. Arunachal has 62 percent of its area forested; Assam has 36 percent, Manipur 68 percent, Meghalaya 37 percent, Nagaland 17 percent, Mizoram 34 percent, and Tripura 58 percent. The reported area of land being utilized for forest in Arunachal is 5.64 million hectares out of a total of 8.36 million hectares of land. In Assam, the total area of 7.9 million hectares of land is reported as utilized. Details of land utilization in the different states of the region are given in Table 4.

Industry

Industrially, the region is extremely backward. If tea processing industry is excluded, the other major industries are few, excepting the oil refineries in Assam which have been set up recently. Besides these, sawmills numbered 25 in Assam in 1974-75. The classification of major industries is based on the criterion of employing at least 50 workers which use power or at least 100 workers without use of power. Employment was provided by such industries in Assam in 1974-75 to about 98,000 workers and income generated by them in that year came to Rs. 1030 million in Assam. For other areas, see Table 5.

Looking at the number of small-scale industries, the picture is more encouraging. Assam in 1978 had 3302 small-scale industrial units, while Manipur came second with 1481 units, followed by Tripura with 898 units. Table 6 gives details.

The key to the development of the region is mainly through the encouragement and further establishment of small and medium industries which have the required raw materials within easy reach for processing. Small-scale, mostly rural, industries have the general goal of providing the rural population with more opportunities for economic and social development and reducing the economic distance between the town and country to minimize migration, for

Table 4: Classification of North Eastern Region, Forest 1976-77

State/Union Territory	Geographical Area	Total Forest Area	Type of Forest	
			Merchantable	Unprofitable
	(hectares)			
Arunachal Pradesh	83,578	51,540	7,500	44,040
Assam	78,523	28,608	7,218	17,571
Manipur	22,356	15,154	15,008	146
Meghalaya	22,489	8,229	4,378	3,851
Mizoram	21,087	7,127	7,127	-
Nagaland	16,527	2,876	2,358	518
Tripura	10,477	6,028	4,925	1,103
Total	255,037	119,562	62,686	56,876
All India	3,287,780	*750,427	565,777	173,961

Table 4 (Contd.)

State/Union Territory	Classification of Forests				Ownwership		
	Reserved	Protected	Unclassed	Forest Department	Civil Authorities	Corporate Bodies	Private individuals
	(hectares)						
Arunachal Pradesh	8,072	206	43,262	51,393	-	-	147
Assam	-	-	11,037	16,420	2,246	9,942	-
Manipur	1,377	4,171	9,606	15,154	-	-	-
Meghalaya	702	12	7,515	718	-	7,511	-
Mizoram	1,300	4,323	1,504	7,127	-	-	-
Nagaland	286	518	2,072	804	-	-	-
Tripura	3,946	2,082	-	6,082	-	-	-
Total	33,254	11,312	74,996	97,644	2,246	17,453	2,219
All India	*236,640	*119,027	699,218	18,782	20,219	12,000	

Source: Directorate of Economics and Statistics, Ministry of Agriculture

* Excludes data in respect of J & K for which legal classification of forest area is not available.

Table 5: Major Large-Scale Industries in Terms of Income Generated: 1974-75

Industry	Number				(Rs. in 100,000)		
	Registered Factories	Employ-ment	Invested capital	Outstand-ing loan	Output	Income Generated	Employ-ment
Assam							
Tea Processing	365	59,360	10,765	1,655	18,908	5,262	888
Sawing and Planning of Wood etc.	25	6,343	1,152	344	2,458	725	160
Railway Wagons and coaches etc.	3	3,574	48	-	484	179	167
Industrial Machinery for Food and Textile Industries	5	704	102	53	276	80	23
Cotton Spinning, Weaving etc.	3	1,280	221	215	275	65	45
Others	65	26,793	20,444	16,992	12,038	3,994	1,077
Total	466	98,054	32,732	19,259	34,489	10,305	2,360
Manipur							
Others	5	805	53	-	42	21	21
Total	5	805	53	-	42	21	21
Meghalaya							
Others	5	948	697	97	198	61	35
Total	5	948	697	97	198	61	35
Tripura							
Tea Processing	17	1,228	80	27	135	36	13
Repairs of Motor, Vehicle etc.	3	154	-	-	28	7	7
Electricity	8	359	-	-	13	1	16
Others	8	344	11	7	48	14	11
Total	36	2,085	91	34	224	58	47

Note: The annual Survey of Industries (ASI) census date covers all factories which employ at least two workers with use of power or at least 100 workers without use of power. Such factories account for about90 percent of the income generated in the entire factory sector.

(...) - Not available; - Nil. Source: ASI-1974 m Census Sector, Part III; CSO

Table 6: Medium and Large Scale Industries in North Eastern Region

(Numbers)

Industries		Arunachal	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Tripura
Sugar Factory	-	3	-	-	-	1	-	
Paper Mill	-	3**	-	-	-	1*	-	
Oil Refinery	-	3*	-	-	-	-	-	
Jute Mills	-	1	-	-	-	-	1*	
Cement Factory*		1	-	1	-	-	-	
Hard Board	-	1	-	-	-	1*	-	
Spun Silk Mills	-	1	1*	-	-	-	-	
Cycle Factory	-	1	-	-	-	-	-	
Distillery Project	-	1	-	-	-	-	-	
Plywood and other wood products	2	13	-	1	2	1	-	
Fertiliser	-	2	-	-	-	-	-	
Chemical Industry (including Petro-Chemical)	-	12	-	2	-	-	-	
Miscellaneous Industries	-	7	-	-	-	-	-	
Total	3	48	1	4	2	4	1	

Source: Report of the Study Team Industrial and Economic Development of the North Eastern Region (Vol. I Annexure XVII).

* Under construction (One in Assam)

** Two under construction

Spinning Mill under construction

example. Agro-based industries have both forward and backward linkages, the former meeting the demand for agricultural inputs and consumer goods and the latter based on locally available materials and human resources.

PRESENT ENERGY POSITION AND FUTURE PROSPECTS

The northeastern region has tremendous hydropower potential on account of the Brahmaputra, the Barak, and their tributaries. The hydel power potential has been estimated to be more than 20,000 MW. Vast potential for thermal generation exists; adequate coal, natural gas, and petroleum reserves are also available. With the current and planned generating capacities, there should be no shortage of electrical power and the potential for augmenting hydroelectric capacities is immense.

Energy Use: Domestic

As in the rest of the country, the energy-use pattern in the domestic sector of the region is still dominated by non-commercial fuels such as firewood, agricultural residues, and charcoal. Indeed, nearly 70 percent of the total energy consumption is accounted for by noncommercial fuels. This is because in the energy consumption pattern, the domestic sector predominates, and its requirements are met largely by noncommercial fuels. Marginal quantities of commercial fuels like coal, kerosene, liquid petroleum gas, and electricity are mostly used in urban areas. Industrial use of power in small quantities is presently found only in the populated areas of Assam and Tripura, and to a still smaller extent, in Meghalaya.

The energy need for domestic purposes is a very significant component of the energy matrix of society as a whole and is location-specific. The fuel efficiency of traditional devices for burning biomass materials is very low. It has been estimated that household energy consumption accounts for 40 to 60 percent of the total energy budget in southeast Asian countries where traditional fuels used are in abundant supply (Tinker 1981). Energy consumption for domestic purposes varies from region to region and also depends upon living standards and working conditions. For instance, it has been found that in Pondicherry region, irrespective of social class, the gross energy utilization in rural areas was much greater than in semi-urban and urban areas; cooking consumed 97 percent of the total energy in rural areas, 93 percent in semi-urban areas, and 90 percent in urban areas (Gupta, Rao, and Vasudevaraju 1979). The energy consumption per capita per day in rural, semi-urban, and urban areas was estimated to be 6880, 4002 and 3010 kcals respectively (ibid).

A study in biomass energy consumption for domestic purposes in Karnal revealed that as the size of the family increased, the daily average energy consumption per person decreased. The daily average energy consumption for each person in small, medium, and large families was estimated as 12,048, 8,438 and 7,647 kcals, irrespective of occupation. The daily average energy consumption for farmer and farm laborer, artisan, and village employee groups were 10,514, 9,144 and 8,473 kcals for each person, irrespective of

family size (R. R. Gupta, Malik, and Jain 1982). No study on domestic use of energy in the northeast has been conducted.

Firewood

In the northeast, one of the most important daily needs in village life is firewood. Nearly 90 percent of the people depend on firewood as the only source of energy for cooking, providing warmth in cold weather, and even for domestic lighting, despite rich coal reserves in the region. The hill terrain and transport problems render the movement of coal and other commercial fuels extremely difficult. As long as the population remains predominantly rural, the transition to commercial fuels will take time. In addition, the low density of population, scattered villages, relatively abundant forests, and the general poverty of the people will make the change difficult. The progress of rural electrification has not been extensive enough to bring about any change in the energy-use pattern. Hence, dependence on firewood cannot be eliminated for many years to come.

Most of the hill areas in the region appear barren. This is usually ascribed to the practice of shifting cultivation, but it has also been claimed that, "firewood collection has a major share in the process of denundation of the hills - this is evident from the denuded hillocks ... where *jhuming* was not practiced" (Singh 1980).

Ecological degradation, which is widespread in the northeast, is primarily due to firewood collection without suitable planned provision for regeneration.

The annual requirement of firewood for a family has been estimated to be around 2 MT, roughly equivalent to 1.5 m^3. According to information available, most of the fast-growing species have a growing capacity of 20 m^3 per hectare per year, in which case, one hectare of firewood plantation might be sufficient to meet the demands of nearly 13 families. Since the fast-growing species like eucalyptus, populus, pines, albizzla, alnus, and nepalensis can be harvested in a cycle of four to five years, the actual area required for having an annual supply of 20 m^3 of firewood for 13 families would be four hectares. The size of the area in a village where firewood could be cultivated would depend on the number of families in the village. A rough estimate would indicate one hectare per four families, assuming a four-year felling cycle (Singh 1980).

At present, not more than two percent of the hill areas of the northeastern region are under annual cultivation, including shifting cultivation. The remaining area is officially classified as forest, but generally what really exists is either scrub forest, bamboo forest, or thatch grass. The potential for raising firewood is high and can easily be assessed. Firewood plantation can be taken up through a comprehensive program of social forestry. If "school education for children to grow and nurture trees and collect timber is carried out, and if small plants for compaction are installed which are maintained by local authorities through community efforts, and if some incentive is given for having forests well protected, the need for fuel and domestic lighting need not pose a threat to the timber availability in the forests"

(Chaturvedi 1984). The fuelwood plantation, therefore, would not only make the villages self- sufficient in firewood, but would also prevent wanton felling of valuable timber-yielding trees. In addition, erosion could be controlled.

To minimize deforestation resulting from large-scale use of firewood, Meghalaya launched a campaign a few years back to encourage the use of electricity for domestic purposes. Meghalaya has an excess of electric power. The campaign, however, was not a success. Firewood is freely available and any price paid for it is negligible when compared to the expenditure for the use of electricity.

Reserves of coal are large; coal is mined in fairly large quantities in Meghalaya and in lesser measure in a few hill areas of Assam. In urban areas and areas close to coal fields, coal is also used for domestic purposes. However, even in many urban areas of the region the use of coal is not as widespread as that of firewood.

The use of kerosene oil, for domestic purposes is slowly increasing in urban areas. In rural areas, however, the rate of increase in its use has rather slow. There is a slightly increased trend in towns like Shillong and Guwahati in the use of liquid petroleum gas for cooking purposes. With greater availability of LPG and increasing incomes, wider use is bound to occur.

Energy Consumption in Agriculture

If tea and sugar are considered industries, energy consumption in the agricultural sector is a very small proportion of total energy consumption. The energy required for agricultural purposes is mainly electricity for light irrigation and oil for tractors and pumps. Per capita consumption of electric power in the agricultural sector in 1977-78 for the states of Meghalaya and Tripura, for which data is available, is one unit per capita, as against the average of 16 units in India as a whole. Vast areas of land under cultivation in the region are unsuitable for the use of power-driven mechanical devices for sowing or harvesting. And in the hill regions, irrigation is rare, except perhaps in the terraced fields of the Angami region in Nagaland. The negligible use of power in agriculture is related to the terrain and the nature of agricultural operations in the region. In the areas of settled cultivation, where primarily wet paddy is cultivated, irrigation facilities are required, and pumpsets to lift water for irrigation purposes would eventually become the instrument of agricultural practice as the hoe is at present. With official recognition of the need to improve agricultural practices, increase foodgrain yields, use tractors, and improve irrigation, a substantially increased energy input in the agricultural sector is anticipated.

Industrial Energy Use

Per capita consumption of industrial energy is a major index of a region's economic progress. In 1977-78, out of a total of 111 units of per capita consumption of electric power in the region, the per capita share of industry was 43 percent. Out of this, Assam's per capita share was 27 and Meghalaya's 14; Tripura consumed three units and Arunchal Pradesh two, and Nagaland

and Manipur one each (Table 7). This is against the all-India figure of 62 units of per capita consumption of electric power by industry out of a total of 100, in 1977-78.

However, the main sources of industrial energy in the region are coal and petroleum products. The use of electricity as industrial energy is low. Apart from tea, petroleum and

Table 7: Per Capita Power Consumption 1977-78 and 1978-79
(Units)

Station/Union Territory	1977-78				1978-79
	Domestic	Agriculture*	Industries	Total	Total
Assam	3	Neg	27	35	36
Meghalaya	6	1	14	35	36
Nagaland	8	-	1	23	31
Manipur	4	-	1	5	12
Tripura	5	1	3	9	11
Mizoram	4	-	-	5	11
Arunachal Pradesh	5	-	2	9	9
All India	11	16	75	121	131

Source: Basic Statics, NEC, 1982.

* Utilised only. Total includes non-utilised also.

fertilizer are the major industries. Besides the Digboi, Guwahati, and Bongaigaon refineries, there is one at Namrup and another is expected to be set up in the private sector. A number of ancillary industries are growing around these units and are likely to increase. The expansion of the activities of the Oil and Natural Gas Commission (ONGC) and Oil India Limited, along with the expansion of the Namrup Fertilizer Plant and the operation of the cement factory at Cherrapunjee, would lead to an increase in the consumption by industry.

The cooperative jute mill at Silghat in Assam, and one in Tripura, produce hessian and sacking. Three sugar factories, (two in Assam and one in Tripura), three paper mills (two in Assam, one in Nagaland), two hardboard mills (one in Assam and the other in Nagaland), and other industrial units such as a cycle factory and distillaries in Assam have all been instrumental in increasing the demand for industrial energy. Schemes for the establishment of power tiller factories, more fruit canneries, pulp and paper mills, a nylon textile factory, and other industrial units are bound to increase the energy requirements of the industrial sector.

It has been estimated that by 1985-86, industrial energy would account for more than 50 percent of the region's total energy consumption. Coal and oil reserves would be more than sufficient

to cope with the increased demands. And with hydroelectric projects in various stages of completion, energy requirements of industry should not pose any problem for the region. In the case of coal, known reserves amount to more than 1500 million tons while known reserves of crude oil and natural gas amount to more than 100 million tons and 50 billion m^3 respectively. With the earlier limitation on refining now removed, the availability of kerosene, aviation turbine fuel, furnace oil, and quality bitumen should be available in adequate quantities. And with the total installed capacity of 510 MW in both hydel and thermal power generation (as of May 1982) electric power should not be a constraint to rapid industrialization of the region.

The main bottleneck for industrialization is lack of adequate transport facilities. The expected increase in road, rail, and air transport will not pose any problem with respect to energy requirements of the transport sector in the region. In fact, the existing refining capacity in the region is enough to cope with the demand; power for the purpose of electrifying the railway system is also available in adequate quantities.

North-Eastern Electric Power Corporation (NEEPCO)

As mentioned earlier, the hydropower potential is estimated at 21,000 MW which constitutes 30 percent of the entire country's power reserve. There is also a very high potential for thermal power, estimated at 1500 MW. However, development of power in the region has lagged behind the rest of India. All possible steps should be taken to augment power generating and transmitting capacities. A great deal of improvement has been achieved since the beginning of the 1970s, especially after the establishment of the North-Eastern Council in 1972 and the setting up of the North-Eastern Electric Power Corporation (NEEPCO) in 1976. NEEPCO has been set up for efficient and integrated development of power: to plan, promote, organize, investigate, design, survey, construct, generate, transmit, operate, and maintain power stations in the entire northeastern region. The NEEPO was organized on the recommendation of the North-Eastern Council (NEC) as an Electric Utility Corporation by the government of India, to harness the enormous power potential of the region and for the planned development of power generation projects including transmission lines for evacuating power.

Prior to the First Five Year Plan, there were only 10 to 12 small hydropower stations in the region, with a total installed capacity of about 2.5 MW. By 1980, a number of hydro and thermal power schemes had been in various stages of implementation in the region, with an installed capacity of 295.2 MW hydropower stations and 332.5 MW thermal power stations; total generation was 627.7 MW. In 1982-83, the total installed capacity increased to 708 MW, and in 1983-84, it further increased to 874 MW. Taking all the hydro projects already executed by the state governments and in operation, those already commissioned by NEEPCO and the projected ones by all the agencies, the estimated installed capacity by 1987-88 is 1469.7 MW, of which 835.2 MW would be hydro projects and 634.5 MW, thermal projects.

The Eleventh Power Survey Report (1982) published by the government of India gives the following figures of the likely energy requirements in 1987-88 for the northeastern region (Chowdhury 1982).

Table 8: Energy Requirements in the Northeast Region for 1987-88

STATE	ENERGY REQUIREMENT in MkWh	PEAK DEMAND in MW
ASSAM	1994	391
MEGHALAYA	238	47.8
MANIPUR	129	31.9
NAGALAND	95	22.5
TRIPURA	164	38.4
ARUNACHAL PRADESH	47	14.9
MIZORAM	36	18.8

Source: NEEPCO News, July-December 1982, p.15.

An investment of Rs. 16.2 billion will be required for the five projects, which will enable generation of 1855 MW of power and 8760 million kWh of energy including projects already under execution or completely investigated. This will start giving benefits from the end of the Sixth Plan and will be completed by the beginning of the Eighth Plan, subject to the availability of funds.

The region has a terrain ranging from sea level to 20,000 ft. The hills and mountains are geologically very young and there are large formations of shale, sediments, etc. The northeast is a highly seismic area, with a history of major earthquakes.

The economic feasibility of large hydel projects and corresponding thermal projects need to be studied along with the technical feasibility of impounding large quantities of water within the limitations of the rock and soil characteristics of the region. This is to say, vulnerability to earthquakes and the nature of the soil and rock may impose great limitations upon hydel projects. There is need for continuous study of the interaction of reservoirs with the behavior of soil and rock formations. Such studies need to be both comprehensive and continuous. These possibilities also indicate the need for utilization of other energy sources.

Microhydel Projects

The northeastern region has not been able to benefit from electricity despite huge hydropower potential. Long transmission lines are difficult to construct and maintain in this hill and mountain region, calling for large investments and long gestation periods. The load requirement in the tribal villages is mostly for heat and light. Since there are numerous streams and rivulets flowing in the region, NEEPCO can take up microhydel schemes so these villages can be provided with power. This will enable provision of power to the villages in the shortest time.

Alternative Sources

In the northeast, as in the rest of the country, expectations of a better life have been rising since the First Five-Year Plan period. In recent years, this expectation has become much more pronounced among the tribal population. The need to provide relief to them is urgent. The large power projects under

contemplation may not save these people living in sparsely populated and widely scattered villages. Alternative schemes need to be designed.

Theoretically, a large number of alternative energy systems are available. These systems are, however, location-specific. In order to adapt and apply their technologies to local situations, careful and detailed location-based surveys and experimental trials are necessary.

Solar Energy

Most of the northeast is cloudy throughout the year, except about 100 days between December and April and five days a month on an average the rest of the year. Large-scale use of solar modules may not be operative or economical in many areas of the region. In remote and inaccessible areas, solar energy for PV pumps, driers, and cookers could be tried to assess their success. Solar PV pumps of half to one HP can help small and marginal farmers to get irrigation and drinking water. In Tripura, one half-HP pump is being operated by solar energy, and it provides water to about three acres of land and helps five tribal families in getting five additional tons of foodgrain per year valued at about Rs. 13,000. A major portion of energy used in the villages is for cooking. It is possible to adapt solar cookers, which would relieve the pressure on firewood and release human energy for more productive work. It is reported that Arunachal Pradesh is setting up a solar timber- seasoning kiln, expected to give 15 to 20 percent more yield per annum. Investigation and experimental trials would be required before large-scale use of solar energy could be tried in remote areas of the region.

Biogas

Another energy system which could be adapted to the conditions of the region, helping villagers to be more self-reliant than if they were to use electricity or other commercial fuels, is biogas. The livestock population of the region is estimated at more than 1.5 million (1979 figure). More than 250 million ft^3 of gas could made available for cooking, domestic lighting, and even street lighting, from the utilization of only 30 percent of the waste of this livestock population.

Besides the livestock waste, the region has other waste material: agro-waste, forest waste, and plants like water hyacinth which are good raw materials for biogas production. Furthermore, the kind of technology for this purpose that would be 'appropriate' for the region is available.

Another proposal sometimes made is to experiment with windmills to ascertain their feasibility for irrigation purposes, as well as for domestic and community use. The average wind energy density (with velocity of 3 to 6 km/h) in many areas of the region is estimated to be sufficient to operate low-speed windmills.

These alternative sources of energy for the northeast involve a high element of risk; the relevant technologies are unknown here, and it would be necessary for the state to undertake a considerable number of pilot projects. Even with a large number of pilot projects, the distances between villages

and the difficulties of communication might hamper the demonstration effect. Capital is also a constraint, though help from the Department of Non-Conventional Energy and the Rural Electrification Corporation could be sought, not only for undertaking pilot projects, but for popularizing extensive use of projects which prove feasible.

Coal

Coal deposits are found in abundance in the hill areas of the region: Khasi, Jaintia, and Garo Hills of Meghalaya, Mikir Hills, Langlai Hills, and Dissoma Valley and Kallaini River Valley. It also occurs in Koilajan in Koila Pahar.

In Khasi, coal is found in various places, the more important coal fields being at Langrin (extreme southwest of Khasi Hills), Um-Rileng, (6 km northwest of Shillong), Mawbehbaker (25 km south of Shillong), Mawsynram (16 km north of Shella) Mawlong, Laiteryngew (near Cherrapunji) and Langkyrdem (near Pynursla). In Jaintia Hills, coal is found at Jarain, Bapung, Sutnga, and Lakadong.

In Garo Hills, the coal seams found in Baljang, Doiring and Waimng are very good quality. The Rongrengiri coal fields in Simsang valley, about 16 km east of Arbela, and 25 km east of Tura, have a vast area of nearly 30 km^2. However, at present the coal seams are rather thin. Another coal field in Derangiri, extending eastwards into the Nongstain area of Khasi Hills, has a reserve of about 125 million tons.

A small quantity of coal mined in these regions is sent to Shillong and is used as domestic fuel. The bulk of the quantity of coal is supplied outside the state for railways, industries, and steamers. As firewood supply is likely to diminish in the future, the use of coal as domestic fuel will increase. In many areas of the region, coal is found on the surface and need not be mined. This enables the villagers to collect coal and use it for daily use. In areas near Cherrapunji, coal is used daily, while in Shillong, its use is greater during cold seasons.

Rural Electrification

Rural electrification is one of the 20-point programs. In some districts of what used to be Assam, electrification of villages in a number of districts had already been started in 1960. It was then undertaken in an ad hoc manner with no particular attention to the wider socioeconomic aspects and the development of rural areas. As a consequence, no worthwhile progress was recorded before the beginning of the seventies.

In Meghalaya, a rural electrification scheme was begun only in 1971-72, when the Rural Electrification Corporation (REC) sanctioned grant and loan finances for the purpose. By 1975, two REC-financed schemes were in operation, covering 63 villages. By June 1985, 56 schemes were at different states of execution in 1978 villages out of a total of 4583 villages (according to the 1971 census). The number of villages electrified in 1975 was 185; ten years later, in 1985, this number increased to 1284; that is, 28 percent of the villages in Meghalaya are electrified.

A few constraints hinder speedier implementation of the scheme; shortage of technical manpower, such as

engineering staff at different levels; lack of surface communication facilities; inadequacy of funds; and slow load-growth resulting in huge recurring loss in rural electrification works.

The electrification of rural areas has as one of its major objectives the socioeconomic goal of providing a measure of the modern facilities of life to the vast majority of people living in the countryside, and to help in increasing income, employment, and productivity. It is also expected to act as a safeguard against the vagaries of the monsoon, by ensuring sustained supply of irrigation water efficiently and economically from village wells by the use of electrically operated pumpsets. In fact, rural electrification is said to constitute the backbone of the ground water development program by ensuring availability of cheap electric power for operation of wells, tubewells, etc.

Out of a total of 23 million hectares of ground water developed by 1980-81 in the country, the share of the northeastern region is negligible. The estimated ground water irrigation potential in Assam of about 0.7 million hectares (6.8 percent) were brought under irrigation by 1980-81. In Tripura, out of an estimated 15,000 hectares of ground water irrigation land potential, only 5500 hectares have been brought under this kind of irrigation. In the other states of the region, land under irrigation is either non-existent or extremely negligible except in Meghalaya, where of a potential 15,000 hectares, 6100 hectares are irrigated by ground water.

Besides the impact of rural electrification on agriculture, it has also helped the development of rural-based processing industries. Studies made by REC have indicated that after electrification, the number of small agro-processing units increased nearly five times in selected areas. The number of industries after electrification ranged from 0.8 per village in backward areas to about two per village in the advanced areas. In most of the states, the existence of such agro-processing units has come to depend more on the locally available inputs than on outside factors.

In the states of the northeastern region, electric power is now contributing to the development of important rural artisan trades such as weaving, embroidery, willow wickers, and bamboo and wooden toys. New employment opportunities have also been generated, the number of persons employed varying from one to five per industrial unit depending on the nature of the small unit and the caliber of the electric motor and its utilization.

It has also been found that rural electrification has contributed to an improvement in rural lifestyle. The use of electricity has further popularized radio (and in some areas cinema) as entertainment. It has helped to minimize human drudgery in agricultural occupations and has opened avenues to have workshops, schools, and dispensaries. The shift to power-driven pumpsets has reduced the time required for lifting ground water from eight to four hours per acre, compared with manual operation, thereby allowing farmers to pursue other occupations.

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